SINGAPORE CHINESE GIRLS' SCHOOL
PRELIMINARY EXAMINATION

CANDIDATE NAME	**ANSWERS**		
CLASS		REGISTER NUMBER	
CENTRE NUMBER		INDEX NUMBER	

BIOLOGY

6093/02

Paper 2 **Wednesday** **23 August 2023**

1 hour 45 minutes

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A
Answer **all** questions.

Section B
Answer **all** questions.
The last question has a choice of parts to answer.

The use of an approved scientific calculator is expected, where appropriate.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use		
Section A		/50
Qn 7		/10
Qn 8		/10
9		/10
Total		/80

Section A

Answer **all** questions.
Write your answer in the spaces provided.

1 Fig. 1.1 shows how a blocked blood vessel outside the heart can be bypassed using an artificial blood vessel.

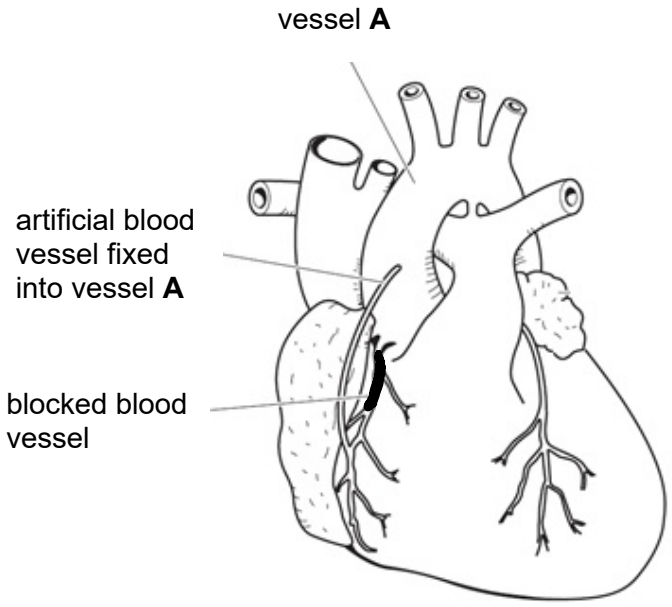


Fig. 1.1

(a) Name the blocked blood vessel and vessel **A** respectively.

Blocked blood vessel: Coronary artery
Vessel A: aorta

....[2]

(b) Describe how the blocked blood vessel in Fig 1.1 can affect the normal functioning of the heart.

-less oxygen and glucose delivered to heart muscles for aerobic respiration
Heart muscle cells die leading to heart attack

.....
.....
.....[2]

(c) Sometimes, instead of using an artificial blood vessel, a vein from another part in the patient's body is used.

Suggest two ways in which a vein might not be suitable for this purpose.

- Thinner muscular walls hence less able to withstand high pressure ;
- Presence of valves, hence blood travel slower/ impede blood flow ;
- Less elastic fibre / tissue hence less able to stretch and recoil;
- Large lumen relative to diameter, hence speed of blood slows down

(any 2)

R:small walls, thin without mentioning about the walls ; treated as foreign body and rejected by immune system

(d) Fig. 1.2 shows the same blocked blood vessel in Fig 1.1, with a 'stent' in place.

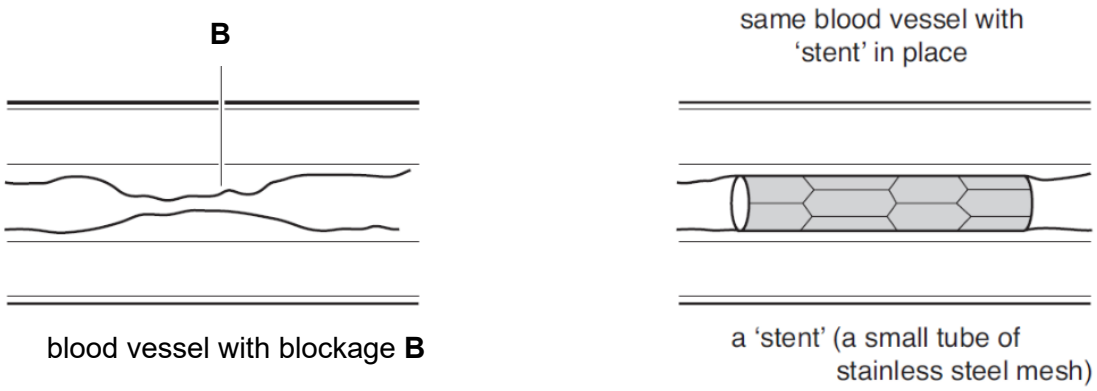


Fig. 1.2

(i) Name a substance that can cause the blockage **B**.

Fat deposits/cholesterol .....[1]

(ii) Insertion of the 'stent' can cause damage to the surrounding tissues around the blockage **B**.

Suggest and explain why patients are given 'anti-platelet' drugs before inserting the 'stent'.

- natural response for blood to clot due to damage or injury caused by insertion of the stent;

- anti-platelets drug administered to prevent platelets + release thrombokinase/cause fibrinogen to change to fibrin ;

R: agglutination

.....
.....
.....
...[2]

e) The blood in blood vessel **A** contains 20 cm^3 of oxygen per 100 cm^3 of blood. 98.5% of the oxygen is carried in red blood cells. The remaining percentage is carried in solution in the blood plasma.

Calculate the volume of oxygen carried in the blood plasms per 100 cm^3 of blood.

Show your working.

(1.5/100) x 20;
= 0.3 cm^3;

……[1]

[Total: 10 marks]

2 Fig. 2.1 shows a diagram of a developing mammalian foetus and part of the uterus wall.

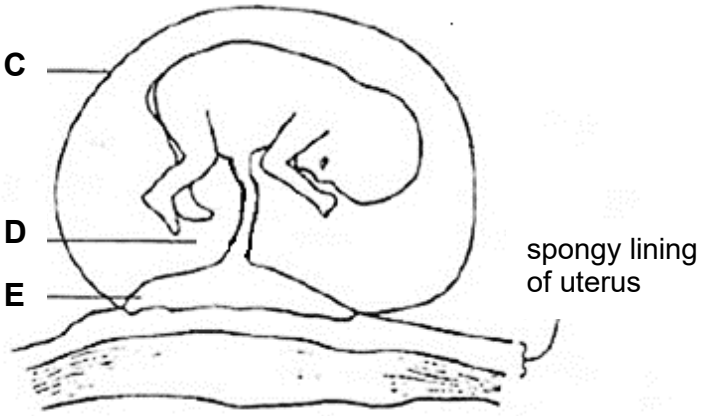


Fig. 2.1

(a) Identify **C** and **D.**

C: Amniotic sac
D: amniotic fluid

penalised spelling (ammiotic, amiotic etc) [1]

(b) State two functions of **D**.

Amniotic fluid supports and cushions the fetus.
Absorbs shocks and as it cannot be compressed, protects the fetus against physical injury *(damage AWW).*
Amniotic fluid lubricates and reduces friction in the vagina or birth canal during birth
Allows fetus space for movement during growth.
(any two)

Reject: maintain internal temperature / provide nutrients / protects fetus (how exactly/what from?) [2]

(b) Suggest how smoking affects the supply of oxygen and nutrients to structure **E** during pregnancy.

- Structure E is the placenta. Cigarette smoke contains nicotine which causes the release of adrenaline. This will cause the maternal arteries to become narrow and the blood supply to the placenta to decrease.

Accept: Carbon monoxide/nicotine increases fatty deposits in walls of artery which narrows lumen

- Cigarette smoke also contains carbon monoxide, which binds more readily to haemoglobin to form carboxyhaemoglobin, reducing the ability of haemoglobin to carry oxygen in the red blood cells. *(max 1m awarded for how it affects supply of oxygen)*
- There will be a decrease in oxygen and nutrients supplied to the placenta and hence to the fetus, causing development of the fetus to be slower. *(marks awarded even if reasoning wrong)*

Reject: tar [3]

(c) Fig 2.2 shows the tissues of the mother and foetus in the placenta of humans. The maternal blood and foetal blood remain separate.

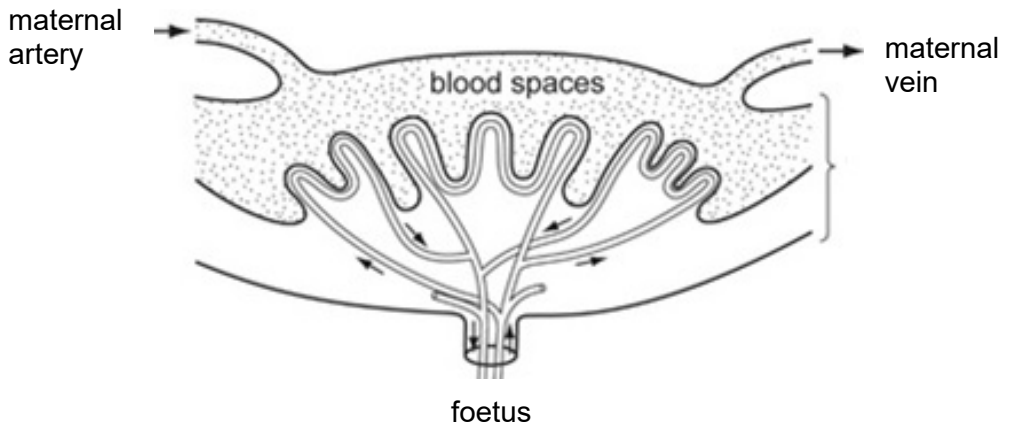


Fig 2.2

(i) State two reasons why the foetal blood must not mix with the maternal blood.

- The mother and fetus can be of different blood groups which can cause blood clotting / agglutination. [1]
- The high pressure of the mother's blood can kill the fetus. [1]

Effect needs to be stated
Oxygenated/deoxygenated blood mixing is not a problem – the mother's blood is oxygenated, which the fetus needs.

(ii) The placenta is often described as "a small intestine, a lung and a kidney". Explain how the placenta functions like each of these organs.

- The placenta is like the small intestine as it allows the diffusion of digested food substances / digested nutrients such as glucose / amino acids / fats from the mother's blood to the fetal blood. [1]
- The placenta is like the lungs as it allows the transport of oxygen from the mother's blood to the fetal blood and carbon dioxide from the fetal blood to the mother's blood. [1]

*Reject: transfer/diffusion of oxygenated **blood** from mother to fetus*

- The placenta is like the kidney as it allows transport of urea / nitrogenous waste from the fetal blood to the mother's blood. [1]

Reject: waste products

[Total: 11 marks]

3 Fig. 3.1 shows a section through the human body divided into regions **F**, **G**, **H** and **I**.

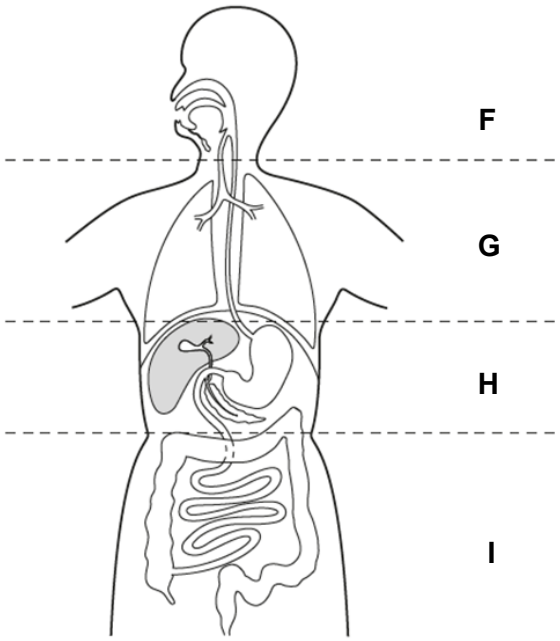


Fig. 3.1

(a) Complete Table 3.1 by matching the letters from Fig. 3.1 to the statements in the table. There may be one or more than one letter for each statement.

Table 3.1

contains an organ which	**region(s)**
produces an acidic secretion	**H**
contains villi	**I**
digests protein	**H, I**
produces insulin	**H**
contains bronchi	**G**
secretes amylase	**F, H**
ingests food	**F**

[3]

Every two correct- 1 mark

(c) Fig 3.2 shows an enlarged diagram of region **H**.

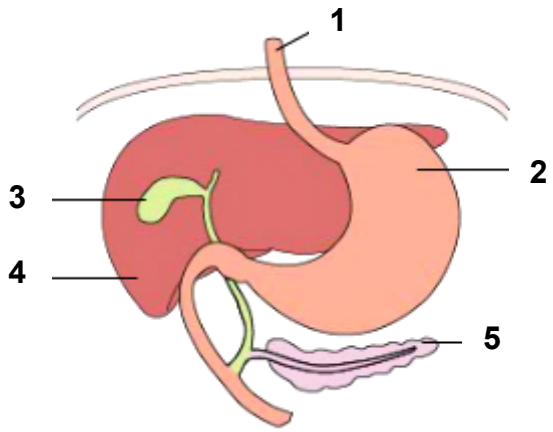


Fig 3.2

(i) Two of the organs produce substances involved in the digestion of fat.

State the organs and name the substances produced by completing Table 3.2.

Table 3.2

number	name of organ	substance produced
4	liver	bile
5	pancreas	lipase

Each correct row-1m

[2]

(ii) Describe how the two substances work together to digest fat.

bile – emulsifies large fats into smaller fat droplets;
lipase digest fats into fatty acids and glycerol;

[2]

(iii) After a meal of carbohydrates, Benedict's test was conducted on a fluid extracted from organ **2**. Suggest and explain the results obtained.

(any acceptable positive result colour) + explanation

Amylase in the mouth digested some of the starch into maltose which tested positive for Benedict's test;

[3]

[Total: 9 marks]

4 Fig. 4.1 shows a variety of moth, *Biston betularia*, with black wings. The moths live in the woods consisting of trees with pale bark. After several years, a new variety of moth, with pale speckled wings shown in Fig 4.2, appeared in the woods. Both varieties of moths are prey of birds.

Fig. 4.1

Fig. 4.2

(a) Explain how the appearance of the new variety of moth came about.

There could have been spontaneous **mutation** that resulted in;
the change in the **gene sequence that determines the colour of the wings**;

..... [2]

(b) Two years after the appearance of the moths with pale speckled wings, it was observed that there is a significant increase in the proportion of these moths compared to those with black wings.

Explain this observation.

The moths with pale speckled wings are more likely to camouflage from their predators;
They are more likely to **survive and reproduce**, passing on their favourable alleles to the offspring;
Through the process of **natural selection** *(OWTTE e.g. "over time")*, there is an increase in the population of the pale, speckled moths.

Reject: only "through the process of natural selection, the moth adapted to the tree bark"
moths adapted to have pale wings to survive
beneficial trait accumulates (the allele accumulates, not the phenotype)
gene switches from dominant to recessive

... [3]
marks]

5 Fig. 5.1 shows how energy is passed from one trophic level to another along two food chains.

food chain **J**

food chain **K**

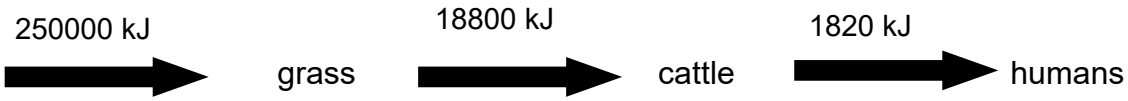


Fig. 5.1

(a) Define the term *trophic level*.

Position / stage in the food chain ;
Reject: "level", "feeding position" only

.....[1]

(b) State the source of the 250000 kJ of energy provided in food chain **J**.

The sun

.....[1]

(c) Calculate the percentage of energy passed on to humans in food chain **J**.

16200/250000 x 100% = 6.48%

.....kJ [1]

(d) Explain the difference in the availability of energy to humans between food chain **J** and **K**.

Less energy in K than J.

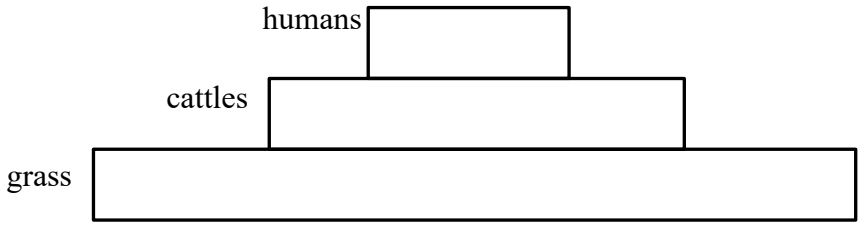
More trophic levels in K, resulting in more energy lost;

through heat energy during respiration, egestion, excretion and uneaten parts.

Reject: cattle used up energy

..... [3]

(e) Construct a fully labelled pyramid of biomass for food chain **K**. [2]



1m – labels (1st trophic level at the bottom, 3rd at the top)

1m – correct bar lengths

[Total: 8 marks]

6 Fig. 6.1 shows a town and its surrounding countryside.

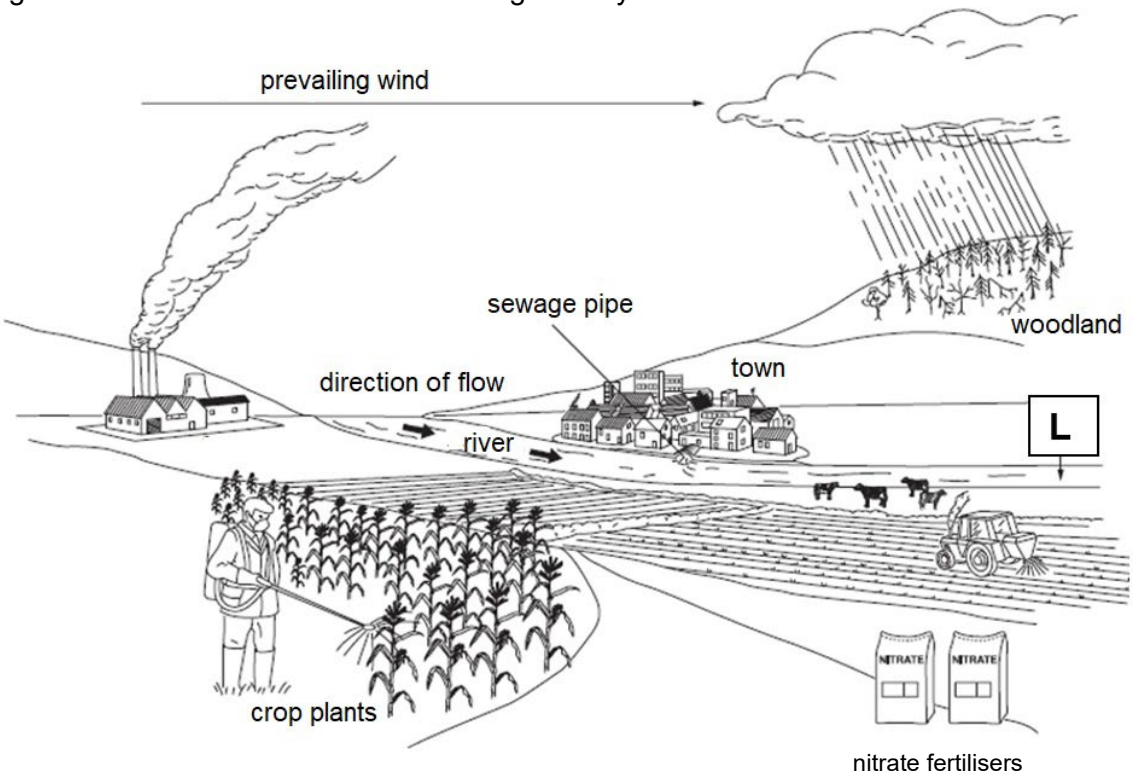


Fig. 6.1

(a) From point **L** in Fig. 6.1, algae in the river grow rapidly and in large numbers.

State two possible reasons for this change.

- excess fertilisers/ untreated sewage/ cow faeces containing nitrates and phosphates washed from farms to the river/ town to river/ factory to river/from woodland to river (any 2 sources) which provides nutrients for the algae to grow and reproduce quickly.

.....
.....
.....

.....[2]

(b) Explain the implications for the organisms living downstream from point **L**.

- Eutrophication leads to excess algae and floating water plants growing rapidly, covering the surface of the water
- Prevents sunlight from reaching the submerged water plants, unable to carry out photosynthesis, dies.
- Dead algae and water plants decomposed by aerobic bacteria
- Decomposers feed on decaying matter, increases in numbers and use up oxygen in water, and more organisms like fishes die.

...
...
...
...
[4]

[Total: 6 marks]

Section B

Answer **three** questions.

Question 9 is in the form of an **Either / Or** question. Only one part should be answered.

7 A healthy person's normal rate of urine production is measured at 3.0 cm^3/min. The effects of drinking water and sodium chloride injection on the rate of urine production were investigated in the following two separate experiments.

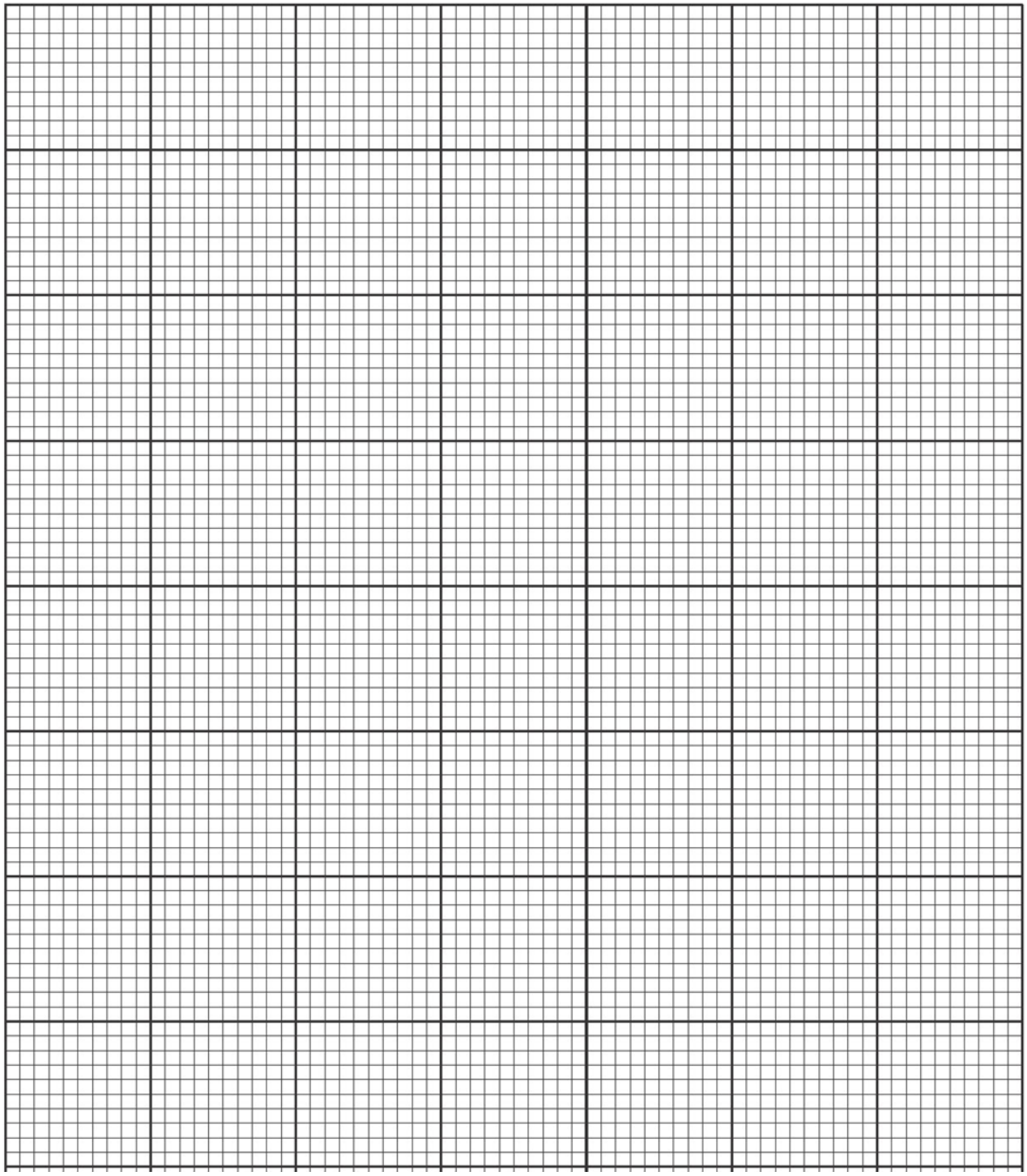
Experiment 1: Person drank 1 litre of water
Experiment 2: Person injected with 7cm^3 of 4% sodium chloride solution

The results are shown in Table 7.1.

Table 7.1

time/min	rate of urine production /cm^3 /min	
	experiment 1	experiment 2
0	2.9	3.1
10	4.1	2.8
20	5.2	0.5
30	6.6	0.8
40	7.7	1.2
50	6.1	1.8
60	3.1	2.6

(a) Plot the data for experiment 1 and 2 in Table 7.1 on the grid provided on page **14**. [4]



(b) With reference to the results in Table 7.1 and the plotted graph, describe the relationship between the responses to sodium chloride injection and the rate of urine production.

From **time 0 to 20 minutes**, in experiment 2 (injection of Nacl), rate of urine production **decreased sharply** from **3.1 to 0.5 cm^3/min.**

From **time 20-60 minutes**, rate of urine production **increased gradually** from **0.5 to 2.6 cm^3/min.**

.....[2]

(c) Describe the response that leads to the change in rate of urine production when a person drank 1 litre of water.

Drinking 1 litre of water **increases the water potential of blood**;

This would have been detected by **the hypothalamus** which in turn **stimulates the pituitary gland to secrete less ADH** into bloodstream;

Less ADH will stimulate the **cells in the walls of the collecting duct to be less permeable** and **absorb less water**;

resulting in a **higher rate of urine production**. Water potential of blood decreases **back to normal**.

.....

.....

.....[4]

[Total: 10 marks]

8 **(a)** Explain why a person's breathing rate remains high after a session of vigorous exercise.

During exercise, there is **insufficient oxygen** for aerobic respiration to meet the energy demands of the vigorous muscular contractions;

Hence the body engages in **anaerobic respiration** to provide the extra energy, however this process produces **lactic acid**.

The breathing rate remains high to **repay the oxygen debt (and remove carbon dioxide)** out of the body.

The oxygen is required to **oxidise lactic acid produced in anaerobic respiration to release energy** and **convert** the remaining lactic acid **to glucose**;

.....

.....

.....[4]

(b) Describe the changes in the human skin when a person exercises vigorously.

During exercise, the body temperature **rises above normal**; *[1m – must have. Award if show understanding that below processes return body temperature **back to normal**]*

[any 5:]

The **sweat glands become more active** and **increase sweat production /more sweat produced**;

When **water** in sweat **evaporates**, more heat is **removed** through **latent heat of vapourisation**;

There is **vasodilation of arterioles near the skin** resulting in **more blood** is sent to **skin capillaries**;

More **heat** is **lost** to surroundings by **conduction**, **convection** and **radiation**;

Hair erector **muscle relaxes**, causing **hair** to **lie flat**

Allowing **air to circulate** over the surface of the skin for increased heat loss / to **prevent a layer of insulating air** from forming

Reject: rate of metabolism decreases (person is exercising!)

[Total: 10 marks]

Either

9 (a) Describe and explain the advantages and disadvantages of wilting.

Advantages
- When the leaf folds up during wilting, it **reduces the surface area exposed** to sunlight, **therefore less water evaporates**
- Guard cells become flaccid and **stomata closes**, which **reduces the rate of transpiration / water loss.** *(Reject: guard cells close)*

Disadvantages
- **Rate of photosynthesis will be reduced** due to **reduced surface area exposed to sunlight**
- **Carbon dioxide** becomes the limiting factor as **stomata closes.**

..... [4]

(b) Describe how a root hair cell is adapted to its function and outline the movement of water from the soil into the conducting tissue of a plant root.

Max 4 for adaptation of root hair cell:

- Root hair cell has a **long, narrow protrusion/ extension**;
- which **increases surface area to volume ratio** for **faster rate of absorption** of water via osmosis;

- **Concentrated cell sap** in the root hair cell to **lower the water potential** of the cell; *(Reject: concentrated vacuole)*
- So as to establish a **steep water potential gradient for water** to enter via **osmosis**; *(Reject: steep concentration gradient)*
-
- **Numerous mitochondria**
- to **release energy** for **active transport of mineral salts** *(Reject: transport of water)*

When the soil water has a higher water potential than in the cell sap of the root hair cell, water **molecules** enters by **osmosis** across a **partially permeable cell surface membrane**;

This causes the water potential of the cell to now be higher than that of the surrounding cells, hence water molecules will **continuously move by osmosis** to the next / neighbouring cells until it reaches the **xylem** tissues in the root (OWTTE)

..... [6]

[Total: 10 marks]

Or

9 (a) Explain how the leaf structure is adapted for the process of photosynthesis.

Petiole holds leaf in position for **maximum light absorption**;

Thin lamina provides **shorter diffusion distance for carbon dioxide** and enables light to reach all mesophyll cells;

Broad lamina has a **large surface area** for **maximum light absorption**;

Waxy cuticle on upper and lower epidermis **reduces water loss through evaporation** from leaf/ **transparent for light to enter** the leaf;

Stomata open in light condition to allow **diffusion of carbon dioxide** and oxygen in leaf;

More chloroplasts in **palisade mesophyll tissue** as more light can be absorbed **near** the **leaf surface**;

Network of veins contain **xylem** and phloem to **transport water** and mineral salts and sugars around the plant;

Intercellular air spaces allows **rapid diffusion of carbon dioxide** and oxygen into and out of mesophyll cells;
(any 5)

[5]

(b) Describe how a molecule of carbon dioxide present in the atmosphere reaches a mesophyll cell for photosynthesis.

During **photosynthesis**, there is **decrease in the carbon dioxide concentration** within the intercellular air spaces **as carbon dioxide is used up**;

A **concentration gradient** is formed with lower carbon dioxide concentration in the leaf compared to the atmosphere/external environment;

Carbon dioxide enters the leaf through the **stomata by diffusion** into intercellular air spaces;

Carbon dioxide **dissolves in the thin moisture** surrounding the **mesophyll cells**;

and **diffuses into the cells** and subsequently the **chloroplasts** for photosynthesis;

[5]

[Total: 10 marks]

End of Paper

BLANK PAGE