

Unit 2 From single cells to multicellular organisms

Time permitted: 90 minutes

	Section	Number of questions	Marks available
A	Multiple choice	15	15
B	Short answer	5	50
C	Extended answer	2	20
	Total		85

Section A Multiple choice (15 marks)

- Which of the following would determine whether a cell is from a prokaryote?

B Presence or absence of internal membranes that partition the cell
- How large a cell can be is mostly limited by:

A the surface area needed to exchange materials with the surroundings.
- Mitochondria are organelles found in eukaryotic cells. These organelles are responsible for:

D cellular respiration.
- The cell theory does not apply to which of the following groups?

C Viruses
- A white blood cell engulfing a pathogen, such as a bacterium, is an example of:

A endocytosis.
- If a substance is more concentrated inside a cell than in its surroundings, which of the following processes could produce a net movement of that substance into the cell?

D Active transport
- Which of the following statements about the phospholipid molecules in the plasma membrane is incorrect?

D The phospholipid heads are hydrophobic (water avoiding).
- In cellular respiration, the first stage is known as glycolysis. Glycolysis uses _____ to produce _____.

A glucose; pyruvate
- Yeast uses the process of fermentation to break down sugars. When in a bread mixture, the fermentation by the yeast produces _____, which causes the bread to rise.

A carbon dioxide
- A paramecium is a simple unicellular eukaryote that contains a contractile vacuole. The contractile vacuole:

C eliminates excess water.

- 11** Which of the following is not a function of epithelial tissue?
C Control of contractions in the tissue
- 12** Which of the following correctly traces the path of blood from the heart to a toe and back to the heart again?
D Left ventricle, aorta, toe capillary, vein, right atrium
- 13** Which of the following is not likely to be present in a herbivore?
D Canine teeth
- 14** Which of the following is not a function of the mammalian kidney?
B Filtration of large proteins and red blood cells from the blood
- 15** Which of the following is not true about plant vascular tissue?
C Phloem cells are hollow, non-living and transport water and sugars.

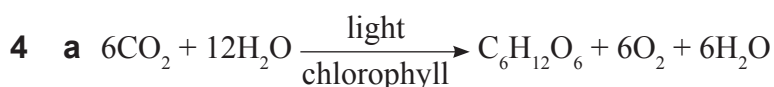
Section B Short answer (50 marks)

- 1 a** *All four types of biomacromolecule have been listed in the table. Students need only provide two. Each cell of the completed table is worth 1 mark.*

Name	Subunit	Example of a cellular function
Carbohydrates	Monosaccharides	Cell walls (cellulose)
Lipids	Triglycerides	Structural component of membranes
Proteins	Amino acids	Metabolism (enzymes)
Nucleic acids	Nucleotide	Controls the functions of the cell

- b** Isotonic
- c** Hypertonic
- d** *Any two of:*
 The surface-area-to-volume ratio of the cell
 Concentration gradients
 The physical and chemical nature of the materials being exchanged
- 2 a** *Any two of:* photosynthesis, respiration, digestion, metabolism
- b i** The optimal pH seemed to be at 7, when the average reaction time was 1.5 s and the reaction rate 0.7 s^{-1} . As pH deviated away from the optimal pH, the average reaction time increased and the rate of reaction decreased. When the pH value decreased to 3, there was no reaction.
- ii** There was no reaction in test tubes A and B because the pH level in those test tubes caused the enzyme to denature. When an enzyme denatures, the shape of the active site changes and is unable to bind to the substrate/reactant.
- iii** A control of pH 7 was used as a comparison point for the other pH values. The average rate of reaction was highest at this optimal value. Reaction rate at other pH values could then be compared to the control and, if all other variables were controlled, then only the change in pH could account for the deviation in reaction time.

- 3 a** Stoma *or* stomata *or* stomatal pore
- b** To allow for gases to enter and leave the leaf (1 mark) and allow water vapour to leave the leaf (1 mark)
- c** Palisade (mesophyll)
- d** To capture light and produce glucose by photosynthesis
- e** Guard cells
- f** Veins transport water and nutrients into the leaf (1 mark) and take the glucose produced out of the leaf (1 mark).
- g** An impermeable thick waxy cuticle on the leaf surface; relatively small leaves for less evaporative surface per leaf



b

Name of stage	Site within a chloroplast
Light dependent	Thylakoid membranes
Light independent	Stroma

- c** Responses will vary. Suggestions are given. Students need only provide two suggestions.

The rate of photosynthesis could be increased by:

- increasing the amount of sunlight available
 - ensuring that each plant has plenty of water available
 - artificially supplying carbon dioxide to the greenhouse
 - ensuring the temperature is maintained at a warm level, to assist enzyme function.
- d** The production of energy in anaerobic respiration is much smaller (2 ATP) than in aerobic respiration (36 ATP).
- e i** Alcohol
- ii** Lactic acid

5 a

Gas exchange surface	Class of vertebrate
Gills	Fish
Alveoli	Mammals (most reptiles)
Skin	Amphibians

- b** Any two of (1 mark each):

Surfaces could be moist, as the gases dissolve in the water and diffuse from one side of the membrane to the other.

Surfaces could be thin and permeable, so the gas molecules can move across them easily and quickly.

The plant organism could have a large surface area in relation to its volume, so as to adequately provide the gaseous requirements.

Surfaces could have a greater concentration of required gas on one side of the membrane than the other, so that a concentration gradient is maintained.

Surfaces could be highly vascularised; a dense network of capillaries are either just beneath the surface (skin) or wrapped around each structure (e.g. alveoli).

- c** Filtration occurs inside the Bowman's capsule (1 mark). Blood inside the capillaries of the glomerulus is under high pressure (1 mark). The pressure forces out water and all small solutes into the Bowman's capsule (1 mark).

d

Substance (g/100 mL)	Plasma (g/100 mL)	Filtrate (g/100 mL)	Urine (g/100 mL)
Glucose	0.15	0.15	0.0
Protein	7.00	0.0	0.0
Salts	0.65	0.65	1.2
Nitrogenous waste	0.03	0.03	2.5

- e** Glucose is a small molecule that can pass through the glomerulus and therefore be present in the filtrate. It is not in the urine as it is reabsorbed from the kidney tubules. (1 mark) Protein is a large molecule that cannot pass through the glomerulus, so it should not be present in either the filtrate or the urine. (1 mark)

Section C Extended answer (20 marks)

- 1** Wet mount steps:

1 Place a drop of water on the centre of the slide. It is also possible to first place the specimen on the slide, but small specimens usually separate more easily from the tweezers or needle if dipped into the drop of water already on the slide. (1 mark)

2 Place the specimen, such as onion cells, into the drop of water. (1 mark)

3 Carefully lower the coverslip so that it touches one side of the drop of water. The coverslip should form an angle of about 45° with the slide. (1 mark) Touch the coverslip on the sides only to prevent fingerprints. Alternatively, use tweezers to hold the coverslip. (1 mark)

4 Lower the coverslip completely. Remove excess water with filter paper or paper towel. (1 mark) A stain can be placed at one end of the coverslip and drawn through using filter paper or paper towel. Iodine and methylene blue are common stains used in the laboratory at school. (1 mark)

FOV = 0.3 mm and 2 cells fit across, so:

Length of one cell = $0.3/2 = 0.15$ mm = 150 micrometres (2 marks)

Total magnification changed from 400× to 4×. FOV will therefore increase by the same proportion.

Old mag/new mag = new FOV/old FOV

$400/40 = x/0.3$

$x = 3$ mm (1 mark)

3 mm = 3000 micrometres

1 cell = 150 micrometres

Number of cells = $3000/150 = 20$ cells (1 mark)

2 Tissue B is phloem (1 mark). Any of the following points for a total of 2 more marks:

Transport of the products of photosynthesis and some mineral nutrients occurs by translocation in the phloem. (1 mark)

It involves the active movement of organic nutrients (sugars)/products of photosynthesis (in solution) from source to sink, and is multidirectional. (1 mark)

The energy for this comes from cellular respiration occurring in the mitochondria of the companion cells. (1 mark)

Transport is against a concentration gradient (from high to low concentration) into the sieve cells. (1 mark)

Tissue B is xylem (1 mark). Any of the following points for a total of 6 more marks:

Transport of water and mineral nutrients from the roots occurs via the xylem through root pressure, capillary action (adhesion and cohesion of water molecules) and transpiration. (1 mark)

Water is transported from roots to leaves unidirectionally. (1 mark)

There is a force pushing water up the stem from the roots. This force is known as root pressure. Root pressure forces water into the plant and works to ensure that the water and minerals reach the vascular tissue of the stem. (1 mark)

Adhesion refers to the forces of attraction between water molecules and the other molecules that make up the inside surface of the structure. (1 mark)

Cohesion refers to the forces of attraction between the water molecules themselves. (1 mark)

The combination of cohesion and adhesion forces that allows water to flow in narrow spaces in opposition of gravitational forces is a phenomena called capillary action. (1 mark)

The constant upwards movement of the transpiration stream is driven by the evaporation of water from the leaves. (1 mark)

Transpiration is the loss of water vapour by evaporation from the surface of a plant, especially via stomata on the underside of leaves. (1 mark)