

## S.6 BIOLOGY (P530/1)

**1Hour 30 Minutes**

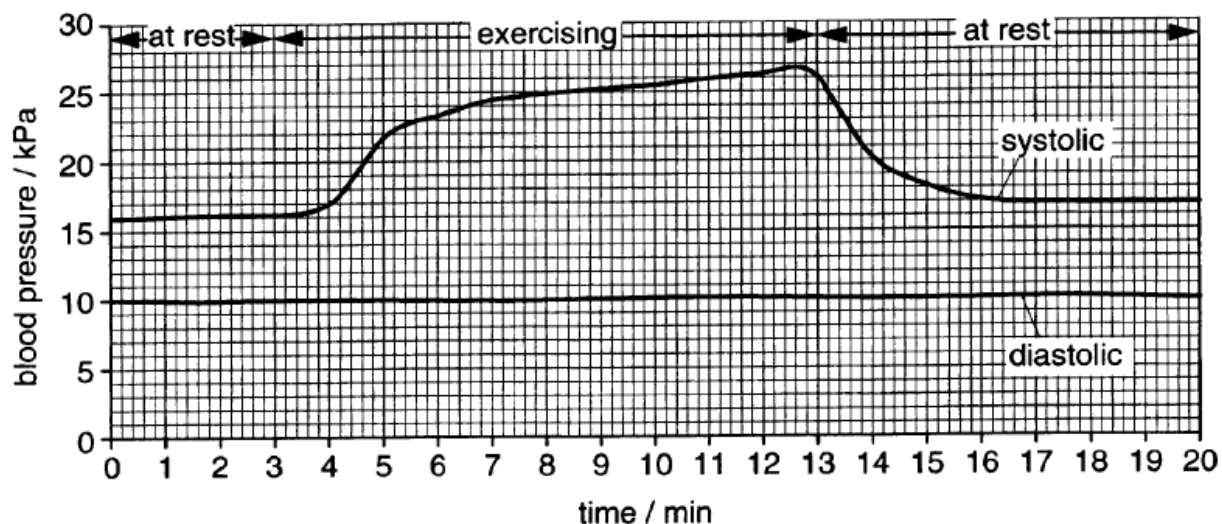
## Instructions

Attempt **all** questions in this paper.

**Precise and sequential presentation of answers** is required of candidates

- The graph in the figure below shows systolic and diastolic blood pressure of an athlete for a period of 20 minutes.

Study it carefully and answer the questions that follow.



- (a) What is meant by the terms

- (i) Systolic blood pressure. (1mark)

**Maximum/highest blood pressure exerted in the arteries during contraction of the heart muscle;✓**

**Acc Maximum/ highest blood pressure exerted in the arteries when blood is pumped/surges out of the heart/left ventricle.**

- (ii) Diastolic blood pressure. (1mark)

**Minimum/lowest blood pressure in the arteries during relaxation of the heart muscle;✓**

**Acc Minimum/lowest blood pressure in the arteries when the heart is filling with blood/ heart is at rest between pulses;**

- (b) (i) Describe the changes in the systolic blood pressure of the athlete during a 20-minute period. (2marks)

**From 0minutes to 3.4minutes during rest, systolic blood pressure remains constant;✓**

**From 3.4minutes to 5minutes into the exercise, systolic blood pressure increases rapidly;✓**

**From 5minutes to 12.8minutes into the exercise, systolic blood pressure increases gradually; to a peak;✓**  
**From 12.8minutes to 16minutes during rest, systolic blood pressure decreases gradually;✓**  
**From 16minutes to 20 minutes during rest, systolic blood pressure remains constant;✓**

**@ ½ mark**

**Max 2**

- (ii) Explain the effect of exercise on the systolic blood pressure. (3marks)

**Increases systolic blood pressure;✓ to rapidly supply sufficient oxygen;✓ and glucose (nutrients);✓ to the highly energy demanding skeletal muscle contraction;✓ and remove lactic acid;✓ carbon dioxide and excess heat produced during exercise;✓**  
**Acc increased adrenaline hormone secretion by medulla of the adrenal glands;✓ that increases power of contraction of heart muscle;✓ to increase blood supply rich in oxygen;✓ and glucose(nutrients);✓ to the respiring skeletal muscle;✓**

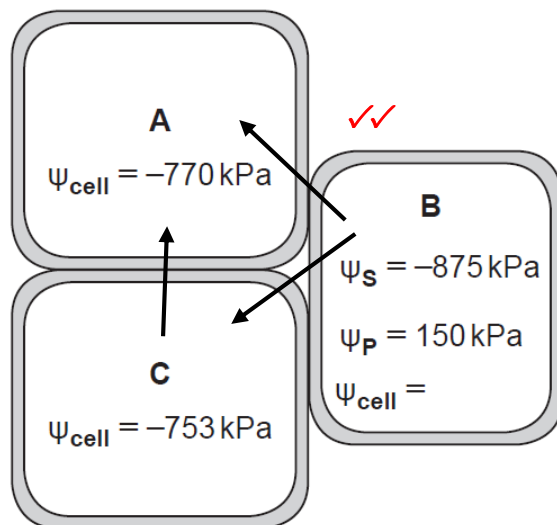
**@ ½ mark**

- (c) Suggest why the athlete's systolic blood pressure did not return to the resting value immediately the exercise stopped. (3marks)

**Increased demand for oxygen;✓ to oxidize accumulated lactic acid;✓ towards the end of exercise;✓✓**  
**Time for the heart to adjust;✓✓**  
**Adrenaline still present in blood;✓✓**

**@ ½ mark**

2. Three plant cells **A**, **B** and **C** are represented in the diagram below, along with values relating to their water potentials.



**Award ½ mark for only two correct arrows.**

**Award 1 mark for all correct arrows.**

**Deny marks for both cases above for no evidence of calculation of water potential**

- (a) Calculate the water potential value of cell B. (1½ marks)

$$\Psi_{\text{cell}} = \Psi_s + \Psi_p ; \checkmark$$

$$\Psi_{\text{cell}} = -875 + 150; \checkmark$$

$$\Psi_{\text{cell}} = -725\text{Kpa}; \checkmark$$

@ ½ mark

- (b) On the diagram, draw arrows to show direction of water movement between the cells. (1mark)

- (c) Explain

- (i) why the water potentials of the plant cells above are negative.

(3marks)

**Highest water potential value of pure water is 0kpa; ✓ plant cells have vacuoles with cell sap; ✓ containing solutes ; ✓ which attract water molecules; ✓ restricting their free flow; ✓ lowering the water potential to a negative value; ✓**

@ ½ mark

- (ii) the changes in solute potential of plant cells with turgidity.

(3marks)

**Increase in turgidity ; ✓ concentration of solutes decrease; ✓ solute potential increases; ✓**

**Decrease in turgidity; ✓ concentration of solutes increase; ✓ solute potential decreases/lowers; ✓**

@ ½ mark

- (d) In terms of water potential, explain why the drinking of large amounts of pure water after sweating a lot may lead to oedema in the brain. (1½ marks)

**Both water and salts are lost from blood plasma during sweating; ✓**

**drinking large amounts of pure water increases water potential of**

**blood plasma beyond that of brain cells; ✓ water moves from blood**

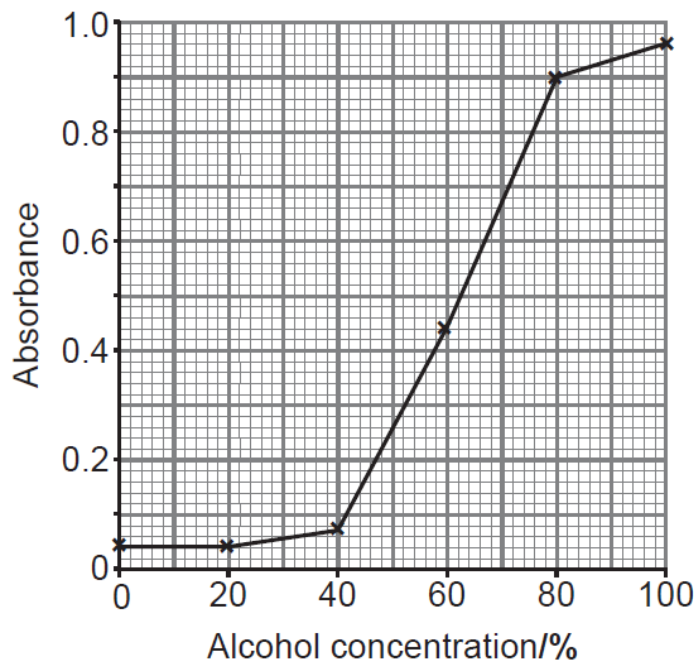
**plasma into brain cells; ✓ by osmosis; subsequently swelling occurs; @ ½ mark**

3. (a) Since the inception of the global covid-19 epidemic, alcohol-based hand sanitizers have become a critical resource in cleaning the virus from the surfaces including the skin. Explain why these brands of hand sanitizers have an alcohol concentration of approximately 70%. (2marks)

**Alcohol concentration of 70% is high enough to completely dissolve the membrane lipids; denature and coagulate membrane proteins (disrupt/destroy the membrane);✓ thus breaking down/destroying the virus ;✓ disrupting their metabolism;✓ without having the associated drying effects of higher concentrations;✓** @ ½ mark

(b) In an experiment to investigate the effect of alcohol concentrations on the membrane permeability of Covid-19, Beetroot tissue was used rather than the virus itself.

Sections of Beetroot tissue were placed in different concentrations of alcohol and the absorbance of the surrounding solution was measured using a colorimeter. The results are shown in the figure below.



- (i) Suggest why Beetroot tissue was preferred in this investigation to the virus. (1mark)

**Release of a red pigment / betanin from the Beetroot cells;✓ can be a measure of membrane permeability;✓**

- (ii) Calculate the percentage increase in absorbance when alcohol concentration was increased from 80% to 100%. (2½ marks)

$$\% \text{ increase in absorbance} = \frac{(\text{Absorbance at 100\% alcohol} - \text{absorbance at 80\% alcohol})}{\text{Absorbance at 80\% alcohol}} \times 100; \checkmark$$

$$\% \text{ increase in absorbance} = \frac{(0.96 - 0.9)}{0.9} \times 100; \checkmark$$

$$\% \text{ increase in absorbance} = \frac{0.06}{0.9} \times 100; \checkmark$$

$$\% \text{ increase in absorbance} = 6.67%; \checkmark$$

@ ½ mark

- (i) Explain the effect of following different alcohol concentrations on absorbance. (4½ marks)

Below 40%

**Absorbance is low;✓ because low concentration of alcohol causes little damage to the cell membrane;✓ cell membrane becomes less permeable;✓ allowing only few red pigment to leak out of the membrane;✓**

Above 40%

**Increases absorbance;✓ because of much destruction/damage of the cell membrane;✓ becoming more permeable;✓ allowing more red pigments to leak out of the membrane;✓ @ ½ mark**

4. (a) Outline **three** salient features of cells embodied in cell theory. (3marks)

**All living organisms are made up of cells;✓**

**New cells arise only by division of pre-existing cells;✓**

**All metabolic reactions of an organism occur in cells;✓**

**Cells contain hereditary information of organisms of which they are part;✓**

**Any correct three @ 1mark**

**Acc cells are capable of independent existence in suitable conditions;**

- (b) Give **three** main functions of intracellular membranes in organisms.

(3marks)

**Provide separate intracellular compartments isolating different chemical reactions within cell organelles;✓**

**Regulate passage of materials and exchange of molecules between cell organelle and its surrounding;✓**

**Acts as a reaction surface;✓ i.e. contain enzymes and other molecules necessary for chemical reactions; @ 1mark**

**Rej function of intracellular membrane in a named cell organelle.**

- (c) Explain the advantages of using electron microscope in observing

biology specimens over light microscope.

(4marks)

**Has a greater resolving power/resolution;✓ and much higher effective magnification than light microscope; ✓ because it uses beam of electrons; ✓ with a shorter wave length than light;✓**

**@ 1mark**

5. In an investigation to determine the influence of alcohol on the volume of urine produced, two groups **A** and **B** each of six healthy males of same age, height and weight, were given the same food and did the same exercise for 24-hour period before resting. After the 24-hour period, each group was given the following to drink.

Group **A**: 1 litre of alcohol- free beer.

Group **B**: 1 litre of alcoholic beer.

Urine was collected from each man every hour.

*Assume that volume of urine collected is equal to the volume of urine produced.*

TIME OF COLLECTION	AVERAGE VOLUME OF URINE COLLECTED(ml)	
	GROUP A	GROUP B
After 1hour	599	643
After 2hours	413	504
After 3hours	112	132

(a) State the **two**,

- (i) planning steps the investigators had to take before the investigation could start. **(2marks)**

***Apparatus /materials needed to be used;✓***

***Number of participants;✓***

***How to record data;✓***

***Factors to be kept constant;✓***

***Develop an indemnity form to be signed by participants;✓***

***Composition of the sample;✓***

***Any two @ 1mark***

- (ii) other factors that need to be kept constant. **(1mark)**

***Same brand of beer;✓***

***No other intake by both groups;✓***

***Same investigators;✓***

***Same apparatus;✓***

***Same environment/room/temperature;✓***

***Any two @ ½ mark***

- (iii) steps that the investigators took to ensure reliability of the results. **(1marks)**

***Use of a large sample;✓***

***Average volume of urine produced was calculated;✓***

***Any two @ ½ mark***

- (b) Explain the difference in results obtained in the table above. (4marks)

***Average volume of urine collected from group B males (males given alcoholic beer) is higher than that from group A (males given alcohol-free beer) at all times of collection;✓ because alcohol inhibits the release of Anti-diuretic hormone/vasopressin by the (posterior) pituitary gland into blood;✓ distal convoluted tubule and collecting duct become less permeable to water;✓ less water is reabsorbed from glomerular filtrate back to blood by osmosis;✓ thus a larger volume of dilute urine is produced;✓***

**@ 1mark**

- (c) Why does urine production almost stop after serious bleeding?

**(2marks)**

***On serious bleeding, total blood volume decreases;✓ blood is diverted from other tissues including the kidney to the brain;✓ maintaining life;✓ volume of blood flowing to the kidney is thus decreased greatly to an extent that less ultrafiltration and thus no formation of urine occurs;✓***

**@ ½ mark**

- 6.(a) Explain the following observations in an investigation on the control of growth and ecdysis in the nymph of the blood-sucking bug, *Rhodinus*.

- (i) Blood –sucking bug continues to live for several months but does not moult on decapitation a day after a blood meal.

**(2marks)**

***Insufficient amounts of the brain hormone/prothoracicotropic hormone had been secreted by the neurosecretory cells of the brain;✓ on distention of the abdomen;✓ inhibiting stimulation of the prothoracic gland;✓ to secrete the moulting hormone/ecdysone;✓***

**@ ½ mark**

- (ii) Moulting occurs on decapitation a week after a blood meal.

**(2marks)**

***Sufficient amounts of the brain hormone had been secreted by the neurosecretory cells of the brain;✓ on distention of the abdomen;✓ stimulating the prothoracic gland to secrete the moulting hormone;✓✓***

**@ ½ mark**



- (iii) Moulting of bug in (i) occurs once connected by a capillary tube to bug in (ii). **(2marks)**

***Sufficient amounts of the brain hormone secreted by the neurosecretory cells of brain of nymph in (ii) is transported in blood through the capillary tube to prothoracic gland of nymph in (i);✓ stimulating it to secrete moulting hormone;✓***

**@ 1mark**

- (b) Suggest **one** piece of evidence supporting the action of the moulting hormone. **(1mark)**

***On exposure to the hormone, certain regions of chromosomes swell up forming chromosome puffs/sites of RNA synthesis;✓ suggesting switching on of genes needed for synthesis of enzymes necessary for growth;✓***

**@ ½ mark**

- (c) With suitable examples, describe the significance of larval forms of organisms. **(2marks)**

***Small and motile larvae allow distribution/dispersal of species of animals having restricted movement (slow moving, sessile or parasitic);✓ e.g. ciliated miracidium of parasitic flukes allowing the flukes get from host to host;✓ ciliated diploleura larva of the slow moving star fish; ciliated planula for the sessile sea anemones; planktonic larva of the mussels and barnacles living on rocky shores;***

***Asexual reproduction;✓ rapidly increasing the number of new offsprings produced; e.g. larva of the parasitic fluke;✓***

***Feeding prior to formation of adult;✓ e.g. caterpillar with well-developed mandibles for chewing plant food and thus growth;✓***

***Feeding on different foods from adults reduces intraspecific competition for food;✓ e.g. adult butterflies and moths feed on nectar while their larva/caterpillar feed on plant material;✓***

***Any two correct significances with an example @ 1mark***

END