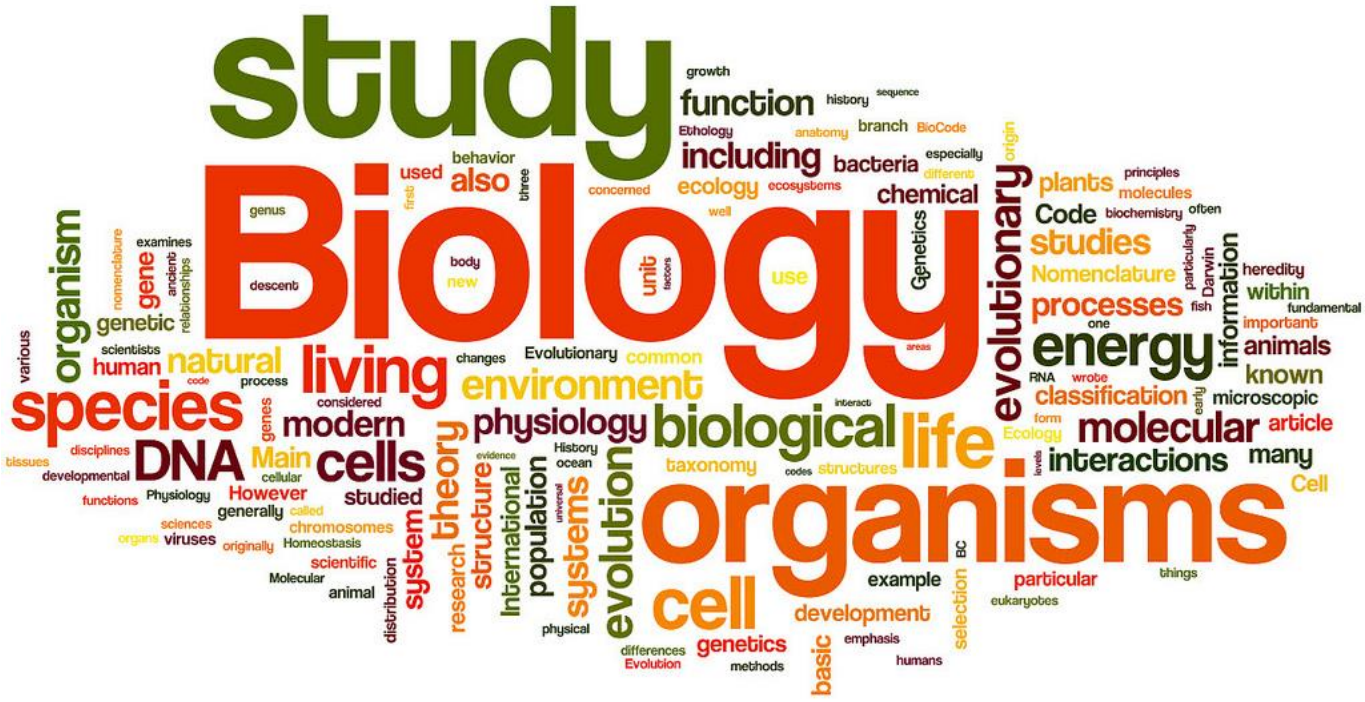
IB HL Biology Study Guide

Name: _____

Teacher: _____



*Keep this packet until AFTER you have taken your exams.

Command Words: What They Imply

Assessment Objective 1

Define	Give the precise meaning of a word, phrase or physical quantity
Draw	Represent by means of a labelled, accurate diagram or graph, using a pencil. A ruler (straight edge) should be used for should be used for straight lines. Diagrams should be drawn to scale. Graphs should have points correctly plotted (if appropriate) and joined in a straight line or smooth curve
Label	Add labels to a diagram
List	Give a sequence of brief answers with no explanation
Measure	Obtain a value for a quantity
State	Give a specific name, value or other brief answer without explanation or calculation (Factual)

Assessment Objective 2

Annotate	Add brief notes to a diagram or graph
Calculate	Obtain a numerical answer showing the relevant stages in the working (unless instructed not to do so)
Describe	Give a detailed account
Distinguish	Make clear the differences between two or more concepts or items
Estimate	Obtain an approximate value
Identify	Provide an answer from a number of possibilities
Outline	Give a brief account or summary (bullet format)

Assessment Objective 3

Analyze	Break down in order to bring out the essential elements or structure
Comment	Give a judgment based on a given statement or result of a calculation
Compare	Give an account if similarities between two (or more) items, referring to both (all) of them throughout.
Compare and Contrast	Given an account of similarities and differences between two (or more) items or situations, referring to both (all) of them throughout
Construct	Display information in a diagrammatic or logical form
Deduce	Reach a conclusion from the information given
Design	Produce a plan, simulation or model
Determine	Obtain the only possible answer
Discuss	Offer a considered and balanced review that includes a range of arguments, factors or hypotheses. Opinions or conclusions should be presented clearly and supported by appropriate evidence. (big picture)
Evaluate	Make an appraisal by weighing up the strengths and limitations
Explain	Give a detailed account including reasons or causes (1-2 paragraphs, step by step, number of marks indicates length of response)
Predict	Give an expected result
Sketch	Represent by means of a diagram or graph (labelled as appropriate). The sketch should give a general idea of the required shape or relationship, and should include relevant features
Suggest	Propose a solution, hypothesis or other possible answer

HL STUDY GUIDE QUESTIONS

*****Answer each question based on the command word. You should use your textbook, notes, and PowerPoints to help you answer each these questions. Answer these questions in full detail so you can use them to study for your IB exams *****

Study Guide Questions for Topic 1: Cell Biology

Topic 1.1 – Introduction to Cells

1. **Outline** (brief summary using bullet format) cell theory. **(3 Marks)**

2. Unicellular organisms carry out all the functions of life. What do these functions of life include? **(4 Marks)**

3. **Explain** (thorough and detailed account in paragraph form) the importance of the surface area to volume ratio as a factor limiting cell size. **(4 Marks)**

4. What is meant by the statement: multicellular organisms show emergent properties (provide an example for your explanation)? **(3 Marks)**

5. **Explain** (thorough and detailed account in paragraph form) how cells in multicellular organisms differentiate. **(4 Marks)**

6. What are stem cells? Are stem cells able to divide? What is meant by the fact that stem cells have the ability to differentiate along different pathways? **(4 Marks)**

7. Explain the relationship between gene expression and cell differentiation. **(2 marks)**

8. **Outline** (brief summary using bullet format) the therapeutic use of stem cells to treat Stargardt's disease and one other named condition. **(4 Marks)**

9. **Discuss** ethical issues associated with stem cell therapy, including the use of embryonic stem cells, umbilical cord blood stem cells, and adult stem cells. **(3 Marks)**

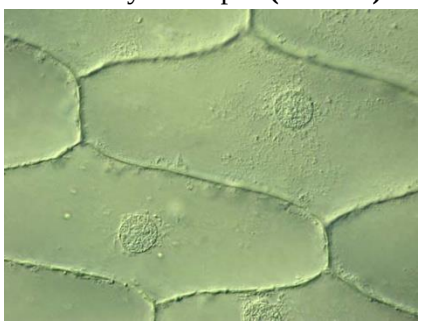
10. **Define** specimen size. **(1 Mark)**

11. **Define** image size. **(1 Mark)**

12. **Define** total magnification. **(1 Mark)**

13. Write the equation for calculating specimen size (include image size, total magnification, and specimen size in your equation) **(1 Marks)**

14. Use this microscopic image of onion cells to calculate the specimen size (length) of one onion cell in micro meters (µm). Show all your steps. **(1 Mark)**



15. **Calculate** the following conversions: 117nm=?mm; 23µm=?nm, 56cm=?nm=?µm (**3 Marks)**

16. **Discuss** (Give an account including, where possible, a range of arguments for and against relative importance of various factors, or comparisons of alternative hypotheses) the evidence for the cell theory. **(4 Marks)**

Topic 1.2 – Ultrastructure of Cells

17. **Draw, label, and annotate** (add labels and brief notes to important parts of your diagram) a diagram of the ultrastructure (detailed structure of a biological specimen) of *Escherichia coli* (*E. coli*) as an example of a prokaryote. **(5 Marks)**

18. **Draw, label, and annotate** (add labels and brief notes to important parts of your diagram) a diagram of the ultrastructure (detailed structure of a biological specimen) of a eukaryotic cell. **(5 Marks)**

19. **Compare and Contrast** light microscopes and electron microscopes. **(2 marks)**

20. How do prokaryotic cells divide? **(1 Mark)**

21. **Compare and contrast** prokaryotic and eukaryotic cells. **(6 Marks)**

22. **Compare and contrast** plant and animal cells. **(4 Marks)**

Topic 1.3 – Membrane Structure

23. **Explain** (thorough and detailed account in paragraph form) how the hydrophobic and hydrophilic properties of phospholipids help to maintain the structure of cells membranes (include a diagram). **(4 Marks)**

24. **List** at least six functions of membrane proteins. **(3 Marks)**

25. **Draw, label, and annotate** (add labels and brief notes to important parts of your diagram) a diagram to show the structure of the fluid mosaic model of a cell membrane. **(6 Marks)**

26. **Describe** how membrane structures can vary in terms of structure and membrane position. **(3 Marks)**

27. **Describe** the effect cholesterol has on membrane fluidity and permeability. **(2 Marks)**

28. What evidence from electron microscopy supported the Davson-Danielli model? **(1 Mark)**

29. What evidence falsified the Davson-Danielli model and supported the Singer-Nicolson model? **(2 Marks)**

Topic 1.4 – Membrane Transport

30. **Define** the term diffusion. **(1 Mark)**

31. **Define** the term osmosis. **(1 Mark)**

32. **Explain** (thorough and detailed account in paragraph form) passive transport across membranes by simple diffusion and facilitated diffusion (include a diagram). **(4 Marks)**

33. **Explain** (thorough and detailed account in paragraph form) active transport. **(4 Marks)**

34. **Explain** (thorough and detailed account in paragraph form) how vesicles are used to transport materials within a cell. Include an explanation the organelles that are used in this process. **(6 Marks)**

35. **Explain** (thorough and detailed account in paragraph form) why the term 'equilibrium' is used with passive but not active transport. **(2 Marks)**

36. **Describe** (provide a detailed account, in paragraph form) how a cell's membrane is able to change shape (break and re-form) during endocytosis and exocytosis. **(3 Marks)**

37. **Distinguish** between membrane pumps and membrane channels. **(2 Marks)**

38. **Describe** the structure and functions of the sodium-potassium pump and potassium channels in an axon. **(4 Marks)**

39. **Explain** the importance of osmolarity of solutions used in medical procedures. **(3 Marks)**

Topic 1.6 – Cell Division

40. **Define** mitosis. **(1 Mark)**

41. **Explain** (thorough and detailed account in paragraph form) how mitosis produces two genetically identical nuclei (include a diagram). **(4 Marks)**

42. **Define** supercoiling. **(1 Mark)**

43. **State** three cellular processes that occur during interphase. **(1 Mark)**

44. **Draw and label** a diagram that describes the cell cycle in eukaryotes, properly indicating the relative time spent in each stage. **(4 Marks)**

45. **Outline** the stages in the cell cycle, including interphase (G_1, S, G_2), mitosis and cytokinesis, and the events of each phase. **(8 Marks)**

46. **Compare and Contrast** cytokinesis in plant and animal cells. **(3 Marks)**

47. **Describe** how to determine the mitotic index from a micrograph. **(2 Marks)**

48. **Distinguish** between Cyclins A, B, D, and E. **(2 Marks)**

49. **Describe** how cyclins control the cell cycle. **(3 Marks)**

50. **Define** mutagens, oncogenes, and metastasis. **(3 Marks)**

51. **Distinguish** between primary and secondary tumors. **(2 Marks)**

52. **Explain** how tumors (cancers) are linked to cell division. **(2 Marks)**

53. **Describe** the correlation between smoking and the incidence of cancers. **(2 Marks)**

54. If a total of 150 cells are counted, and the mitotic index of the organism is 0.32, how many cells would you expect to be undergoing mitosis? **(1 Mark)**

Study Guide Questions for Topic 2: Molecular Biology

Topic 2.1 – Molecules to Metabolism

55. **Describe** the relationship between chemistry and biology. **(2 Marks)**

56. How is carbon unique and how does this contribute to its importance in biology? **(2 Marks)**

57. Using a table, compare and contrast the 4 major types of macromolecules, including the elements of which they are composed, monomer and polymer forms, and functions. **(4 Marks)**

58. **Define** metabolism. **(1 Mark)**

59. **Distinguish** between anabolism and catabolism. **(2 Marks)**

60. **Compare and contrast** condensation and hydrolysis reactions. **(2 Marks)**

61. **Describe** how urea is produced in living systems and how it is artificially synthesized. **(2 Marks)**

62. **Draw** the chemical structure of glucose. **(2 Marks)**

63. **Draw** the chemical structure of ribose. **(2 Marks)**

64. **Draw** the chemical structure of a saturated fatty acid. **(2 Marks)**

65. **Draw and label** (add labels and brief notes to important parts of your diagram) the structure of an amino acid. **(2 Marks)**

Topic 2.2 – Water

66. **Define** polarity. **(1 Mark)**

67. **Draw, label, and annotate** (add labels and brief notes to important parts of your diagram) a water molecule and label its partial charges **(2 Marks)**

68. **Draw, label, and annotate** (add labels and brief notes to important parts of your diagram) five water molecules showing their polarity and hydrogen bond formation. **(2 Marks)**

69. **Outline,** by giving a brief account or summary, using bullet format, the thermal, cohesive and solvent properties of water. **(6 Marks)**

70. **Distinguish** between hydrophobic and hydrophilic molecules, including an example of each. **(3 Marks)**

71. **Compare and contrast** the thermal properties of water and methane. **(2 Marks)**

72. **Explain** (provide a thorough and detailed account in paragraph form) the relationship between the properties of water and its uses in living organisms as a coolant, medium for metabolic reactions and transport medium. **(6 Marks)**

Topic 2.3 – Carbohydrates and Lipids

73. **Outline,** by giving a brief account or summary, using bullet format, the role of condensation and hydrolysis in the relationships between monosaccharaides, disaccharides and polysaccharides. (How are they formed? How are they broken) **(5 Marks)**

74. **Outline,** by giving a brief account or summary, using bullet format, the role of condensation and hydrolysis in the relationships between fatty acids, glycerol and triglycerides. (How are they formed? How are they broken?) **(5 Marks)**

75. **Distinguish** between saturated, monounsaturated, and polyunsaturated fatty acids. **(3 Marks)**

76. **Distinguish** between cis and trans isomers of unsaturated fatty acids. **(2 Marks)**

77. **Describe** the structure and function of cellulose in plants and glycogen in humans. **(3Marks)**

78. **Evaluate** the health risks of trans fats and saturated fatty acids. **(2 Marks)**

79. **Compare** (use a table to show the similarities and differences) the use of carbohydrates and lipids in energy storage. **(3 Marks)**

80. **Evaluate** evidence and methods used to obtain evidence for human health claims about lipids. **(3 Marks)**

81. What is the BMI of a man who has mass of 80kg and a height of 1.9 meters?

Topics 2.4 – Proteins

82. **Outline,** by giving a brief account or summary, using bullet format, the role of condensation and hydrolysis in the relationships between amino acids and polypeptides. (How are they formed? How are they broken?) **(5 Marks)**

83. **Draw** molecular diagrams to show the formation of a peptide bond. **(2 Marks)**

84. How many amino acids are there? How many can the human body synthesize? How many need to be obtained in food? **(2 Marks)**

85. **Describe** the relationship between peptides, polypeptides, and proteins. **(3 Marks)**

86. **Describe** the relationship between DNA, genes, and polypeptides. **(2 Marks)**

87. **Explain** (provide a thorough and detailed account in paragraph form) the four levels of protein structure, indicating the significance of each level. **(6 Marks)**

88. **Explain** (provide a thorough and detailed account in paragraph form) the significance of polar and non-polar amino acids. **(4 Marks)**

89. **State** the functions of rubisco, insulin, immunoglobulins, rhodopsin, collagen, and spider silk. **(3 Marks)**

90. **Define** proteome. **(1 Mark)**

91. **Define** denaturation. **(1 Mark)**

92. **Explain** how heat can denature a protein. **(2 Marks)**

93. **Explain** how a change in pH can denature a protein. **(2 Marks)**

Topics 2.5 – Enzymes

94. **Define** enzyme, substrate, active site, and enzyme-substrate specificity. **(2 Marks)**

95. **Explain** (provide a thorough and detailed account in paragraph form) how enzymes catalyze reactions. (Provide a graph diagram to show this). **(4 Marks)**

96. **Explain** (provide a thorough and detailed account in paragraph form) the effects of temperature, pH and substrate concentration on enzyme activity. **(6 Marks)**

97. **Draw** a graph showing the effect of increasing temperature on the rate of reaction of an enzyme-catalyzed reaction (label each axis). **(5 Marks)**

98. **Draw** a graph showing the effect of substrate concentration on the rate of reaction of an enzyme-catalyzed reaction (label each axis). **(5 Marks)**

99. **Explain** (provide a thorough and detailed account in paragraph form) the use of lactase in the production of lactose-free milk. **(4 Marks)**

100. What are immobilized enzymes and how can they be used industrially? **(4 Marks)**

Topics 2.6 – Structure of DNA

101. **Outline,** by giving a brief account or summary, using bullet format, a DNA nucleotide structure and an RNA nucleotide structure. **(4 Marks)**

102. **Outline,** by giving a brief account or summary, using bullet format, how DNA nucleotides are linked together. **(2 Marks)**

103. **Compare and contrast** (using a table) DNA and RNA. **(4 Marks)**

104. **State** the names of the four bases of DNA. **(2 Marks)**

105. **Draw and label** (add labels and brief notes to important parts of your diagram) a detailed ladder diagram of DNA in which the nitrogenous base sequence of one strand is C, T, G, G, A, T. Be sure to include a representation of the phosphate groups and deoxyribose sugar in each nucleotide, the antiparallel strands and hydrogen bonding between purines and pyrimidines. **(5 Marks)**

106. **Discuss** the discovery of DNA structure by Watson and Crick and others. **(5 Marks)**

Topics 2.7 – DNA Replication, transcription, and translation

107. **State** the type of replication that DNA accomplishes. **(1 Mark)**

108. **State** what is meant by semiconservative replication? **(2 Marks)**

109. **Explain** (provide a thorough and detailed account in paragraph form) the significance of complementary base paring. **(4 Marks)**

110. **State** the functions of helicase and DNA polymerase. **(2 Marks)**

111. **Explain** (provide a thorough and detailed account in paragraph form) the process of DNA replication in prokaryotes. **(10 Marks)**

112. **State** the direction that DNA replication occurs in. **(1 Mark)**

113. **Define** transcription. **(1 Mark)**

114. **State** the direction that transcription is carried out in. **(1 Mark)**

115. **Outline,** by giving a brief account or summary, using bullet format, DNA transcription in terms of the formation of an RNA strand complementary to the DNA strand by RNA polymerase. **(5 Marks)**

116. **Distinguish** between the sense and antisense strands of DNA. **(2 Marks)**

117. **Define** translation. **(1 Mark)**

118. **Describe** (provide a detailed account, in paragraph form) the genetic code (specifically how it codes and what it codes for). **(3 Marks)**

119. How is the genetic code "universal?" **(1 Mark)**

120. **Define** codon. **(1 Mark)**

121. **Outline**, giving a brief account or summary, using bullet format, the structure of ribosomes. **(4 Marks)**

122. **State** the direction that translation occurs in. **(1 Mark)**

123. **Explain** (provide a thorough and detailed account in paragraph form) the process of translation. **(10 Marks)**

124. **Describe** Meselson and Stahl's experiments and results. **(3 Marks)**

125. Given the following DNA base sequence from an anti-sense strand, determine the sequence of the sense strand, the mRNA sequence that would be produced by transcription, and the amino acid sequence that would be produced by translation.

T A C G G A C T T A A A G C G T T C G A C A T T

Topics 2.8 – Cell Respiration

126. **Define** the term cell respiration. **(1 Mark)**

127. How quickly can ATP made by cell respiration by used? **(1 Mark)**

128. **Outline,** by giving a brief account or summary, using bullet format, the process of glycolysis. **(5 Marks)**

129. **Explain** (provide a thorough and detailed account in paragraph form) what pyruvate can be converted into during anaerobic cell respiration. Is ATP produced in this process? Where does this process take place**? (5 Marks)**

130. **Explain** (provide a thorough and detailed account in paragraph form) what pyruvate can be broken down into during *aerobic cell respiration*? Is ATP produced? Where does this occur? **(5 Marks)**

131. **Explain** (provide a thorough and detailed account in paragraph form) aerobic respiration. **(8 Marks)**

132. **Describe** the production alcohol and carbon dioxide by yeast and its applications. **(3 Marks)**

133. **Describe** what happens in human muscles during exercise. **(2 Marks)**

Topics 2.9 – Photosynthesis

134. **Define** the term photosynthesis. **(1 Mark)**

135. **State** what the light from the Sun is composed of. **(1 Mark)**

136. **Describe** the visible light spectrum. **(3 Mark)**

137. **State** the main photosynthetic pigment. **(1 Mark)**

138. **Outline,** by giving a brief account or summary, using bullet format, the differences in absorption of red, blue and green light by chlorophyll. **(4 Marks)**

139. **Draw** an absorption spectrum of chlorophyll. **(2 Marks)**

140. What are the requirements for photosynthesis? **(2 Marks)**

141. **Define** photolysis. **(1 Mark)**

142. What is the product of the photolysis of water? **(1 Mark)**

143. **Outline,** by giving a brief account or summary, using bullet format, the effects of temperature, light intensity, and carbon dioxide concentration on the rate of photosynthesis. **(4 Marks)**

144. **Explain** (provide a thorough and detailed account in paragraph form) the light-dependent reactions. **(5 Marks)**

145. **Explain** (provide a thorough and detailed account in paragraph form) the light-independent reactions. **(5 Marks)**

146. **Explain** (provide a thorough and detailed account in paragraph form) the relationship between the action spectrum and the absorption spectrum of photosynthetic pigments in green plants. **(4 Marks)**

147. **Explain** (provide a thorough and detailed account in paragraph form) the concept of limiting factors in photosynthesis. **(5 Marks)**

148. **Describe** how photosynthesis can cause changes to the Earth's atmosphere, oceans, and rock deposition. **(3 Marks)**

Study Guide Questions for Topic 3: Genetics

Topics 3.1 – Genes

149. **Define** gene. **(1 Mark)**

150. **Define** locus. **(1 Mark)**

151. **Define** allele. **(1 Mark)**

152. **Explain** how one allele is different from another allele. **(1 Mark)**

153. How are new alleles formed? **(1 Mark)**

154. **Define** genome. **(1 Mark)**

155. **Define** mutation. **(1 Mark)**

156. What was the purpose of the Human Genome Project? **(1 Mark)**

157. **Explain** (provide a thorough and detailed account in paragraph form) the consequence of a base substitution mutation in relation to the processes of transcription and translation, using the example of sickle cell anemia. **(3 Marks)**

158. **Compare and contrast** (using a table) the number of genes in humans with the number of genes in at least 3 other diverse species. **(3 Marks)**

Topics 3.2 – Chromosomes

159. **Describe** a prokaryotic chromosome. **(2 Mark)**

160. **Define** plasmid. **(1 Mark)**

161. **Compare and contrast** prokaryotic and eukaryotic chromosomes. **(3 Marks)**

162. **Draw and label** a eukaryotic chromosome **(3 Marks)**

163. What are histones and what is their function? **(2 Marks)**

164. **Define** Homologous chromosomes. **(1 Mark)**

165. **Distinguish** between haploid and diploid nuclei. **(2 Marks)**

166. **Define** karyogram (karyotype). **(1 Mark)**

167. How are chromosomes arranged in karyotyping? **(1 Mark)**

168. **Distinguish** between sex chromosomes and autosomes. **(2 Marks)**

169. **Describe** Cairn's technique for measuring length of DNA molecules. **(2 Marks)**

170. **Compare** genome size in T2 phage, *Escherichia coli*, *Drosophila melanogaster, Homo sapiens* and *Paris japonica* **(3 Marks)**

171. **Compare** diploid chromosome numbers of *Homo sapiens, Pan troglodytes, Canis familiaris, Oryza sativa, Parascaris equorum* **(3 Marks)**

Topics 3.3 – Meiosis

172. How many cells are produced by meiosis? **(1 Mark)**

173. **Define** diploid and haploid. **(2 Marks)**

174. **Draw, label, and annotate** (add labels and brief notes to important parts of your diagram) the stages of meiosis II. For each drawing, **outline**, giving a brief account or summary, using bullet format, the process of each stage of meiosis. Also, **describe** (provide a detailed account, in paragraph form) the behavior of the chromosomes in each of the different stages of meiosis. **(20 Marks)**

175. **Explain** (provide a thorough and detailed account in paragraph form) why meiosis is referred to as a reduction division. If a monkey diploid cell with 66 chromosomes undergoes a reduction division, how many chromosomes does the new haploid cell have? **(3 Marks)**

176. **Explain** (provide a thorough and detailed account in paragraph form) why meiosis rather than mitosis is necessary for gamete production. **(4 Marks)**

177. Why is it necessary for DNA replication to occur before meiosis? **(1 Mark)**

178. Why is it necessary for homologous chromosomes to pair up in meiosis I? **(1 Mark)**

179. **Outline**, giving a brief account or summary, using bullet format, the formation of chiasmata in meiosis. **(4 Marks)**

180. **Explain** (provide a thorough and detailed account in paragraph form) how meiosis results in an effectively infinite genetic variety in gametes. What is the relationship between Mendel's law of independent assortment and meiosis? **(6 Marks)**

181. At what point in meiosis is the chromosome number halved? **(1 Mark)**

182. How does sexual reproduction promote genetic variation? **(2 Marks)**

183. **Define** non-disjunction. **(1 Mark)**

184. **Explain** (provide a thorough and detailed account in paragraph form) what non-disjunction can lead to (make sure to include the consequences of a trisomy 21). **(3 Marks)**

185. **Describe** the relationship between parental age and chromosomal abnormalities. **(2 Marks)**

186. **Describe** how karyotyping is performed. Name two methods for obtaining samples for a karyotype. **(3 Marks)**

<u>Topics 3.4 – Inheritance</u>

187. Describe the methods used by Mendel to discover the principles of inheritance. **(4 Mark)**

188. What is the genetic content of a haploid cell? **(1 Mark)**

189. **Explain** the Laws of Independent Assortment and Segregation. **(2 Marks)**

190. **Explain** (provide a thorough and detailed account in paragraph form) how the fusion of two gametes promotes variation in a species. **(3 Marks)**

191. **Define** Dominant allele. **(1 Mark)**

192. **Define** Recessive allele. **(1 Mark)**

193. **Define** Homozygous. **(1 Mark)**

194. **Define** Heterozygous. **(1 Mark)**

195. **Define** Codominant alleles. **(1 Mark)**

196. **Define** Genotype. **(1 Mark)**

197. **Define** Phenotype. **(1 Mark)**

198. In garden peas, the allele for smooth seeds (S) is dominant over the allele for wrinkled seeds (s). If a plant with a genotype Ss is crossed with a plant of genotype ss, determine the possible genotypes and phenotypes of the offspring using a Punnett grid. Show work and **determine** the probabilities of each offspring. **(2 Marks)**

199. **Define** Sex linkage. **(1 Mark)**

200. Do an X chromosome and a Y chromosome have the same genes? **(1 Mark)**

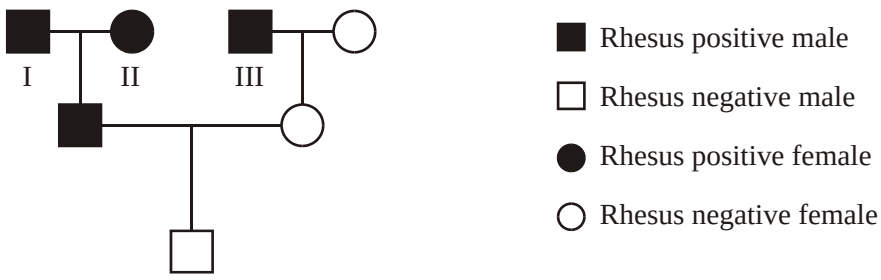
201. **Explain** (provide a thorough and detailed account in paragraph form) how females can be carriers for X-linked diseases (provide an example). Explain why males cannot be carriers for X-linked diseases. **(3 Marks)**

202. If colorblindness is a sex-linked recessive trait, what is the genotype of a colorblind male? What is the genotype of a colorblind female? What are the two possible genotypes for a non-colorblind female? What is the only genotype of a non-colorblind male? **(3 Marks)**

203. **Describe** (provide a detailed account, in paragraph form) the inheritance of color blindness and hemophilia as examples of sex linkage. **(3 Marks)**

204. **Describe** (provide a detailed account, in paragraph form) ABO blood groups as an example of codominance and multiple alleles. **(4 Marks)**

205. The pedigree below shows which members of a family were Rhesus positive (■ and •) and Rhesus negative (□ and O). The allele for Rhesus positive blood (Rh+) is dominant over the allele for Rhesus negative blood (R-). Deduce the possible genotypes of the individuals numbered I, II and III. **(3 Marks)** (Topic 4.3.11).



206. **Define** mutagen. **(1 Mark)**

207. **Explain** the relationship between mutagens and cancer. **(4 Marks)**

208. **Compare and contrast** the inheritance of cystic fibrosis and Huntington's disease. **(4 Marks)**

Topic 3.5 – Genetic Modification and Biotechnology

209. During gel electrophoresis, why is it possible to use an electric field to separate DNA fragments? **(1 Mark)**

210. What are DNA fragments separated according to in gel electrophoresis? Explain why a smaller DNA fragment ends up farther down the gel than a larger DNA fragment. **(2 Marks)**

211. What is gel electrophoresis of DNA used for? Provide a couple examples. **(2 Marks)**

212. **Define** Clone. **(1 Mark)**

213. **Explain** (provide a thorough and detailed account in paragraph form) why PCR is necessary. **(3 Marks)**

214. **Outline**, giving a brief account or summary, using bullet format, the use of polymerase chain reaction (PCR) to copy and amplify minute quantities of DNA. **(3 Marks)**

215. **Describe** (provide a detailed account, in paragraph form) the application of DNA profiling. **(2 Marks)**

216. **Outline**, giving a brief account or summary, using bullet format, a basic technique used for gene transfer involving plasmids, a host cell (bacterium, yeast or other cell), restriction enzymes (endonucleases) and DNA ligase. **(5 Marks)**

217. **Explain** what is meant by the term "natural cloning" (giving examples). **(2 Marks)**

218. **Define** somatic-cell nuclear transfer. **(2 Marks)**

219. **Outline**, giving a brief account or summary, using bullet format, a technique for cloning using differentiated animal cells. **(5 Marks)**

220. **Discuss** the creation of clones at the embryo stage. **(2 Marks)**

221. **Discuss** (Give an account including, where possible, a range of arguments for and against relative importance of various factors, or comparisons of alternative hypotheses) the potential benefits and possible harmful effects of one example of genetic modification. **(5 Marks)**

Study Guide Questions for Topic 4: Ecology

Topic 4.1 – Species, communities, and ecosystems

222. **Define** Species. **(1 Mark)**

223. **Define** Population. **(1 Mark)**

224. **Define** Reproductive isolation. **(1 Mark)**

225. **Distinguish** between autotrophs and heterotrophs. **(2 Marks)**

226. **Define** Consumer. **(1 Mark)**

227. **Define** Detritovore. **(1 Mark)**

228. **State** the role of saprotrophic bacteria and fungi (decomposers). **(1 Mark)**

229. **Define** External digestion. (**1 Mark)**

230. **Define** Community. **(1 Mark)**

231. **Define** Ecosystem. **(1 Mark)**

232. **Explain** how autotrophs obtain nutrients. **(3 Marks)**

233. **Define** Sustainability. **(1 Mark)**

Topic 4.2 – Energy Flow

234. **State** the initial energy source for almost all communities. **(1 Mark)**

235. Are energy transformations ever 100% efficient? If not, where does the energy go? **(1 Mark)**

236. **Describe** (provide a detailed account, in paragraph form) what a food chain is, giving three examples, each with at least three linkages (four organisms). **(4 Marks)**

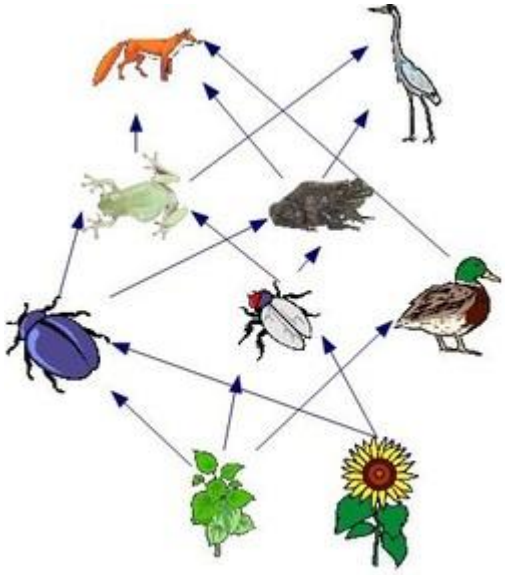
237. **Define** Trophic level. **(1 Mark)**

238. **Explain** (provide a thorough and detailed account in paragraph form) the energy flow in a food chain. **(3 Marks)**

239. **Explain** (provide a thorough and detailed account in paragraph form) reasons for the shape of pyramids of energy. **(4 Marks)**

240. **Explain** (provide a thorough and detailed account in paragraph form) what happens to energy and nutrients in ecosystems. **(5 Marks)**

241. **Deduce** the trophic level of organisms for the following food web. **(3 Marks)**



Topic 4.3 – Carbon Cycling

242. **Describe** where carbon can be found in aquatic ecosystems. **(2 Marks)**

243. **Draw, label, and annotate** (add labels and brief notes to important parts of your diagram) a diagram of the carbon cycle. **(5 Marks)**

244. **Discuss** the role of methane in the environment. **(3 Marks)**

245. **Define** Peat. **(1 Mark)**

246. **Describe** what fossil fuels are and where they can be found. **(2 Marks)**

247. What is combustion and what does it produce? **(2 Marks)**

248. **Describe** how fossils form and the requirements for fossil formation. **(3 Marks)**

Topic 4.4 – Climate Change

249. **State** the most significant greenhouse gases. **(1 Mark)**

250. **Explain** (provide a thorough and detailed account in paragraph form) the relationship between rises in concentrations of atmospheric carbon dioxide, methane and oxides of nitrogen and the enhanced greenhouse effect. **(5 Marks)**

251. **Explain** the relationship between greenhouse gases and long wave radiation. **(2 Marks)**

252. **Describe** the relationship between global temperatures and greenhouse gases. **(2 Marks)**

253. **Describe** the impact of carbon dioxide on coral reefs. **(2 Marks)**

254. **Discuss and evaluate** claims that human activities are or are not causing climate change. **(5 Marks)**

Study Guide Questions for Topic 5: Evolution and Biodiversity

Topic 5.1 – Evidence for Evolution

255. **Define** Evolution (topic 5.4.1) **(1 Mark)**

256. **Outline**, giving a brief account or summary, using bullet format, the evidence for evolution. **(5 Marks)**

257. **Define** Artificial selection. **(1 Mark)**

258. **Define** Homologous structures and give an example. **(2 Marks)**

259. **Define** Adaptive radiation. **(1 Mark)**

260. **Explain** how populations of a species can diverge into separate species. **(4 Marks)**

261. **Define** Gradual divergence. **(1 Mark)**

262. **Describe** the development of melanistic insects in industrialized areas. **(4 Marks)**

263. **Describe** the forms and functions of pentadactyl limbs of mammals, birds, amphibians, and reptiles. **(4 Marks)**

Topic 5.2 – Natural Selection

264. **Define** Variation. **(1 Mark)**

265. Why is variation critical to natural selection? **(1 Mark)**

266. **State** three causes of variation and **explain** how they cause variation. **(3 Marks)**

267. **Define** Adaptation. **(1 Mark)**

268. Do populations tend to produce more or less offspring than the environment can support? **(1 Mark)**

269. **Outline** the process of natural selection. **(4 Marks)**

270. **Describe** the results of natural selection in a population. **(2 Marks)**

271. **Explain** (provide a thorough and detailed account in paragraph form) how natural selection leads to evolution. **(6 Marks)**

272. **Explain** (provide a thorough and detailed account in paragraph form) two examples of evolution in response to environmental change; one must be antibiotic resistance in bacteria. **(4 Marks)**

Topic 5.3 – Classification of Biodiversity

273. **Outline**, giving a brief account or summary, using bullet format, the binomial system of nomenclature. **(3 Marks)**

274. **List** seven levels in the hierarchy of taxa using an example from two different kingdoms for each level **(5 Marks)**

275. **State** the 3 domains. **(1 Mark)**

276. How does classification help in species identification? **(1 Mark)**

277. What might cause a species of groups of species to be reclassified? **(1 Mark)**

278. **Distinguish** (use a table to give the differences) between three or more different items between the following phyla of plants, using simple external recognition features: *bryophyta, filicinophyta, coniferophyta* and *angiospermophyta*. **(3 Marks)**

279. **Distinguish** (use a table to give the differences) between three or more different items between the following phyla of animals, using simple external recognition features: *porifera, cnidaria, platyhelminthes, annelida, mollusca* and *arthropoda*. **(3 Marks)**

280. **Classify** one plant and one animal species from domain to species level. **(4 Marks)**

281. **Apply and design** a key for a group of up to eight organisms. **(4 Marks)**

Topic 5.4 – Cladistics

282. **Define** Clade. **(1 Mark)**

283. What types of evidence are used to determine if species are part of a clade? **(1 Mark)**

284. **Explain** how the evidence from the previous questions is used to determine evolutionary relationships. **(3 Marks)**

285. **Distinguish** between analogous and homologous traits. **(2 Marks)**

286. **Describe** how cladograms are constructed and what they show. **(2 Marks)**

287. How has cladistics influenced the prior classifications of groups based solely on body structures? **(2 Marks)**

288. **Construct** a cladogram of humans and at least 5 primates. **(4 Marks)**

289. **Classify** the figwort family using cladistics. **(2 Marks)**

Study Guide Questions for Topic 6: Human Physiology

Topic 6.1 – Digestion and Absorption

290. **Explain** (provide a thorough and detailed account in paragraph form) why the digestion of large food molecules is essential. **(3 Marks)**

291. **Describe** the structure and functions of smooth muscle in the small intestine. **(2 Marks)**

292. **Outline** the function of the pancreas. **(3 Marks)**

293. **Outline** the source, substrate, location of action, optimum pH, and products of the enzymes amylase, pepsin, and lipase. **(5 Marks)**

294. **Describe** the structure, function, and importance of villi. **(3 Marks)**

295. **Distinguish** (use a table to give the differences) between *absorption* and *assimilation*. **(2 Marks)**

296. **Discuss** the different types of membrane transport involved in absorption of nutrients. **(3 Marks)**

297. **Outline**, giving a brief account or summary, using bullet format, the function of the stomach, small intestine, accessory organs (liver, pancreas, and gall bladder), and the large intestine. **(5 Marks)**

298. Where do digested nutrients go first after absorption into the bloodstream? **(1 Mark)**

299. **Draw**, **label, and annotate** (add labels and brief notes to important parts of your diagram) a diagram of the digestive system. **(5 Marks)**

300. **Draw, label, and annotate** (add labels and brief notes to important parts of your diagram) the structure of an intestinal villus. **(3 Marks)**

Topic 6.2 – The Blood System

301. **Compare and contrast** arteries, veins, and capillaries. **(6 Marks)**

302. What are the functions of muscle and elastic fibers in blood vessel walls? **(2 Marks)**

303. **Draw, label, and annotate** (add labels and brief notes to important parts of your diagram) a diagram of the heart showing and the route of blood through the heart and body. Label oxygenated and deoxygenated blood. **(5 Marks)**

304. **Outline**, giving a brief account or summary, using bullet format, the control of the heartbeat in terms of myogenic muscle contraction. **(4 Marks)**

305. **Explain** how control of the heartbeat changes during vigorous physical activity. **(2 Marks)**

306. **Explain** the role of epinephrine in the control of heart rate. **(2 Marks)**

307. **Describe** William Harvey's contribution to our current understanding of circulation. **(2 Marks)**

308. **Describe** the movement of blood through the heart in terms of pressure changes, blood volume, and valve openings and closures. **(4 Marks)**

Topic 6.3- Defense Against Infectious Disease

309. **Outline**, giving a brief account or summary, using bullet format, the role of skin and mucous membranes in defense against pathogens. **(4 Marks)**

310. **Describe** the process of blood clotting. **(4 Marks)**

311. **Define** Non-specific immunity. **(1 Mark)**

312. **Outline**, giving a brief account or summary, using bullet format, the how phagocytic leucocytes ingest pathogens in the blood and in body tissue. **(3 Marks)**

313. **Define** Specific immunity. **(1 Mark)**

314. **Define** Pathogen. **(1 Mark)**

315. **Distinguish** (use a table to give the differences) between *antigens* and *antibodies*. (use a table) **(3 Marks)**

316. **Explain** (provide a thorough and detailed account in paragraph form) antibody production. **(5 Marks)**

317. **Explain** (provide a thorough and detailed account in paragraph form) why antibiotics are effective against bacteria but not against viruses. **(2 Marks)**

318. **Discuss** the emergence of resistance and multiple resistances to antibiotics in bacteria. **(3 Marks)**

319. **Describe** the causes and consequences of blood clot formation in the coronary arteries. **(2 Marks)**

320. **Describe** Florey and Chain's experiments to the penicillin on bacterial infections. **(3 Marks)**

321. **Discuss** the transmission of HIV and its effects on the immune system. **(4 Marks)**

Topic 6.4 – Gas Exchange

322. **Explain** (provide a thorough and detailed account in paragraph form) the need for a ventilation system. **(3 Marks)**

323. **Distinguish** (use a table to give the differences) between *ventilation*, *gas exchange*, and *cell respiration*. **(5 Marks)**

324. **Distinguish** between type I and type II pneumocytes. **(3 Marks)**

325. **Draw**, **label, and annotate** (add labels and brief notes to important parts of your diagram) a diagram of the ventilation system. **(4 Marks)**

326. **Explain** (provide a thorough and detailed account in paragraph form) the mechanism of ventilation of the lungs in terms of volume and pressure changes caused by the internal and external intercostal muscles, the diaphragm and abdominal muscles. **(6 Marks)**

327. **Discuss** the causes and consequences of lung cancers. **(3 Marks)**

328. **Discuss** the causes and consequences of emphysema. **(3 Marks)**

329. What is antagonistic muscle action and where can it be observed in ventilation? **(2 Marks)**

330. **Describe** changes in ventilation during vigorous exercise. **(2 Marks)**

Topic 6.5 – Neurons and Synapses

331. What is the function of a neuron? **(1 Mark)**

332. What is the purpose of myelin? **(1 Mark)**

333. **Define** Saltatory conduction. **(1 Mark)**

334. **Define** Resting potential. **(1 Mark)**

335. **Explain** how a resting potential is generated. **2 Marks)**

336. **Define** Action potential. **(1 Mark)**

337. **Define** Depolarization. **(1 Mark)**

338. **Define** Repolarization. **(1 Mark)**

339. **Explain** how a nerve impulse is propagated along a neuron. **(8 Marks)**

340. **Define** Synapse. **(1 Mark)**

341. **Outline** synaptic transmission of a nerve impulse. **(6 Marks)**

342. **Explain** the importance of having a threshold potential. **(2 Marks)**

343. **Describe** what happens to acetylcholine after synaptic transmission has occurred. **(2 Marks)**

344. **Explain** how neonicotinoid pesticides work. **(3 Marks)**

Topic 6.6 – Hormones, Homeostasis, and Reproduction

345. **Explain** (provide a thorough and detailed account in paragraph form) the control of blood glucose concentration. **(6 Marks)**

346. **Explain** (provide a thorough and detailed account in paragraph form) the control of body temperature. **(6 Marks)**

347. **Describe** the function of leptin and its use in obese patients. **(3 Marks)**

348. **Outline** the control of circadian rhythms. **(3 Marks)**

349. How is sex determination controlled in the embryo? **(2 Marks)**

350. **Outline** the functions of testosterone. **(3 Marks)**

351. **Outline** the functions of estrogen and progesterone. **(3 Marks)**

352. **Distinguish** between positive and negative feedback. **(4 Marks)**

353. **Outline** the control of the menstrual cycle including discussion of the hormones involved. **(5 Marks)**

354. **Distinguish** (use a table to give the differences) between *type I* and *type II diabetes*. **(5 Marks)**

355. What is jet lag? How can melatonin alleviate it? **(2 Marks)**

356. **Outline** the use of hormones in IVF. **(3 Marks)**

357. **Describe** William Harvey's investigations of sexual reproduction in deer. **(3 Marks)**

358. **Draw, label, and annotate** (add labels and brief notes to important parts of your diagram) diagrams of the adult male and female reproductive systems. **(5 Marks Each)**

Study Guide Questions for Topic 7: Nucleic Acids

Topic 7.1 – DNA Structure and Replication

359. **Outline**, giving a brief account or summary, using bullet format, the structure of nucleosomes. **(3 Marks)**

360. **Explain** (provide a thorough and detailed account in paragraph form) the process of DNA replication in prokaryotes. **(15 Marks)**

361. **Outline** the names and functions of the major enzymes involved in DNA replication. **(4 Marks)**

362. **Outline** the functions and uses of different regions of DNA. **(3 Marks)**

363. **Describe** the contributions made by Rosalind Franklin and Maurice Wilkins to the discovery of the structure of DNA. **(3 Marks)**

364. **Describe** the contributions of Hershey and Chase in identifying DNA as genetic material. **(3 Marks)**

Topic 7.2 – Transcription and Gene Expression

365. **Explain** the role of nucleosomes in regulating gene expression. **(3 Marks)**

366. **Outline** how mRNA is processed after transcription. **(3 Marks)**

367. **Discuss** (Give an account including, where possible, a range of arguments for and against relative importance of various factors, or comparisons of alternative hypotheses) the one gene and one polypeptide hypothesis. **(2 Marks)**

368. **Define** Gene expression. **(1 Mark)**

369. **Explain** the role of protein binding in gene expression. **(3 Marks)**

370. **Discuss** conditions that can impact gene expression. **(2 Marks)**

371. **Define** Promoter. **(1 Mark)**

372. **Describe** DNA methylation. **(2 Marks)**

Topic 7.3 – Translation

373. **Distinguish** between initiation, elongation, and termination of translation. **(4 Marks)**

374. **Distinguish** between the proteins produced by free-floating ribosomes in the cell and those made by bound ribosomes. **(2 Marks)**

375. **Compare and contrast** protein synthesis in prokaryotes and eukaryotes. **(2 Marks)**

376. **Explain** (provide a thorough and detailed account in paragraph form) the four levels of protein structure, indicating the significance of each level. **(6 Marks)**

377. What is the function of tRNA-activating enzymes? **(1 Mark)**

378. **Define** Polysomes. **(1 Mark)**

Study Guide Questions for Topic 8: Metabolism, Cell Respiration, and Photosynthesis

Topic 8.1 - Metabolism

379. What are metabolic pathways and how are they regulated? **(2 Marks)**

380. **Define** activation energy. **(1 Mark)**

381. **Distinguish** between competitive and non-competitive inhibitors. **(2 Marks)**

382. **Describe** end-product inhibition using threonine and isoleucine as an example. **(4 Marks)**

383. **Discuss** the use of enzymes inhibition in potentially treating malaria. **(4 Marks)-**

Topic 8.2 – Cell Respiration

384. **Describe** the function and importance of electron carriers. **(2 Mark)**

385. **Explain** the role of oxidation and reduction reactions in cell respiration. **(2 Marks)**

386. **Define** phosphorylation and describe how it changes the stability of molecules. **(2 Marks)**

387. **Distinguish** between glycolysis, the Kreb's Cycle, and the electron transport chain. **(6 Marks)**

388. **Describe** the production of acetyl coA and **explain** its significance in aerobic respiration. **(3 Marks)**

389. **Outline** the process of chemiosmosis. **(4 Marks)**

390. **Explain** the role of oxygen in aerobic respiration. **(4 Marks)**

391. **Explain** how the structure of the mitochondria is suited to its function in cell respiration. **(3 Marks)**

392. **Define** Decarboxylation. **(1 Mark)**

393. **Draw, label, and annotate** a diagram of a mitochondrion. **(4 Marks)**

Topic 8.3 – Photosynthesis

394. **Distinguish** between the light-dependent and light-independent reactions of photosynthesis. **(4 Marks)**

395. **Describe** the structure and functions of photosystems. **(2 Marks)**

396. **Explain** the importance of creating a proton gradient and **describe** how it is done. **(2 Marks)**

397. **Describe** the structure and function of ATP synthase. **(3 Marks)**

398. **Outline** the functions of excited electrons in photosynthesis. **(2 Marks)**

399. **Describe** the function of carboxylase. **(1 Mark)**

400. **Discuss** the various reduction and oxidation reactions involved in photosynthesis. **(3 Marks)**

401. **Describe** functions of ATP in photosynthesis. **(2 Marks)**

402. **Explain** how the structure of the chloroplast is suited to its function in photosynthesis. **(3 Marks)**

403. **Describe** the work of Calvin on the carboxylation of RuBP. **(3 Marks)**

404. **Draw, label, and annotate** a diagram of the chloroplast. (**4 Marks)**

Topic 9- Plant Biology

Topic 9.1 – Transport in the xylem of plants

405. **Define** Transpiration (1 Mark)

406. **Outline** how the root system structure aids with the uptake of water. (**4 mark)**

407. **Explain** the relationship between cohesion and adhesion and tension in plants. (**5 marks)**

408. **Outline** four adaptations of xerophytes that help to reduce transpiration. (**4 marks**)

409. **Explain** the process of mineral ion adsorption from the soil into roots. (**4 marks)**

410. **Explain** how water is carried up a stem. (**5 marks)**

411. **Draw** the structure of primary xylem vessels in sections of stems based on microscope images. (**4 marks)**

Topic 9.2- Transport in the Phloem of Plants

412. **Outline** the role of phloem. (**5 marks)**

413. **Explain** the role of pressure gradients in transport. (**2 marks)**

414. **Outline** types of cellular transport used in water and solute uptake in plants. (**4 marks)**

415. **Draw, label, and annotate** a phloem sieve tube. (**3 marks)**

Topic 9.3 - Growth in Plants

416. **State** the function of undifferentiated cells in the meristems of plants. (**1 mark)**

417. What is the purpose of mitosis in the shoot apex? (**1 mark)**

418. **Outline** different types of tropism. (**4 marks)**

419. **Explain** the role of auxin. (**5 marks)**

420. **Outline** the plant hormones involved in plant growth in the shoot apex. (**4 marks)**

421. **Define** micripropogation. (**1 mark)**

Topic 9.4 – Reproduction in Plants

422. **Describe** the factors that cause a plant to switch to flowering. (**5 marks)**

423. **Distinguish** between *pollination, fertilization,* and *seed dispersal.* (**5 marks)**

424. **Describe** the relationship between flowering plants and pollinators. (**3 marks)**

425. **Draw, label, and annotate** the internal structures of a seed. (**4 marks)**

426. **Draw, label, and annotate** a half-view of an animal pollinate flower. **(4 marks)**

427. **Explain** the conditions needed for the germination of a typical seed. (**4 marks)**

428. **Outline** methods used to induce flowering out of season. (**3 marks)**

Topic 10 – Genetics and Evolution

Topic 10.1 – Meiosis

429. **Describe** the events which occur in interphase before meiosis. (**2 marks)**

430. **Define** crossing over. (**1 mark)**

431. **Draw, label, and annotate** a diagram to show chiasmata formed by crossing over. **(3 marks)**

432. **Outline** the differences between meiosis I and meiosis II. (**3 marks)**

433. How is the independent assortment of genes achieved? (**1 mark)**

434. **Describe** how crossing over can produce new combinations of alleles on chromosomes. **(2 marks)**

Topic 10.2 – Inheritance

435. What are linked genes? (**1 mark)**

436. **Explain** why Punnett squares can be used to predict outcomes reliability for unlinked genes but not for linked genes? (**3 marks)**

437. **Explain** how polygenic inheritance can contribute to continuous variation using two examples. (**3 marks)**

438. What is the purpose of a chi-square test? (**1 mark)**

439. **Describe** Morgan's experiments with *Drosophila.* (**3 marks)**

440. The allele for red flower color (R) in a certain plant is incompletely dominant with the allele for white flowers (R'). Thus a plant with the genotype RR' has pink flowers. Tall (D) is a dominant to dwarf (d). **Predict** the expected phenotypic ration from a cross of RR'dd plants with R'R'Dd plants? (**2 marks)**

441. **Explain**, using an example, how environmental factors can influence polygenic traits. (**3 marks)**

442. In garden peas, the pairs of alleles coding for seed shape and seed color are unlinked. The allele for smooth seeds (S) is dominant over the allele for wrinkled seeds (s). The allele for yellow seeds (Y) is dominant over the allele for green seeds (s). If a plant of genotype Ssyy is crossed with a plant of genotype ssYs, **determine** which offspring are recombinants. (**2 marks)**

Topic 10.3 – Gene Pools and Speciation

443. **Define** gene pool. (**1 mark)**

444. **Define** evolution, in term of allele frequencies. (**1 mark)**

445. **Distinguish** between temporal, behavioral, geographic, and reproductive isolation. (**5 marks)**

446. **Define** speciation. (**1 mark)**

447. **Describe,** using examples, how evolution can be gradual or occur abruptly. (**6 marks)**

448. **Distinguish** between directional, stabilizing, and disruptive selection. (**6 marks)**

449. **Describe,** using *Allium,* as an example, how polyploidy can result in speciation. (**6 marks)**

Topic 11: Animal Physiology

Topic 11.1 – Antibody Production and Vaccination

450. **Define** antigen. (**1 mark)**

451. **Distinguish** between species-specific and non-specific pathogens. (**3 marks)**

452. **Describe** the activation of B lymphocytes in mammals. (**3 marks)**

453. **Outline** the principle of challenge and response, clonal selection and memory cells as the basis of immunity. (**4 marks)**

454. **Distinguish** between *antigens* and *antibodies.* **(3 marks)**

455. **Outline** the production, function, and impact of histamine production. (**3 marks)**

456. **Explain** the principle of vaccination. (**5 marks)**

457. **Outline** the production, function, and impact of Hybridoma cells. (**3 marks)**

458. **State** the first human infectious disease to be eradicated by vaccination. (**1 mark)**

459. **Describe** how monoclonal antibodies are used in pregnancy tests. (**3 marks)**

460. **Explain** the relationship between immunity and blood typing for transfusions and transplants. (**4 marks)**

Topic 11.2 – Movement

461. **State** the functions of bones and exoskeleton. (**2 marks)**

462. **Distinguish** between synovial joints and others types of joints. (**3 marks)**

463. **Explain** why muscles must occur in antagonistic pairs. (**2 marks)**

464. **Describe** the structure of skeletal muscle fibers. (**4 marks)**

465. **Draw, label, and annotate** a diagram to show the structure of a sarcomere, including Z lines, actin filaments with heads, and the resultant light and dark bands. (**5 marks)**

466. **Define** muscle fiber and myofibril. (**2 marks)**

467. **Explain** how skeletal muscle contract. (**10 marks)**

468. **Draw, label, and annotate** a diagram of the human elbow joint. (**4 marks)**

469. Draw, label, and annotate a diagram of a sarcomere, including Z lines, actin, myosin with heads, and the resulting dark and light bands. (**5 Marks**)

470. Explain how skeletal muscles contract. (**8 Marks**)

Topic 11.3 – The Kidney and Osmoregulation

471. **Define** osmoregulator and osmoconformer. **(2 Marks**)

472. **Compare** the kidneys to the Malpighian tubule system of insects. **(2 Marks)**

473. **Compare and contrast** the composition of blood in the renal artery and the renal vein. **(2 Marks**)

474. **Draw, label, and annotate** a diagram of the glomerulus and associated nephron to show the function of each part. **(4 Marks)**

475. **Explain** the process of ultrafiltration. **(4 Marks**)

476. **Explain** what happens in the proximal convoluted tubule in terms of reabsorption. **Explain** how the structure of the tubule aids in reabsorption. **(6 Marks)**

477. **Explain** the roles of the loop of Henle, medulla, collecting duct, and ADH in maintaining water balance in the blood. **(5 Marks)**

478. **Outline** the relationship between evolutionary history and habitat and the types of nitrogenous waste found in animals. **(4 Marks)**

479. **Draw, label, and annotate** the structure of the kidney. **(4 Marks)**

480. **Draw, label, and** annotate a nephron. **(8 Marks)**

481. **Describe** the consequences of dehydration and overhydration**. (4 Marks)**

482. **Explain** how dialysis works. **(4 Marks)**

483. **Outline** the substances that can be detected by urinary tests that should not be in the urine of a healthy person and what their presence indicates. **(6 Marks)**

Topic 11.4 – Sexual Reproduction

484. **Outline** the processes involved in spermatogenesis. **(6 Marks)**

485. **Outline** the processes involved in oogenesis. **(6 Marks)**

486. **Compare and contrast** spermatogenesis and oogenesis. **(4 Marks)**

487. **Distinguish** between internal and external fertilization. **(2 Marks)**

488. **Define** Polyspermy. **(1 Mark)**

489. **Describe** the mechanisms that prevent polyspermy. **(3 Marks)**

490. **Draw, label, and annotate** a seminiferous tubule during spermatogenesis. (**4 Marks)**

491. **Draw, label, and annotate** and ovary during oogenesis. **(4 Marks)**

492. **Draw, label, and annotate** a mature sperm cell. **(4 Marks)**

493. **Draw, label, and annotate** a mature egg cell. **(4 Marks)**

494. **Define** blastocyst. **(1 Mark)**

495. **Outline** the functions of HCG. **(2 Marks)**

496. **Describe** the functions of the placenta. **(3 Marks)**

497. **Describe** the regulation of labor and birth. **(3 Marks)**