



**Preliminary Examination 2020
Secondary Four Express
Biology Paper 1 (6093/01)**

Date of Examination: 2 September 2020

Duration : 1 hour

*Chua Chu Kang Secondary School Chua Chu Kang Secondary School Chua Chu Kang Secondary School
Chua Chu Kang Secondary School Chua Chu Kang Secondary School Chua Chu Kang Secondary School
Chua Chu Kang Secondary School Chua Chu Kang Secondary School Chua Chu Kang Secondary School
Chua Chu Kang Secondary School Chua Chu Kang Secondary School Chua Chu Kang Secondary School
Chua Chu Kang Secondary School Chua Chu Kang Secondary School Chua Chu Kang Secondary School*

Name: ()

Class:

Instructions to Candidates

Write your name, index number and class on all the work you hand in.

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers, **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in soft pencil on the Optical Answer Sheet (OAS) provided.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

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

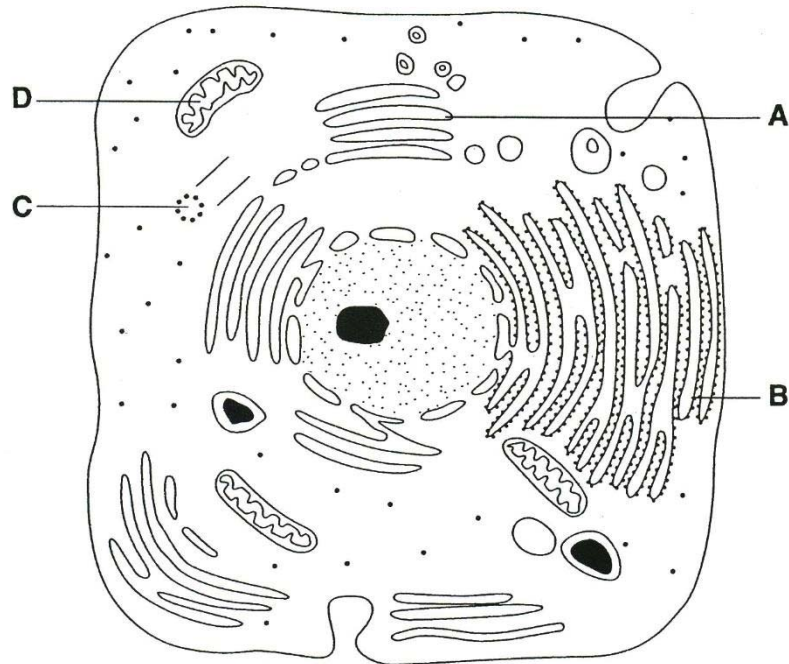
For Examiner's Use	
Total	/40

This Paper consists of **18** printed pages, including the cover page.

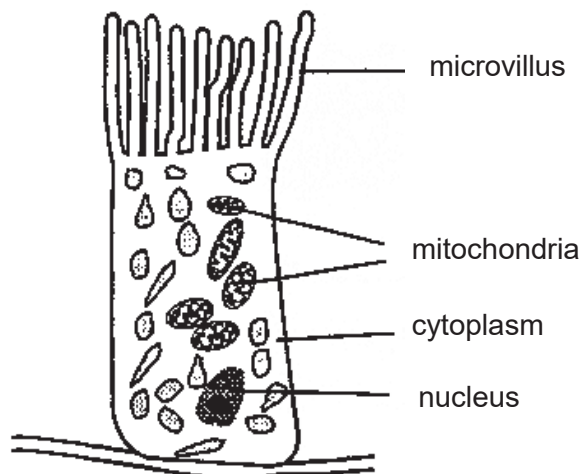
[Turn Over]

1 The diagram shows an animal cell.

In which organelle can a newly synthesised protein, which was modified by adding carbohydrate, be found?



2 The cell shown below is from the lining of the small intestine.



Which of the following explains why this cell contains many mitochondria?

- A for rapid cell division
- B for the production of amylase
- C for storage of glucose
- D for active transport of substances

3 Which structures are found in an onion cell?

	cell wall	haploid nucleus	chloroplast	nuclear membrane
A	√	√	√	X
B	√	X	X	√
C	X	X	√	X
D	X	√	X	√

key
present √
absent X

4 The following are components of the nervous system.

- 1 eye
- 2 brain
- 3 neurone
- 4 retina

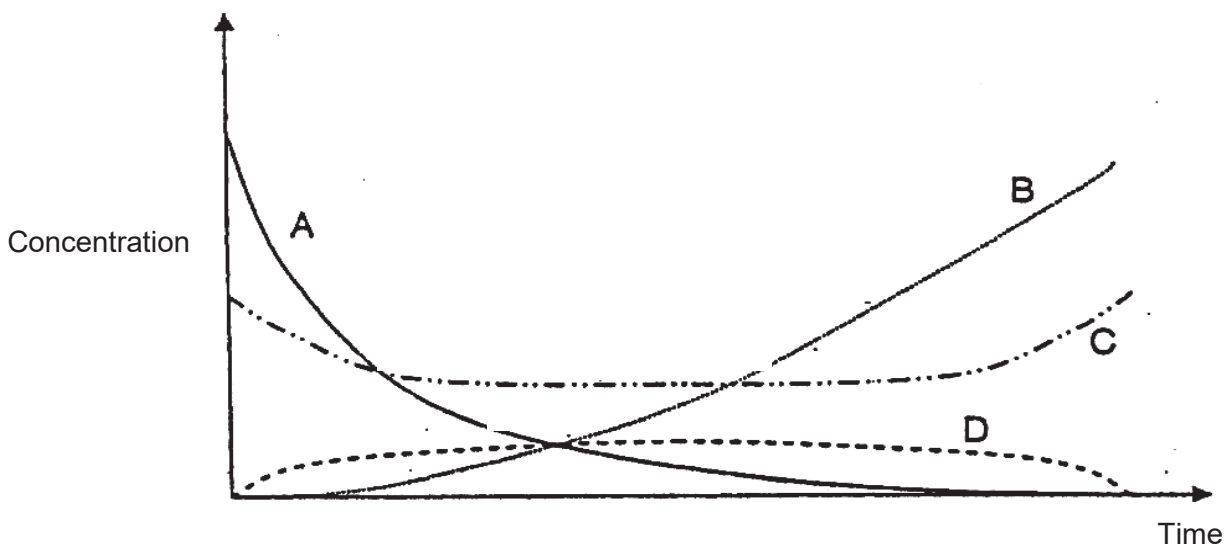
How are the components classified?

	cell	tissue	organ
A	1	2	3 and 4
B	3	2	1 and 4
C	3	4	1 and 2
D	2	3	1 and 4

5 An enzyme-catalysed reaction may be shown as follows:



Which line in the graph below represents the concentration of the ES complex?



- 6 A company claims that its new range of clothes detergent is cost saving. The following are some of its claims:
- more effective at lower temperature
 - less detergent needed
 - more effective against grease stains

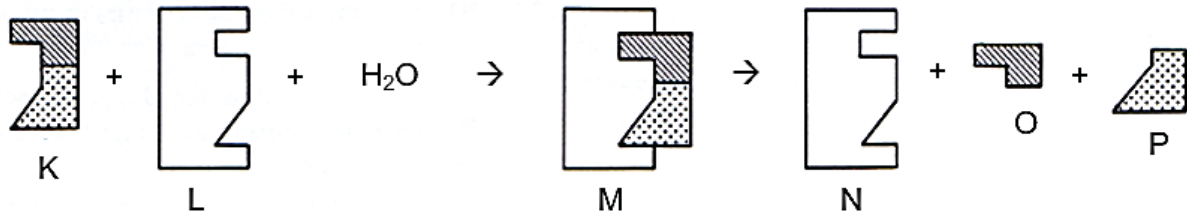
Among the new ingredients added is a lipase and an emulsifier.

Which row best describes the function of the lipase and emulsifier?

	lipase	emulsifier
A	activation energy is raised so that the lipase and fats can collide with each other frequently	faster digestion of fats at lower temperature
B	dispersion of fats to increase its surface area	faster digestion of fats at lower temperature; recycled at the end of reaction
C	faster digestion of fats at lower temperature, destroyed at the end of reaction	dispersion of fats to increase its surface area
D	faster digestion of fats at lower temperature; recycled at the end of reaction	dispersion of fats to increase its surface area

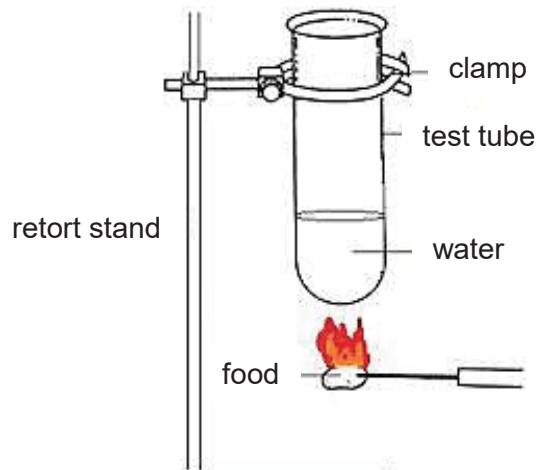
- 7 Why is glycogen the preferred storage molecule rather than glucose?
- A** Glycogen can yield more energy than its individual glucose molecules.
- B** Glycogen is more compact than its individual glucose molecules.
- C** Glycogen is more easily used in respiration to liberate energy than glucose.
- D** Glycogen is stored only in the liver and muscles.

- 8 The diagram below shows the reactions between different substances.



Which type of reaction is most likely illustrated by the diagram?

- A digestion of starch
 B formation of cellulose
 C hydrolysis of lactose
 D synthesis of organic compounds
- 9 Four equal masses of different foods were burned. The temperature of the water was measured before and after the experiment and recorded as shown.



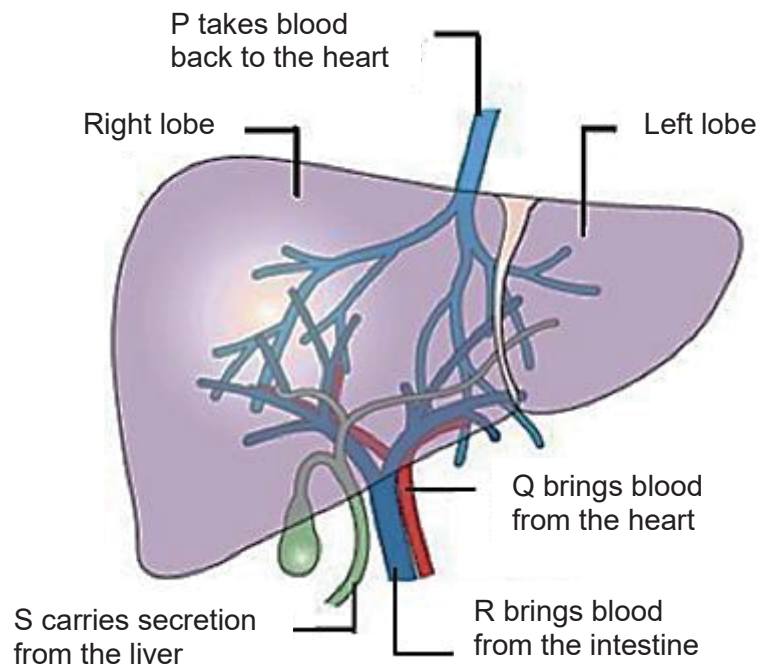
Which food sample probably contains the most amount of fat?

	food sample	water temperature at start / °C	water temperature at end / °C
A	P	18	50
B	Q	16	97
C	R	19	65
D	S	18	80

- 10 Enzymes from gland cells of the pancreas were added to a test-tube containing a mixture of starch and proteins.

Which of the following substances would likely be found in the test-tube after one hour?

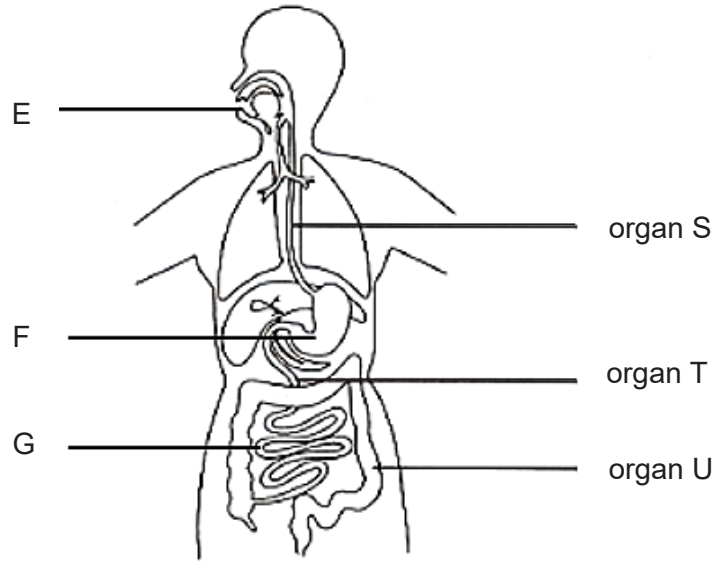
- A glucose and fatty acids
 B glucose and polypeptides
 C maltose and polypeptides
 D starch and polypeptides
- 11 Which is not a function of the liver?
- A breakdown of haemoglobin
 B metabolism of amino acids
 C neutralize toxic substances
 D production of digestive enzymes
- 12 The diagram shows the vessels P, Q, R and S which either carry fluids to or away from the liver.



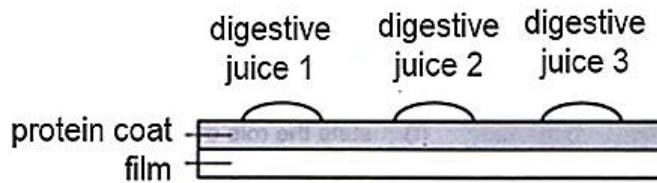
Which statement best describes the composition in these vessels?

- A Vessel Q contains more carbon dioxide than vessel R.
 B Vessel R contains more amino acids than vessel P.
 C Vessel R contains more metabolic waste than vessel P.
 D Vessel S contains more fats than vessel Q.

For Questions 13 and 14, refer to the diagram below which shows parts of the human digestive system.



- 13** What does each of the labelled organs (S, T and U) have in common?
- A** All the organs secrete digestive juices.
 - B** All the organs move their contents using peristaltic movement.
 - C** Protein digestion occurs in all three organs.
 - D** Villi are present along the inner walls of all three organs.
- 14** Digestive juices 1, 2 and 3 were collected from parts E, F and G respectively and mixed with a buffer solution of pH 1.6. Small drops of these digestive juices were put on a strip of film which was coated with protein, as shown in the diagram below.



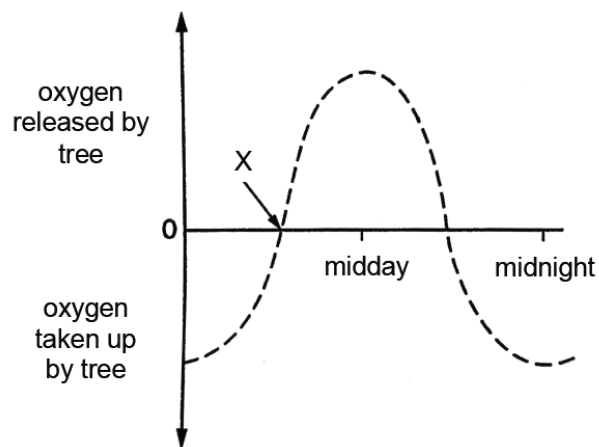
Which digestive juice(s) will digest the protein coat?

- A** 2 only
- B** 1 and 2 only
- C** 2 and 3 only
- D** 1, 2 and 3

- 15** A shade plant is placed in a very sunny area for several hours. At some point, its stomata are observed to have closed.

Which statement best describes this phenomenon?

- A** The guard cells are overly turgid.
B The plant cells are no longer photosynthesising.
C The plant has lost excessive amounts of water.
D The plant requires less carbon dioxide from the surroundings at higher light intensities.
- 16** The graph shows the oxygen released and taken up by a plant during a 24-hour period.

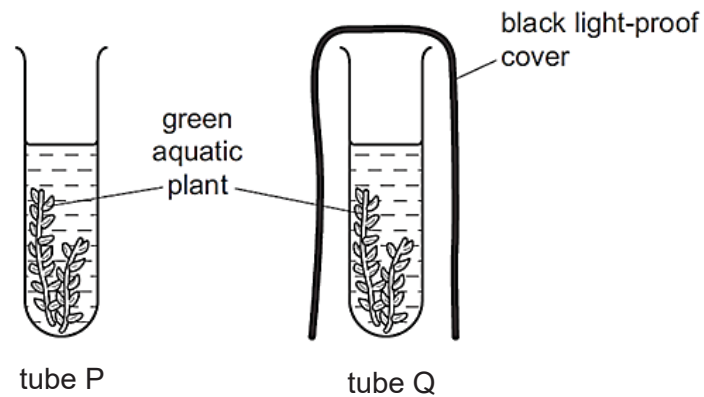


Which statement correctly describes the situation at point X?

- A** Photosynthesis stops.
B Respiration begins.
C The rate of respiration is equal to the rate of photosynthesis.
D The rate of respiration is greater than the rate of photosynthesis.

- 17** Two test-tubes, P and Q, were set up, each containing a solution of red hydrogencarbonate indicator. Hydrogencarbonate indicator turns yellow when the carbon dioxide concentration increases and turns purple when the carbon dioxide concentration decreases.

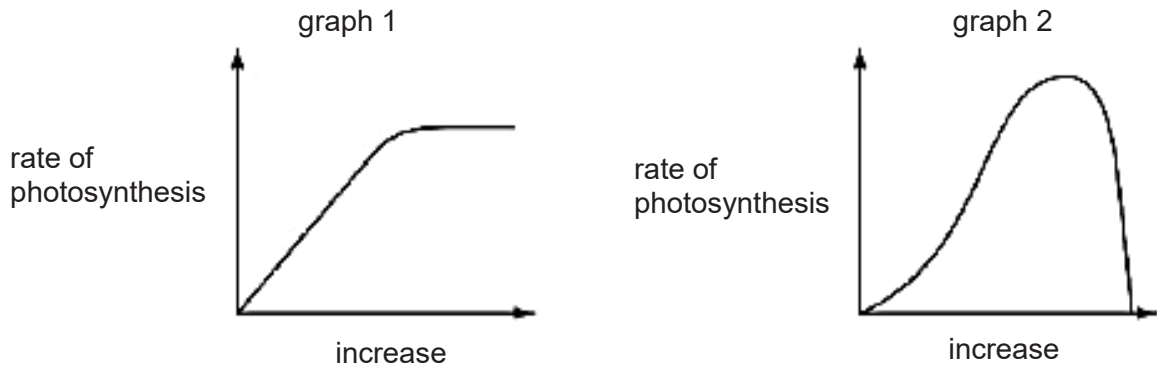
Similar pieces of the same aquatic plant were placed into tubes P and Q. Tube P was uncovered, while tube Q had a black light-proof cover. The tubes were left in a warm room in sunlight for four hours.



What would be the colour of the hydrogencarbonate indicator in the two tubes after four hours?

	tube P	tube Q
A	purple	red
B	red	purple
C	purple	yellow
D	yellow	red

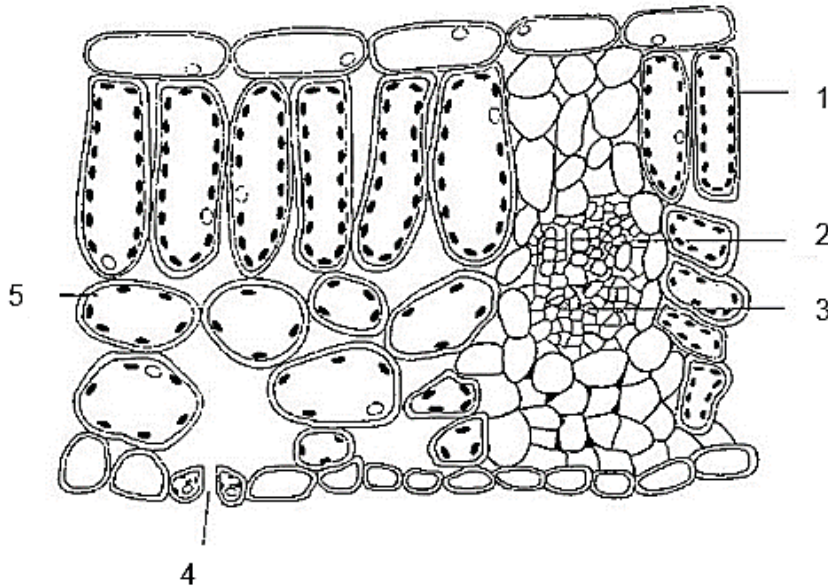
18 The graphs show how two different conditions affect the rate of photosynthesis.



Which conditions are being shown in graphs 1 and 2?

	graph 1	graph 2
A	carbon dioxide concentration	light intensity
B	carbon dioxide concentration	temperature
C	temperature	carbon dioxide concentration
D	temperature	light intensity

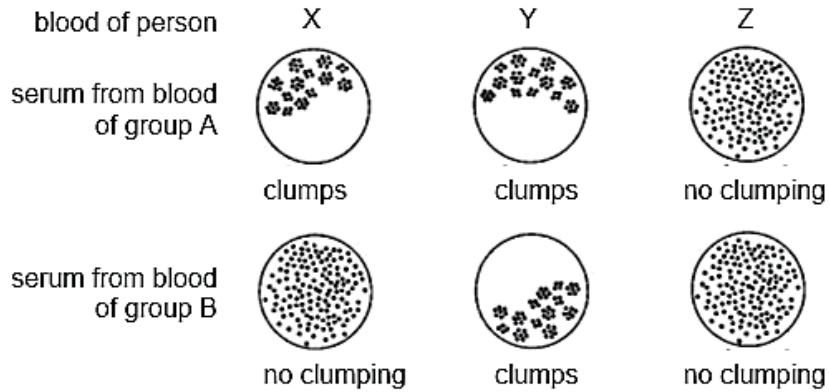
19 The diagram shows a section through a leaf.



Which of the following describes the function of the numbered parts?

	where most photosynthesis occurs	where most water is lost from the leaf	where food substances are transported
A	1	4	3
B	2	5	1
C	3	1	2
D	5	2	4

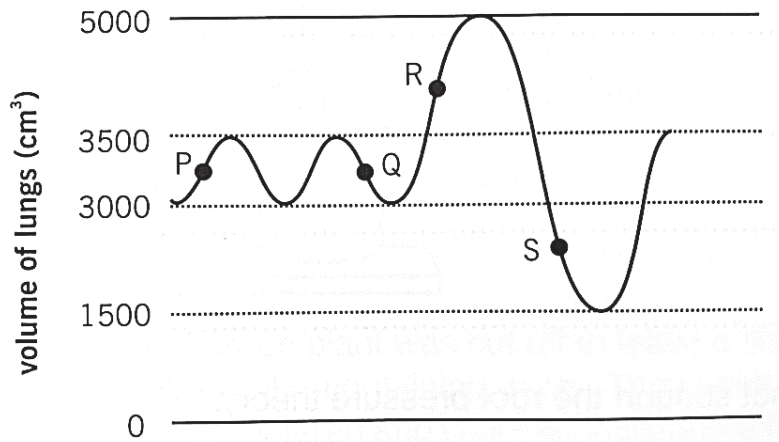
20 The blood samples of three persons, X, Y and Z were tested with samples of blood from groups A and B to determine their blood groups. Results are shown in the diagram.



Identify the blood groupings for X, Y and Z respectively.

	X	Y	Z
A	A	O	AB
B	A	AB	O
C	B	O	AB
D	B	AB	O

21 The graph below shows changes in volume of air in the lungs whilst breathing in and out.



In which positions is the air pressure in the lungs higher than in the atmosphere?

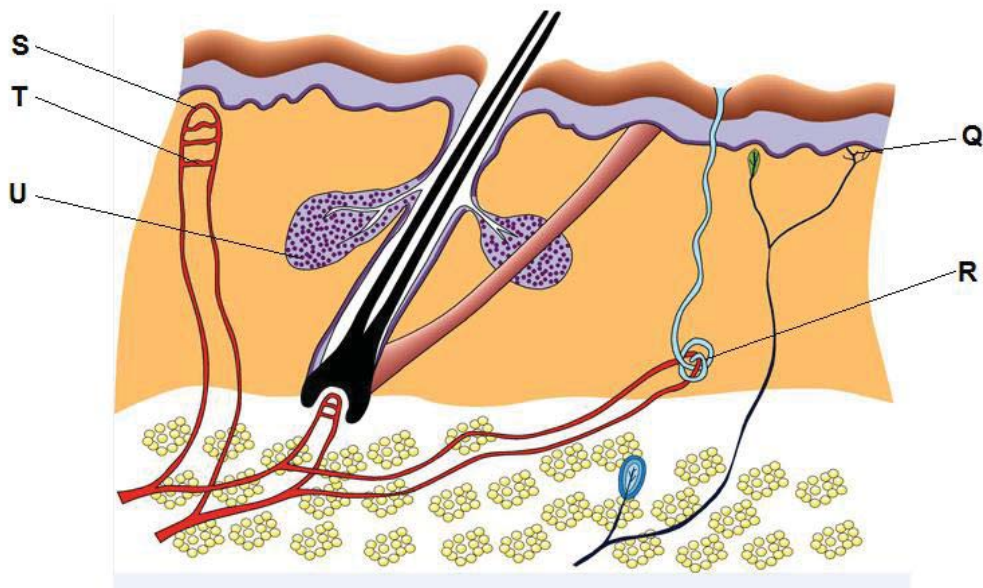
- A** P and Q
- B** P and R
- C** R and S
- D** Q and S

- 22 Which route does oxygen gas take when it enters the body?
- A pharynx → larynx → trachea → bronchus → bronchiole → alveolus
 B larynx → pharynx → trachea → bronchus → bronchiole → alveolus
 C trachea → pharynx → larynx → alveolus → bronchus → bronchiole
 D trachea → larynx → pharynx → bronchiole → bronchus → alveolus
- 23 Which of the following is not an example of excretion?
- A Removal of glycogen in the liver.
 B Removal of uric acid in the skin.
 C Removal of excess water in the kidneys.
 D Removal of bile pigments in the liver.
- 24 The kangaroo rat is native to the deserts of North and Central America. The rodent is highly adapted to life in a hot and dry environment. Its kidneys are four times more efficient at retaining water than those of humans.

Which physical feature of the kidney allows this to be achieved?

- A A very long loop of Henle
 B A very short loop of proximal convoluted tubule
 C A very large bladder
 D A very long ureter

For questions 25 and 26, refer to the diagram below which shows a section of the human skin.



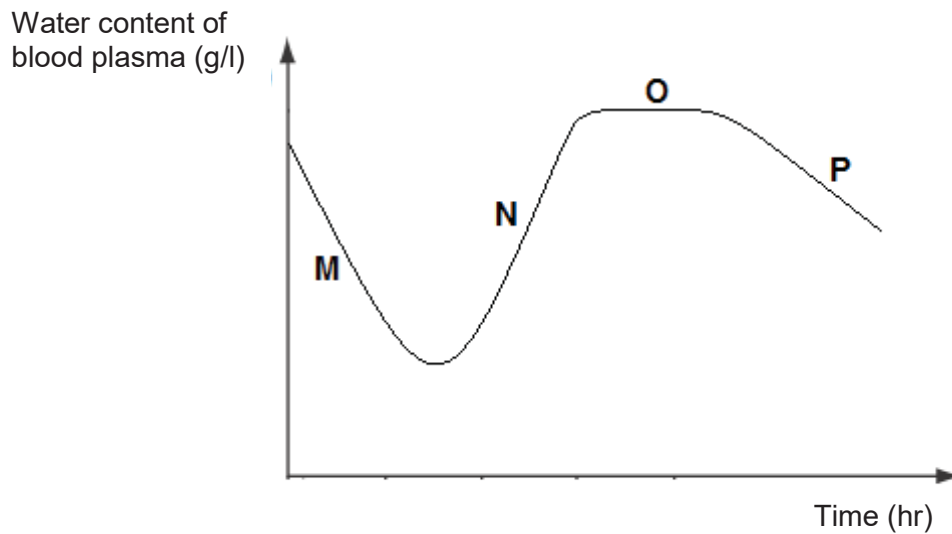
25 Which structures refer to the sweat gland and sebaceous gland?

	sweat gland	sebaceous gland
A	U	R
B	Q	S
C	R	U
D	S	R

26 Which of the following describes what happens at S and T on a hot day?

	S	T
A	increased blood flow	constricts
B	decreased blood flow	constricts
C	increased blood flow	dilates
D	decreased blood flow	dilates

27 The graph shows the effect of antidiuretic hormone (ADH) on the regulation of water content in blood plasma.

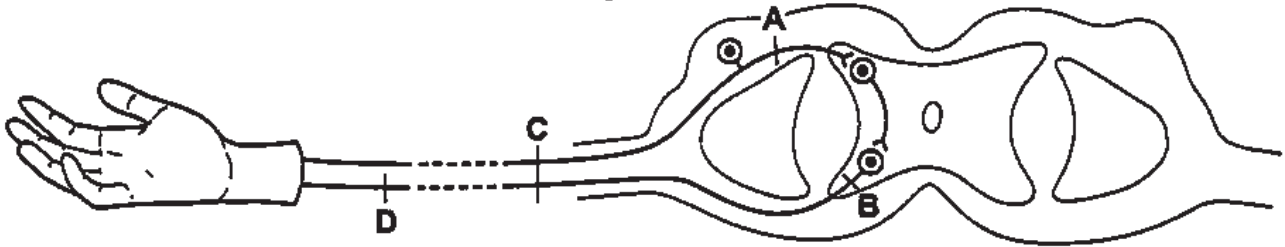


Which part(s) of the graph reflect(s) the effect of increased ADH secretion?

- A** M only
- B** N only
- C** M and P
- D** N and O

- 28 The diagram shows some neurones present in a section through the spinal cord.

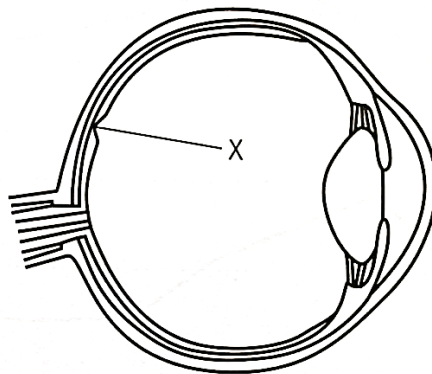
Which neurone, when damaged, would cause a person to not know that he has touched a hot object, but still be able to move his hand voluntarily?



- 29 Which is the receptor and effector involved in the constriction of the pupil when a person moves from dim to bright light?

	receptor	effector
A	optic nerve	ciliary muscle
B	retina	ciliary muscle
C	optic nerve	circular iris muscle
D	retina	circular iris muscle

- 30 The diagram below shows the structures of the human eye.

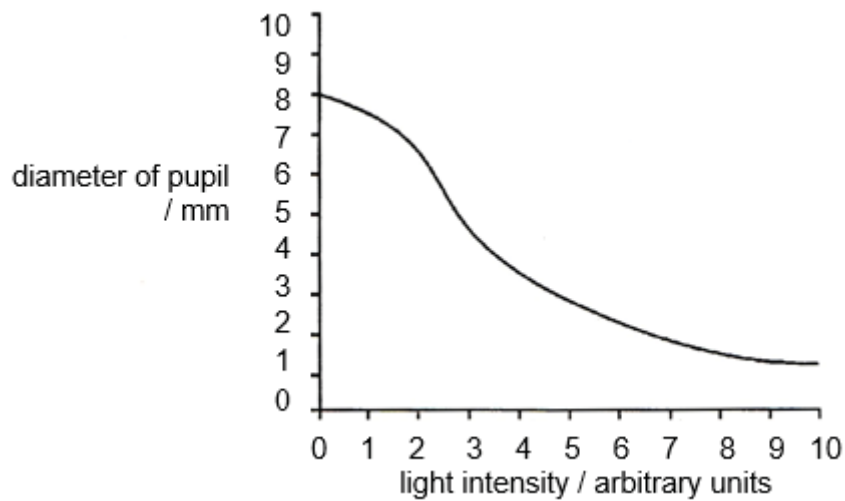


A girl had an infection at region X.

Which of the following may the girl suffer from?

- A** She may not be able to see things in colour.
- B** She could not see sharp, detailed images.
- C** She is not sensitive to light.
- D** She may not be able to send electrical impulses to the brain.

- 31** In an experiment, a person looked at the same light source from various different distances. The diameter of his pupil was measured at different light intensities. The graph below shows how the diameter varied.



Which changes take place in the eye when the light intensity is changed from 2 to 4 arbitrary units?

	circular muscles	radial muscles
A	contract	contract
B	contract	relax
C	relax	contract
D	relax	relax

- 32** Adrenaline is sometimes given to patients. In which of the following conditions would the administration of adrenaline be useful to the patient?

- 1 low heart rate
- 2 low blood sugar levels
- 3 low water potential of blood

- A** 2 only
B 2 and 3 only
C 1 and 2 only
D 1, 2 and 3

- 33** Where is the hormone insulin produced and where does it act?

	site of production	site of action
A	adrenal glands	liver
B	adrenal glands	body muscles
C	liver	body muscles
D	pancreas	liver

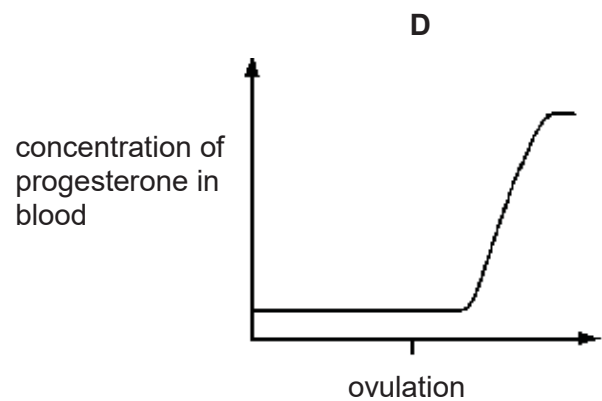
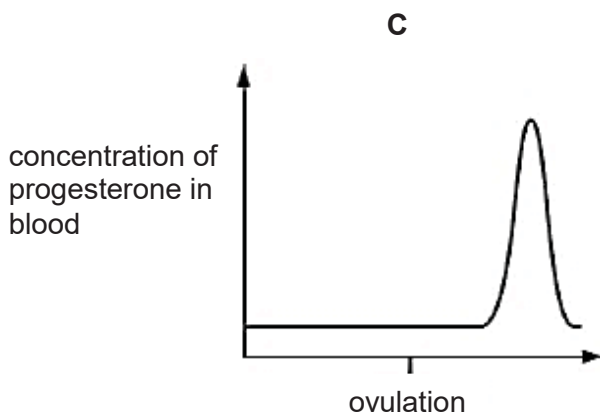
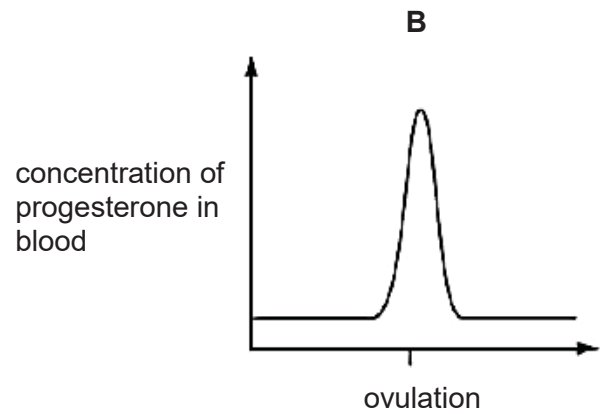
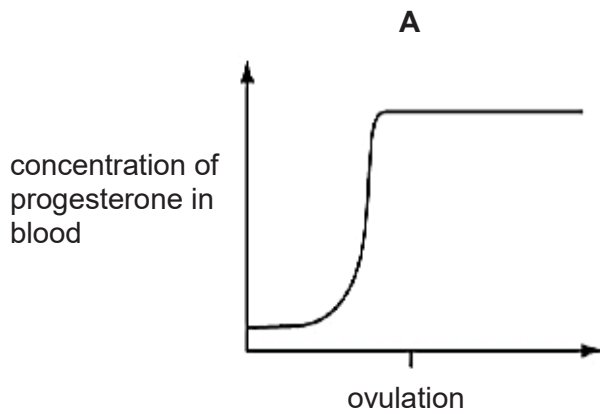
- 34** A couple who had been unsuccessful in having a baby wished to take advantage of the technique of in-vitro fertilisation (commonly called “test-tube baby”), using the woman’s egg and her husband’s sperm.

Which one of the following fertility problems could be most easily overcome in this way?

- A** failure of the follicle to mature
- B** blocked oviducts from severe infection
- C** pelvis is too small to allow for normal development of the fetus
- D** unstable uterine wall which greatly reduces the probability of implantation

- 35** The graphs below show the concentration of progesterone in the blood of a female during a 28-day cycle.

Which graph shows the changes in concentration of progesterone if pregnancy occurs during the cycle?



36 The sequence of bases on part of an mRNA molecule is GUA CUC GCG.

What is the base sequence on the corresponding part of the template strand on the DNA molecule?

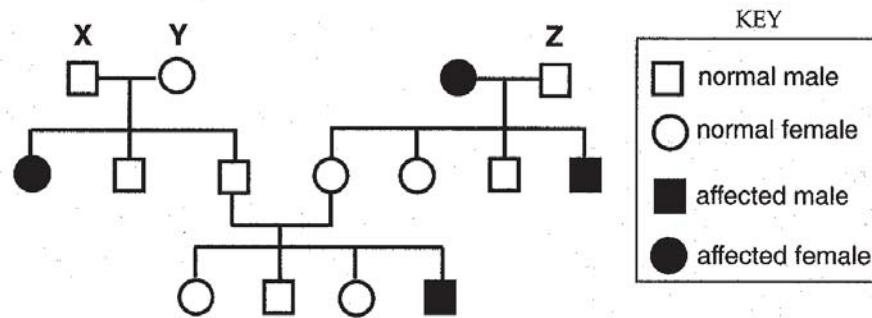
- A CAT GAG CGC
- B CTT GTG CGC
- C CGC GTG TAC
- D CAU GAG CGC

37 In the Andalusian breed of chickens, feather colour is determined by a pair of co-dominant alleles: B for black feathers and W for white feathers, Heterozygotes (BW) have blue-grey feathers.

What phenotypic ratio would you expect from crossing two blue-grey Andalusian chickens?

- A all blue grey
- B 3 blue grey: 1 white
- C 1 black: 2 blue grey : 1 white
- D 3 blue grey: 1 black

38 The diagram shows the inheritance pattern of a recessive characteristic.



What are the most likely genotypes of individuals X, Y, and Z, if R is the dominant allele and r is the recessive allele?

	X	Y	Z
A	RR	Rr	Rr
B	RR	RR	Rr
C	Rr	Rr	RR
D	Rr	Rr	Rr

- 39** What does gene therapy refer to?
- A** Insertion of defective genes into cells of people with healthy genes.
 - B** Insertion of healthy genes into cells of disabled people with healthy genes.
 - C** Insertion of healthy genes into cells of people with defective genes.
 - D** Insertion of healthy genes into defective cells of people with healthy genes.
- 40** Which of the following describes an example of artificial selection?
- A** It has been found that some strains of bacteria produce antibiotics.
 - B** It is a common practice to mate bulls with cows that produce the most milk.
 - C** It is possible to control caterpillar feeding on food crops by releasing small wasps which lay their eggs in caterpillar and kill them.
 - D** Mosquitoes have developed strains that are resistant to insecticides.

End of Paper 1



**Preliminary Examination 2020
Secondary Four Express
Biology Paper 2 (6093/02)**

Date of Examination: 27 August 2020

Duration: 1 h 45 min

*Chua Chu Kang Secondary School Chua Chu Kang Secondary School Chua Chu Kang Secondary School
Chua Chu Kang Secondary School Chua Chu Kang Secondary School Chua Chu Kang Secondary School
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Name: _____ ()

Class: _____

Instructions to Candidates

Write your name, index number and class in the spaces provided on the question paper.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions. Write your answers in the spaces provided on the Question Paper.

Section B

Answer **all** the questions, the last question is in the form either/or. Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

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.

Section	Marks
A	50
B	30
Total	80

This Paper consists of **18** printed pages, including the cover page.

Section A

Answer **all** questions.

Write your answers in the spaces provided.

- 1 Fig. 1.1 shows a single cell from an organism called *Spirogyra*. *Spirogyra* is usually found in freshwater ponds, where the concentration of mineral salts is low.

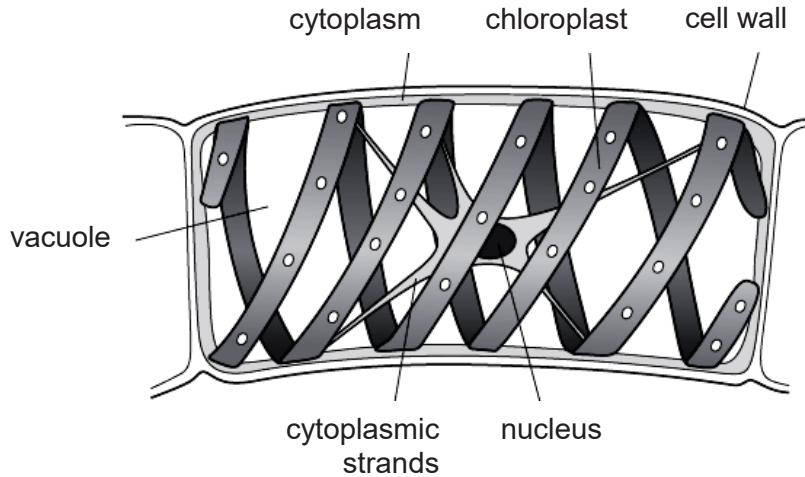


Fig. 1.1

- (a) Suggest one reason why *Spirogyra* can be considered a plant cell and not an animal cell.

.....
..... [1]

- (b) A defect in the formation of cell wall during the *Spirogyra*'s development will eventually cause its death in freshwater ponds.

Explain the reason behind this in terms of water potential.

.....
.....
.....
..... [3]

[Total: 4]

- 2 Some students investigated the effect of pH on the digestion of boiled egg white by an enzyme.

The students:

- placed a glass tube containing boiled egg white into a test tube
- added a solution containing the enzyme at pH 7
- set up six more tubes with solutions of the enzyme at different pH values
- left the test tubes for 24 hours at room temperature.

Fig. 2.1 shows one of the test tubes, at the start and at the end of the 24 hours.

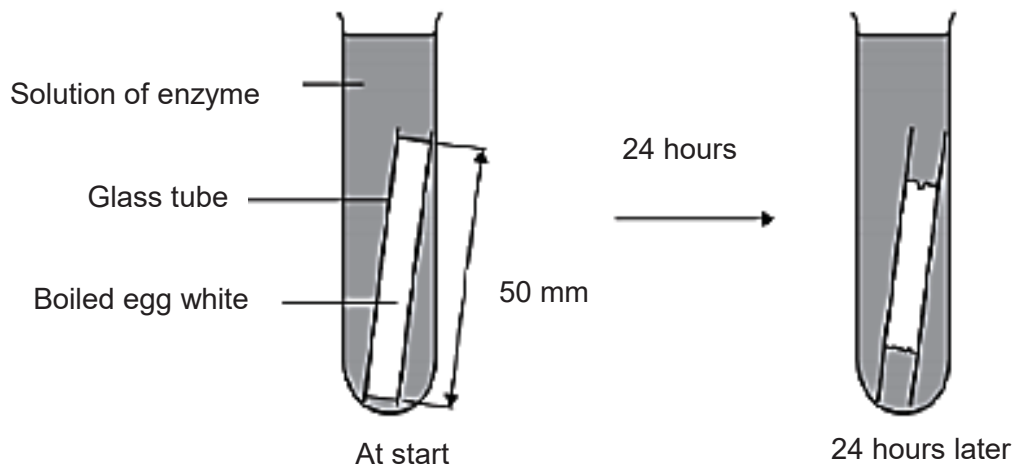


Fig. 2.1

- (a) The above reaction is highly sensitive to temperature changes.

Suggest how the experimental setup can be modified to improve the reliability of the experiment.

.....
 [1]

- (b) The egg white in each tube was 50 mm long at the start of the investigation.

Table 2.1 shows the students' results.

Table 2.1

pH	length of boiled egg white after 24 hours / mm
5	50
6	50
7	43
8	36
9	32
10	38
11	45

(i) With reference to Table 2.1, identify the enzyme used in the experiment and its optimum pH.

enzyme

optimum pH [1]

(ii) Deduce the part of the human body in which the enzyme in (b)(i) can be found.

..... [1]

(c) Explain the length of the egg white in the glass tube from pH 5 to pH 6.

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

[Total: 5]

- 3 Fig. 3.1 shows a cross section of the heart from a person suffering from a heart defect known as “hole in the heart”.

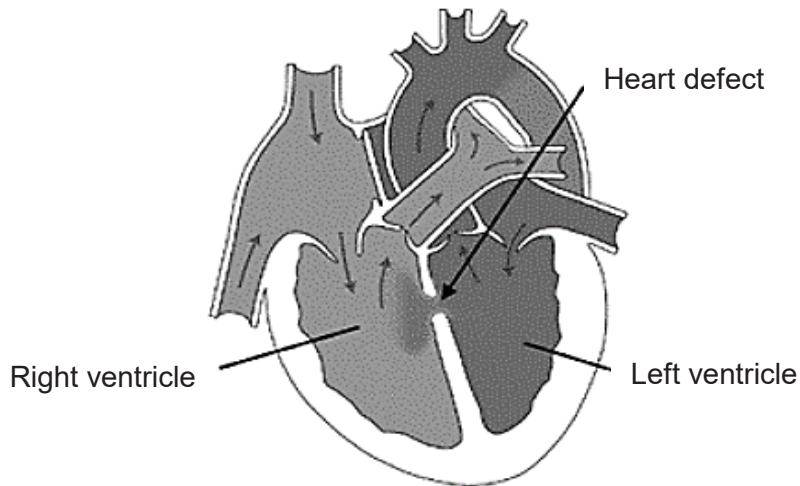


Fig. 3.1

- (a) Predict and explain how the heart defect will affect the lifestyle of this person.

.....

 [3]

- (b) Fig. 3.2 shows pressure changes in the left side of the heart and aorta over time. The total length of a cardiac cycle is 0.8 seconds. Points 1, 2, 3 and 4 indicate when the atrio-ventricular valves and semi-lunar valves are either open or close.

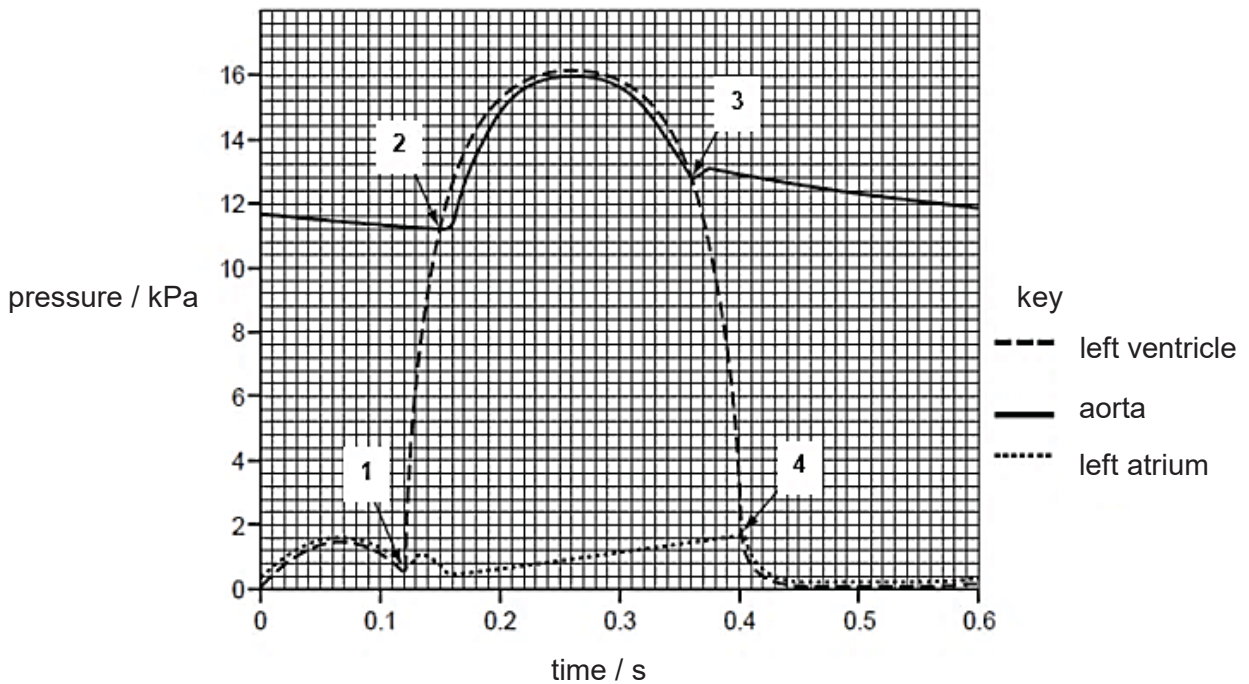


Fig. 3.2

- (i) Circle on Fig. 3.2, the area(s) of the graph where the atrio-ventricular valves, and the semi-lunar valves are both closed at the same time during the cardiac cycle shown. [2]
- (ii) Calculate how many times the heart described in Fig 3.2 will beat in one minute.

Number of heart beats per minute = [1]

[Total: 6]

4 Fig. 4.1 shows a longitudinal section of a flower.

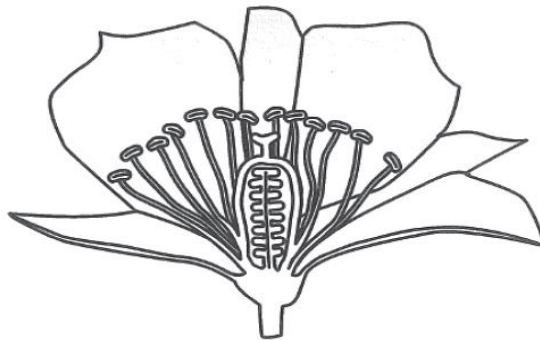


Fig. 4.1

- (a) (i) Suggest the most likely vector which carries out the pollination of this flower.
 [1]
- (ii) State one feature shown in Fig. 4.1 that would confirm your answer in part (a)(i).
 [1]
- (b) When a flower is pollinated, it bore fruit. A student wanted to prevent pollination and hence wrapped an unopened flower with a transparent plastic bag. Three days later, he observed that the flower bloomed and a week after, a fruit appeared.

Explain how the flower could have been pollinated.

.....

 [2]

(c) In some species, there are plants with only male flowers or only female flowers. Explain one advantage of this to the species.

.....
 [1]

(d) Suggest one reason why pollination may not lead to fertilisation.

.....
 [1]

[Total: 6]

5 Fig. 5.1 shows the changes in the amount of DNA in a cell during one mitotic cell cycle.

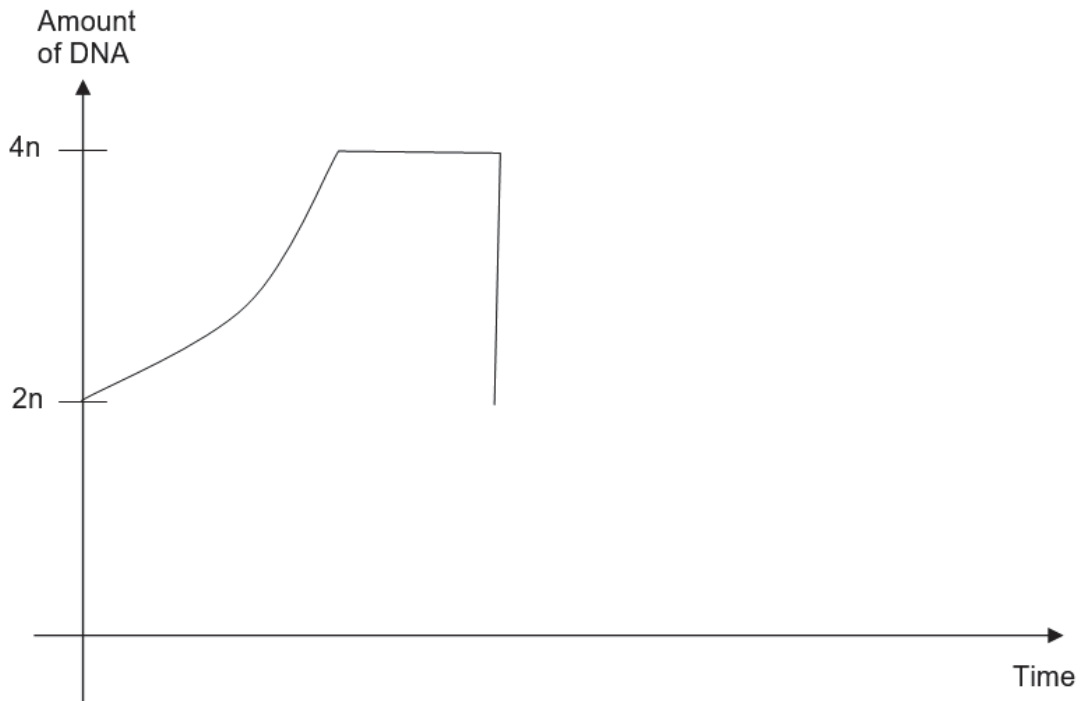


Fig. 5.1

(a) Label on Fig. 5.1

- (i) a "X" where interphase takes place,
- (ii) a "Y" where mitosis takes place.

[2]

(iii) If the next cycle includes meiosis and ends with formation of a gamete, complete the graph in Fig. 5.1.

[2]

Meiosis is a type of nuclear division which produces gametes for sexual reproduction. Fig. 5.2 shows diagrams of stages of meiosis, A to J, which are not arranged in the correct order.

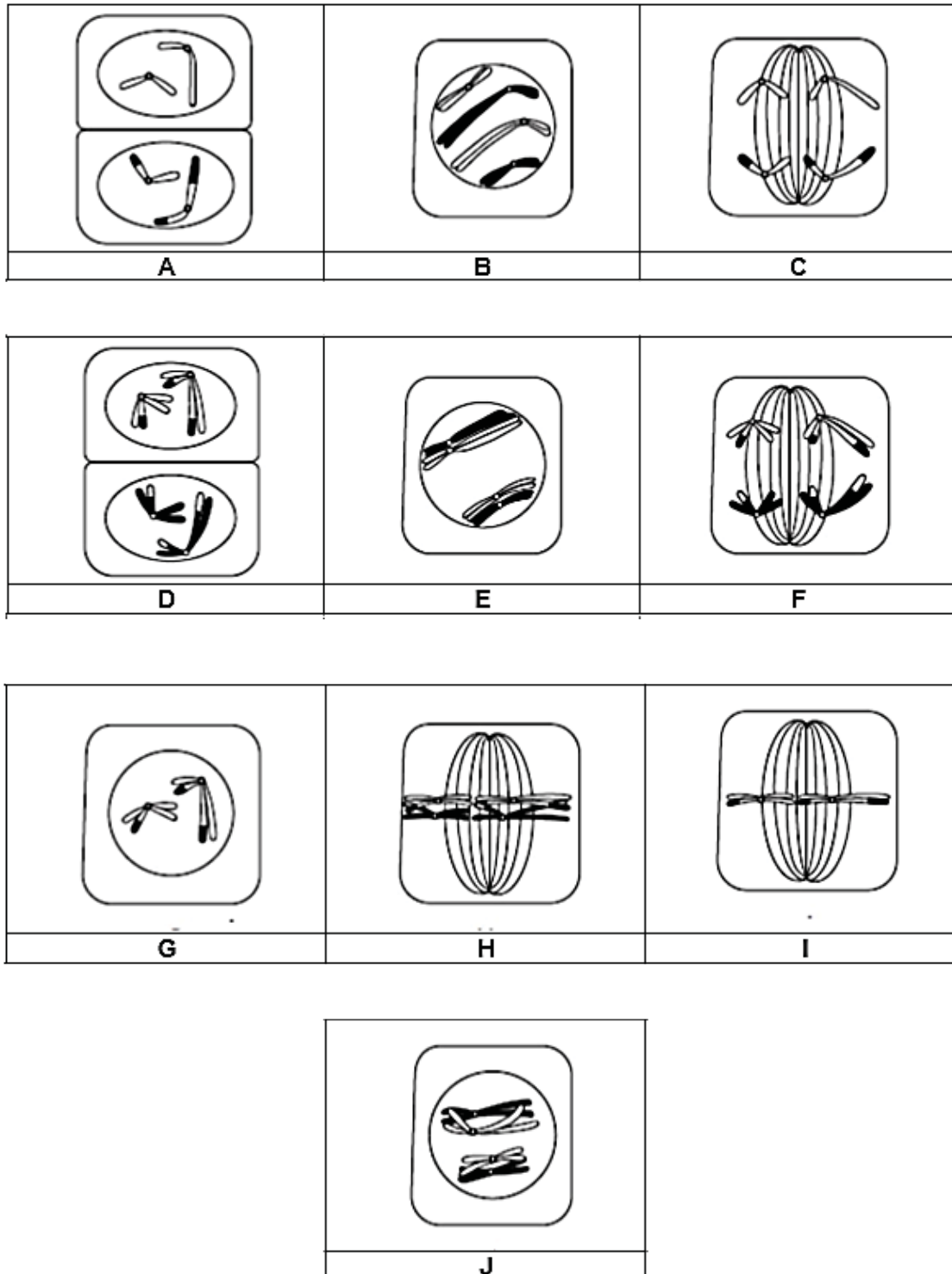


Fig. 5.2

(b) Complete the table below by writing the stages of meiosis in the correct order. [3]

nuclear division	letter of stage
meiosis I	B
meiosis II	
	A

(c) Describe how meiosis helps to increase genetic variation in the zygote.

.....

.....

..... [2]

[Total: 9]

6 Table 6.1 shows the pH of muscle tissues of a wild boar at various times after its death.

Table 6.1

time after death/ h	pH of muscle tissues
1	6.1
2	5.9
6	5.7
12	5.6
24	5.5
48	5.4

(a) Name the substance responsible for the decrease in pH value of muscle tissue in the wild boar.

.....[1]

(b) Name the process and explain the change in pH as time increases after death.

.....
.....
.....
.....
..... [3]

[Total: 4]

7 As blood passes through the kidney, it is filtered and the urine formed in the nephron leaves the kidney through the ureter.

Table 7.1 shows the concentration of some of the substances in blood, glomerular filtrate and urine.

Table 7.1

component	blood (g/ 100 cm ³)	glomerular filtrate (g/ 100 cm ³)	urine (g/ 100cm ³)
glucose	0.10	0.10	0.00
urea	0.03	0.03	1.80
amino acids	0.05	0.05	0.00
plasma proteins	8.00	0.00	0.00

Table 7.2 shows the presence or absence of red blood cells in blood, glomerular filtrate and urine.

Table 7.2

component	blood	glomerular filtrate	urine
red blood cells	present	absent	absent

(a) With reference to the parts of the nephron, explain the changes in fluid composition shown in Table 7.1 and 7.2.

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

(b) Outline briefly the principles of how a dialysis machine works.

.....
.....
.....
..... [3]

[Total: 7]

8 The room temperature in Sam's house was at 33°C.

Fig. 8.1 below shows the changes in his core body temperature and skin temperature over time. At the 10th minute, he ate some ice cream.

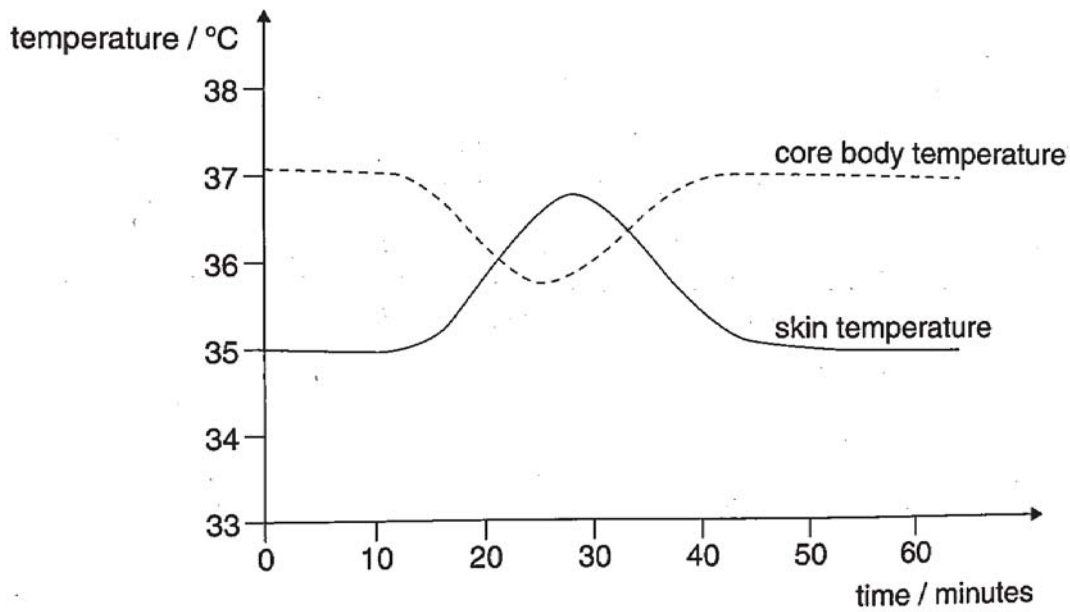


Fig. 8.1

(a) Describe what happened to Sam's core body temperature and skin temperature after he ate the ice cream.

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

(b) Explain why eating ice cream caused Sam's skin temperature to rise.

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

[Total: 4]

9 Fig. 9.1 shows the nervous relationship between the spinal cord and the pricking of the hand.

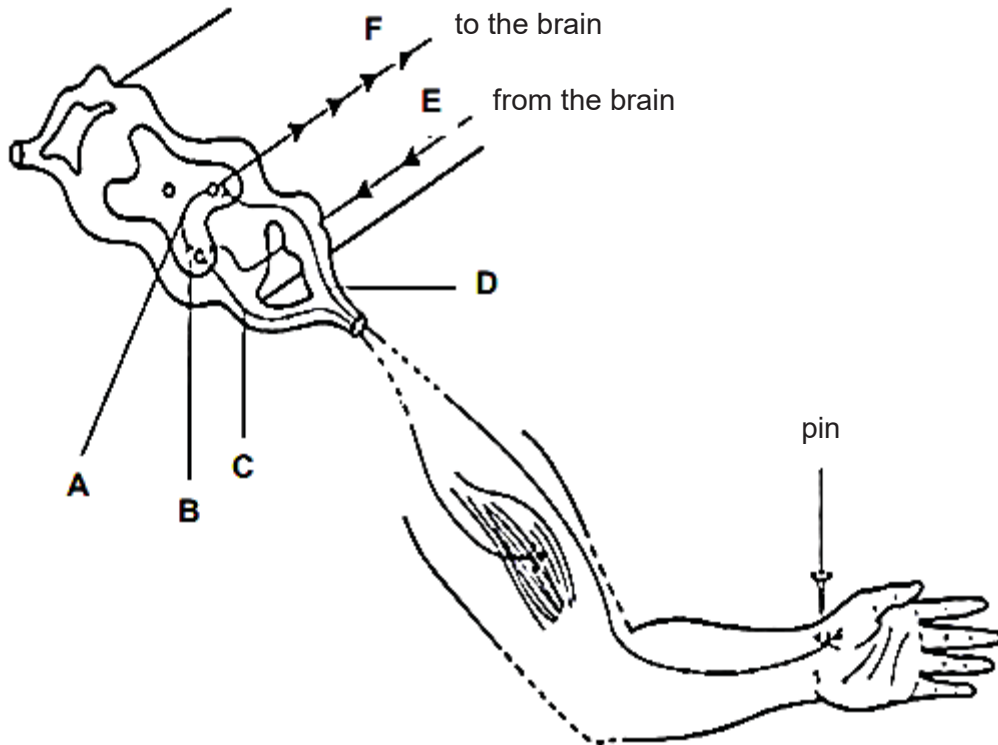


Fig. 9.1

(a) Describe the reflex pathway taking place in Fig. 9.1.

.....

.....

.....

.....

..... [3]

(b) State two differences between the nervous pathway above and hormonal endocrine system .

.....

.....

..... [2]

[Total: 5]

Section BAnswer **three** questions.

Write your answer in the spaces provided.

- 10** A potometer is a piece of apparatus that is used to measure water uptake by plants. Most of the water taken up by plants replaces water lost in transpiration.

A student used a potometer to investigate the effect of wind speed on the rate of water uptake by a leafy shoot. As the shoot absorbs water, the air bubble moves upwards.

The student's apparatus is shown in Fig. 10.1.

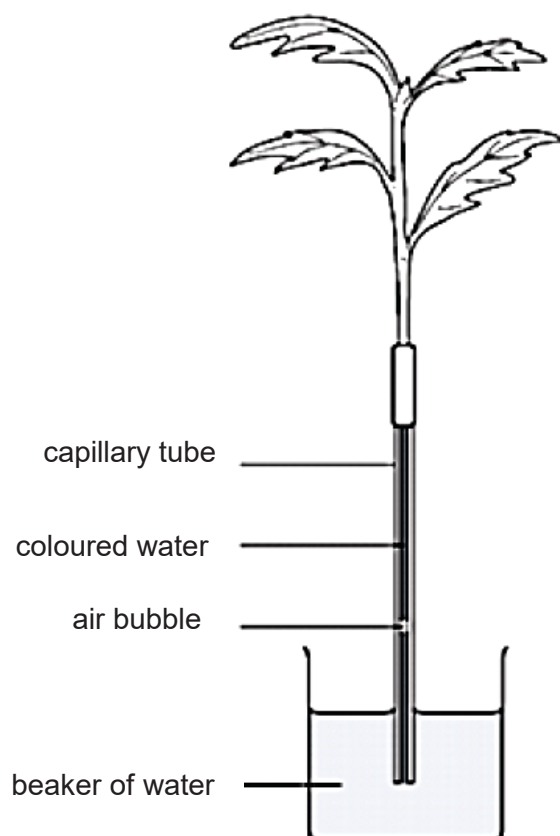


Fig. 10.1

The student used a fan with five different settings and measured the wind speed. The results are shown in Table 10.2.

Table 10.2

wind speed / metres per second	distance travelled by the air bubble / mm	time / minutes	rate of water uptake / mm per minute
0	4	10	0.4
2	12	5	2.4
4	20	5	4.0
6	35	5	7.0
8	40	2	

- (a)** Calculate the rate of water uptake at the highest wind speed and write your answer in Table 10.2. [1]

(b) Plot a graph using the grid in page 15 to show the relationship between wind speed and the rate of water uptake. [3]

(c) Describe the effect of increasing wind speed on the rate of water uptake.

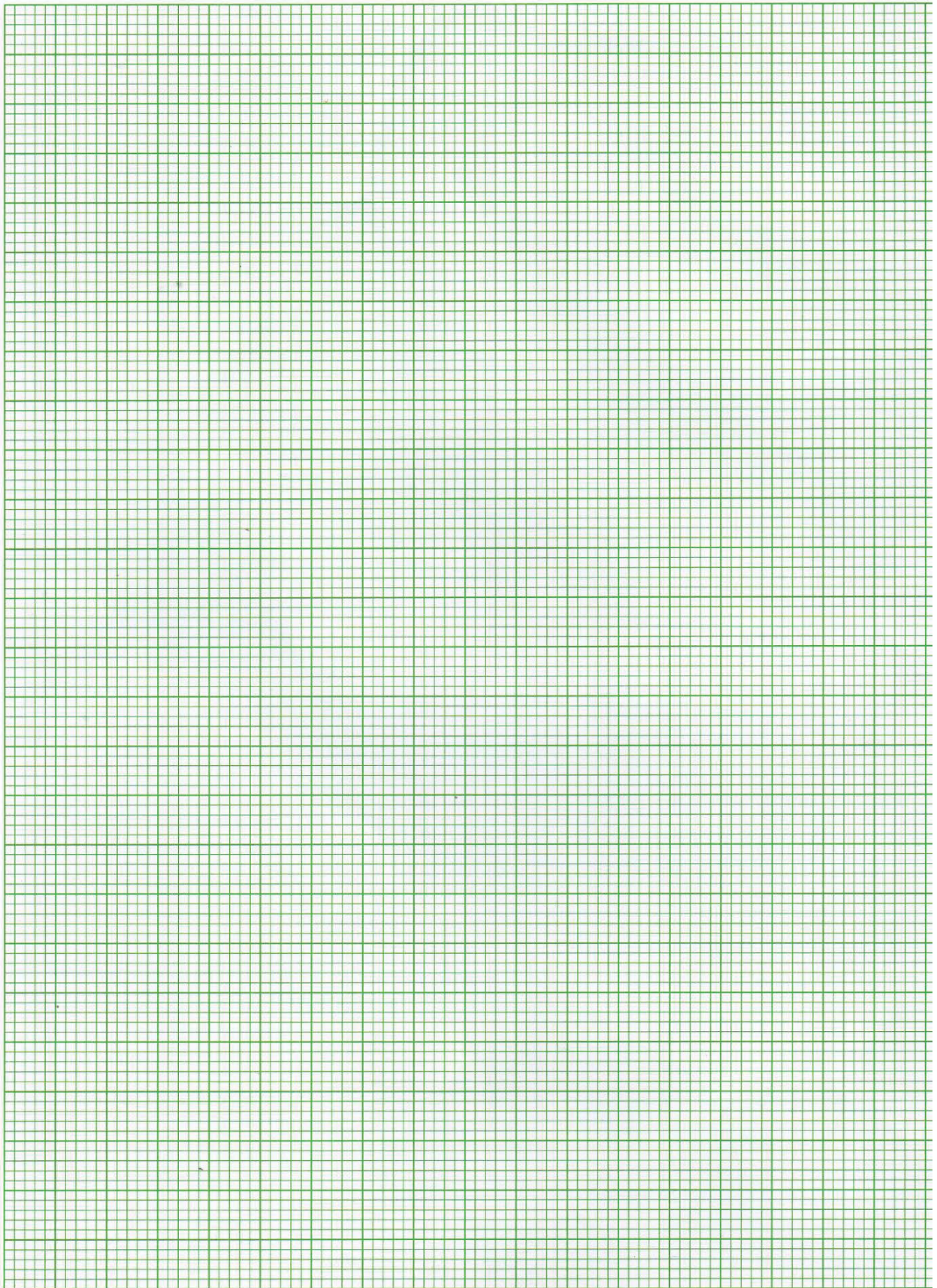
.....
.....[2]

(d) Water moves through the xylem to the tops of very tall trees, such as giant redwoods of North America. The movement of water in the xylem is caused by transpiration.

Explain how transpiration is responsible for the movement of water in the xylem.

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

[Total: 10]



11

In almost all mammals, the placenta - the organ that develops in pregnancy to provide oxygen and nutrients to the baby and remove waste products - is eaten by the mother immediately after giving birth. Humans and aquatic mammals are the only exceptions.

But the number of women choosing to eat their placenta has [increased over the past decade](#).

Articles "No. you shouldn't be eating your placenta, here's why?" from <https://theconversation.com/no-you-shouldnt-eat-your-placenta-heres-why-86405>

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

(i) a small intestine

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

(ii) a lung

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

(iii) a kidney

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

(b) The placenta produce hormones. However, in some cases when the placenta is damaged, it may not be able to produce hormones for a healthy pregnancy.

Suggest how scientists can produce hormones in a large scale?

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

[Total: 10]

12 Janice was waiting for the bus to school. She checked the time on her watch to see if she will be late. Just then, she heard the sound of the bus. She looked up and saw a bus clearly from afar.

(a) Describe the changes that are taking place in Janice’s eyes from when she was looking at her watch until she saw the bus.

.....
.....
.....
.....
..... [3]

Aniridia is a condition that results in the complete loss of iris.

(b) Predict and explain how the vision of an individual with *arinidia* may be affected.

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

(c) The inheritance of *arinidia* involves a single gene. The gene exists as two alleles. Two healthy parents had three children. The third child was found to have arinidia although the other two children are normal.

(i) Is the allele that causes *arinidia* dominant or recessive? Explain.

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

(ii) What is the chance of giving birth to a son with this disease? Use a genetic diagram to explain your answer. [3]

[Total: 10]

13 This is a dummy question.

.....
.....

End of Paper 2

2020 Marking Scheme for 4E Pure Biology Prelim

Paper 1

1. A	2. D	3. B	4. C	5. D
6. D	7. B	8. C	9. B	10. C
11. D	12. B	13. B	14. A	15. C
16. C	17. C	18. B	19. A	20. D
21. D	22. A	23. A	24. A	25. C
26. A	27. B	28. A	29. D	30. B
31. B	32. C	33. D	34. B	35. D
36. A	37. C	38. D	39. C	40. B

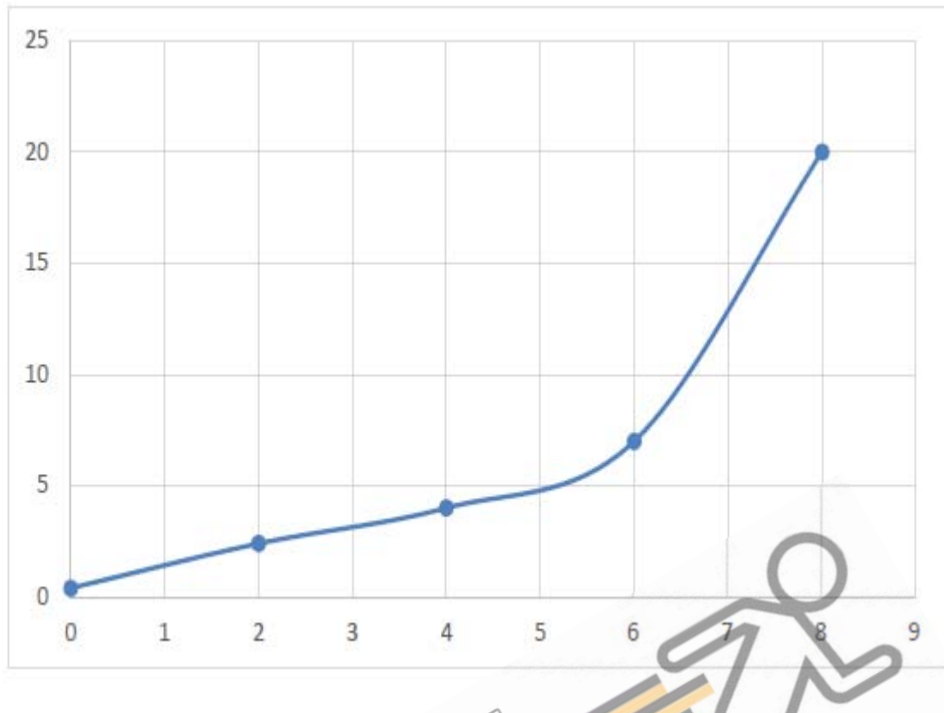
Paper 2

Qn	Marking Scheme	Remarks
1a	presence of chloroplast ; present of a large vacuole ; presence of a cell wall ;	Any 1
1b	freshwater pond has a higher water potential than the cell sap of <i>Spirogyra</i> ; [1] water molecules will enter the vacuole of <i>Spirogyra</i> cells via osmosis through the partially permeable cell surface membrane ; [1] cell will swell and expand, and eventually burst as there is no cell wall to prevent bursting ; [1]	3
2a	Place the test tube in a water bath to maintain a constant temperature	1
2bi	- enzyme: trypsin - optimum pH: 9.0	Both correct, 1m
2bii	pancreatic juice / pancreas / pancreatic glands	1
2c	- the enzymes were completely denatured at acidic pH values of pH 5 and 6, protein substrates were unable to bind to the enzyme active sites and thus, cannot form enzyme-substrate complex [1] - reaction cannot occur and the length of the egg white remains the same [1]	2
3a	The hole in the median septum will cause the oxygenated blood in the left side of the heart to mix with the deoxygenated blood in the right side of the heart. [1] This will result in less oxygen transported in the blood around the body. [1] Hence, he will be unable to participate in any strenuous activities. [1]	3
3bi		Each circle: 1m [2]
3bii	$60 \text{ s} / 0.8 \text{ s} = 75 \text{ heart beats per minute}$	1
4ai	Insects	1
4aii	Presence of large petals; or	Any 1

	Stigma is small and compact / does not protrude out of the flower													
4b	Pollen grains from the anthers could have fallen on the stigma of the flower [1] Allowing self-pollination to occur [1]	2												
4c	Offspring may inherited beneficial qualities from both parents; More genetic variation which increases the chance of the species surviving changes in the environment; Offspring may express desirable traits from both parents; Reduce chances where recessive harmful alleles will be expressed; Ensure cross pollination and only sexual reproduction	Any 1												
4d	The pollen may have fallen on the stigma of different species of flower (R: different plants); The stigma on which the pollen grain landed on is not mature [1]	Any 1												
5ai 5aii		2												
5aii	correct shape correct position: (n values) of each stage is important, time value is not	2												
5b	<table border="1"> <thead> <tr> <th>nuclear division</th> <th>letter of stage</th> </tr> </thead> <tbody> <tr> <td rowspan="6">meiosis I</td> <td>B</td> </tr> <tr> <td>E</td> </tr> <tr> <td>J</td> </tr> <tr> <td>H</td> </tr> <tr> <td>F</td> </tr> <tr> <td>D</td> </tr> <tr> <td rowspan="2">meiosis II</td> <td>G</td> </tr> <tr> <td>I</td> </tr> </tbody> </table>	nuclear division	letter of stage	meiosis I	B	E	J	H	F	D	meiosis II	G	I	7 – 8 correct: 3m 5 – 6 correct: 2m 3 – 4 correct: 1m 0 – 2 correct: 0m
nuclear division	letter of stage													
meiosis I	B													
	E													
	J													
	H													
	F													
	D													
meiosis II	G													
	I													

		C	
		A	
5c	<p>During <u>prophase I</u>, there is <u>crossing over between</u> (non-sister) <u>chromatids of homologous chromosomes at chiasma/chiasmata</u>, hence there is exchange of genetic material / genetic recombination/ resulting in chromosomes with new combination of alleles from both parents' set of chromosomes [1]</p> <p>During <u>metaphase I</u>, <u>independent assortment of homologous chromosomes</u> results in random combination of alleles which introduces variation by producing gametes with different combinations of both mother's and father's set of chromosomes [1]</p>		2
6a	Lactic acid [1]		1
6b	When the wild boar dies, its <u>lungs are no longer taking in oxygen</u> ; [1] Body cells begin to respire anaerobically, / <u>anaerobic respiration occurs</u> ; [1] resulting in the <u>production and accumulation of lactic acid in the wild boar tissues</u> ; [1] Hence, the pH continues to decrease over time.		3
7a	In the glomerulus, the high hydrostatic <u>blood pressure</u> caused glucose, urea and amino acids to be filtered and <u>enter the glomerular filtrate and Bowman's capsule</u> , as they are small enough to <u>pass through the basement membrane</u> ; [1] However, plasma proteins and red blood cells are too large to pass through the filter, and thus zero concentration in glomerular filtrate and urine; [1]. In the proximal convoluted tubule, <u>selective reabsorption of glucose and amino acids</u> take place, resulting in zero concentration in urine as they return back to the blood; [1] Urea is <u>excreted via urine with 1.8 g/ 100 cm³ of urea in urine</u> ; [1]		4
7b	Partially permeable dialysis membrane allows small molecules of water, urea and salts to diffuse out from the blood while preventing large molecules of protein and blood cells from diffusing out; convoluted tubule of dialysis membrane provides large surface area to volume ratio for rapid diffusion; opposite flow of dialysis fluid and blood flow generates steep diffusion gradient for urea and excess water to be removed quickly from blood; Dialysis fluid contains the same concentration as salts glucose and same water potential as blood to prevent loss of essential nutrients; Absence of urea in dialysis fluid ensures removal by diffusion out from blood.		Any 3
8a	After Sam ate the ice cream, his core body temperature decreased from 37.1°C to 35.5°C over the next 15 minutes while his skin temperature increased from 35°C to 36.8°C; [1] His core temperature then increased back to normal/ 37.1°C over the following 15 minutes while his skin temperature dropped back to 35°C; [1]		2
8b	The drop in his core body temperature caused Hair erector muscles contract causing hairs to stand, trapping a layer of insulating air; [1] Sweat glands stop/reduce production of sweat to prevent heat loss by evaporation; [1]		Any 2

	Arteriole vasoconstriction occurred to reduce blood flow and thus, heat loss from the skin; [1]																	
9a	<p>Touch/ stimulus from finger stimulates nerve endings of sensory neurone to generate impulse;</p> <p>Impulses generated travel along sensory neurone and transmitted across a synapse to the relay neurone;</p> <p>And then across another synapse to the motor neurone. Motor neurone transmits the impulses to effector (hand muscles) to contract and hand withdrawn;</p>		3m															
9b	<table border="1"> <thead> <tr> <th style="background-color: #d3d3d3;">Nervous control</th> <th style="background-color: #d3d3d3;">Endocrine control</th> </tr> </thead> <tbody> <tr> <td>Involves <u>neurons</u> (nerve impulses)</td> <td>Involves <u>hormones</u> (chemical substances)</td> </tr> <tr> <td><u>Electrical</u> and <u>chemical</u> transmission</td> <td><u>Chemical</u> transmission</td> </tr> <tr> <td>Nerve <u>impulses</u> are transmitted by neurones</td> <td><u>Hormones</u> are transmitted by the <u>blood</u></td> </tr> <tr> <td>Rapid transmission and response</td> <td><u>Slower</u> transmission and relatively <u>slow-acting</u></td> </tr> <tr> <td>Often causes <u>short-term</u> changes</td> <td>Can cause long-term or short-term changes</td> </tr> <tr> <td>May be <u>voluntary</u> or <u>involuntary</u></td> <td>Always <u>involuntary</u></td> </tr> <tr> <td>Usually <u>localised</u> response (e.g. one muscle)</td> <td><u>Widespread</u> responses (usually affects more than one target organ)</td> </tr> </tbody> </table>	Nervous control	Endocrine control	Involves <u>neurons</u> (nerve impulses)	Involves <u>hormones</u> (chemical substances)	<u>Electrical</u> and <u>chemical</u> transmission	<u>Chemical</u> transmission	Nerve <u>impulses</u> are transmitted by neurones	<u>Hormones</u> are transmitted by the <u>blood</u>	Rapid transmission and response	<u>Slower</u> transmission and relatively <u>slow-acting</u>	Often causes <u>short-term</u> changes	Can cause long-term or short-term changes	May be <u>voluntary</u> or <u>involuntary</u>	Always <u>involuntary</u>	Usually <u>localised</u> response (e.g. one muscle)	<u>Widespread</u> responses (usually affects more than one target organ)	Any 2 comparison
Nervous control	Endocrine control																	
Involves <u>neurons</u> (nerve impulses)	Involves <u>hormones</u> (chemical substances)																	
<u>Electrical</u> and <u>chemical</u> transmission	<u>Chemical</u> transmission																	
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Usually <u>localised</u> response (e.g. one muscle)	<u>Widespread</u> responses (usually affects more than one target organ)																	
10a	20.0 mm per minute		1															
10b			3															



[1] for correct scale, axis and axis labelling
 [1] correct plotting of all points
 [1] curve of best fit without extrapolation

10c Rate of water uptake gradually increases from 0.4 mm per minute to 7.0 mm per minute as wind speed increases from 0 metres per second to 6 metres per second. [1]
 Rate of water uptake increases steeply from 7.0 mm min⁻¹ to 20.0 mm min⁻¹ as wind speed increases from 6 ms⁻¹ to 8 ms⁻¹ [1]

10d - evaporation of water from surfaces of mesophyll cells into intercellular air spaces in leaf [1]
 - water vapour diffuses through stomata in leaves and is lost to drier air outside the leaves [1]
 - loss of water from mesophyll cells decreases water potential of cell sap, water moves into these cells via osmosis from cells deeper inside the leaf and xylem vessels [1]
 - this results in transpiration pull, a suction force which pulls the water column up the xylem vessels [1]

11a **Absorption of nutrients**
 allows transfer/absorption/diffusion of nutrients from mother/into fetus [1]
 such as glucose/amino acids/mineral salts/vitamins [1]
Gaseous exchange
 allows transfer / diffusion of oxygen from mother/to fetus [1]
 allows transfer / diffusion of carbon dioxide from fetus/to mother [1]
Removal of metabolic waste
 allows transfer/diffusion of metabolic waste / excretory products from fetus/to mother [1]
 such as urea [1]

11b The hormone gene is isolated by cutting it out with an appropriate restriction enzyme. [1] A plasmid is then cut using the same type of restriction enzyme and the human insulin gene is inserted in to the plasmid using DNA ligase. [1]The

Up to 4

	<p>plasmids containing the hormone gene are then mixed with bacteria. The bacteria must be treated temporarily with heat or an electric shock to take up the plasmid. [1] Then, the bacteria containing the hormone gene is isolated. These transgenic bacteria are placed in a fermenter containing a nutrient broth where they will multiply and produce the hormone that can be harvested.[1]</p>	
12a	<p>The contracted ciliary muscles become relax; Suspensory ligament that was originally slacken becomes taut; Convex lens becomes less convex and thinner, increasing its focal length.</p>	3m
12b	<p>Person cannot respond/ is insensitive to changes in light intensity; Cannot see clearly in the dark or in bright light;</p>	2m
12 ci	<p>Recessive; as the parents are healthy but gives rise to offspring with the disease. This shows that the parents are heterozygous;</p>	2m
12 cii	<p>Let A be the dominant allele for not affected with arinia.</p> <p>Let a be the recessive allele for affected with arinia.</p> <p>Parental Phenotype. Normal Normal</p> <p>Parental Genotype Aa x Aa</p> <p>Gametes (A) (a) (A) (a)</p> <p>Fertilization</p> <p>Offspring genotype AA Aa Aa aa</p> <p>" phenotype normal normal normal affected with arinia.</p> <p>Phenotypic ratio 3 normal : 1 arinia, 25%</p> <p>∴ chance of giving birth to a son with the disease, = 0.5×0.25 = 0.125, 12.5%. [1].</p>	3m

