



**FACULTY OF SCIENCE**

**DEPARTMENT OF BOTANY AND PLANT BIOTECHNOLOGY**

**BIO10A1**

**BIOLOGY 1A**

**APK CAMPUS**

**JUNE ON-LINE EXAM MEMO**

**3 JUNE 2020**

**DATE:** 3 JUNE 2020

**SESSION:** 8H30 – 15H30

**ASSESSOR:** MS J. WILLIAMSON

**INTERNAL MODERATOR :** DR. H. BYTH-ILLING

**DURATION:** 6 HOURS

**TOTAL MARKS:** 260

**NUMBER OF PAGES: 38 PAGES**

**Please read the following instructions carefully**




















1. Answer all the questions in the question paper – write or type answers, however flow diagrams and drawings should be hand drawn and labelled – scanned or a photo taken of the diagram – and e-mailed together with the rest of the answers. (Please take care to number each drawing or diagram clearly)
2. Work neatly.
3. Read your questions carefully.
4. Good Luck.
5. Plagiarism is a criminal offence – please use your own words when answering the questions – plagiarized answers will be marked incorrect.

**QUESTION 1**

[40]

*Choose the alternative that best completes the statement or answers the question. Only write down the correct letter next to the appropriate question number.*

- 1.1 What is the correct order (from small to large)?
- A. Cells, organelles, organ system, community, ecosystems
  - B. Molecules, organism, population, communities, biosphere**
  - C. Molecules, cells, tissues, ecosystems, communities
  - D. Organelles, cells, population, biosphere, ecosystems
  - E. Cells, organs, population, ecosystems, communities
- 1.2 The idea that form and function are related would not be exemplified by which of the following examples?
- A. Cells in the intestinal lining of vertebrates have many small projections that increase the surface area for absorption of nutrients.
  - B. Plants that live in dry areas have large roots for absorbing water.
  - C. Seeds that are dispersed by wind are very light.
  - D. Fish that swim rapidly have bodies that are streamlined.
  - E. none of the above**
- 1.3 Based on the periodic table shown below, which elements will most likely form an ionic bond?

First shell	<div>Hydrogen <math>{}^1_1\text{H}</math></div> <div></div>	<div><div>2</div><div>Atomic number</div></div> <div><div>He</div><div>Element symbol</div></div> <div><div>4.00</div><div>Mass number</div></div> <div><div>Electron distribution diagram</div></div> <td><div>Helium <math>{}^2_2\text{He}</math></div><div></div></td>						<div>Helium <math>{}^2_2\text{He}</math></div> <div></div>
Second shell	<div>Lithium <math>{}^3_3\text{Li}</math></div> <div></div>	<div>Beryllium <math>{}^4_4\text{Be}</math></div> <div></div>	<div>Boron <math>{}^5_5\text{B}</math></div> <div></div>	<div>Carbon <math>{}^6_6\text{C}</math></div> <div></div>	<div>Nitrogen <math>{}^7_7\text{N}</math></div> <div></div>	<div>Oxygen <math>{}^8_8\text{O}</math></div> <div></div>	<div>Fluorine <math>{}^9_9\text{F}</math></div> <div></div>	<div>Neon <math>{}^{10}_{10}\text{Ne}</math></div> <div></div>
Third shell	<div>Sodium <math>{}^{11}_{11}\text{Na}</math></div> <div></div>	<div>Magnesium <math>{}^{12}_{12}\text{Mg}</math></div> <div></div>	<div>Aluminum <math>{}^{13}_{13}\text{Al}</math></div> <div></div>	<div>Silicon <math>{}^{14}_{14}\text{Si}</math></div> <div></div>	<div>Phosphorus <math>{}^{15}_{15}\text{P}</math></div> <div></div>	<div>Sulfur <math>{}^{16}_{16}\text{S}</math></div> <div></div>	<div>Chlorine <math>{}^{17}_{17}\text{Cl}</math></div> <div></div>	<div>Argon <math>{}^{18}_{18}\text{Ar}</math></div> <div></div>

- A. **Li and F**  
 B. C and O  
 C. N and O  
 D. Si and Cl  
 E. all of the above
- 1.4 Titanium has an atomic number of 22. How many protons, neutrons, and electrons are in an isotope of titanium with mass number of 48?  
 A. **p - 22, n - 26, e - 22**  
 B. p - 11, n - 26, e - 11  
 C. p - 11, n - 11, e - 70  
 D. p - 11, n - 22, e - 48  
 E. p - 22, n - 22, e - 48
- 1.5 Carbon is an unusual atom in that it can form multiple bonds. Which statement is NOT true?  
 A. A carbon-to-carbon cis double bond is the type found in nature and is associated with cardiovascular health.  
 B. A carbon-to-carbon trans double bond is made artificially in food processing and is associated with poor cardiovascular health.  
 C. Multiple carbon-to-carbon double bonds located near each other can absorb light, so they are found in molecules in the eye or in chloroplasts.  
 D. Multiple carbon-to-carbon bonds are stronger than single bonds.  
 E. **Saturated fats are those that have a carbon-to-carbon double bond and are associated with good health.**
- 1.6 Which type of molecule always contains phosphate groups?  
 A. Carbohydrates  
 B. Lipids  
 C. Proteins  
 D. **Nucleic acids**  
 E. None of the above
- 1.7 Which cellular structure is common to all three (3) domains of life?  
 A. Nucleus  
 B. Endoplasmic reticulum  
 C. Mitochondria  
 D. **Phospholipid bilayer cell membrane**

- E. endocytotic vesicles
- 1.8 What is the correct order of the exocytosis or secretion pathway?
- A. Rough ER, endosome, Golgi, smooth ER.
  - B. Rough ER, Golgi, smooth ER, plasma membrane.
  - C. Smooth ER, rough ER, exocytosis, Golgi.
  - D. Rough ER, Golgi, transport vesicle, plasma membrane.**
  - E. Rough ER, Golgi, endosome, plasma membrane, transport vesicle.
- 1.9 Which of the following molecules will diffuse most quickly across a lipid bilayer membrane?
- A.  $\text{H}_2\text{O}$
  - B.  $\text{O}_2$**
  - C.  $\text{H}_2\text{PO}_4^-$
  - D. glucose
  - E.  $\text{Na}^+$
- 1.10 Cells (e.g., bacteria) are taken up by other cells (e.g., an immune cell) by which of the following processes?
- A. Pinocytosis
  - B. Exocytosis
  - C. Receptor-mediated endocytosis
  - D. Phagocytosis**
  - E. Facilitated diffusion
- 1.11 Cellular respiration can best be described as \_\_\_\_\_
- A. using energy released from breaking high-energy covalent bonds in organic molecules to force ATP formation from ADP and phosphate.
  - B. taking electrons from food and giving them to phosphate to make ATP.
  - C. taking electrons from food and giving them to oxygen to make water and using the energy released to drive ATP formation.**
  - D. converting higher-energy organic molecules to lower-energy organic molecules and using the energy released to drive ATP formation.
- 1.12 Newborn mammals have a specialized organ called brown fat, where cells burn fat to  $\text{CO}_2$  without capturing the energy to reduce electron carriers or drive ATP formation. How can this energy be used instead?
- A. To synthesize glucose from  $\text{CO}_2$ .

- B. To directly power muscle contraction.
- C. To provide energy for endergonic biosynthetic reactions.

**D. To generate heat.**

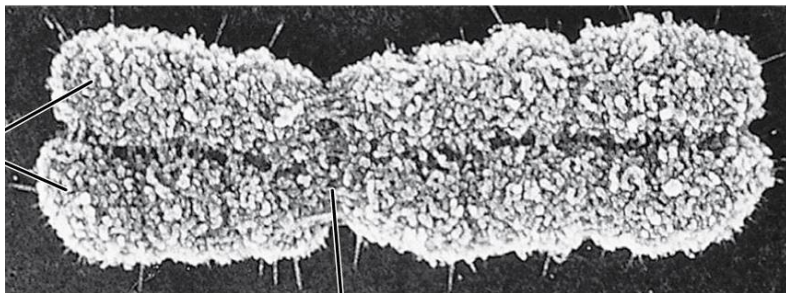
1.13 Which of the following INCORRECTLY matches a process with its typical location?

- A. Oxygen gas is produced—the soluble space surrounded by the thylakoid membranes.
- B. Activated chlorophyll donates an electron — in the thylakoid membranes.
- C. NADPH is oxidized to NADP—the stroma of the chloroplast
- D. ATP is produced—the space between the two (2) chloroplast envelope membranes.**
- E. RUBISCO catalyzes carbon fixation — the stroma of the chloroplast.

1.14 In a protein complex for the light reaction (a reaction center), energy is transferred from pigment molecule to pigment molecule, to a special chlorophyll a molecule, and eventually to the primary electron acceptor. Why does this occur?

- A. The action spectrum of that molecule is such that it is different from other molecules of chlorophyll.
- B. The potential energy of the electron has to go back to the ground state.
- C. The molecular environment lets it boost an electron to a higher energy level and also to transfer the electron to another molecule.**
- D. Each pigment molecule has to be able to act independently to excite electrons.
- E. These chlorophyll a molecules are associated with higher concentrations of ATP.

1.15 At what stage of the cell cycle would you see a chromosome that looks like the one (1) in the diagram below?



- A. G1
- B. G2
- C. M**
- D. S

- 1.16 Which of the following best describes the kinetochore?
- A. **A structure composed of several proteins that associate with the centromere region of a chromosome and that can bind to spindle microtubules.**
  - B. The centromere region of a metaphase chromosome at which the DNA can bind with spindle proteins.
  - C. The array of vesicles that will form between two dividing nuclei and give rise to the metaphase plate.
  - D. The ring of actin microfilaments that will cause the appearance of the cleavage furrow.
  - E. The core of proteins that forms the cell plate in a dividing plant cell.
- 1.17 John, age 47, has just been diagnosed with Huntington's disease, which is caused by a dominant allele. His daughter, age 25, now has a 2-year-old son. No one else in the family has the disease. What is the probability that the daughter will be diagnosed with the disease?
- A. 0%
  - B. 25%
  - C. **50%**
  - D. 75%
  - E. 100%
- 1.18 ABO blood type in humans exhibits codominance and multiple alleles. What is the likelihood of a type A father and a type A mother having a type O child?
- A. It is impossible.
  - B. **25% if both parents are heterozygous.**
  - C. 50% if both parent are heterozygous.
  - D. 25% if only the father is heterozygous.
  - E. 25% if only the mother is heterozygous.
- 1.19 How do the leading and the lagging strands differ?
- A. **The leading strand is synthesized in the same direction as the movement of the replication fork, whereas the lagging strand is synthesized in the opposite direction.**
  - B. The leading strand is synthesized at twice the rate of the lagging strand.
  - C. The lagging strand is synthesized continuously, whereas the leading strand is synthesized in short fragments that are ultimately stitched together.

- D. The leading strand is synthesized by adding nucleotides to the 3' end of the growing strand, whereas the lagging strand is synthesized by adding nucleotides to the 5' end.
- 1.20 Who conducted the X-ray diffraction studies that were key to the discovery of the structure of DNA?
- A. Griffith
  - B. Franklin**
  - C. Meselson and Stahl
  - D. Chargaff
  - E. McClintock
- 1.21 Which of the following most closely represents the male gametophyte of seed-bearing plants?
- A. Ovule
  - B. Microspore mother cell
  - C. Pollen grain interior**
  - D. Embryo sac
  - E. Fertilized egg
- 1.22 The cycads, a mostly tropical phylum of gymnosperms, evolved about 300 million years ago and were dominant forms during the Age of the Dinosaurs. Though their sperm are flagellated, their ovules are pollinated by beetles. These beetles get nutrition (they eat pollen) and shelter from the microsporophylls. Upon visiting megasporophylls, the beetles transfer pollen to the exposed ovules. In cycads, pollen cones and seed cones are borne on different plants. Cycads synthesize neurotoxins, especially in the seeds, that are effective against most animals, including humans.

Which feature of cycads distinguishes them from most other gymnosperms?

1. *They have exposed ovules.*
2. *They have flagellated sperm.*
3. *They are pollinated by animals.*

A. 1 only

B. 2 only

C. 3 only

**D. 2 and 3**

E. 1, 2, and 3

1.23 Which of the following is a characteristic of all angiosperms?

A. Complete reliance on wind as the pollinating agent.

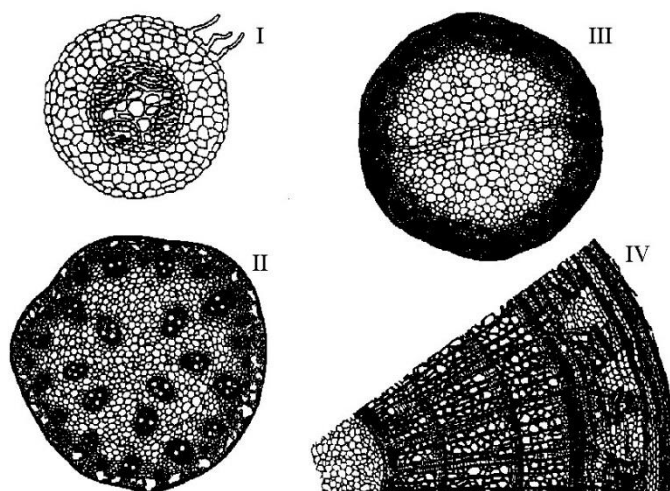
**B. Double internal fertilization.**

C. Free-living gametophytes.

D. Carpels that contain microsporangia.

E. Ovules that are not contained within ovaries.

***The following questions are based on the drawing of root or stem cross sections shown below.***



1.24 A monocot stem is represented by

A. I only.



**B. II only.**

C. III only.

D. IV only.

E. Both I and III.

1.25 A plant that is at least three (3) years old is represented by\_\_\_\_\_

A. I only.

B. II only.

C. III only.

**D. IV only.**

E. Both I and III.

1.26 A woody eudicot is represented by \_\_\_\_\_

A. I only.

B. II only.

C. III only.

**D. IV only.**

E. Both I and III.

1.27 In plant roots, the Casparian strip is correctly described by which of the following?

A. It is located in the walls between endodermal cells and cortex cells.

B. It provides energy for the active transport of minerals into the stele from the cortex.

C. It ensures that all minerals are absorbed from the soil in equal amounts.

**D. It ensures that all water and dissolved substances must pass through a cell membrane before entering the stele.**

E. It provides increased surface area for the absorption of mineral nutrients.

1.28 What regulates the flow of water through the xylem?

- A. Passive transport by the endodermis.
- B. The number of companion cells in the phloem .

**C. The evaporation of water from the leaves.**

- D. Active transport by sieve-tube members.
- E. Active transport by tracheid and vessel elements.

1.29 A young farmer purchases some land in a relatively arid area and is interested in earning a reasonable profit for many years. Which of the following strategies would best allow such a goal to be achieved?

- A. Establishing an extensive irrigation system.
- B. Using plenty of the best fertilizers.
- C. Finding a way to sell all parts of crop plants.

**D. Selecting crops adapted to arid areas.**

- E. Converting hillsides into fields.

1.30 You are given the task of designing an aerobic, mixotrophic protist that can perform photosynthesis in fairly deep water (e.g. 250 m deep), and can also crawl about and engulf small particles. With which two (2) of these structures would you provide your protist?

- 1. hydrogenosome
- 2. apicoplast
- 3. pseudopods
- 4. chloroplast from red alga
- 5. chloroplast from green alga

- A. 1 and 2

B. 2 and 3

C. 2 and 4

**D. 3 and 4**

E. 4 and 5

1.31 Which of the following is not characteristic of ciliates?

A. They use cilia as locomotory structures or as feeding structures.

B. They are relatively complex cells.

**C. They can exchange genetic material with other ciliates by the process of mitosis.**

D. Most live as solitary cells in fresh water.

E. They have two (2) or more nuclei.

1.32 The clownfish and parrotfish died on the same day. Autopsies revealed the presence of many small, flat worms using tiny suckers to attach to the fish gills. If the worms discovered during the autopsies have all features characteristic of their phylum, dissection of the worms should reveal the presence of \_\_\_\_\_

1. nephridia.

2. chaetae.

3. segmentation.

4. a gastrovascular cavity.

5. the acoelomate condition.

A. 5 only

B. 1 and 2

**C. 4 and 5**

D. 1, 2, and 3

E. 3, 4, and 5

1.33 Of the annelid classes below, which make castings that are agriculturally important?

**A. Oligochaeta**

B. Polychaeta

C. Hirudinea

D. all three (3) of these

E. two (2) of these

1.34 In terms of food capture, which sponge cell is most similar to the cnidocyte of a Cnidarian?

A. Zygote

**B. Choanocyte**

C. Gamete

D. Epidermal cell

E. Pore cell

1.35 All types of muscle tissue have \_\_\_\_\_

A. intercalated discs that allow cells to communicate.

B. striated banding pattern seen under the microscope.

C. cells that lengthen when appropriately stimulated.

D. a response that can be consciously controlled.

**E. interactions between actin and myosin.**

1.36 Compared with a smaller cell, a larger cell of the same shape has \_\_\_\_\_

A. less surface area.

**B. less surface area per unit of volume.**

- C. the same surface-to-volume ratio.
- D. a smaller average distance between its mitochondria and the external source of oxygen.
- E. a smaller cytoplasm-to-nucleus ratio.
- 1.37 The epithelium best adapted for a body surface subject to abrasion is \_\_\_\_\_
- A. simple squamous.
- B. simple cuboidal.
- C. simple columnar.
- D. stratified columnar.
- E. stratified squamous.**
- 1.38 The vegetal pole of the zygote differs from the animal pole in that \_\_\_\_\_
- A. the vegetal pole has a higher concentration of yolk.**
- B. the blastomeres originate only in the vegetal pole.
- C. the posterior end of the embryo forms at the vegetal pole.
- D. the vegetal pole cells undergo mitosis but not cytokinesis.
- E. the polar bodies bud from this region.
- 1.39 All individuals of a particular species of whiptail lizards are females. Their reproductive efforts depend on \_\_\_\_\_
- A. fertilization of their eggs by males of other lizard species.
- B. gonadal structures that only undergo mitosis.
- C. meiosis followed by a doubling of the chromosomes in eggs.**
- D. budding prior to the development of a sexual phenotype.
- E. fragmentation via autolysis.

1.40 As an embryo develops, new cells are produced as the result of \_\_\_\_\_

A. differentiation.

B. preformation.

**C. cell division.**

D. morphogenesis.

E. epigenesis.

**QUESTION 2**

[21]

*Give the correct biological term for each of the following definitions. Only write down the correct term next to the appropriate question number.*

2.1 The property of life shown by pygmy horses who camouflage themselves in their environment, this adaption evolved over many generations by reproductive success of those individuals with heritable traits best suited to their environment. **Evolutionary adaptation**

2.2 Organisms which act as recyclers, changing complex matter into simpler mineral nutrients. **Decomposers**

2.3 Substances that have characteristics that differ from their elements. **Compound**

2.4 The deficiency of this element prevents production of thyroxine, resulting in the formation of a goitre. **Iodine**

2.5 The organic molecule used as a main fuel source for cellular work and used as raw materials to manufacture other organic molecules. **Glucose / monosaccharides**

2.6 The bond that joins two (2) carbohydrate monomers. **Glycosidic linkage/bond**

2.7 The organelle containing digestive enzymes not found in a plant cell. **Lysosome**

2.8 The part of the cell which support the cell's shape and are involved in motility. **Microfilaments**

- 2.9 The phenomenon that occurs in a hypertonic environment, where a plant cell loses water and eventually, the membrane pulls away from the wall. **Plasmolysis**
- 2.10 The process by which fluids are taken into small vesicles into the cell. **Pinocytosis**
- 2.11 The quantity of heat required to raise the temperature of 1 kilogram (kg) of water by 1°C. **kilocalorie**
- 2.12 The co-enzyme involved with the citric acid cycle of a cell. **Acetyl coenzyme A**
- 2.13 Prokaryotes that use inorganic chemicals as their energy source. **Chemoautotrophs**
- 2.14 Tiny pores in the leaves of a plant. **Stomata**
- 2.15 Reproduction method which involves inheritance of all genes from one (1) parent. **Asexual -/ cloning**
- 2.16 Cancer which arise in external or internal body coverings. **Carcinomas**
- 2.17 Alternative versions of genes. **Alleles**
- 2.18 A common fatal genetic disease in the United States, resulting in excessive thick mucus secretions. **cystic fibrosis (CF)**
- 2.19 The beginning of the DNA code needed to be recognized at the start of protein synthesis. **Promotor**
- 2.20 The amount of hydrogen bonds between Guanine and Adenine in a DNA molecule. **None**
- 2.21 Fungi which absorb phosphorus and other essential materials from the soil and make them available to the plant. **Mycorrhizae**
- 2.22 The male reproductive organ of an Angiosperm. **Stamen**
- 2.23 The site of embryonic development of a seed plant. **Ovule**
- 2.24 The points at which leaves are attached on a plant. **Nodes**
- 2.25 Plant cells which usually have a thin and flexible primary cell wall and perform most of the metabolic functions of a plant. **Parenchyma cells**

- 2.26 A lateral meristem that lies at the outer edge of the stem cortex. **Cork cambium**
- 2.27 Plants that grow anchored on other plants and absorb water and minerals from rain. **Epiphytes**
- 2.28 Bacteria converting ammonium to nitrates in the soil. **Nitrifying bacteria**
- 2.29 Compounds given to plants to promote growth. **Fertilizer**
- 2.30 The mobile zygote in the life cycle of *Plasmodium*. **Ookinete**
- 2.31 The feeding stage in the life cycle of *Plasmodium*. **Trophozoit**
- 2.32 The unique feature visible in all organisms of the sub-phylum Sarcodina. **Pseudopodia**
- 2.33 The largest class of molluscs. **Gastropoda**
- 2.34 The class which includes sea urchins. **Echinoidea**
- 2.35 Term used to describe animals with three (3) embryonic layers. **Triploblastic**
- 2.36 The spleen is part of this organ system. **Lymphatic and immune system**
- 2.37 Cell found in bone tissue. **Osteocytes**
- 2.38 Study of structure. **Anatomy**
- 2.39 The fertilization process that takes place as soon as the sperm makes contact with the egg. **Acrosome reaction**
- 2.40 Two (2) membranes surrounding the egg of a human. **Zona pullucida, Plasma membrane and vitelline layer (Any 2)**

### **QUESTIONS ON BIOCHEMISTRY SECTION OF BIOLOGY 1A**

#### **QUESTION 3**

[7]

- 3.1 Why are cells said to be at the level at which the properties of life emerge, the lowest level that perform all activities required for life? (6 x ½ = 3)

- **A cell can**



- regulate its internal environment,
- take in and use energy,
- respond to its environment,
- develop and maintain its complex organization, and
- give rise to new cells-growth
- /repair.

3.2 Name and distinguish between the two (2) basic types of cells with regard to complexity of the cells. (8 x ½ = 4)

- Prokaryotic cells
  - were the first to evolve,
  - are simpler, and
  - are usually smaller than eukaryotic cells.
- Eukaryotic cells
  - contain membrane-enclosed organelles,
  - including a nucleus containing DNA, and
  - are found in plants, animals, and fungi.

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**QUESTION 4**

[7]

4.1. What **type of bond** is very prevalent in lipids and gives lipids their properties? (1)

**Non polar covalent bonds**

4.2 Name the four (4) most commonly found elements in the human body. Which one of these four (4) has the most valence electrons? (5)

- O, C, H, N
- Oxygen has the most valence electrons

4.3 Water shows high cohesion and surface tension and can absorb large amounts of heat because of large numbers of which bonds between water molecules? (1)

**Hydrogen bonds**

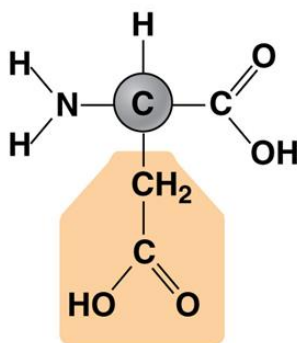
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**QUESTION 5**

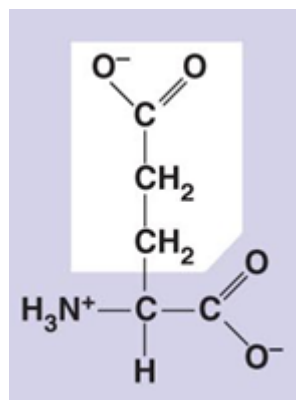
[9]

5.1 Study the following structural formulas and answer the questions that follow.

**Diagram A**



**Diagram B**



5.1.1 To which organic molecules do the molecules represented by Diagram A belong? Give two (2) reasons for your answer. (2)

- **Proteins**
- **Contains an aminogroup, R-group and carbonyl group**

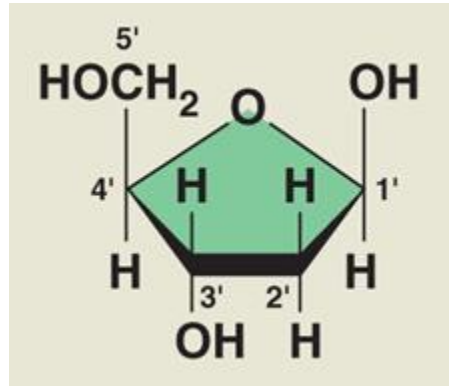
5.1.2 Is the molecule represented by Diagram A, hydrophobic or hydrophilic and polar or nonpolar? Give a reason for your answers. (3)

**Hydrophilic and polar – has an OH- in its R-group**

5.1.3 Is the molecule represented by Diagram B, acidic or basic? Give a reason for your answer. (2)

**Acidic – The R-group is negatively charged.**

5.2 Study the diagram of the structural formula of a sugar below.



- 5.2.1 According to the amount of carbons in the sugar in the diagram, what sugar is represented by the diagram? (1)

**Pentose sugar (deoxyribose sugar)**

- 5.2.2 Name the nucleic acid which contains this sugar? (1)

**DNA (Deoxyribose nucleic acid)**

## QUESTION 6

[9]

- 6.1 In developed countries over the last 50 years, there has been a decline in human sperm quality. Give possible reasons for this. (2 x ½ = 1)

- **The causes of this decline may be:**
  - **environmental chemicals or**
  - **genetic disorders that interfere with the movement of sperm and cilia.**

- 6.2 How do adjacent cells communicate, interact, and adhere to one another? (5)

- **Through specialized junctions between them.**
  - **Tight junctions prevent leakage of extracellular fluid across a layer of epithelial cells.**
  - **Anchoring junctions fasten cells together into sheets.**

- Gap junctions are channels that allow molecules to flow between cells
- Plant cells have cell junctions called plasmodesmata that serve in communication between cells.

6.3 Eukaryotic cell structures can be grouped on the basis of four (4) functions. Briefly mention these basic functions. (4 x ½ = 2)

- genetic control,
- manufacturing, distribution, and breakdown,
- energy processing, and
- structural support, movement, and communication between cells.

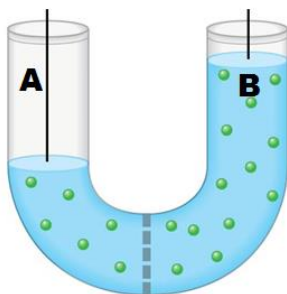
6.4 Why are peroxisomes important to a cell? (1)

It breaks down toxic hydrogen peroxide by products.

## QUESTION 7

[9]

7.1 Study the diagram of a U-tube with 50% sugar solution inside A, separated by a selectively permeable membrane that only allows water to pass through, and a 70% sugar solution in side B.



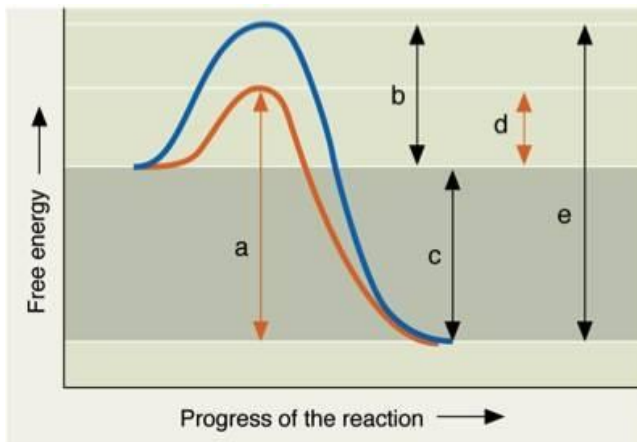
7.1.1 What process will occur across the selectively permeable membrane? (1)

### Osmosis

7.1.2 Explain and briefly discuss what will happen in the next few minutes if this tube is left undisturbed. (5)

- Water will move from side A to side B.
- Side A has 50% water and Side B 30% water – side A has a higher WP than side B.
- Therefore water will move from a high WP in A to a low WP in B.
- Decreasing the water level of A
- Increasing the water level in B.

7.2 Study the energy diagram below and answer the questions that follow.



7.2.1 Supply labels for a, b, c, d and e.

(5 x ½ = 2½)

- a. Total energy used when an enzyme is present (catalysed reaction)
- b. activation energy for an uncatalysed reaction
- c. difference in free energy/  $\Delta G$
- d. Activation energy of a catalysed reaction
- e. Total energy of an uncatalysed reaction.

7.2.2 Which of the energy changes would be the same in both the enzyme-catalysed and uncatalysed reactions?

(½)

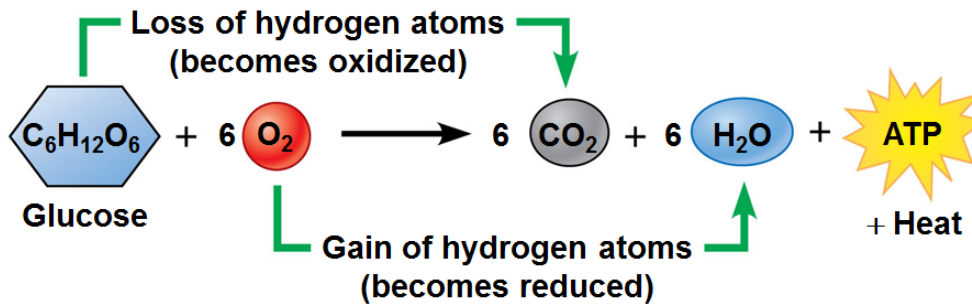
C – amount of free energy

## QUESTION 8

[11]

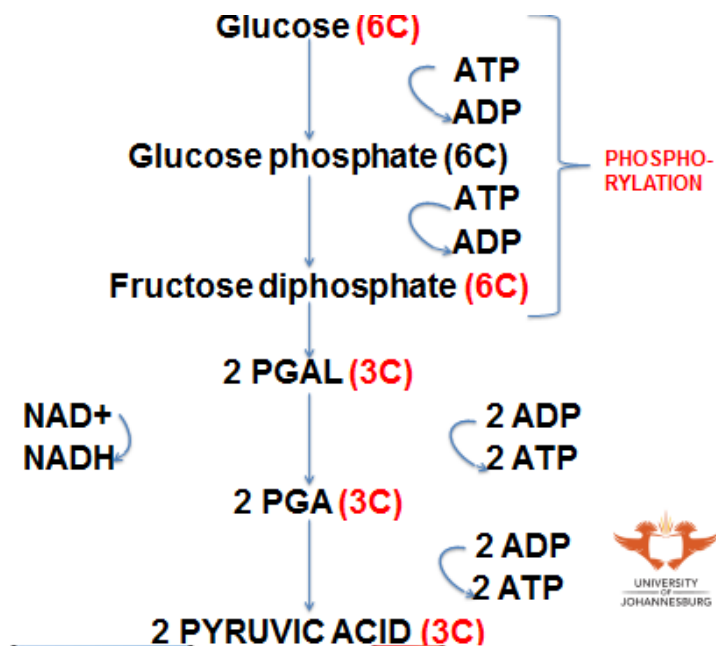
8.1 Supply an equation to explain the redox reaction that takes place during the process of energy production in a plant or animal cell.

(8 x ½ = 4)



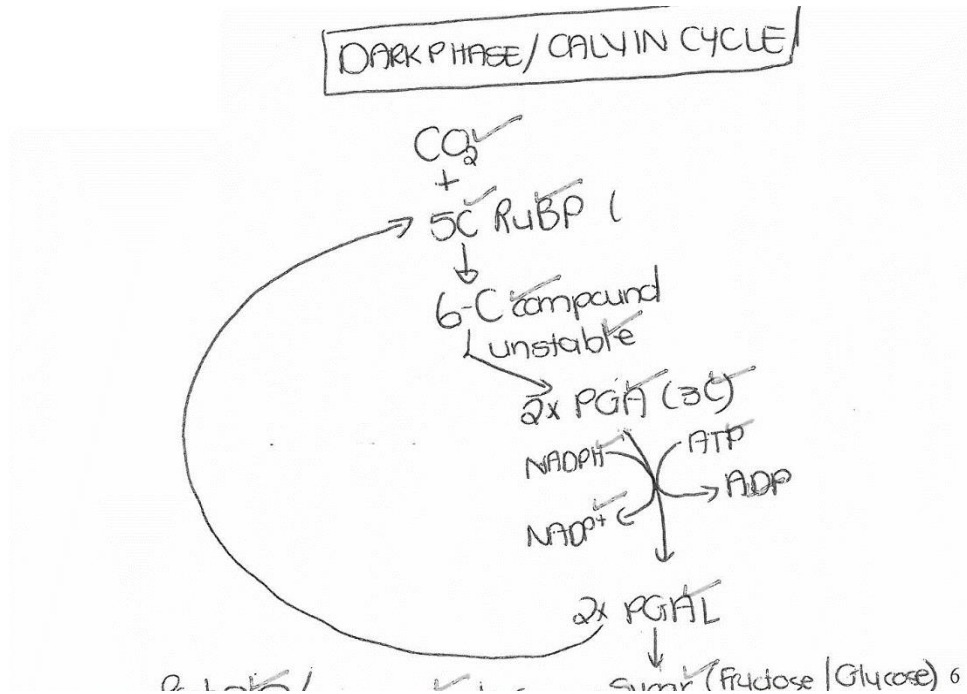
- 8.2 Draw a diagram to only explain the first phase of the process which cause the production of energy in a plant cell. (You have to draw the flow diagram, scan it or take a photo - number the question to which to diagram belong clearly - and e-mail it to with the rest of your exam – you are not allowed to type this answer) (12 x ½ = 6)

**Glycolysis**



- 8.3 Which phase of the process which produces energy, produces the most energy and where does this phase take place in the cell? (2 x ½ = 1)
- Oxidative phosphorylation/ Hydrogen transfer system
  - Takes place in the cristae of the mitochondrion

- 9.1 Name and draw a labelled diagram to clarify the events that takes place during the second phase of photosynthesis (You have to draw the flow diagram, scan it or take a photo - number the question to which to diagram belong clearly - and e-mail it to with the rest of your exam – you are not allowed to type this answer). (16 x ½ = 8)



**PGAL are now used for the following reactions:**

**Some PGAL are used to make RuBP again, so that the cycle can start over again.**

**Some PGAL are used to form hexose sugars like glucose and fructose. Which combine to form disaccharides and polysaccharides.**

**\* The carbohydrates can then be converted to other biological compounds like proteins or fats by adding mineral salts like nitrates and phoshates.**

- 9.2 What end product are formed during the first phase of photosynthesis? (3)

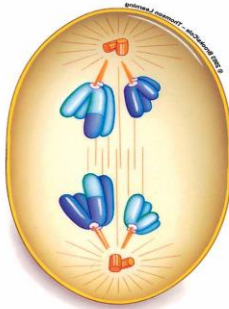
- **NADPH,**
- **ATP, and**
- **oxygen**

**QUESTION 10**

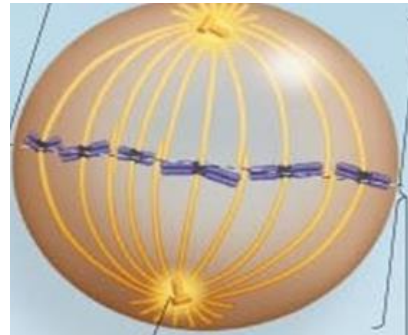
[6]

10.1 Study the following diagrams and answer the questions that follow.

**Diagram A**



**Diagram B**



10.1.1 Name the respective cell division processes and phases of the above diagrams. (4)

**Diagram A: Meiosis I**

**Diagram B: Mitosis**

**Anaphase I**

**Metaphase**

10.1.2 Give reasons for your answers in question 10.1.1. (2)

- **Diagram A: Homologous chromosomes separate during anaphase I of meiosis.**
- **Diagram B: Single chromosomes attach to single spindle fibers during meiosis Metaphase.**

**QUESTION 11**

[10]

11.1 Tim and Jan both have freckles, but their son Mike does not. With the aid of a punnet square explain how this is possible. If Tim and Jan have two (2) more children, what is the probability that both will have freckles? (Hint: Use the letter "r/R" as the gene that codes for freckles or no freckles". (10 x ½ = 5)

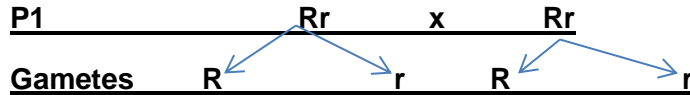
**R – freckles and r – no freckles**

**Tim and Jan – Both heterozygous for freckles**

**Mike was homozygous for not having freckles – 25% chance to have been born without freckles**

**How?**





	<u>R</u>	<u>r</u>
<u>R</u>	<b>RR</b>	<b>Rr</b>
<u>R</u>	<b>Rr</b>	<b>rr</b>

**If they have kids again they will have a 75% chance of having freckles.**

- 11.2 In humans the gene for normal blood clotting, H, is dominant to the gene for hemophilia, h. A woman with normal blood clotting has four (4) children. They are a normal son, a hemophiliac son and two (2) normal daughters. The father has normal blood clotting. What is the probable genotype for each member of the family? (5)

**Mother  $X^H X^h$**

**Father  $X^H Y$**

**Normal son  $X^H Y$**

**Hemophilic son  $X^h Y$**

**Normal daughters  $X^H X^h$  and/or  $X^H X^H$**

**QUESTION 12**

**[10]**

- 12.1 From the DNA strand below, write down the expected mRNA strand and protein strand that would result. (use the table below) (6)

DNA: ACTACGGGCATCGTCCCATTGCCC

**mRNA: UGAUGCCCGUAGCAGGGUAACGG** (3½)

**Protein: Met-Pro-Val-Ala-Gly** (2½)

Figure 10.8A

		Second base				
		U	C	A	G	
First base	U	UUU Phe	UCU Ser	UAU Tyr	UGU Cys	U
	U	UUC Phe	UCC Ser	UAC Tyr	UGC Cys	C
	U	UUA Leu	UCA Ser	UAA Stop	UGA Stop	A
	U	UUG Leu	UCG Ser	UAG Stop	UGG Trp	G
C	C	CUU Leu	CCU Pro	CAU His	CGU Arg	U
	C	CUC Leu	CCC Pro	CAC His	CGC Arg	C
	C	CUA Leu	CCA Pro	CAA Gln	CGA Arg	A
	C	CUG Leu	CCG Pro	CAG Gln	CGG Arg	G
A	A	AUU Ile	ACU Thr	AAU Asn	AGU Ser	U
	A	AUC Ile	ACC Thr	AAC Asn	AGC Ser	C
	A	AUA Ile	ACA Thr	AAA Lys	AGA Arg	A
	A	AUG Met or start	ACG Thr	AAG Lys	AGG Arg	G
G	G	GUU Val	GCU Ala	GAU Asp	GGU Gly	U
	G	GUC Val	GCC Ala	GAC Asp	GGC Gly	C
	G	GUA Val	GCA Ala	GAA Glu	GGA Gly	A
	G	GUG Val	GCG Ala	GAG Glu	GGG Gly	G

12.2 For the process of Mitosis to occur, it is important to make sure each new daughter cell has the same genetic material as the original parent cell, therefore during interphase a very important process must take place.

12.2.1 Name the very important process referred to in the above statement (12.2). (1)

### DNA replication

12.2.2 There are a few enzymes which assist in the process answered in question 12.2.2. What are the functions of the following enzymes in this process?

a. Topoisomerase (1)

Topoisomerase breaks, swivels and re-joins the parental DNA ahead of the replication fork, to prevent over winding.

b. Helicase (2 x ½ = 1)

The enzyme helicase unwinds (1) the parental double helix and break H-bonds(1)

c. DNA ligase (1)

All the fragments are then joined with the help of the enzyme DNA ligase.

**QUESTIONS ON THE BOTANY SECTION OF BIOLOGY**

**QUESTION 13**

**[16]**

13.1 What are the most likely pollination agents of the following plants shown in the diagrams below? Give a suitable reason for your answer in each case. (6 x ½ = 3)

A.



B.

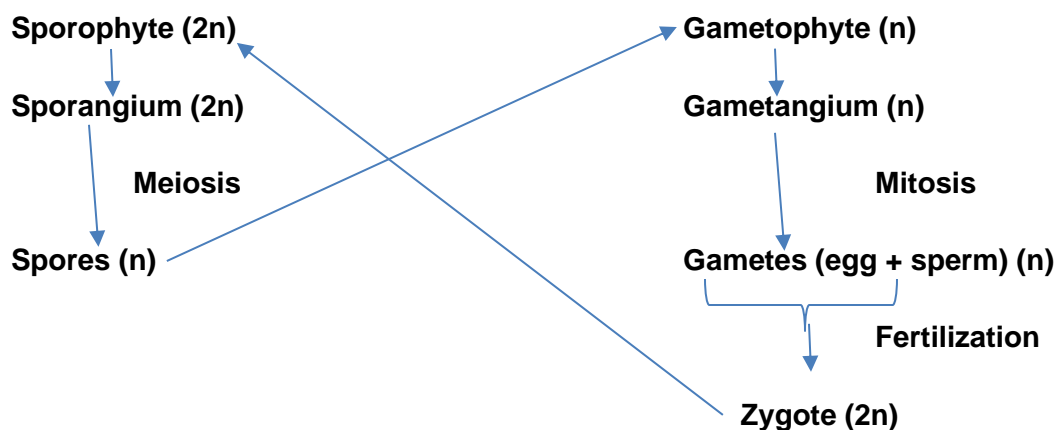


C.



- **A – Wind – light pollen – no brightly coloured flower**
- **B – Insect – shape – easy access – scented – bright colour**
- **C – bird – bright red – no scent – narrow tube shaped flower to allow only beak of bird to enter.**

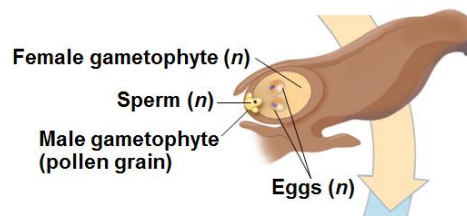
13.2 Draw a general flow diagram to explain alternation of generations in plants. (You have to draw the flow diagram, scan it or take a photo - number the question to which to diagram belong clearly - and e-mail it to with the rest of your exam – you are not allowed to type this answer). (10 x ½ = 5)



13.3 Plant diversity reflects the evolutionary history of the plant kingdom. Name the four (4) key adaptations for life on land which distinguish the main lineages of the plant kingdom from one another. (4)

- Dependent embryos are present in all plants.
- Lignified vascular tissues mark a lineage that gave rise to most living plants.
- Seeds are found in a lineage that includes all living gymnosperms and angiosperms.
- Flowers mark the angiosperm lineage.

13.4 Draw and label one (1) diagram which form part of the life cycle of the pine tree after meiosis has occurred in the female gametophyte. (You have to draw and the diagram, scan it or take a photo - number the question to which the diagram belong clearly - and e-mail it to with the rest of your exam – you are **not allowed to type this answer**). (4)



#### QUESTION 14

[11]

14.1 Give suitable definitions or descriptions of the following terminology.

14.1.1 Apical dominance: (2 x ½ = 1)

- When the terminal bud produces hormones that
- inhibit growth of the axillary buds.

14.1.2 Cuticle (2 x ½ = 1)

- A waxy layer,
- which reduces water loss.

14.2 Which modified organs are found in the following plants (Include specific name of modified organ where applicable)? What modified function does this organ have?

(14 x ½ = 7)



14.2.1

**Root – storage**



14.2.2

**Stem – tuber – storage**



14.2.3

**Stem – Rhizome – storage**



14.2.4

**Leave – tendril – climbing**



14.2.5

**Leave – thorn – protection and prevent excess water loss**

14.3 Briefly name and explain the type of fertilization portrayed by Angiosperms. (4 x ½ = 2)

**At fertilization,**

- **one sperm fertilizes the haploid egg to produce a diploid zygote, and**
- **another sperm fuses with the diploid central cell nucleus**
- **to produce a triploid (3n) cell that will give rise to the endosperm, which nourishes the developing embryo.**

- This formation of a diploid zygote and a triploid nucleus is called double fertilization.

**QUESTION 15**

**[13]**

- 15.1 Discuss the feeding methods of the plant in the photograph below. Why do plants like these feed in this manner? (4)



- The venus fly trap feeds on insects, they are Carnivores. They
  - capture and digest small animals such as insects,
  - absorb inorganic elements from prey, and
  - are found in nutrient-poor environments.

- 15.2 Distinguish between the nutrition methods of the following two (2) plants. (6 x ½ = 3)

Plant A



Holo parasite

Use all plants resources

Plant B



Semi-parasite

Photosynthesize self



**Do not photosynthesize itself (no chlorophyll) Absorb water and minerals**

**Absorb sugar and minerals from plant**

- 15.3 Identify the agricultural practices responsible for the degradation of soil. Choose the correct diagrams (only write down the letters of the diagram) and briefly discuss why it is responsible for the degradation of the soil. (4)

A



B



C



D



- **A - Irrigation can gradually make soil salty.**
- **C - Ploughed lands are subject to erosion by wind and rain, which removes topsoil.**

- 15.4 Describe the factors which play a role in guard cell activity. (4 x ½ = 2)

- **Sunlight signals guard cells to accumulate K<sup>+</sup> and open stomata.**

- Low CO<sub>2</sub> concentration in leaves also signals guard cells to open stomata.
- Plants have natural rhythms that help them close stomata at night to conserve water.
- Plants may also close stomata during the day to conserve water when necessary.

### QUESTIONS ON ZOOLOGY SECTIONS OF BIOLOGY

#### QUESTION 16

[12]

16.1 Protista is a vastly diverse kingdom which constitute a polyphyletic group with several characteristics unique to this kingdom. Discuss these characteristics AND give examples of specific organisms with these characteristics. (20 x ½ = 10)

#### Locomotion

- Protists move by means of
  - flagella (*Trypanosoma*),
  - cilia (*Paramecium*),
  - spores (*Plasmodium*) and
  - pseudopodia (*Amoeba*)

#### Nutrition

- Autotrophs – *Euglena*/ *Volvox*
- Heterotrophs
  - Phagotrophs / holozoic feeders which ingest visible whole particles (*Amoeba*)
  - Osmotrophs / saprozoic feeders which ingest soluble food (*Paramecium*)

#### Asexual Reproduction

- Binary fission = division (transverse or longitudinal) of the parent body into two exact halves. Mitoses is part of the process e.g *Paramecium* / *Vorticella*



- Budding = outgrowths from the parent form and pinch off to live independently or remain attach to form a colony
- Multiple fission through:
  - Schizogony – multiple fission into many cells (*Plasmodium*)
  - Sporogony – the formation of spores
- Reproduction: Sexual
  - Types of gametes
    - Isogametes – one of a pair of gametes that are morphologically the same
    - Anisogametes – gametes that are morphologically different e.g. sperm and egg
    - Microgametes – male gametes
    - Macrogametes – female gametes

Reproduction: Sexual

1) Conjugation = \* Exchange of gametic nuclei

\* Exchange of genetic material

2) Syngamy = Fusion of anisogametes (sperm & egg)

3) Autogamy = \* Fusion of haploid nuclei from the same individual

\* Fusion of isogametes

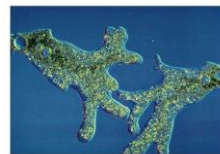
16.2 Study the following diagrams and photos and identify the required taxa. (4 x ½ = 2)

A



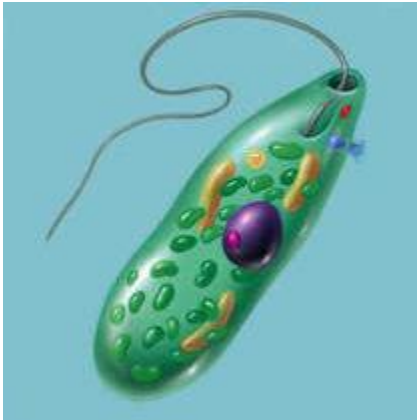
Genus name: Trypanosoma

B



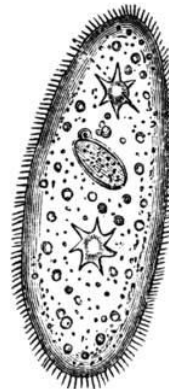
Phylum: Sarcomastigophora

C



Class: Phytomastigophorea

D



Phylum: Ciliophora

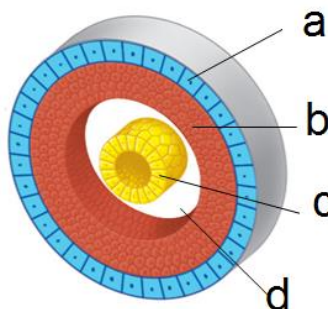
**QUESTION 17**

[13]

17.1 The simplest chordates are tunicates and lancelets. Why is this statement true? (2)

- Both do not have a backbone and
- Both use their pharyngeal slits for suspension feeding.

17.2 Study the following diagram and answer the questions that follow.



17.2.1 Label a – d and indicate what tissue each will develop into.

(6 x ½ = 3)

- a - Ectoderm – become epidermis
- b – Mesoderm – become muscle layer
- c – Endoderm – become lining of digestive tract

17.2.2 In what group will organisms be categorized who have the type of body cavity depicted in the diagram above. Give a reason for your answer. (2 x ½ = 1)

**Pseudocoelomata – the body cavity is derived from the mesoderm and endoderm.**

17.2.3 To which phylum will an organism belong with a body cavity as shown in the diagram? (½)

**Nematoda**

17.2.4 Organisms in the phylum answered in question 17.2.3 can prevent their bodies from drying out. What structure is used to accomplish this? (½)

**Cuticle**

17.2.5 What are the functions of the body cavity shown in the diagram? (2 x ½ = 1)

- **distribute nutrients**
- **and act as a hydroskeleton**

17.3 Why are Arthropods so diverse and successful? (3)

- **Segmentation = tagmatisation,**
- **a hard exoskeleton - molting, and**
- **jointed appendages, for which the phylum is named.**

17.4 Distinguish between the two (2) types of Myriapoda. (2)

- **Millipedes are herbivores that have two pairs of short legs per body segment.**
- **Centipedes are carnivores that have one pair of legs per body segment.**

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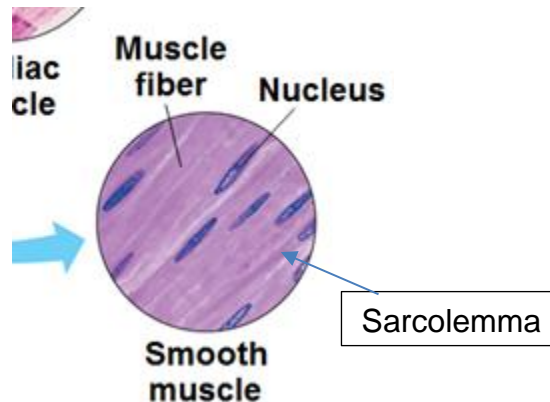
**QUESTION 18**

**[12]**

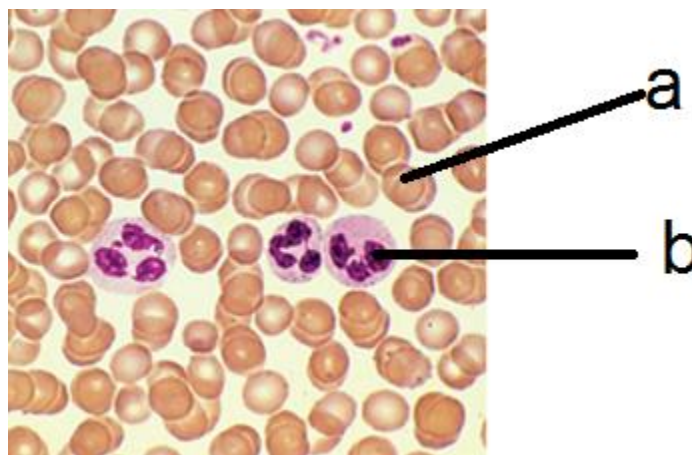
18.1 Name the main parts which form part of the respiratory system. (6 x ½ = 3)

**Nose, pharynx, larynx, Trachea, bronchus and lungs**

- 18.2 Name, draw and label a diagram to clearly show the unique structure of the muscle tissue which make up a person's biceps. (Please draw and label a part of this type of muscle tissue – number the question clearly – scan or take a photo of your drawing and email it to me together with the rest of your exam – do not copy and paste a picture from a textbook or from the internet). (4)



- 18.3 What will be the effect on a person's health who has a lesser amount of either a or b in the diagram below, respectively? (4)



- a – with less red blood cells the person will not transport enough oxygen to the brain and other organs and muscles – will become tired and could go in a coma – suffer from anemia

- o **b – a person will be very susceptible for infection as the function of the white blood cells is immunity – to destroy any organism or particle intended to infect the body.**

18.4 What is the function of adipose tissue, and which animals will have many of these cells? (2 x ½ = 1)

**Store fat – animals in very cold areas – polar bear**

**QUESTION 19**

**[14]**

19.1 Study the following diagrams and answer the questions that follow.

**A**



**B**



**C**



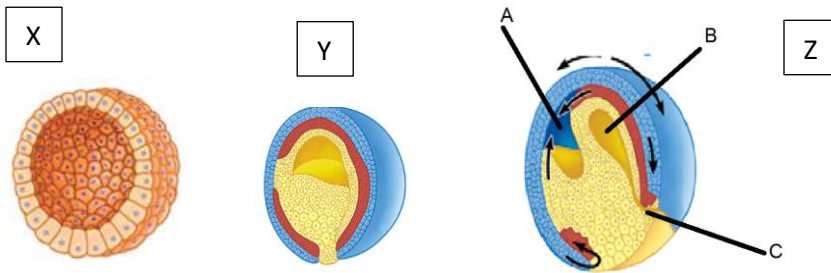
19.1.1 What type of fertilization is used by each of the organisms above (internal and external fertilization). Briefly explain your answer. (3)

- o A - **External fertilization occurs female frog lays eggs and male from covers the eggs with sperm outside the body of the femail**
- o B and C : **Internal fertilization occurs where sperm is deposited in or near the female reproductive tract**

19.1.2 Which of the organisms portray parental care? (1)

**Bird – C**

19.2 Study the diagrams below and answer the questions that follow.



19.2.1 Identify structures X and Y in the development of animals. (2 x ½ = 1)

**X – Blastula**      **Y – Gastrula**

19.2.2 Label A, B and C in diagram Z. (3)

- **A – Blastocoel**
- **B – Formation of simple digestive tract**
- **C – Blastopore**

19.2.3 Name and briefly explain the process that takes place between the formation of structures X and Y. (6)

**Gastrulation**

- **cells migrate to new locations,**
- **a rudimentary digestive cavity forms, and**
- **the basic body plan of three layers is established with**
  - **ectoderm outside—becomes skin and nervous systems,**
  - **endoderm inside—becomes digestive tract,**
  - **mesoderm in the middle—becomes muscle and bone.**

ooOOOoooo