



MODULE 1
FOUNDATION MODULE
1ST YEAR BDS

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Vision & Mission

Khyber Medical University (KMU) Vision:

Khyber Medical University will be the global leader in health sciences academics and research for efficient and compassionate health care.

Khyber Medical University (KMU) Mission:

Khyber Medical University aims to promote professional competence through learning and innovation for providing comprehensive quality health care to the nation.

Institute of Health Professions Education & Research (IHPER) Mission:

To produce leaders, innovators and researchers in health professions education who can apply global knowledge to resolve local issues.

Teaching Hours Allocation

Table 2: Hours allocation for different subjects

S. No	Subject	Hours
1.	Anatomy	47
2.	Oral biology (oral histology and tooth morphology)	28
3.	Physiology	22
4.	Biochemistry	24
5.	Pathology	2
6.	Pharmacology	2
Total		125

Themes for Foundation Module

S#	Theme	Duration in Weeks
1.	Orientation week	1 week
2.	Basic unit of life: The Cell	1 week
3.	Development of Human body & Human Dentition	1 week
4.	Organization of Human Body & Human Dentition	2 week
Total		5 weeks

Learning Outcomes

By the end of this module, the students should be able to;

Cognitive Domain

1. Familiarize with BDS Curriculum.
2. Recognize the role of different disciplines in studying human body.
3. Describe the various stages of pre embryonic human development.
4. Familiarize about basic Anatomical terms (General and Oral Anatomy).
5. Recognize various developmental stages of face and oral cavity.
6. Describe the structure, function and biochemical composition of cell.
7. Describe the cell division, its types and genetic material along with its clinical correlation.
8. Describe various cellular adaptations during cell growth, differentiation and cell injury.
9. Describe the basic organization of human body.
10. Explain the maintenance of homeostatic mechanism.
11. Describe the importance of buffer and PH system.

Psychomotor Domain

1. Perform the basic laboratory techniques and use of microscope.
2. Display steps of sterilization and disinfection.
3. Prepare assignment on MS office individually and in team.

Affective Domain

1. Follow the standard operating procedures of lab.
2. Follow preventive and safety measures in dental practices.
3. Participate individually and in team work efficiently.
4. Maintain discipline of the college.
5. Follow the norms of the college properly.

Theme I: Orientation Week

(White Coat Ceremony+ Departmental Visits)

1.	White coat ceremony (Day-01 Activity)
	Departmental visits (Day-02- 05)
2.	Visit to Basic Medical Sciences Departments (DME, Anatomy, Physiology, Biochemistry, Pathology, Pharmacology, Library, Digital Library, SAS, Hostels).
3.	Visit to Basic Dental Sciences Departments (Oral Biology, Science of Dental Materials, Oral Pathology, Community Dentistry, Phantom- Head Lab).
4.	Visit to Clinical Dental/ Medical Departments (Operative Dentistry, Periodontology, Orthodontics, Prosthodontics, Oral & Maxillofacial Surgery, Oral Medicine, Oral Radiology, Paediatric Dentistry, Diagnostic Department, General Medicine, and General Surgery).
5.	Introductory Lectures (Refer to Table of Specification below)

TABLE OF SPECIFICATION

Subject	Topic	Hours	Learning objectives
Anatomy	Anatomy and its sub-branches	1 hour	1. Define anatomy and its branches. 2. Describe purpose of study of anatomy and its branches.
Physiology	Physiology and its sub branches	1 hour	3. Define physiology and enumerate its branches. 4. Discuss human physiology and its sub branches. 5. Discuss functional organization of human body.
Biochemistry	Introduction to biochemistry	3 hour	6. Define biochemistry. 7. Discuss the role of biochemistry in dentistry. 8. Discuss biochemistry of the cell. 9. Define Nutrition 10. Discuss carbohydrates, proteins, biological membrane. 11. Discuss vitamins, mineral & trace elements. 12. Classify food groups
Pathology	Introduction to pathology	1 hour	11. Define pathology. 12. Enumerate the different branches of pathology. 13. Identify different sampling and processing techniques in different branches of pathology.
Pharmacology	Intro to pharmacology	1 hour	14. Define pharmacology and its role in patient care.
Oral Biology	Introduction to oral histology and tooth morphology	1 hour	15. Define oral biology and its branches. 16. Define tooth morphology. 17. Recognize Anatomic and physiologic consideration of form and function of oro-dento-facial structures.
Community & Preventive Dentistry	Introduction to community dentistry and dental health	1 hour	18. Define public health, health and dental public health. 19. Enlist tools of public health. 20. Discuss the scope of dental public health. 21. Explain history of dental public health. 22. Discuss significance of nutrition in oral health

Medical Education	Curriculum structure Teaching learning strategies	1 hour	22. Discuss the curriculum and modules. 23. Describe the use of study guides. (not to be assessed) 24. Differentiate between various teaching & learning strategies. 25. Enlist various assessment tools & assessment policy. 26. Explain the role of teacher. 27. Discuss the responsibilities of the student. 28. Apply Study skills.
	Role of Regulatory Bodies (PMDC And HEC)	1 hour	29. Describe the structure and functions of Pakistan Medical and Dental Council (PM&DC). 31. Discuss the role of World Federation Medical Education (WFME). 30. Describe the structure and functions of Higher Education Commission (HEC). 31. Describe the role of Higher Education Commission (HEC). 32. Discuss the relevant policies related to educational institutes. e.g., policy on protection against sexual harassment in higher education institutions, policy on drug and tobacco abuse in higher education institutions etc.
Self-Learning Resource Centre (SLRC)	Importance of IT skills	1 hour	33. Define IT and its importance. 34. Introduction to library/e-library. 35. Intro to AI tools in academics and research. 36. Discuss policy of institute regarding social media usage.
	MS word skills PowerPoint skills Excel sheet	1 hour	37. Prepare the assignment on MS word with insertion of tables and flowchart. 38. Prepare the presentation on power point. 39. Draw tables on the excel sheet using formulas.

Theme II: Basic Unit of Life: The Cell

Subject	Topic	Hours	Learning Outcomes
Histology	Histological concepts of cell	1 hour	40. Describe the cell as a living unit of body. 41. Describe the structure of cell and its organelles. 42. Describe the structure of cytoplasmic organelles of the cell & correlate it with their functions.
	Nuclear structure & components	1 hour	43. Describe the structure of the nucleus, nucleolus & chromosome and their functions in cell integrity.
	Cell junction	1 hour	44. Define cell junction. 45. Describe the structure and functions of the junctions. 46. Discuss the junctions on the basal and lateral surfaces of the cell. 47. Enlist the junctional complex.
Embryology	Cell division Mitosis and meiosis	2 hour	48. Explain the process of cell division. 49. Describe mitotic cell division with its stages.
			50. Explain the process of Meiosis. 51. Explain the non-disjunction of chromosomes. 52. Correlate the process of non-disjunction with chromosomal abnormalities.
Oral Biology	Tooth structures & cells of oral cavity	1 hour	53. Define and recognize tooth structures. 54. Identify different cells in the oral cavity.

Physiology	Cell Membrane	1 hour	55. Discuss the structural organization of cell membrane. 56. Explain the functions lipids and proteins of cell membrane. 57. State the significance of glycocalyx of cell membrane.
	Cytoplasmic Organelles	2 hours	58. Enlist cytoplasmic organelles. 59. Discuss the functions of ribosomes, endoplasmic reticulum, golgi bodies, mitochondria, cytoskeleton, lysosomes and peroxisomes. 60. State the functions of different types of cytoskeleton. 61. Explain the mechanism of endocytosis: Pinocytosis and Phagocytosis. 62. State the steps of Phagocytosis.
	Locomotion of the cell	1 hour	63. Enlist the types of cellular movements. 64. Discuss the mechanism of ameboid locomotion. 65. Discuss ciliary movement of the cell.
	Transport across Cell Membrane	2 hours	66. Differentiate between diffusion and active transport. 67. Discuss diffusion of lipid soluble substances through cell membrane. 68. Discuss diffusion of water soluble substances through protein channels. 69. Explain the mechanism of facilitated diffusion. 70. Explain the graph showing differentiation between simple and facilitated diffusion. 71. Discuss the mechanism of active transport across the cell membrane. 72. Differentiate between primary and secondary active transport.
	Membrane Potentials & Action Potentials	2 hours	73. Define membrane potential and explain its mechanism. 74. Discuss the resting membrane potential in neuronal cell. 75. Describe ionic conc. differences across cell membrane. 76. Explain the Nernst equation. 77. Explain origin of normal resting membrane potential. 78. Explain action potential in neuronal cell and its stages. 79. Explain the role of voltage gated Na ⁺ and K ⁺ channels in action potentials.

			80. Discuss the changes in conductance of Na and K channels with changes in membrane potentials. 81. Discuss “All-or-nothing” Principle.
Biochemistry	Biochemical structure of cell and its organelles	1 hours	82. Explain the Bio-chemical composition of cell organelles and cytoplasm. 83. Describe the chemical structure of cytosol. 84. Describe the chemical structure and importance of mitochondrial membrane.
	Nucleus	2 hours	85. Describe Bio-chemical structure of nuclear membrane and its functions. 86. Define and explain nucleotides and nucleosides. 87. Describe the components of nucleotides. 88. Describe the functions of Nucleotides. 89. Describe the types of nucleic acids. 90. Differentiate between RNA and DNA. 91. Describe the Structure of nucleic acids. 92. Describe biochemical functions.
	Cell transport mechanism	1 hour	93. Explain membrane transport. 94. Discuss passive diffusion, active transport, and facilitated transport via a channel or carrier.

			95. Describe and evaluate the role of ion gradients, co transporters, and ATP in active transport mechanisms.
Pathology	Cell injury	1 hour	96. Enumerate the various causes of cell injury. 97. Describe the response of a normal cell to stimuli. 98. Describe the mechanisms of cell injury. 99. Enumerate the different types of cellular adaptations.
Pharmacology	Routes of administration of drugs	1 hour	100. Enlist the route of administration of a drug. 101. Explain how drugs are transported across cell membrane and factors affecting it. 102. Describe different types of drug receptors and enzyme inhibition as a mechanism of action of drugs.
	Drug distribution and bioequivalence		
	Receptor and cellular basis		
Lab Work			
Physiology Practical	Microscope	2 hours	103. Identify the parts of microscope. 104. Demonstrate the operation of microscope. 105. Demonstrate the focusing of slide on microscope using different powers and magnifications. <ul style="list-style-type: none"> • Identify the equipment used in Labs • Follow SOPs (standard operating protocols) • Display safety measures in performing lab techniques
	Lab equipment and Techniques		
Oral biology & Tooth Morphology	Introduction to oral biology & Tooth Morphology	2 hours	107. Recognize the tooth structures. 108. Identify different cells in the oral cavity.

Theme III: Development of Human Body & Human Dentition

Subject	Contents	Hours	Learning Outcomes
Embryology	Introduction to Embryology	1 hour	111. Discuss embryologic terminology. 112. Explain significance of embryology.
	Gametogenesis	1 hour	113. Describe the process of Gametogenesis. 114. Enlist the differences between spermiogenesis and spermatogenesis 115. Describe the morphological changes during maturation of gametes. 116. Describe oogenesis and its correlation with meiosis. 117. Compare oogenesis and spermatogenesis.
	Female reproductive cycle	1 hour	118. Describe the ovarian cycle. 119. Discuss the process of follicular development. 120. Explain the process of ovulation. 121. Correlate with the phases of menstrual cycle
	Fertilization	1 hour	122. Define fertilization. 123. Describe the process of fertilization. 124. Describe the outcome of fertilization.
	First week development Cleavage & Blastocyst Formation	1 hour	125. Describe the process of cleavage of zygote. 126. Discuss the formation of blastocyst. 127. Summarize the events of first week of development normal and abnormal.
	Bilaminar Germ Disc	1 hour	128. Describe the formation of amniotic cavity. 129. Discuss the development of embryonic disc 130. Explain the development of Chorionic sac.

	3 rd week of development.	3 hours	<p>131. Describe Formation of three germ layers.</p> <ul style="list-style-type: none"> ○ Derivatives of Ectoderm. ○ Derivatives of Mesoderm(A. Paraxial mesoderm,B. Intermediate mesoderm, C. Lateral plate mesoderm.) ○ Derivatives of endoderm
	3 rd to 8 th week the embryonic period 4 th to 8 th week of development.	2 hours	<p>132. Describe the formation of different organo-genetic period with a process of folding.</p> <p>133. Define fetal period.</p> <p>134. Enlist the important changes that occur during the fetal period.</p> <p>135. Enumerate the factors affecting the fetal period.</p> <p>136. Discuss the role of folic acid in early fetal development.</p>
	Third month to birth: The fetus and placenta fetal membrane	2 hours	<p>136. Describe str.of placenta.</p> <p>137. Describe chorionic frondosum and decidua basalis.</p> <p>138. Discuss fetal membranes in twins.</p> <p>139. Describe parturition.</p> <p>140. Enlist the development of different types of fetal membranes.</p> <p>141. Describe the formation and function of amniotic fluid.</p> <p>142. Enumerate teratogens.</p> <p>143. Describe the effects of teratogens on fetus.</p>

Biochemistry	Carbohydrates	1 hours	<p>145. Explain carbohydrate and its Bio-chemical structure.</p> <p>146. Classify carbohydrate and give their Bio-chemical importance.</p> <p>147. Relate the structure of polysaccharides with its clinical importance.</p> <p>148. List the functions of carbohydrates in cell membrane, energy provision and nutrition supply to different parts of body.</p> <p>149. Describe the different isomers of monosaccharides Galactose, mannose, fructose, dextrose.</p> <p>150. Describe the role of dextrose in I/V infusion.</p> <p>151. Describe the role of mannitol in cerebral edema.</p> <p>152. Describe the structure of disaccharides and oligosaccharides.</p>
	Monosaccharides	1 hour	<p>153. Define Monosaccharide's.</p> <p>154. Discuss structure and types.</p>
	Polysaccharides		<p>155. Define and discuss Polysaccharides.</p> <p>156. Discuss structures and types of Polysaccharides.</p>
	Reducing and non-reducing Sugars	1 hour	<p>157. Define reducing sugars, types.</p> <p>158. Discuss the structure and types of reducing sugars.</p> <p>159. Discuss the cariogenic effect of carbohydrates.</p>
Physiology	Homeostasis	1 hour	<p>159. Differences between extra and intracellular fluids.</p> <p>160. Discuss the mechanism of homeostasis.</p> <p>161. Describe the origin of nutrients in extracellular fluid</p> <p>162. Describe the role of electrolytes in maintaining homeostatis.</p>
	Control system of the body	1 hour	<p>162. Explain control mechanisms of the body with examples.</p> <p>163. Discuss the characteristics of control system: Negative and positive feedback mechanisms.</p>

Oral biology	Tooth development	3hours	164. Discuss the stages of tooth development. 165. Discuss the cells involved in tooth development. 166. Explain single and multiple root formation. 167. Discuss clinic consideration. 168. Discuss the role of nutrients in tooth development.
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Lab Work			
Physiology Practical	Capillary blood sampling	2 hours	168. Identify the sites for obtaining blood sample with different methods and discuss the indication for their use. 169. Obtain capillary blood sample for hematological investigation through prick method.
	Separation of Blood & Plasma by Centrifuge method	2 hours	170. Demonstrate the correct use of a centrifuge machine to separate blood components into plasma and cellular fractions. 171. Demonstrate the step-by-step process of preparing a blood sample for centrifugation, including proper handling and labeling.
Biochemistry Practical	Detection of Monosaccharide in a given Solution	4 hours	172. Perform test for detection of glucose. 173. Perform test for detection of fructose. 174. Perform test for detection of galactose. 175. Perform test for detection of lactose.
	Detection of unknown sugar in a solution	2 hours	176. Perform the test for unknown sugar in a solution.
	Detecting of Reducing and non-reducing Sugars	2 hours	177. Perform test for detection of maltose. 178. Perform test for detection of sucrose.
Oral biology	Tooth development	3hours	179. Identify the stages of tooth development. 180. Recognize the cells involved in tooth development. 181. Identify single and multiple root formation.

Theme IV: Organization of Human Body & Human Dentition

Subject	Topic	Hours	Learning Outcomes
Anatomy	Anatomical terms	1 hour	182. Describe the anatomical terms for planes, position, and movements.
	General anatomy of bones cartilage and joints	1 hour	183. Describe the structure and function of bone. 184. Classify bones on the basis of length and shape. 185. Identify the markings on bone.
		1 hour	186. Describe cartilage. 187. Classify the types of cartilage. 188. Describe the types of cartilages.
		1 hour	189. Classify joints on the basis of structure. 190. Describe the mechanism of movements of joint.
	Muscles	1 hour	191. Describe various muscle types along with structure.
	Connective tissue	3 hour	192. Explain different cells of connective tissue. 193. Describe composition of the ground substance. 194. Describe components of connective tissues. 195. Discuss loose and dense connective tissue.
	Integumentary system Skin	2 hours	196. Describe layers of epidermis and dermis 197. Discuss skin creases, Nails, Hairs, Glands (Sebaceous & sweat) 198. Discuss the anatomical structures of Skin / Integumentary system.
	General anatomy of circulatory system	1 hour	199. Describe Various types of Arteries and veins. 200. Describe capillaries.

	Lymphatic system	1 hour	201. Describe organization of the lymphatic system. 202. Explain the functions of lymphatic system. 203. Explain the mechanisms for the movement of lymph in the body. 204. Identify lymph nodes of head and neck.
	Nervous system Divisions (central & peripheral and somatic & autonomic)	1 hour	205. Define the organization of nervous system. 206. Describe the divisions of nervous system. 207. Describe the formation of spinal nerve and concept of dermatome and myotome. 208. Describe the formation of nerve plexus.
Anatomy		1 hour	209. Describe the organization of autonomic nervous system. 230. Differentiate between sympathetic and parasympathetic nervous system on the basis of structure.
Maxillofacial surgery	Membranes: Fascia, ligaments and raphe	1 hour	231. Describe the structure of membranes of human body. 232. Describe the anatomy and significance of fascia, ligaments and raphe.
	Radiological anatomy in dentistry (PA, OPG, CEPH, PNS)	1 hour	233. Identify various anatomical landmarks on radiograph. 234. Describe commonly used radiographs. 235. Describe various view used for obtaining radiographs.

Physiology	Organization of nervous system: Structure of Neuron, Hormones and their functions	2 hour	236. Describe the structure of neuron. 237. Discuss major levels of CNS functions. 238. Define and classify hormone. 239. Describe the synthesis, secretion and transport of hormones in the body. 240. Discuss the mechanism of action of hormones.
	Synapse, its types and synaptic transmitters	2 hours	241. Enlist the types of synapses: Chemical and electrical. 242. Discuss physiological anatomy synapse. 243. Enlist chemical substances that function as synaptic transmitter. 244. Describe the electrical events during neuronal excitation and inhibition.
	Autonomic nervous system	2 hours	245. Discuss general organization of autonomic nervous system. 246. Compare and contrast the functions of sympathetic and parasympathetic nervous system. 247. Classify autonomic receptors and their types. 248. Explain the autonomic effects on various organs of the body.
Histology	Basic Body tissue	1 hour	249. Define tissue. 250. Describe the basic tissues in human body. Definition of tissue i. Epithelial tissue ii. Connective tissue iii. Muscular tissue iv. Nervous tissue
	Epithelial tissues	2 hours	251. Define epithelium. 252. Classify epithelium. 253. Describe the general features of epithelium. 254. Explain the specialized functions of different types of epithelial cells. 255. Describe the structure of main types of cell junctions. 256. Describe the surface specialization of epithelia. 257. Correlate their structure, with their location and function.

	Glandular Epithelium	1 hour	258. Enlist glandular epithelia. 259. Classify them on the basis of morphology, nature of secretion and mode of secretion. 260. Differentiate between exocrine & endocrine glands on the basis of structure and function.
	Basement Membrane	1 hour	261. Describe the structure of the basement membrane & correlate it with its function.
	Bone	1 hour	262. Enumerate different cells of bone tissue. 263. Describe histological structure of bone. 264. Classify bone on the basis of histological feature.
Oral Biology	Enamel	6 hours	265. Discuss the organic and inorganic composition of enamel. 266. Explain enamel crystallites, rods, orientation, and their strength. 267. Discuss histological structures of enamel, their significance. 268. Differentiate enamel spindle, tufts, and lamellae. 269. Define and discuss significance of dentin enamel junction. 270. Describe life cycle of Ameloblast with theoretical background of each stage. 271. Interpret amelogenesis including matrix formation and mineralization. 272. Enlist enamel proteins and their role in amelogenesis. 273. Discuss Defects of development and amelogenesis including
Biochemistry	Chemistry of Acids and Bases	1 hour	274. Define acids, bases, strong acids, and weak acids. 275. List different types and sources of acids and bases in our body.

	Buffers	1 hour	<p>276. Describe the mechanism of their normal balance and biochemical importance.</p> <p>277. Explain PH of acids Buffer pairs.</p> <p>278. Define Buffer and its role in maintenance of body PH.</p> <p>279. Differentiate between good chemical and physiologic buffers Intracellular and extra cellular buffers, chemical buffers of plasma, chemical buffers of urine.</p> <p>280. Explain Mechanism of Acidosis and alkalosis and compensation.</p> <p>281. Define colloidal state and Henderson Hasselbalch equation.</p>
	Solutions	1 hour	<p>282. Define normal solution.</p> <p>283. Define standard solution.</p>
Oral Biology	Introduction To tooth morphology/ nomenclature	3 hours	<p>284. Classify human dentition on the basis of types of teeth and sets of dentitions.</p> <p>285. Define dental formula.</p> <p>286. Indicate sequence and age of eruption of teeth.</p> <p>287. Describe numbering system (FDI, universal and palmer notation system).</p> <p>288. Describe various morphological structures on tooth surfaces</p> <p>289. Enumerate line and point angles of anterior and posterior teeth.</p> <p>290. Describe various morphological on tooth surfaces.</p>
	Anatomic and Physiologic considerations	2 hours	<p>291. Discuss number and significance of lobes in permanent teeth.</p> <p>292. Define and discuss inter-proximal spaces, contact areas, embrasures, cervical line and height of contour.</p> <p>293. Describe crown surface form in terms of general shape and its significance to specific function of tooth.</p>

	of form and function of teeth		294. Describe proper location and form of marginal ridges and facial line angles and their relationship to embrasure form. 295. Identify the number, length and distribution of roots and their influence on tooth form and function of both anterior and posterior teeth.
Lab Work			
Histology	Tissue Processing	2 hours	296. Demonstrate the process of tissue processing for histo-pathological examination.
	H& E staining		297. Perform H & E staining of tissue slides under supervision in the laboratory.
	Epithelia	2 hours	298. Identify and describe simple epithelia under Microscope. 299. Identify different types of epithelia based on histological features under Microscope such as simple squamous epithelium, simple cuboidal, simple columnar, pseudostratified columnar, stratified squamous, stratified cuboidal, stratified columnar, transitional epithelium.
	Cartilage	1 Hour	300. Differentiate different types of cartilages based on histological structure such as Hyaline cartilage, Fibrocartilage, Elastic cartilage.
	Bone	1 Hour	301. Differentiate different types of bones based on histological structure such as compact bone and spongy bone.
	Muscles	2 hours	302. Identify the histological features of skeletal, cardiac and smooth muscles.
Biochemistry	Solutions	2 hours	303. Prepare of 0.9% NaCl. 304. Measure the PH of given solution.
	Examination instruments	1 hour	340. Identification and handling of examination instruments.
	Ergonomics		341. Define dental ergonomics. 342. Discuss importance of ergonomics in dentistry.

			<p>343. Discuss the posture of dentist in sitting and standing position with respect to the patient and unit.</p> <p>344. Discuss position of dental assistant.</p> <p>345. Describe ergonomics of 4 handed dentistry.</p> <p>346. Enumerate ergonomics hazards.</p>
Tooth Morphology	Introduction to tooth morphology/ nomenclature	2 hours	<p>347. Identify on tooth models/images different morphological structures present on tooth surface.</p> <p>348. Draw and label the diagram of all tooth surfaces (anterior and posterior teeth).</p>
	Enamel	4 hours	<p>349. Identify the organic and inorganic composition of enamel.</p> <p>350. Recognize enamel crystallites, rods, orientation, and their strength.</p> <p>351. Identify histological structures of enamel, their significance.</p> <p>352. Differentiate enamel spindle, tufts, and lamellae.</p> <p>353. Identify the dentine enamel junction.</p>



MODULE 2
BLOOD & IMMUNOLOGY
1ST YEAR BDS

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Vision & Mission

Khyber Medical University (KMU) Vision:

Khyber Medical University will be the global leader in health sciences academics and research for efficient and compassionate health care.

Khyber Medical University (KMU) Mission:

Khyber Medical University aims to promote professional competence through learning and innovation for providing comprehensive quality health care to the nation.

Institute of Health Professions Education & Research (IHPER) Mission:

To produce leaders, innovators and researchers in health professions education who can apply global knowledge to resolve local issues.

Teaching Hours Allocation

Table 2: Hours allocation for different subjects

S. No	Subject	Hours
1	Anatomy	10
2.	Physiology	45
3.	Biochemistry	07
4.	Oral Biology	28
5.	Pathology	06
6.	Pharmacology	01
7.	Oral Medicine	02
Total		99

Themes for Blood Module

SNO	Theme	Duration
1	Pallor and swelling	1 week
2	Fever (Infection and Immunity)	1.5 week
3	Excessive bleeding	1 week
4	Transfusion Reaction	0.5 week
Total		4 weeks

Learning Outcomes

Cognitive Domain

By the end of this module, first-year BDS students shall be able:

1. Describe the various cellular and non-cellular components of blood in relation to its Anatomy, Physiology & Biochemistry.
2. Describe the structure, synthesis, and degradation of Hemoglobin.
3. Describe the regulatory mechanisms of normal hemostasis and coagulation.
4. Describe the conditions associated with the dysfunction of cellular and non-cellular components of blood.
5. Describe the basic characteristics of the immune system.
6. Discuss the structure, functions, and biochemical aspects of the Lymphoreticular system.
7. Explain the principles and clinical significance of the ABO/RH blood grouping system.
8. Explain the pathophysiology of various bleeding disorders.
9. Identify the role of pharmacology in anemia and bleeding disorders.

Psychomotor Domain

Description of the psychomotor skills to be developed and the level of performance required:

By the end of the Blood Module, the student should be able to:

1. Perform practical work as instructed in an organized and safe manner
2. Record observations accurately.
3. Identify slides of the Lymph node, thymus, tonsils, and spleen under the microscope.
4. Identify the slide of Gut-associated lymphoid tissue.
5. Determine the percentage of formed blood elements.

6. Identify RBC and should be able to do its counting-on-counting chamber and to know normal values. And also classify Anemia morphologically.
7. Determine the Hemoglobin with the apparatus and have knowledge of normal and abnormal values.
8. Identify WBC morphology and its different types to count them on the counting chamber and know the normal values. Diagnostic importance of each WBC.
9. Identify Platelets and should be able to do its counting on the counting chamber and to know normal values. Its diagnostic importance in relation to bleeding disorders.
10. Perform bleeding time and clotting time, know normal values and their diagnostic importance in relation to bleeding disorders.
11. Perform Blood group typing and Rh factor.
12. Perform ESR and to know its normal value and prognostic importance.
13. Detect blood, bile pigments & bile salts in the given sample of urine.

Affective Domain

By the end of the Blood Module, the student should be able to.

1. Demonstrate ability to give and receive feedback and respect for self and peers.
2. Demonstrate empathy and care to patients.
3. Develop respect for the individuality and values of others - (including having respect for oneself), patients, colleagues, and other health professionals.
4. Organize and distribute tasks.
5. Exchange opinion & knowledge.
6. Develop communication skills and etiquette with a sense of responsibility.
7. Equip themselves with teamwork.
8. Regularly attend the classes.
9. Demonstrate good laboratory practices.

Theme I: Pallor and Swelling			
Subject	Topic	Hours	Learning objectives
Physiology	Introduction to Blood	1 hour	<ol style="list-style-type: none"> 1. Enumerate the composition & functions of blood. 2. Enlist the types of blood cells and their specific functions. 3. Enlist the components of plasma. 4. Differentiate between serum and plasma.
	Introduction to hematopoietic system	1 hour	<ol style="list-style-type: none"> 5. Define Hematopoiesis and Classify hematopoietic stem cells. 6. Describe the genesis of blood cells.
	Red blood cells & Erythropoiesis	3 hours	<ol style="list-style-type: none"> 7. Describe the structure, functions, life span and normal count of red blood cells. 8. Discuss the stages of RBC development (erythropoiesis) from pluripotent hematopoietic stem cells to a mature RBC. 9. Describe the factors regulating erythropoiesis. 10. Describe the role of Vitamin B12 and Folic acid in RBC maturation and the effects of their deficiency. 11. Classify and Discuss RBC indices and their clinical significance.
	Erythropoietin	1 hour	<ol style="list-style-type: none"> 12. Describe source, control/regulation, and functions of Erythropoietin. 13. Explain the role of Erythropoietin in RBC production. 14. Describe the effects of high altitude and exercise on RBC production.
	Anemia and Polycythemia	2 hours	<ol style="list-style-type: none"> 15. Classify the types of anemia on the basis of etiology and morphology 16. Interpret the type of anemia on the basis of red cell indices 17. Define and classify polycythemia 18. Differentiate between primary and secondary polycythemia

			19. Describe the effects of anemia & polycythemia on functions of circulatory system / human body
Biochemistry	Introduction of Porphyrins	1 hour	20. Define Porphyrins. 21. Describe Chemistry of Porphyrins. 22. Enlist the types, metabolic causes, and clinical presentation of different types of Porphyria's.
	Iron metabolism	1 hour	26. Describe the iron metabolism.
	Introduction to heme synthesis and degradation	1 hour	27. Define heme and describe its structure and functions. 28. Describe the biochemical features of the hemoglobin molecules. 29. Describe Heme Synthesis on cellular and molecular level. 30. Describe Heme Degradation. 31. Describe the Regulation of Heme Synthesis. 32. Describe the concept of Oxygen binding with hemoglobin.
	Hemoglobinopathies	3 hours	33. Define Hemoglobinopathies and enlist the variants of hemoglobin. 34. Describe causes of Hemoglobinopathies. 35. Describe two major categories of hemoglobinopathies. 36. Describe the amino acid substitution in sickle cell disease. 37. Define and Classify thalassemia's. 38. Explain the genetic defects in α and β thalassemia's. 39. Enlist the clinical features of α and β thalassemia's. 40. Discuss the role of vit B12 and Folic acid in prevention of anemia. 41. Describe abnormalities of iron metabolism. 42. Enlist foods that are rich in vitamin B12 and folic acid.

Pathology	Anemias of diminished erythropoiesis and Hemolytic anemia's	2 hours	44. Define anemia. 45. List the factors for regulation of erythropoiesis. 46. Enlist the types of anemia.
			47. Define hemolytic anemia. 48. Enlist types of hemolytic anemia. 49. Discuss pathophysiology of hemolytic anemias.
Pharmacology	Drug treatment of anemia's	1 hour	50. Enlist the drugs used in the treatment of iron deficiency & Megaloblastic anemia. 51. Describe the pharmacological basis/ role of iron in iron deficiency anemia (hypochromic normocytic anemia). 52. Describe the pharmacological basis/ role of vitamin B12 and folic acid in megaloblastic anemia. 53. Describe the role of erythropoietin in the treatment of anemia (normochromic normocytic anemia).
Oral medicine	Oral manifestation of anemia	1 hour	54. Enlist oral manifestations of anemia. 55. Discuss various oral conditions associated with anemia.
Lab Work			
Physiology	RBC count	2 hours	56. Demonstrate the preparation of a blood sample using an appropriate dilution method for an accurate RBC count. 57. Operate a microscope and use a Neubauer's chamber to accurately count red blood cells in a given sample. 58. Apply the formula for calculating the total number of red blood cells per microliter of blood based on the chamber grid and dilution factor. 56. Interpret and record the findings of the RBC count, identifying normal and abnormal values based on physiological reference ranges.
	Hemoglobin (Hb) determination	2 hours	57. Demonstrate the proper collection of a blood sample and its preparation for Hb estimation using Sahli's method.

			<p>58. Calculate the Hb concentration using the readings obtained and the provided formula or calibration chart.</p> <p>59. Interpret the Hb concentration in relation to standard physiological ranges and identify deviations indicating anemia or polycythemia.</p>
	Erythrocyte sedimentation rate (ESR)	2 hour	<p>60. Demonstrate the correct procedure for collecting and preparing a blood sample for the estimation of ESR.</p> <p>61. Set up a Westergren or Wintrobe tube accurately to measure ESR according to standard protocols.</p> <p>62. Interpret the ESR results by comparing them with standard reference ranges and identify potential causes of abnormal values.</p>

Theme -II Fever (Infection and Immunology)			
Subject	Topic	Hour	Learning Objectives
Anatomy	Histology of lymphoid tissues	4 hours	64. Describe the histological features and functions of lymph node. 65. Describe the histological features and functions of thymus. 66. Describe the histological features and functions of tonsils 67. Describe the histological features and functions of spleen.
Pathology	Inflammation	1 hour	68. Define inflammation. 69. Enlist the types of inflammation. Describe characteristics of inflammation (hallmark of inflammation).
	Abnormal Leukocyte counts/ Leukemia	2 hours	70. Define leukopenia and leukocytosis and Leukemia.

Physiology	White blood cells and its types	2 hours	<p>71. Classify WBCs and Describe general characteristics of leukocytes (structure, functions & life-span).</p> <p>72. Describe the stages of differentiation of white blood cells (leukopoiesis).</p> <p>73. Describe the “Walling-Off Effects” of Inflammation.</p> <p>74. Discuss neutrophils and macrophages responses during inflammation.</p> <p>75. Discuss first, second, third and fourth line of defense cells.</p> <p>76. Discuss the role of eosinophils in combating parasitic infections.</p> <p>77. Discuss the role of basophils in allergic reactions.</p>
	Reticuloendothelial (monocyte-macrophage) system	1 hour	<p>78. Discuss the components of reticuloendothelial system (monocyte-macrophage system).</p> <p>79. Describe the role of macrophage system in immunity in different body tissues (skin, lymph nodes, lungs, liver sinusoids, spleen and bone marrow).</p>

Physiology	Introduction to Immunity	2 hours	80. Define and classify immunity: Innate & Acquired (adaptive). 81. Define antigen and pathogen. 82. Enlist different aspects of innate immunity. 83. List the substances and cells that participate in adaptive immunity. 84. Compare the characteristics innate and acquired immunity. 85. Classify acquired immunity: Active & Passive. 86. Compare the differences between active and passive acquired immunity.
	Humoral & Cell Mediated Immunity	2 hours	87. Describe and differentiate between humoral and cell mediated immunity. 88. Explain the role of antigen-presenting cells in the activation of T lymphocytes. 100. Classify T cells and discuss their specific immune functions. 101. Discss the role of nutrition in strengthening immunity.
	Complement System	2 hours	101. Describe the structural features of antibody. 102. Enlist different types of antibodies and specify their functions. 103. Discuss the direct action of antibodies on invading agents. 104. Explain the complement system of antibody action. 105. Compare classic and alternate pathways of complement activation. 106. Discuss the important effects of complement system.
	Allergy & Hypersensitivity	1 hour	107. Describe and classify the hypersensitivity reaction. 108. Compare the immediate and delayed hypersensitivity reactions. 109. List the diseases associated with hypersensitivity reactions
Biochemistry	Immunoglobulin's /Antibodies	1 hour	112. Define Immunoglobulins. 113. Describe the types of Immunoglobulins. 114. Describe Structure of Immunoglobulins. 115. Describe the mechanism of action of antibodies. 116. Explain biochemical role of each immunoglobulin in immunity.

Oral Biology	Dental Pulp	6 hours	<p>117. Discuss anatomy of pulp including coronal and radicular pulp.</p> <p>118. Describe the histology of pulp including cells, ground substance, fibers, blood and nerve supply and lymphatic drainage.</p> <p>119. Identify microscopic zones of pulp with detailed theoretical and diagrammatic representation.</p> <p>120. Describe functions of pulp.</p> <p>121. Differentiation of pulp of primary and permanent dentition.</p> <p>122. Discuss regressive changes of pulp (age changes).</p> <p>123. Explain development of pulp.</p> <p>124. Draw different microscopic zones of pulp with labelling.</p> <p>125. Differentiate types and properties of pulpal sensory nerve fibers.</p> <p>126. Interpret the number of root canals its configuration and position of apical foramen for endodontic procedures.</p>
	Periodontal Ligament (PDL)	8 hours	<p>129. Define Periodontal Ligament (PDL).</p> <p>130. Explain in detail the development of principle fibers and cells of PDL.</p> <p>131. Explain PDL homeostasis which helps to maintain the width of PDL.</p> <p>132. Describe cells of PDL under headings of synthetic, resorptive, defense, progenitor cells and epithelial rest cells of Malassez.</p> <p>133. Name markers of PDL and growth factors involved in normal biology.</p> <p>134. Discuss the functions of PDL.</p> <p>135. Discuss cell biology of PDL.</p> <p>136. Enumerate the principal fibers of PDL with complete description of course and functions.</p> <p>137. Describe composition of ground substance of PDL and its functions.</p> <p>138. Describe synthetic cells and their individual function in detail.</p> <p>139. Discuss clinical correlation of PDL with operative, surgical, and orthodontic procedures and conventional to latest treatment modalities for periodontal inflammatory diseases.</p>

Lab Work			
Histology		6 hours	<p>140. Identify and describe the microscopic anatomy of bone marrow and spleen under microscope.</p> <p>141. Identify histological features of lymph nodes, spleen, thymus, and tonsils.</p>
Physiology	WBC count	2 hours	<p>142. Demonstrate the preparation of a blood sample using the correct dilution technique for accurate WBC counting.</p> <p>143. Use a Neubar's chamber to accurately count white blood cells under a microscope, ensuring proper focus and grid identification.</p> <p>144. Apply the standard formula to calculate the total WBC count per microliter of blood based on the observed count and dilution factor.</p> <p>145. Interpret WBC count results by comparing them to normal physiological reference ranges and identify abnormalities.</p>
	DLC	2 hours	<p>146. Demonstrate the preparation of high quality peripheral blood smear suitable for differential leukocyte count analysis.</p> <p>147. Apply the appropriate staining technique (e.g., Leishman or Wright's stain) to highlight the morphology of different types of leukocytes.</p> <p>148. Identify and classify the different types of white blood cells (neutrophils, lymphocytes, monocytes, eosinophils, and basophils) based on their size, shape, and staining characteristics under a microscope.</p> <p>149. Calculate the percentage of each type of leukocyte by systematically counting cells in various microscopic fields.</p> <p>150. Interpret the results of the differential leukocyte count in relation to normal reference ranges and correlate deviations with pathological conditions, such as infections, allergies, or hematological disorders.</p>

Theme -III Bleeding Gums

Physiology	Hemostasis	1 hour	151. Describe the structure, function, life span and normal count of Platelets. 152. Define hemostasis. 153. Describe the role of platelets in hemostasis. 154. Outline the sequence of processes involved in hemostasis.
	Blood coagulation	1 hour	155. Enlist clotting factors and explain their role in blood coagulation. 156. Outline the sequence of processes during blood coagulation. 157. Describe with the help of a flow diagram the intrinsic and extrinsic pathways of coagulation cascade. 158. Discuss the role of calcium in coagulation.
	Anti-clotting mechanisms	1 hour	159. Discuss the prevention of blood clotting in normal vascular system. 160. Describe the lysis of blood clot. 161. Enlist anticoagulants and their mechanism of action: Heparin, coumarins (warfarin). 162. Describe the prevention of blood coagulation outside the body.
	Bleeding disorders	1 hour	163. Enlist bleeding disorders. i.e; decreased clotting factors, hemophilia, thrombocytopenia, thromboembolic conditions, disseminated intravascular coagulation (DIC). 159. Describe the bleeding disorders related to Vitamin K deficiency. 160. Enlist food sources of Vitamin K.

Oral Biology	Oral mucosa	6 hours	<p>163. Define oral mucosa and classify on basis of function and histophysiology, into lining mucosa, masticatory mucosa, and specialized mucosa.</p> <p>164. Describe structure of Oral epithelium, Basement membrane, Lamina Propria, Sub mucosa.</p> <p>165. Describe functions of oral mucosa, compare with intestinal and skin mucosa.</p>
			<p>166. Enlist the histological differences between keratinized & non keratinized oral epithelium.</p>
Lab Work			
Physiology	Platelet count	2 hours	<p>166. Demonstrate the correct preparation of a blood sample using an appropriate anticoagulant and dilution method for platelet counting.</p> <p>167. Use a Neubar's chamber under a microscope to accurately identify and count platelets in a diluted blood sample.</p> <p>168. Apply standard formula to calculate platelet count per microliter of blood based on observed counts and dilution factors.</p> <p>167. Interpret the platelet count results by comparing them with normal reference ranges and recognize deviations such as thrombocytopenia or thrombocytosis.</p>

	Bleeding time	2 hours	<p>169. Demonstrate the correct procedure for performing the bleeding time test using standardized methods, such as Ivy or Duke's method.</p> <p>170. Measure and record the bleeding time accurately using a stopwatch and appropriate observation of blood cessation.</p> <p>171. Interpret bleeding time results by comparing them with normal reference ranges and identify abnormalities such as prolonged bleeding time.</p>
	Clotting time	2 hours	<p>172. Demonstrate the correct procedure for performing the clotting time test using the capillary method or test tube method.</p> <p>173. Accurately time the formation of a clot using a stopwatch, recording the clotting time for the given blood sample.</p> <p>174. Interpret clotting time results by comparing them with normal reference values and recognize abnormal clotting time indicative of bleeding or clotting disorders.</p> <p>175. Relate prolonged or shortened clotting times to specific clinical conditions such as hemophilia, liver disease, or vitamin K deficiency.</p>
	PT & APTT tests	2 hours	<p>176. Perform the PT and APTT tests accurately using a coagulation analyzer or manual method, following standard protocols.</p> <p>177. Apply the appropriate reagents (e.g., thromboplastin for PT and partial thromboplastin with calcium for APTT) and ensure proper timing during the tests.</p> <p>178. Calculate PT and APTT results and compare them with normal reference ranges to assess clotting function.</p> <p>179. Interpret abnormal PT and APTT results to identify potential causes, such as vitamin K deficiency, liver disease, or coagulation factor deficiencies.</p>

Oral Biology	PDL, pulp and oral mucosa in slides.	4 hours	180. Identify structures of PDL, pulp and oral mucosa in slides. 181. Identify the central and lateral incisors on models. 182. Draw the diagram of maxillary incisors. 183. Interpret the anatomical structure of maxillary incisors.
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Theme -IV Cross Infection Prevention and Control in Dentistry

Physiology	Blood grouping	1 hour	184. Describe different types of blood groups. 185. Describe and interpret the genotype phenotype relationships in blood groups. 186. Describe the role of agglutinogens (antigens) and agglutinins (antibodies) in blood grouping. 187. Describe the process of agglutination.
	Transfusion reactions	1 hour	188. Describe Rh blood type and Rh Antigens. 189. Discuss Rh immune response. 190. Classify and manifest the characteristics of transfusion reactions.
	Erythroblastosis fetalis	1 hour	191. Discuss the mechanism and clinical picture of erythroblastosis fetalis. 192. Describe the treatment options and preventive measures of erythroblastosis fetalis.
Pathology	Transfusion reaction and organ transplant	1 hour	200. Discuss transfusion reaction and organ transplant. 201. Explain the criteria for transplant, donor, recipient, role of immune system in transplant, different types of transplants.
Oral Medicine	Oral manifestations of blood disorders	1 hour	202. 203. Discuss leukemia & its oral presentation. 204. Discuss thrombocytopenia & its oral presentation. 205. Discuss leukocytic disorders (neutropenia, agranulocytosis & certain syndromes) & their oral presentation.

Lab Work			
Physiology	Blood group	2 hours	206. Determine the O-A-B and Rh blood group in the given sample
Oral Bio & Tooth Morphology	Maxillary Central and Lateral Incisors	4 hours	207. Explain the morphology of labial, lingual, mesial, distal, and incisal, aspects of crown of maxillary central and lateral incisors. 208. Explain morphology of root of maxillary incisors. 209. Explain variations and anomalies associated with maxillary central and lateral incisors. 210. Explain variations and anomalies associated with maxillary central and lateral incisors. 211. Differentiate between maxillary central and lateral incisor.



MODULE 3
CRANIOFACIAL MODULE
1st Year BDS

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Vision & Mission

Khyber Medical University (KMU) Vision:

Khyber Medical University will be the global leader in health sciences academics and research for efficient and compassionate health care.

Khyber Medical University (KMU) Mission:

Khyber Medical University aims to promote professional competence through learning and innovation for providing comprehensive quality health care to the nation.

Institute of Health Professions Education & Research (IHPER) Mission:

To produce leaders, innovators and researchers in health professions education who can apply global knowledge to resolve local issues.

Teaching Hours Allocation

S. No	Subject	Hours
1.	Anatomy	89
2.	Oral Biology & Tooth Morphology	56
3.	Physiology	64
4.	Biochemistry	13
5.	Oral Medicine	1
Total		223

Themes

S. No	Theme	Duration in Weeks
1.	Orofacial Pain	1
2.	Head injury	2
3.	Neck Stiffness	1
4.	Facial Paralysis	0.5
5.	Sore Mouth	0.5
6.	Dental Caries	1
7.	Swollen Eye	1
8.	Nosebleed	1
Total		8 weeks

Learning Objectives

By the end of this Module, 1st year BDS students will be able to:

1. Describe the histology, structure, biochemical properties, function, and pathologies of bones and muscles in the cranium and face.
2. Describe the histology, anatomical structures, biochemical properties, and functions of the cranium.
3. Describe the development and anatomical structures of the face.
4. Discuss the overview of Trigeminal Neuralgia and Bell's Palsy.
5. Discuss the structure and features of maxillary central and lateral incisors, maxillary pre-molars, and maxillary canines.
6. Discuss the structure and features of mandibular central and lateral incisors and mandibular canines.
7. Describe the development, histology, functions, and different structures of the oral cavity.
8. Discuss an overview of common dental diseases such as caries, plaque, and calculus.
9. Describe the development, histology, structure, and function of the orbit and eye.
10. Describe the development, histology, structure, and function of the nose and paranasal sinuses.

Theme 1: Orofacial pain

Theme 1: Orofacial pain			
Subject	Subject	Subject	Subject
Oral Biology & Tooth Morphology	Alveolar Bone	3hrs	<ol style="list-style-type: none"> 1. Describe structure of alveolar bone with its functions. 2. Discuss types and formation of alveolar bone. 3. Discuss age related changes of bone.
	Mandibular Central & Lateral Incisors	4hrs	<ol style="list-style-type: none"> 4. Explain the morphology of labial, lingual, mesial, distal, and incisal, aspects of crown of mandibular central and lateral incisors. 5. Explain morphology of root of both incisors. 6. Explain variations and anomalies associated with mandibular central and lateral incisors. 7. Explain variations and anomalies associated with mandibular central and lateral incisors. 8. Differentiate between maxillary and mandibular incisors
Anatomy	Parathyroid Gland	1hr	<ol style="list-style-type: none"> 9. Describe gross and histological features of parathyroid gland. 10. Describe blood supply of Parathyroid gland. 11. Describe nerve supply of Parathyroid gland.
	Trigeminal Nerve and Ganglion	2hrs	<ol style="list-style-type: none"> 12. Explain the origin, course, and enumerate the main divisions of the trigeminal nerve. 13. Describe location and relations of Trigeminal Ganglion (TG). 14. Enumerate roots and branches of TG. 15. Describe blood supply of TG. 16. Define trigeminal neuralgia.

Physiology	Bone Metabolism: 1. Calcium and phosphate 2. Remodelling of bone 3. Vitamin D 4. Parathyroid hormone	4hrs	17. Describe the overview of Calcium and Phosphate regulation in ECF and plasma. 18. Describe the role of Vitamin D in the absorption of calcium and phosphate by the intestines. 19. Describe bone and its relationship to extracellular calcium and phosphate 20. Describe the mechanism of bone calcification. 21. Discuss remodeling of bone and functions of bone cells (osteoblasts and osteoclasts). 22. Discuss the formation and actions of Vitamin D. 23. Explain the effects of parathyroid hormone on calcium and phosphate in ECF. 24. Describe the control of parathyroid hormone secretion by calcium ion concentration. 25. Discuss pathophysiology of parathyroid hormone and bone diseases: Hypoparathyroidism & Hyperparathyroidism.
	Growth hormone	1hr	26. Discuss the physiological functions of growth hormone. 27. Describe the regulation of growth hormone secretion. 28. Enlist the factors that stimulate or inhibit the secretion of growth hormone secretion. 29. Discuss the abnormalities of growth hormone secretion.
	Skeletal Muscle physiology	2hrs	30. Discuss the physiological anatomy of skeletal muscle. 31. Explain the general and molecular mechanism of muscle contraction. 32. Describe the “Walk-along” theory of contraction. 33. Differentiate between isometric verses isotonic muscle contraction.
	Neuromuscular junction	1hr	34. Draw and label neuromuscular junction - the motor end plate. 35. Discuss the secretion and regulation of acetylcholine at neuromuscular junction. 36. Discuss muscle action potential. 37. Explain the mechanism of excitation-contraction coupling in the muscles.

Biochemistry	Vitamins	2hrs	38. Define vitamins. 39. Describe different types of vitamins. 40. Discuss sources of vitamins. 41. Enlist functions of vitamins. 45. Identify deficiency diseases of each vitamin.
	Role of Vitamin D In Bone Metabolism Role of protein and vitamin C (ascorbic acid) Role of Vitamin B1, B5, sodium and potassium	2hr	46. Discuss the role of vitamin D. 47. Describe the effect of vitamin D in calcium absorption and in bone mineralization. 48. Discuss the impact of vitamin D deficiency on bones. 49. Discuss the role of Vitamin C in synthesis of collagen matrix 50. Enlist the food sources of B1. 51. Discuss the role of B5 in acetylcholine synthesis. 52. Enlist the food sources of sodium and potassium.

	Role of GAGS	1hr	49. Discuss GAGS. 50. Enlist the functions of GAGS. 51. Discuss the role of GAGS in formation of connective tissues, cartilage, bones, and tendons.
	Role of vitamin B1, sodium and potassium	1hr	52. Discuss the role of B1 as TPP in transmission of nerve impulse and acetylcholine synthesis. 53. Discuss the role of sodium and potassium in the transmission of nerve impulse.
	Prostaglandins	1hr	54. Discuss prostaglandins. 55. Discuss synthesis and functions of prostaglandins and pain management.

Lab Work

Oral Biology & Tooth Morphology	Mandibular Central & Lateral Incisors	6hrs	56. Identify on tooth models/specimens or images labial depressions, imbrication lines, height of contour, cingulum, lingual fossa, marginal ridges, incisal edge. 57. Draw and label mandibular central and lateral incisors.
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Anatomy	Parathyroid Gland	2hrs	58. Identify the histological features of Parathyroid gland.
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Theme 2: Head Injury

Embryology	Cranium	1hr	58. Describe the development of skull.
Gross Anatomy	Norma Frontalis (5 th)	2hrs	59. Identify the skeletal features of norma frontalis (including Zygoma, Maxilla, and Mandible). 60. Describe muscle attachments. 61. Enlist structures passing through foramina. 62. Enumerate relevant clinical problems of Norma frontalis.
	Norma Basalis (3 rd)	3hrs	63. Discuss the anterior cranial fossa, middle and posterior cranial fossa. 64. Describe muscle attachments. 65. Enlist structures passing through foramina.
	Norma Lateralis (4 th)	3hrs	66. Identify the skeletal features of Norma lateralis. 67. Describe muscle attachments. 68. Enlist structures passing through foramina. 69. Enumerate relevant clinical problems of norma lateralis. 70. Discuss temporal fossa, infra-temporal fossa, and pterygopalatine fossa.
	Norma Occipitalis (2 nd)	1hr	71. Identify the skeletal features of norma occipitalis. 72. Describe muscle attachments. 73. Describe emissary veins of skull.
	Norma Verticalis (1 st sequence)	1hr	74. Identify the skeletal features of norma verticalis. 75. Enumerate relevant clinical problems of norma verticalis.

Neuroanatomy	Neuron	1hr	<p>76. Define neuron.</p> <p>77. Enumerate the supporting cells of nervous tissue.</p> <p>78. Describe the structure of multi-polar neuron.</p> <p>79. Classify neurons on the basis of morphology, function, and length.</p>
	Meninges	1hr	<p>80. Explain structural features of meninges.</p> <p>81. Describe blood supply of meninges.</p> <p>82. Describe nerve supply of meninges.</p> <p>83. Enumerate relevant clinical problems of structures of cranial cavity (e.g., headache, extradural and subdural hemorrhage etc.).</p> <p>84. Enlist paired and unpaired venous sinuses of dura matter.</p>
	Dural Venous Sinuses	1hr	<p>85. Enlist paired and unpaired venous sinuses of dura matter</p> <p>86. Identify various folds of the dura mater on a model</p> <p>87. Describe relations, tributaries, and drainage of venous sinuses</p> <p>88. Enumerate relevant clinical problems of venous sinuses (e.g., thrombosis of cavernous sinus, sigmoid and super sagittal sinus pulsating exophthalmos etc.).</p> <p>89. Relate connection of emissary veins with sinuses.</p>
	Hypophysis Cerebri	1hr	<p>90. Describe relations of hypophysis cerebri.</p> <p>91. Describe parts of hypophysis cerebri.</p> <p>92. Describe blood supply of hypophysis cerebri.</p> <p>93. Briefly explain hypothalamus-hypophyseal portal system.</p>
	Cranial Nerves	1hr	<p>94. Enlist cranial nerves.</p> <p>95. Classify cranial nerves according to their functions.</p>

	Middle Meningeal Artery	1hr	96. Explain course and relations of middle meningeal artery. 97. Enlist branches of middle meningeal artery. 98. Discuss clinical relevance of extradural hemorrhage with middle meningeal artery.
	Cerebrum Cerebral Cortex	2hrs	99. Identify all the lobes of the brain. 100. Explain the detail of the cerebral hemisphere including internal structures. 101. Identify the location of the cortical areas. 102. Explain the functions of all the important cortical areas.
	Cerebellum	2hrs	103. Describe the gross anatomy of the cerebellum. 104. Describe the blood supply of the cerebellum. 105. Discuss the connections and functions of cerebellum.
	Thalamus	1hr	106. Enumerate all the important nuclei of the thalamus and their functions. 107. Identify gross structures of the thalamus. 108. Discuss the connections of thalamus.
	Basal Nuclei (Ganglia)	1hr	109. Enumerate the basal nuclei and its most important structures. 110. Recall the important functions of the basal nuclei along with their clinical correlations.
	Hypothalamus	1hr	111. Enumerate the nuclei and their functions of the hypothalamus. 112. Discuss the connections of hypothalamus.
	Limbic System	1hr	113. Describe components of limbic system.
	Circle of Willis	1hr	114. Describe structure of circle of Willis. 115. Describe supply by circle of Willis to various structures.

	Ventricular System of the Brain	2hrs	116. Describe anatomy of Ventricular system of the brain. 117. Describe pathway of ventricular system.
	Brain Stem	4hrs	118. Identify gross structures of the Medulla oblongata, Pons, and mid-brain on a model. 119. Draw and label the cross sections of Medulla Oblongata, Pons, and mid-brain at various levels. 120. Enlist the clinical problems associated with Medulla Oblongata Pons, and mid-brain.
Physiology	Pituitary hormones	2hrs	121. Discuss the pituitary gland and its two lobes: anterior & posterior. 122. Enlist the physiological functions of pituitary gland hormones. 123. Describe the relation of pituitary to hypothalamus. 124. Enlist the physiological functions of hypothalamic hormones that control the secretions of anterior pituitary gland. 125. Summarize the hypothalamic-hypophysial portal blood vessels of the anterior pituitary gland and its significance.
	Cerebral Cortex	4hrs	126. Discuss the physiological anatomy of cerebral cortex. 127. Describe the functions of specific cortical areas: 128. Primary motor area - supplementary and premotor areas. 129. Somatosensory area - secondary sensory area. 130. Describe the function of association areas of cerebral cortex. a. Parieto-occipitotemporal association area. b. Prefrontal association area. c. Limbic association area. 131. Explain the role of Broca area in the formation of word and language. 132. Interpret the function of the posterior superior temporal lobe - Wernicke'e area.

			<p>133. Discuss the function of angular gyrus in the interpretation of visual information.</p> <p>134. Discuss the concept of the dominant hemisphere.</p> <p>135. Enlist the Functions of the parieto-occipitotemporal cortex in the non-dominant hemisphere.</p>
	Memory	2hrs	<p>136. Describe memory and explain its mechanism of formation.</p> <p>137. Discuss the role of synaptic facilitation or inhibition in the formation of positive and negative memory.</p> <p>138. Classify the types of memory: short term memory, intermediate long-term memory, long term memory.</p> <p>139. Classify memory on the basis of type of information stored: declarative memory, skill memory.</p> <p>140. Explain consolidation of memory.</p> <p>141. Discuss the Retrograde Amnesia.</p>
	Limbic System & Hypothalamus	2hrs	<p>142. Explain the functions of limbic system.</p> <p>143. Illustrate the anatomic structures of limbic system, showing key position of hypothalamus.</p> <p>144. Discuss the hypothalamus as a major control headquarter for limbic system.</p> <p>145. Explain the vegetative and behavioral functions of limbic system.</p> <p>146. Enlist specific functions of other parts of limbic system:</p> <ul style="list-style-type: none"> a) Hippocampus b) Amygdala c) Limbic cortex
	Basal ganglia	2hrs	<p>147. Draw and label basal ganglia nuclei.</p> <p>148. Discuss neuronal circuitry of basal ganglia and its anatomical relations to</p>

		<p>other structures of the brain.</p> <p>149. Classify and explain the specific functions of circuits of basal ganglia nuclei:</p> <p style="padding-left: 40px;">a) Putamen circuit</p> <p style="padding-left: 40px;">b) Caudate circuit</p> <p>150. Enlist the specific neurotransmitters in the basal ganglia system: Dopamine, GABA.</p> <p>151. Introduce the clinical relevance of basal ganglia: Parkinson's disease.</p>
Cerebral blood flow (CSF)	1hr	<p>152. Discuss the regulation of CSF in detail.</p> <p>153. Explain the formation, flow and absorption of CSF.</p> <p>154. Discuss the cushioning function of the cerebrospinal fluid.</p> <p>155. Explain the cerebrospinal fluid pressure.</p> <p>156. Discuss blood-brain barrier and blood-CSF.</p> <p>157. Define brain edema and its causes.</p>
States of brain activity	1hr	<p>158. Define sleep and describe its two types.</p> <p>159. Describe the neuronal centers, neurohormonal substances and mechanism of sleep.</p> <p>160. Describe the physiological effects of sleep.</p> <p>161. Discuss brain waves of EEG and its types.</p>
Brainstem	2hrs	<p>162. Enlist the role of brainstem in controlling motor functions.</p> <p>163. Discuss the role of reticular and vestibular nuclei in the support of body against gravity.</p> <p>164. Explain the vestibular sensations and maintenance of equilibrium.</p>
Cerebellum	2hrs	<p>165. Describe the anatomical functional areas of cerebellum</p> <p>166. Describe with the help of diagrams the input pathways to cerebellum: afferent pathways.</p>

			<p>167. Describe with the help of diagrams the output pathways from cerebellum: efferent pathways.</p> <p>168. Explain the function of cerebellum in motor control:</p> <ol style="list-style-type: none"> Vestibulocerebellum Spinocerebellum Cerebrocerebellum <p>169. Discuss clinical abnormalities of cerebellum: ataxia, past pointing, dysarthria</p>
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Biochemistry	Synthesis of Neuro Transmitters	2hrs	<p>175. Define the characteristics of neurotransmitters.</p> <p>176. Enlist neurotransmitters involved in central nervous tissues.</p> <p>177. Explain the role of amino acid (tyrosine, glutamate, and tryptophan) in biosynthesis of neurotransmitters.</p> <p>178. Discuss the role of vitamin B6 (pyridoxine) in decarboxylation of certain amines to produce neurotransmitters.</p> <p>179. Enlist the food sources of tyrosine, glutamate and tryptophan.</p> <p>180. Enlist the dietary sources of vitamin B6.</p>
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Lab Work

Anatomy	Norma Basalis (3rd)	2hrs	<p>179. Demonstrate surface markings of different structures on skull model.</p> <p>180. Identify the structures present in:</p> <ul style="list-style-type: none"> • Anterior Cranial fossa. • Middle Cranial fossa. • Posterior Cranial fossa.
	Norma Lateralis (4 th)	2hrs	181. Demonstrate surface markings of different structures in skull model.
	Norma Occipitalis (2 nd)	2hrs	182. Demonstrate surface markings of different structures in skull model.

	Norma Verticalis (1 st)	2hrs	183. Demonstrate surface markings of different structures in skull model.
Neuroanatomy	Meninges	2hrs	184. Identify various folds of the dura mater on a model.

	Cranial Nerves	2hrs	185. Identify the site of origin of cranial nerves.
	Brain	2hrs	186. Identify the different parts of the brain on model.
Physiology	Examination of cerebellum	2hrs	187. Examine and interpret the results of various cerebellar tests such as the finger-to-nose test, rapid alternating movements, and heel-to-shin test, identifying normal versus abnormal findings.
Theme 3: Neck Stiffness			
Histology	Spinal cord	1hr	188. Describe histological features of spinal cord. 189. Discuss transverse section of spinal cord at different levels.
Neuroanatomy	Vertebral Canal	1hr	190. Describe contents of vertebral canal.
	Accessory Nerve	1hr	191. Explain the origin, course, branches of the divisions of the accessory nerve.
	Spinal Cord	1hr	192. Explain the gross anatomy of the spinal cord. 193. Enumerate clinical problems of spinal cord.
	Ascending and Descending Tracts	2hrs	194. Enumerate the ascending and descending tracts of the spinal cord with functions. 195. Discuss spinothalamic tract. 196. Discuss corticospinal tract.
Physiology	Sensory receptors and somatic sensations	1hr	197. Classify and describe the sensory receptors 198. Describe the adaptation of receptors 199. Classify nerve fibers 200. Classify somatic sensations 201. Describe detection and transmission of tactile sensations
Physiology	Spinal Cord Sensory functions	2hrs	202. Enumerate the classification of sensory pathways 203. Describe dorsal column medial lemniscal system and enumerate its characteristics 204. Discuss the sensations transmitted through antero-lateral system pathway

	Spinal Cord Motor functions (Spinal Reflexes)	3hrs	205. Describe the structural organization of spinal cord 206. Define reflex action and enlist components of reflex arc 207. Explain the role of proprioceptors (muscle spindles and Golgi tendon organs) in motor movements. 208. Explain muscle stretch reflex and golgi tendon reflex 209. Describe the mechanism of flexor reflex and withdrawal reflex 210. Describe the mechanism of crossed extensor reflex 211. Identify the reflexes of posture and locomotion in the spinal cord. 212. Differentiate between signs of the upper and lower motor neurons
Lab Work			
Neuroanatomy	Spinal Cord	2hrs	213. Identify and describe microscopic anatomy of spinal cord. 214. Draw and label the cross sections of spinal cord at different levels.
Physiology	Spinal Cord Reflexes	2hrs	215. Demonstrate the correct technique for eliciting spinal reflexes, such as the knee-jerk (patellar), ankle-jerk (Achilles), biceps, triceps, and plantar reflexes, using a reflex hammer. 216. Apply the principles of reflex arc physiology to interpret the results of different spinal reflexes.
Theme 4: Facial Paralysis			
Anatomy	Pharyngeal Arches, Pouches, and Clefts	2hrs	187. Describe derivatives of pharyngeal arches. 188. Describe derivatives of pharyngeal pouches. 189. Describe derivatives of pharyngeal clefts. 190. Describe anomalies of pharyngeal apparatus.
	Development of Face	1hrs	191. Discuss role of molecular regulation in face development.
Oral Biology & Tooth Morphology	Development of Maxilla and Mandible	2hrs	192. Describe the development of mandible. 193. Describe the development of maxilla.
Gross Anatomy	Face	2hrs	194. Describe features of skin and superficial fascia. 195. Tabulate facial muscles, their origin, insertion, actions. 196. Classify functional groups of facial muscles.

			<p>197. Describe nerve supply of face.</p> <p>198. Describe blood supply of face.</p> <p>199. Describe lymphatic drainage of face.</p> <p>200. Enumerate relevant clinical problems of structures of face.</p> <p>201. Demonstrate how different facial muscles help in facial expressions.</p>
Neuroanatomy	Facial Nerve	2hrs	<p>202. Explain the origin and course (intracranial, extra-cranial) of facial nerve.</p> <p>203. Enumerate the main divisions of the facial nerve.</p> <p>204. Explain the distribution of its branches along with the functions.</p> <p>205. Enumerate the clinical conditions associated with facial nerve.</p>
Oral Medicine	Bell's Palsy	1hr	<p>206. Describe the pathophysiology of bell's palsy.</p> <p>207. Enlist the etiology of bell's palsy.</p> <p>208. Enumerate clinical features of bell's palsy.</p> <p>209. Discuss the preventive aspects of bell's palsy.</p>
	Somatosensory cortex	1hr	<p>210. Describe the distinct areas of somatosensory cortex.</p> <p>211. Discuss the spatial orientation of signals from different parts of the body in somatosensory area.</p> <p>212. Describe the functions of somatosensory area I and somatosensory association area.</p>
	Pain and thermal sensations	2hrs	<p>213. Describe the types of pain: fast pain, slow pain.</p> <p>214. Discuss the dual pathways for transmission of pain signals to CNS.</p> <p>215. Differentiate between fast and slow pain.</p> <p>216. Describe pain suppression system in brain and spinal cord.</p> <p>217. Describe referred and visceral pain.</p> <p>218. Classify and describe the headache</p> <p style="padding-left: 40px;">a) Intracranial headache</p> <p style="padding-left: 40px;">b) Extracranial headache</p> <p>219. Describe thermal receptors and their mechanism of stimulation.</p>

	Motor cortex	2hrs	<p>220. Discuss the types and functions of motor cortex</p> <p>a) Primary motor cortex b) Premotor cortex c) Supplementary motor cortex</p> <p>221. Define motor homunculus.</p> <p>222. Discuss transmission of signals from motor cortex to muscles (descending tracts).</p> <p>a) Corticospinal tract (pyramidal) b) Extrapyramidal tracts</p>
Lab Work			
Physiology	Cranial nerve 7th (Facial) examination	2hrs	223. Examine subject's facial nerve.
Gross Anatomy	Face	2hrs	224. Identify different facial muscles on model.
Theme 5: Sore Mouth			
Oral Biology & Tooth Morphology	Tongue	1hr	<p>225. Explain development of tongue.</p> <p>226. Explain development of taste buds.</p>
	Palate	1hr	<p>227. Explain development of primary and secondary palate.</p> <p>228. Discuss common anomalies related to the development of palate.</p>
	Oral Cavity	2hrs	216. Describe structures of oral cavity.
			<p>217. Describe blood supply of teeth and gums.</p> <p>218. Describe lymphatic drainage of oral cavity.</p> <p>219. Describe nerve supply of teeth and gums.</p>

	Hard And Soft Palate	1hr	<p>220. Describe structure of hard and soft palate.</p> <p>221. Describe muscles of the soft palate, their origin and insertion, actions.</p> <p>222. Describe nerve supply of hard and soft palate.</p> <p>223. Explain lymphatic drainage of hard and soft palate</p>
	Oral Mucosa	4 hrs	<p>224. Elaborate cells of OMM that is Keratinocytes and Non-keratinocytes, Melanocytes Langerhans cells & Merkel cells.</p> <p>225. Identify histological features, location, and function of tongue papillae & taste buds,</p> <p>226. Correlate Gingival sulcus, dento-gingival junction mucocutaneous junction.</p> <p>227. Explain development of OMM, age changes, blood supply & nerve supply of oral mucosa.</p> <p>228. Discuss the clinical significance of oral mucosa.</p>
Anatomy	Gross Anatomy of Tongue	2hrs	<p>226. Describe external features of tongue.</p> <p>227. Describe muscles of tongue, their origin and insertion, actions.</p> <p>228. Explain blood supply of tongue.</p> <p>229. Describe lymphatic drainage of tongue.</p> <p>230. Enumerate the nerve supply of tongue.</p> <p>231. Enumerate relevant clinical problems tongue (glossitis, lingual tonsil, carcinoma etc.).</p>
Neuroanatomy	Hypoglossal Nerve	1hr	<p>232. Explain the origin, course, and branches of hypoglossal nerve.</p> <p>233. Describe the clinical significance of hypoglossal nerve.</p>
	Glossopharyngeal Nerve		<p>234. Explain the origin, course, branches of the divisions of the glossopharyngeal nerve.</p>

Physiology	Sense of taste	1hr	235. Discuss primary sensations of taste and threshold for taste. 236. Describe the taste bud and its function. 237. Describe mechanism of stimulation of taste buds. 238. Describe transmission of taste signals into the central nervous system.
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Lab Work

Oral Biology & Tooth Morphology	Hard And Soft Palate	2hrs	239. Demonstrate surface marking of different structures of hard and soft palate on model.
Histology	Tongue	2hrs	240. Identify the histological features of tongue and taste buds.
	Lip	2hrs	241. Identify the histological features of lip.
Physiology	Cranial nerves examination: trigeminal, facial	2hrs	242. Examine subject's trigeminal and facial nerve.
	Cranial nerves examination: Hypoglossal, vagus, glossopharyngeal, accessory	2hrs	243. Examine subject's hypoglossal nerve. 244. Examine subject's accessory nerve

Theme 6: Dental Caries

	Dentine	10 hrs	<p>245. Describe physical and chemical properties of dentin.</p> <p>246. Explain microscopic structures of dentin covering dentinal tubules, peritubular dentin, intertubular dentin, pre-dentin.</p> <p>247. Describe of odontoblast with diagrammatic representation in detail.</p> <p>248. Types of dentin including primary secondary and tertiary dentin.</p> <p>249. Differentiation of incremental lines, interglobular dentin, granular layer.</p> <p>250. Interpret different types of incremental lines seen in dentin.</p> <p>251. Describe the age changes related to dentin.</p> <p>252. Review development of dentin with complete comprehension of dentinogenesis.</p> <p>253. Compare the process of amelogenesis and dentinogenesis.</p> <p>254. Enlist the genes effecting dentinogenesis.</p> <p>255. Explain hypersensitivity of dentin and its mechanism.</p> <p>256. Discuss the theories of pain transmission and hydrodynamic.</p>
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	Cementum	6hrs	<p>257. Discuss introduction to cementum with explanation of its physical and chemical properties.</p> <p>258. Enlist growth factors which control cementogenesis.</p> <p>259. Define cementogenesis with complete description of cement oblast structure and its origin.</p> <p>260. Describe types of cementum and tabulate differences of various types including cellular and a cellular cementum.</p> <p>261. Discuss cement dentinal and cement enamel junction and explain its types.</p> <p>262. Draw diagram of cement enamel junctions.</p> <p>263. Enumerate functions of cementum with short description.</p> <p>264. Correlate cementum pathologies clinically.</p> <p>265. Explain hypercementosis associated with difficult extraction.</p>
Oral Biology & Tooth Morphology	Maxillary & Mandibular Canines	2hrs	<p>266. Discuss initiation of calcification, crown completion age, age of eruption and root completion age. arch position, general outline.</p> <p>267. Describe various aspects (labial, lingual, mesial, distal, and incisal) of crowns of maxillary and mandibular canines.</p> <p>268. Discuss number, shape, and inclination of root.</p> <p>269. Discuss number, location and significance of pulp horns, chamber, and canal.</p> <p>273. Differentiate between maxillary and mandibular canines.</p>
Biochemistry	Role of Calcium, Phosphorus in Teeth	1hr	<p>274. Discuss the role of Calcium and Phosphorus in formation of cellular matrix and bone.</p>

			275. Explain the role of Calcium and Phosphorus in the development of bones and teeth.
	Magnesium	1hr	281. Discuss the role of Magnesium in formation of cellular matrix and bone.
Physiology	Calcitonin	1hr	282. Discuss calcium and phosphate regulation in the body. 283. Discuss relationship of bone with extracellular calcium and phosphate. 284. Discuss the role of calcitonin in the regulation of calcium concentration.
Lab Work			
Oral Biology & Tooth Morphology	Maxillary & Mandibular Canines	4hrs	285. Identify labial depressions, imbrication lines, height of contour, cingulum, lingual fossa, marginal ridges, incisal slop on tooth models/specimens or images. 286. Draw and label different aspects of maxillary and mandibular canines.
Theme 7: Swollen Eye			
Gross Anatomy	Bony Orbit	1hr	287. Describe walls and openings in the orbital cavity. 288. Enumerate foramen and fissures in bony orbit and structures passing through it.
	Extraocular Muscles	1hr	289. Explain origin, insertion, nerve supply and action of extraocular muscles.

	Eye Ball	3hrs	290. Describe features & relevant clinical anatomy of: <ul style="list-style-type: none"> • Outer Coat • Cornea • Middle Coat • Inner Coat • Aqueous Humour • Vitreous Body
	Lacrimal Gland and Ciliary Gland	1hr	291. Discuss lacrimal and ciliary glands.
	Ophthalmic Artery Ophthalmic Vein	3hrs	292. Explain origin, course, and relations of ophthalmic artery. 293. Describe branches of ophthalmic artery. 294. Describe parts of ophthalmic vein. 295. Describe supply of ophthalmic vein. 296. Discuss clinical significance associated with the vessels.
Neuroanatomy	Cranial Nerves II, III, IV, VI	2hrs	297. Explain the Origin, course, branches, and functions of: <ul style="list-style-type: none"> • Optic Nerve • Oculomotor Nerve • Trochlear nerve • Abducent nerve 298. Discuss clinical significance associated with the nerves.
	Cavernous Sinus	1hr	299. Explain the important relations of the cavernous sinus. 300. Enumerate the contents of the cavernous sinus.
Physiology	Photochemistry of vision	2hrs	301. Describe the physiological anatomy of eye. 302. Describe function of structural elements of retina.

			303. Discuss rhodopsin-retinal visual cycle. 304. Describe the photochemistry of color vision by cones. 305. Discuss light and dark adaptation of retina.
	Optics of eye	2hrs	306. Discuss the mechanism of accommodation of eye. 307. Describe the errors of refraction. 308. Explain the visual acuity of the eye.
	Intraocular fluid	1hr	309. Describe the formation of aqueous humor by ciliary body. 310. Describe the regulation of intraocular pressure. 311. Enumerate the pathophysiology of glaucoma.
	Visual pathways	1hr	312. Discuss the visual pathway from retinal cells to visual cortex. 313. Enumerate the specific functions of all five types of retinal cells. 314. Enumerate the neurotransmitters released by retinal neurons.
	Reflexes of eye	2hrs	315. Explain the mechanism of Accommodation reflex. 316. Explain the mechanism of Pupillary light reflex.
Biochemistry	Vitamin A	1hr	317. Discuss the role of vitamin A. 318. Enlist the food sources of vitamin A.

Oral Biology & Tooth Morphology	Maxillary 1 st and 2 nd Pre-molars	3hrs	318. Discuss initiation of calcification, age of crown completion, age of eruption, and root completion. 319. Discuss arch position and general outlines. 320. Describe various aspects (labial, lingual, mesial, distal, and occlusal aspect) of crowns of maxillary pre-molars. 321. Describe number, location and significance of pulp horns, chamber, and canals. 322. Describe number, shape, and inclination of roots. 323. Differentiate between maxillary 1st and 2 nd premolar.
Anatomy	Eye	2hrs	324. Demonstrate anatomical features of eye on a model.
Lab Work			
Oral Biology & Tooth Morphology	Maxillary 1 st and 2 nd Pre-molars	4hrs	325. Identify crown outline, buccal, lingual, mesial, distal surfaces, occlusal table and its components on tooth models/specimens or images. 326. Draw and label different aspects of maxillary first and second pre-molar.
Physiology	Cranial nerves examination: oculomotor, abducent, trochlear	2hrs	327. Examine subject's 3rd, 4th and 6th cranial nerve.
	Optic nerve examination: Visual acuity, Color vision, Perimetry	2hrs	328. Examine subject's 2nd cranial nerve.

Theme 8: Nosebleed

Gross Anatomy	Nose	1hr	<p>329. Describe features of nose.</p> <p>330. Describe blood supply of nose.</p> <p>331. Describe nerve supply of nose.</p> <p>332. Describe lymphatic drainage of nose.</p> <p>333. Enumerate relevant clinical problems of nose (e.g., rhinitis, fracture of cribriform plate, epistaxis etc.).</p>
	Lateral and Medial Wall of Nose	1hr	<p>334. Discuss features of lateral wall of nose.</p> <p>335. Discuss features of conchae and meatuses.</p>
	Paranasal Sinuses	1hr	<p>336. Discuss features of paranasal sinuses (frontal, maxillary, sphenoidal, ethmoidal).</p> <p>337. Explain relations of sinuses.</p> <p>338. Describe blood supply of sinuses.</p> <p>339. Describe nerve supply of sinuses.</p> <p>340. Describe lymphatic drainage of sinuses.</p> <p>341. Enumerate relevant clinical problems related to sinuses (e.g., carcinoma of maxillary sinus, sinusitis etc).</p>
	Pterygopalatine Ganglion	1hr	<p>342. Describe features of pterygopalatine ganglion.</p> <p>343. Explain connections of Pterygopalatine ganglion.</p>
			<p>344. Describe branches of Pterygopalatine ganglion.</p> <p>345. Enumerate relevant clinical problems related to Pterygopalatine ganglion.</p>

Neuroanatomy	Olfactory Nerve	1hr	346. Explain the origin, course, and function of the olfactory nerve. 347. Describe the clinical aspects associated with Olfactory nerve.
Oral Biology & Tooth Morphology	Maxillary Sinus	2hrs	348. Enumerate the para nasal sinuses. 349. Describe the anatomical structures & boundaries of maxillary sinus. 350. Discuss the development and functions of maxillary sinus. 351. Describe the microscopic features such as mucus membrane and epithelium of maxillary sinus to differentiate between oral mucosa & respiratory mucosa.
Physiology	Sense of smell	1hr	352. Describe olfactory membrane. 353. Explain mechanism of excitation of the olfactory cells. 354. Discuss Rapid Adaptation of Olfactory Sensations. 355. Describe transmission of smell signals into the central nervous system.
Lab Work			
Gross Anatomy	Lateral Wall of Nose	2hrs	356. Demonstrate anatomical features of conchae and meatuses on model.
Physiology	Olfactory nerve examination	2hrs	357. Examine the subject's olfactory nerve.

Learning Resources

S#	Subjects	Resources
1.	Anatomy	<p>A. GROSS ANATOMY</p> <ol style="list-style-type: none"> 1. Last's Anatomy <p>B. EMBRYOLOGY</p> <ol style="list-style-type: none"> 1. Langman's Medical Embryology <p>C. HISTOLOGY</p> <ol style="list-style-type: none"> 1. Medical Histology By Laiq Hussain <p style="text-align: center;">Reference Books</p> <ol style="list-style-type: none"> 1. Netter Atlas of Human Anatomy 2. Gray's Anatomy
2	Biochemistry	<p style="text-align: center;">Text Books</p> <ol style="list-style-type: none"> 1. Lippincott illustrated reviews 8th 2. Harper's illustrated Biochemistry 30th 3. U. Satyanarayan and U. Chakarpani 4th <p style="text-align: center;">Reference Books</p> <ol style="list-style-type: none"> 1. Lippincott illustrated reviews 2. MLA. Harvey, Richard A., PhD. Lippincott's illustrated reviews: Biochemistry 3. U. Satyanarayana Biochemistry 4. U. satyanarayan and U. Chakarpani 4th edition 5. Harper's illustrated Biochemistry 6. Rodwell VW, Bender DA ,Botham KM., Kennelly PJ, Weil P. Eds. Victor W. Rodwell et al. 7. Fundamentals of Biochemistry 8. Donald V., Judith G. Voet, Charlotte W. John wiley and sons, New york 9. Netter's essential Biochemisty 10. Lippincott illustrated reviews 11. MLA. Harvey, Richard A., PhD. Lippincott's illustrated reviews: Biochemistry

3	Physiology	<p style="text-align: center;">Textbooks</p> <ol style="list-style-type: none"> 1. Guyton and Hall Textbook of Medical Physiology, 13th Edition by John E. Hall. 2. Human Physiology: From Cells to Systems, 8th Edition by Lauralee Sherwood
4	Oral Biology	<p style="text-align: center;">Textbook</p> <ol style="list-style-type: none"> 1. Ten Cate's Oral Histology 2. Orban's Oral Histology and Embryology 3. Concise Dental Anatomy and Morphology by James L. Fuller <p style="text-align: center;">Reference Books</p> <ol style="list-style-type: none"> 1. Oral Anatomy, Histology and Embryology by B.K.B Berkovitz



MODULE 4
CERVICO-FACIAL MODULE
1st Year BDS

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Vision & Mission

Khyber Medical University (KMU) Vision:

Khyber Medical University will be the global leader in health sciences academics and research for efficient and compassionate health care.

Khyber Medical University (KMU) Mission:

Khyber Medical University aims to promote professional competence through learning and innovation for providing comprehensive quality health care to the nation.

Institute of Health Professions Education & Research (IHPER) Mission:

To produce leaders, innovators and researchers in health professions education who can apply global knowledge to resolve local issues.

Themes

S#	Theme	Duration in Weeks/days
1.	Neck Pain	3 days (18hrs)
2.	Neck Swelling	3 days (22hrs)
3.	Earache & Imbalance	2 days (10hrs)
4.	Difficulty in Chewing	1 week (29hrs)
Total		3 weeks (79 hrs)

Teaching Hours Allocation

S. No	Subject	Hours
1.	Anatomy	42
2.	Physiology	9
3.	Oral Biology & Tooth Morphology	21
4.	Orthodontics	2
5.	Biochemistry	2
6.	Oral Maxillofacial	2
7.	General Medicine	1
Total		79

Learning Objectives

By the end of this Module, 1st year BDS students will be able to:

1. Identify the anatomical structures of the neck.
2. Discuss the development, histology, structure, and common diseases associated with thyroid and parathyroid gland.
3. Describe the development, histology, structure, and function of ear.
4. Discuss the structure, function, and diseases of the muscles, joints, and other tissues involved in mastication.
5. Define occlusion and malocclusion.
6. Discuss the structure and features of mandibular pre-molars and molars.
7. Classify impression materials and demonstrate manipulation of impression materials.
8. Discuss the classification, structure, function, biochemical properties, pathology, and management of salivary glands.
9. Discuss the histology, structure, biochemical properties, and function of cervical spine.

Theme 1: Neck Pain			
Subject	Topic	Hours	Learning Objective
Gross Anatomy	Hyoid Bone	1hr	<ol style="list-style-type: none"> 1. Describe the structure of the hyoid bone. 2. Describe muscle attachments of hyoid bone. 3. Explain the clinical implications.
	Anterior Triangle of Neck	2hrs	<ol style="list-style-type: none"> 4. Describe superficial fascia and deep fascia. 5. Enlist subdivisions of anterior triangle of neck <ol style="list-style-type: none"> a. Submental Triangle b. Digastric triangle c. Carotid Triangle d. Muscular Triangle 6. Describe boundaries of anterior triangle of neck. 7. Describe content of anterior triangle of neck. 8. Describe boundaries of carotid triangle of neck. 9. Describe content of carotid triangle of neck. 10. Describe boundaries of muscular triangle. 11. Enlist contents of muscular triangle. 12. Describe attachments, nerve supply and actions of infrahyoid muscles. 13. Enumerate clinical problems related to anterior neck region.
	Posterior Triangle	1hr	<ol style="list-style-type: none"> 14. Describe boundaries of posterior triangle. 15. Enlist divisions of posterior triangle. 16. Explain contents of posterior triangle. 17. Discuss swelling of supraclavicular lymph nodes.
	Pharynx	1hr	<ol style="list-style-type: none"> 18. Describe boundaries of pharynx.

		<p>19. Enlist parts of pharynx and compare them.</p> <p>20. Describe structure of pharynx.</p> <p>21. Describe structures passing between pharyngeal muscles.</p> <p>22. Describe origin, insertion of constrictors of pharynx.</p> <p>23. Explain Waldeyer's lymphatic ring.</p>
Pharyngeal Spaces	1hr	24. Explain types of pharyngeal spaces.
Larynx	2hrs	<p>25. Describe gross features of larynx, cartilages membranes and muscles.</p> <p>26. Enlist muscles which cause movement of larynx.</p> <p>27. Describe movements of vocal cords.</p> <p>28. Describe blood supply of vocal cords.</p> <p>29. Describe nerve supply of vocal cords.</p> <p>30. Describe lymphatic drainage of vocal cords.</p> <p>31. Enumerate clinical problems (e.g., tumors of vocal cords, damage to external laryngeal nerve, damage to recurrent laryngeal nerve etc.)</p>
Cervical Fascia	1hr	<p>32. Describe skin, superficial fascia and deep cervical fascia.</p> <p>33. Discuss attachments of deep cervical fascia and pharyngeal spaces.</p>
Common Carotid Artery and its branches	2hrs	<p>34. Describe parts of common carotid artery i.e., carotid sinus, carotid body.</p> <p>35. Describe course and relation of ECA.</p> <p>36. Explain branches of ECA.</p> <p>37. Describe parts of ICA with reference to relations.</p>
Subclavian, Internal Jugular, Brachiocephalic Vein	2hrs	<p>38. Describe course of subclavian vein.</p> <p>39. Describe course and relations of IJV.</p> <p>40. Describe different parts of Brachiocephalic vein.</p>

	Lymphatic Drainage of Head and Neck	1hr	41. Explain role of superficial and deep group of lymph nodes in drainage of head and neck.
	Cervical Vertebrae	2hrs	42. Describe attachments of Cervical vertebrae. 43. Enumerate clinical problems of cervical vertebrae (e.g., cervical spondylosis, fracture of cervical vertebrae etc.)
	Cervical Plexus	1hr	45. Enlist branches of cervical plexus.
	Brachial Plexus	1hr	46. Describe the formation of brachial plexus. 47. Enlist the branches of brachial plexus.
Theme 2: Neck Swelling			
Gross Anatomy	Thyroid	1hr	48. Describe location and extent of thyroid gland. 49. Briefly explain capsules of thyroid. 50. Explain parts and relations of thyroid gland. 51. Describe blood supply of thyroid gland. 52. Describe nerve supply of thyroid gland. 53. Describe lymphatics of thyroid gland.
Neuroanatomy	Vagus Nerve and Ansa Cervicalis	1hr	54. Explain the origin, course, branches, and the divisions of the vagus nerve. 55. Describe Ansa cervicalis.
	Cervical Part of Sympathetic Trunk:	1hr	56. Describe features and relations of Cervical part of sympathetic trunk.

			<p>57. Discuss features, location, and branches of:</p> <ol style="list-style-type: none"> a. Superior cervical ganglion b. Middle cervical ganglion c. Inferior cervical ganglion <p>58. Discuss Horner's syndrome.</p>
Physiology	Thyroid hormone physiological functions	2	<p>58. Discuss the Synthesis and Secretion of the Thyroid Metabolic Hormones</p> <p>59. Discuss the physiological functions of thyroid hormones</p> <p>60. Describe the regulation of thyroid hormone secretion</p> <p>61. Describe the diseases of thyroid:</p> <ol style="list-style-type: none"> a. Hyperthyroidism b. Hypothyroidism
Biochemistry	Thyroid Hormone	2hr	<p>62. Describe the Sources of iodine, zinc and Selenium.</p> <p>63. Discuss diseases of iron deficiency.</p> <p>64. Discuss the role of Iodine, Zinc and Selenium in the synthesis and regulation of thyroid hormone.</p> <p>65. Describe the daily requirements for iodine, Zinc and Selenium</p> <p>66. Enlist the sources of iodine Zinc and Selenium.</p>
General Medicine	Thyroid, and Parathyroid	1hr	<p>65. Discuss the clinical aspects of common diseases associated with thyroid and parathyroid.</p>
Oral and maxillofacial	Cervical Lymphadenopathy	1hr	<p>66. Describe the features of acute & chronic cervical lymphadenopathy.</p>

surgery	Facial space infections	11.	67. Explain clinical features of facial space infections.
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Lab Work			
Physiology	Thyroid Status examination	2	<p>68. Demonstrate the proper technique for inspecting the thyroid gland for visible enlargement or asymmetry in a patient.</p> <p>69. Evaluate the thyroid gland's mobility by asking the patient to swallow and observing its movement with the trachea</p> <p>70. Relate physical examination findings to the physiological changes in thyroid function (e.g., hypo- or hypersecretion of thyroid hormone.</p> <p>71. Interpret findings from thyroid examination and correlate them with clinical conditions such as goiter, hypothyroidism, or hyperthyroidism</p>
Anatomy	Anterior and posterior triangles of neck	2hrs	72. Demonstrate surface landmarks on a person of anterior and posterior triangles of the neck.
	Pharynx	2hrs	73. Demonstrate surface anatomy of pharynx on model.
	Larynx	2hrs	74. Demonstrate the gross features of larynx.
	Thyroid Gland	2hrs	75. Identify histological features of thyroid gland.
	Cervical vertebrae	2hrs	<p>76. Identify different parts of cervical vertebrae</p> <ul style="list-style-type: none"> • Atlas(C1) • Axis(C2) • C3 • C7

Theme 3: Earache & Imbalance

Gross Anatomy	External Ear	1hr	77. Discuss parts of external ear.
	External Acoustic Meatus.		78. Describe features of external acoustic meatus.
	Tympanic Membrane		79. Describe structure of tympanic membrane.
	Middle Ear	1hr	80. Describe features of middle ear. 81. Explain boundaries of middle ear. 82. Briefly explain functions of middle ear. 83. Briefly explain mastoid air cells.
	Internal Ear		1hr
Neuroanatomy	Vestibulocochlear Nerve	1hr	85. Explain the origin, course, branches of the divisions of the vestibulocochlear nerve and enumerate its functions.
Physiology	Auditory System	2hrs	86. Explain conduction of sound from the tympanic membrane to the cochlea 87. Describe functional anatomy of the cochlea 88. Describe the functions of organ of corti. 89. Discuss auditory pathways and functions of cerebral cortex in hearing 90. Describe types of deafness.
Lab Work			
Anatomy	Ear	2hrs	91. Demonstrate various structures of ear on model.
Physiology	Hearing tests	2hrs	92. Demonstrate the correct technique for performing basic hearing tests, including the Rinne test, Weber test, and Schwabach test, using a tuning fork. 93. Apply the principles of air conduction (AC) and bone conduction (BC) to interpret the results of the Rinne test. 94. Analyze the findings of the Weber test to differentiate between conductive and sensorineural hearing loss. 95. Perform the absolute bone conduction test (Schwabach test) to assess the integrity of cochlear function. 96. Interpret the results of hearing tests in relation to normal and abnormal auditory physiology, identifying potential causes of hearing impairment.

Theme 4: Difficulty in Chewing

Anatomy	Muscles Of Mastication	2hrs	97. Explain origin, insertion, nerve supply, blood supply and actions of muscles of mastication.
	Otic Ganglion	1hr	98. Describe location and connections of otic ganglion. 99. Briefly explain branches of otic ganglion.
Physiology	Ingestion of food	1hr	100. Describe the process of mastication (chewing) 101. Enlist the muscles involved in masticatory process 102. Name the cranial nerve that innervate muscles of mastication 103. Describe chewing reflex 104. Discuss the importance of chewing
Oral Biology & Tooth Morphology	Deciduous teeth	1hr	105. Describe differences between deciduous and permanent teeth.
	Eruption	3hrs	106. Describe various eruption movements. 107. Discuss the theories of eruption. 108. Describe mechanism of tooth movement. 109. Describe histology of tooth movement.
	Shedding	3hrs	110. Describe the process of shedding of deciduous teeth. 111. Enumerate the differences in the shedding pattern between the anterior and posterior teeth. 112. Describe role of odontoclast in shedding of deciduous teeth. 113. Explain the occurrence of retained deciduous root, deciduous teeth, and sub merged teeth.

	Mandibular 1st & 2nd Pre-Molars	3hrs	<p>114. Discuss initiation of calcification, age of crown completion, age of eruption, and root completion.</p> <p>115. Discuss arch position and general outlines.</p> <p>116. Describe various aspects (labial, lingual, mesial, distal, and occlusal aspect) of crowns of mandibular pre-molars.</p> <p>117. Describe number, location and significance of pulp horns, chamber, and canals.</p> <p>. Describe number, shape, and inclination of roots.</p>
	Maxillary 1 st Molar	2 hrs	<p>119. Indicate initiation of calcification, crown completion age, age of eruption and root completion age, arch position, general outline.</p> <p>120. Describe various aspects (buccal, lingual, mesial, distal, and occlusal) of crowns of maxillary and mandibular molars.</p> <p>121. Describe number, shape, and inclination of roots.</p> <p>122. Describe number, location and significance of pulp horns, chamber, and canals.</p> <p>123. Differentiate between mandibular 1st and second molar.</p> <p>124. Differentiate between mandibular and maxillary molars</p>
	Temporomandibular Joint	4hrs	<p>125. Enlist main types of joints (fibrous, cartilaginous, and synovial).</p> <p>126. Describe TMJ Articulation and how does it differ from other synovial joints.</p> <p>127. Discuss the embryology, gross anatomy, and functions of TMJ.</p> <p>128. Describe histological features of articular disc, structure of synovial membrane, composition of synovial fluid.</p> <p>129. Identify the parts of TMJ in slides/image such as glenoid fossa, articular disc, superior & inferior compartments, and condyle on skull and on a patient.</p> <p>130. Discuss the blood supply, nerve supply, age related changes in TMJ.</p>

			131. Correlate clinical aspects of TMJ, integrate the knowledge of anatomy & 132. histology of TMJ into clinical practice and summarize TMJ disorders.
Orthodontics	Occlusion	2hrs	133. Define normal occlusion. 134. Describe the functions of teeth in mastication. 135. Describe malocclusion.
Lab Work			
Anatomy	Muscles of mastication	2hrs	136. Demonstrate palpation of muscles of mastication.
Oral Biology & Tooth Morphology	Mandibular Pre-Molars	3 hrs	137. Identify on tooth models/specimens or images crown outline, buccal, lingual, mesial, distal surfaces, occlusal table, and its components. 138. Draw and label different aspects of mandibular pre-molars (buccal, lingual, mesial, distal, and occlusal aspect).
	Maxillary 1 st Molar	2 hrs	139. Identify on tooth models/specimens or images crown outline, buccal, lingual, mesial, distal surfaces, occlusal table, and its components. 140. Draw and label different aspects of maxillary 1st molar (buccal, lingual, mesial, distal, and occlusal aspect).

Learning Resources		
S#	Subjects	Resources
1.	Anatomy	<p>A. GROSS ANATOMY 1. Last's Anatomy</p> <p>B. EMBRYOLOGY 1. Langman's Medical Embryology</p> <p>C. HISTOLOGY 1. Medical Histology By Laiq Hussain</p> <p>Reference Books 1. Netter Atlas of Human Anatomy 2. Gray's Anatomy</p>
2.	Biochemistry	<p>Text Books 1. Lippincott illustrated reviews 8th 2. Harper's illustrated Biochemistry 32th 3. U. Satyanarayan and U. Chakarpani 4th</p> <p>Reference Books 1. Lippincott illustrated reviews 2. MLA. Harvey, Richard A., PhD. Lippincott's illustrated reviews: Biochemistry 3. U. Satyanarayana Biochemistry 4. U. satyanarayan and U. Chakarpani 4th edition 5. Harper's illustrated Biochemistry 6. Rodwell VW, Bender DA ,Botham KM., Kennelly PJ, Weil P. Eds. Victor W.Rodwell et al. 7. Fundamentals of Biochemistry 8. Donald V., Judith G. Voet, Charlotte W. John wiley and sons, New york 9. Netter's essential Biochemisty 10. Lippincott illustrated reviews 11. MLA. Harvey, Richard A., PhD. Lippincott's illustrated reviews: Biochemistry</p>

3.	Physiology	<p style="text-align: center;">Textbooks</p> <ol style="list-style-type: none"> 1. Guyton and Hall Textbook of Medical Physiology, 13th Edition by John E. Hall. 2. Human Physiology: From Cells to Systems, 8th Edition by Lauralee Sherwood
4.	Oral Biology	<p style="text-align: center;">Textbook</p> <ol style="list-style-type: none"> 1. Ten Cate's Oral Histology 2. Orban's Oral Histology and Embryology 3. Concise Dental Anatomy and Morphology by James L. Fuller <p style="text-align: center;">Reference Books</p> <p>Oral Anatomy, Histology and Embryology by B.K.B Berkovitz</p>



MODULE

CARDIO-PULMONARY MODULE

1st Year BDS

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Vision & Mission

Khyber Medical University (KMU) Vision:

Khyber Medical University will be the global leader in health sciences academics and research for efficient and compassionate health care.

Khyber Medical University (KMU) Mission:

Khyber Medical University aims to promote professional competence through learning and innovation for providing comprehensive quality health care to the nation.

Institute of Health Professions Education & Research (IHPER) Mission:

To produce leaders, innovators and researchers in health professions education who can apply global knowledge to resolve local issues.

Teaching Hours Allocation

S. No	Subject	Hours
1.	Anatomy	15hrs
2.	Physiology	33hrs
3.	Biochemistry	8hrs
4.	Oral Biology & Tooth Morphology	4 hrs
5.	Pharmacology	3hrs
6.	General Pathology	3hrs
7.	Medicine	1hr
Total		67 hrs

Themes

S. No	Theme	Duration in Weeks (hrs)
1.	Chest pain	17hrs
2.	Breathlessness and Ankle swelling	25hrs
3.	Blood Pressure and Palpitations	9hrs
4.	Cough and Hemoptysis	16hrs
Total		2 Weeks (67hrs)

Learning Objectives

By the end of this Module, 1st year BDS students will be able to:

1. Describe the structure and surface markings of the heart, valves, and great vessels.
2. Describe the steps of development of the heart.
3. Describe the steps of development of arterial, venous, and lymphatic system.
4. Describe the conduction system of the heart.
5. Describe the anatomy of valves of the heart.
6. Describe the microscopic structure of myocardium, and blood vessels.
7. Describe the cardiac cycle.
8. Discuss cardiac output, and venous return.
9. Discuss blood pressure and its regulation.
10. Discuss coronary circulation and diseases associated with it.
11. Describe the mechanisms and types of circulatory shock and associated compensatory mechanisms.
12. Describe the anatomy and common pericardial diseases.
13. Describe the cardiac enzymes.
14. Discuss the hyperlipidemias and the roles lipoproteins and cholesterol in the development of atherogenesis.
15. Describe the mechanisms of impulse generation, conduction, and excitation of myocardium.
16. Discuss normal ECG and common ECG abnormalities.
17. Enlist the drugs used in ischemic heart disease and hyperlipidemias.
18. Describe preventive strategies of cardiovascular diseases.

Theme 1: Chest Pain

Subject	Topic	Hours	Learning Objectives
Embryology	Fetal Circulation	1hr	1. Describe the physiological changes in circulation after birth.
Anatomy	Pericardium Surface anatomy Coronary circulation	1hr	2. Define pericardium. 3. Describe different reflections of pericardium. 4. Describe the gross structure of the heart. 5. Enlist the Coronary arteries and its branches.
Physiology	Cardiac Muscles Properties	1hr	6. Explain the physiologic anatomy and properties of the cardiac muscle. 7. Describe gap-junctions and the significance of functional syncytium.
	Excitation and contraction of cardiac muscles	2hrs	8. Describe excitation-contraction process in cardiac muscles and outline its differentiation from skeletal muscles. 9. Describe chronotropic, Inotropic and dromotropic effects. 10. Explain phases of action potential in cardiac muscle, plateau formation and its significance 11. Describe the significance of prolonged action potential in cardiac muscle. 12. Define automaticity and rhythmicity of heart's specialized conduction system 13. Define pacemaker of the heart and explain why SA node is the normal pacemaker of the heart. 14. Describe the conduction through AV node and ventricular purkinji system 15. Discuss sympathetic and parasympathetic effects on hearth rhythmicity and conductivity
	Normal ECG	1hr	16. Discuss the characteristics of normal ECG. 17. Describe different waves of ECG and its significance.
	Arrhythmias	1hr	18. Describe the types of arrhythmias: tachycardia and bradycardia 19. Describe the types of heart block along with their ECG characteristics 20. Describe the types and causes of premature contractions

			21. Describe the atrial fibrillation and atrial flutter along with their ECG characteristics
Biochemistry	Enzymes	4hrs	22. Define Enzymes. 23. Define activation energy. 24. Define Gibbs Free energy. 25. Explain the general structure of enzymes.
			26. Define co-factors. 27. Explain the function of co-factors. 28. Enlist different types of co-factors. 29. Define different parts and forms of enzymes. 30. Describe the factors involved in structure of enzymes. 31. Describe the mechanism of Enzyme activity. 32. Define catalysis. 33. Explain different mechanism of catalysis. 34. Explain the Principals for Nomenclature of enzymes. 35. Classify Enzymes on the basis of functions. 36. Enlist the factors affecting the activity of enzymes. 37. Describe roles of factors affecting enzyme activity. 38. Define enzyme kinetics. 39. Explain different areas of enzyme kinetics. 40. Describe the role of Km in Enzyme kinetics. 41. Define Isoenzymes (Isozymes). 42. Explain Factors affecting the properties of isozymes. 43. Explain the role of enzymes as a diagnostic tool.
	Cardiac enzymes	1hr	44. Enlist the enzymes that increase in myocardial infarction. 45. Describe lipid profile and its clinical significance. 46. Lipid peroxidation. 47. Describe the dietary sources of sodium, potassium, calcium and magnesium. 48. Describe the role of Na, K, Ca, and Mg in cardiac muscle contractility

			and their biochemical abnormalities. 49. Describe the cardiac manifestations of vitamin B1 deficiency. 50.
Pharmacology	Drugs in Cardio-vascular diseases.	1hr	51. Enlist and classify the group of drugs used in the treatment of coronary artery diseases (angina and MI). 52. Enlist the groups of lipid-lowering drugs.
Lab Work			
Anatomy	Anatomy of heart	2hrs	53. Identify the Heart and major blood vessels. 54. Identify chambers of the heart. 55. Identify internal structures of various chambers of the heart.
Physiology	ECG	2hrs	56. Understand and Apply Proper ECG Electrode Placement 57. Analyze the waveform to ensure proper identification of each segment (P wave, QRS complex, T wave). 58. Measure key intervals and segments, such as the PR interval, QT interval, and RR interval, and explain how these values can indicate normal or abnormal cardiac function. 59. Evaluate Heart Rate Using ECG 60. Identify any potential abnormalities in the rhythm (e.g., atrial fibrillation, ventricular tachycardia), morphology (e.g., ST elevation in myocardial infarction), or intervals (e.g., prolonged QT). 61. Understand the significance of these abnormalities and how they relate to clinical conditions.

Theme 2: Breathlessness and Ankle Swelling

Anatomy	General features of thorax	1hr	62. Describe main features of thoracic wall. 63. Describe the location and shape of the sternum. 64. Describe the parts of the sternum. 65. Describe the gross features of the thoracic vertebra. Describe the general features of the ribs.
	Diaphragm and Mediastinum	1hr	66. Describe the origin and insertion of the diaphragm. 67. Describe the openings of the diaphragm. 68. Enlist the contents of the superior mediastinum. Enlist the contents of the Anterior & Posterior Mediastinum.
	Pleura	1hr	69. Describe the gross features of pleura.
Physiology	Cardiac cycle	1hr	70. Discuss the cardiac cycle and its regulation. 71. Describe the concept of systole and diastole. 72. Describe the role of atria and ventricles as pumps. 73. Explain pressure-volume diagram during cardiac cycle. 74. Correlate the cardiac cycle events with ECG with the help of diagram
	Heart Sounds	1hr	75. Describe heart sounds and its association with closure or opening of heart valves. 76. Differentiate between first and second heart sounds.

Cardiac output and Regulation of heart pumping	1hr	<p>77. Describe the concept of preload and afterload</p> <p>78. Describe Frank-Starling mechanism of heart pumping regulation</p> <p>79. Describe end-diastolic volume, ejection fraction, systolic volume, and stroke volume</p> <p>80. Discuss regulation and control of heart pumping by sympathetic and parasympathetic nerves</p> <p>81. Explain the role of potassium and calcium and temperature on heart function.</p> <p>82. Describe Normal Cardiac output and venous return during rest and during activity</p>
Blood flow	2hrs	<p>83. Discuss vascular distensibility and vascular compliance.</p> <p>84. Describe the regulation of blood flow and “Starling forces”</p> <p>85. Discuss arterial pressure pulsations.</p> <p>86. Discuss auto-control of local blood flow.</p> <p>87. Explain the local metabolic vasodilator hypothesis.</p> <p>88. Describe the physiological vasodilators and vasoconstrictors. Explain their mechanism of action.</p> <p>89. Describe the role of oxygen in long term regulation of blood flow</p> <p>90. Discuss humoral control of circulation and describe the role of vasoconstrictor and vasodilator agents in blood circulation</p>
Microcirculation & Lymphatic System	2hrs	<p>91. Enumerate the structure of microcirculation and structure of capillary wall</p> <p>92. Discuss diffusion of substances through capillary membrane</p> <p>93. Explain the forces that affect fluid filtration across capillaries</p> <p>94. Describe the function of lymphatic system in the maintenance of interstitial fluid volume.</p>
Mechanics of Respiration	1hr	<p>95. Discuss mechanics of respiration.</p> <p>96. Enlist the muscles involved in lung expansion and contraction.</p> <p>97. Discuss the pressures that cause movement of air in and out of lungs.</p> <p>98. Explain the pressure volume changes graph during normal breathing</p>

Lung compliance and surfactant	1hr	99. Define compliance of the lung. 100. Discuss compliance curve. 101. Describe elastic forces caused by surface tension. 102. Explain the role of surfactant in the collapse of alveoli. 103. Discuss the role of surfactant in respiratory distress syndrome of newborn.
Pulmonary volumes and capacities	1hr	104. Describe types of pulmonary volumes and its significance. 105. Discuss types of pulmonary capacities. 106. Explain the graph of lung volume and capacities.
Pulmonary ventilation	1hr	107. Define alveolar ventilation. 108. Describe the formula of rate of alveolar ventilation 109. Discuss dead space and its effects on alveolar ventilation. 110. Compare anatomic and physiologic dead space. 111. Describe the basic concepts of measurement of dead space. 112. Differentiate between alveolar ventilation and minute ventilation.
Gas exchange through respiratory membrane	2hrs	113. Enlist differences between composition of alveolar and atmospheric air. 114. Discuss partial pressures of oxygen and carbon dioxide in alveoli and atmosphere. 115. Describe physiological anatomy of respiratory membrane and factors affecting gas diffusion through respiratory membrane. 116. Describe the diffusing capacity of respiratory membrane. 117. Describe the effects of ventilation/perfusion ratio of alveolar gas concentration. 118. Discuss physiological shunt and dead space. 119. Describe abnormalities of ventilation perfusion ratio.
Transport of O ₂ and CO ₂ in blood and tissue fluids	2hrs	120. Discuss the transport of oxygen from lungs to tissue cells. 121. Discuss the diffusion of carbon dioxide from tissue cells to alveoli. 122. Describe the role of Hb in oxygen transport. 123. Explain Oxy/Hb dissociation curve and Enlist the factors that shift Oxy/Hb dissociation curve to right and left.

			124. Describe the transport of oxygen in dissolved state and oxygen poisoning. 125. Discuss the mechanism of transport of carbon dioxide in blood. 126. State Bohr effect and Haldane effect.
	Regulation of Respiration	1hr	127. Enlist respiratory centers in CNS. 128. Describe the role of dorsal and ventral respiratory group of neurons. 129. Discuss the chemical control of respiration. 130. Explain the role of oxygen in respiratory control. 131. Describe the regulation of respiration during exercise Describe periodic breathing and basic mechanism of Cheyne-Stokes breathing. 132. Define sleep apnea. 133. Describe the mechanism of hypoxia and cyanosis
	Common Respiratory Abnormalities	1hr	134. Describe periodic breathing and basic mechanism of Cheyne-Stokes breathing. 135. Define sleep apnea. 136. Describe the mechanism of hypoxia and cyanosis.
Biochemistry	Complex lipids	2hrs	137. Define complex lipids. 138. Classify complex lipids. 139. Define and classify phospholipids. 140. Describe functions of glycolipids 141. Describe Lipoproteins, their functions, and bio-medical significance.
Lab Work			
Physiology	Spirometry	2hrs	142. Draw a normal spirogram, labeling the four lung volumes and four capacities. 143. List the volumes that comprise each of the four capacities. 144. Identify which volume and capacities cannot be measured by spirometry. 145. Define the factors that determine total lung capacity, functional residual capacity, and residual volume.

Theme 3: Blood Pressure and Palpitations

Physiology	Short term regulation of blood pressure	1hr	146. Define blood pressure and discuss high and low blood pressures. 147. Describe Autonomic regulation of blood pressure. 148. Discuss the mechanism of baroreceptors in arterial blood pressure control. 149. Discuss the chemo receptors and CNS ischemic response.
	Long term regulation of blood pressure	1hr	150. Discuss the role of kidneys in long-term control of arterial pressure 151. Explain the renin-angiotensin system in arterial pressure control 152. Classify hypertension and describe its pathophysiology a. Primary hypertension b. Secondary hypertension
	Shock	1hr	153. Define shock and describe its physiological causes 154. Describe the stages of shock 155. Explain the types of shocks: a. Hemorrhagic shock b. Neurologic shock c. Anaphylactic shock d. Septic shock
General Pathology	Circulatory Shock	1hr	156. Define shock and explain causes and types of circulatory shock. 157. Explain the stages of circulatory shock.
Biochemistry	Derived lipids	1hr	158. Define and classify Fatty Acids. 159. Describe the functions of fatty acids. 160. Describe the structure, bio-chemical functions, and fate of cholesterol. 161. Discuss the types of lipo-proteins.
Medicine	Hypertension	1hr	162. Define hypertension. 163. Enlist the causes and types of hypertension. 164. Identify the major risk factors contributing to diseases of the CVS. 165. Discuss the preventive strategies for hypertension. 166. Educate the patient regarding lifestyle modifications for maintaining optimal cardiovascular health.

Pharmacology	Anti-hypertensive drugs Drugs used to treat Arrhythmias	1hr	166. Classify antihypertensive drugs. 167. Describe the mechanism of action of drugs used to manage hypertension. 168. Enlist Antiarrhythmic drugs on the basis of their Effect on Action Potential
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Lab Work

Physiology	Blood pressure measurement	2hrs	169. Apply appropriate techniques to measure blood pressure. 170. Interpret and record blood pressure values.
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Theme 4: Cough and Hemoptysis

Anatomy	Introduction	1hr	171. Describe the major components of the (upper and lower) respiratory system.
	Trachea and bronchi	1hr	172. Describe the general and anatomical features of trachea and bronchi.
	Lungs	1hr	173. Describe the anatomical features of lungs.
Histology	Histological features of trachea	1hr	174. Describe the histological features of trachea and its layers.
Physiology	Functions of respiratory passageways	1hr	175. Describe the respiratory and non-respiratory functions of the respiratory passageways. 176. Discuss autonomic control of bronchial musculature. 177. Explain the role of mucous lining. 178. Discuss cough and sneeze reflex.
Pathology	Pneumonias Pulmonary Tuberculosis Pulmonary Edema Bronchial Asthma	2hrs	179. Define pneumonia and enlist the causative pathogens of pneumonia. 180. Define primary and secondary Tuberculosis and state its etiology. 181. Define pulmonary edema and classify it according to underlying causes. 182. Enlist the etiological factors and clinical features of asthma.

Pharmacology	Anti-Asthmatic drugs Anti-Tuberculous drugs	1hr	183. Classify Anti-asthmatic drugs. 184. Classify Anti-tuberculous drugs.
Lab Work			
Histology	Microscopic features of trachea, bronchi, and lung alveoli.	2hrs	185. Identify the various microscopic features of trachea.
		2hrs	186. Identify the various microscopic features bronchi, and lung alveoli.
Oral Biology & Tooth Morphology	Mandibular 2 nd and 3 rd Molars	4 hrs	4. Identify on tooth models/specimens or images crown outline, buccal, lingual, mesial, distal surfaces, occlusal table, and its components. 5. Draw and label different aspects of mandibular molars (buccal, lingual, mesial, distal, and occlusal aspect). 1. Differentiate between mandibular 1 st and 2 nd Molar.

Learning Resources

S#	Subjects	Resources
1.	Anatomy	<p>A. GROSS ANATOMY 1. SNELL Last's Anatomy</p> <p>B. EMBRYOLOGY 1. Langman's Medical Embryology</p> <p>C. HISTOLOGY 1. Medical Histology By Laiq Hussain</p> <p style="text-align: center;">Reference Books</p> <p>1. Netter Atlas of Human Anatomy 2. Gray's Anatomy</p>
2	Biochemistry	<p style="text-align: center;">Text Books</p> <p>1. Lippincott illustrated reviews 8th 2. Harper's illustrated Biochemistry 30th 3. U. Satyanarayan and U. Chakarpani 4th</p> <p style="text-align: center;">Reference Books</p> <p>1. Lippincott illustrated reviews 2. MLA. Harvey, Richard A., PhD. Lippincott's illustrated reviews: Biochemistry 3. U. Satyanarayana Biochemistry 4. U. satyanarayan and U. Chakarpani 4th edition 5. Harper's illustrated Biochemistry 6. Rodwell VW, Bender DA ,Botham KM., Kennelly PJ, Weil P. Eds. Victor W. Rodwell et al. 7. Fundamentals of Biochemistry 8. Donald V., Judith G. Voet, Charlotte W. John wiley and sons, New york 9. Netter's essential Biochemisty 10. Lippincott illustrated reviews 11. MLA. Harvey, Richard A., PhD. Lippincott's illustrated reviews: Biochemistry</p>

3	Physiology	<p style="text-align: center;">Textbooks</p> <p>Physiology Text Books:</p> <ol style="list-style-type: none"> 1. Guyton and Hall Textbook of Medical Physiology, 13th Edition by John E. Hall. 2. Human Physiology: From Cells to Systems, 8th Edition by Lauralee Sherwood
4	Oral Biology	<p style="text-align: center;">Textbook</p> <ol style="list-style-type: none"> 1. Ten Cate's Oral Histology 2. Orban's Oral Histology and Embryology 3. Concise Dental Anatomy and Morphology by James L. Fuller <p style="text-align: center;">Reference Books</p> <ol style="list-style-type: none"> 2. Oral Anatomy, Histology and Embryology by B.K.B Berkovitz



MODULE
Gastro-Intestinal Tract (GIT) & Uro-Genital System (UGS)
1st Year BDS

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Vision & Mission

Khyber Medical University (KMU) Vision:

Khyber Medical University will be the global leader in health sciences academics and research for efficient and compassionate health care.

Khyber Medical University (KMU) Mission:

Khyber Medical University aims to promote professional competence through learning and innovation for providing comprehensive quality health care to the nation.

Institute of Health Professions Education & Research (IHPER) Mission:

To produce leaders, innovators and researchers in health professions education who can apply global knowledge to resolve local issues.

Teaching Hours Allocation

S. No	Subject	Hours
1.	Anatomy (Gross Anatomy & Histology)	14
2.	Oral Biology & Tooth Morphology	17
3.	Physiology	36
4.	Biochemistry	36
5.	General Pathology	3
6.	Medicine	2
7.	Pharmacology	2
Total		110

Themes

S. No	Theme	Duration in week (hrs)
1.	Difficulty in Swallowing	1.5 week (46 hrs)
2.	Abdominal Pain	
3.	Jaundice	
4.	Vomiting & Diarrhea	
5.	Obesity and beyond	1 week (31hrs)
6.	Loin pain/ Flank Pain	1.5 week (33hrs)
7.	Edema	
Total		4 weeks (110hrs)

Learning Objectives

By the end of this Module, 1st year BDS students will be able to:

1. Discuss the anatomy, development, histological structure, and functions of salivary glands.
2. Describe the gross anatomy of the esophagus, stomach, small intestine, large intestine, rectum, and anal canal.
3. Discuss the histological structure of the esophagus.
4. Explain the movements, secretions, and regulations of gastrointestinal functions.
5. Describe the structure and functions of the hepatobiliary system and pancreas.
6. Discuss the mechanisms of digestion and absorptions of carbohydrates, proteins, fats, and other nutrients.
7. Discuss the chemistry and functions of gastric, hepatic, & pancreatic secretions.
8. Describe common pathological conditions like peptic ulcers, viral hepatitis, obstructive jaundice, and liver cirrhosis.
9. Describe the mechanism of drug detoxification and metabolism in the liver.
10. Explain the basic metabolic processes related to carbohydrates, fats, and proteins.
11. Describe the anatomy and physiological functions of the kidneys, ureters, bladder, and urethra.
12. Discuss the role of the kidneys in filtration, reabsorption, and secretion, along with their structural details.
13. Identify and explain the roles of the renal corpuscle, glomerulus, nephron, and collecting-duct system.
14. Describe the structure, cell types, and functions of the juxtaglomerular apparatus, focusing on granular cells.
15. Differentiate between glomerular filtration, tubular reabsorption, and tubular secretion.
16. Describe Auto Regulation Mechanisms of Renal Blood Flow.
17. List common symptoms associated with renal disorders and classify different types of renal diseases.
18. Explain the processes involved in the reabsorption and secretion of substances in the renal tubules.
19. Describe the effects of hormones such as aldosterone, angiotensin-II, ADH, and parathyroid hormone on tubular reabsorption.
20. Explain the Regulation of Water and Electrolyte Balance by the Kidneys

Theme 1: Difficulty in Swallowing			
Subject	Topic	Hours	Learning Objectives
Anatomy	Esophagus	2hrs	1. Describe the extent, course, relations, and gross structure of esophagus. 2. Describe the histological features of the esophagus.
Oral Biology & Tooth Morphology	Development of salivary glands	1hr	3. Describe the development of salivary glands.
	Salivary glands	3hrs	4. Describe anatomical features of major & minor salivary glands. 5. Describe histology of Parotid gland. 6. Describe histology of Submandibular gland. 7. Describe histology of Sublingual gland. 8. Describe histology of minor salivary glands. 9. Describe modification of saliva and ductal system of salivary glands 10. Describe functions of saliva and its role in maintenance of healthy oral cavity. 11. Discuss age changes in salivary glands. 12. Define xerostomia & ptyalism. 13. Enumerate different diseases affecting salivary glands.
Physiology	Swallowing	1hr	14. Explain the process of swallowing and its stages
	Alimentary tract	1hr	15. Classify and describe alimentary tract glands. 16. Describe the mechanism of stimulation of alimentary tract glands.
	Functions of Mucus and Saliva	1hr	17. Describe the secretion of saliva and its nervous regulation. 18. Describe the plasma and saliva concentrations of Na ⁺ , Cl ⁻ , and HCO ₃ ⁻ at low secretion rates and at high secretion rates and the principal cell types involved in each secretion rate.

		<p>19. Identify the stimuli and cell types involved in GI secretion of mucous, and identify the function of salivary mucus.</p> <p>20. Describe three types of stimuli that increase salivary secretion.</p> <p>21. State the components of the saliva important in oral hygiene, and identify the role of salivary secretions in eliminating heavy metals.</p> <p>22. Describe the lubricating and protective properties of mucus in GIT.</p>
GIT Smooth muscles	1hr	<p>23. Discuss the characteristics of GIT smooth muscles.</p> <p>24. Explain the electrical activity of GIT smooth muscles.</p> <p>25. Describe the mechanism of excitation of smooth muscle of GIT.</p>
Neural control of GIT functions - Enteric nervous system	2hrs	<p>26. Differentiate between mesenteric and submucosal plexus</p> <p>27. Classify neurotransmitters secreted by enteric neurons:</p> <ol style="list-style-type: none"> a. Excitatory b. Inhibitory <p>28. Describe the role of autonomic nervous system in regulation of GIT's function.</p> <p>29. Differentiate between sympathetic and parasympathetic modulation of the enteric nervous system and the effector organs of the GI tract.</p> <p>30. Describe Gastrointestinal reflexes.</p>
Hormonal control of GIT motility	1hr	<p>31. Describe the actions of GIT hormones</p> <p>32. Tabulate stimuli of secretion, site of secretion and the specific function of each GIT hormones.</p>
Disorders of swallowing and esophagus	1hr	<p>33. Enlist the clinical abnormalities of swallowing mechanism (Oral dysphagia).</p>

Biochemistry	Salivary composition and function	1hr	<p>34. State the substrates and digestion products of salivary amylase (ptyalin).</p> <p>35. Describe the composition of salivary secretions.</p> <p>36. Describe the formation and characteristics of salivary secretions.</p> <p>37. Elaborate the functions of saliva.</p> <p>38. Role of hydration in maintaining healthy oral cavity, teeth, mucous membrane.</p>
Oral Bio & Tooth Morpho	Maxillary 2 nd and 3 rd Molar	3 hrs	<p>38. Indicate initiation of calcification, crown completion age, age of eruption and root completion age, arch position, general outline.</p> <p>39. Describe various aspects (buccal, lingual, mesial, distal, and occlusal) of crowns of maxillary 2nd and 3rd molars.</p> <p>40. Describe number, shape, and inclination of roots.</p> <p>41. Describe number, location and significance of pulp horns, chamber, and canals.</p>
	Mandibular First Molar	4 hrs	<p>42. Indicate initiation of calcification, crown completion age, age of eruption and root completion age, arch position, general outline.</p> <p>43. Describe various aspects (buccal, lingual, mesial, distal, and occlusal) of crowns of mandibular first molar.</p> <p>44. Describe number, shape, and inclination of roots.</p> <p>45. Describe number, location and significance of pulp horns, chamber, and canals.</p> <p>46. Differentiate between mandibular and maxillary molars.</p>

Theme 2: Abdominal Pain

Anatomy	Abdominal Surface Anatomy	1hr	47. Describe the quadrants and regions of abdomen. 48. Discuss the applied anatomy of nine quadrants of abdomen. 49. Discuss the anatomical landmarks of abdomen.
Physiology	Motor function of Stomach	1hr	50. Describe the motor function of stomach. 51. Describe the regulation of gastric emptying
	Gastric secretion	1hr	52. Classify and Describe characteristics of the gastric glands: a. Oxyntic (gastric) glands b. Pyloric glands 53. Discuss the mechanism of secretion of HCl from gastric mucosa. 54. Describe the role of Intrinsic factor from gastric parietal cells. 55. Discuss the secretions of pyloric glands - mucus and gastrin 56. Enumerate the phases of gastric secretions 57. Enumerate the reflexes that inhibit and increase gastric secretions
	Pancreatic secretions	1hr	58. Describe the role of pancreatic secretions in digestion. 59. Describe the secretion and function of bicarbonate ions from pancreatic ductules. 60. Enumerate the regulation and phases of pancreatic secretion.
Biochemistry	Gastric secretions	1hr	61. Describe the chemical composition of gastric secretions. 62. Describe the functions of HCl and other constituents of gastric secretions.

	Pancreatic secretions	1hr	63. Describe the composition of pancreatic secretions. 64. Describe the action of pancreatic enzymes.
Pharmacology	Drugs used in Peptic ulcer	1hr	65. Enlist the drugs used in Peptic ulcer disease.
Medicine	GERD and Peptic ulcer	1hr	66. Enumerate the etiology and clinical features of GERD and peptic ulcer disease. 67. Enumerate the etiology and clinical features of pancreatitis. 68. The role of diet in GERD and Peptic Ulcer.

Theme 3: Jaundice

Anatomy	Liver	1hr	68. Describe the gross anatomy of liver
	Extra hepatic biliary apparatus		69. Describe the gross anatomy of gall bladder. 70. Describe the gross anatomy of extra hepatic biliary tree.
Physiology	Liver & Biliary secretion	2hr	71. Describe the metabolic functions of liver. 72. Describe the mechanism of secretion of bile by the liver. 73. Describe the function of bile salts in fat digestion and absorption. 74. Describe the liver secretion of cholesterol and gallstone formation.

Biochemistry	Bile	1hr	75. Describe the constituents of bile. 76. Describe the functions of bile. 77. Describe jaundice and its types.
General Pathology	Acute/ Chronic Viral Hepatitis	1hr	78. Enumerate the different viruses causing acute and chronic hepatitis.
Pharmacology	Hepatotoxic drugs	1hr	79. Enlist some of the commonly used hepatotoxic drugs.

Theme 4: Vomiting & Diarrhea

Anatomy	Development of GIT	1hr	83. Enlist the derivatives of foregut, mid gut, hind gut.
Anatomy	Gross Anatomy of Small intestine	2hrs	84. Describe the gross features of jejunum, ileum, and appendix.
	Gross Anatomy of Large intestine		85. Describe the gross features of cecum, ascending, transverse and descending, sigmoid colon, and anal canal.
Physiology	Secretions and Movements of Small intestine	1hr	86. Describe different types of movements of small intestine. 87. Describe the control of peristalsis by nervous and hormonal signals. 88. Describe the function of mucus secreted by Brunner's glands in duodenum 89. Describe the secretion of intestinal digestive juices by crypts of lieberkuhn. 90. Describe the secretion of mucus by large intestine.
	Movement of colon & Defecation reflex	1hr	91. Describe different types of movements of colon. 92. Discuss the mechanism of defecation and defecation reflex
	GIT disorders	1hr	93. Describe general GIT disorders: a. Gastritis and its causes b. Peptic ulcer, its basic and specific causes c. Pancreatitis d. Malabsorption by small intestinal mucosa - Sprue e. Disorders of large intestine: Constipation, Megacolon, Diarrhea and its causes f. Vomiting & Nausea
Biochemistry	Digestion and absorption	1hr	94. Describe the mechanism of digestion and absorption of fats in the intestines. 95. Describe the mechanism of digestion and absorption of proteins in the intestines. 96. Describe the mechanism of digestion and absorption of carbohydrates in the intestines. 97. Describe the mechanism of absorption of Iron, Vitamin-B12 and Folate in

			the intestines.
Medicine	Seasonal diarrhea & vomiting	1hr	98. Enlist the Seasonal Gastrointestinal Infections. 99. Describe the dietary modification in vomiting and diarrhea.
Lab work			
Anatomy (Histology)	Histology of small intestine	2hrs	99. Discuss the general histological features of small intestine.

Theme 5: Obesity and beyond

Physiology	Insulin	2hrs	100. Describe the functions of insulin. 101. Discuss metabolic effects of insulin on carbohydrate, fats, and protein metabolism. 102. Discuss the mechanism of insulin secretion.
	Glucagon	1hr	103. Describe the glucagon function. 104. Discuss the regulation of glucagon secretion.
	Blood glucose regulation	1hr	105. Discuss the summary of blood glucose regulation. 106. Define the diabetes. 107. Enlist the types of diabetes. 108. Define the Glycemic index and Glycemic load.

Biochemistry	Glycolysis	1hr	108. Define Glycolysis 109. Describe the entry of glucose into different kinds of cells through various GLUT transporters.
			110. Describe the transportation of NADH to Mitochondria via various Shuttles. 111. Describe the energetics of glycolysis. 112. Describe the fates of pyruvate. 113. Describe the types of glycolysis especially the anaerobic glycolysis. 114. Describe the key enzymes and regulation of glycolysis. 115. Discuss the glycolysis in RBC. 116. Describe the biomedical Significance and clinical disorders of glycolysis.
	Oxidation of Pyruvate	1hr	117. Describe the conversion of pyruvate into acetyl CoA. 118. Enumerate the enzymes & coenzymes of PDH complex. 119. Describe the regulation of PDH complex. 120. Discuss the clinical aspects of PDH complex especially the congenital lactic acidosis.
	Tricarboxylic Acid Cycle	1hr	121. Define citric acid cycle. 122. Describe the sources of acetyl CoA in mitochondria. 123. Discuss the energetics of TCA. 124. Discuss the energy yield of one molecule of glucose when it is converted into carbon dioxide and water. 125. Name the vitamins that play a key role in TCA. 126. Describe the amphibolic nature of TCA. 127. Discuss the regulation of TCA. 128. Enumerate the inhibitors of TCA and their sites of inhibition.

	Gluconeogenesis	2hrs	<p>129. Define Gluconeogenesis.</p> <p>130. Name the organs and sub cellular location where Gluconeogenesis occurs.</p> <p>131. Describe the substrates or precursors of Gluconeogenesis.</p> <p>132. Describe the three bypass reactions.</p>
			<p>133. Describe the Gluconeogenesis from Fatty Acids.</p> <p>134. Discuss the Cori's cycle.</p> <p>135. Discuss the regulation of Gluconeogenesis.</p> <p>136. Name the key enzymes of Gluconeogenesis.</p>
	Hexose Mono Phosphate shunt	1hr	<p>137. Discuss the Role of Pentose Phosphate Pathway.</p> <p>138. Name the tissues where Hexose Mono Phosphate shunt occurs.</p> <p>139. Describe the Role of thiamine in Hexose Mono Phosphate shunt.</p> <p>140. Discuss the functions of NADPH (produced in Hexose Mono Phosphate shunt) in various tissues and cells.</p> <p>141. Discuss G6PD deficiency and its effects in various tissues and cells.</p> <p>142. Enlist the food items to be avoided in the G6PD deficiency.</p>
Biochemistry	Fatty acid (FA) synthesis (De Novo)	1hr	<p>143. Enumerate the organs where fatty acid occurs with sub cellular sites.</p> <p>144. Discuss how acetyl CoA comes out of mitochondria for the synthesis of FA.</p> <p>145. Discuss lipo-proteins.</p>
	Mobilization of stored fats (oxidation of FA)	1hr	<p>146. Describe how fats are mobilized from adipose tissues to the organs where they will be used for oxidation.</p> <p>147. Enumerate the various methods of oxidation of FA.</p> <p>148. Discuss the stages of beta oxidation with its reactions.</p> <p>149. Calculate the no. of ATP obtained when one molecule of palmitic acid is oxidized completely.</p>

Diseases of GIT	1hr	146. Discuss BMI. 147. Define BMR. 148. Enlist causes of high and low BMR. 149. Discuss nutritional diseases. 150. Define nutritional diseases (Obesity, Steatorrhea, constipation, irritable bowel syndrome IBS).
Proteins	3hrs	150. Define proteins. 151. Describe structure of amino acids. 152. Enumerate the seven classes of proteins. 153. Differentiate the four levels of protein structure. 154. Describe functions and properties of protein. 155. Discuss the diseases related to protein metabolism. 149. Discuss separation of proteins.
Ammonia transport and effects of ammonia toxicity on brain	1hr	157. Discuss how ammonia is formed in various tissues and transported to liver. 156. Discuss the effects of ammonia toxicity in brain.
Urea cycle & its associated inherited disorders	1hr	159. Describe The Krebs-Henseliet Cycle of Urea Formation in Liver. 158. Describe the clinical significance of various enzymes involved in urea formation.
Energy requirement of human body	1hr	161. Discuss the daily energy requirement of a human body in health and disease. 162. Discuss vitamins. 163. Describe the daily requirements of common vitamins, Iron, Calcium, Iodine, and other minerals. 164. Describe the daily requirements, uses, symptoms Vitamin C deficiency.
Lab Work		

Anatomy	Esophagus	2hrs	166. Identify the epithelium of esophagus and esophageal glands in mucosa. 167. Differentiate between musculature in different parts of the esophagus.
Oral Biology & Tooth Morphology	Parotid, submandibular, and Sublingual glands	4hrs	168. Identify the histological features of Parotid, submandibular and Sublingual glands under the microscope.
Biochemistry	Protein	4hrs	169. Identify proteins in a solution.

Theme 6: Loin pain/ Flank Pain

Anatomy	Overview of the urinary system	1hr	171. Describe the main components of the urinary system.
Physiology	Physiological Anatomy Of the kidneys and structure of nephron	2hrs	172. State major functions of the kidneys & brief physiological anatomy of kidney.
			173. Define the components of the nephron and their interrelationships: renal corpuscle, glomerulus, nephron, and collecting-duct system. 174. Define juxtaglomerular apparatus and describes its 3 cell types; states the function of the granular cells.

	Glomerular filtration rate (GFR), its determinants and autoregulation	3hrs	<p>175. Define the basic renal processes: glomerular filtration, tubular reabsorption, and tubular secretion.</p> <p>176. Discuss the physiological anatomy of glomerular capillary membrane.</p> <p>177. State the formula for determinants of GFR.</p> <p>178. Discuss the determinants of GFR and their effects on GFR.</p> <p>179. Enlist the determinants of GFR and their physiological causes in tabulated form.</p> <p>180. Discuss renal blood flow and its determinants.</p> <p>181. Describe the effects of sympathetic nervous system activation on GFR.</p> <p>182. Describe the hormonal control of renal circulation.</p>
			183. Discuss the importance of autoregulation of GFR and renal blood flow
Biochemistry	Acid-base balance & imbalance	1hr	<p>184. Describe Carbonic acid, protein, and phosphate buffer.</p> <p>185. Describe Transporting acid and mitigating pH changes.</p> <p>186. Describe Respiratory Regulation of Acid Base Balance.</p>
General Pathology	Smoky urine Renal disorders	1hr	<p>187. List the common symptoms of renal disorders.</p> <p>188. Classify renal diseases.</p> <p>189. Enlist the Causes, types of renal stones.</p> <p>190. Enlist the dietary restrictions for patients having renal stones.</p>

Theme 7: Edema

Physiology	Body fluid compartments	2hrs	<p>190. Enlist the body fluid compartments.</p> <p>191. Enlist the constituents of extra-cellular and intra-cellular fluids.</p> <p>192. Describes principles of osmosis and osmotic pressure.</p> <p>193. Discuss osmotic equilibrium between extra-cellular and intra-cellular fluids.</p> <p>194. Define isosmotic, hyperosmotic, and hypo-osmotic fluids.</p> <p>195. Describe clinical abnormalities of fluid volume regulation: hypernatremia and hyponatremia.</p> <p>196. Define the edema and describe the types of edema.</p> <p>197. Discuss the causes of extracellular edema.</p>
	Reabsorption and Secretion along the different Parts of the Nephron Mechanisms of regulation of tubular reabsorption	3hrs	<p>198. Discuss the general mechanism of tubular reabsorption and secretion.</p> <p>199. Describe the proximal tubular reabsorption.</p> <p>200. Describe the reabsorption of solutes and water along the loop of Henle and distal tubule.</p> <p>201. Describe the reabsorption along the late distal tubules and cortical collecting tubules.</p> <p>202. Explain the regulation of tubular reabsorption.</p>
			<p>203. Discuss hormonal control of tubular reabsorption.</p>
	Mechanism of diluted and concentrated urine formation	2hrs	<p>204. Describe the influence of antidiuretic hormone (ADH) on water reabsorption.</p> <p>205. Discuss the mechanism of excreting dilute urine from kidneys.</p> <p>206. Discuss the mechanism of excreting concentrated urine from kidneys.</p> <p>207. Describe central and nephrogenic diabetes insipidus.</p> <p>208. Discuss osmoreceptor-ADH feedback mechanism for regulating extracellular fluid osmolarity in response to water deficit.</p>

	Urinary bladder and micturition	1hr	209. Describe the functional anatomy of urinary bladder. 210. Explain the mechanism of micturition. 211. Explain the micturition reflex and nervous control of bladder functions. 212. Enlist abnormalities of micturition.
	Thirst	1hr	213. Describe the importance of thirst in controlling ECF osmolarity and sodium concentration. 214. Enumerate CNS centers for thirst. 215. Describe the stimuli for thirst. 216. Discuss the mechanism of thirst.
Biochemistry	Renal control of Calcium & Phosphorus	3hrs	217. State the normal total plasma calcium concentration and the fraction that is free. 218. Describe the distribution of calcium between bone and extracellular fluid and the role of bone in regulating extracellular calcium. 219. Describe and compare osteocytes, osteolysis and bone remodeling. 220. Describe renal handling of phosphate and its regulation by parathyroid hormone.
	Constituents of urine		221. Describe the normal and abnormal constituents of urine.
	Water balance/ metabolism		222. Discuss mechanism & regulation of Water balance. 223. Explain disorders of water balance, such as dehydration & over hydration.
General Pathology	Renal failure	1hr	224. Enlist the causes of Renal failure/ uremia and abnormalities related to micturition including incontinence. 225. Define the terms Nephrotic syndrome, nephritic syndrome, Azotemia.
Lab Work			
Anatomy	Surface anatomy of the urinary system	2hrs	226. Identify the gross anatomic features of the kidneys, renal pelvis, ureter, urinary bladder, and urethra.
Physiology	Measuring blood pressure	2hrs	227. Perform the procedure of measuring blood pressure.

Biochemistry	Protein analysis	6 hrs	228.Perform the procedure of protein analysis.
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Learning Resources

S#	Subjects	Resources
1.	Anatomy	<p>A. GROSS ANATOMY 1. Last's Anatomy</p> <p>B. EMBRYOLOGY 1. Langman's Medical Embryology</p> <p>C. HISTOLOGY 1. Medical Histology By Laiq Hussain</p> <p style="text-align: center;">Reference Books</p> <p>1. Netter Atlas of Human Anatomy 2. Gray's Anatomy</p>
2	Biochemistry	<p style="text-align: center;">Text Books</p> <p>1. Lippincott illustrated reviews 8th 2. Harper's illustrated Biochemistry 30th 3. U. Satyanarayan and U. Chakarpani 4th</p> <p style="text-align: center;">Reference Books</p> <p>1. Lippincott illustrated reviews 2. MLA. Harvey, Richard A., PhD. Lippincott's illustrated reviews: Biochemistry 3. U. Satyanarayana Biochemistry 4. U. satyanarayan and U. Chakarpani 4th edition 5. Harper's illustrated Biochemistry 6. Rodwell VW, Bender DA ,Botham KM., Kennelly PJ, Weil P. Eds. Victor W. Rodwell et al. 7. Fundamentals of Biochemistry 8. Donald V., Judith G. Voet, Charlotte W. John wiley and sons, New york 9. Netter's essential Biochemisty 10. Lippincott illustrated reviews 11. MLA. Harvey, Richard A., PhD. Lippincott's illustrated reviews: Biochemistry</p>

3	Physiology	<p style="text-align: center;">Textbooks</p> <ol style="list-style-type: none"> 1. Guyton and Hall Textbook of Medical Physiology, 13th Edition by John E. Hall. 2. Human Physiology: From Cells to Systems, 8th Edition by Lauralee Sherwood
4	Oral Biology	<p style="text-align: center;">Textbook</p> <ol style="list-style-type: none"> 1. Ten Cate's Oral Histology 2. Orban's Oral Histology and Embryology 3. Concise Dental Anatomy and Morphology by James L. Fuller <p style="text-align: center;">Reference Books</p> <ol style="list-style-type: none"> 1. Oral Anatomy, Histology and Embryology by B.K.B Berkovitz

KHYBER MEDICAL UNIVERSITY



LOGBOOK FOR BIOCHEMISTRY

1st YEAR BDS

CERTIFICATE

Name of Institution:

Full Name of Student:

Roll Number:

Class:

It is certified that _____
S/D of _____ has fulfilled the
requirement of practical work in Department of Biochemistry.

Signature of Teacher

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Block A Module 1: FOUNDATION I

Block A
Module 1: Foundation I
Carbohydrates

Number of hours:8

Learning Outcomes:

1. Detection of Monosaccharide in a given Solution
2. Detection of unknown sugar in a solution
3. Detecting of Reducing and non-reducing Sugars

FOOD CONSTITUENTS.

The food we eat consists of substances called "NUTRIENTS" which are derived from animal and plant tissues. Nutrients are essential chemical substances obtained from food that sustain human health, growth, and energy, categorized into macronutrients (carbohydrates, proteins, fats) for energy and micronutrients (vitamins, minerals) for metabolic function. Water and fiber are also crucial components of a balanced diet.

Key Nutrient Classifications

Macronutrients: Required in large amounts to provide energy (calories).

Carbohydrates: Primary energy source.

Proteins: Build, repair, and maintain tissues.

Fats: Energy, insulation, and organ protection.

Micronutrients: Required in small amounts to support metabolism, immune function, and structural health.

Vitamins: Organic compounds (e.g., A, C, D, E, K).

Minerals: Inorganic elements (e.g., Calcium, Iron, Potassium).

Water: Essential for transporting nutrients and oxygen to cells.

Functions and Importance

Nutrients regulate gene expression, build cellular structures, provide fuel for daily activities, and help prevent diseases like diabetes and heart disease. A balanced diet, rich in varied foods, ensures the body receives the necessary nutrition. Carbohydrates, proteins and lipids are the major food constituents present in bulk in the food, whereas vitamins and minerals are in smaller amounts. Water is one of the most essential constituents, to think of life without it is impossible.

CARBOHYDRATES

Carbohydrates are defined as polyhydroxy aldehydes or polyhydroxy ketones. Consist of polyhydroxy aldehydes (glucose) or polyhydroxy ketones (fructose). Carbohydrates are widely distributed both in animal and plant tissues. The carbohydrates to be considered here are those which occur in mammalian tissues and are of importance in human nutrition. Vegetables contain a considerable amount of carbohydrates, but human beings lack some of the enzymes in their digestive systems to hydrolyze all of them. However, only a very few of the complex carbohydrates are broken down by the digestive enzymes into utilizable sugars which can be absorbed by the intestinal mucosa.

Carbohydrates are classified as:

a) Monosaccharides

- i. Glucose.
- ii. Fructose.
- iii. Galactose.

b) Disaccharides

- i. Lactose.
- ii. Maltose.
- iii. Sucrose.

c) Oligosaccharides

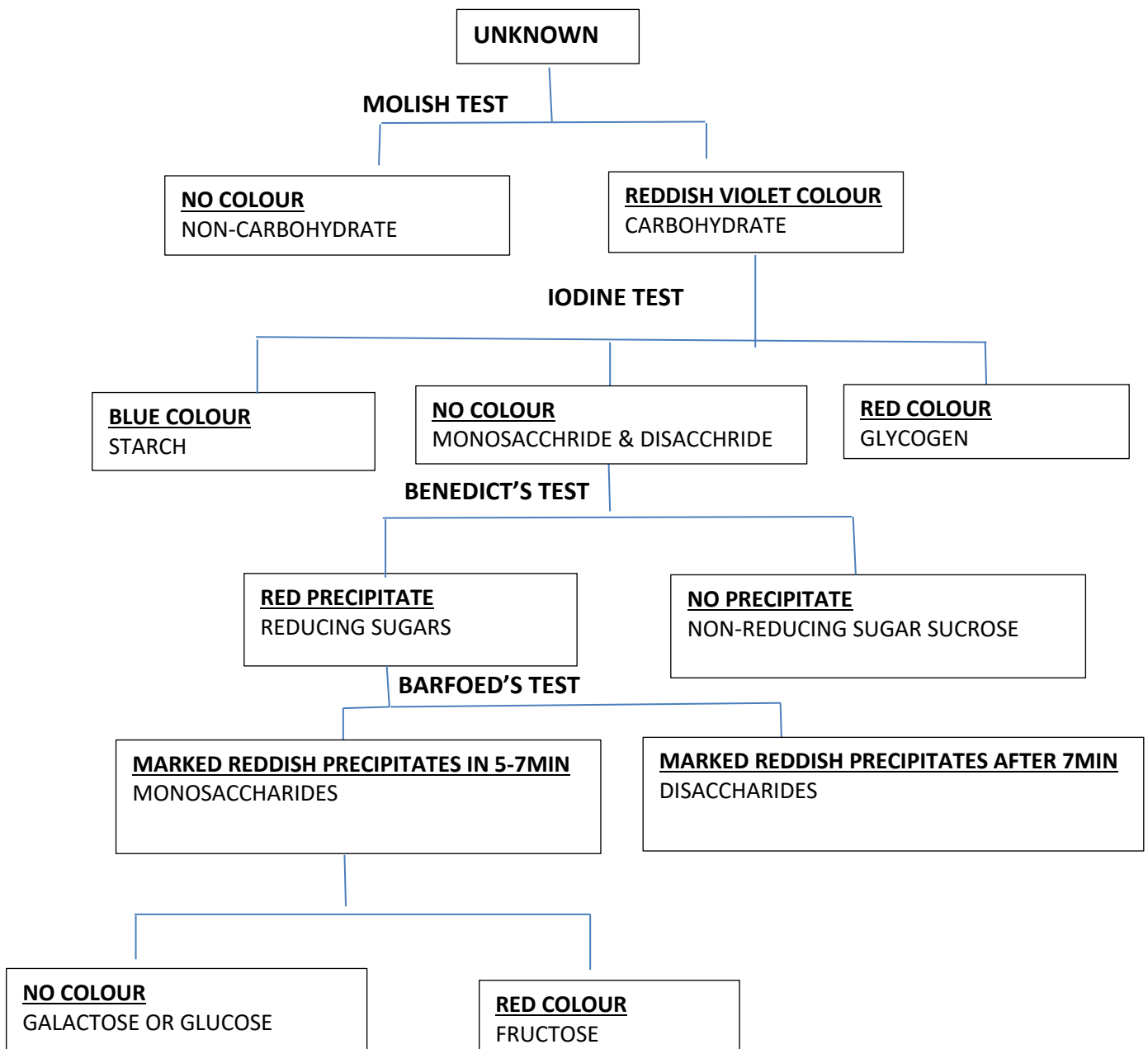
- i. Maltotriose

d) Polysaccharides

- i. Starch.
- ii. Glycogen.
- iii. Dextrin.

Monosaccharides such as glucose, fructose and galactose and disaccharides like maltose and lactose are classed as "reducing sugars". These sugars can reduce in alkaline or slightly acidic solutions some of the metal ions such as Cu^{2+} , Ag^+ , Bi^{3+} , and $\text{Fe}(\text{CN})^3$.

Qualitative Tests of Carbohydrates:



Qualitative tests of Carbohydrates:

GENERAL REACTIONS OF CARBOHYDRATES

MOLISCH'S REACTION:

PRINCIPLE:

Sugars on reaction with dehydrating agents like concentrated strong acids (concentrated H₂SO₄) yield furfural and furfural derivatives, such as hydroxymethyl furfural, which condense with α -naphthol and give a reddish violet ring.

REAGENTS:

1. Molisch's Reagent:
 - i- α -naphthol,
 - ii-Ethyl alcohol
2. Concentrated H₂SO₄
3. Original solution (O.S.) - containing a carbohydrate.

PROCEDURE:

To 2ml of sugar solution (original solution) add 2 to 3 drops of Molisch's reagent Mix thoroughly. Carefully pour 5 ml concentrated H₂SO₄ along the side of the test tube. Acid being heavier will form a layer beneath the sugar solution. The formation of a reddish violet ring at the junction of the two liquids indicates the presence of carbohydrates. This test is very sensitive and is given by all the carbohydrates.

REACTIONS GIVEN BY MONOSACCHARIDES AND DISACCHARIDES

1. COPPER REDUCTION TESTS:

Carbohydrates which give reduction tests have free aldehyde or ketonic groups, and are called "reducing sugars".

PRINCIPLE:

Alkaline copper reagents (Benedict's and Fehling's reagents) are reduced by the reducing sugars with the formation of yellow, orange or red precipitate.

The reaction of acid copper reagents (Barfoed's reagent) with reducing sugars is slow and can be used to distinguish monosaccharides from disaccharides.

a. FEHLING'S TEST:

1. Fehling's reagent:

- i. Solution A - Copper sulphate solution, and
- ii. Solution B - Alkaline tartrate solution.

These solutions are preserved in separate bottles. Fehling's reagent is freshly prepared by mixing equal volumes of solution-A with solution-B.

2. Original solution (O.S.)-containing a carbohydrate.

PROCEDURE:

To 1ml of sugar solution (original solution) in a test tube, add 1ml of Fehling's reagent. Mix and boil carefully. The production of yellow or brownish-red precipitate of cuprous oxide indicates the presence of reducing sugars in the sample.

b. BENEDICT'S TEST:

1. Benedict's reagent:

- i. Copper sulphate,
- ii. Sodium Citrate, and
- iii. Sodium Carbonate.

2. Original solution (O.S.)-containing a carbohydrate.

PROCEDURE:

To 5ml of Benedict's reagent in a test tube add 8 drops of sugar solution (original solution). Mix thoroughly and heat to boil for 2 minutes. Allow the tube to cool. The solution, in addition to formation of a precipitate, will change colour from blue to green, yellow, orange or red depending upon the amount of reducing sugar present.

This test can be used as a rough quantitative test for the clinical evaluation as shown in the following table:

OBSERVATIONS	CONCENTRATION OF SUGAR	CLINICAL EVALUATION
No colour change (Blue)	0.0%	Nil
Green coloured solution with no precipitate.	0.1%	Traces
Green coloured solution with yellow precipitate.	0.1-0.5%	+
Olive green coloured solution with yellow precipitate.	0.5-1%	++
Yellow orange coloured precipitate.	1-2%	+++
Brick red coloured precipitate	2% or more.	++++

c. BARFOED'S TEST:

1. Barfoed's Reagent:

- i. Copper acetate, and
- ii. Acetic acid.

2. Original solution (O.S.) - containing a carbohydrate.

PROCEDURE:

To 5ml of Barfoed's reagent in a test tube add 0.5ml of sugar solution (original solution). Mix thoroughly and place it in the boiling water bath. Note the time when signs of reduction i.e., formation of a red precipitate of cuprous oxide first appears in the test tube.

The monosaccharides start forming precipitates in less than 7 minutes where as

The precipitates appearing after 7 minutes indicate the presence of disaccharides in the solution. SPECIAL REACTIONS GIVEN BY THE INDIVIDUAL SUGARS

TEST FOR FRUCTOSE (FREE OR COMBINED):

1. SELIWANOFF'S TEST:

PRINCIPLE:

Fructose on heating with the HCl, rapidly forms furfural, which on reaction with resorcinol gives red coloured compounds.

REAGENT:

1. Seliwanoff's Reagent:
 - i. Resorcinol, and
 - ii. Concentrated HCl.
2. Original solution (O.S.) - containing a carbohydrate.

PROCEDURE:

To 3ml of Seliwanoff's reagent in a test tube add 3 drops of a original solution (fructose solution) and heat the mixture to just boiling. A positive reaction is indicated by the production of a red colour. Ketoses free or combined (Fructose or Sucrose), give a red colour. Prolonged boiling with aldoses is bound to give a false positive result, as the aldoses also start giving a similar reaction.

HYDROLYSIS OF SUCROSE

Sucrose does not reduce Benedict's, Barfoed's or Fehling's reagents. Sucrose, upon hydrolysis, takes one molecule of water and breaks down into two molecules of monosaccharides ie, glucose and fructose.

PROCEDURE:

To 3ml of sugar solution (original solution) in a test tube add few drops of concentrated HCL Mix carefully and gently heat to boil. Cool under tap water. Add 1ml 5% NaOH drop by drop to the test tube. Heat to boil again. On completion of hydrolysis the solution will turn yellowish, indicating the presence of a reducing sugar. After acid hydrolysis it gives positive copper reduction tests.

REACTIONS GIVEN BY POLYSACCHARIDES

The polysaccharides are complex carbohydrates. They have high molecular weight. Few of them are appreciably digested in the alimentary canal by human beings. They are not reducing sugars and so cannot reduce Benedict's reagent. When starch and glycogen are boiled with dilute acids, they are hydrolyzed to glucose. The intermediate products formed during the course of hydrolysis, are dextrans and maltose.

1. IODINE TEST:

REAGENTS:

- a. 0.01N Iodine solution.
- b. Original solution (O.S.)-containing a carbohydrate.

PROCEDURE:

To 3ml of the starch solution (original solution) in a test tube, add 1-2 drops of the dilute iodine solution. Observe the production of a blue colour. The blue colour produced disappears on heating and it reappears on cooling the solution. Starch, glycogen and higher dextrans on reaction with dilute iodine solution form coloured compounds

Starch	Blue colour.
Amylodextrin.	Purple colour.
Erythrodextrin.	Red colour.
Glycogen.	Red colour.
Achrodextrin (lower dextrans), Disaccharides (Maltose) and Monosaccharides.	No change in colour.

HYDROLYSIS OF STARCH

Starch does not reduce Benedict's, Barfoed's or Fehling solution.

PROCEDURE:

To 3-5ml of sugar solution (original solution) in a test tube add 0.5ml of concentrated HCl. Mix carefully and gently heat to boil. Cool under tap water. Add 5% NaOH drop by drop to the test tube. Heat to boil again. On completion of hydrolysis the solution will turn yellowish, indicating the presence of a reducing sugar.

QUESTION/ANSWERS

1. Describe a test for the detection of sugar in urine?

A. Benedict's Test - To 5 ml Benedict's Reagent add 8 drops of urine, mix and heat to boil for 2 minutes. The change in the colour of solution indicates the presence of sugar in the urine.

2. What is the composition of Benedict's Reagent?

A. Benedict's Reagent contains: Sodium citrate, Sodium carbonate, Cupric sulphate and distilled water.

3. What is the use of Benedict's Test?

A. Benedict's Test is used to detect the presence of reducing sugars in any solution.

4. What is positive Benedict's Test?

A. A positive Benedict's Test gives various shades of colour from green, yellow, orange, red and brick-red colour depending upon the increasing concentration of reducing sugars in the solution.

5. What is the clinical significance of a positive Benedict's Test?

A. A positive Benedict's Test indicates the presence of reducing sugars particularly glucose in the urine. Being a qualitative test it indicates a rough estimate of glucose in the urine sample. This can be helpful in diagnosing and monitoring the level of glucose in patients with diabetes mellitus.

6. What is the pH required for Benedict's and Barfoed's Test?

A. pH for Benedict's Test is alkaline and for Barfoed's Test it is acidic.

7. What is reducing sugar?

A. All the sugars which have free aldehyde or ketone group are known as reducing sugars. They reduce the cupric (Cu^{2+}) to cuprous (Cu) ions.

8. Name the reducing sugars?

A. All the monosaccharides and disaccharides (i.e., glucose, fructose, galactose, lactose and maltose) except sucrose are the reducing sugars.

9. What is a non-reducing sugar?

A. The sugars which do not have any free aldehyde or ketone group are called non-reducing sugars e.g., sucrose and polysaccharides.

10. Why sucrose being disaccharide is a non-reducing sugar?

A. Sucrose being disaccharide consisting of glucose and fructose, both are reducing sugars but the aldehyde group of glucose and ketone group of fructose is linked together in glucosidic linkage, thus there is no free reducing group available.

11. What is the principle of Molisch's Test?

A. Carbohydrates are converted into furfural by concentrated H_2SO_4 , which acts as a dehydrating agent. Furfurals form a coloured complex with α -naphthol (Molisch's Reagent) producing a violet ring at the junction of two liquids.

12. What is the use (or significance) of Molisch's Test?

A. It is used for detection of carbohydrates in any solution.

13. How much is ++ sugar in the urine?

A. 0.5-1%

14. What is the significance of Barfoed's Test?

A. Copper in acid medium in Barfoed's reagent is reduced slowly and can be used to distinguish between monosaccharides and disaccharides e.g., A positive Barfoed's Test within or less than 7 minutes indicates the presence of monosaccharides, whereas, a positive Barfoed's Test after or more than 7 minutes indicates the presence of disaccharides in any solution i.e., it is faster in monosaccharides than in disaccharides.

15. What is the composition of Seliwanoff's Reagent?

A. It contains: i- Resorcinol, and ii- HCl.

16. What is the significance of Seliwanoff's Reagent?

A. Positive Seliwanoff's Test indicates the presence of keto-sugars; thus, it helps in differentiating between aldo- and keto- sugars.

17. What is the principle of Seliwanoff's Test?

A. The HCl in Seliwanoff's Reagent acts as a dehydrating agent, converting keto- sugars into furfurals, which form a cherry-red coloured complex with Resorcinol.

18. What is the use of Iodine Test?

A. It indicates the presence of polysaccharides in any solution.

EXPERIMENT No.,

Date

DETECTION OF GLUCOSE IN A GIVEN SOLUTION

APPARATUS: Test tubes, Test tube holder, Test tube, Burner, Glass slide, cover slip
Microscope, Rack, Pipettes, Beaker and Water bath
Original solution (Glucose solution).

REAGENTS: Molisch's Reagent, Iodine Reagent, Benedict's Reagent, Seliwanoff's Reagent,
Conc. HCl, Conc. H₂SO₄, 5% NaOH & Barfoed's Reagent

No.	Tests	OBSERVATION	INFERENCE
1	MOLISCH'S TEST		
2	IODINE TEST		
3	BENEDICT'S TEST		
4	BARFOED'S TEST		
5	SELIWANOFF'S TEST		

RESULT: _____

EXPERIMENT No.,

Date

DETECTION OF FRUCTOSE IN A GIVEN SOLUTION

APPARATUS: Test tubes, Test tube holder, Test tube, Burner, Glass slide, cover slip
Microscope, Rack, Pipettes, Beaker and Water bath
Original solution (Glucose solution).

REAGENTS: Molisch's Reagent, Iodine Reagent, Benedict's Reagent, Seliwanoff's Reagent,
Conc. HCl, Conc. H₂SO₄, 5% NaOH & Barfoed's Reagent

No.	Tests	OBSERVATION	INFERENCE
1	MOLISCH'S TEST		
2	IODINE TEST		
3	BENEDICT'S TEST		
4	BARFOED'S TEST		
5	SELIWANOFF'S TEST		

RESULT: _____

EXPERIMENT No.,

Date

DETECTION OF GALACTOSE IN A GIVEN SOLUTION

APPARATUS: Test tubes, Test tube holder, Test tube, Burner, Glass slide, cover slip
Microscope, Rack, Pipettes, Beaker and Water bath
Original solution (Glucose solution).

REAGENTS: Molisch's Reagent, Iodine Reagent, Benedict's Reagent, Seliwanoff's Reagent,
Conc. HCl, Conc. H₂SO₄, 5% NaOH & Barfoed's Reagent

No.	Tests	OBSERVATION	INFERENCE
1	MOLISCH'S TEST		
2	IODINE TEST		
3	BENEDICT'S TEST		
4	BARFOED'S TEST		
5	SELIWANOFF'S TEST		

RESULT: _____

EXPERIMENT No.,

Date

DETECTION OF LACTOSE IN A GIVEN SOLUTION

APPARATUS: Test tubes, Test tube holder, Test tube, Burner, Glass slide, cover slip
Microscope, Rack, Pipettes, Beaker and Water bath

Original solution (Glucose solution).

REAGENTS: Molisch's Reagent, Iodine Reagent, Benedict's Reagent, Seliwanoff's Reagent,
Conc. HCl, Conc. H₂SO₄, 5% NaOH & Barfoed's Reagent

No.	Tests	OBSERVATION	INFERENCE
1	MOLISCH'S TEST		
2	IODINE TEST		
3	BENEDICT'S TEST		
4	BARFOED'S TEST		
5	SELIWANOFF'S TEST		

RESULT: _____

EXPERIMENT No.,

Date

DETECTION OF MALTOSE IN A GIVEN SOLUTION

APPARATUS: Test tubes, Test tube holder, Test tube, Burner, Glass slide, cover slip
Microscope, Rack, Pipettes, Beaker and Water bath
Original solution (Glucose solution).

REAGENTS: Molisch's Reagent, Iodine Reagent, Benedict's Reagent, Seliwanoff's Reagent,
Conc. HCl, Conc. H₂SO₄, 5% NaOH & Barfoed's Reagent

No.	Tests	OBSERVATION	INFERENCE
1	MOLISCH'S TEST		
2	IODINE TEST		
3	BENEDICT'S TEST		
4	BARFOED'S TEST		
5	SELIWANOFF'S TEST		

RESULT: _____

EXPERIMENT No.,

Date

DETECTION OF SUCROSE IN A GIVEN SOLUTION

APPARATUS: Test tubes, Test tube holder, Test tube, Burner, Glass slide, cover slip
Microscope, Rack, Pipettes, Beaker and Water bath
Original solution (Glucose solution).

REAGENTS: Molisch's Reagent, Iodine Reagent, Benedict's Reagent, Seliwanoff's Reagent,
Conc. HCl, Conc. H₂SO₄, 5% NaOH & Barfoed's Reagent

No.	Tests	OBSERVATION	INFERENCE
1	MOLISCH'S TEST		
2	IODINE TEST		
3	BENEDICT'S TEST		
4	BARFOED'S TEST		
5	SELIWANOFF'S TEST		

Perform tests after hydrolysis

a.	BENEDICT'S TEST		
b.	BARFOED'S TEST		

RESULT: _____

EXPERIMENT No.

Date

DETECTION OF UNKNOWN SOLUTION IN A GIVEN SOLUTION

APPARATUS: Test tubes, Test tube holder, Test tube, Burner, Glass slide, cover slip
Microscope, Rack, Pipettes, Beaker and Water bath

Original solution (Glucose solution).

REAGENTS: Molisch's Reagent, Iodine Reagent, Benedict's Reagent, Seliwanoff's Reagent,
Conc. HCl, Conc. H₂SO₄, 5% NaOH & Barfoed's Reagent

No.	Tests	OBSERVATION	INFERENCE
1	MOLISCH'S TEST		
2	IODINE TEST		
3	BENEDICT'S TEST		
4	BARFOED'S TEST		
5	SELIWANOFF'S TEST		

RESULT: _____

Solutions

Number of hours:2

Learning Outcomes:

1. Prepare of 0.9% NaCl.
2. Measure the PH of given solution. SOLUTIONS

Solution is a homogeneous mixture of a solid, liquid, or gaseous substance (the solute) in a liquid (the solvent) from which the dissolved substances can be recovered by crystallization or other physical processes.

TYPES OF SOLUTIONS:

There are different terms used for expressing the strength of biomedical solution.

I. PERCENT SOLUTION.

a. Weight by volume percent (w/v%)

Weight of the solute dissolved per 100 ml of the solvent.

b. Weight by weight percent (w/w%)

Weight of the solute dissolved per 100 grams of the solvent.

c. Volume by volume percent (v/v%)

Volume of solute dissolved per 100 ml (volume) of the solvent.

II. MOLAR SOLUTION (M).

A solution which contains molecular weight of a substance in grams per litre of the solution.

IM = Gram molecular weight/litre.

IM of HCl = $1+35.5 = 36.5$

1mM of HCl = 36.5×10^{-3}

1 μ M of HCl 36.5×10^{-6}

WATER OF CRYSTALIZATION:

Substances like CuSO₄ exist in the form of crystals. Those molecules which hold molecules of water as integral part of their crystal lattice to form their molecular solution.

CuSO₄.5H₂O

IM $64+32+4(16)+10+5(16)$

$=64+32+64+10+80$

$= 160+10+80$

$=250$

1M solution 250g CuSO₄/L

III. NORMAL SOLUTION:

Normal solution contains gram equivalent weight of the solute per litre of the solvent.

Eq. Wt. = Gm. Mol. Wt./Valency

Eq. Wt. of H₂SO₄ = $2(1) + 32 + 16(4)$

$=2+32+64$

$= 98 \div 2$

$= 49$

Valency = Number of replaceable hydrogen ions.

IV. MOLAL SOLUTION:

Number of moles of a substance dissolved in 1000 grams of water (w/w). Final volume is more than one litre.

V. SATURATED SOLUTION:

Saturated solution is that solution which normally contains the maximum amount of substance able to be dissolved at a given temperature. The solution can stay in equilibrium with an excess of the solute.

VI. SUPERSATURATED SOLUTION:

Supersaturated solution is one that contains a greater quantity of solid than can normally be dissolved at a given temperature. It is an unstable system. The excess of the solute above the saturation quantity crystallizes out when a crystal of the solute is added to it.

VII. HYPERTONIC SOLUTION:

Hypertonic solution is one that has an osmotic pressure greater than that of blood or plasma.

VIII. HYPOTONIC SOLUTION:

Hypotonic solution has osmotic pressure less than that of blood or plasma.

IX. ISO-OSMOTIC OR ISOTONIC SOLUTION:

Iso-osmotic or isotonic solution is that solution which has same osmotic pressure as that of blood serum or a reference solution.

X. COLLOIDAL SOLUTIONS:

Colloidal solutions are a macroscopically homogeneous system consisting of either single, large molecules or aggregations of smaller molecules suspended in a liquid. Colloidal particles are large and they cannot pass through the pores of ordinary parchment or collodion membranes. However, they are not large enough to settle out by gravity. There are two phases in a colloidal system - the finely divided particles called the dispersed phase, and the medium in which they are, usually a fluid, is the dispersion phase.

XI. BUFFER SOLUTION:

Buffer solution is a solution which tends to resist a change in pH on the addition of small amounts of acid or alkali.

QUESTION/ANSWERS

1. What is Normal solution?

A. A solution that contains gram equivalent weight of the solute per litre of the solvent.

2. What is an Acid?

A. Acid is proton donor.

3. What is a base?

A. Base is a proton acceptor.

4. What is a weak acid?

A. An acid which dissociates only partially e.g., H_2CO_3 , CH_3COOH .

5. What is a strong acid?

A. An acid which can completely dissociate e.g., HCl , H_2SO_4 .

6. What is an indicator?

A. Indicators are weak organic acids which dissociate in a solution to give ions of different colour from the undissociated molecule e.g., phenolphthalein is colourless in acid and pink in alkaline medium.

7. What is pH?

A. pH is the negative log of hydrogen ion concentration ($-\log [\text{H}^*]$).

8. What is Hendersen-Hasselbalch Equation?

A. $\text{PH} = \text{pKa} + \log [\text{Salt}]/[\text{Acid}]$

9. What is a Buffer solution?

A. Buffers are solutions which tend to resist changes in their pH on the addition of moderate amounts of acid or alkali.

10. What is Buffer capacity?

A. Is the ability of a buffer solution to resist pH changes.

11. What is the pH of blood?

A. pH of blood is 7.35 - 7.45

12. What is the pH of urine?

A. pH 4-6

13. What is Normal Saline?

A. Normal Saline is also called as Physiological or Isotonic Saline. Normal Saline solution consists of Sodium Chloride (NaCl) and water. It is 0.9 percent Sodium Chloride solution.

14. What are the uses of Normal Saline Solution?

A. Normal Saline has many uses. It is used to:

1. Clean wounds and abrasions.
2. Clean eyes.
3. Clear Sinuses.
4. Treat dehydration.
5. Given intravenous in hypovolemic conditions.

Experiment No.

Date:

PREPARATION OF 0.9% SODIUM CHLORIDE (NORMAL SALINE) SOLUTION.

METHOD:

Dilution method.

PRINCIPLE:

A measured known amount of solute that is sodium chloride is dissolved in distilled water. The solution of sodium chloride is then diluted to get the desired percentage solution.

APPARATUS:

Weighing machine, beaker, volumetric flask, funnel, stirrer.

REAGENTS:

1. Sodium Chloride (dry) [NaCl],
2. Distilled Water.

PROCEDURE:

Take 0.9 gram of Sodium Chloride in a beaker and add 50ml of distilled water in it. Stir the contents of the beaker until the solute is dissolved in the distilled water. Pour the contents of the beaker into the 100ml volumetric flask with help of a funnel. Now dilute the solution with distilled water up to the 100 ml mark. Mix well.

CALCULATIONS:

$$W_1/V_1=W_2/V_2$$

W_1 = Weight of Solute used.

V_1 =Volume of Solvent used.

W_2 Required Weight of Solute

V_2 Required volume of Solvent

By applying the equation $W_1 / V_1 = W_2/V_2$ find out the value for W_2 .

$$W_1 \times V_2 = W_2 \times V_1$$

$$W_2 = W_1 \times V_2 / V_1$$

$$W_2 = X \text{ gm}$$

TO PREPARE 1000 mL OF 0.9% SODIUM CHLORIDE SOLUTION

DETERMINATION OF PH OF A SOLUTION

pH, is the measurement of acidity or basicity of the solutions. In chemistry it is considered as the concentration of Hydrogen ions in a solution. The original concept of pH was proposed by a Danish Biochemist Søren Peder Lauritz Sørensen in 1909, as negative logarithm of hydrogen ion concentration in an aqueous solution.

$$\text{pH} = -\log[\text{H}^+]$$

Arrhenius gave the definition of an acid as a substance that dissociates or ionizes to form hydrogen (H^+) ions when dissolved in water, and a base is a substance that dissociates into hydroxyl (OH^-) ions when dissolved in water.

pH measurement ranges between 0 and 14. pH values below 7 are acidic whereas pH values above 7 are considered alkaline. pH value of 7 is taken as neutral.

METHODS FOR MASUREMENT OF PH

The methods for measuring pH in a given solution are:

1. Colorimetric/Indicator method,
2. Metal Electrode method,
3. Glass Electrode method, and
4. ISFET Electrode / Semiconductor method.

Colorimetric / Indicator method: Litmus paper is used to check the pH of the solution. It tells whether the solution is acidic if it turns red or basic if it turns blue. The litmus paper turns purple if the pH is close to neutral that is 7. The change in colour to red is when the pH is below 4.5 and it changes to blue the pH will be above 8.3. Exact pH of the substance cannot be determined by the use of a litmus paper.

Indicators are chemicals when added to acidic or alkaline solutions change colour. The indicators commonly used in laboratories are phenolphthalein, and methyl orange.

Phenolphthalein when added to basic or alkaline solution turns pink in colour whereas methyl orange when added to acidic solution changes to red colour.

Metal Electrode method: The method includes the hydrogen-electrode method, quinhydrone-electrode method and antimony-electrode method. All the methods have their limitations and are not in frequent use nowadays.

Glass Electrode method: The method uses two electrodes, one being the glass electrode and the other is the reference electrode. It measures the voltage or potential difference generated between the two electrodes dipped in the solution. This is one of the most common methods used to determine pH of a solution.

ISFET Electrode / Semiconductor method: Ion-selective field effect transistor (ISFET) is a semiconductor chip which is resistant to damage in solution. This sensor replaces the glass electrode. The miniature size of the semiconductor chip is helpful in case of determination of pH in small amount of sample.

PH METER

A pH meter is a device used to measure the acidity or alkalinity of a solution. It determines the pH of a solution more accurately than the pH strips.

Principle of pH Meter:

The principle of pH meter is basically potentiometry. The variation in the electrical potential between the Measuring and Reference electrodes dipped in the given solution leads to flow of electrons resulting in generation of current which is measured with the help of a voltmeter.

PARTS OF PH METER

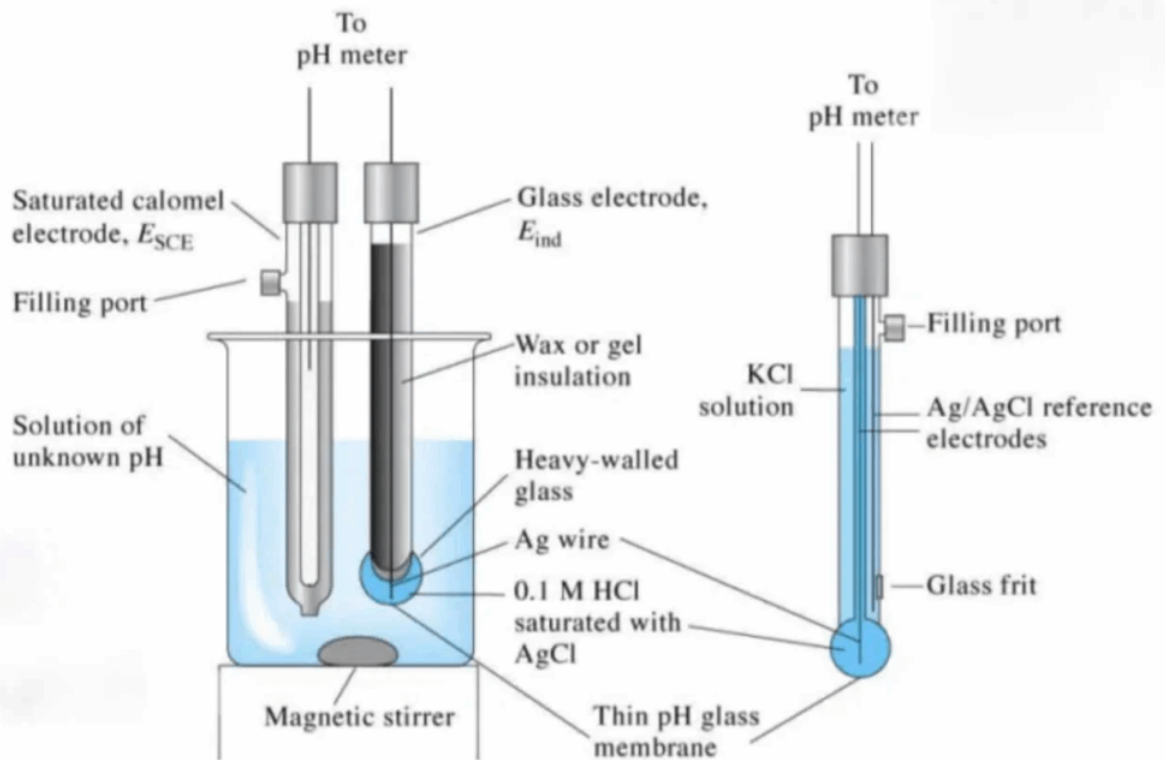
The pH meter consists of important components like Measuring Electrode, Reference Electrode and Voltmeter.

a. Measuring Electrode: The Measuring Electrode is a Glass Electrode also called Indicator Electrode or pH-Responsive Electrode. The Glass Electrode comprises of glass membrane that is very sensitive to concentration of hydrogen ions in a solution to be tested. The electric potential of a Glass Electrode is variable depending on the sample solution.

b. Reference Electrode: The Reference Electrode is considered as a standard. The electrical potential does not vary from sample to sample and remains constant.

The Reference Electrode is usually a silver chloride (AgCl) electrode and can also be of mercurous chloride (Hg₂Cl₂) electrode also called Calomel Electrode.

The pH meters usually have a Combination Electrode, which comprises both the Measuring and the Reference Electrodes in one unit.



Parts of a pH meter

Experiment No.:
Date:

TO DETERMINE THE PH OF A GIVEN SOLUTION

METHOD:

PROCEDURE:

RESULT:

Block B: CRANIOFACIAL
No Practical in block B

Block C: GIT & UGS

Block C

Number of hours:6

Learning Outcomes:

Perform the procedure of protein analysis.

PROTEINS

Proteins are large, nitrogenous compounds. They are polymers of amino acids, connected chains folded into a specific three-dimensional structure. Protein is found in every animal and with each other by peptide linkages. A protein molecule consists of one or more polypeptide Proteins are stored in seeds of many plants, and are required for the growth and development of vegetable cell. The enzymes and many of the hormones present in the body are protein in nature.

The major protein of milk is casein and that of egg white is ovalbumin.

Egg, milk and milk products, lean meat, fish, nuts, legumes, and some cereals are good sources of protein in our diet.

All proteins in all species, whatsoever their function or biological activity may be, are made up of 20 amino acids.

AMINO ACIDS FOUND IN PROTEINS

I. Having Aliphatic side chains:

- a. Glycine,
- b. Alanine,
- c. Valine,
- d. Leucine, and
- e. Isoleucine.

II. Having side chains containing hydroxyl groups:

- a. Serine,
- b. Threonine, and
- c. Tyrosine.

III. Having side chains containing sulphur atom:

- a. Cysteine, and
- b. Methionine.

IV. Having side chains containing acidic groups:

- a. Aspartic acid,
- b. Asparagine,
- c. Glutamic acid, and
- d. Glutamine.

V. Having side chains containing basic groups:

- a. Arginine,
- b. Lysine, and
- c. Histidine.

VI. Having Aromatic rings:

- a. Histidine,
- b. Phenylalanine,
- c. Tyrosine, and
- d. Tryptophan.

VII. Imino acids:

- a. Proline.

REACTIONS FOR PROTEINS

1. GENERAL REACTIONS:

i. BIURET REACTION:

This reaction is given by all substances containing two or more peptide amino acids do not give this reaction. The name "Biuret" was given to a compound which was linkages i.e. proteins and their hydrolytic products (proteoses and peptones). Dipeptides and produced after urea were heated at 180°C. This compound on reaction with dilute solution of copper sulphate gave a violet colour. Both biuret and peptides contain -CONH- (peptide linkages) and give positive biuret reaction, though biuret is not a protein in nature.

PRINCIPLE:

The peptide nitrogen atoms form a coordination complex with the cupric ions and a violet colour is produced.

PROCEDURE:

To 2ml of original solution (protein solution) in a test tube add 2 drops of 2% copper sulphate solution and 1ml of 5% sodium hydroxide solution. Mix thoroughly. A violet colour is produced with proteins, a bluish violet colour with gelatin, whereas peptones will give a pink colour.

ii. HEAT COAGULATION OF PROTEINS

Albumins, globulins and other proteins on heating undergo coagulation whereas gelatin, peptones and peptides do not coagulate on heating.

PROCEDURE:

Fill 2/3rd of the test tube with original solution (protein solution). Heat to boil. A white coagulum is formed. Add few drops of 2% acetic acid to the boiled solution and note that the coagulum does not re-dissolve, but it persists.

2. SEPARATION OF THE ALBUMIN AND GLOBULINS

i. AMMONIUM SULPHATE SATURATION TEST:

Half-saturation (50% saturation) with ammonium sulphate will result in precipitation of globulins, whereas albumins are precipitated after full-saturation (100% saturation) of the test sample with ammonium sulphate.

a. 50% Ammonium Sulphate Saturation Test:

To 2ml of original solution (protein solution) add 2ml of saturated ammonium sulphate solution. Mix thoroughly. The solution is now half-saturated. A bulky precipitate of globulin is formed. Allow the precipitate to settle down and then filter through a filter into a clean and dry beaker. Filtrate if cloudy, should be re-filtered through the same filter paper, to get a clear filtrate. No precipitation will indicate the presence of peptones in the test sample paper

b. 100% Ammonium Sulphate Saturation Test:

To 2ml filtrate from 50% ammonium sulphate saturation test, add ammonium sulphate crystals. Shake vigorously in order to dissolve crystals. Continue adding ammonium sulphate crystals to the filtrate until some crystals remain un-dissolved at the base of Filter out the precipitated albumin. Absence of precipitation indicates the presence of peptones the test tube. The solution is now fully saturated and white precipitate of albumin is formed.

3. SEPARATION OF GELATIN

MAGNESIUM SULPHATE SATURATION TEST:

To the precipitate from the 50% ammonium sulphate saturation test, add 2ml of distilled water and heat, the precipitate dissolves. Cool under tap water. Now saturate the solution in the test tube with magnesium sulphate crystals. A white precipitate is formed indicating the presence of gelatin.

B. TESTS FOR AMINO ACIDS

1.GENERAL REACTIONS OF AMINO ACIDS (Free or Combined):

NINHYDRIN REACTION (Triketo Hydrindene Hydrate):

PRINCIPLE:

Ninhydrin reaction is given by both free and combined α -amino acids. Amino acids, on heating with ninhydrin, are oxidatively decarboxylated, producing carbon dioxide, ammonia (NH_3), and an aldehyde. Reduced ninhydrin then reacts with the liberated ammonia and a blue or purple coloured complex is produced.

PROCEDURE:

To 1ml of original solution (protein solution) in a test tube add 2 - 3 drops of freshly prepared 0.5% ninhydrin solution and heat to boil. A blue or purple colour is produced if proteins, peptides or amino acids are present.

2.XANTHOPROTEIC REACTION (Test for Benzoid Radicals):

PRINCIPLE:

Nitration of benzoid radicals present in the amino acid side chain occurs due to reaction with nitric acid, giving the solution a yellow colouration.

PROCEDURE:

To about 1ml of original solution (protein solution) in a test tube add 5 drops of concentrated nitric acid. A white precipitate is formed due to denaturation of proteins by nitric acid. Heat to boil for half minute. The colour of the precipitate turns yellow and then partially gets dissolved to give a yellow-coloured solution. Cool under the tap water and add about 10 drops of strong aqueous ammonia, or sodium hydroxide. The yellow colour is intensified and changes to orange. Yellow colour solution indicates the presence of aromatic amino acids (Tyrosine, Tryptophan and Phenylalanine) in the protein. Phenylalanine like other amino acids contain benzene ring, but nitration of its benzene ring with nitric acid occurs with a great difficulty, and the process of nitration cannot be performed ordinarily by this method.

3. MILLON'S REACTION (Test for Hydroxybenzene Radicals):

Amino acid Tyrosine (Hydroxyphenylalanine) and other phenolic compounds give this reaction.

MILLON'S REAGENT:

Mixture of mercurous and mercuric nitrates.

PRINCIPLE:

The mercurous and mercuric nitrate reacts with the hydroxybenzene radicals (Phenols) forming a red coloured compound.

PROCEDURE:

To 2ml of original solution (protein solution) in a test tube add a few drops of the Millon's reagent. Boil gently for half a minute. The solution will turn red or a red precipitate will be formed. The proteins, on the addition of Millon's reagent, form a white precipitate first due to denaturation of proteins by mercury salts, which upon heating turn red. Tyrosine is the only amino acid which gives this reaction.

4. CYSTEINE TEST (Test for Sulphur):

PRINCIPLE:

Protein or amino acids when heated with sodium hydroxide, sulphur splits out as sodium sulphide, which on reaction with lead acetate, forms greyish brown to black precipitate of lead sulphide (PbS).

PROCEDURE:

To 1ml of original solution (protein solution) in a test tube add 1ml of 20% sodium hydroxide and 0.5ml of 2% lead acetate. A white precipitate is obtained due to denaturation of proteins. Now boil the mixture. The white precipitate turns grayish brown or black indicating the presence of sulphur. A positive reaction is due to the presence of a sulphur containing amino acid in the protein. This can be cysteine or methionine.

5. HOPKINS-COLE REACTION (Test for Tryptophan):

HOPKINS-COLE REAGENT:

Glyoxalic acid.

PROCEDURE:

To 1ml of original solution (protein solution) in a test tube add 1ml of Hopkins- Cole reagent. Mix thoroughly and add 1ml of concentrated sulphuric acid, pouring it down along the side of the test tube. A deep violet or purple ring forms at the junction of the two liquids. This indicates the presence of tryptophan. Gelatin and other proteins which do not contain tryptophan do not give this reaction.

6. ARGININE TEST (Test for Guanidine Group):

This test is specific for Arginine and indicates the presence of guanidine group in the arginine molecule.

PROCEDURE:

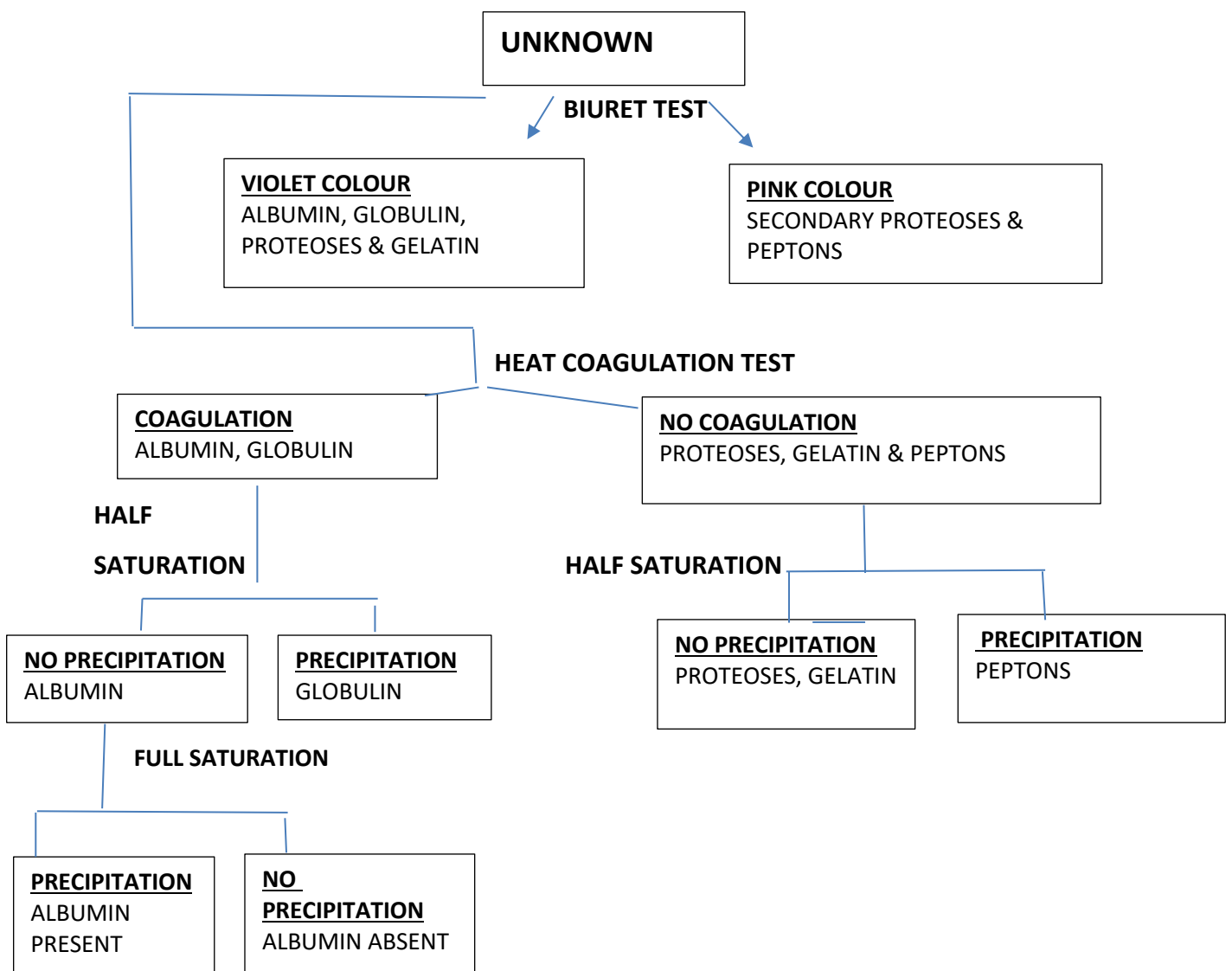
To 1ml of original solution (protein solution) in a test tube add 1ml of 5% sodium hydroxide and add 2 drops of 1% alcoholic α -naphthol mix and add 3 drops of sodium hypobromite (NaOBr) reagent. Mix it thoroughly. A bright red colour is formed. This confirms the presence of arginine.

7. TEST FOR PHOSPHATE

PROCEDURE:

To 1ml of original solution (protein solution) in a test tube add 1ml of ammonium molybdate reagent. Heat to boil. A yellow precipitate is formed. This confirms the presence of phosphate. Casein and other phosphoproteins give this test positive.

Qualitative Tests for Identification of Proteins



QUESTION/ANSWERS

1. What are Aromatic amino acids?

A Those amino acids which contain benzene ring are called aromatic amino acids.

2. Name the amino acids containing benzene ring?

A. These are phenylalanine, tyrosine and tryptophan.

3. Which of the amino acids can give positive Xanthoproteic Test?

A. All aromatic amino acids can give positive Xanthoproteic test.

4. Which of the amino acids can give positive Millon's Test?

A. Tyrosine, because it contains phenolic or hydroxyl-benzene group.

5. Which of the amino acids can give positive Hopkin-Cole Test?

A. Tryptophan, because it contains an indole ring.

6. Name the sulphur containing amino acids?

A. Methionine, cysteine, and cystine.

7. Name the simplest amino acid?

A. Glycine.

8. Which of the sulphur containing amino acid is an essential amino acid?

A. Methionine.

9. What is the significance of Ninhydrin Test?

A. A positive Ninhydrin Test indicates the presence of an amino acid (both in free or combined form) in any solution.

10. What is a Protein?

A. Proteins are nitrogenous compounds containing large number of amino acids linked through peptide linkages.

11. What is peptide linkage?

A. It is the linkage established between an alpha amino (α -NH₂) group of one amino acid with alpha carboxyl (α -COOH) group of another amino acid, with the removal of 1 molecule of water.

12. What is a peptide?

A. A peptide consists of 2 or more amino acid residues joined by peptide linkage e.g., Glutathione.

13. What is a dipeptide?

A. A dipeptide consists of two amino acids joined by one peptide linkage.

14. What is tripeptide?

A. A tripeptide consists of three amino acids joined by two peptide linkages e.g., Glutathione.

15. What is a polypeptide?

A. Peptides containing more than 10 amino acids residues joined by peptide linkages.

16. What is the effect of cationic and anionic precipitants on proteins?

A. The proteins behave as cations in an acid medium and are precipitated with large acid radicals. In alkaline medium the proteins behave as anions and are precipitated with heavy metal ions.

17. What is Biuret?

A. Two molecules of urea on heating at 180° C, produce a compound called "Biuret".

18. What is the importance of Biuret Test?

A. Biuret test is performed to detect the presence of peptide linkages in a solution.

19. What is the minimum number of peptide linkages required for a biuret test to be positive (positive biuret test)?

A. A minimum of two peptide linkages must be present to give a positive biuret test.

20. What is an iso-electric point (iso-electric pH) of a protein?

A. It is the pH of electrical neutrality, i.e., the pH at which the protein will not migrate to either anode or cathode in an electrical field. At this pH the net charge on the molecule is zero.

21. What is denaturation of protein?

A. Denaturation can be defined as loss of biologic activity of a protein. Denaturation does not involve covalent bond cleavage, but results from a re-arrangement of secondary, tertiary and quaternary structure of protein molecule. Proteins become more digestible when get denatured.

22. What is the clinical importance of Heat Coagulation test?

A. This test can be used to detect proteins in the urine.

EXPERIMENT No.

Date.

DETECTION OF ALBUMIN IN THE GIVEN SOLUTION

APPARATUS: Test tubes, Test tube holder, Test tube Rack, Pipettes, Beaker, and Burner.

REAGENTS: Albumin solution, 2% CuSO₄, 5% NaOH, 2% acetic acid, 0.5% Ninhydrin solution, conc. HNO₃, strong aqueous ammonia, Millon's Reagent, 20% NaOH, 2% lead acetate, Hopkin Cole Reagent, conc. H₂SO₄, 1% alcoholic a-naphthol, and NaOBr.

NO.	TEST	OBSERVATION	INFERENCE
1.	BIURET TEST		
2.	HEAT COAGULATION TEST		
3	AMMONIUM SULPHATE SATURATION TEST:		
a.	50% SATURATION TESTS.		
b.	100% SATURATION TESTS.		
4.	TESTS FOR INDIVIDUAL AMINO ACIDS:		
A	NINHYDRIN TEST.		
B	XANTHOPROTEIC TEST.		
C	MILLON'S TEST		
D	CYSTEINE TEST		
E	HOPKIN-COLE'S TEST.		
F	ARGININE TEST		
5.	TEST FOR PHOSPHATE.		

RESULT _____

EXPERIMENT No.

Date.

DETECTION OF GLOBULIN IN THE GIVEN SOLUTION

APPARATUS: Test tubes, Test tube holder, Test tube Rack, Pipettes, Beaker, and Burner.

REAGENTS: Albumin solution, 2% CuSO₄, 5% NaOH, 2% acetic acid, 0.5% Ninhydrin solution, conc. HNO₃, strong aqueous ammonia, Millon's Reagent, 20% NaOH, 2% lead acetate, Hopkin Cole Reagent, conc. H₂SO₄, 1% alcoholic a-naphthol, and NaOBr.

NO.	TEST	OBSERVATION	INFERENCE
1.	BIURET TEST		
2.	HEAT COAGULATION TEST		
3	AMMONIUM SULPHATE SATURATION TEST:		
a.	50% SATURATION TESTS.		
b.	100% SATURATION TESTS.		
4.	TESTS FOR INDIVIDUAL AMINO ACIDS:		
A	NINHYDRIN TEST.		
B	XANTHOPROTEIC TEST.		
C	MILLON'S TEST		
D	CYSTEINE TEST		
E	HOPKIN-COLE'S TEST.		
F	ARGININE TEST		
5.	TEST FOR PHOSPHATE.		

RESULT _____

EXPERIMENT No.

Date.

DETECTION OF GELATIN IN THE GIVEN SOLUTION

APPARATUS: Test tubes, Test tube holder, Test tube Rack, Pipettes, Beaker, and Burner.

REAGENTS: Albumin solution, 2% CuSO₄, 5% NaOH, 2% acetic acid, 0.5% Ninhydrin solution, conc. HNO₃, strong aqueous ammonia, Millon's Reagent, 20% NaOH, 2% lead acetate, Hopkin Cole Reagent, conc. H₂SO₄, 1% alcoholic a-naphthol, and NaOBr.

NO.	TEST	OBSERVATION	INFERENCE
1.	BIURET TEST		
2.	HEAT COAGULATION TEST		
3	AMMONIUM SULPHATE SATURATION TEST:		
a.	50% SATURATION TESTS.		
b.	100% SATURATION TESTS.		
4.	TESTS FOR INDIVIDUAL AMINO ACIDS:		
A	NINHYDRIN TEST.		
B	XANTHOPROTEIC TEST.		
C	MILLON'S TEST		
D	CYSTEINE TEST		
E	HOPKIN-COLE'S TEST.		
F	ARGININE TEST		
5.	TEST FOR PHOSPHATE.		

RESULT _____

EXPERIMENT No.

Date.

DETECTION OF PEPTONE IN THE GIVEN SOLUTION

APPARATUS: Test tubes, Test tube holder, Test tube Rack, Pipettes, Beaker, and Burner.

REAGENTS: Albumin solution, 2% CuSO₄, 5% NaOH, 2% acetic acid, 0.5% Ninhydrin solution, conc. HNO₃, strong aqueous ammonia, Millon's Reagent, 20% NaOH, 2% lead acetate, Hopkin Cole Reagent, conc. H₂SO₄, 1% alcoholic a-naphthol, and NaOBr.

NO.	TEST	OBSERVATION	INFERENCE
1.	BIURET TEST		
2.	HEAT COAGULATION TEST		
3	AMMONIUM SULPHATE SATURATION TEST:		
a.	50% SATURATION TESTS.		
b.	100% SATURATION TESTS.		
4.	TESTS FOR INDIVIDUAL AMINO ACIDS:		
A	NINHYDRIN TEST.		
B	XANTHOPROTEIC TEST.		
C	MILLON'S TEST		
D	CYSTEINE TEST		
E	HOPKIN-COLE'S TEST.		
F	ARGININE TEST		
5.	TEST FOR PHOSPHATE.		

RESULT _____

EXPERIMENT No.

Date.

DETECTION OF UNKNOWN IN THE GIVEN SOLUTION

APPARATUS: Test tubes, Test tube holder, Test tube Rack, Pipettes, Beaker, and Burner.

REAGENTS: Albumin solution, 2% CuSO₄, 5% NaOH, 2% acetic acid, 0.5% Ninhydrin solution, conc. HNO₃, strong aqueous ammonia, Millon's Reagent, 20% NaOH, 2% lead acetate, Hopkin Cole Reagent, conc. H₂SO₄, 1% alcoholic a-naphthol, and NaOBr.

NO.	TEST	OBSERVATION	INFERENCE
1.	BIURET TEST		
2.	HEAT COAGULATION TEST		
3	AMMONIUM SULPHATE SATURATION TEST:		
a.	50% SATURATION TESTS.		
b.	100% SATURATION TESTS.		
4.	TESTS FOR INDIVIDUAL AMINO ACIDS:		
A	NINHYDRIN TEST.		
B	XANTHOPROTEIC TEST.		
C	MILLON'S TEST		
D	CYSTEINE TEST		
E	HOPKIN-COLE'S TEST.		
F	ARGININE TEST		
5.	TEST FOR PHOSPHATE.		

RESULT _____

**END OF PRACTICAL LOGBOOK KHYBER MEDICAL
UNIVERSITY**



PREPARED BY:

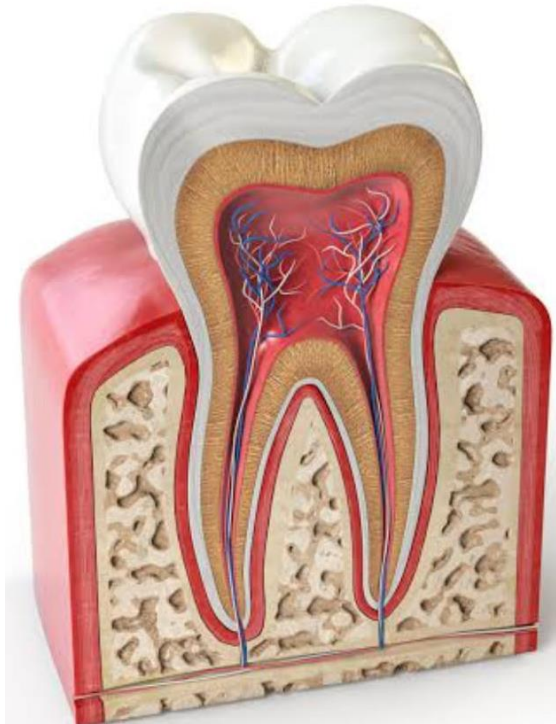
Dr Nazma Saleem

M.Phil. Biochemistry, CHR& CHPE

Assistant Professor and Academic Head of Biochemistry Department

Rehman College of Dentistry

FIRST YEAR BDS PRACTICAL LOGBOOK



Name: _____

Roll No: _____

Session: _____

Department of Oral Biology

FACULTY

Full Name	Designation

Khyber Medical University

1st Year BDS

Oral Biology and Tooth Morphology LogBook



Prepared By:

DR. FARHAN DIL

“This logbook is designed to enable students to systematically identify and describe the anatomical features of the hard and soft tissues of the oral cavity, understand the fundamental concepts of tooth morphology, and correlate structural characteristics with their functional and clinical significance.”

CERTIFICATE

Certified that Mr. / Miss _____

S /o D/o _____

Class No: _____ Exam Roll No. _____

Has fulfilled the requirements of practical work in the subject of Oral

Biology as prescribed by _____.

GRADE: _____ **HEAD / INCHARGE** _____

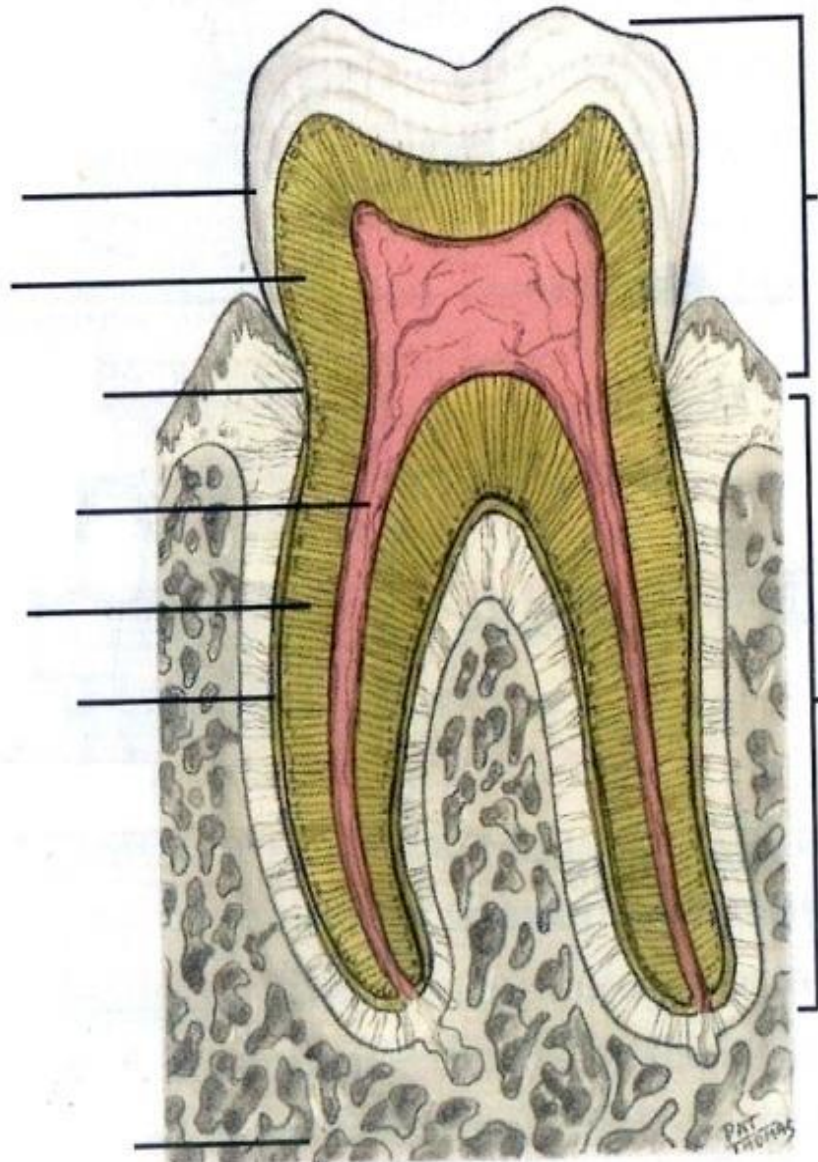
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Block: A
MODULE 1
FOUNDATION MODULE

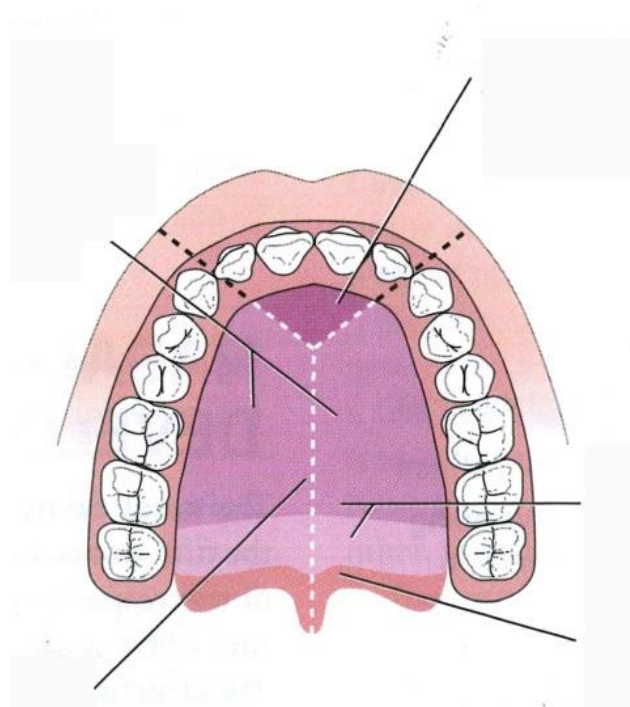
ANATOMY OF TOOTH



DRAW AND LABEL THE DIAGRAM

DEVELOPMENT OF OROFACIAL STRUCTURES

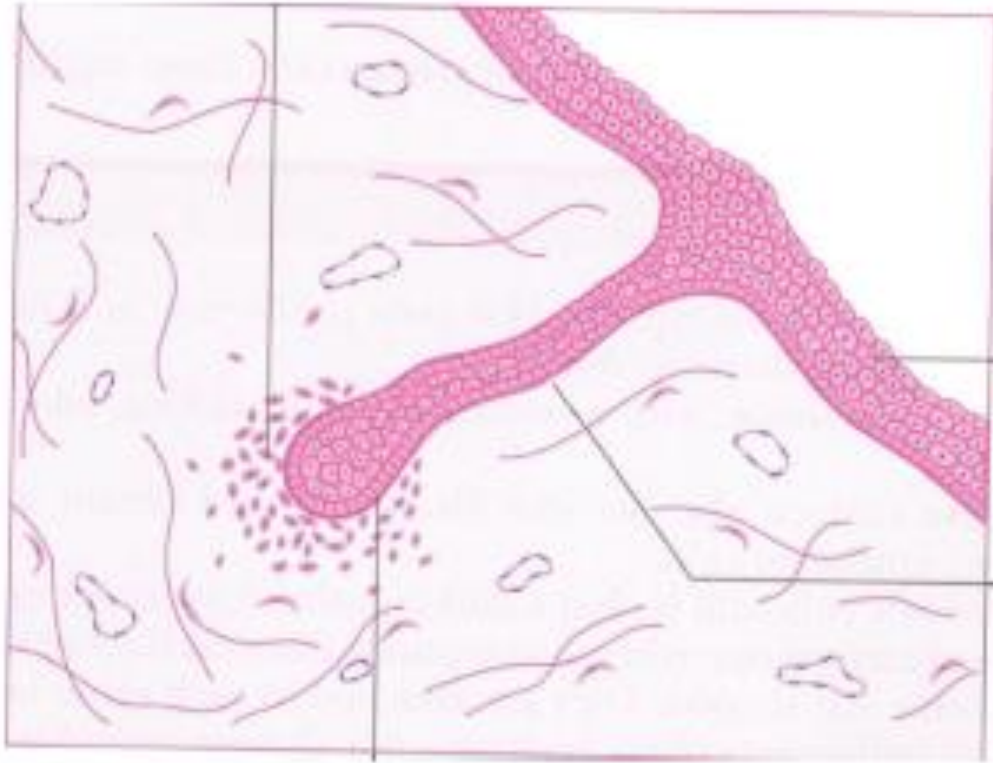
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DRAW AND LABEL THE DIAGRAM

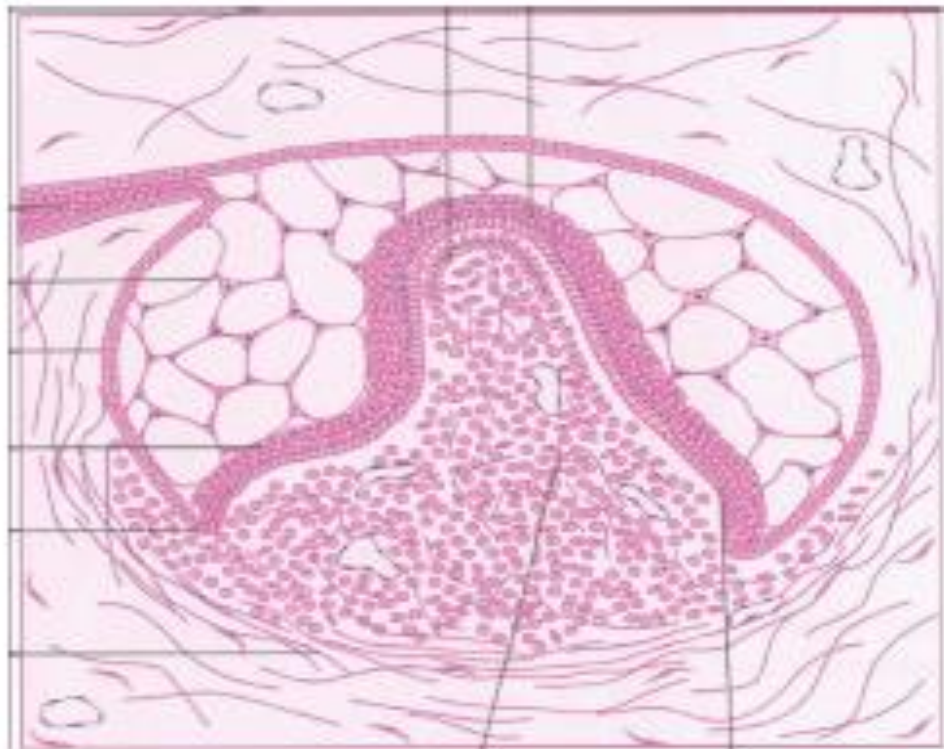
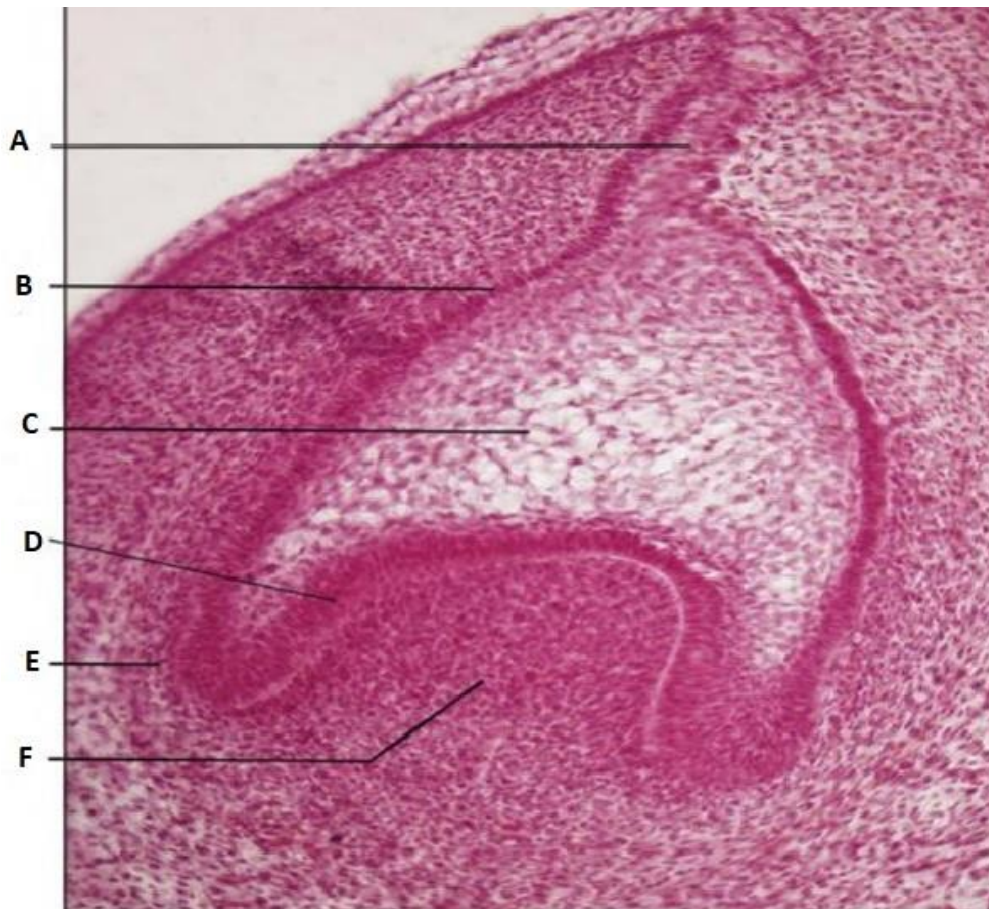
TOOTH DEVELOPMENT

Figure



DRAW AND LABEL THE DIAGRAM

TOOTH DEVELOPMENT



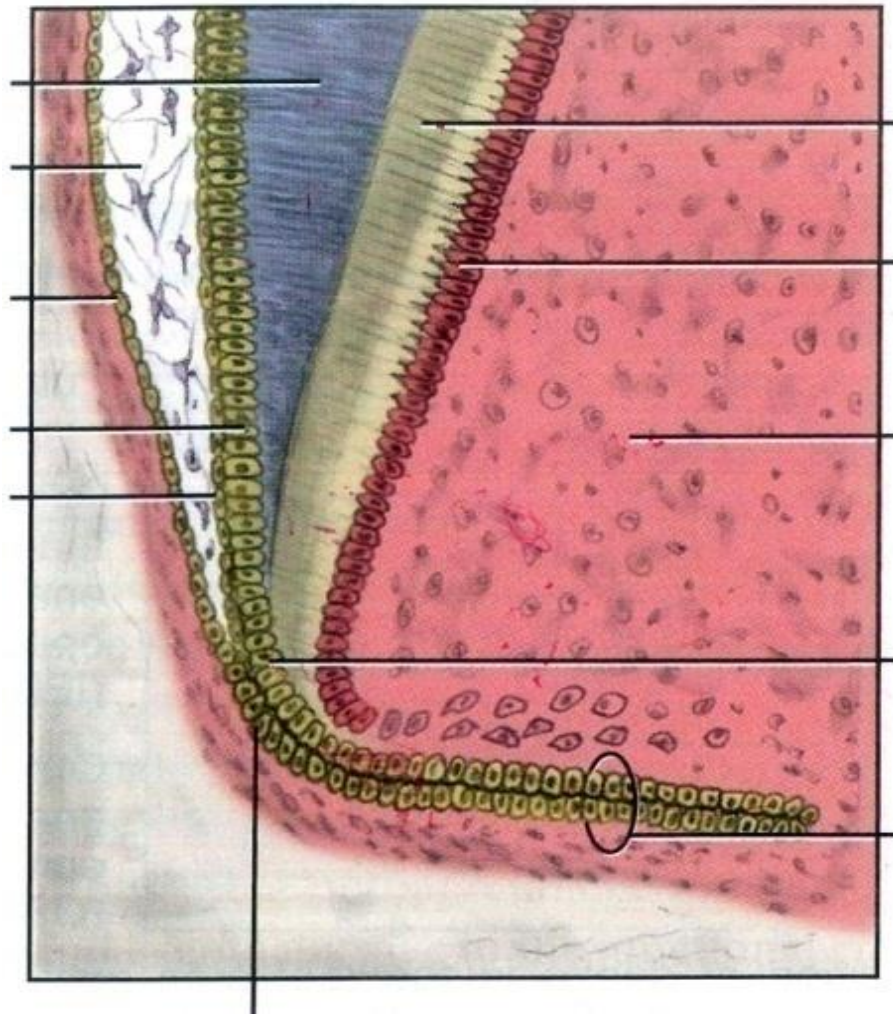
DRAW AND LABEL THE DIAGRAM

Identify the given stages of the tooth development (Bud, Cap & Bell Stage) and briefly write its key events?

Stages of the Tooth Development

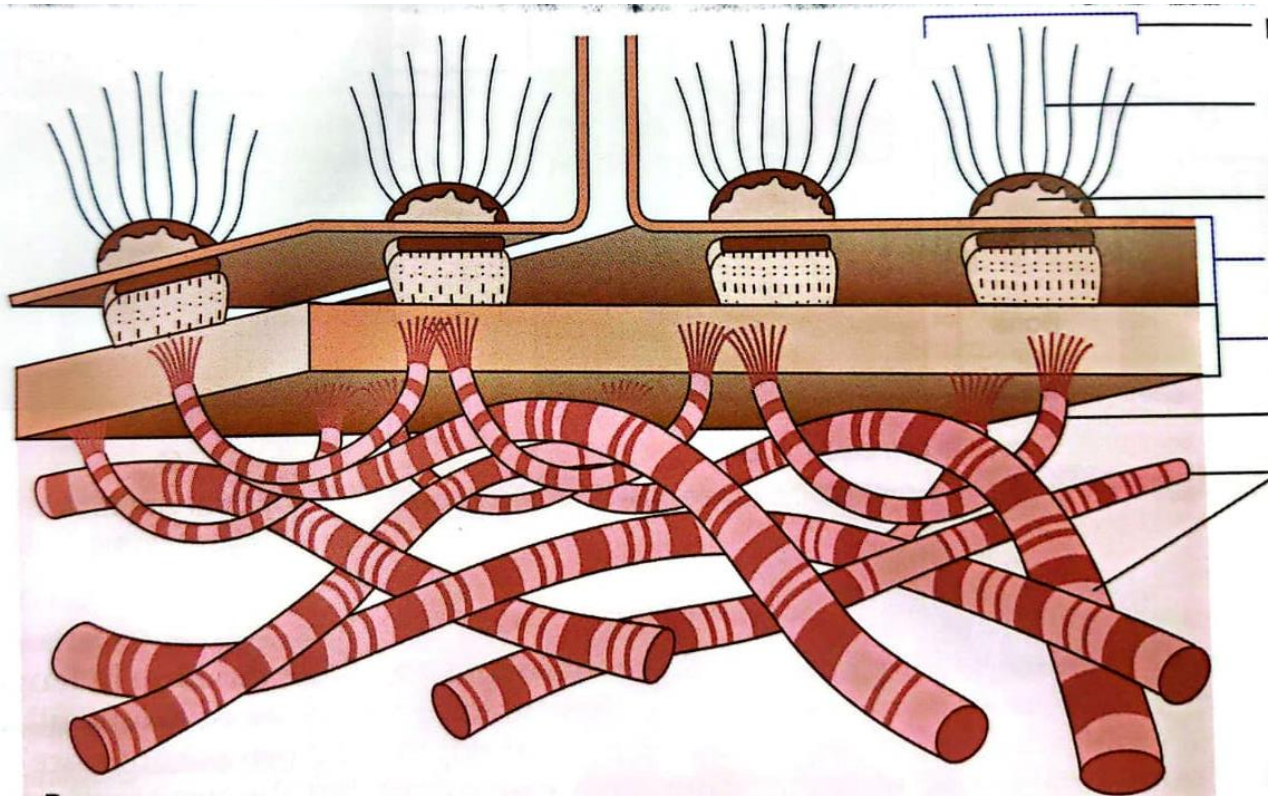
ROOT DEVELOPMENT

Figure



DRAW AND LABEL THE DIAGRAM

BASEMENT MEMBRANE



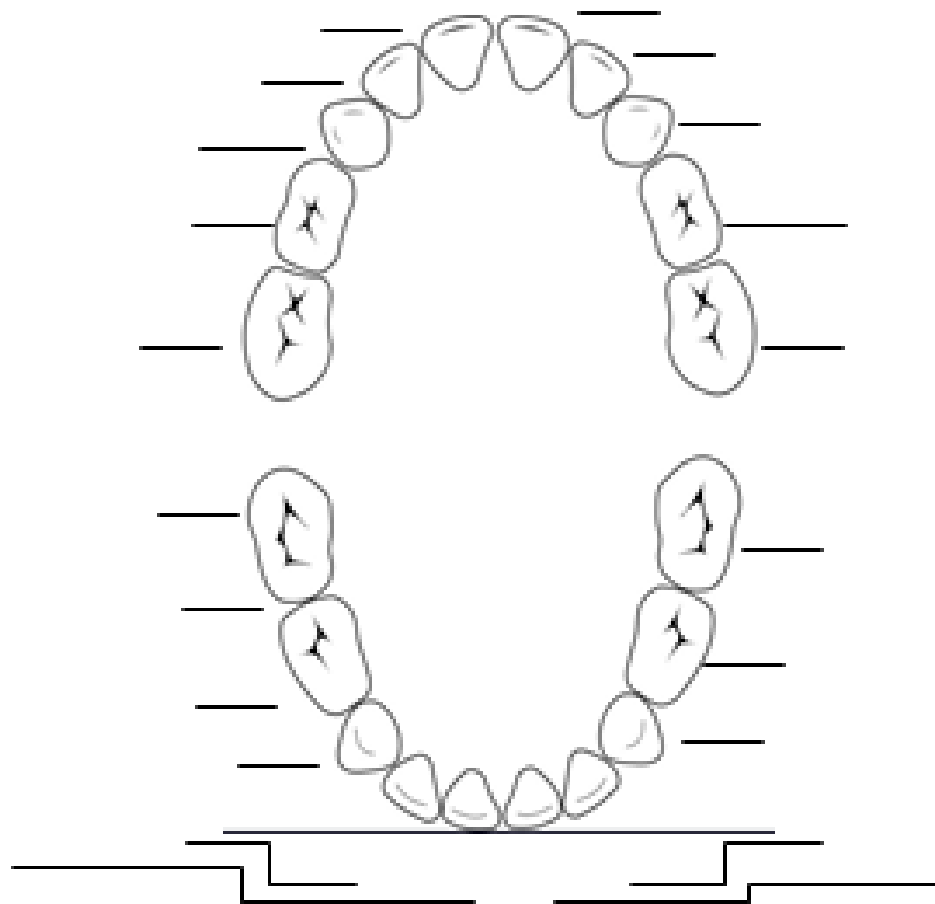
DRAW AND LABEL THE DIAGRAM

LABEL THE DIAGRAM

TOOTH MORPHOLOGY

OVERVIEW OF DENTITIONS

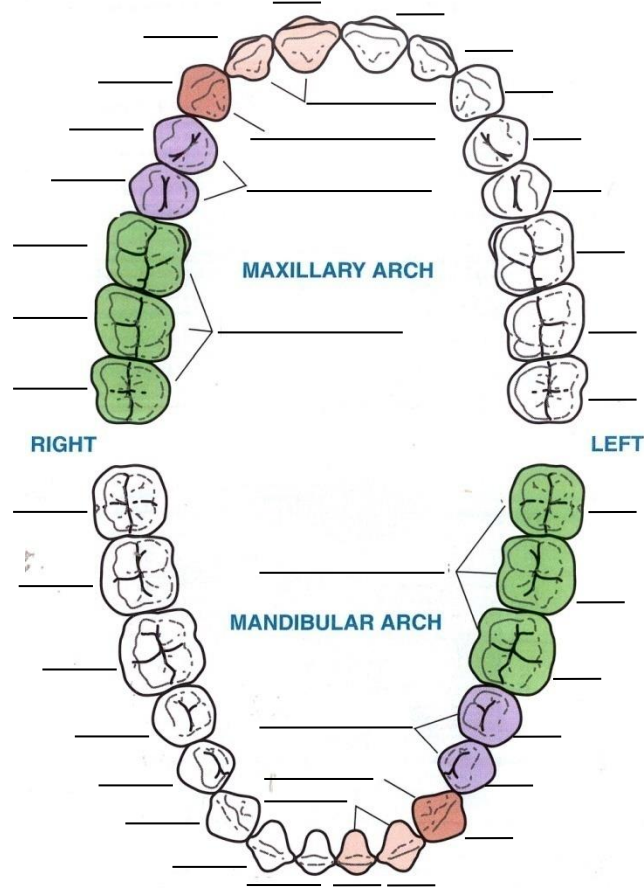
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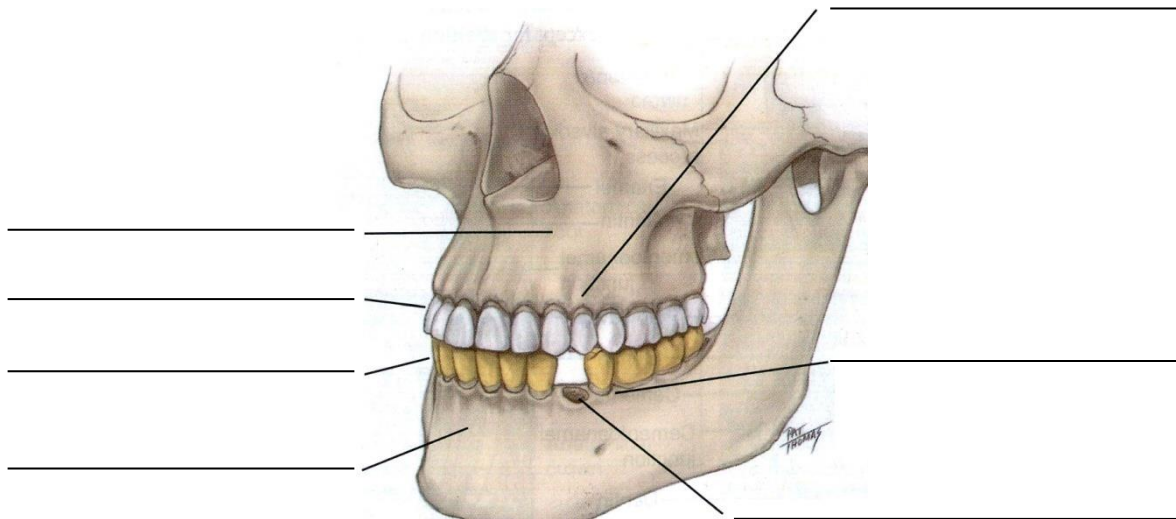
Primary Dentition

LABEL THE DIAGRAM

Figure

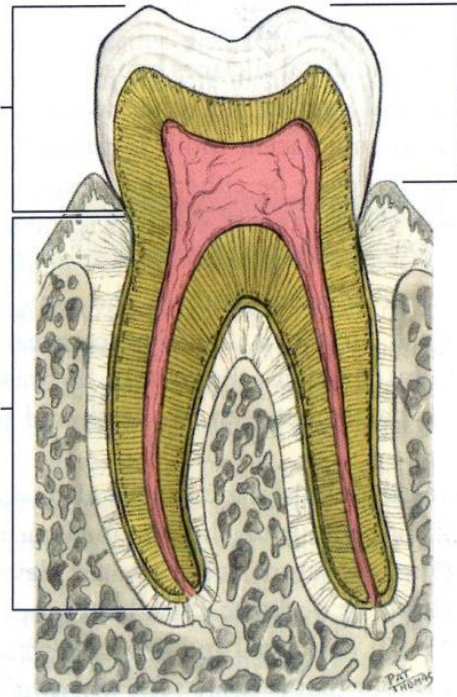


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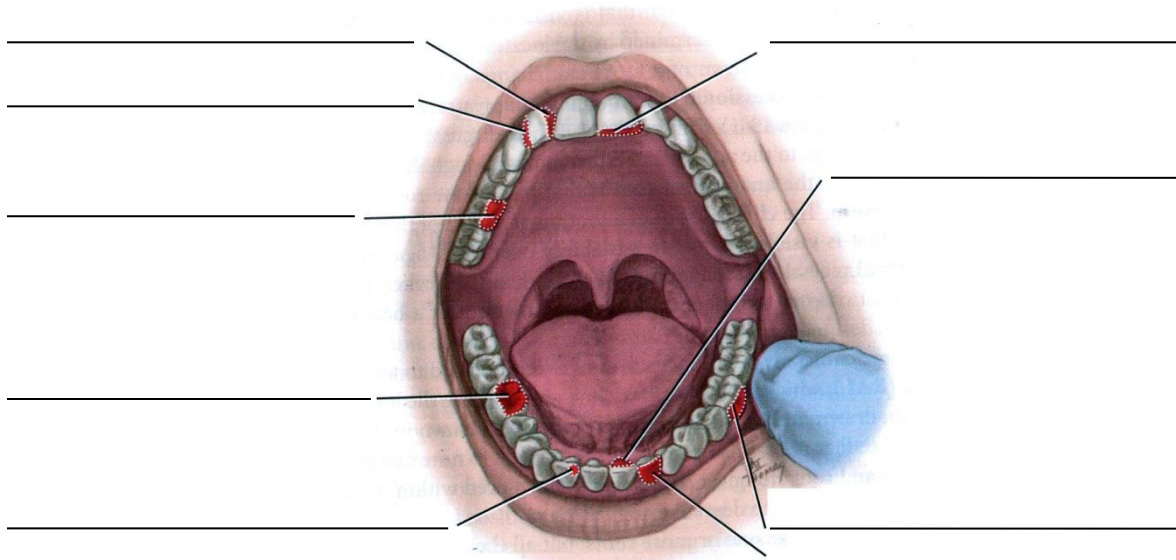


LABEL THE DIAGRAM

Figure



Figure

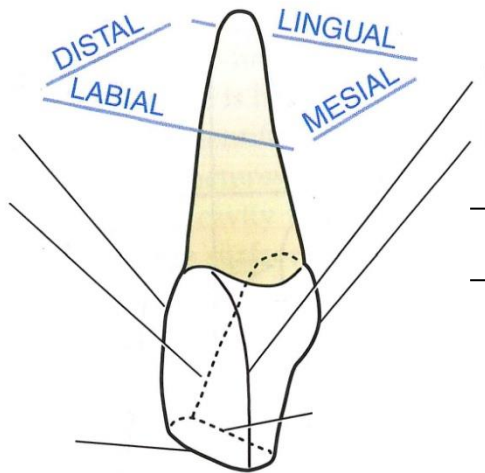


Tooth Surfaces

LABEL THE DIAGRAM

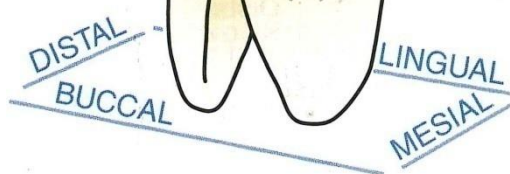
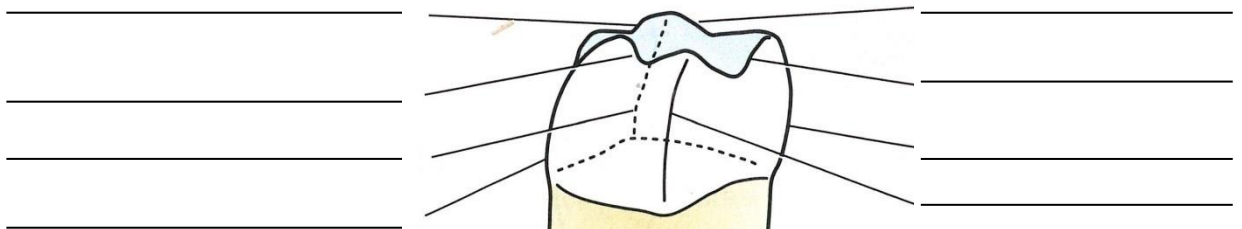
LINE ANGLES
ANGLES

AND POINT



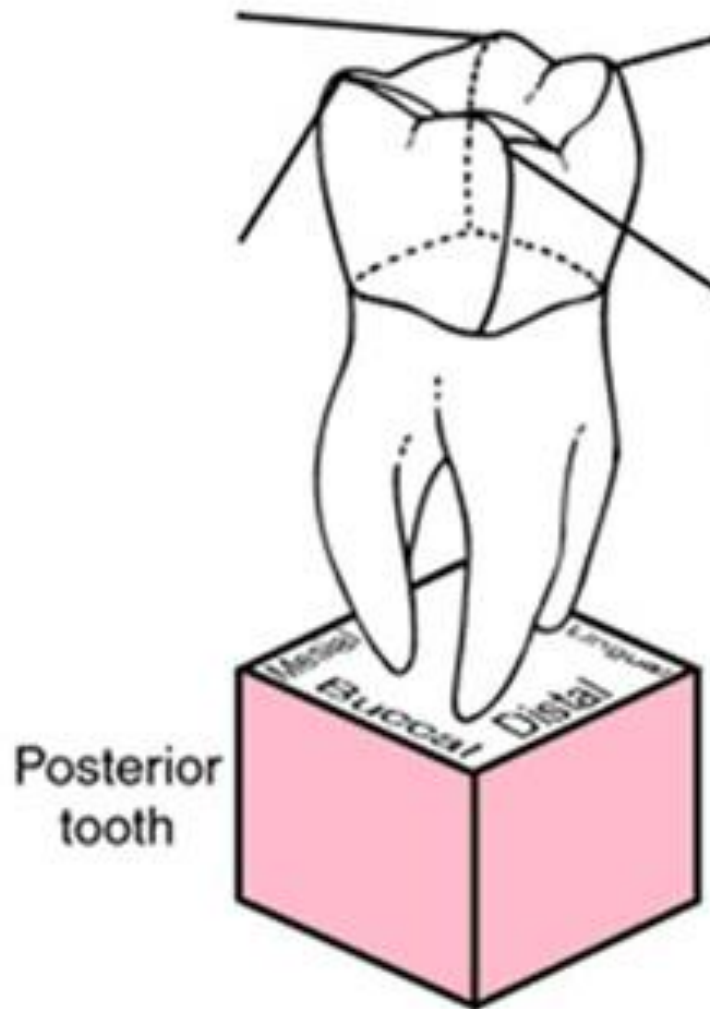
**Anterior Tooth
Line Angles**

Figure



LABEL THE DIAGRAM

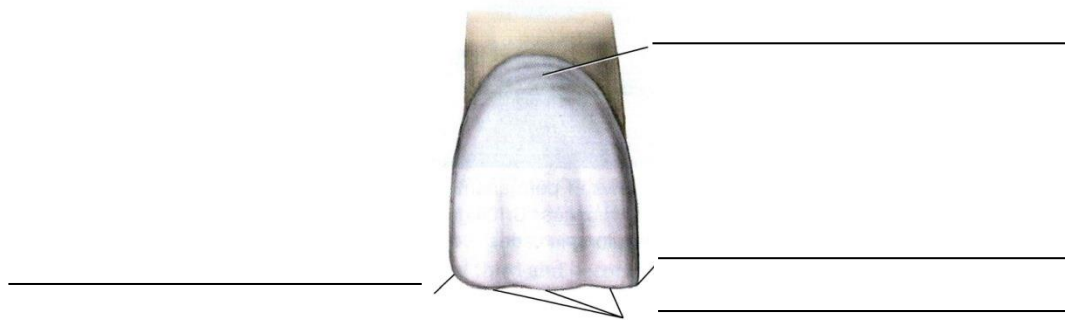
POINT ANGLES



LABEL THE DIAGRAM

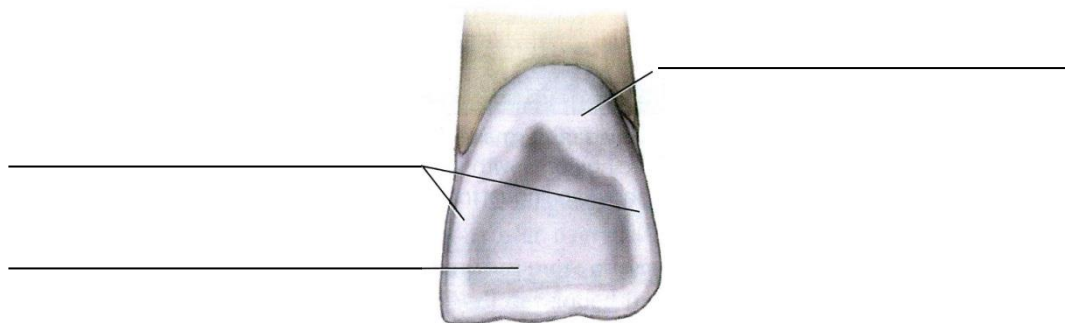
PERMANENT ANTERIOR TEETH

Figure



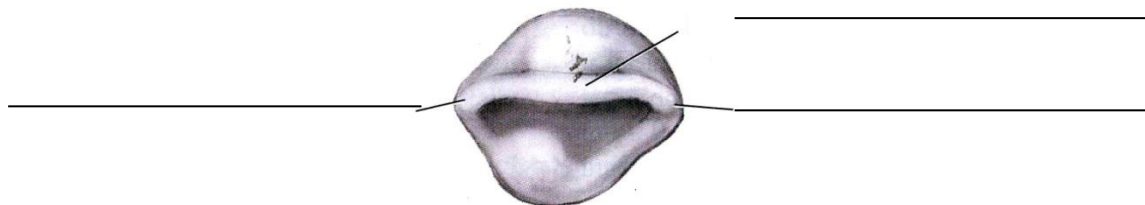
Labial
Permanent Incisor

Figure



Lingual
Permanent Incisor

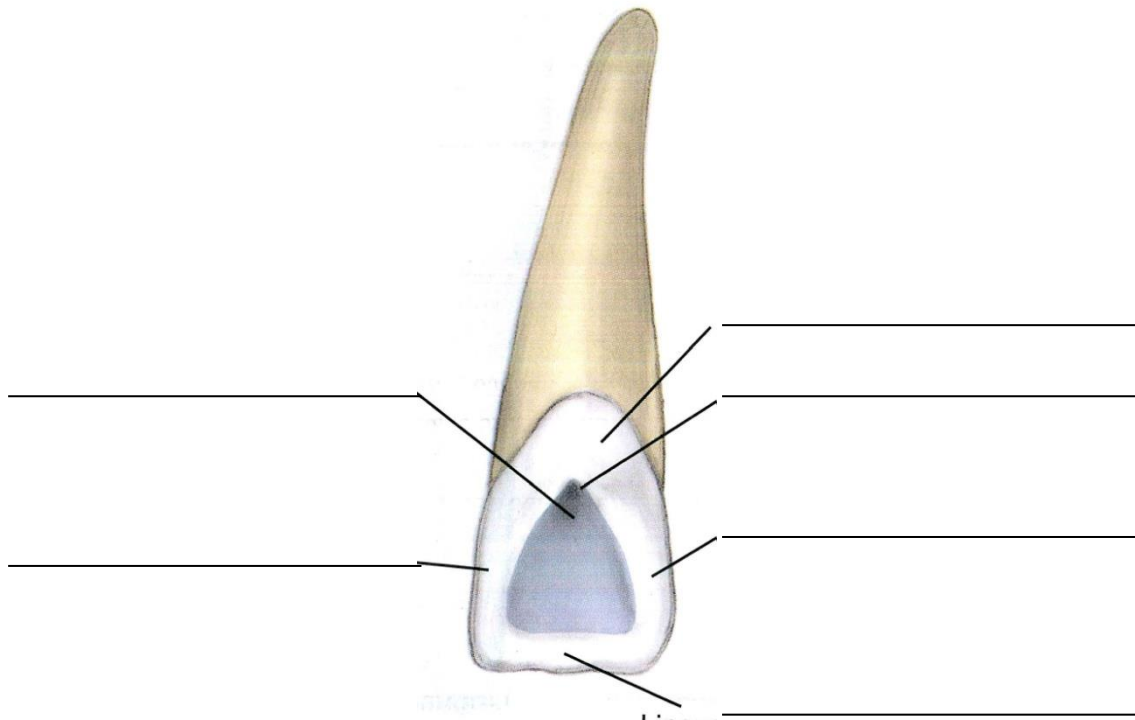
Figure



Incisal

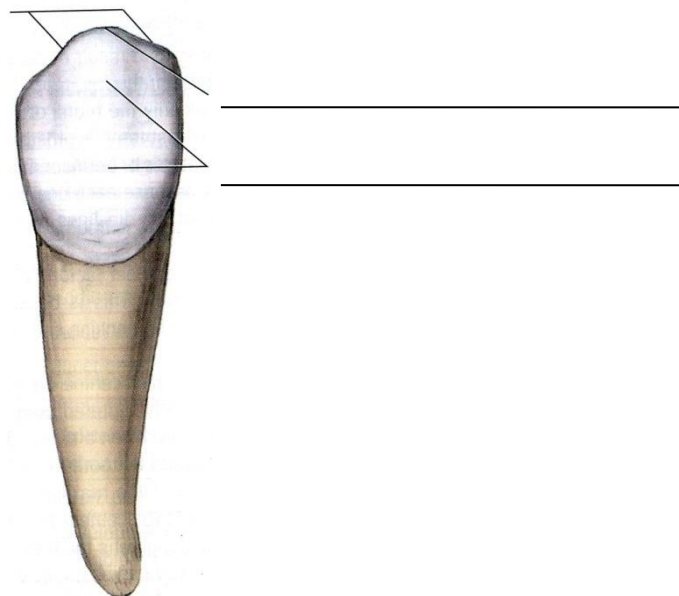
LABEL THE DIAGRAM

Figure



Permanent Maxillary Right Lateral Incisor

Figure



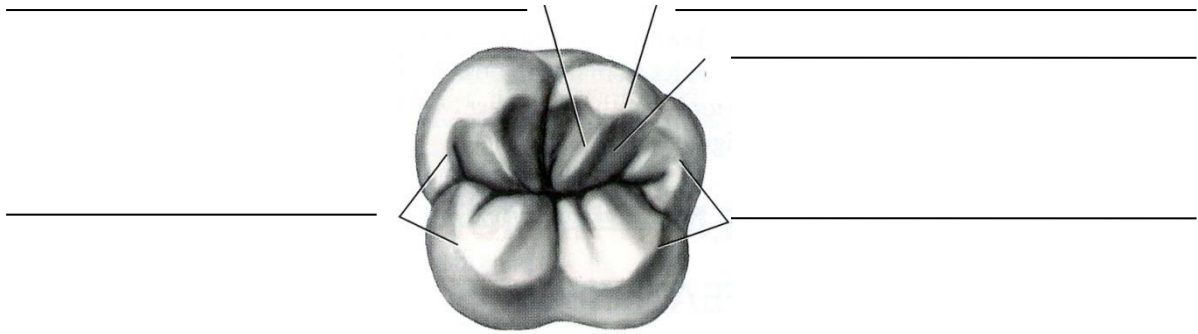
Labial View

Permanent Mandibular Right Canine

LABEL THE DIAGRAM

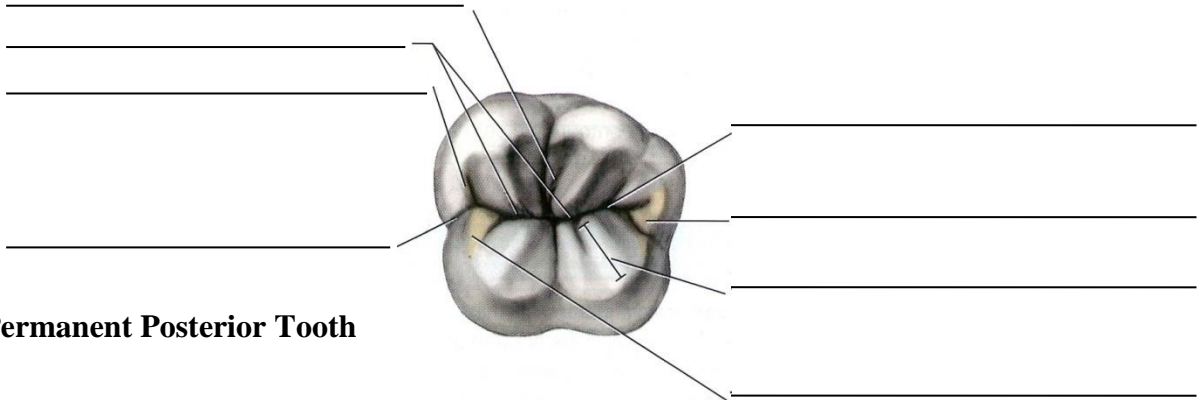
PERMANENT POSTERIOR TEETH

Figure



Permanent Posterior Teeth

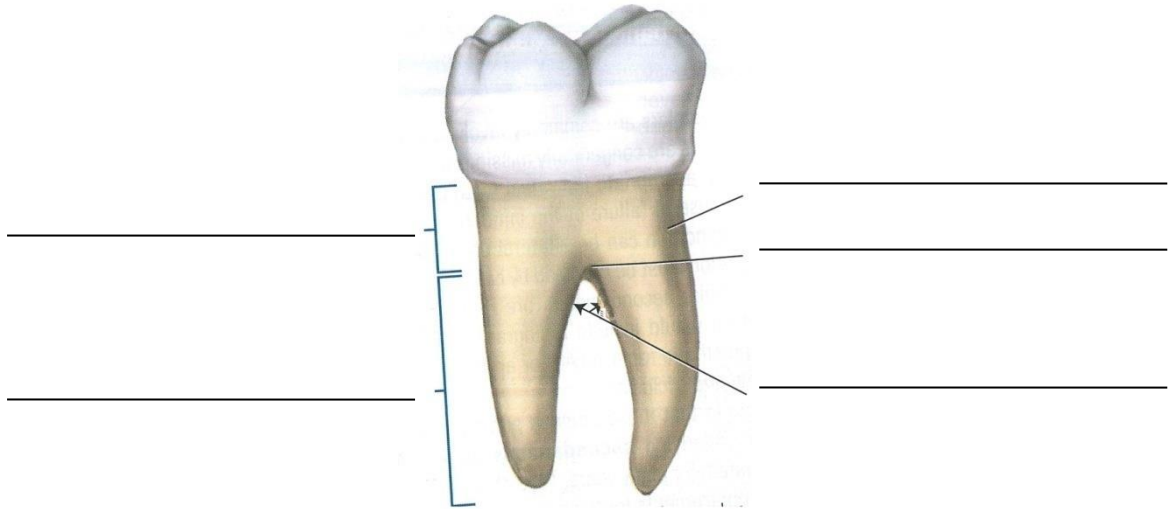
Figure



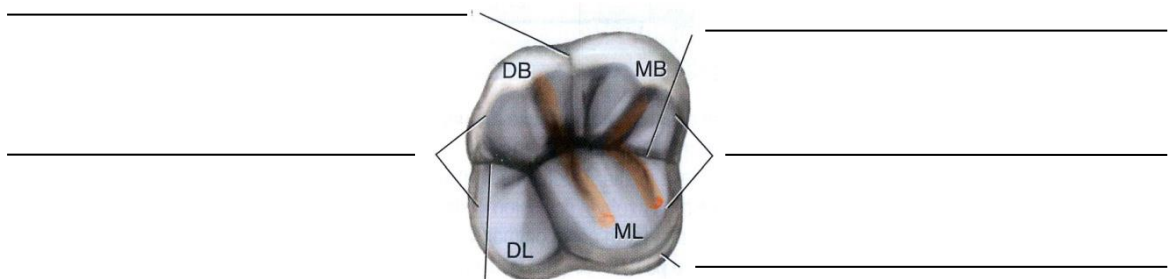
Permanent Posterior Tooth

LABEL THE DIAGRAM

Figure

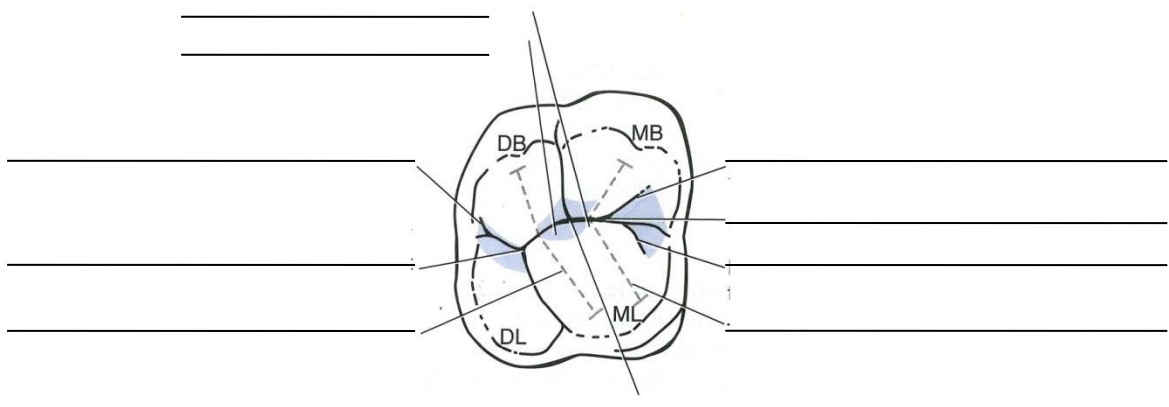


Figure



Permanent Maxillary Right First Motar

Figure



Permanent Maxillary Right First Molar

NUMBERING SYSTEM

Figure

		Molars		Canine	Incisors				Canine	Molars	
Maxillary Arch											
I		A	B	C	D	E	F	G	H	I	J
II		55	54	53	52	51	61	62	63	64	65
III		E	D	C	B	A	A	B	C	D	E
Mandibular Arch											
Right						Left					
III		E	D	C	B	A	A	B	C	D	E
II		85	84	83	82	81	71	72	73	74	75
I		T	S	R	Q	P	O	N	M	L	K

- I Universal Tooth Designation System
- II International Standards Organization Designation System
- III Palmer Notation Method

A

A: Universal Tooth Designation System, International Standards Organization Designation System, and Palmer Notation Method for the primary teeth.

DRAW AND LABEL THE DIAGRAMS

NUMBERING SYSTEM

Figure

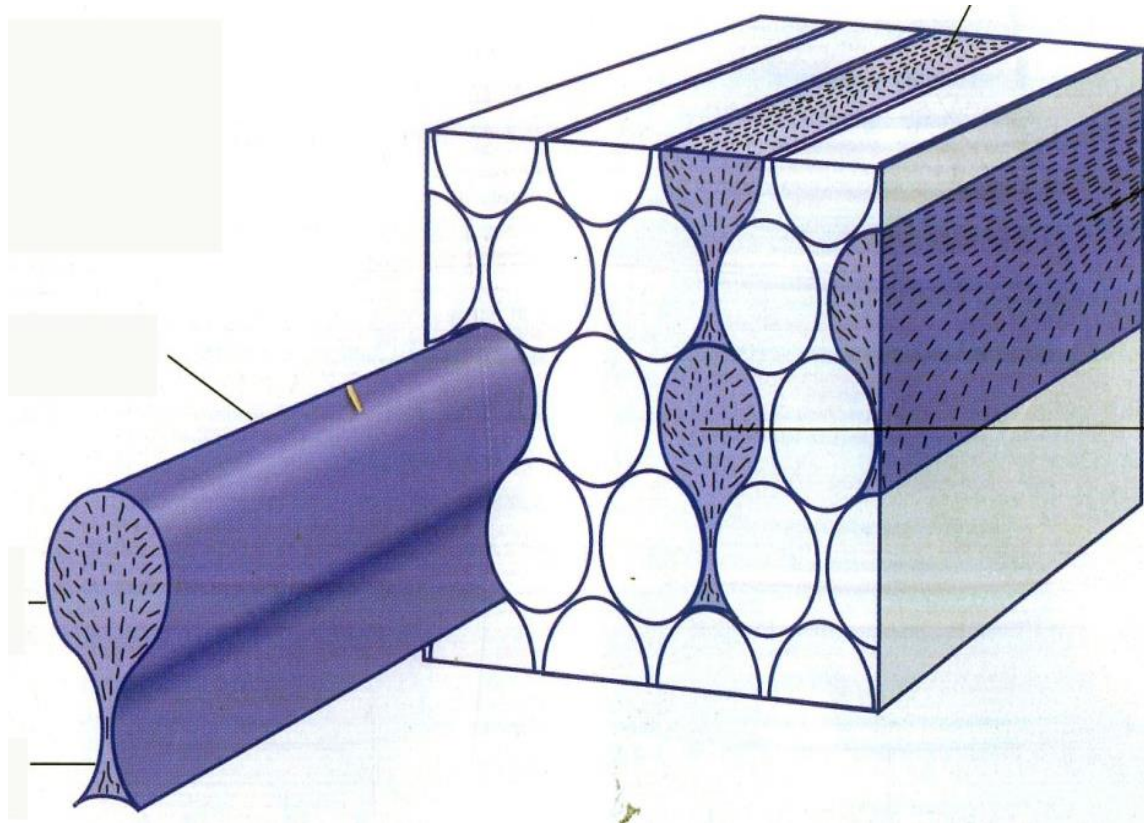
Molars			Premolars		Canine	Incisors		Canine	Premolars		Molars				
Maxillary Arch															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
Mandibular Arch															
Right						Left									
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17

- I Universal Tooth Designation System
- II International Standards Organization Designation System
- III Palmer Notation Method

Universal Tooth Designation System, International Standards Organization Designation System, and Palmer Notation Method for the permanent teeth.

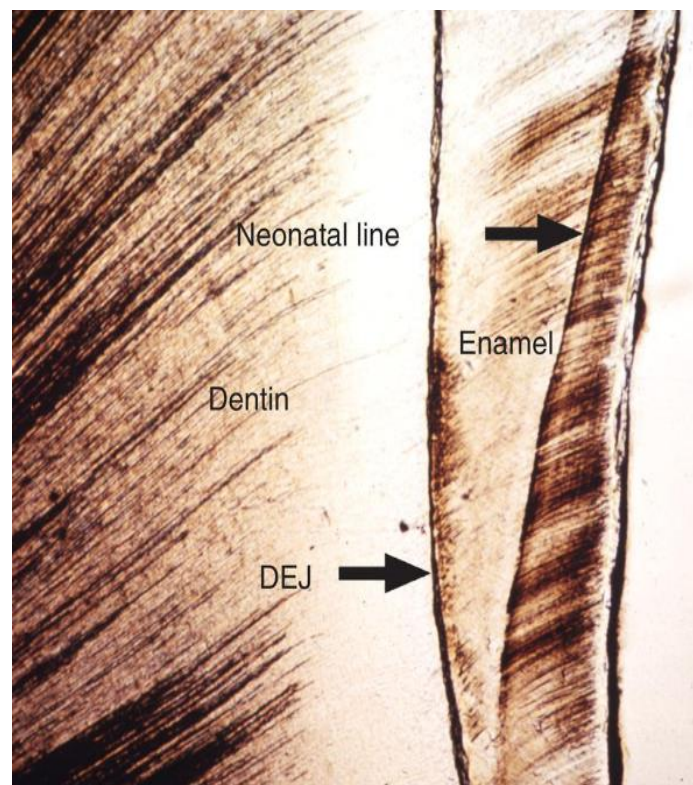
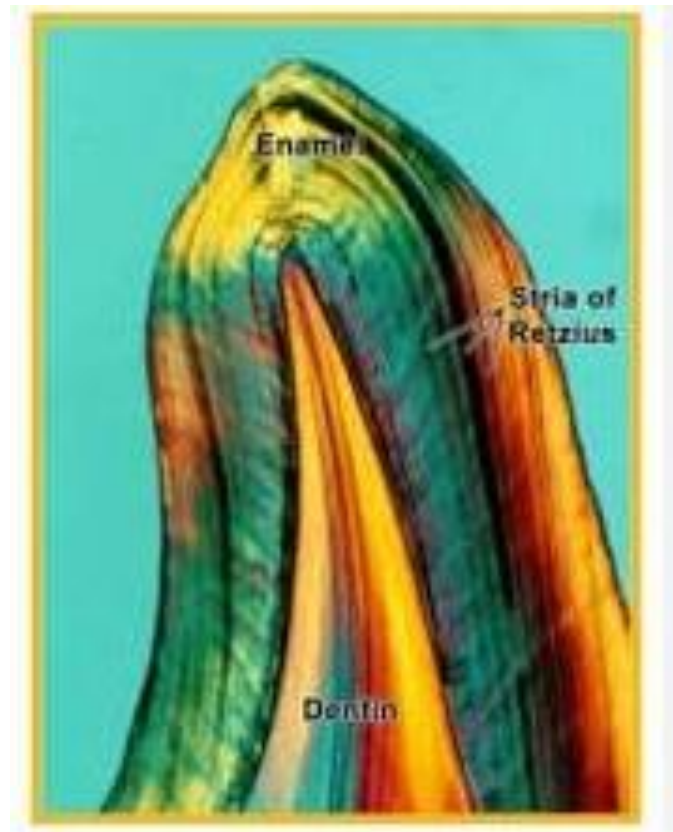
DRAW AND LABEL THE DIAGRAMS

ENAMEL RODS



DRAW AND LABEL THE DIAGRAMS

STRIA OF RETZIUS AND NEONATAL LINE



Briefly Describe Stria of Retzius and Neonatal Line

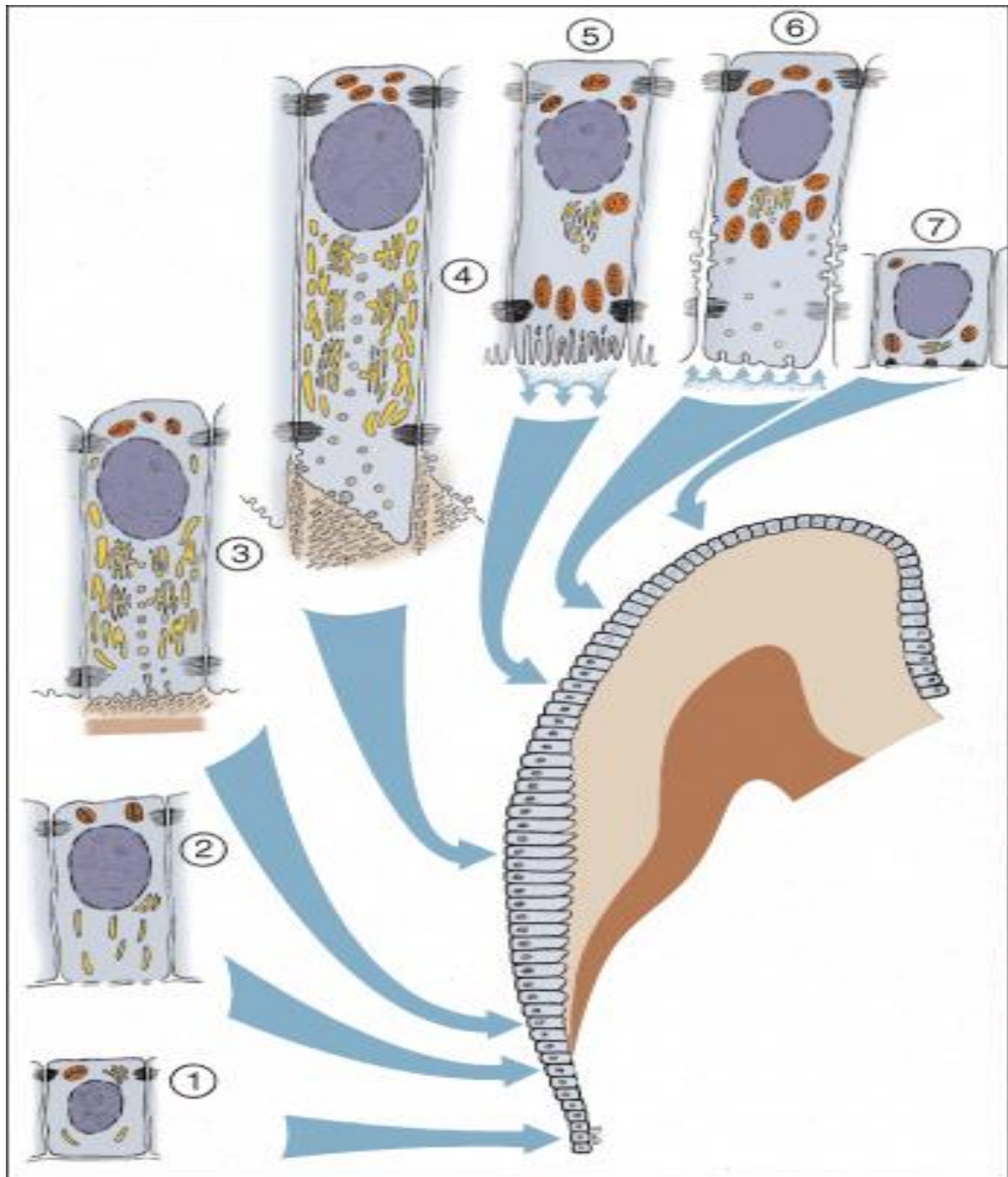
DENTINOENAMAL JUNCTION



DRAW AND LABEL THE DIAGRAM

LIFE CYCLE OF AMELOBLASTS

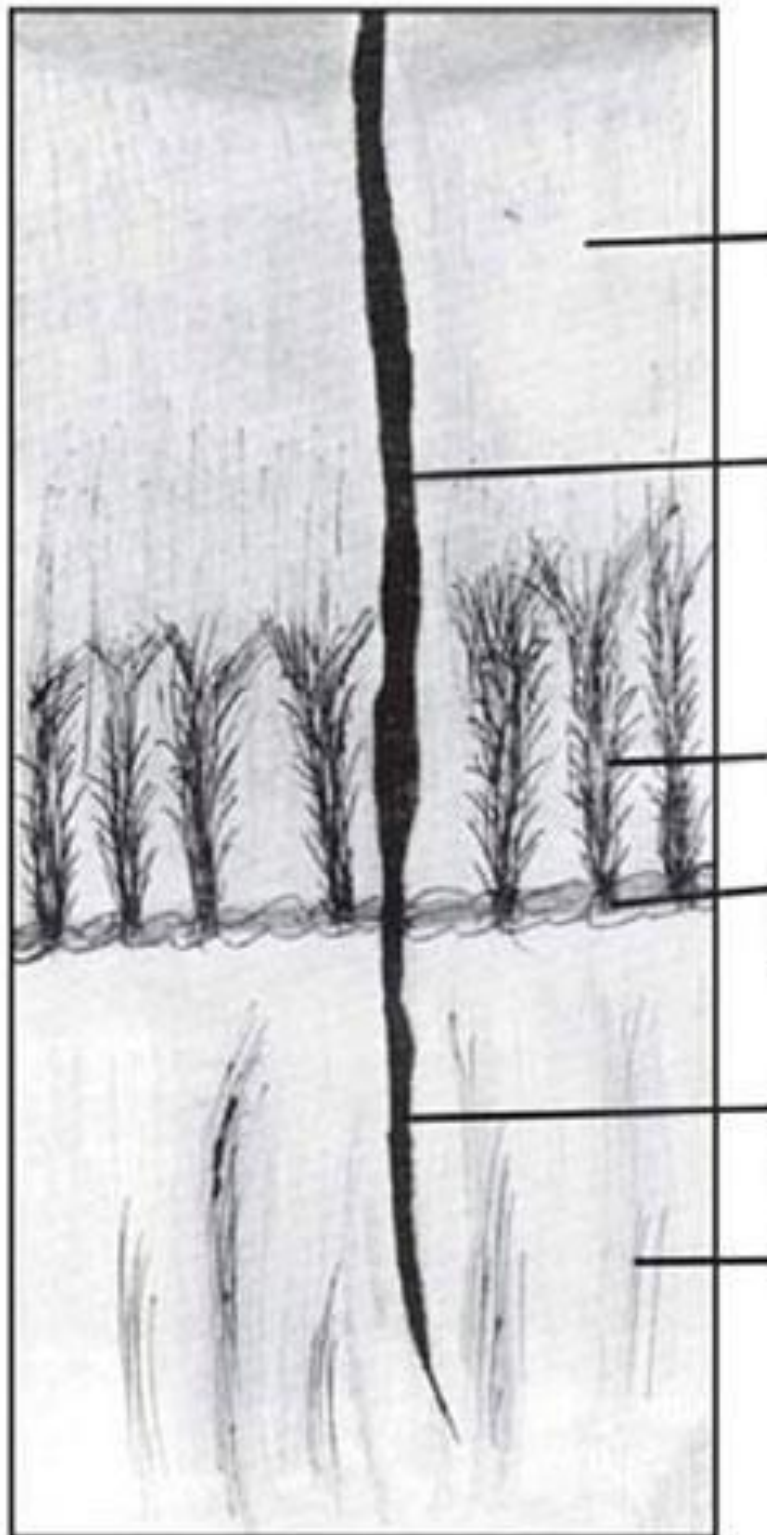
Figure



DRAW AND LABEL THE DIAGRAMS

Q) Write the key events that occur during the stages of lifecycle of ameloblast?

GROUND SECTION OF ENAMEL



DRAW AND LABEL THE DIAGRAMS

Block: A
MODULE 2
BLOOD MODULE

Pulp:

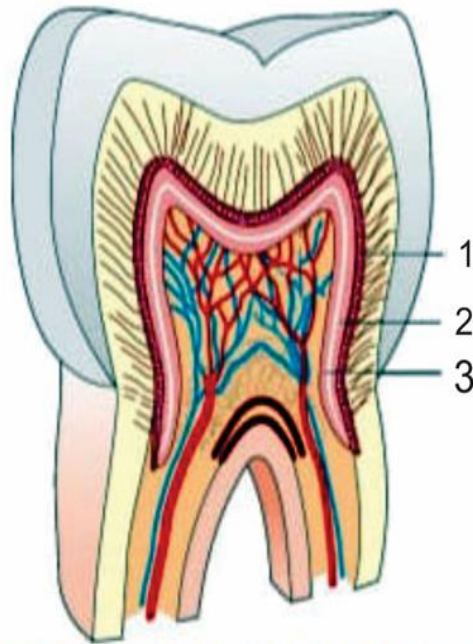


Diagram of pulp organ, illustrating architecture of large central nerve trunks (dark) and vessels (light) and peripheral cell-rich, cell-free, and odontoblast rows. Observe small nerves on blood vessels.

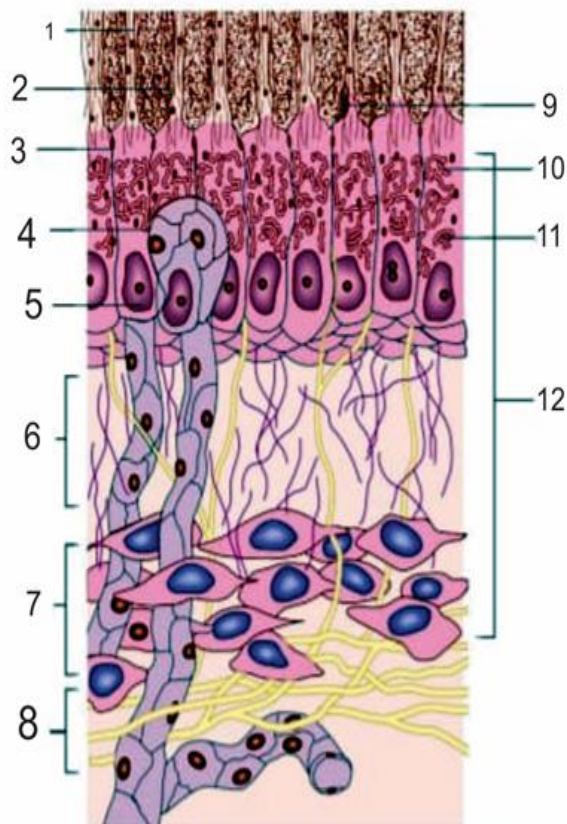
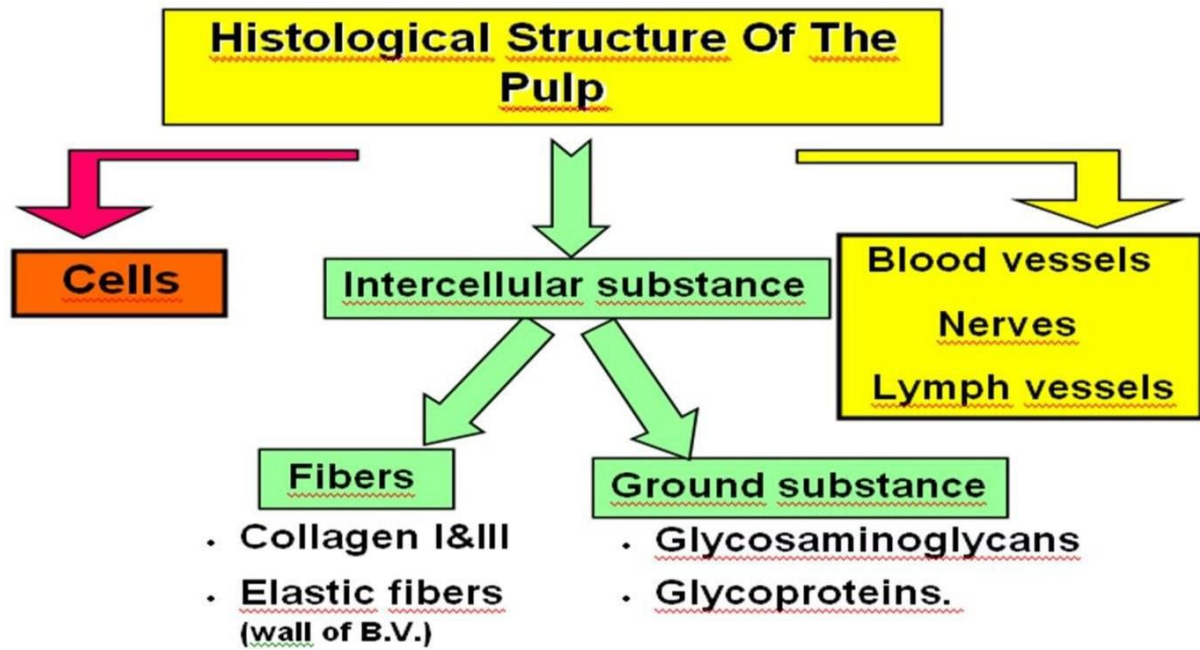


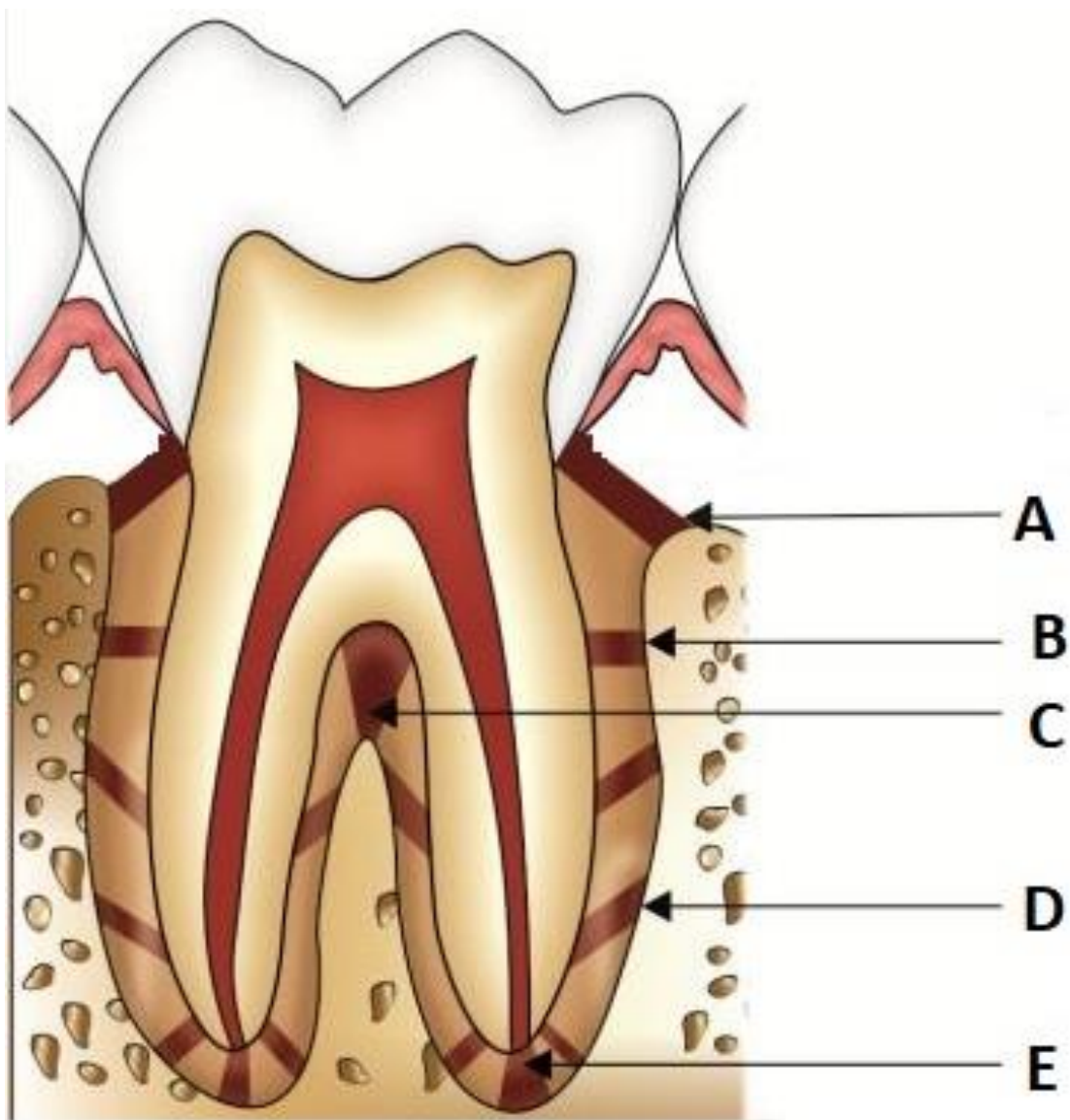
Diagram of odontogenic zone illustrating odontoblast, cell-free, and cell-rich zones, with blood vessels and nonmyelinated nerves among odontoblasts.

DRAW AND LABEL THE DIAGRAMS

HISTOLOGY STRUCTURE OF THE PULP



FIBERS OF PDL



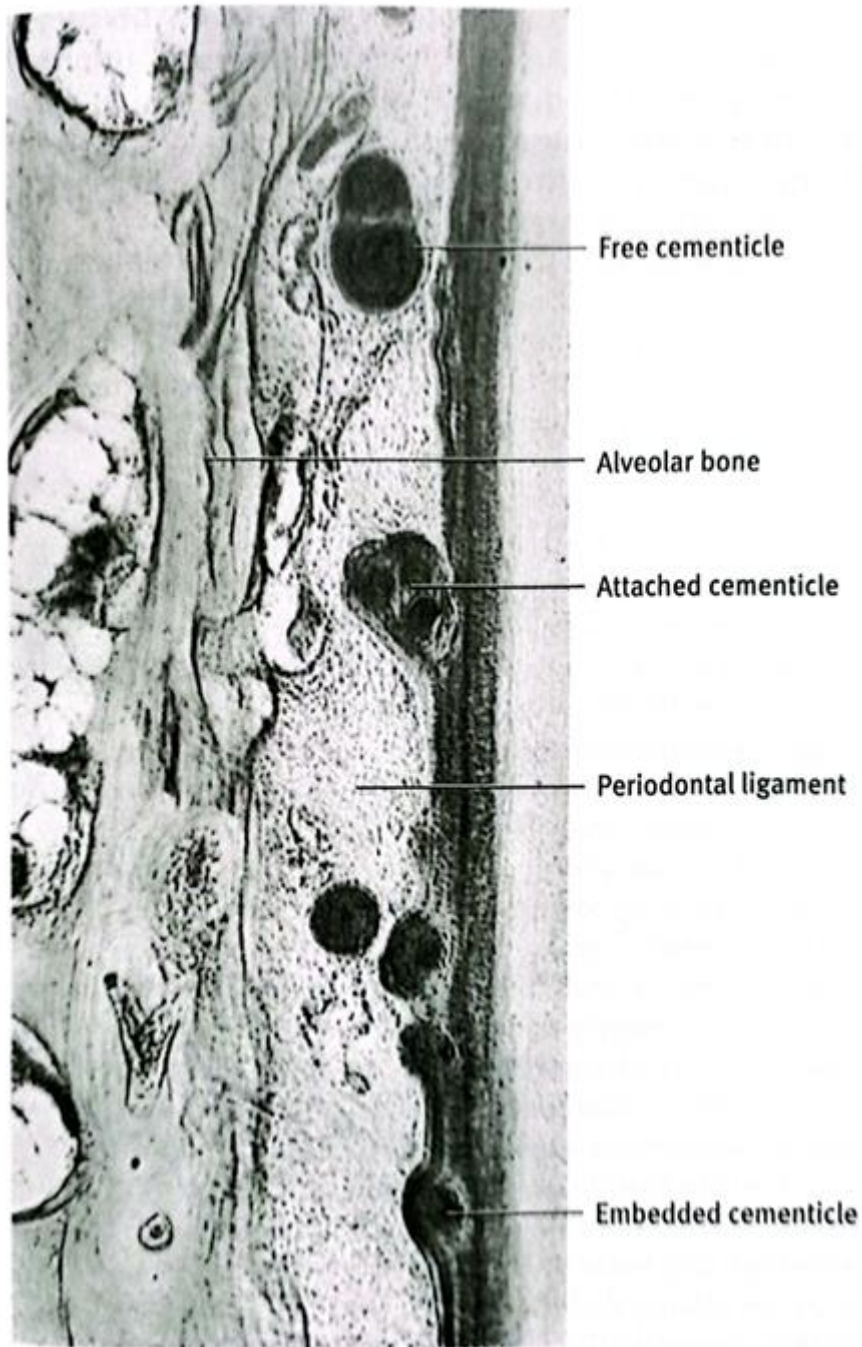
**DRAW AND LABEL THE DIAGRAMS MARKED A, B,
C, D AND E**

PRINCIPLES FIBER OF PERIODONTAL LIGAMENT

Type of Fiber	Origin and Insertion	Function
Alveolar crest group	<ul style="list-style-type: none"> Extend obliquely from cementum just beneath junctional epithelium to alveolar crest Also extend from cementum over the alveolar crest to fibrous layer of periosteum covering alveolar bone 	Resist tilting, intrusive, extrusive and rotational forces
Horizontal group limited to coronal one fourth of pdl space	<ul style="list-style-type: none"> Extend at right angles to the long axis of the tooth from cementum to the alveolar bone and parallel to occlusal plane Gets inserted into alveolar process as Sharpey's fibers 	Resist horizontal and tipping force
Oblique group most numerous and occupy 2/3rd of ligament	Extend into alveolar bone coronal to their attachment to cementum	Resist vertical and intrusive forces
Apical group not seen in incompletely formed roots	Extend from root tip and radiate through the periodontal space into fundus of bony socket	Resist luxation, prevent tooth tipping, protect delicate lymph and blood vessels and nerves traversing the PDL space at the root apex
Interradicular group fibers lost if furcation area is exposed	Extend into cementum from the crest of inter-radicular septum of multirooted teeth	Resist tooth tipping, torque and luxation

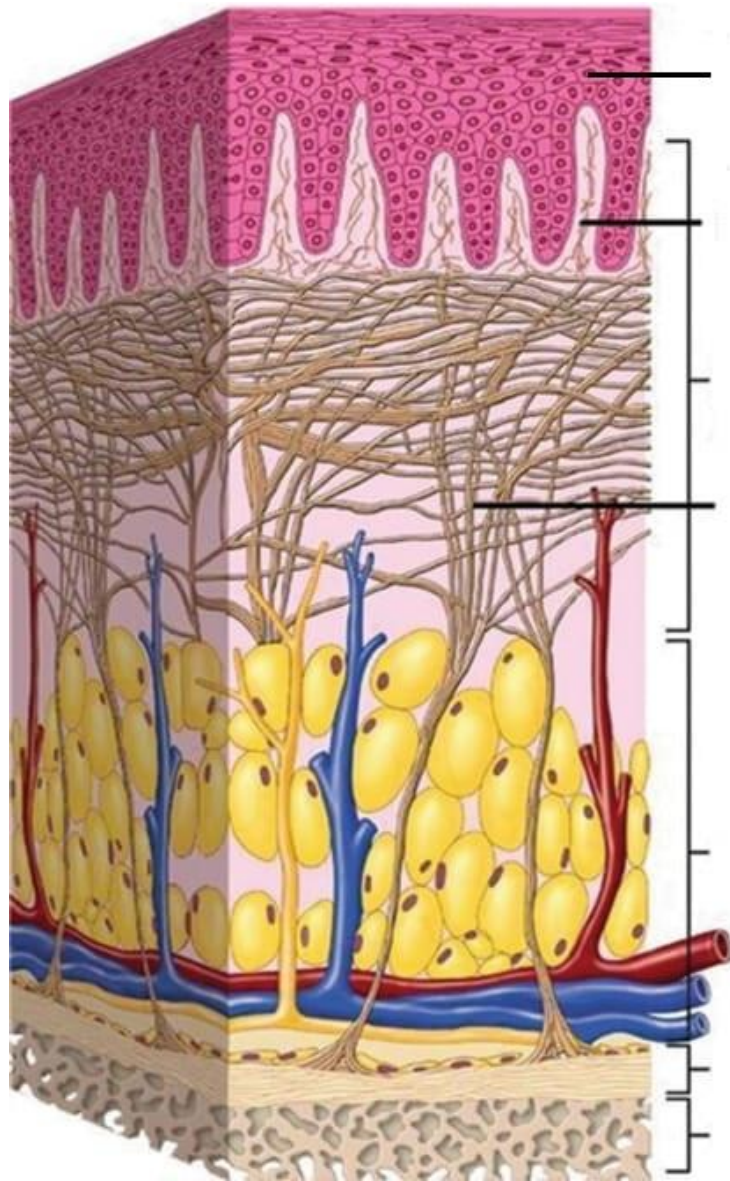
Briefly Describe Functions of Periodontal Ligament.

CEMENTICLES IN PERIODONTAL LIGAMENT



Briefly Describe Cementicles in Periodontal Ligament

STRUCTURE OF ORAL MUCOSA



DRAW AND LABEL THE DIAGRAMS

KERATINIZED / NON-KERATINIZED EPITHELIUM:

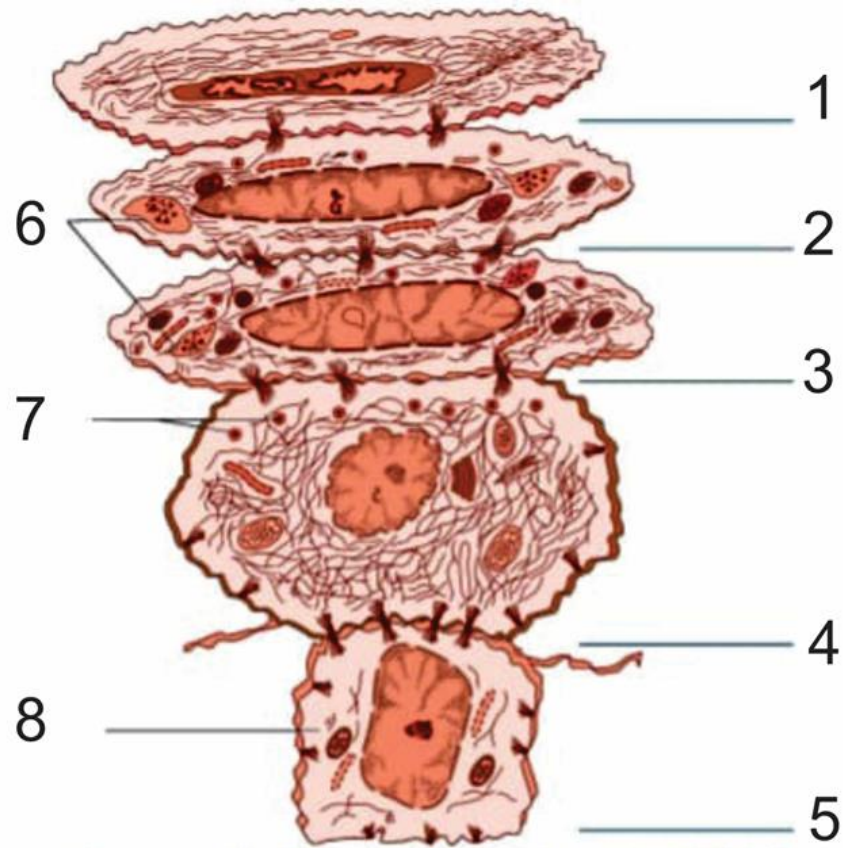


Diagram showing details of the different cell layers of the nonkeratinized epithelium.

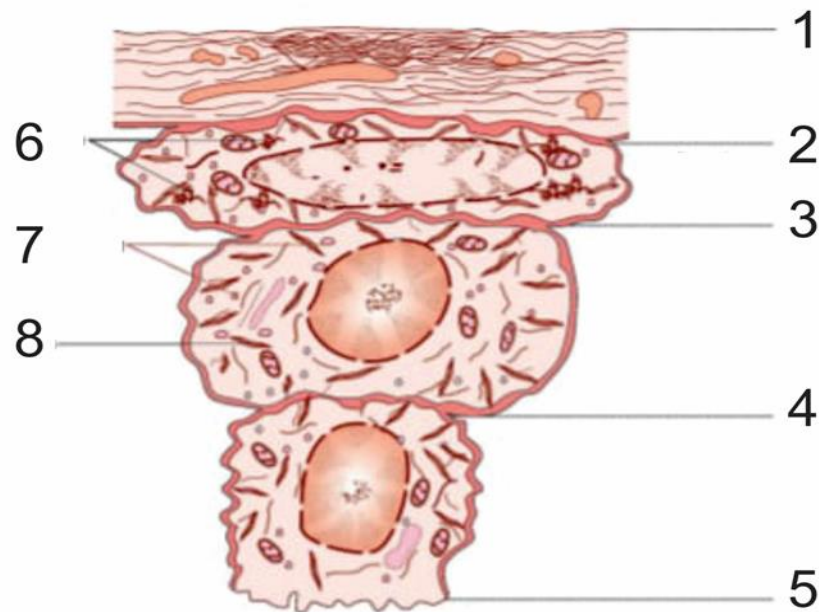


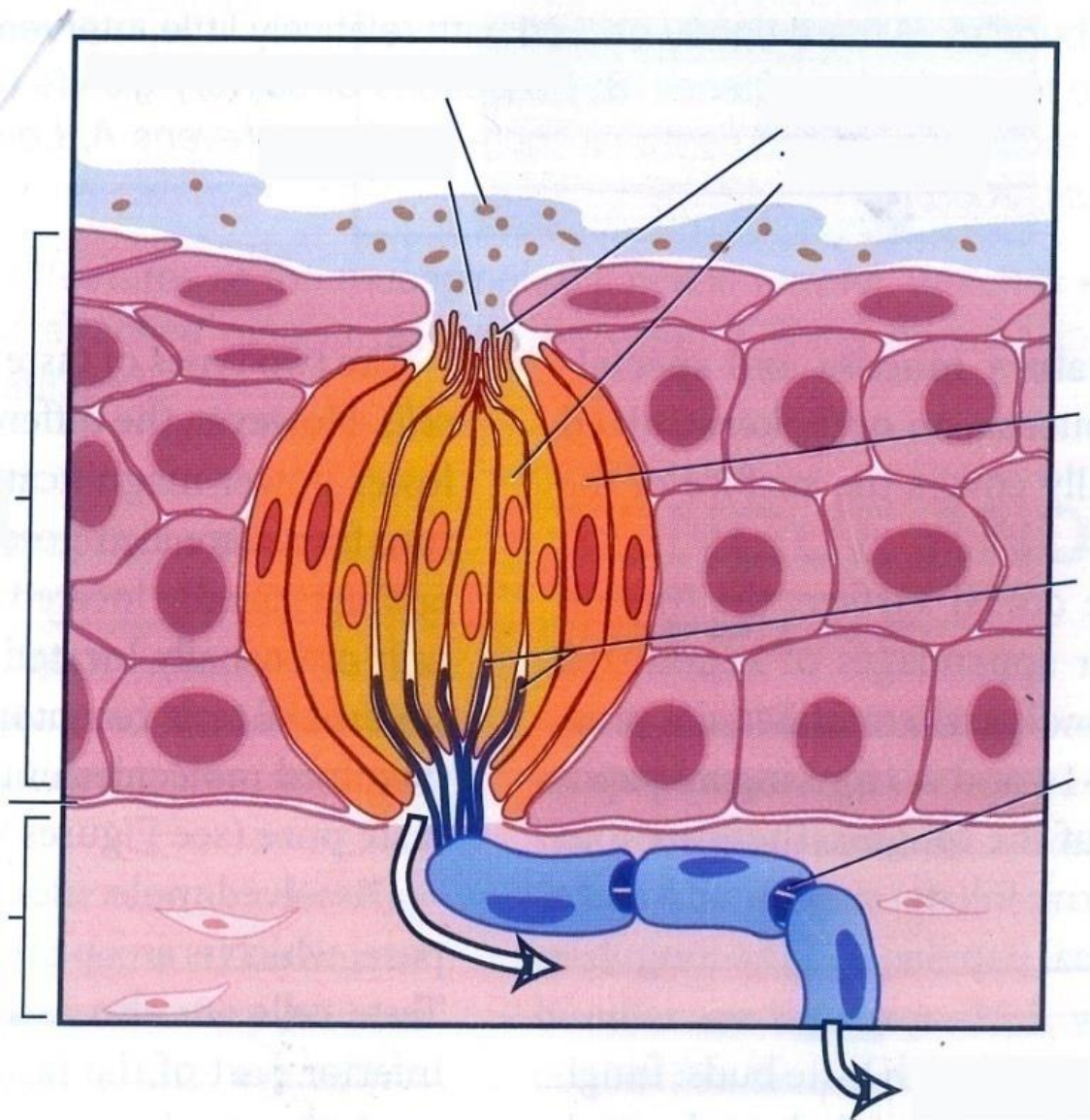
Diagram showing details of the different cell layers of the orthokeratinized epithelium.

DRAW AND LABEL THE DIAGRAMS

Q) Tabulate the differences between keratinized and non-keratinized epithelium.

TASTE BUD AND TASTE

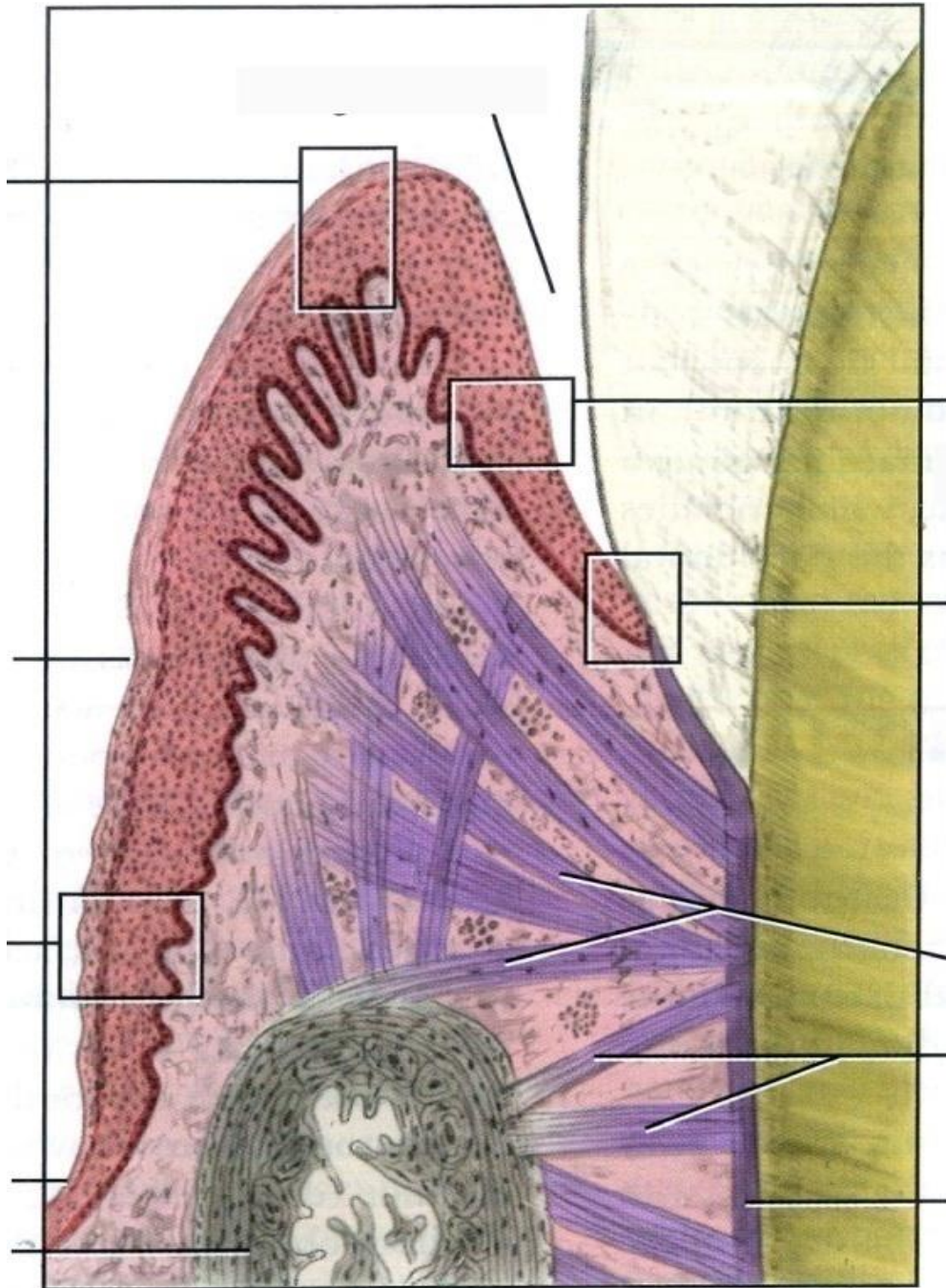
Figure



DRAW AND LABEL THE DIAGRAM

GINGIVAL AND DENTOGINGIVAL JUNCTIONAL TISSUES

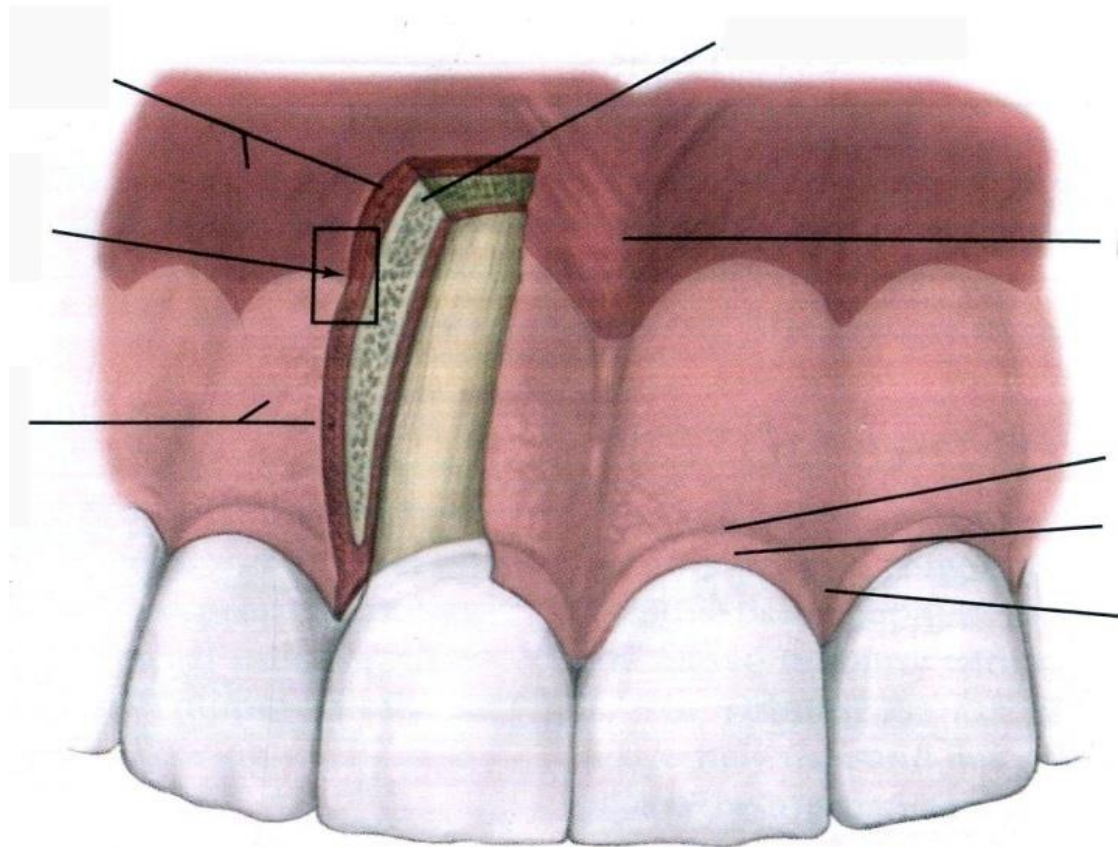
Figure



DRAW AND LABEL THE DIAGRAMS

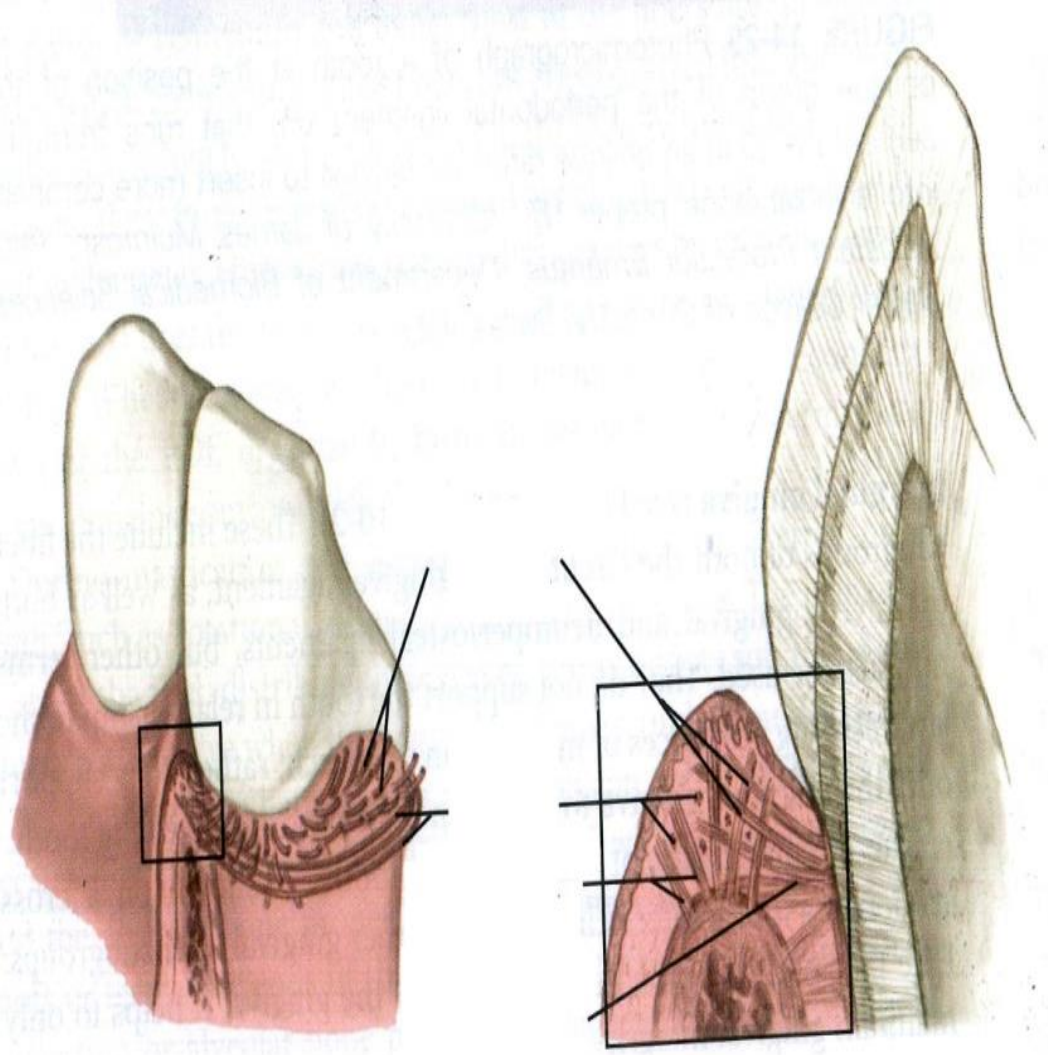
MUCOGINGIVAL JUNCTION

Figure



DRAW AND LABEL THE DIAGRAMS

GINGIVAL FIBER SUBGROUPS

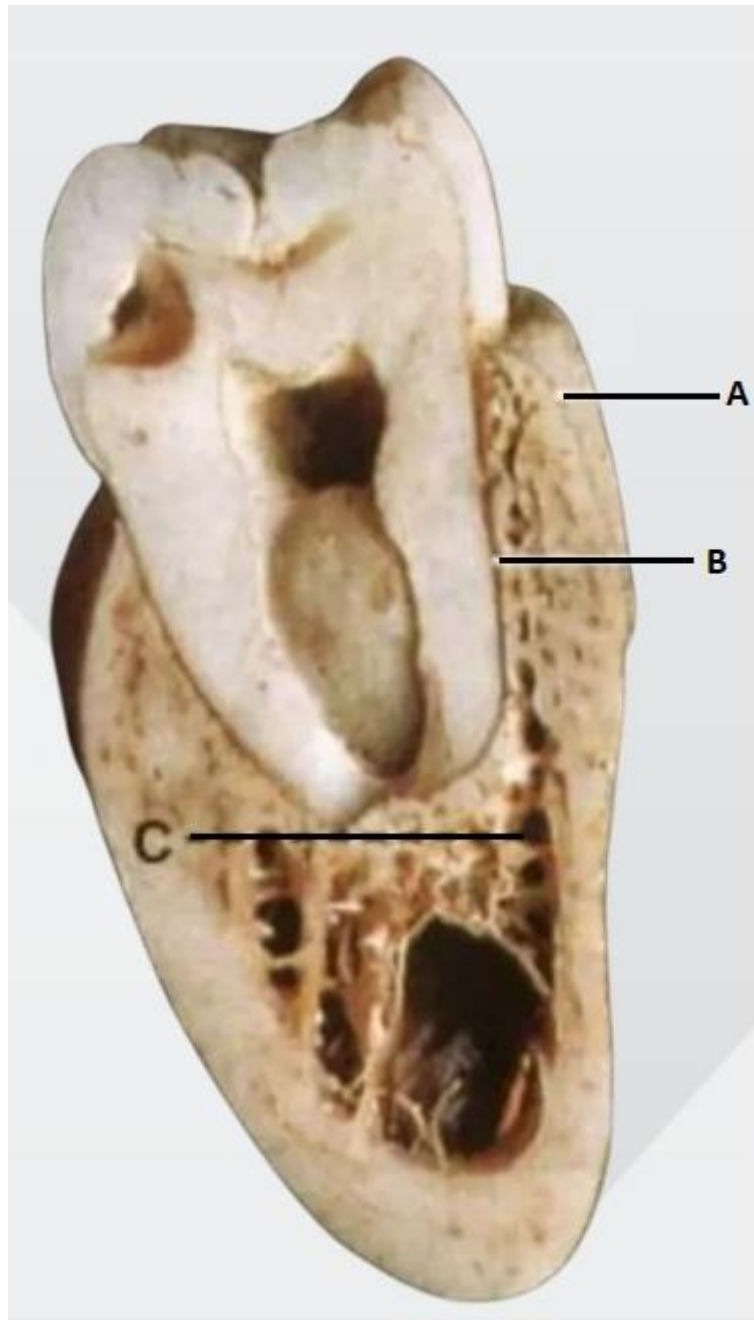


DRAW AND LABEL THE DIAGRAMS

Q) Write the functions of each group of Gingival fibres

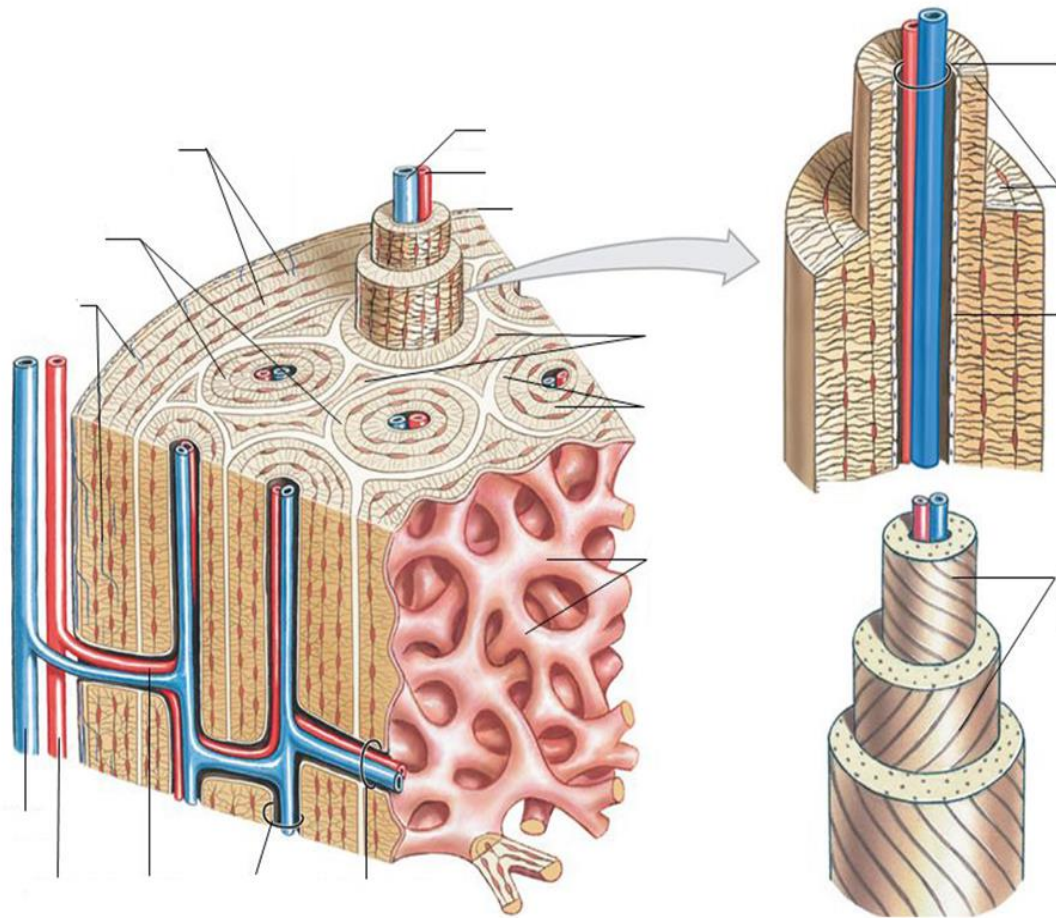
Block: B
MODULE: 3
CRANIOFACIAL MODULE

STRUCTURE OF ALVEOLAR BONE



DRAW AND LABEL THE DIAGRAMS

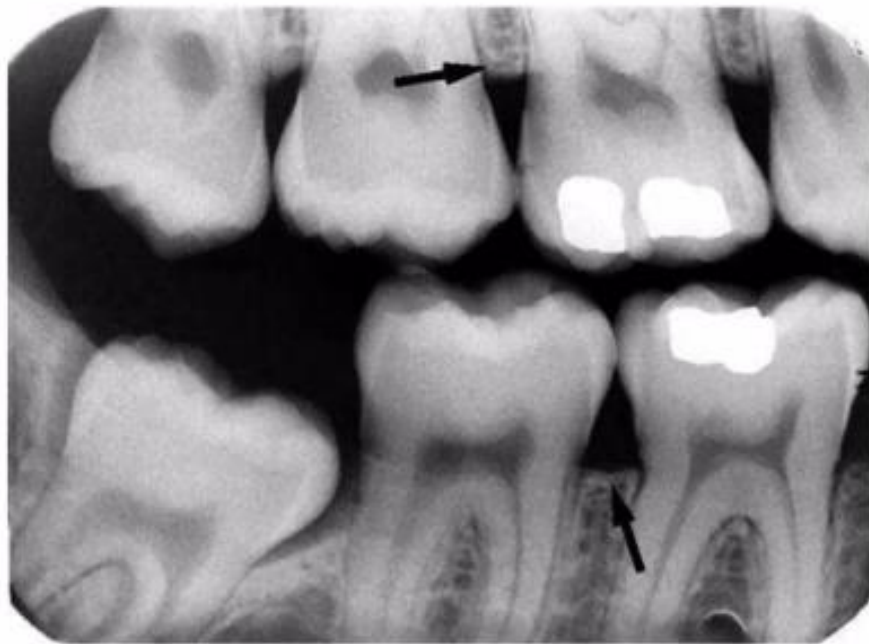
HISTOLOGY OF BONE



a The organization of osteons and lamellae in compact bone

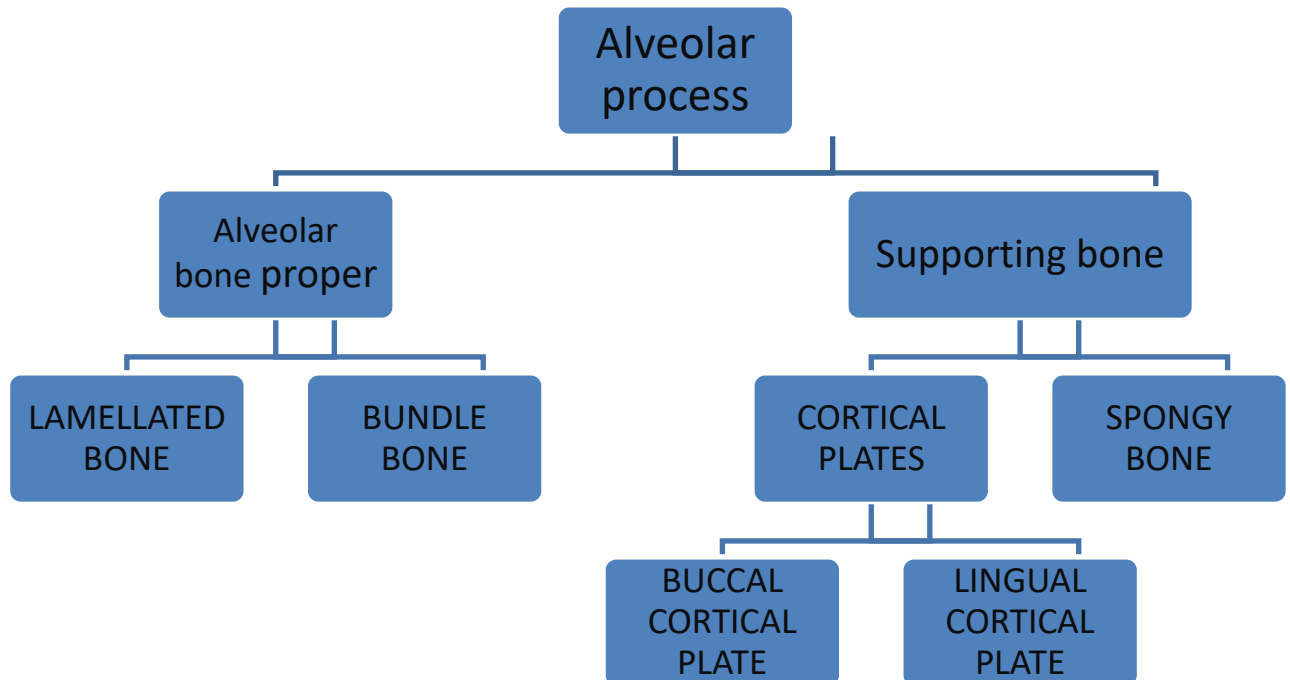
DRAW AND LABEL THE DIAGRAMS

CREST OF THE ALVEOLAR SEPTA (ALVEOLAR CRESTS)



Briefly Describe Crest of the Alveolar Septa (Alveolar Crests)

THE HISTOLOGY OF ALVEOLAR BONE AND REGULATORY FACTORS IN BONE REMODELING



SYSTEMIC FACTORS

1.) HORMONES

- a.) Decrease bone resorption
 - Calcitonin
 - Estrogen
- b.) Increase bone resorption
 - PTH
 - Glucocorticoids
 - Vitamin D (high doses)
- c.) Increase bone formation
 - Growth hormone
 - Vitamin D
 - Insulin
 - Low dose PTH
- d.) Decrease bone formation
 - Glucocorticoids

LOCAL FACTORS

- a.) Growth Factors
 - IGF I & II
 - TGF β
 - FGF
 - PGDF
- b.) Cytokines
 - IL- 1, IL- 6, IL- 11
 - PGE₂

FUNCTIONS OF ALVEOLAR BONE

- Houses the roots of teeth.
- Anchors the roots of teeth to the alveoli, which is achieved by the insertion of Sharpey's fibers into the alveolar bone proper.
- Helps to move the teeth for better occlusion.
- Helps to absorb and distribute occlusal forces generated during tooth contact.
- Supplies vessels to periodontal ligament.
- Houses and protects developing permanent teeth, while supporting primary teeth.
- Organizes eruption of primary and permanent teeth.

GUIDE LINES FOR DRAWING OF TEETH ACCORDING TO ITS MORPHOLOGY

Introduction

Tooth-drawing assignments emphasize fundamental principles in tooth design, which later have direct practical application in clinical coursework of a dental professional. Initial drawings are most likely to be the student's first attempts at capturing any tooth likeness; they will certainly encourage accuracy and discernment of the teeth and hopefully facilitate the recognition of tooth details. *Artistic inclinations are not really needed with these basic technical drawings.*

It is important to also note that these drawings are only two-dimensional and are somewhat limited to fundamental outlines and proportions. However, they will serve to help create mental pictures of teeth in their ideal or composite state. Remember that real specimens in patients' mouths vary considerably.

Activity Steps

1. Locate the two, blank gridded worksheets in the workbook. Any additional gridded worksheets needed can be easily copied for the correct spacing of the grid needed. Correctly label the worksheet at the bottom of the page with the tooth that will be drawn as shown in the smaller professionally drawn figures.
2. Using the attached table of tooth dimensions (same as in the associated textbook's appendices), mark off the overall peripheral tooth measurements for each of the gridded view boxes of the tooth. Note that the grid of the blank worksheet is larger than that shown with the professionally drawn tooth outlines to better enable the student to have room to work. Each square of grid equals 1 mm, so count off as many squares for each peripheral dimension (such as the mesiodistal diameter) as indicated from the table onto the proper area of the gridded worksheet.
3. To establish crown and root proportions, divide each gridded view box into two parts corresponding to these two dimensions, except for the incisal/occlusal view.
4. To indicate the height of contour, locate the approximate area of contact between the adjacent teeth and the area of greatest convexity on the labial/buccal, lingual/mesial, and distal surfaces as mentioned in the associated textbook.
5. To locate the root axis line (RAL), draw a line that exactly bisects the overall gridded box showing the overall crown and root measurements. The cementoenamel junction (CEJ) will then be bisected by the RAL. The root apex may or may not be located on this RAL, depending on the tooth's apex traits.
6. To locate the center of the cingulum or midpoint of the incisal edge, divide the crown and root (if included in that particular gridded view box) into imaginary thirds. Then place the root apex, cingulum, or incisal edge into proper perspective with respect to the other peripheral overall tooth dimensions such as the mesiodistal diameter.
7. To complete the crown outline, connect the heights of contour to the incisal/occlusal edge, to the CEJ, and to the other heights of contour. Any additional anatomical features such as mamelons, lobes, marginal ridges, depressions, and so forth, can be indicated upon completion of the crown outline.
8. To complete the root outline, follow the directions for developing the crown outline with the understanding that the cervical one third to one half of the root width generally approximates the cervical width of the crown before it starts to narrow considerably to form the root apex.
9. Shading or stippling of the features may now be added, if desired. An evaluation form for the drawings for use by both the student and instructor is also included in the workbook. Multiple copies of the form may be copied if needed.

DIMENSIONS OF PERMANENT MAXILLARY LATERAL INCISOR*	
Cervico-incisal Length of Crown	9.0
Length of Root	13.0
Mesiodistal Diameter of Crown	6.5
Mesiodistal Diameter of CEJ	5.0
Labiolingual Diameter	6.0
Labiolingual Diameter of CEJ	5.0
Curvature of CEJ—Mesial	3.0
Curvature of CEJ—Distal	2.0

*In millimeters; adapted from Nelson SJ: *Wheeler's Dental Anatomy, Physiology, and Occlusions*, ed 9, WB Saunders, Philadelphia, 2009.

CEJ = cements enamel junction

CHECKLIST FOR PERMANENT MAXILLARY LATERAL INCISOR	
Features Noted	Features Present
Crown Features	
Incisal edge, mamelons, centered and narrow cingulum, deep lingual fossa, pronounced marginal ridges, and linguoincisor ridge	
Sharper MI incisal angle, rounder DI angle, and more pronounced mesial CEJ curvature	
Height of contour in cervical third	
Mesial contact is just cervical to the junction of occlusal and middle thirds	
Distal contact is at middle third or junction with incisal third	
Root Features	
Single rooted, overall conical shape, root curve to the distal, with sharp apex	
No proximal root concavities and the same or longer than central, yet thinner	

CEJ = cements enamel junction; DI = distoincisor; MI = mesioincisor

DIMENSIONS OF PERMANENT MAXILLARY CENTRAL INCISOR*	
Cervico-incisal Length of Crown ✓	10.5
Length of Root ✓	13.0
Mesiodistal Diameter of Crown ✓	8.5
Mesiodistal Diameter of CEJ	7.0
Labiolingual Diameter	7.0
Labiolingual Diameter of CEJ	6.0
Curvature of CEJ—Mesial	3.5
Curvature of CEJ—Distal	2.5

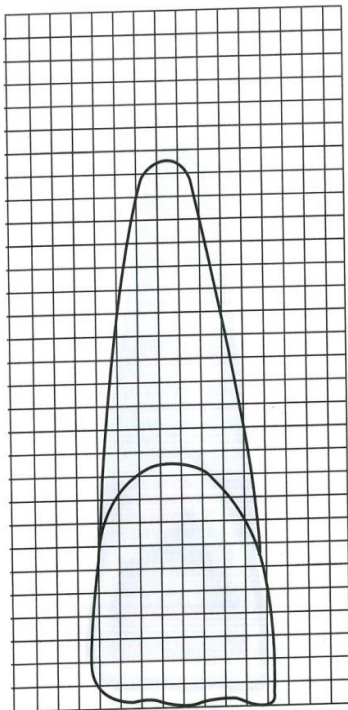
*In millimeters; adapted from Nelson SJ: *Wheeler's Dental Anatomy, Physiology, and Occlusions*, ed 9, WB Saunders, Philadelphia, 2009.

CEJ = cementoenamel junction

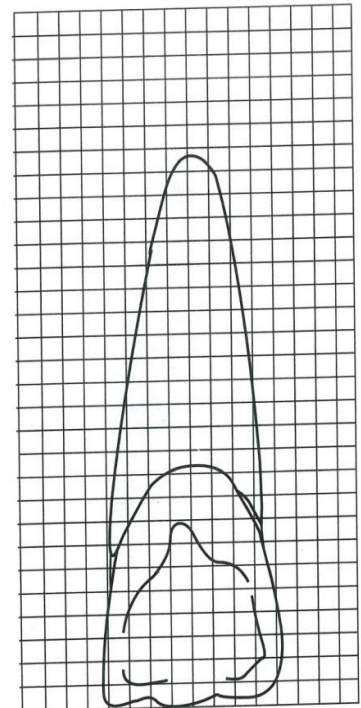
CHECKLIST FOR PERMANENT MAXILLARY CENTRAL INCISOR	
Features Noted	Features Present
Crown Features	
Incisal edge, mamelons, distal offset cingulum, wide and shallow lingual fossa, longer mesial than distal marginal ridges, and linguoincisor edge	
Sharper MI incisal angle, rounder DI angle, and more pronounced mesial CEJ curvature	
Height of contour in cervical third	
Mesial contact is just cervical to the junction of occlusal and middle thirds	
Distal contact is at junction of incisal and middle thirds	
Root Features	
Single rooted, overall conical shape, rounded apex	
No proximal root concavities	

CEJ = cementoenamel junction; DI = distoincisor; MI = mesioincisor

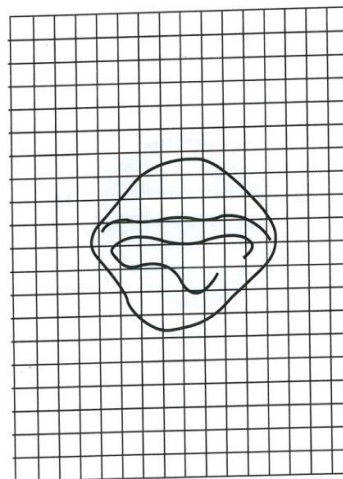
MAXILLARY CENTRAL INCISOR



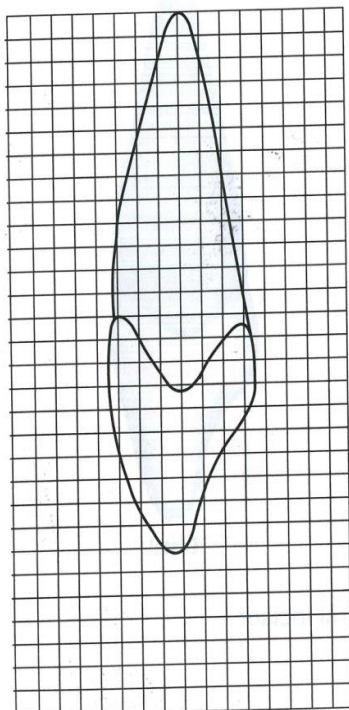
Labial



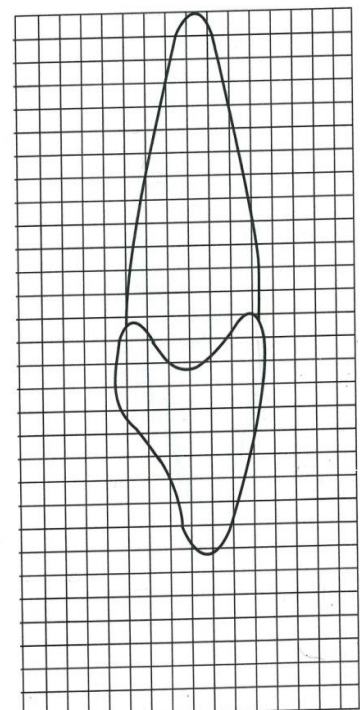
Lingual



Incisal

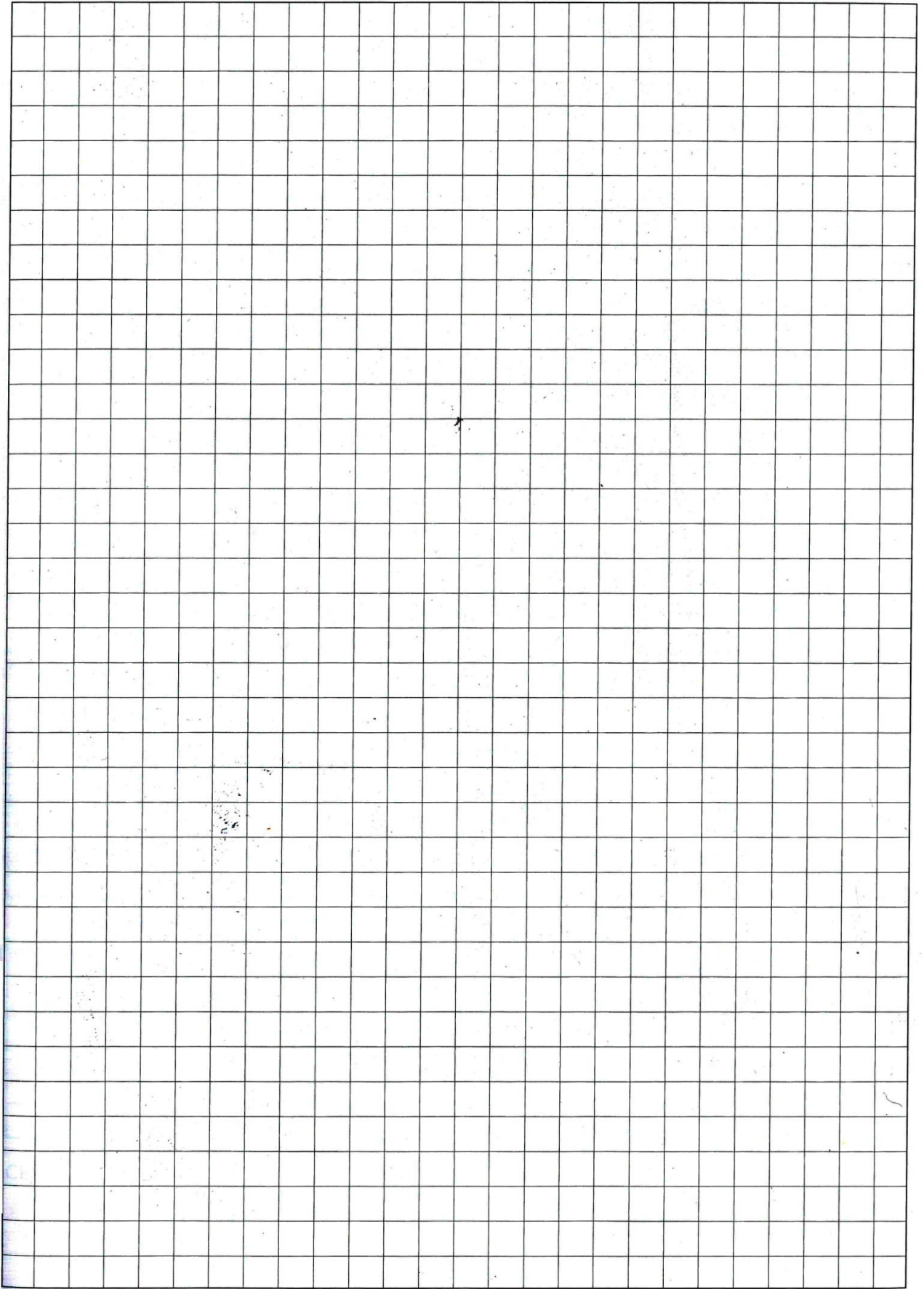


Mesial

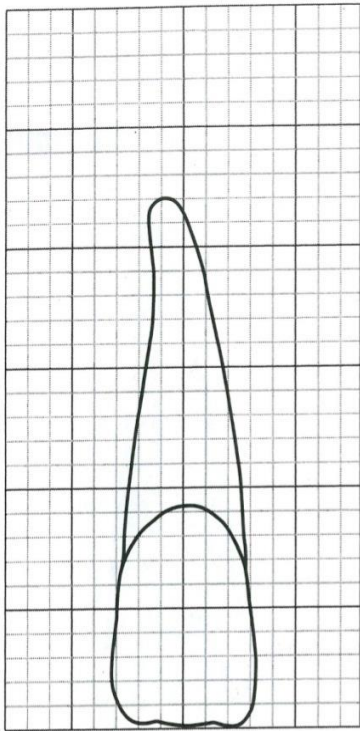


Distal

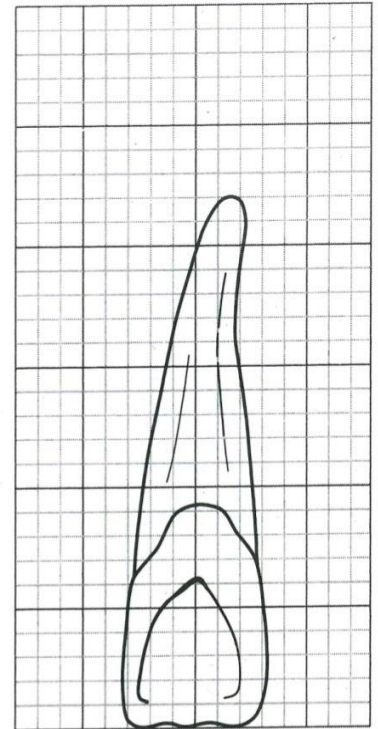
Various Outline Views of a Permanent Maxillary Right Central Incisor



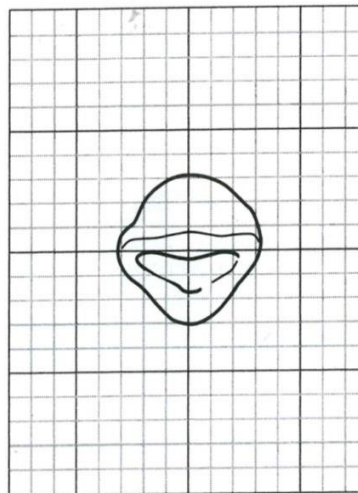
MAXILLARY LATERAL INCISOR



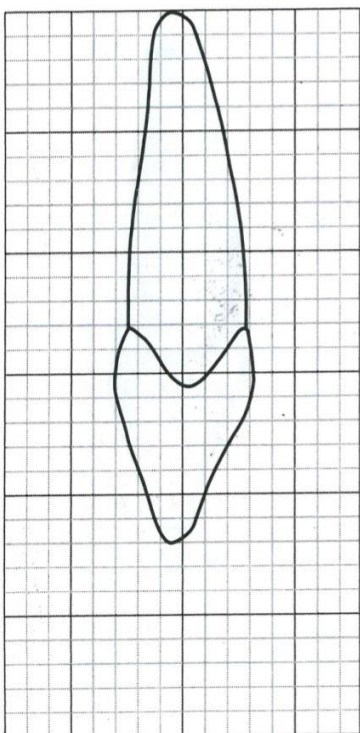
Labial



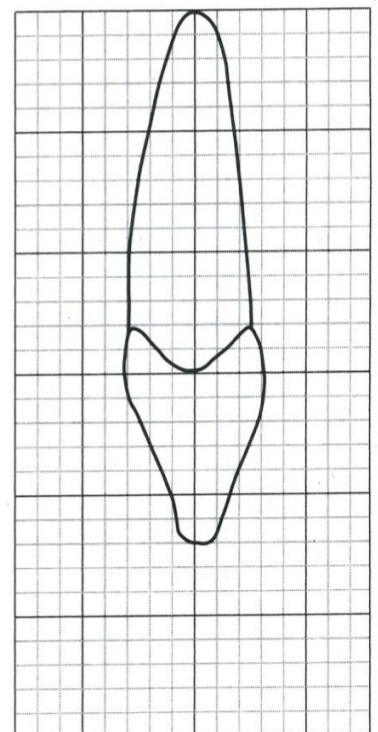
Lingual



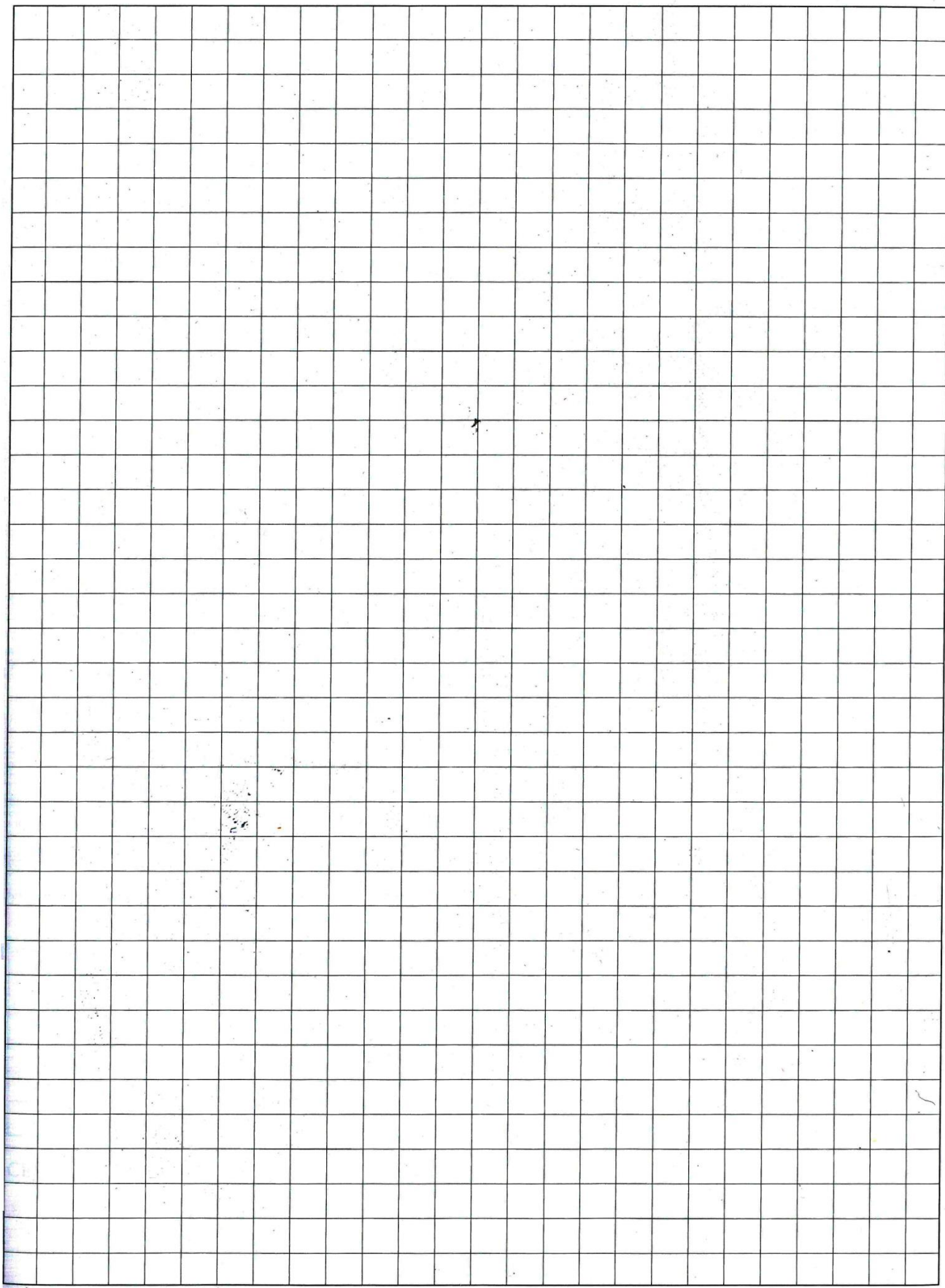
Incisal



Mesial



Distal



DIMENSIONS OF PERMANENT MANDIBULAR CENTRAL INCISOR*		
Cervico-incisal Length of Crown	Buccal: 9.0	Lingual: 9.5
Length of Root	12.5	
Mesiodistal Diameter of Crown	5.0	
Mesiodistal Diameter of CEJ	3.5	
Labiolingual Diameter	6.0	
Labiolingual Diameter of CEJ	5.3	
Curvature of CEJ—Mesial	3.0	
Curvature of CEJ—Distal	2.0	

*In millimeters; adapted from Nelson SJ: *Wheeler's Dental Anatomy, Physiology, and Occlusions*, ed 9, WI Saunders, Philadelphia, 2009.

CEJ = cements enamel junction

CHECKLIST FOR PERMANENT MANDIBULAR CENTRAL INCISOR	
Features Noted	Features Present
Crown Features	
Bilaterally symmetrical	
Incisal edge, mamelons, small centered cingulum, subtle lingual fossa, and equal subtle marginal ridges	
Sharper MI incisal angle, rounder DI angle, and more pronounced mesial CEJ curvature	
Height of contour in cervical third	
Mesial contact is just cervical to the junction of occlusal and middle thirds	
Distal contact is at incisal third	
Root Features	
Single rooted, with root longer than the crown	
Proximal root concavities give double-rooted appearance	

CEJ = cements enamel junction; DI = distoincisor; MI = mesioincisor

DIMENSIONS OF PERMANENT MANDIBULAR LATERAL INCISOR*		
Cervico-incisal Length of Crown	Buccal: 9.5	Lingual: 10.0
Length of Root	14.0	
Mesiodistal Diameter of Crown	5.5	
Mesiodistal Diameter of CEJ	4.0	
Labiolingual Diameter	6.5	
Labiolingual Diameter of CEJ	5.8	
Curvature of CEJ—Mesial	3.0	
Curvature of CEJ—Distal	2.0	

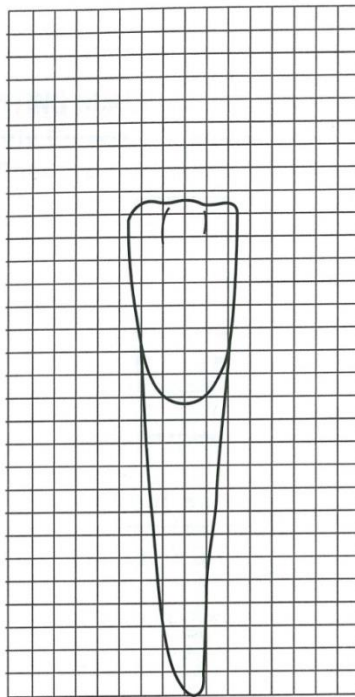
*In millimeters; adapted from Nelson SJ: *Wheeler's Dental Anatomy, Physiology, and Occlusions*, ed 9, WB Saunders, Philadelphia, 2009.

CEJ = cements enamel junction

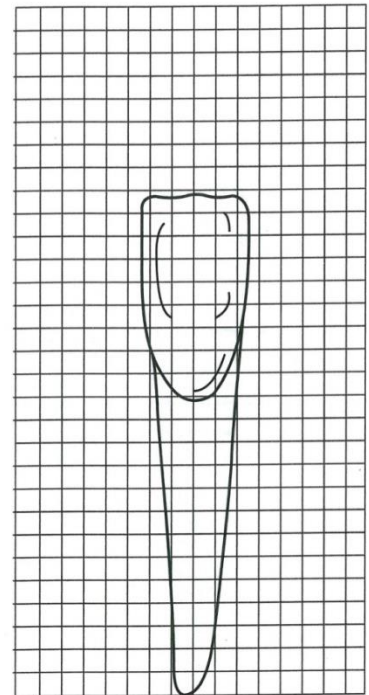
CHECKLIST FOR PERMANENT MANDIBULAR LATERAL INCISOR	
Features Noted	Features Present
Crown Features	
Larger than central and not bilaterally symmetrical, and appears twisted distally	
Incisal edge, mamelons, small distally displaced cingulum, lingual fossa, and moderate mesial marginal ridge longer than distal	
Sharper MI incisal angle, rounder DI angle, and more pronounced mesial CEJ curvature	
Height of contour in cervical third	
Mesial contact is just cervical to the junction of occlusal and middle thirds	
Distal contact is at incisal third	
Root Features	
Single rooted, with root longer than the crown	
Proximal root concavities give double-rooted appearance	

CEJ = cements enamel junction; DI = distoincisor; MI = mesioincisor

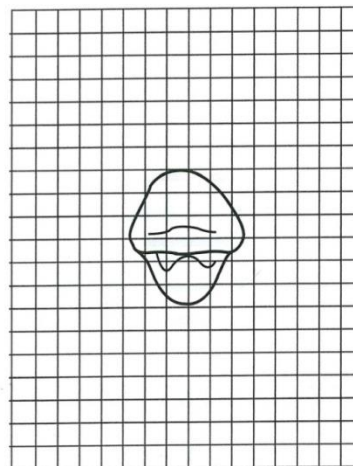
MANDIBULAR CENTRAL INCISOR



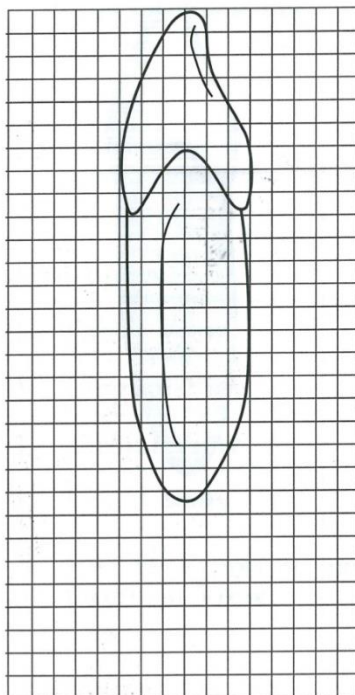
Labial



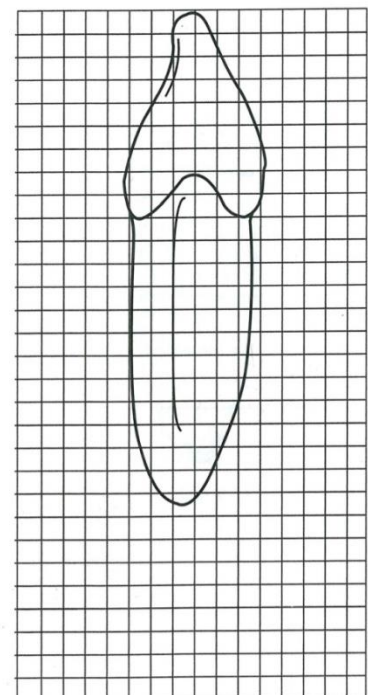
Lingual



Incisal

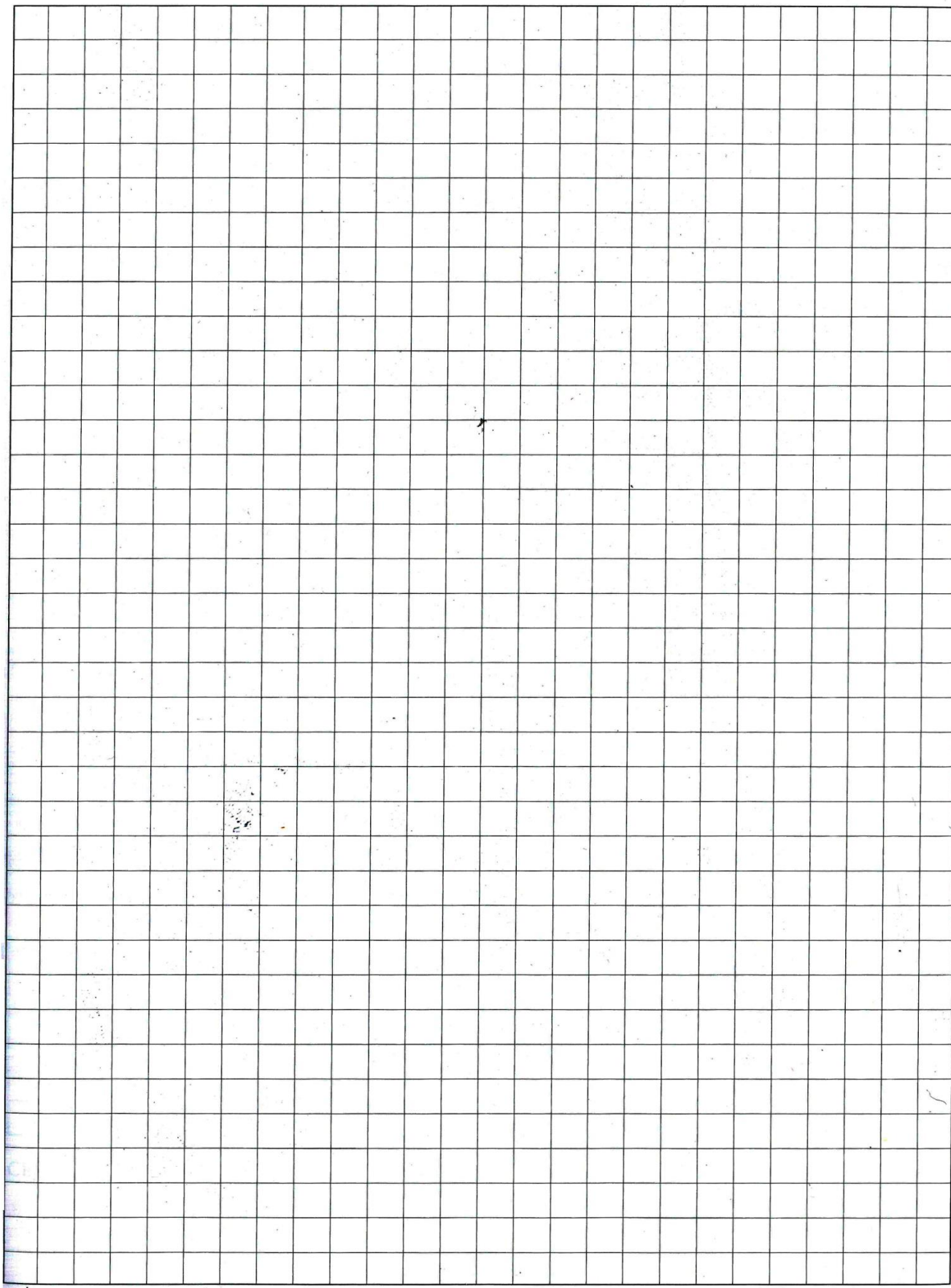


Mesial

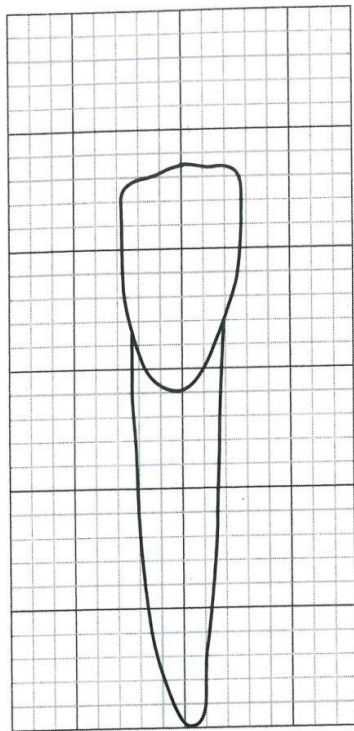


Distal

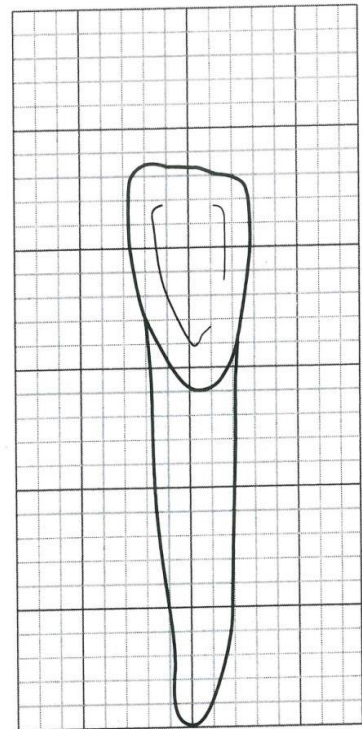
Various Outline Views of a Permanent Mandibular Right Central Incisor



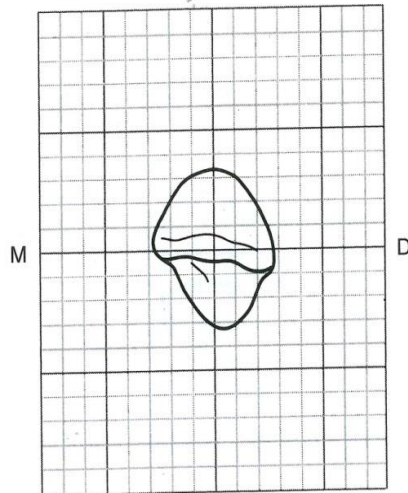
MANDIBULAR LATERAL INCISOR



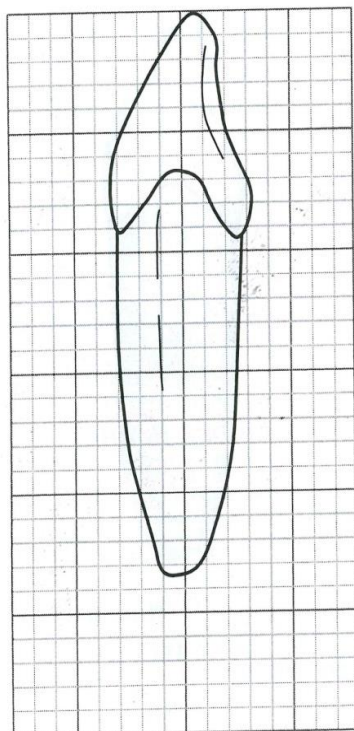
Labial



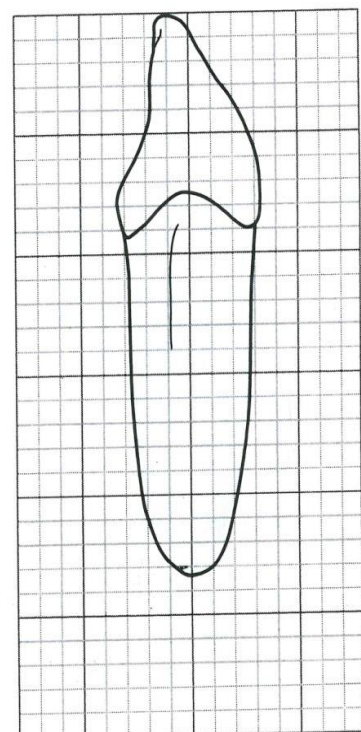
Lingual



Incisal

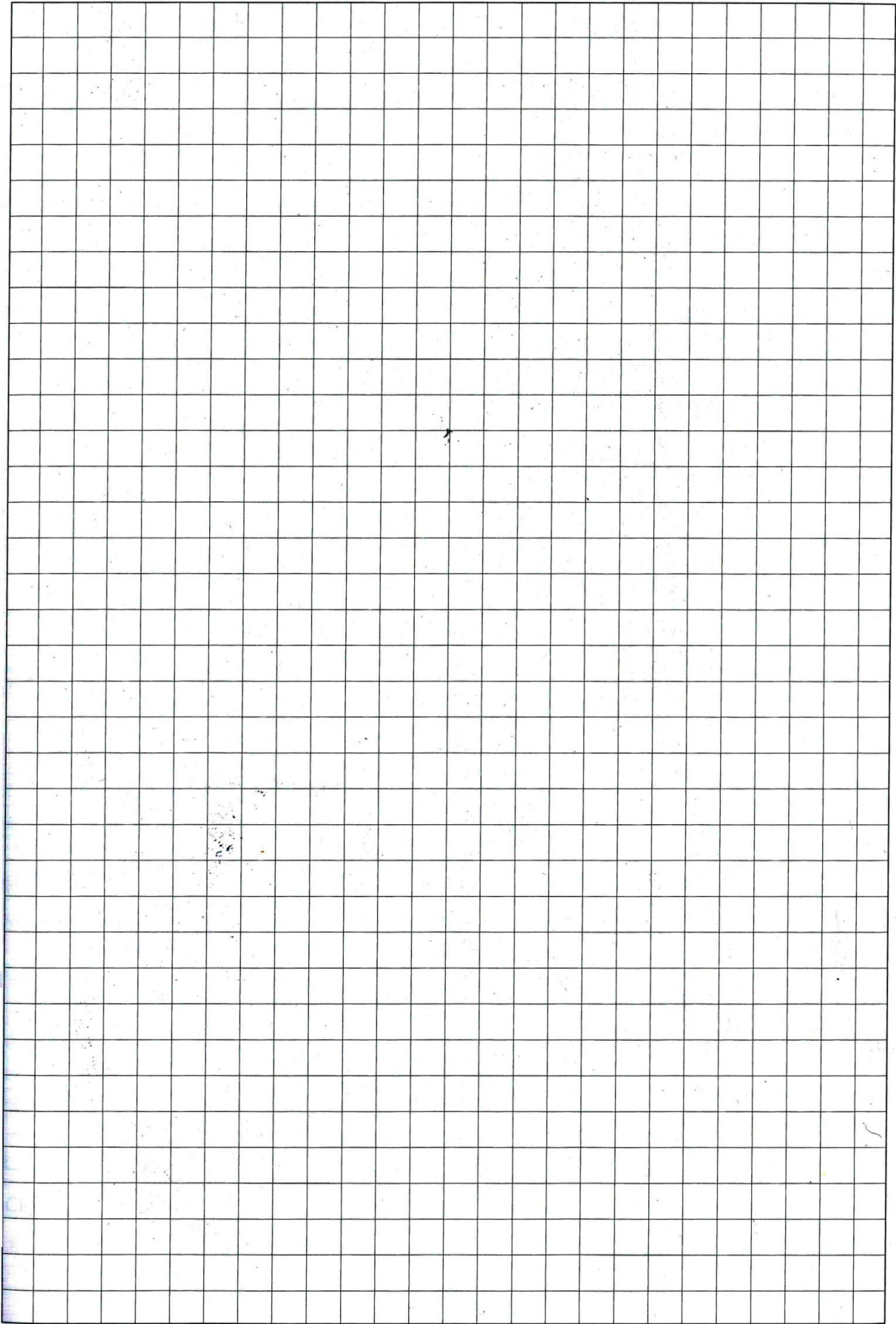


Mesial



Distal

Various Outline Views of a Permanent Mandibular Right Lateral Incisor



DIMENSIONS OF PERMANENT MAXILLARY CANINE*

Cervico-incisal Length of Crown	10.0
Length of Root	17.0
Mesiodistal Diameter of Crown	7.5
Mesiodistal Diameter of CEJ	5.5
Labiolingual Diameter	8.0
Labiolingual Diameter of CEJ	7.0
Curvature of CEJ—Mesial	2.5
Curvature of CEJ—Distal	1.5

*In millimeters; adapted from Nelson SJ: *Wheeler's Dental Anatomy, Physiology, and Occlusions*, ed 9, WB Saunders, Philadelphia, 2009.

CEJ = cements enamel junction

CHECKLIST FOR PERMANENT MAXILLARY CANINE

Features Noted	Features Present
Crown Features	
Single cusp, with sharp cusp tip and slopes, labial ridge	
Shorter mesial cusp slope, more cervical contact on distal, more pronounced mesial CEJ curvature	
Shorter distal outline on labial view with depression between the distal contact and CEJ	
Prominent lingual anatomy with marginal ridges and lingual ridge, cingulum, and lingual fossae	
Height of contour for buccal is cervical third and for lingual is middle third	
Mesial contact is at junction of incisal third and middle thirds	
Distal contact is at middle third	
Root Features	
Long, thick single root with proximal root concavities	
Blunt root apex	

CEJ = cements enamel junction

DIMENSIONS OF PERMANENT MANDIBULAR CANINE*

Cervico-incisal Length of Crown	11.0
Length of Root	16.0
Mesiodistal Diameter of Crown	7.0
Mesiodistal Diameter of CEJ	5.5
Labiolingual Diameter	7.5
Labiolingual Diameter of CEJ	7.0
Curvature of CEJ—Mesial	2.5
Curvature of CEJ—Distal	1.0

*In millimeters; adapted from Nelson SJ: *Wheeler's Dental Anatomy, Physiology, and Occlusions*, ed 9, WB Saunders, Philadelphia, 2009.

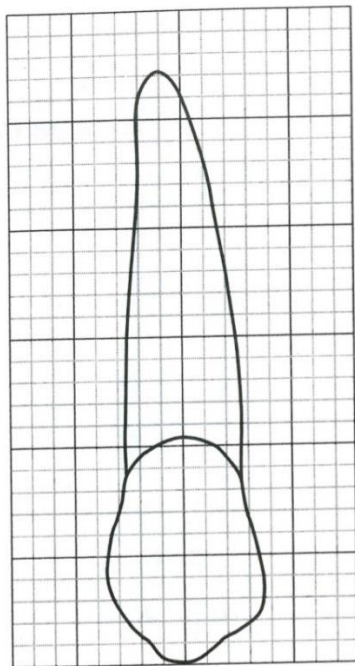
CEJ = cementoenamel junction

CHECKLIST FOR PERMANENT MANDIBULAR CANINE

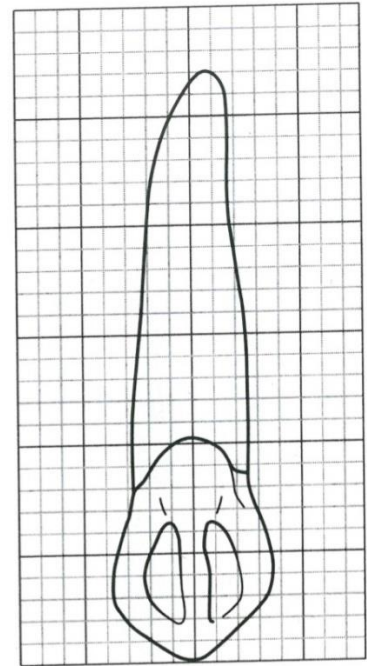
Features Noted	Features Present
Crown Features	
Single cusp, with less sharp cusp tip and slopes, labial ridge	
Shorter mesial cusp slope, more cervical contact on distal, more pronounced mesial CEJ curvature	
Shorter and rounder distal outline on labial view, with a shorter mesial slope than distal	
Smoother lingual anatomy	
Height of contour for buccal is cervical third and for lingual is middle third	
Mesial contact is at incisal thirds	
Distal contact is at junction of incisal and middle thirds	
Root Features	
Long, thick single root with proximal root concavities and with pointed apex	
Developmental depressions on mesial and distal give tooth double-rooted appearance	

CEJ = cementoenamel junction

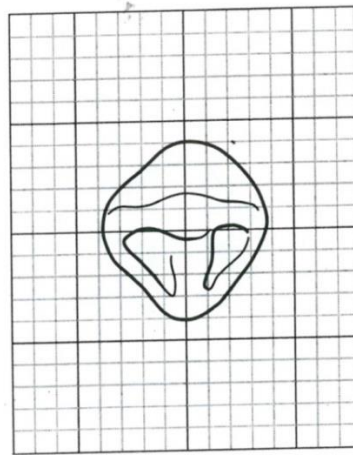
MAXILLARY CANINE



Labial



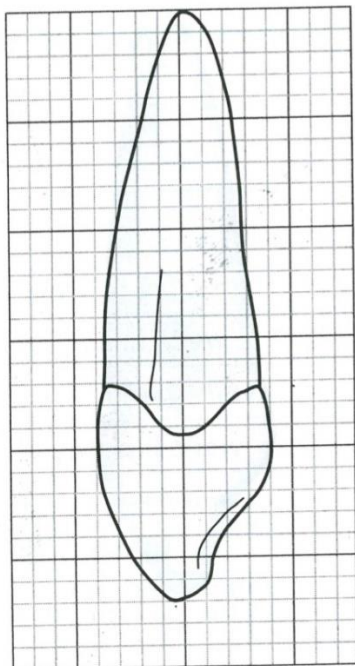
Lingual



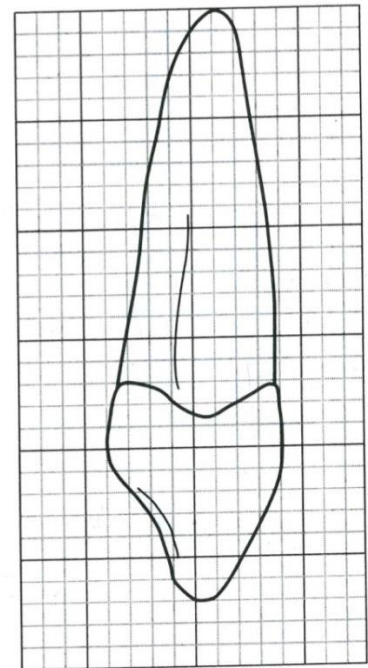
Incisal

D

M

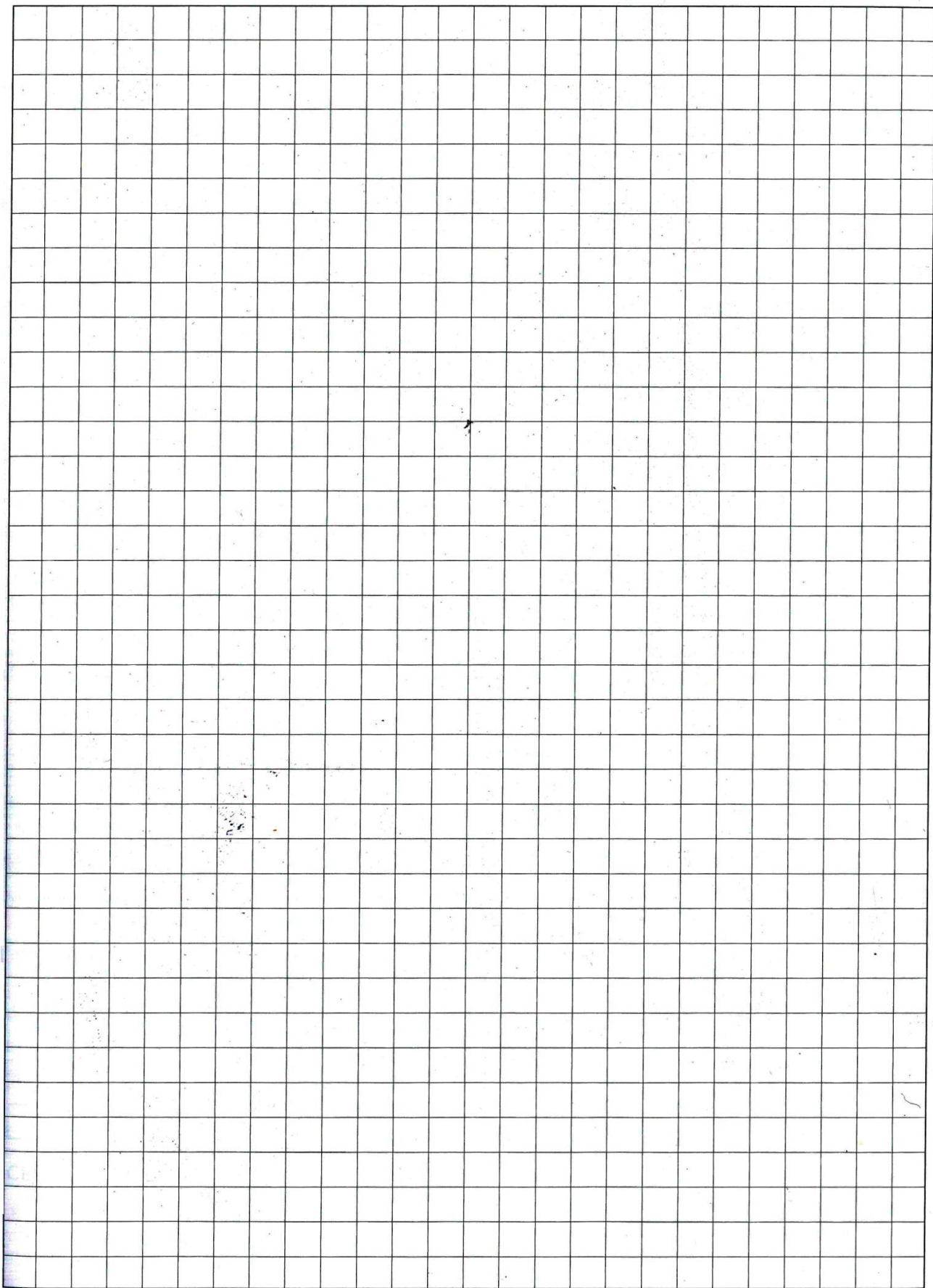


Mesial

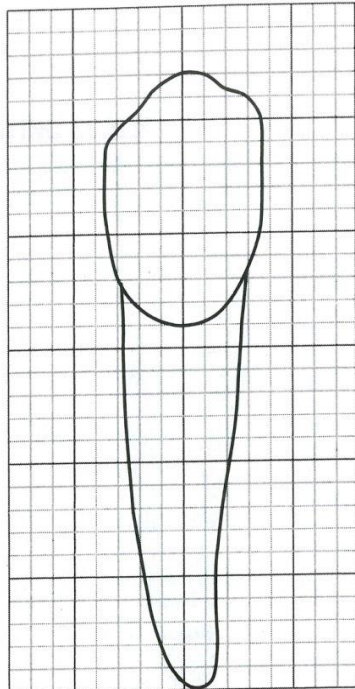


Distal

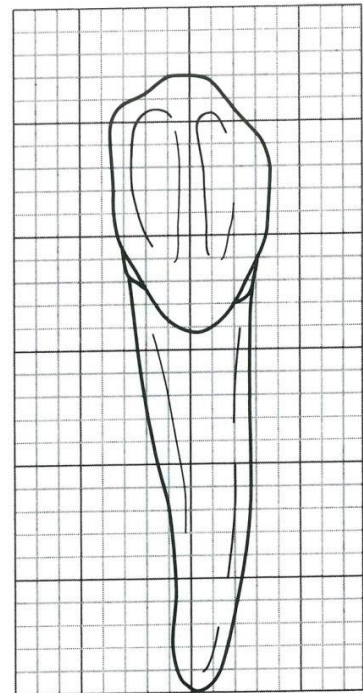
Various Outline Views of a Permanent Maxillary Right Canine



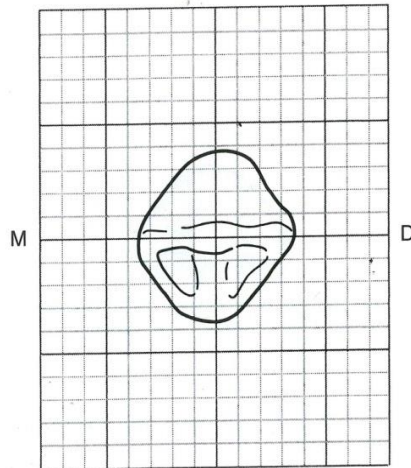
MANDIBULAR CANINE



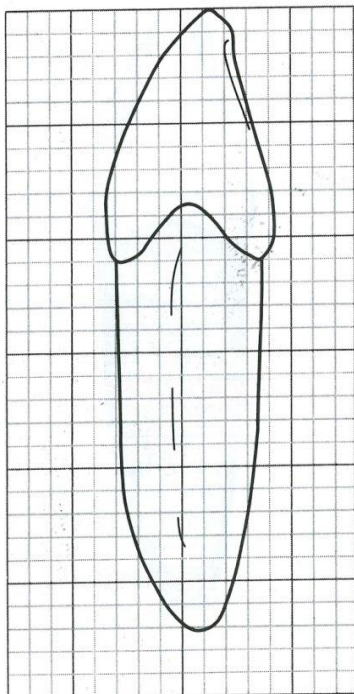
Labial



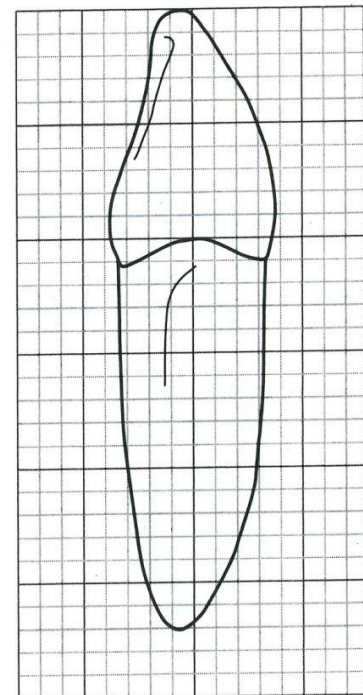
Lingual



Incisal

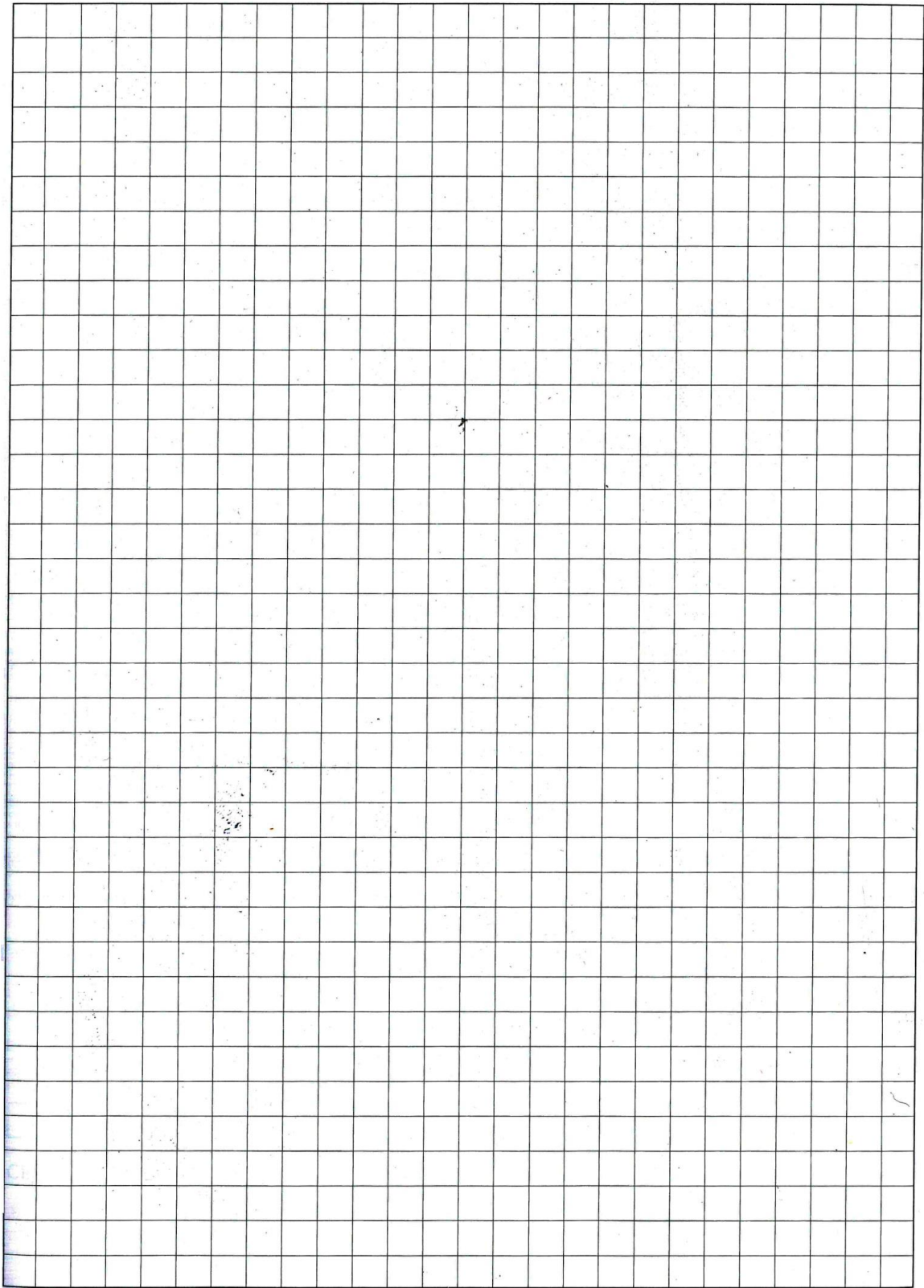


Mesial



Distal

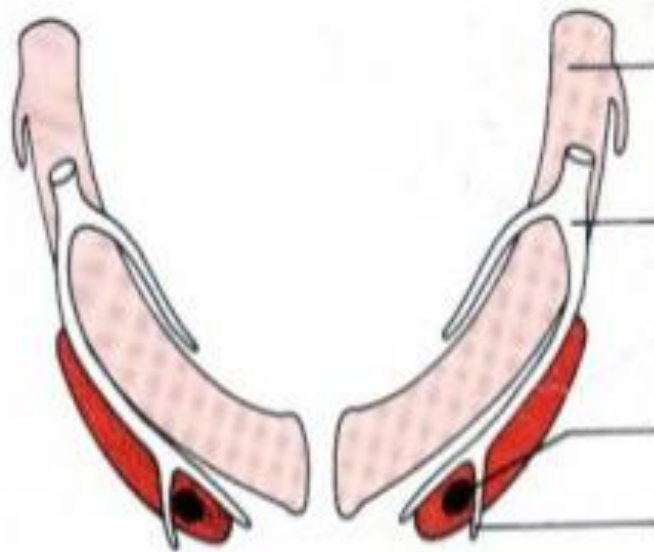
Various Outline Views of a Permanent Mandibular Right Canine



DEVELOPMENT OF MANDIBLE

DEVELOPMENT OF MANDIBLE

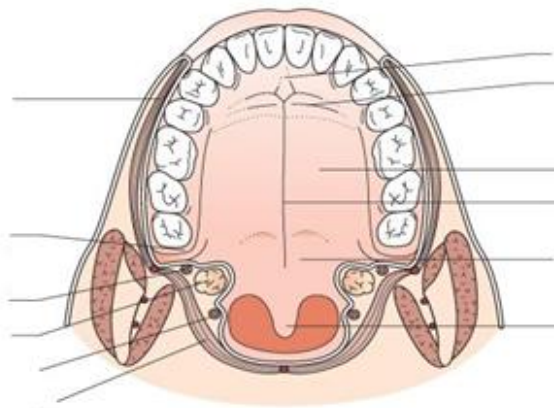
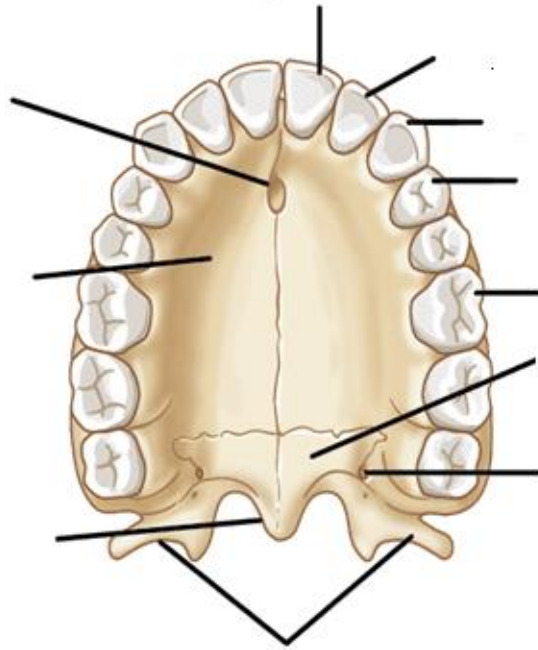
- 2nd bone to ossify
- Intramembranous + endochondrial
- 6th week of intrauterine life



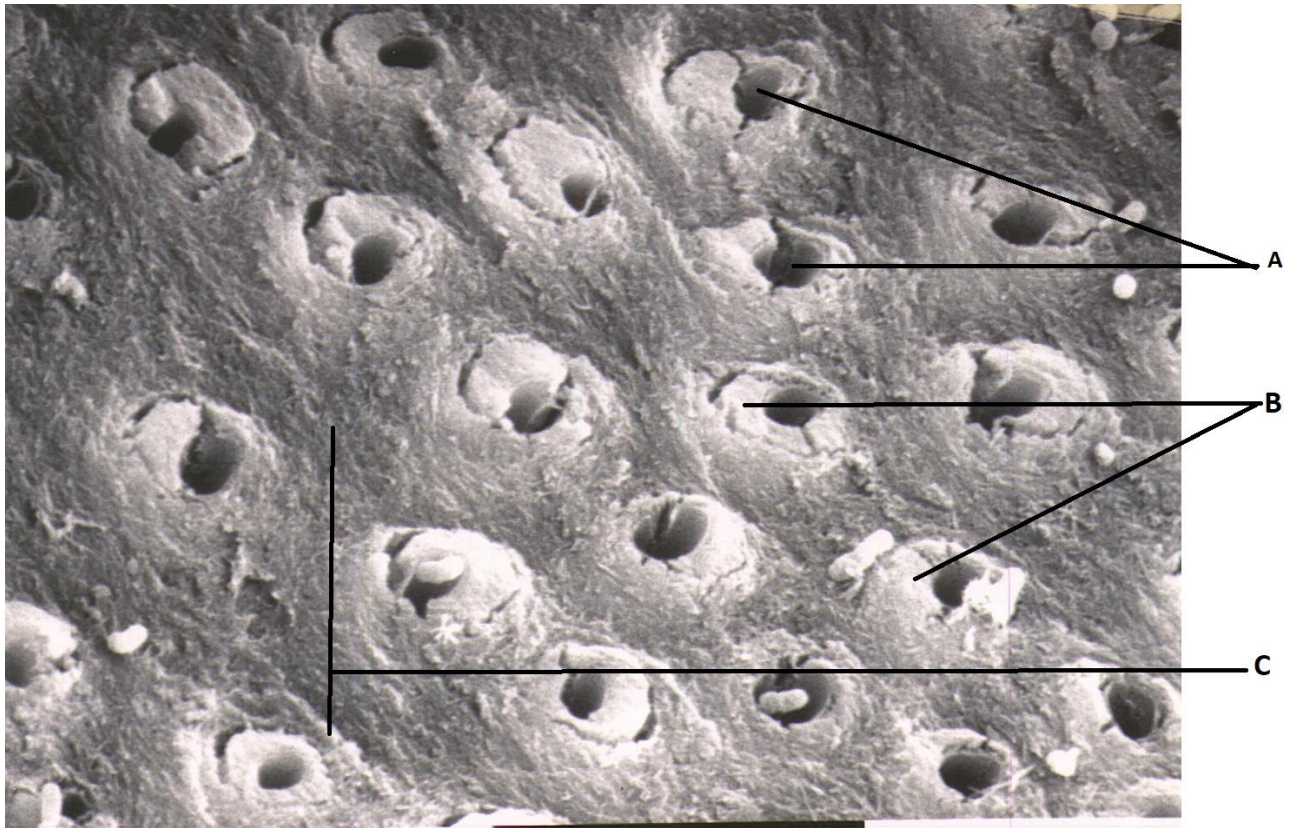
Q) What is the role of Meckle's cartilage in the development of mandible?

LABEL THE FIGURES

HARD AND SOFT PALATE

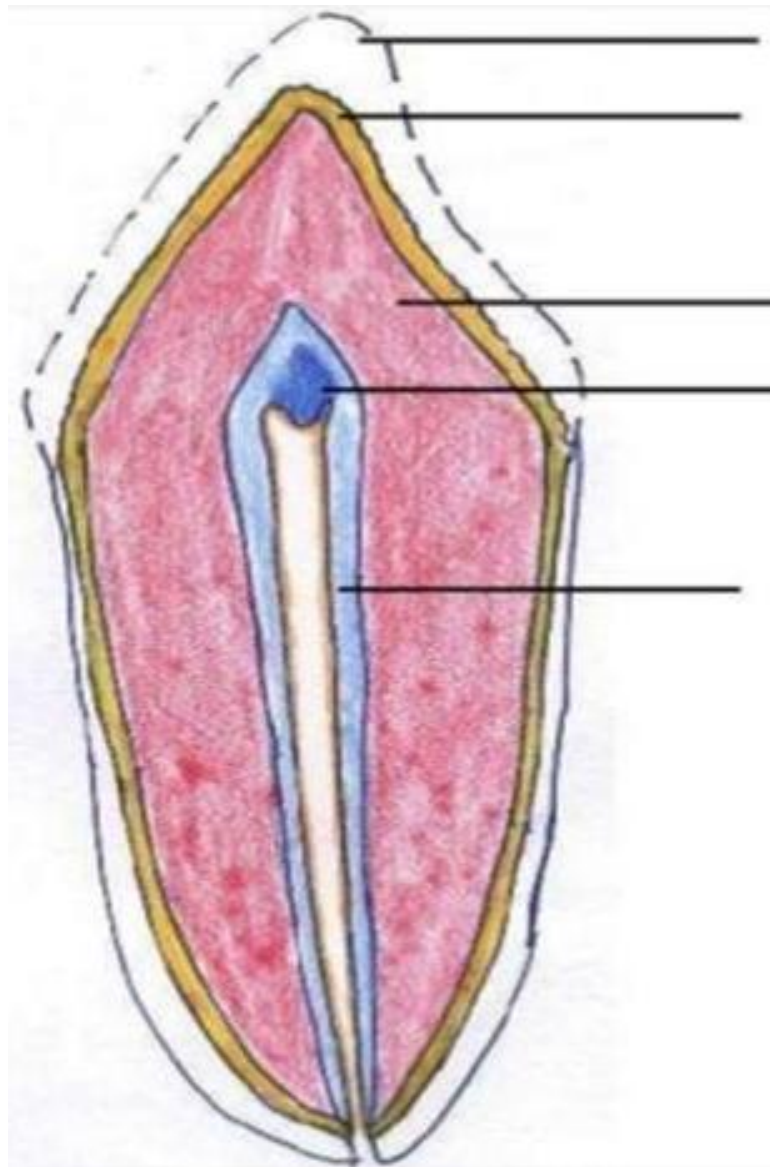


STRUCTURE OF DENTIN



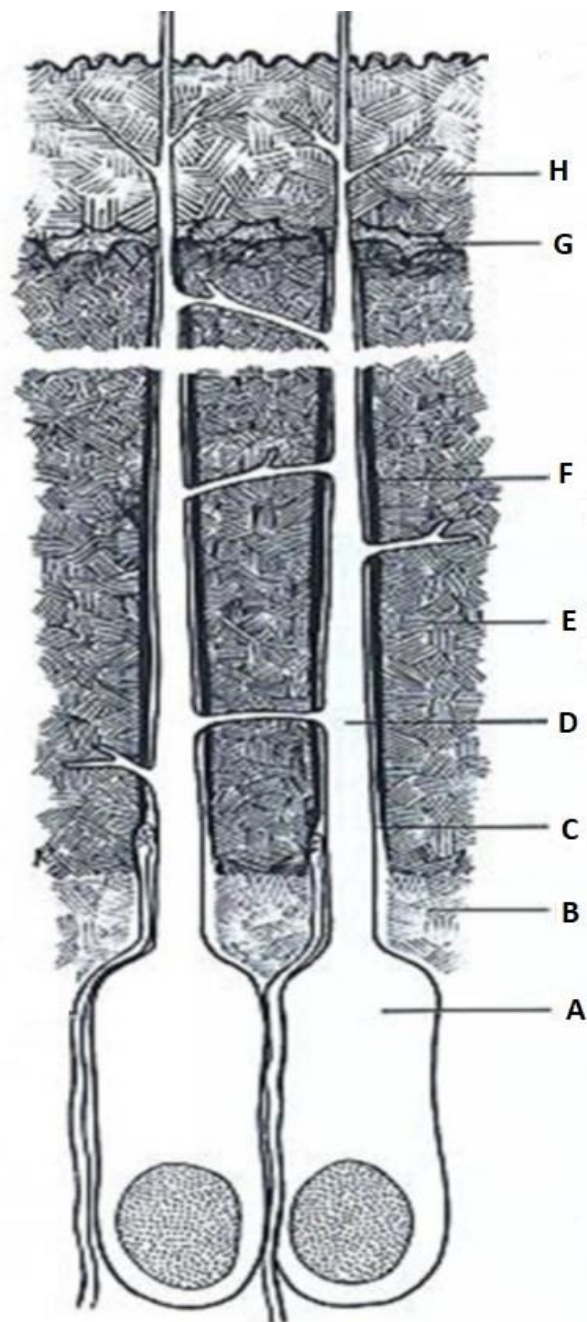
DRAW AND LABEL THE DIAGRAMS

TYPES OF DENTIN



DRAW AND LABEL THE DIAGRAMS

STRUCTURE OF ODONTOBLAST



**DRAW AND LABEL THE DIAGRAMS MARKED A, B,
C, D, E, F, G AND H**

LOCATION, MINERALIZATION AND DEVELOPMENTAL PATTERN OF DENTIN

Location	Pattern of Mineralization	Developmental Pattern
Intertubular dentin: found around and between dentinal tubules	Globular dentin: formed from calcospherites	Primary dentin: formed prior to and during active eruption
Intratubular dentin: found and formed within dentinal tubules; also called peritubular dentin	Interglobular dentin; hypomineralized dentin between mantle and circumpulpal dentin; normally only found in coronal dentin	Secondary dentin; formed when the tooth first comes into occlusion
Mantle dentin: formed initially in the crown; outer coronal dentin	Tomes granular layer; hypomineralized layer in root dentin; similar to interglobular dentin in the crown	Tertiary dentin; formed as a result of a pathologic response; may be reactionary or reparative
Circumpulpal dentin: nearest to the pulp: formed in crown after mantle dentin has been deposited	Sclerotic dentin; hypermineralized, occluding intratubular dentin	

DENTIN SENSITIVITY

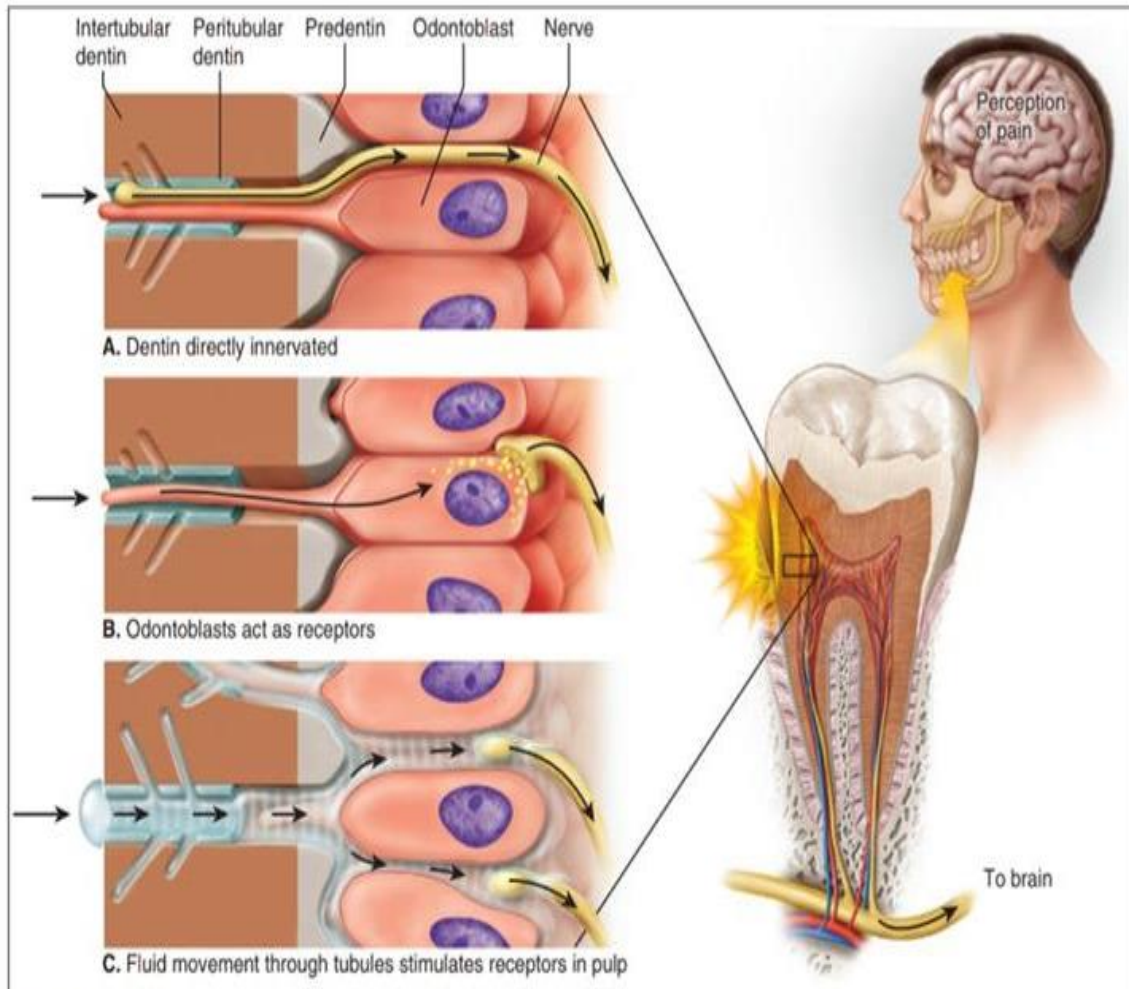
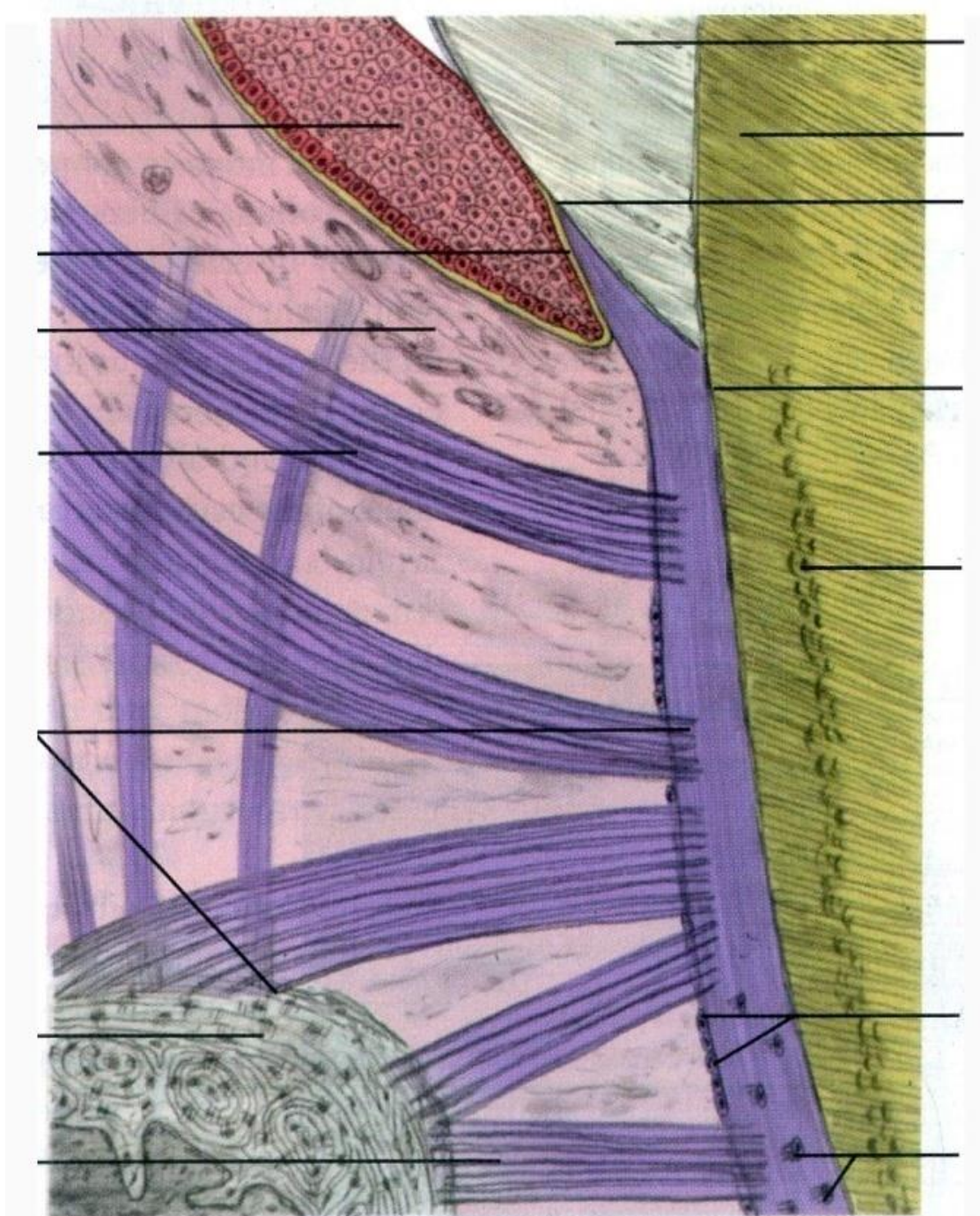


FIGURE 8-66 Three theories of dentin sensitivity. *A* suggests that the dentin is innervated directly. *B* suggests that the odontoblast acts as a receptor. *C* suggests that the receptors at the base of odontoblasts are stimulated directly or indirectly by fluid movement through the tubules.

Q) Briefly describe dentin sensitivity/Pain theories?

CEMENTUM AND ITS RELATIONSHIP TO TOOTH AND ALVEOLAR BONE



DRAW AND LABEL THE DIAGRAMS

DIFFERENCE BETWEEN ACELLULAR AND CELLULAR CEMENTUM:

ACELLULAR CEMENTUM	CELLULAR CEMENTUM
Embedded cementocytes are absent.	Embedded cementocytes present.
Deposition rate is slower.	Deposition rate is faster.
It is first formed layer.	Formed after acellular cementum.
Width is more or less constant.	Width highly variable
Found more on cervical region.	Mainly apical third and inter radicular area.
Also called primary cementum.	Also called secondary cementum.
Sharpey's fibres are well mineralized. Incremental lines are regular.	Sharpey's fibres partially mineralized. Incremental lines are irregular.

GUIDE LINES FOR DRAWING OF TEETH ACCORDING TO ITS MORPHOLOGY

Introduction

Tooth-drawing assignments emphasize fundamental principles in tooth design, which later have direct practical application in clinical coursework of a dental professional. Initial drawings are most likely to be the student's first attempts at capturing any tooth likeness; they will certainly encourage accuracy and discernment of the teeth and hopefully facilitate the recognition of tooth details. *Artistic inclinations are not really needed with these basic technical drawings.*

It is important to also note that these drawings are only two-dimensional and are somewhat limited to fundamental outlines and proportions. However, they will serve to help create mental pictures of teeth in their ideal or composite state. Remember that real specimens in patients' mouths vary considerably.

Activity Steps

1. Locate the two, blank gridded worksheets in the workbook. Any additional gridded worksheets needed can be easily copied for the correct spacing of the grid needed. Correctly label the worksheet at the bottom of the page with the tooth that will be drawn as shown in the smaller professionally drawn figures.
2. Using the attached table of tooth dimensions (same as in the associated textbook's appendices), mark off the overall peripheral tooth measurements for each of the gridded view boxes of the tooth. Note that the grid of the blank worksheet is larger than that shown with the professionally drawn tooth outlines to better enable the student to have room to work. Each square of grid equals 1 mm, so count off as many squares for each peripheral dimension (such as the mesiodistal diameter) as indicated from the table onto the proper area of the gridded worksheet.
3. To establish crown and root proportions, divide each gridded view box into two parts corresponding to these two dimensions, except for the incisal/occlusal view.
4. To indicate the height of contour, locate the approximate area of contact between the adjacent teeth and the area of greatest convexity on the labial/buccal, lingual/mesial, and distal surfaces as mentioned in the associated textbook.
5. To locate the root axis line (RAL), draw a line that exactly bisects the overall gridded box showing the overall crown and root measurements. The cementoenamel junction (CEJ) will then be bisected by the RAL. The root apex may or may not be located on this RAL, depending on the tooth's apex traits.
6. To locate the center of the cingulum or midpoint of the incisal edge, divide the crown and root (if included in that particular gridded view box) into imaginary thirds. Then place the root apex, cingulum, or incisal edge into proper perspective with respect to the other peripheral overall tooth dimensions such as the mesiodistal diameter.
7. To complete the crown outline, connect the heights of contour to the incisal/occlusal edge, to the CEJ, and to the other heights of contour. Any additional anatomical features such as mamelons, lobes, marginal ridges, depressions, and so forth, can be indicated upon completion of the crown outline.
8. To complete the root outline, follow the directions for developing the crown outline with the understanding that the cervical one third to one half of the root width generally approximates the cervical width of the crown before it starts to narrow considerably to form the root apex.
9. Shading or stippling of the features may now be added, if desired. An evaluation form for the drawings for use by both the student and instructor is also included in the workbook. Multiple copies of the form may be copied if needed.

DIMENSION OF MAXILLARY FIRST PREMOLAR

Cervico-occlusal Length of Crown	8.5
Length of Root	14
Mesiodistal Diameter of Crown	7
Mesiodistal Diameter of Crown at Cervix	5
Labio- or Bucco-lingual Diameter of Crown	9
Labio- or Bucco-lingual Diameter of Crown at Cervix	8
Curvature of Cervical Line—Mesial	1
Curvature of Cervical Line—Distal	0

In millimeters: adapted from Nelson Sj: Wheeler's Dental Anatomy, Physiology, and Occlusos, ed 9, WB Saunders, Philadelphia, 2009.

CEJ = cementoenamel junction

CHECKLIST FOR MAXILLARY FIRST PREMOLAR

Features Noted	Features Present
Crown Features	
Smaller lingual cusp of two with buccal ridge	
Occlusal table with marginal ridges and cusps, with tips, ridges, inclined planes, and grooves, fossae, pits	
Shorter mesial cusp slope, mesiolingual groove, deeper mesial CEJ curvature	
Mesial and distal contact is just cervical to the junction of occlusal and middle thirds	
Root Features	
Single rooted	
Proximal root concavities	

CEJ = cementoenamel junction

DIMENSIONS OF PERMANENT MAXILLARY SECOND PREMOLAR*	
Cervico-incisal Length of Crown	8.5
Length of Root	14.0
Mesiodistal Diameter of Crown	7.0
Mesiodistal Diameter of CEJ	5.0
Buccolingual Diameter	9.0
Buccolingual Diameter of CEJ	8.0
Curvature of CEJ—Mesial	1.0
Curvature of CEJ—Distal	0.0

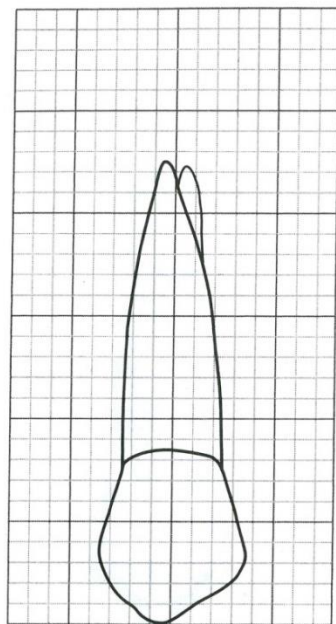
*In millimeters; adapted from Nelson SJ: *Wheeler's Dental Anatomy, Physiology, and Occlusions*, ed 9, WB Saunders, Philadelphia, 2009.

CEJ = cementoenamel junction

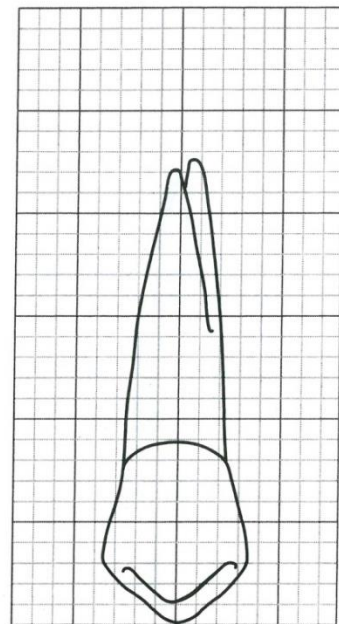
CHECKLIST FOR PERMANENT MAXILLARY SECOND PREMOLAR	
Features Noted	Features Present
Crown Features	
Two cusps same length with buccal ridge	
Occlusal table with marginal ridges and cusps, with tips, ridges, inclined planes, and grooves (short central groove and increased supplemental grooves), fossae, pits	
Lingual cusp offset to the mesial	
Mesial and distal contact is just cervical to the junction of occlusal and middle thirds	
Root Features	
Single rooted	
Proximal root concavities	

CEJ = cementoenamel junction

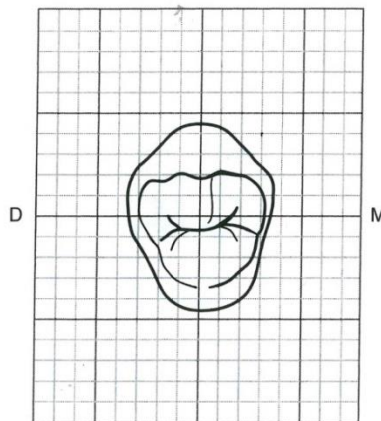
MAXILLARY 1ST PREMOLAR



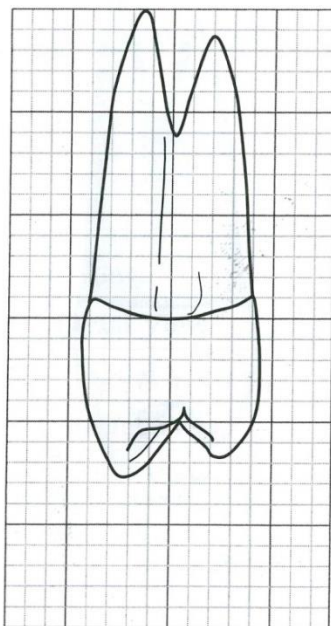
Buccal



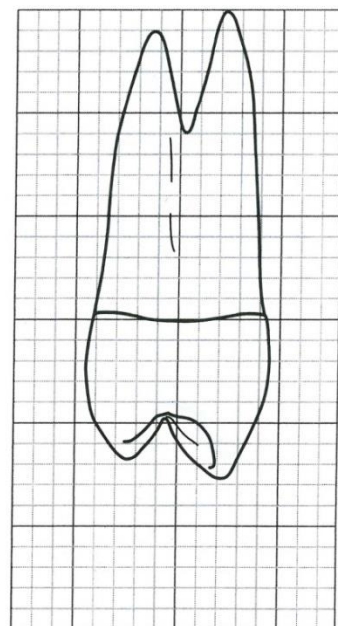
Lingual



Occlusal

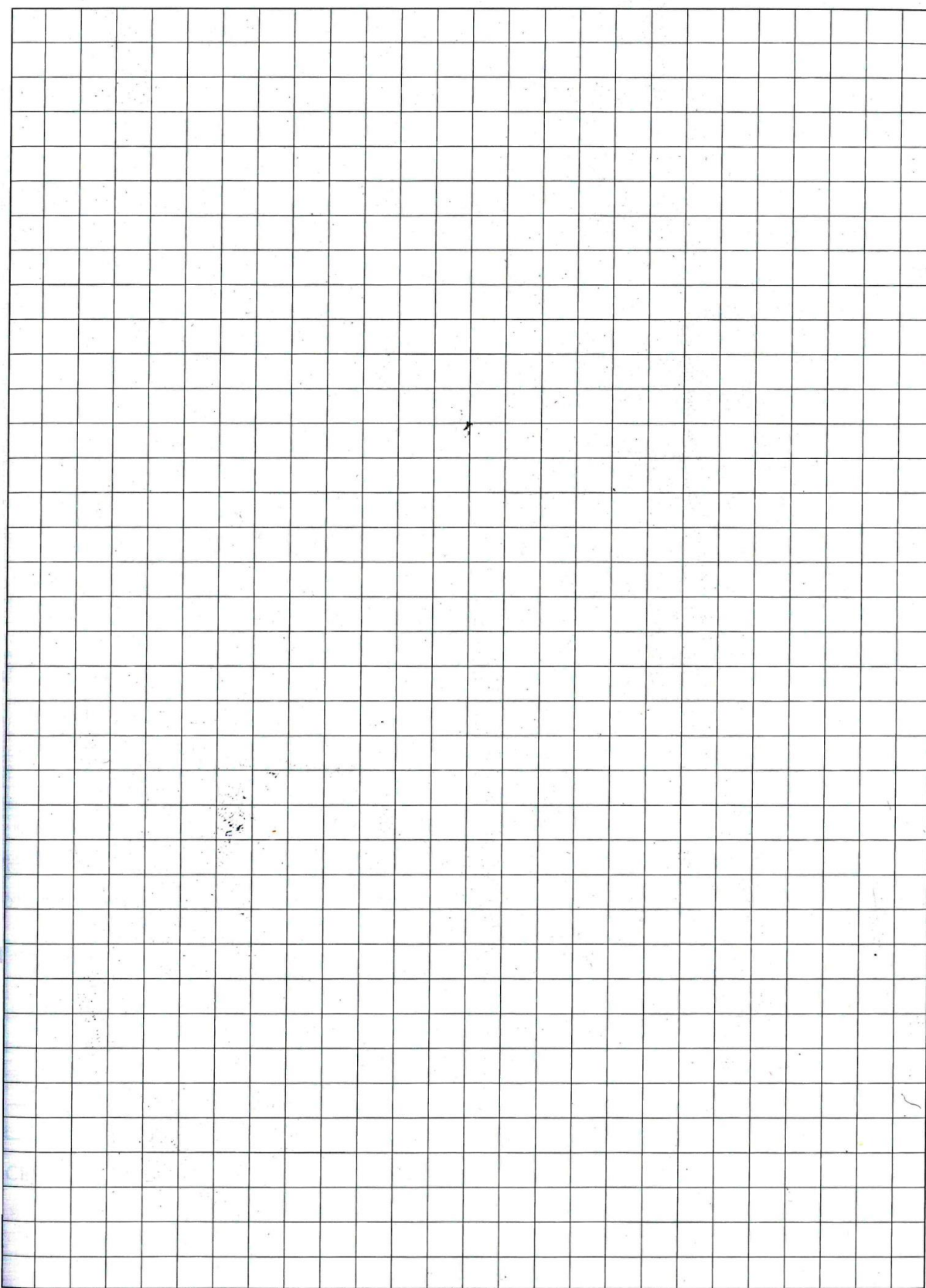


Mesial

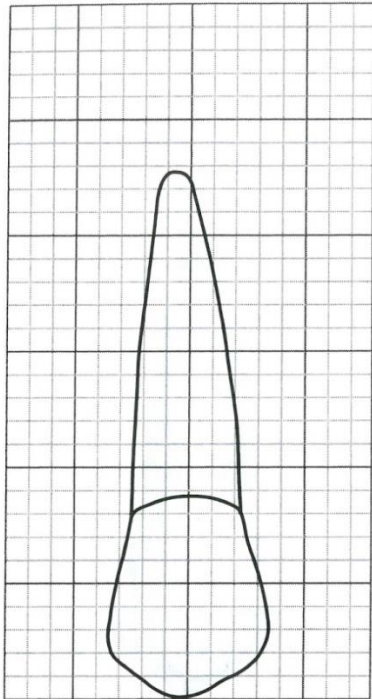


Distal

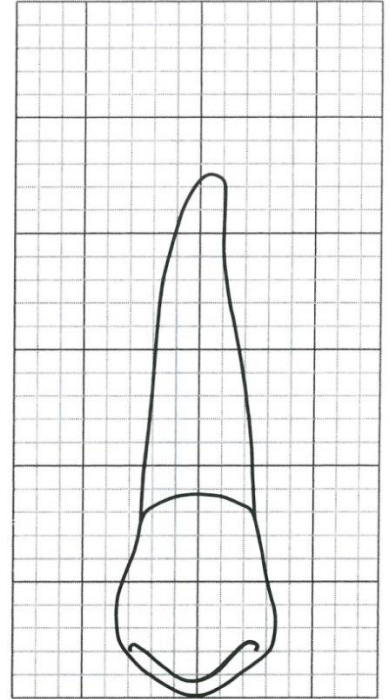
Various Outline Views of a Permanent Maxillary Right First Premolar



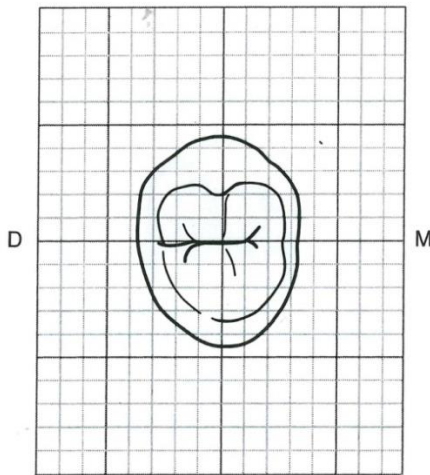
MAXILLARY 2ND PREMOLAR



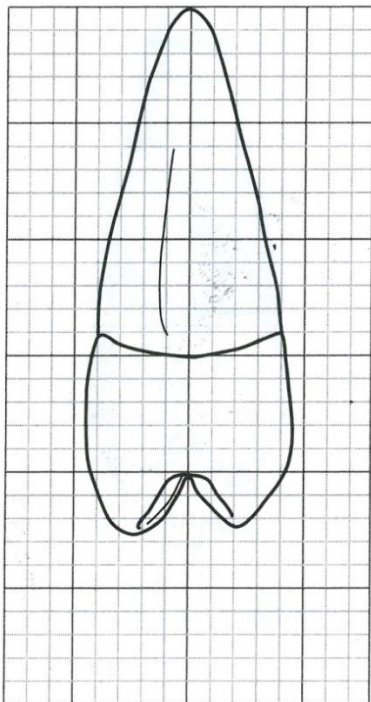
Buccal



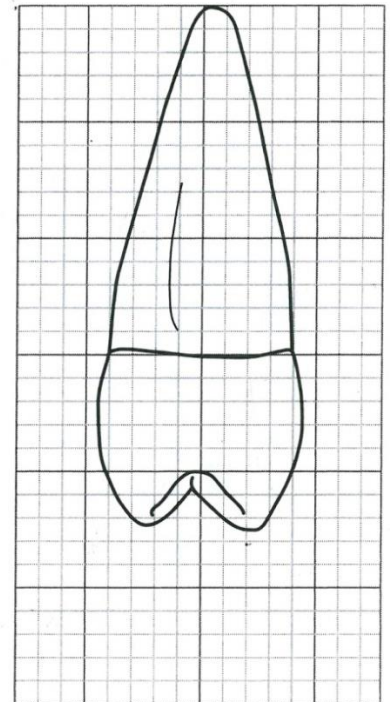
Lingual



Occlusal

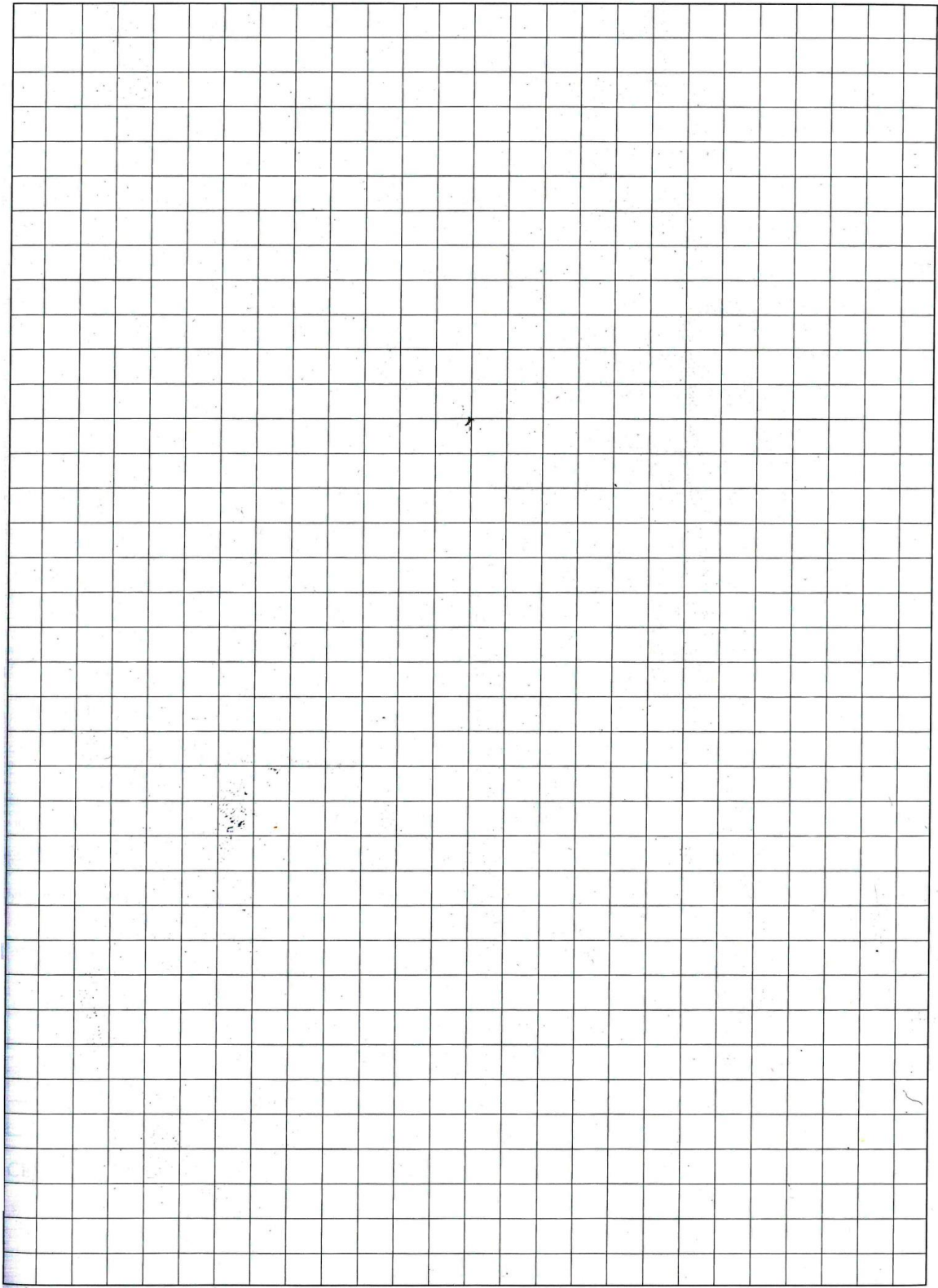


Mesial

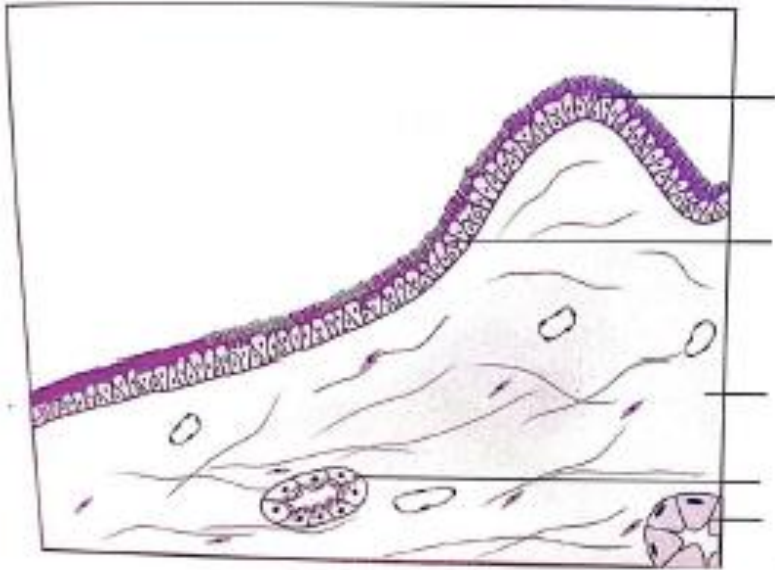
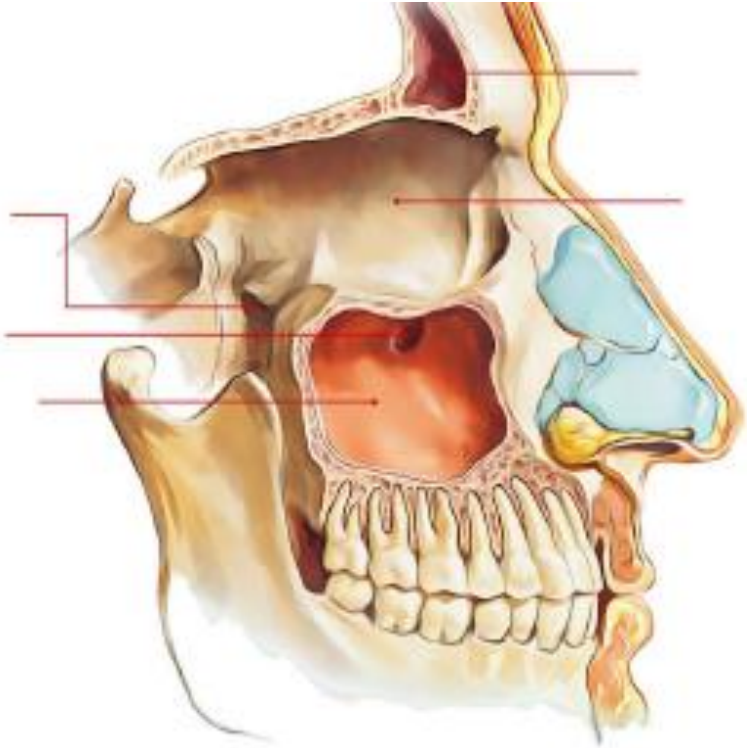


Distal

Various Outline Views of a Permanent Maxillary Right Second Premolar



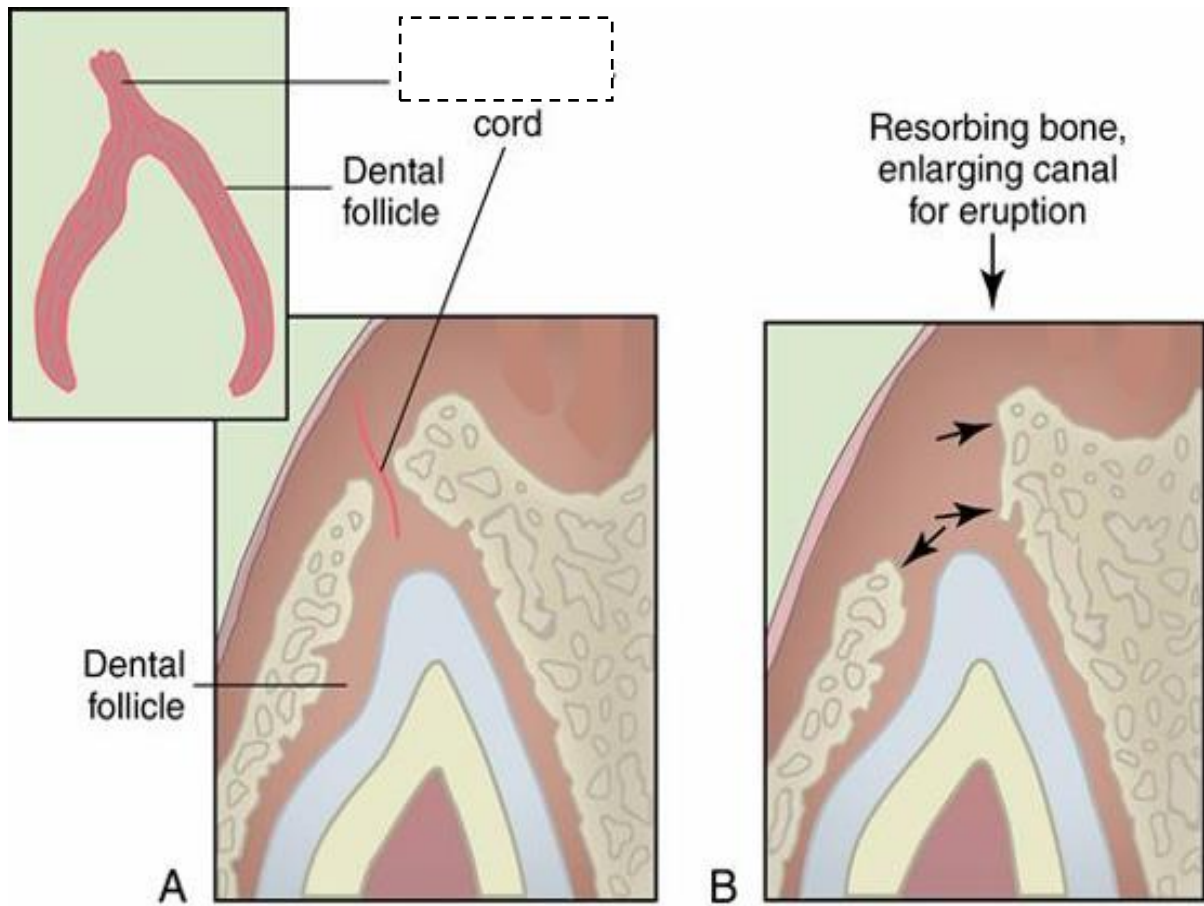
MAXILLARY SINUS



DRAW AND LABEL THE DIAGRAMS

Block C
MODULE 4
CERVICOFACIAL MODULE

ERUPTION & SHEDDING



DRAW AND LABEL THE DIAGRAMS

ERUPTION SHEDDING OF DECIDUOUS TEETH

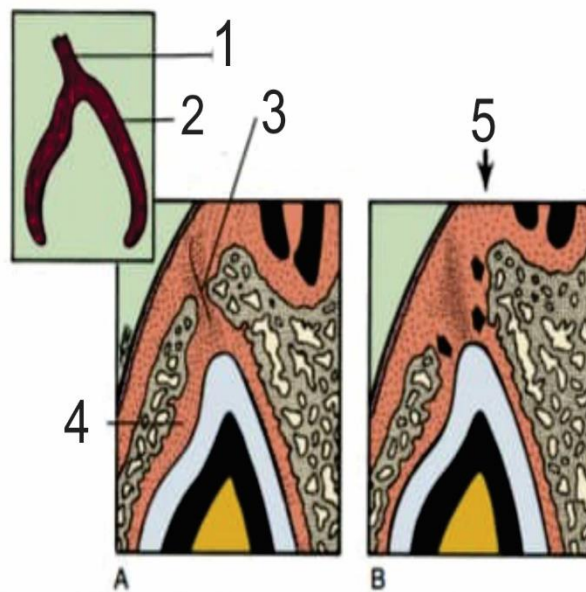
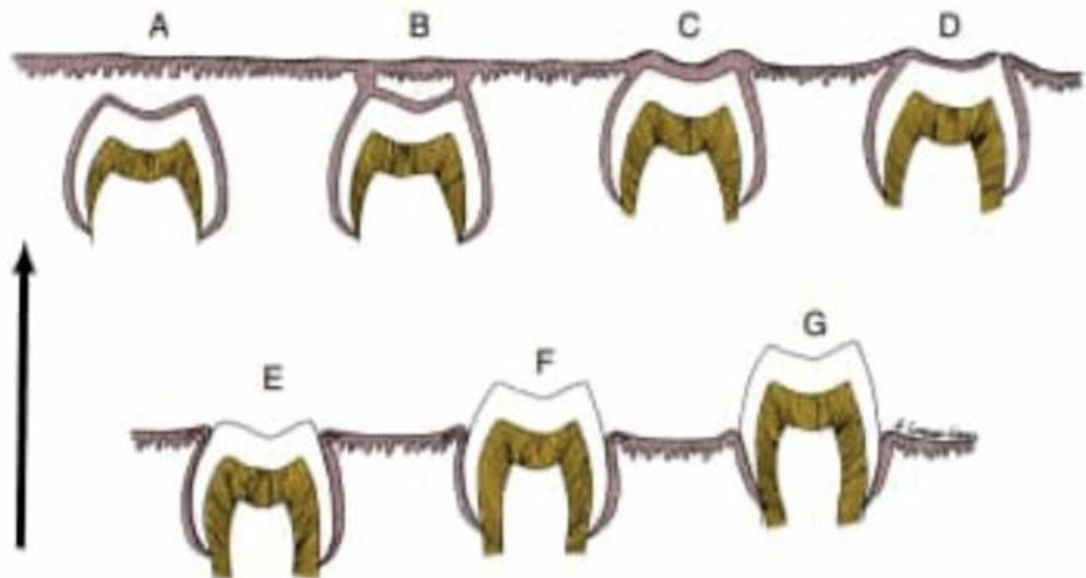


Diagram of a developing eruption pathway. **A**, Early developing eruption pathway **B**, Resorption of bone in eruption pathway (From James K. Avery and Daniel J. Chiego: *Essentials of Oral Histology and Embryology*, 3rd Edition, Mosby).



write stages of tooth eruption from A to G

DRAW AND LABEL THE DIAGRAMS

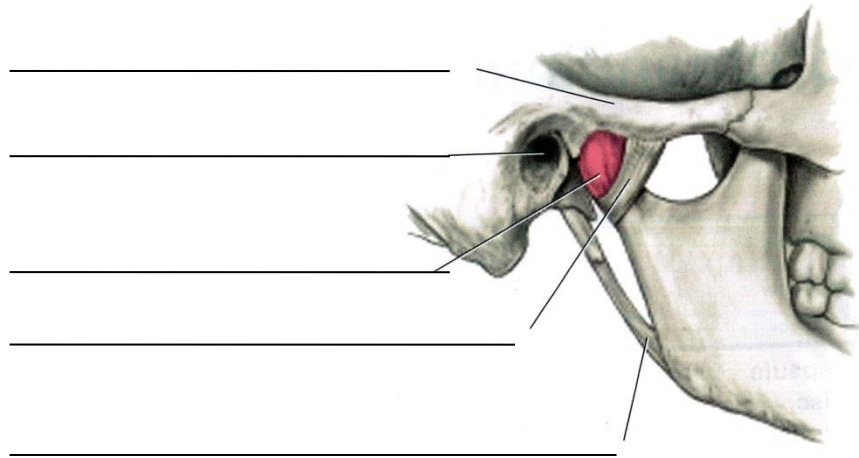
SHEDDING OF DECIDUOUS TEETH



BRIEFLY DESCRIBE PROCESS OF SHEDDING

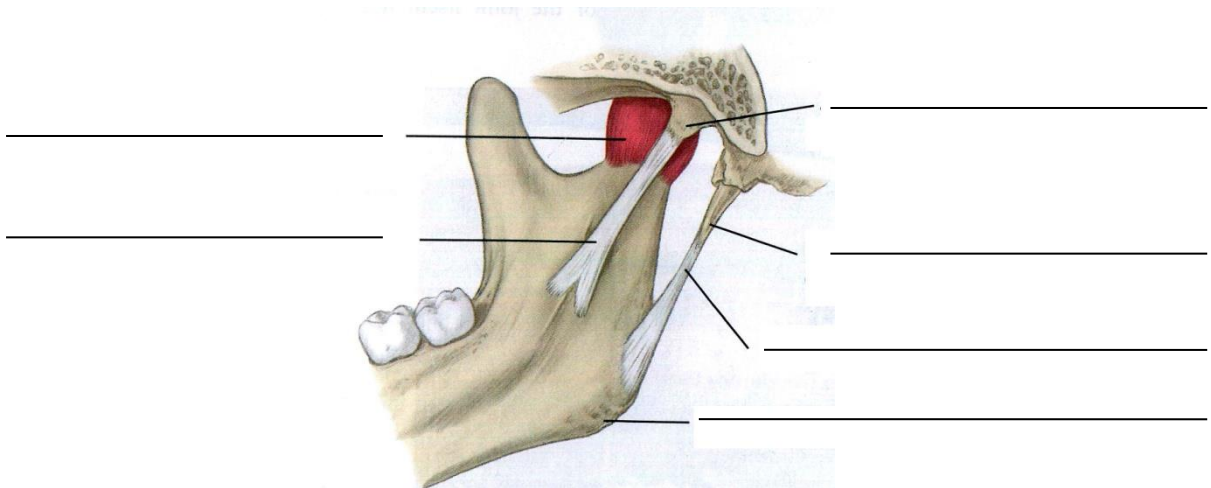
TEMPOROMANDIBULAR JOINT

Figure

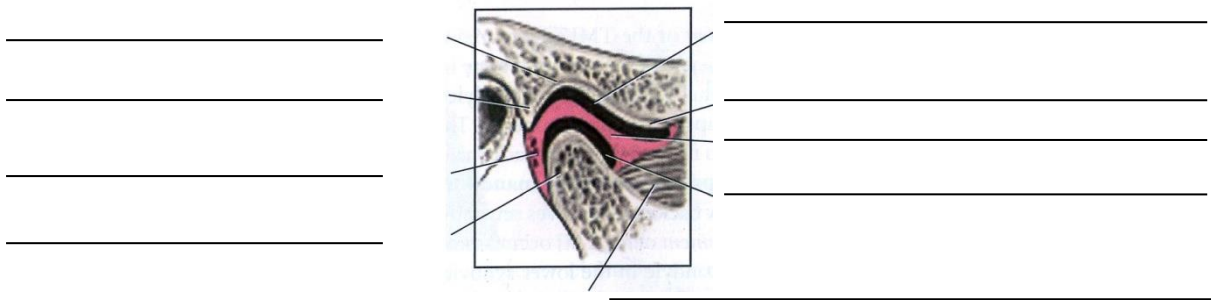


Temporomandibular Joint

Figure



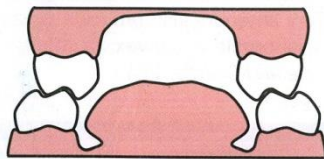
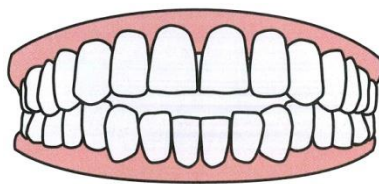
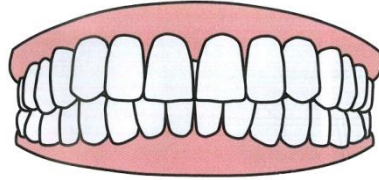
Figure



DRAW AND LABEL THE DIAGRAMS

OCCLUSION

Figure



Posterior (bilateral)



Anterior

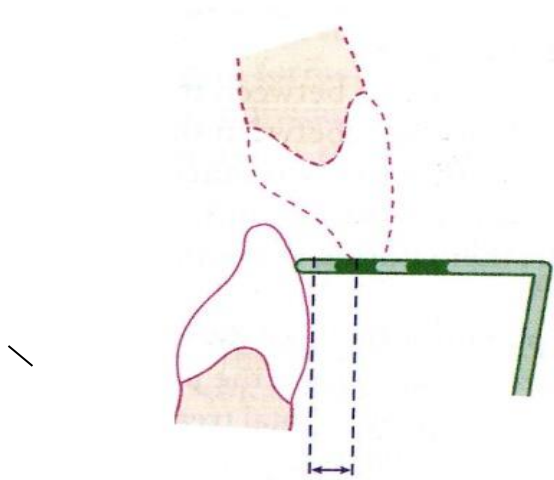


Posterior

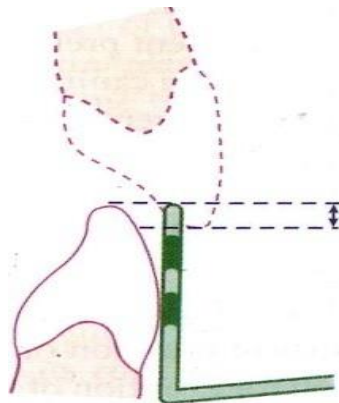
DRAW AND LABEL THE DIAGRAMS

OCCLUSION

Figure



Figure



Define over jet, overbite, canine relationship and molar relationship

DRAW AND LABEL THE DIAGRAMS

GUIDE LINES FOR DRAWING OF TEETH ACCORDING TO ITS MORPHOLOGY

Introduction

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8. To complete the root outline, follow the directions for developing the crown outline with the understanding that the cervical one third to one half of the root width generally approximates the cervical width of the crown before it starts to narrow considerably to form the root apex.
9. Shading or stippling of the features may now be added, if desired. An evaluation form for the drawings for use by both the student and instructor is also included in the workbook. Multiple copies of the form may be copied if needed.

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Cervico-incisal Length of Crown	8.5
Length of Root	14.0
Mesiodistal Diameter of Crown	7.0
Mesiodistal Diameter of CEJ	5.0
Buccolingual Diameter	7.5
Buccolingual Diameter of CEJ	6.5
Curvature of CEJ—Mesial	1.0
Curvature of CEJ—Distal	0.0

*In millimeters; adapted from Nelson SJ: *Wheeler's Dental Anatomy, Physiology, and Occlusion*, ed 9, WB Saunders, Philadelphia, 2009.

CEJ = cementoenamel junction

CHECKLIST FOR PERMANENT MANDIBULAR FIRST PREMOLAR	
Features Noted	Features Present
Crown Features	
Smaller lingual cusp of two with buccal ridge	
Occlusal table with marginal ridges and cusps, with tips, ridges, inclined planes, and grooves, fossae, pits	
Shorter mesial cusp slope, mesiolingual groove, deeper mesial CEJ curvature	
Mesial and distal contact is just cervical to the junction of occlusal and middle thirds	
Root Features	
Single rooted	
Proximal root concavities	

CEJ = cementoenamel junction

DIMENSIONS OF PERMANENT MANDIBULAR SECOND PREMOLAR*	
Cervico-incisal Length of Crown	8.0
Length of Root	14.5
Mesiodistal Diameter of Crown	7.0
Mesiodistal Diameter of CEJ	5.0
Buccolingual Diameter	8.0
Buccolingual Diameter of CEJ	7.0
Curvature of CEJ—Mesial	1.0
Curvature of CEJ—Distal	0.0

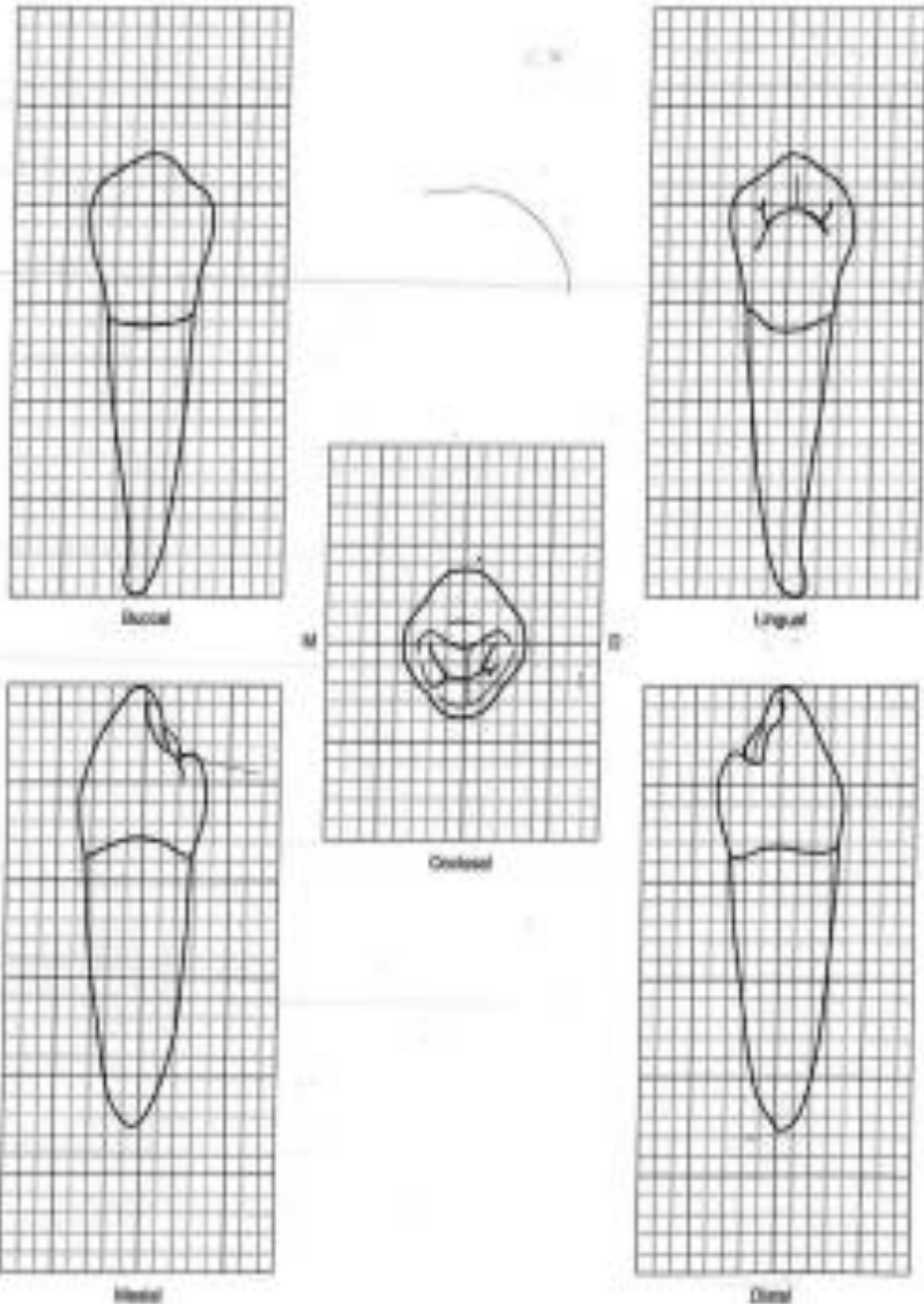
*In millimeters; adapted from Nelson SJ: *Wheeler's Dental Anatomy, Physiology, and Occlusions*, ed 9, WB Saunders, Philadelphia, 2009.

CEJ = cementoenamel junction

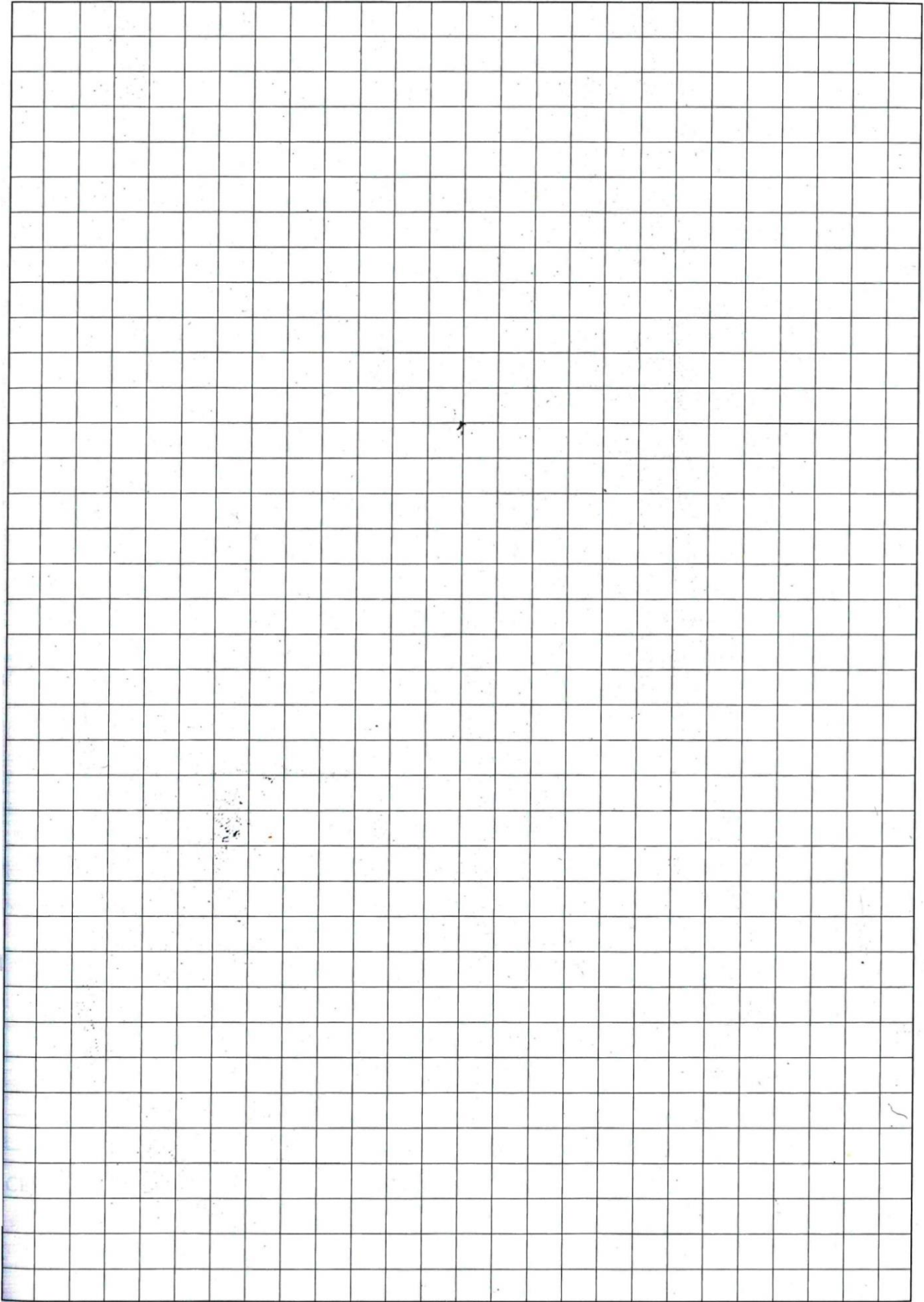
CHECKLIST FOR PERMANENT MANDIBULAR SECOND PREMOLAR	
Features Noted	Features Present
Crown Features	
Usually three cusps present with buccal ridge	
Occlusal table with marginal ridges and cusps, with tips, ridges, inclined planes, and grooves (usually U-shaped groove pattern with increased supplemental grooves), fossae, pits	
Distal marginal ridge more cervically located, so more occlusal surface visible from distal view	
Mesial and distal contact is just cervical to the junction of occlusal and middle thirds	
Root Features	
Single rooted	
Proximal root concavities	

MANDIBULAR 1ST PREMOLAR

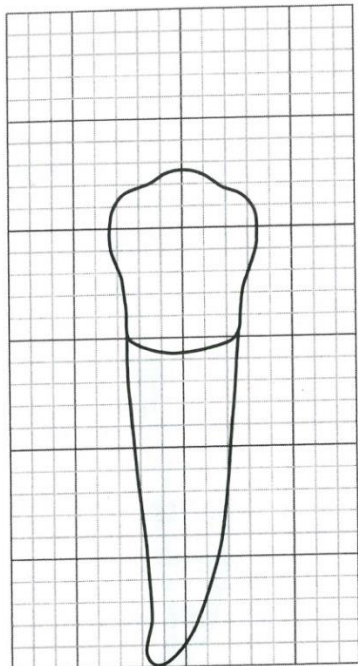
180 GUIDELINES FOR TOOTH DRAWING



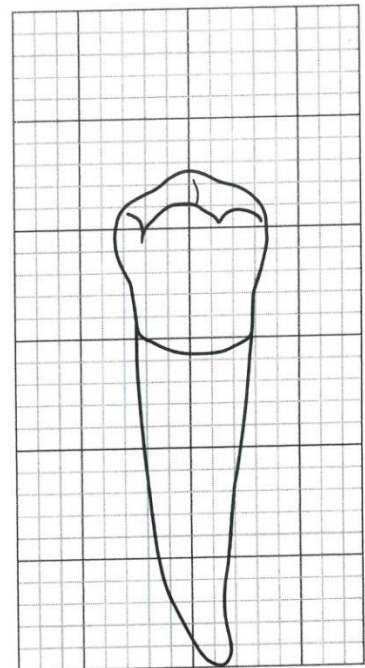
Various Outline Views of a Permanent Mandibular Right First Premolar



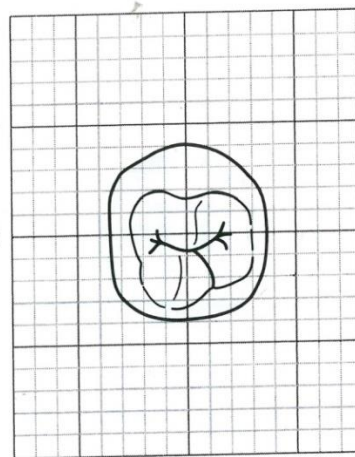
MANDIBULAR 2ND PREMOLAR



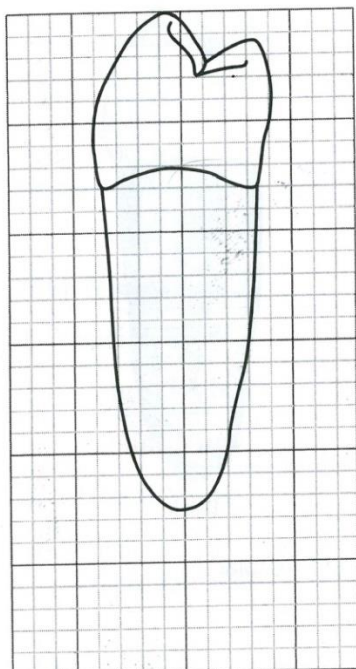
Buccal



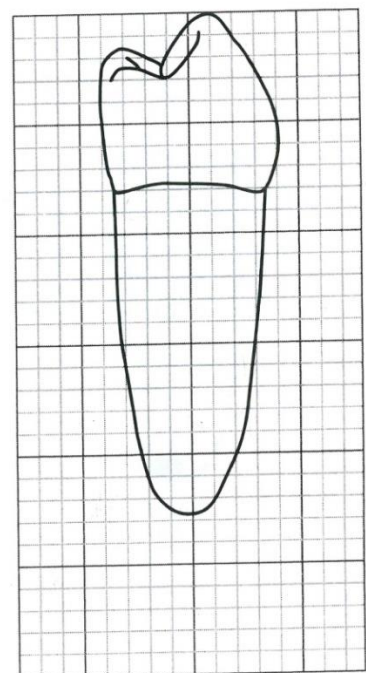
Lingual



Occlusal

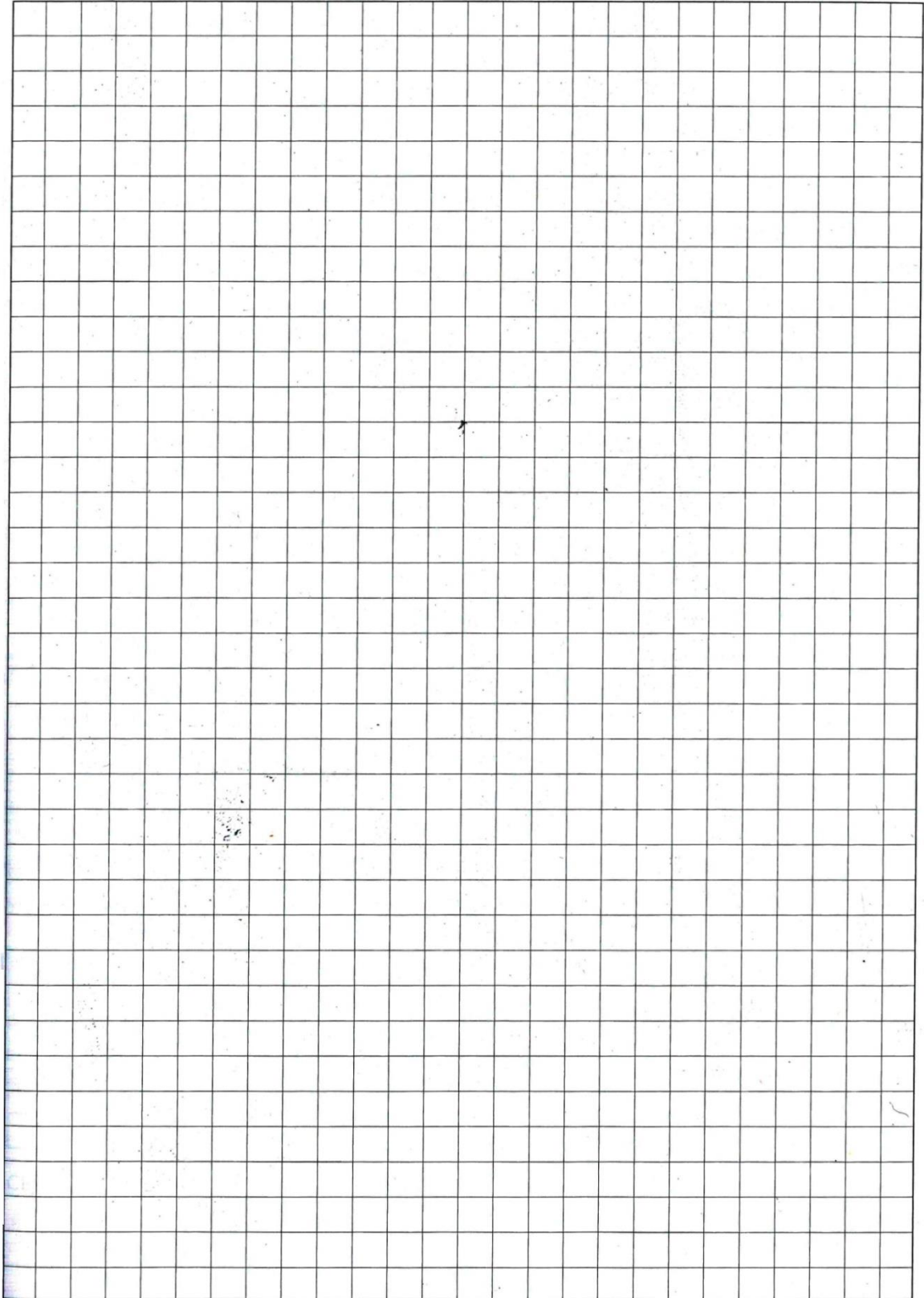


Mesial



Distal

Various Outline Views of a Permanent Mandibular Right Second Premolar



DIMENSIONS OF PERMANENT MAXILLARY FIRST MOLAR*		
Cervico-incisal Length of Crown	Buccal: 7.0	Lingual: 6.0
Length of Root	Buccal: 12	Lingual: 13
Mesiodistal Diameter of Crown	10.0	
Mesiodistal Diameter of CEJ	8.0	
Buccolingual Diameter	11.0	
Buccolingual Diameter of CEJ	10.0	
Curvature of CEJ—Mesial	1.0	
Curvature of CEJ—Distal	0.0	

*In millimeters; adapted from Nelson SJ: *Wheeler's Dental Anatomy, Physiology, and Occlusion*, ed 9, WB Saunders, Philadelphia, 2009.

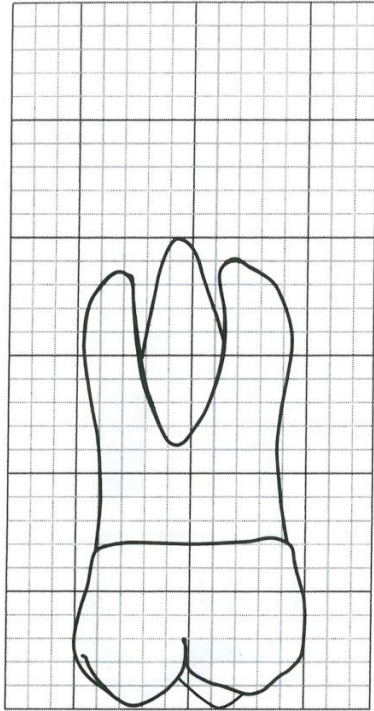
CHECKLIST FOR PERMANENT MAXILLARY FIRST MOLAR	
Features Noted	Features Present
Crown Features	
Four major cusps, with buccal cusps almost equal in height and fifth minor cusp of Carabelli associated with mesiolingual cusp and groove	
Buccal cervical ridge	
Mesiolingual cusp outline longer and larger, but not as sharp as distolingual cusp	
Occlusal table with prominent oblique ridge, marginal ridges and cusps, with tips, ridges, inclined planes, and grooves, fossae, pits	
Mesial contact is at junction of occlusal and middle thirds	
Distal contact at middle third	
Root Features	
Trifurcated roots with furcations, root trunks, and root concavities	
Divergent roots with furcations well removed from the CEJ	

DIMENSIONS OF PERMANENT MANDIBULAR FIRST MOLAR*	
Cervico-incisal Length of Crown	7.5
Length of Root	14.0
Mesiodistal Diameter of Crown	11.0
Mesiodistal Diameter of CEJ	9.0
Buccolingual Diameter	10.5
Buccolingual Diameter of CEJ	9.0
Curvature of CEJ—Mesial	1.0
Curvature of CEJ—Distal	0.0

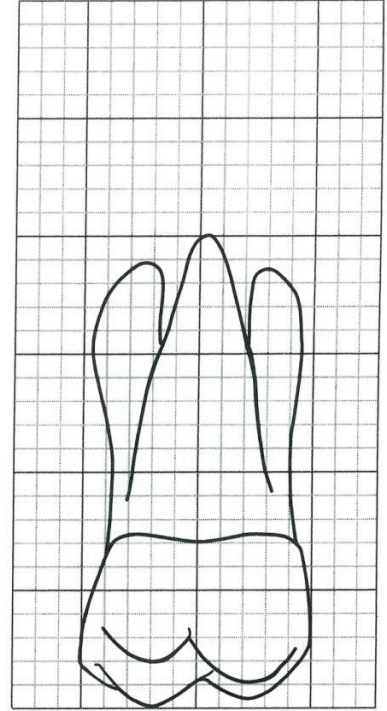
*In millimeters; adapted from Nelson SJ: *Wheeler's Dental Anatomy, Physiology, and Occlusions*, ed 9, WB Saunders, Philadelphia, 2009.

CHECKLIST FOR PERMANENT MANDIBULAR FIRST MOLAR	
Features Noted	Features Present
Crown Features	
Five cusps with Y-shaped groove pattern and with buccal groove	
Buccal cervical ridge	
Distal cusp is smallest	
Occlusal table with marginal ridges and cusps, with tips, ridges, inclined planes, and grooves, fossae, pits	
Mesial and distal contact is at junction of occlusal and middle thirds	
Root Features	
Bifurcated roots with furcations, root trunks, and root concavities	
Divergent roots with furcations well removed from the CEJ	

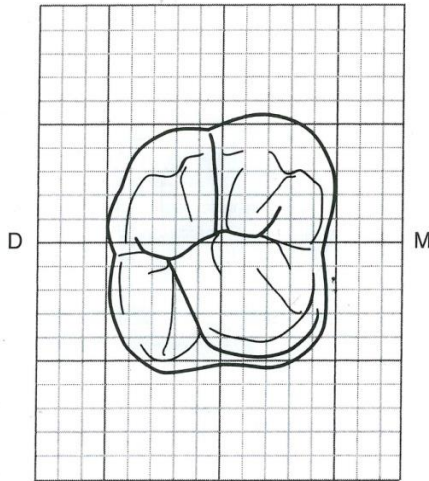
MAXILLARY 1ST MOLAR



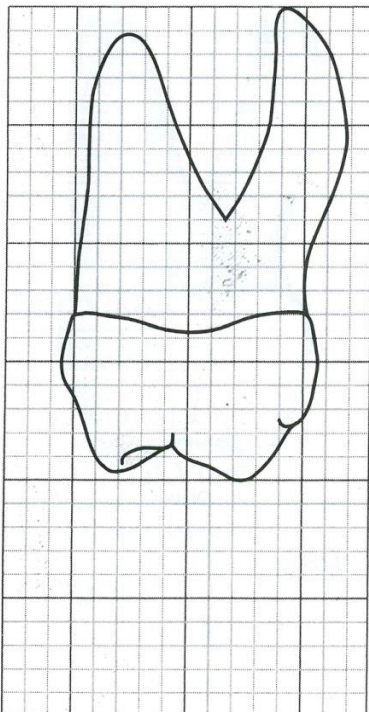
Buccal



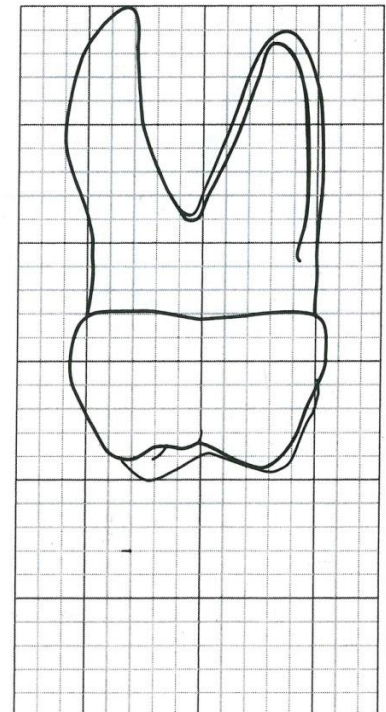
Lingual



Occlusal

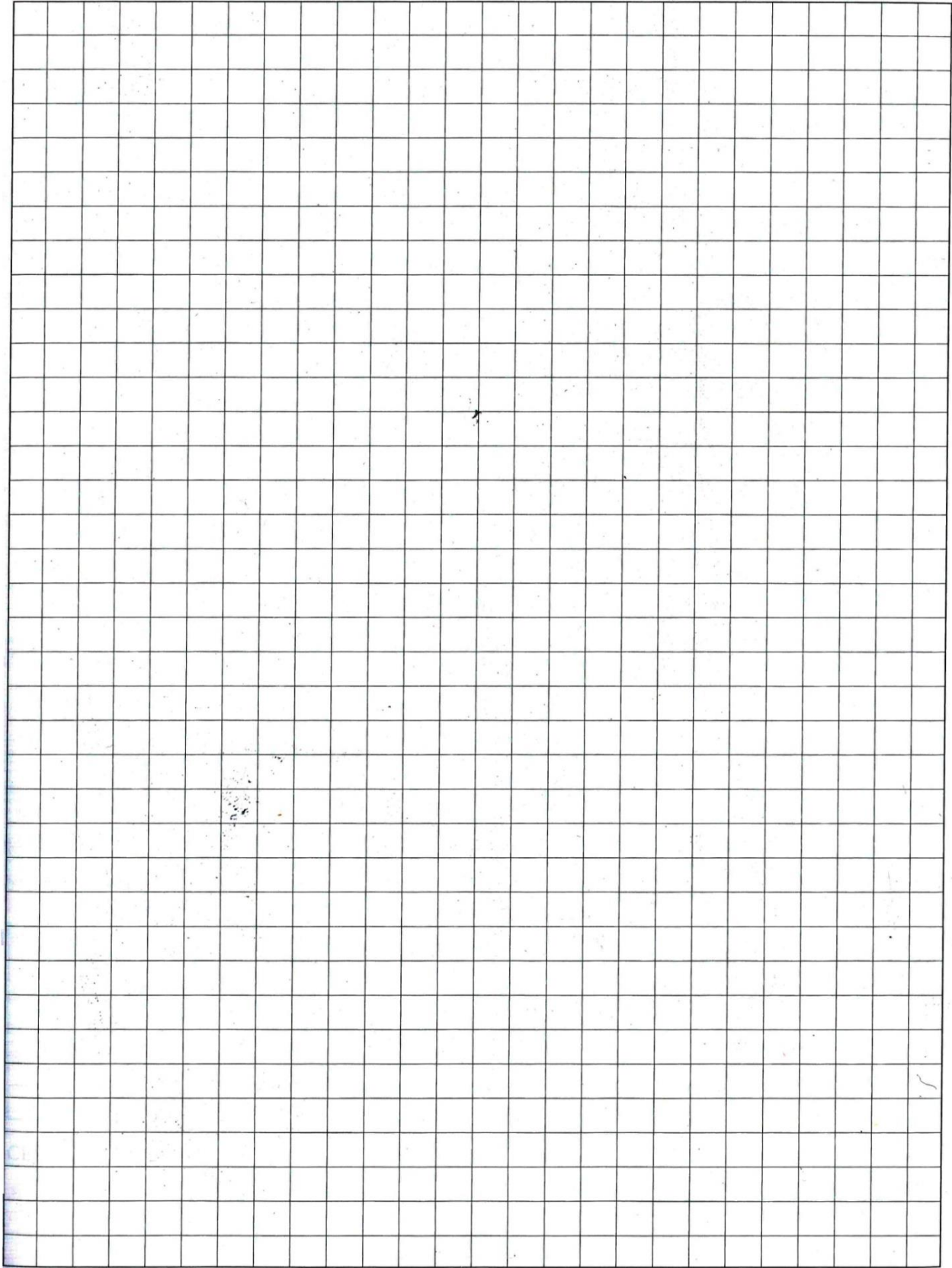


Mesial

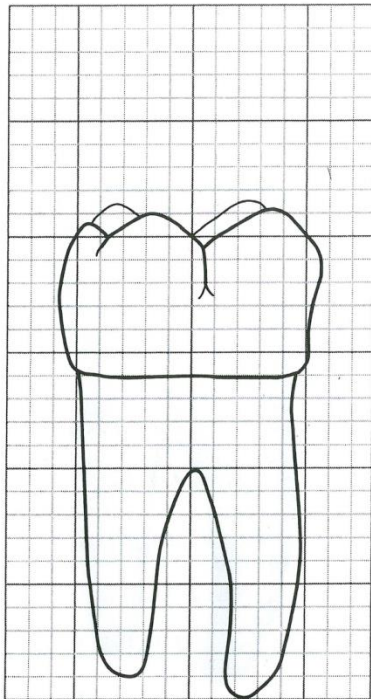


Distal

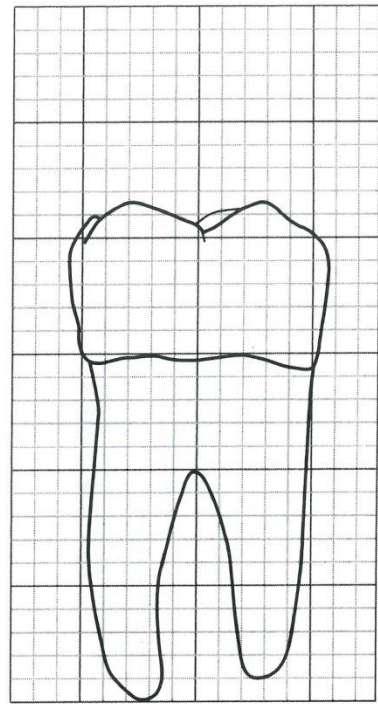
Various Outline Views of a Permanent Maxillary Right First Molar



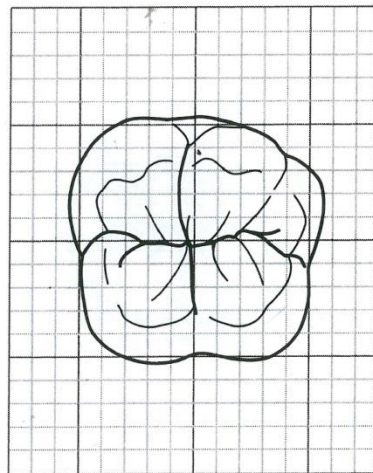
MANDIBULAR 1ST MOLAR



Buccal



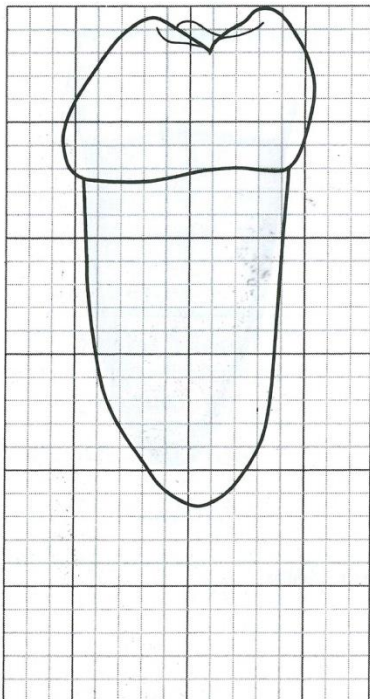
Lingual



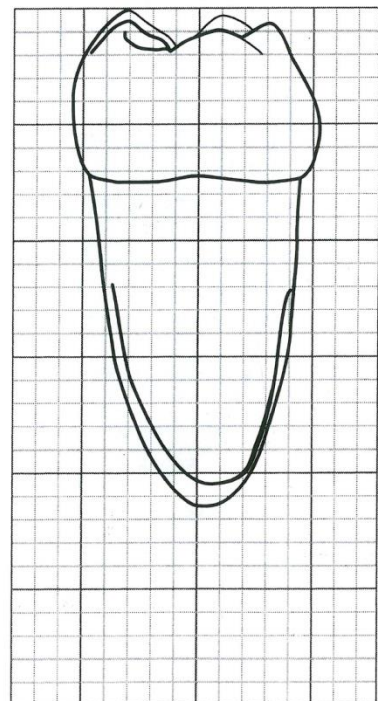
Occlusal

M

D

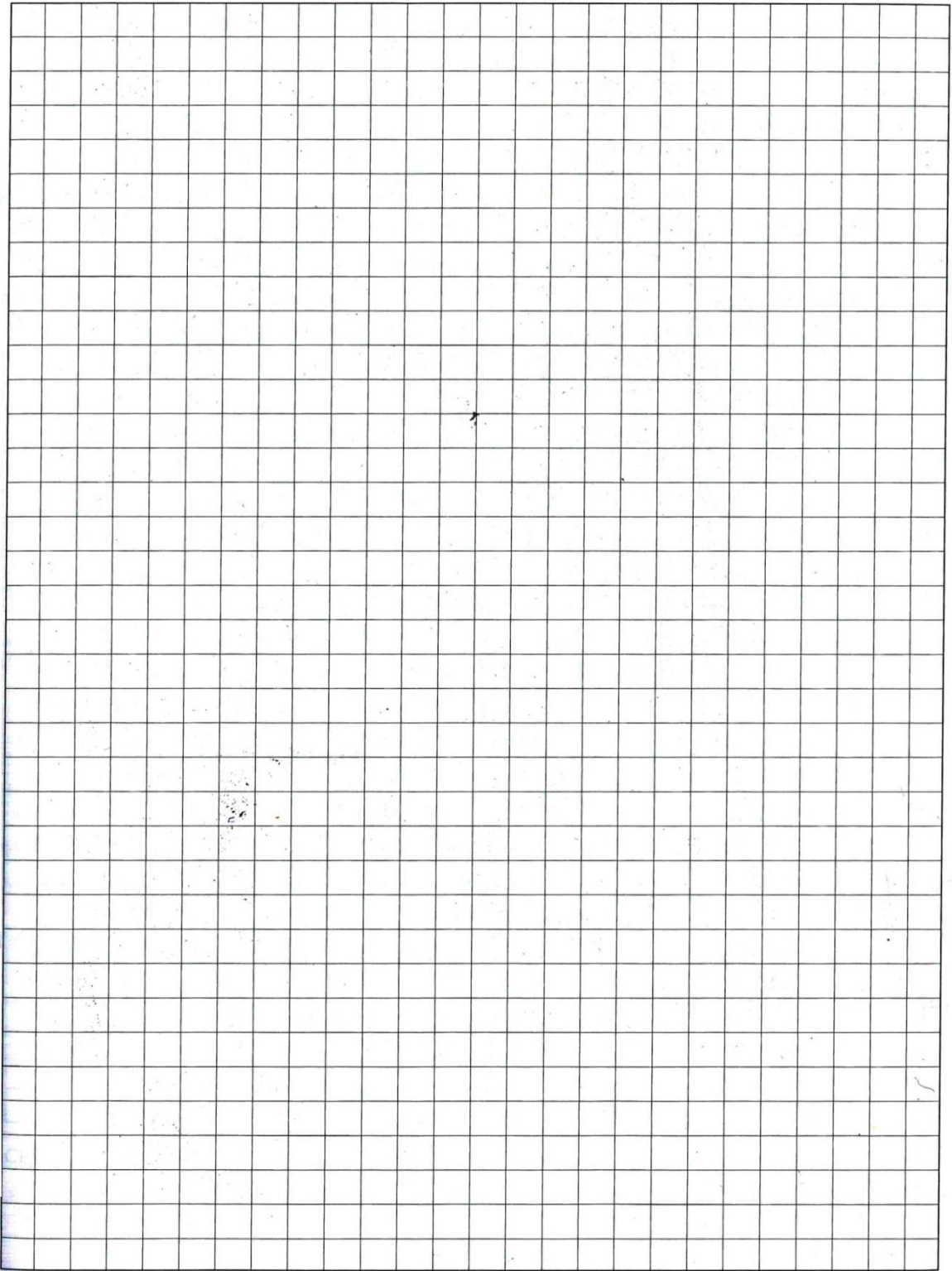


Mesial



Distal

Various Outline Views of a Permanent Mandibular Right First Molar



DIMENSIONS OF PERMANENT MAXILLARY SECOND MOLAR*		
Cervico-incisal Length of Crown	Buccal: 6.5	Lingual: 5.5
Length of Root	Buccal: 11	Lingual: 12
Mesiodistal Diameter of Crown	9.0	
Mesiodistal Diameter of CEJ	7.0	
Buccolingual Diameter	11.0	
Buccolingual Diameter of CEJ	10.0	
Curvature of CEJ—Mesial	1.0	
Curvature of CEJ—Distal	0.0	

*In millimeters; adapted from Nelson SF: Wheeler's Dental Anatomy, Physiology, and Occlusions, ed 9, WB Saunders, Philadelphia, 2009.

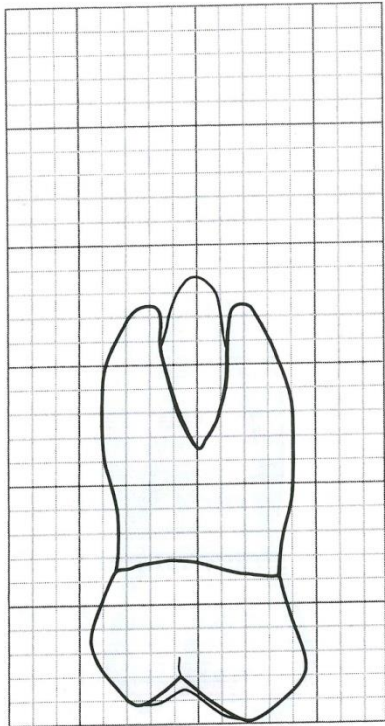
CHECKLIST FOR PERMANENT MAXILLARY FIRST MOLAR	
Features Noted	Features Present
Crown Features	
Four cusps usually	
Buccal cervical ridge	
Mesiobuccal cusp longer than distobuccal cusp; distolingual cusp usually smaller	
Occlusal table with less prominent oblique ridge, marginal ridges and cusps, with tips, ridges, inclined planes, and grooves, fossae, pits	
Mesial contact at middle third	
Distal contact at middle third	
Root Features	
Trifurcated roots with furcations, root trunks, and root concavities	
Less divergent roots	

DIMENSIONS OF PERMANENT MANDIBULAR SECOND MOLAR*	
Cervico-incisal Length of Crown	7.0
Length of Root	13.0
Mesiodistal Diameter of Crown	10.5
Mesiodistal Diameter of CEJ	8.0
Buccolingual Diameter	10.0
Buccolingual Diameter of CEJ	9.0
Curvature of CEJ—Mesial	1.0
Curvature of CEJ—Distal	0.0

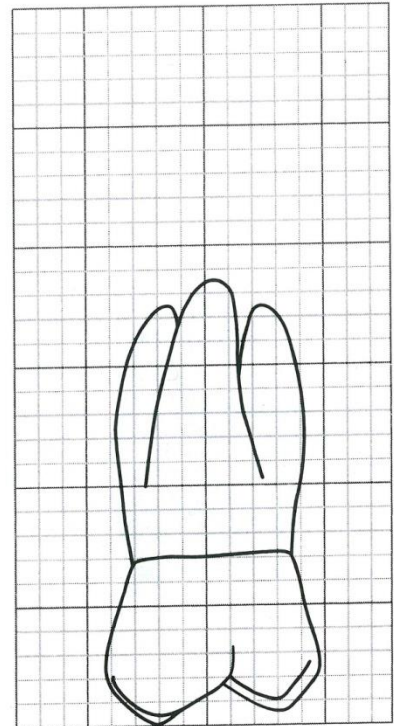
*In millimeters; adapted from Nelson SJ: *Wheeler's Dental Anatomy, Physiology, and Occlusions*, ed 9, WB Saunders, Philadelphia, 2009.

CHECKLIST FOR PERMANENT MANDIBULAR SECOND MOLAR	
Features Noted	Features Present
Crown Features	
Four cusps with cross-shaped groove pattern	
Buccal cervical ridge	
Wider mesial proximal surface than distal	
Occlusal table with marginal ridges and cusps, with tips, ridges, inclined planes, and grooves, fossae, pits	
Mesial and distal contact is at middle third	
Root Features	
Bifurcated roots with furcations, root trunks, and root concavities	
Less divergent roots with furcations closer to CEJ	

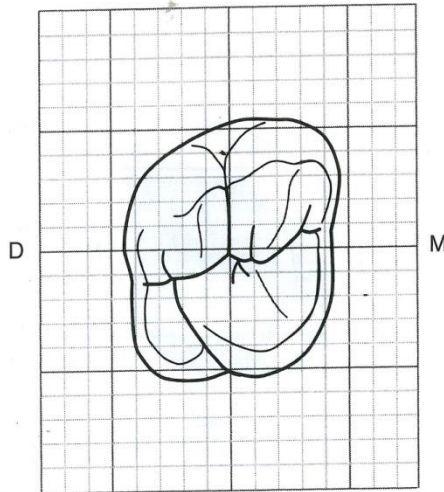
MAXILLARY 2ND MOLAR



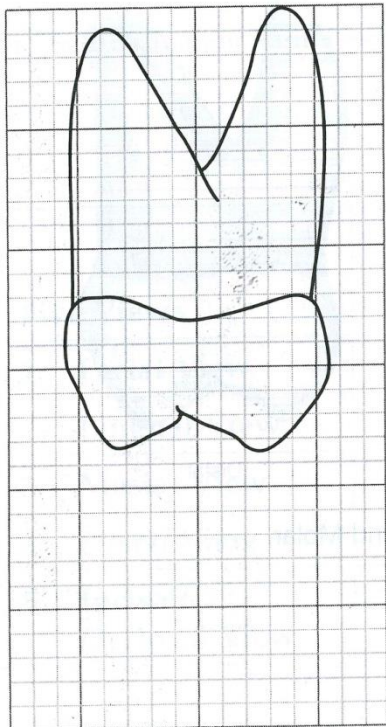
Buccal



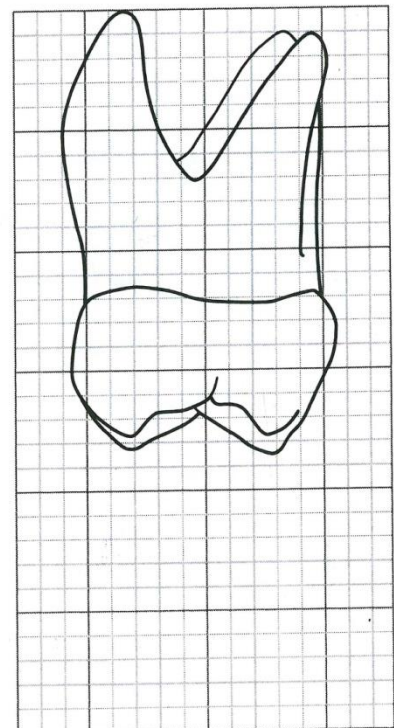
Lingual



Occlusal

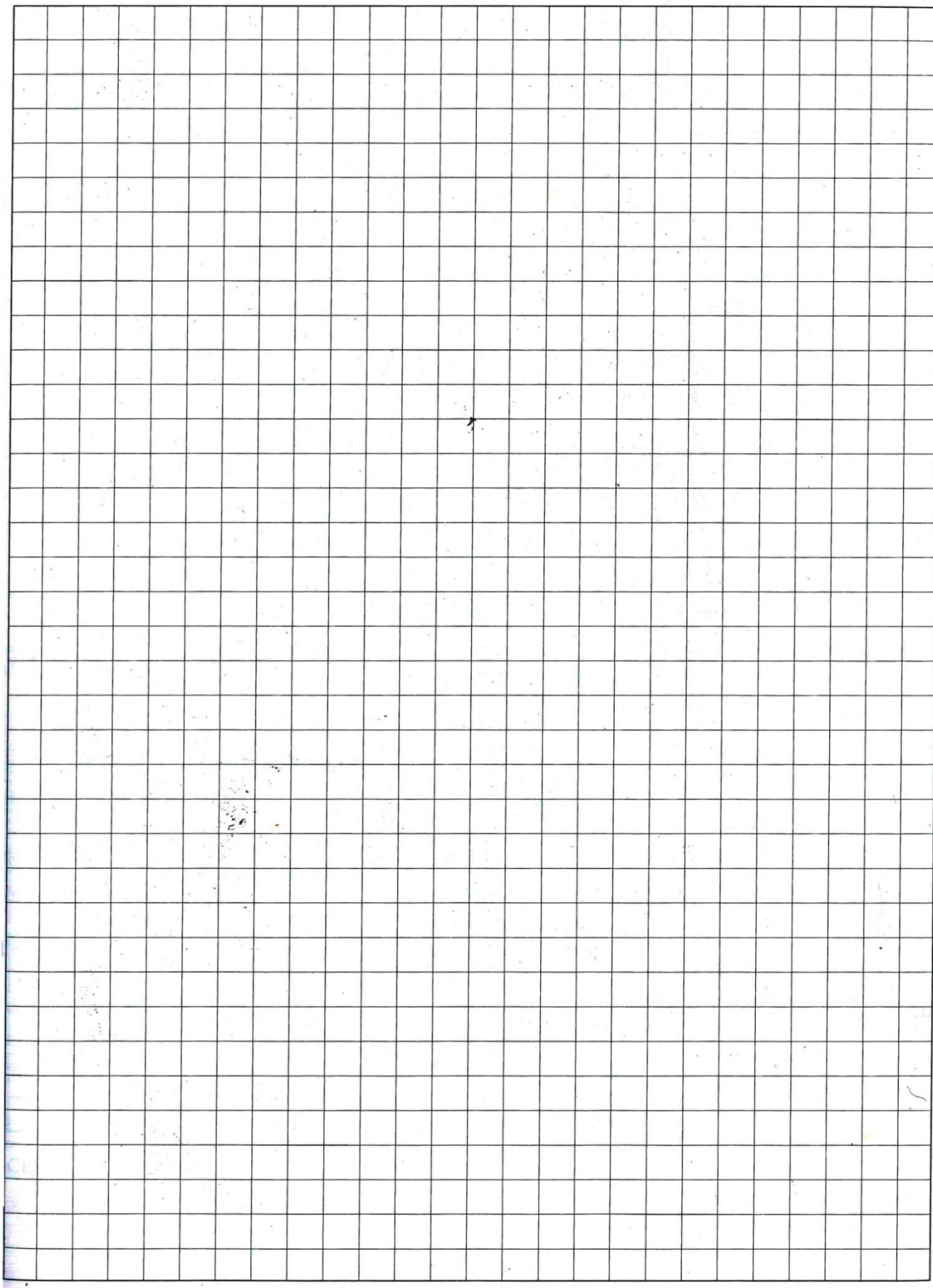


Mesial

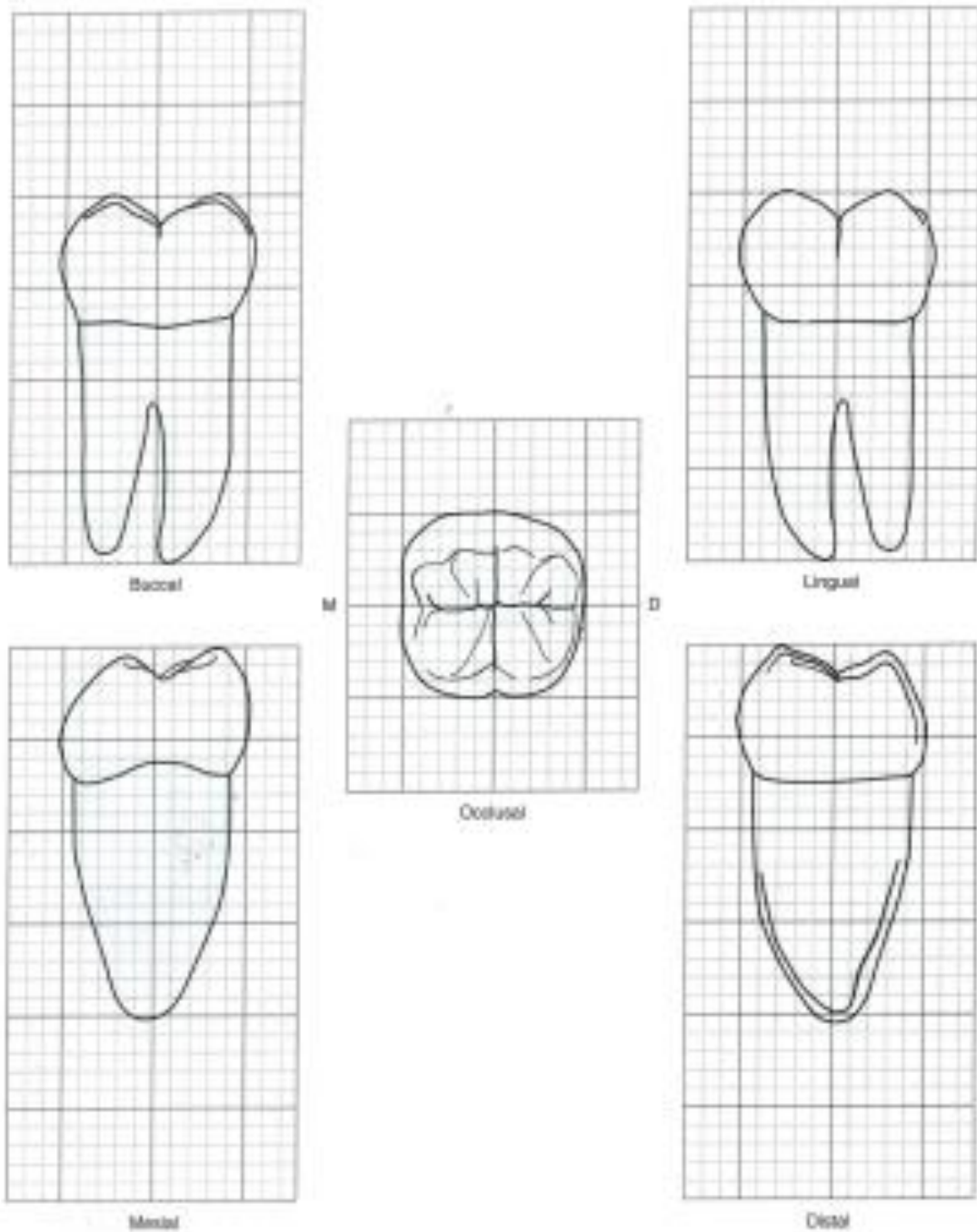


Distal

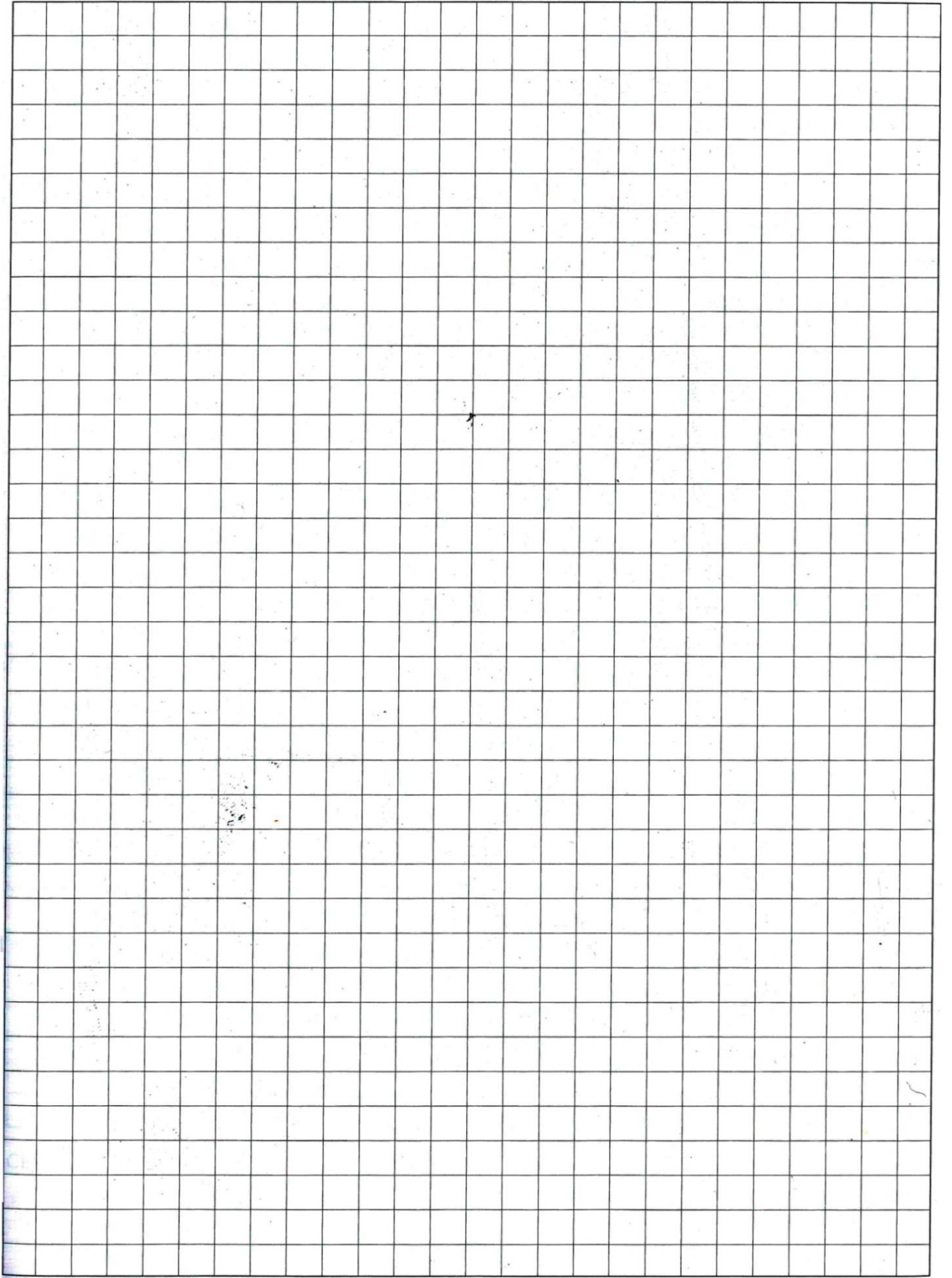
Various Outline Views of a Permanent Maxillary Right Second Molar



MANDIBULAR 2ND MOLAR



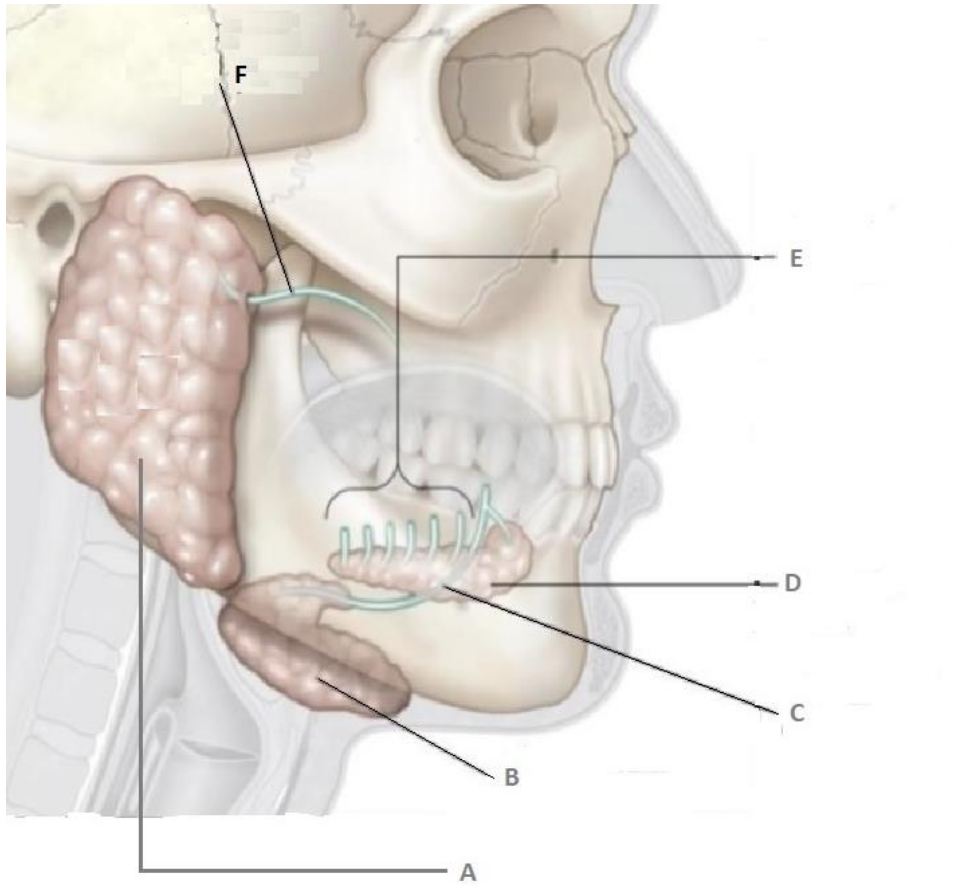
Various Outline Views of a Permanent Mandibular Right Second Molar



Block C
MODULE 5, 6 AND 7
GIT, UGS AND CARDIOPULMONARY

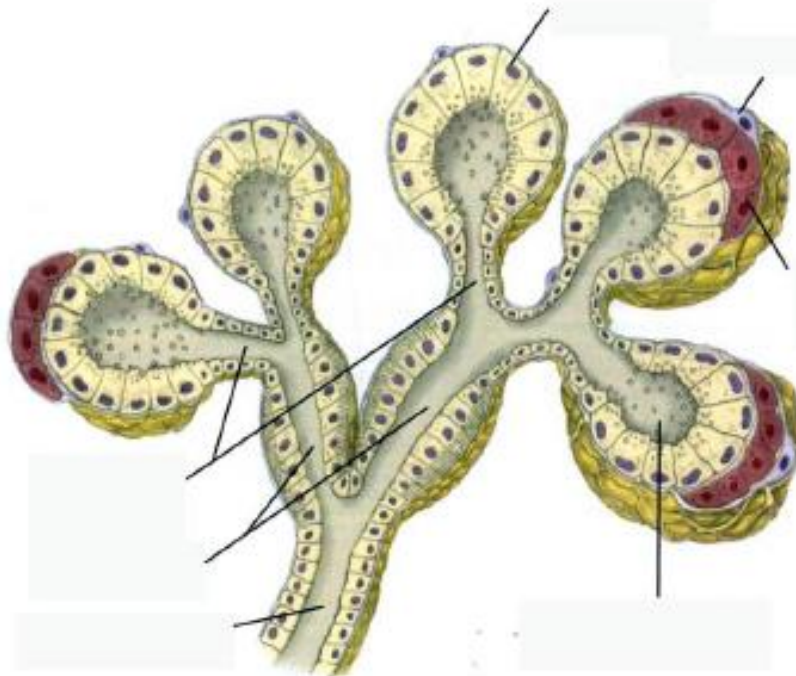
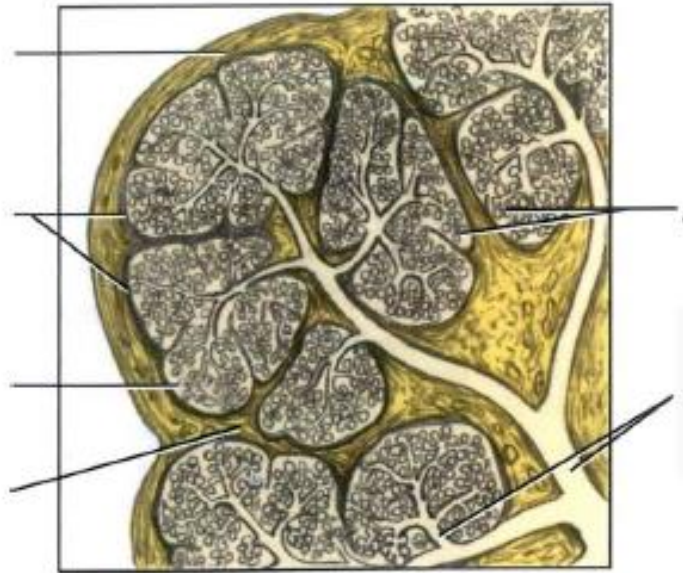
MAJOR SALIVARY GLANDS AND ITS DUCTS

LABEL THE FIGURE MARKED A, B, C, D, E AND F



SALIVARY GLAND APPARATUS

LABEL THE DIAGRAMS



SALIVARY GLAND SECRETION

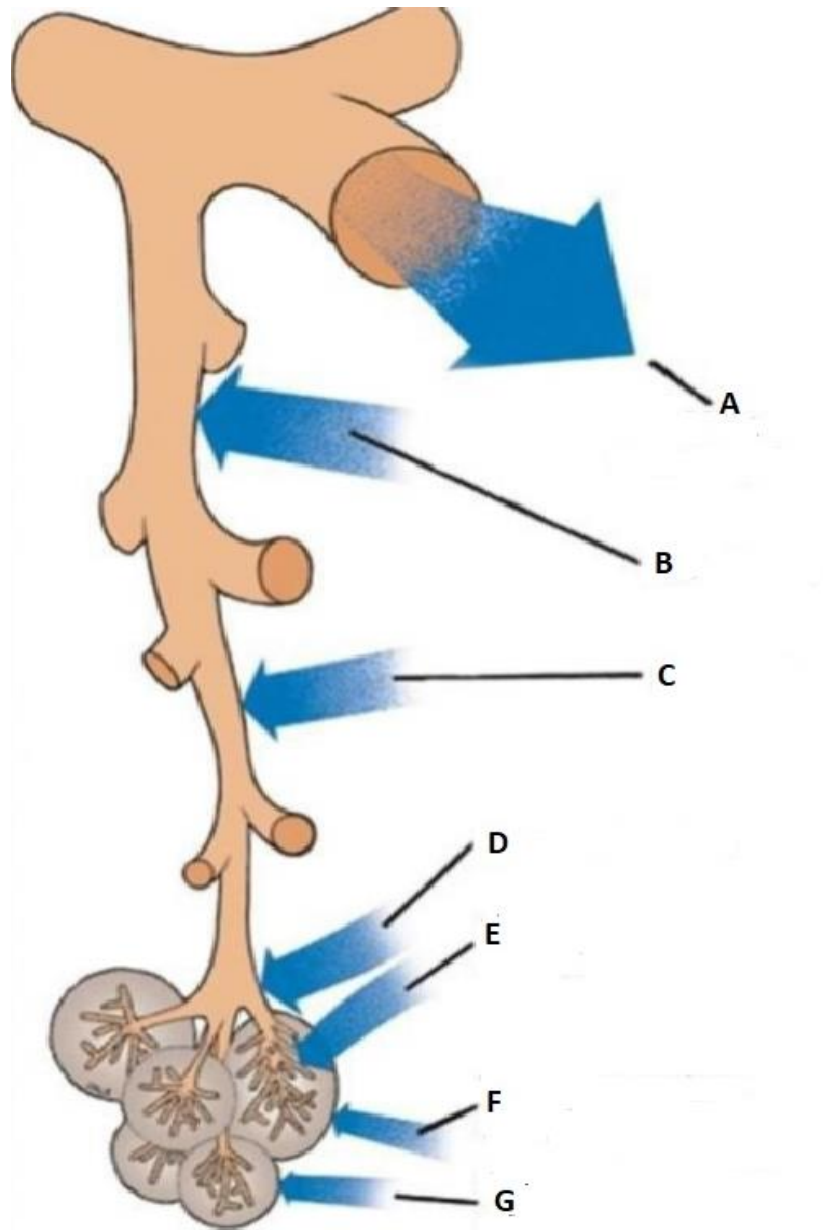
Secretion of Saliva (800-1500 mL/day; pH: 6.0-7.0, suitable for ptyalin; has K and bicarbonate

Salivary Glands	Secretion
Parotid	Serous
Submandibular	Serous and mucus
Sublingual	Serous and mucus
Buccal	Mucus

Serous-has ptyalin for starch digestion (thin watery secretions)

Mucus-has mucin for lubrication and surface protection (viscous secretions)

SALIVARY GLAND DUCT



**DRAW AND LABEL THE DIAGRAM MARKED A, B,
C, D, E, F AND G**

REFERENCE BOOKS

- 1) Orban's Oral Histology and Embryology.
- 2) Ten Cate's Oral Histology.
- 3) James L. Fuller Concise Dental Anatomy and Morphology.
- 4) Nelson SJ: Wheeler's Dental Anatomy, Physiology and occlusion.



PRIME MODULE

Introduction

The PRIME (Professionalism, Research, Identity formation, Management and leadership, and Ethics) curriculum, devised by the Institute of Health Professions Education & Research at Khyber Medical University, is a forward-thinking approach aimed at nurturing future doctors with a profound sense of societal care and empathy. This comprehensive module spans all four years of BDS training, encompassing disciplines such as behavioral sciences, medical education, research, management, leadership, and ethics. Furthermore, it incorporates essential subjects like Islamic studies and Pakistan studies, intended to foster a strong sense of Muslim and Pakistani identity, laying a foundational groundwork before professional identity formation within medicine.

The provided document outlines the module's topics, learning objectives, their sequential placement over the course of 1st year BDS, hours allocation, and assessment strategies. The initial segment of the module study guide elucidates general learning outcomes, while the subsequent portion delves into detailed learning objectives and a comprehensive table of specifications.

In addition to emphasizing professional competency, the PRIME curriculum underscores the significance of broader societal awareness, cultural identity, and ethical grounding in medical practice. This holistic approach aims to produce well-rounded medical professionals capable of navigating the complexities of healthcare with integrity and compassion.

General Learning Objectives

By the end of 1st year BDS, the students should be able to.

1. Describe the Bio-Psycho-Social model of healthcare.
2. Correlate health with Behavioral sciences.
3. Recognize the importance of behavioral sciences in healthcare.
4. Define and describe attitudes in healthcare professionals.
5. Identify factors affecting attitudes.
6. Define attention, concentration, and personality.
7. Explore factors influencing attention, concentration, and personality development.
8. Define motivation and its types.
9. Explain stress and its management strategies.
10. Recognize the relationship between stress, stressors, and illness.
11. Describe coping skills and psychological defense mechanisms.
12. Define professionalism and its attributes.
13. Discuss dynamics of professionalism and trust in healthcare settings.
14. Explain emotional and social intelligence.
15. Display appropriate emotional and social intelligence in various contexts.

BDS PRIME Module – 1st Year

16. Prepare personal development plans and reflective portfolios.
17. Discuss the concept of professional identity formation and its components.
18. Display cultural sensitivity and awareness of individual differences.
19. Demonstrate effective verbal and non-verbal communication skills.
20. Demonstrate the principles of equality, equity, and confidentiality in communication.
21. Differentiate between leadership and management.
22. Discuss various attributes and styles of leadership.
23. Explain ethical principles and their application in healthcare.

BDS PRIME Module – 1st Year

Topic	Contents	Learning Objectives	Teaching Method	Module	Hours	Assessment
Behavioral Sciences						
Model of healthcare	Bio-Psycho-Social model of health care Health and behavioral sciences	1. Describe Bio-Psycho-Social model of health care 2. Correlate health with Behavioral sciences. 3. Describe Important of behavioral sciences in health.	Lecture/ SGD	Foundation	1	MCQs / OSPE
Affective domain	Attitude	4. Describe Attitudes in health professionals	Lecture/ SGD	Blood	1	MCQs / OSPE
	Attention and concentration	5. Describe factors affecting it. 6. Define attention and concentration.	Lecture/ SGD			
	Personality	8. Define personality. 9. Describe factor affecting personality development.	Lecture/ SGD	Craniofacial	1	MCQs / OSPE
	Motivation	10. Define motivation and describe the types of motivation.	Lecture/ SGD			

BDS PRIME Module – 1st Year

Stress	Stress and its management	11. Define and classify stress and stressors. Describe relationship of stress and stressor with illness. 12. Describe the concept of life events and their relationship with stress and illness.	Lecture/ SGD	Cervico-facial	1	MCQs / OSPE
	Coping skills and Defense mechanism	13. Describe the concepts of adjustment and maladjustment? 14. Explain coping skills and describe the psychological defense mechanisms.	Lecture/SGD	Cervico-facial	1	MCQs / OSPE
Professionalism						
Introduction and Dynamics to Professionalism	Definition of a professionalism, behavior's, attitudes, emotions, and their attributes.	15. Define Professionalism, and its attributes	Lectures/ SGD / Role Play	Foundation	2	MCQs / OSPE
Attributes of professionalism	Differences between empathy and sympathy	16. Discriminate between empathy and sympathy				
Dynamics of Professionalism	Trust definition, its attributes, and components, and its' application	17. Explain Dynamics of trust in health professional-patient relationship				

BDS PRIME Module – 1st Year

Professional identity formation (PIF)	White coat ceremony, Types, multiple identities, Components, Professional identity formation	18. Students' roles in terms of professional identity	White coat ceremony	Foundation	2	MCQs/ OSPE
Attributes	Accept errors and mistakes in responsible manner	19. Accept errors and mistakes in responsible manner	Lecture	Blood	1	MCQs/ OSPE
PIF	Identifies his own strengths and weaknesses	20. Identifies his own strengths and weaknesses	Lecture/ SGD /Role Play	Blood	1	MCQs/ OSPE Portfolio
Emotional intelligence	Emotional and social intelligence in given contexts	21. Describe & display appropriate emotional and social intelligence.	Lecture/ SGD /Role Play	Cranio-facial	1	MCQs/ OSPE
Personal Development Plan (PDP)	Personal development plan & reflective portfolios	22. Prepare personal development plan & reflective portfolios.	Lecture/ SGD	Cervico-facial	2	Assignment
Social accountability	Describe social accountability	23. Definition, types, components, theoretical background.	Lecture/ SGD	GIT & UGS	1	MCQ

BDS PRIME Module – 1st Year

Communication Skills

Cultural sensitivity	Concepts of Equality and Equity, Cultural sensitivities.	24. Display sensitivity towards individual and cultural differences keeping in view the principles of equality and equity.	Lecture equity, equality/Role play,	Blood	2	MCQs/ OSPE
Teamwork	Dynamics of Teamwork	25. Display teamwork in group activities for creativity and problem solving.	Role play/SGD	Blood		
Communicating with	Share with administration on matters	26. Communicate with administration effectively.	DME Orientation session / Role play	Cranio-facial	2	MCQs/ OSPE
Communicate as a peer-teacher	Recognizing the limits of one's knowledge and skills; and to ensure the accuracy of teaching content delivered	27. Communicate with peer and teachers with respect.	Lecture / SGD			
	Evaluating the quality of teaching	Understanding of methods to evaluate the effectiveness and quality of teaching.				
Confidentiality	Confidentiality of colleague and patients. Appropriate use of social	28. Ensuring confidentiality	Lecture/Role play / SGD	Cervico-facial	1	MCQs/ OSPE
Communicate with media and press	Use of social media/blogs for communication Communicating with	29. Understanding of who should 30. give information to the media and press and what form it should take, including the need to maintain confidentiality where individual	Lecture/ SGD / Role Play	Cardio-pulmonary	1	Continuous MCQs/ OSPE

BDS PRIME Module – 1st Year

Leadership and Management

Introduction	Definition of a leader & manager Differences between leadership and management	31. Differentiate between leadership and management.	Lecture/ SGD	Blood	1	MCQ, SAQ MCQs/ OSPE
Self-management skills	What is self-management? Its importance. Self-management Mechanisms	32. Demonstrate self-management skills	Task/ SGD	GIT & UGS	2	
	Attributes and style of leadership	33. Describe different attributes and styles of leader in their own cultural context.	Lecture/ SGD			

Ethics

Ethical principles	Ethical principles. (Autonomy, Beneficence, Non-maleficence, Justice)	34. Explain the pillars of medical ethics and their application in different situations.	Lecture/ SGD	Cranio-facial	1	MCQs/ OSPE
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BDS PRIME Module – 1st Year