West Spring Secondary School

PRELIMINARY EXAMINATION 2020

BIOLOGY **6093/01**

SECONDARY 4 **Express**

Name _____ ( ) **Date** 17 September 2020

Class _____ **Duration** 1 hour

Additional Materials: 1 OTAS

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name and index number on the Answer Sheet in the spaces provided.

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 separate answer sheet.

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

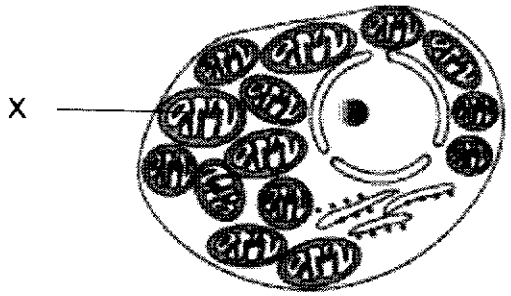
Any rough working should be done in this booklet.

The use of approved scientific calculators is allowed for this paper.

This document consists of 18 printed pages including the cover page.

Setter(s) Ms Dolly Khoo **[Turn over]**

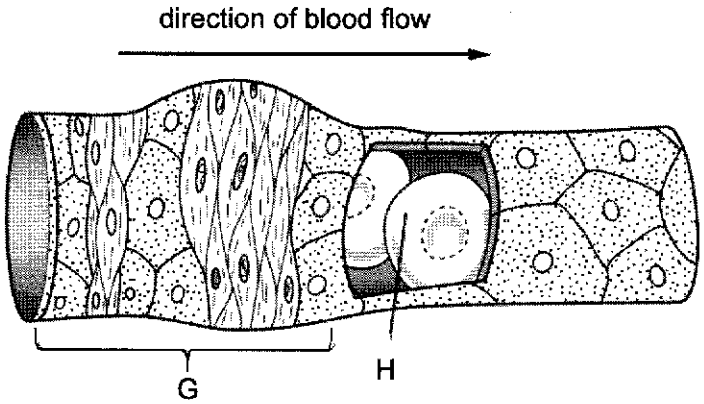
1 The diagram shows an animal cell with large number of structure X.



What other cell will likely have a large number of structure X?

A epithelial cell of villus
B mature red blood cell
C onion epidermal cell
D sieve tube cell

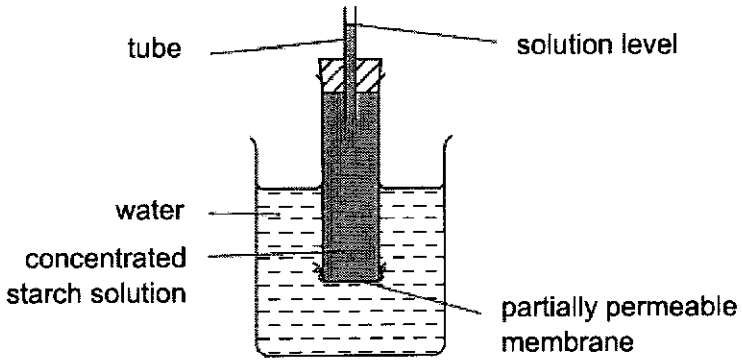
2 The diagram shows blood passing through an arteriole into a capillary. Part of the capillary wall has been cut away to show the blood.



What are the levels of organisation of the structures labelled G and H?

	G	H
A	organ	cell
B	organ	tissue
C	tissue	cell
D	tissue	tissue

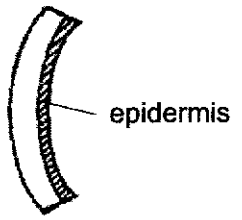
3 The diagram represents an apparatus used to investigate osmosis.



Which molecules will move across the partially permeable membrane and which change will occur in the solution level?

	molecules	solution level
A	starch	fall
B	starch	rise
C	water	fall
D	water	rise

4 The diagrams show four sections of the mustard green stem before and after immersion in solutions P, Q, R and S of different sucrose concentrations respectively. The shaded region is the stem epidermis.

before immersion	after immersion in solutions			
	 solution P	 solution Q	 solution R	 solution S

Which of the following shows the correct order of the solutions in increasing water potentials as compared to the cell sap of the mustard green stem cell?

	water potential			
	lowest →			highest
A	P	Q	R	S
B	Q	P	S	R
C	R	S	P	Q
D	S	R	P	Q

5 During an experiment, Jerry did an analysis of the cell sap from a marine plant and the surrounding seawater. His results are shown in the table.

substance analysed	concentration of ions (arbitrary units)		
	sodium ions (Na^+)	potassium ions (K^+)	chloride ions (Cl^-)
cell sap	0.13	0.56	0.61
sea water	0.57	0.02	0.59

He made the following deductions about the cell of the marine plant:

1 It removes chloride ions by diffusion.
2 It removes sodium ions by active transport.
3 It accumulates sodium ions by active transport.
4 It accumulates potassium ions by active transport.

Which of his deductions are correct?

A 1, 2 only
B 1, 2 and 4 only
C 1, 3 and 4 only
D 2, 3 and 4 only

6 Biuret test was carried out on substance T. A violet solution was observed.

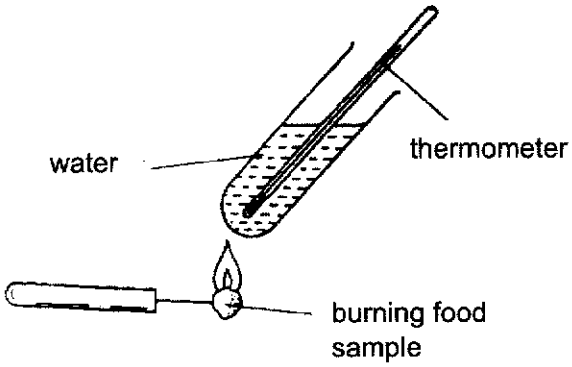
What is substance T?

A glucagon
B glucose
C glycerol
D glycogen

7 According to the lock and key hypothesis, which is the lock and which is the key for the reaction catalysed by maltase?

	lock	key
A	maltase	maltose
B	maltase	starch
C	maltose	maltase
D	starch	maltase

8 Four equal masses of different foods were burned as shown in the diagram.

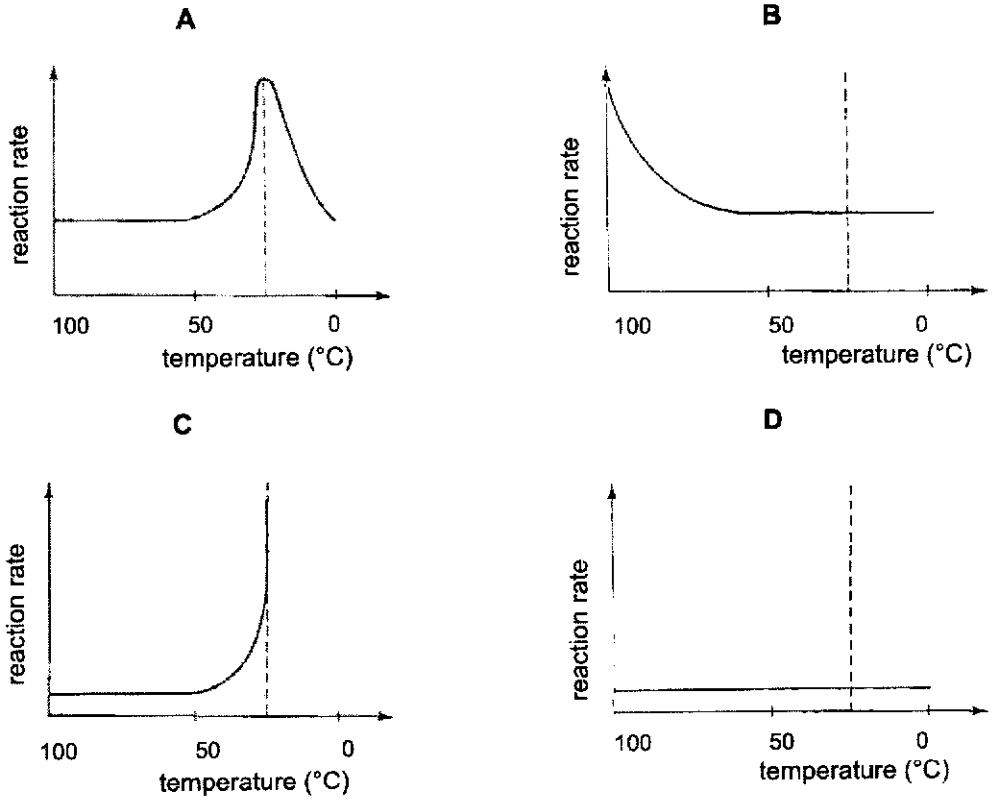


The temperature of the water was measured before and after each experiment. The results are shown in the table.

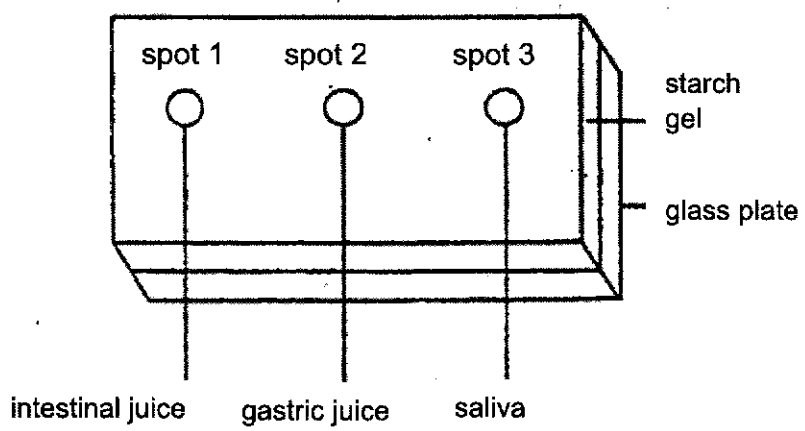
Which food sample is most likely to contain the most amount of fat?

	water temperature at start/ ^{0}C	water temperature at end/ ^{0}C
A	17	37
B	17	95
C	18	87
D	19	22

9 Which of the following graphs shows the rate of reaction when a hot mixture of starch and amylase is cooled down from 100°C to 0°C?



10 Digestive juices were collected from different regions of the alimentary canal.
Drops of these juices were added to a glass plate coated with starch gel as shown. After 1 hour, the starch gel was rinsed with distilled water and iodine solution was added to each spot.



What are the results?

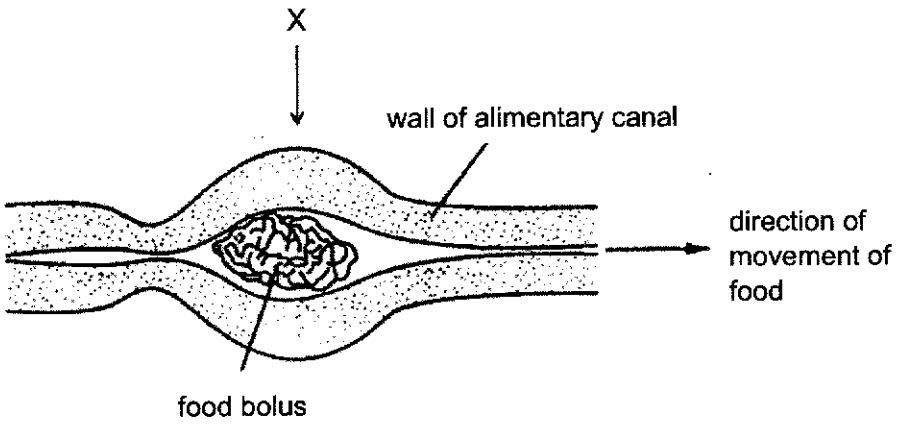
	spot 1	spot 2	spot 3
A	blue black	blue black	brown
B	brown	brown	blue black
C	brown	blue black	brown
D	brown	blue black	blue black

11 When 1 cm^3 of human bile was added to 5 cm^3 of milk in a test tube that also contained a few drops of Universal Indicator solution, the colour change indicated an increase in pH.

Which of the following functions or properties of bile accounts for the change in pH?

A Bile contains alkaline salts.
B Bile emulsifies fats.
C Bile has a high optimum pH.
D Bile hydrolyses lipids and releases fatty acids.

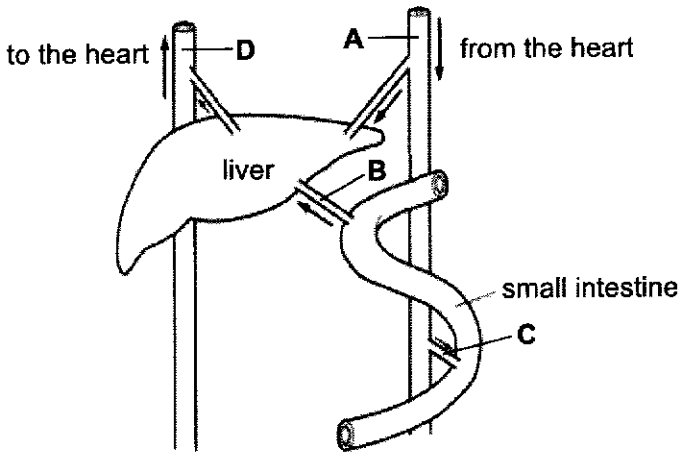
12 The diagram shows the movement of food along the alimentary canal.



What is the state of the muscles in the walls of the alimentary canal at point X?

	circular muscles	longitudinal muscles
A	contracting	contracting
B	contracting	relaxing
C	relaxing	contracting
D	relaxing	relaxing

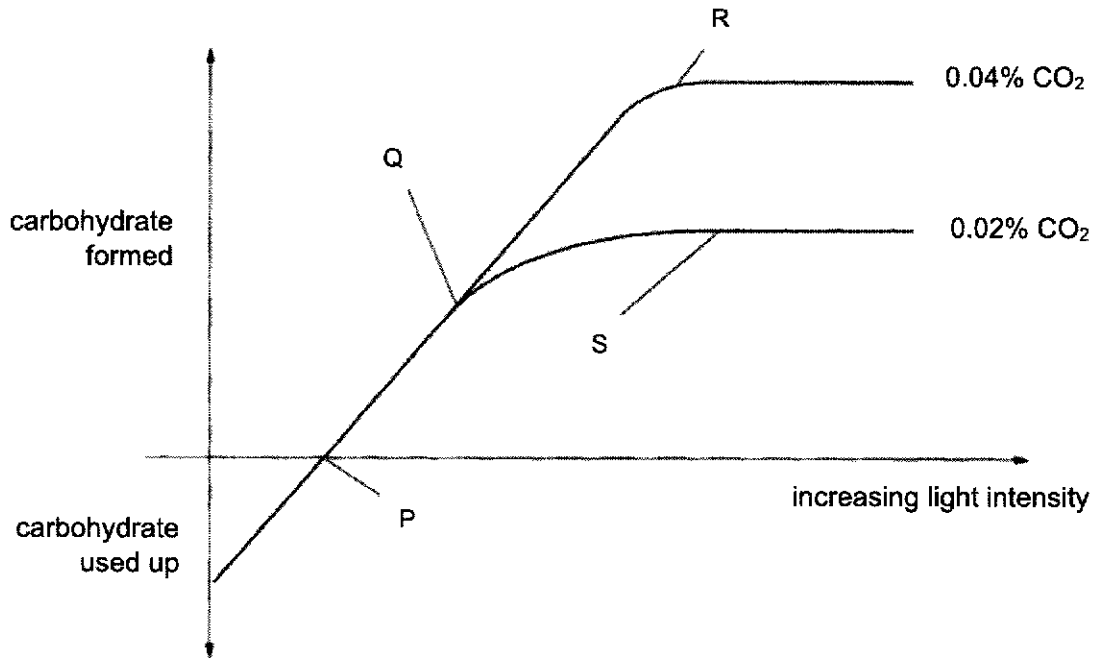
13 The diagram represents the liver and associated blood vessels. After a meal, which blood vessel will contain blood with the most glucose?



14 What happens to the excess glucose that is converted into sucrose in plants?

A It is stored in the leaves.
B It is transported to storage organs.
C It is used up in cellular respiration.
D It reacts with nitrates and other mineral salts to form amino acids.

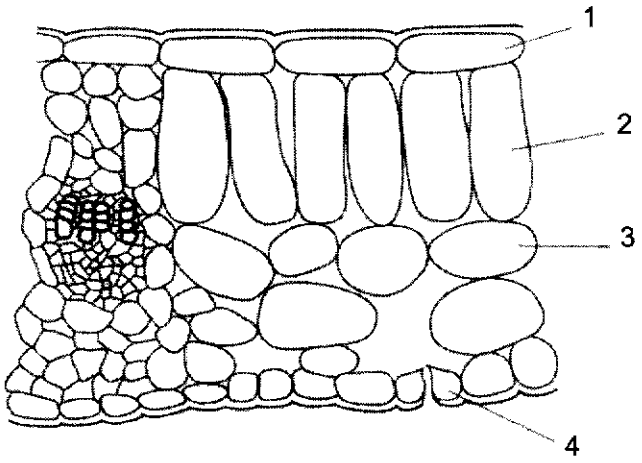
15 The amount of carbohydrate formed in a green plant by photosynthesis, as light intensity increases, under 0.02% CO_2 and 0.04% CO_2 respectively are shown in the two graphs. The temperature was 40°C for all measurements.



Which of the following statements about the graphs is correct?

A At point P, the rate of photosynthesis is equal to the rate of respiration for both carbon dioxide concentrations.
B At point Q, carbon dioxide concentration is a limiting factor for photosynthesis for both carbon dioxide concentrations.
C At point R, an increase in temperature by 10°C will increase the rate of photosynthesis.
D At point S, any further increase in light intensity will cause the plant to wilt.

16 The diagram shows part of the transverse section of a leaf.



Which cells contain chloroplasts?

A 1 and 3 only
B 2 and 3 only
C 2, 3 and 4 only
D all of the above

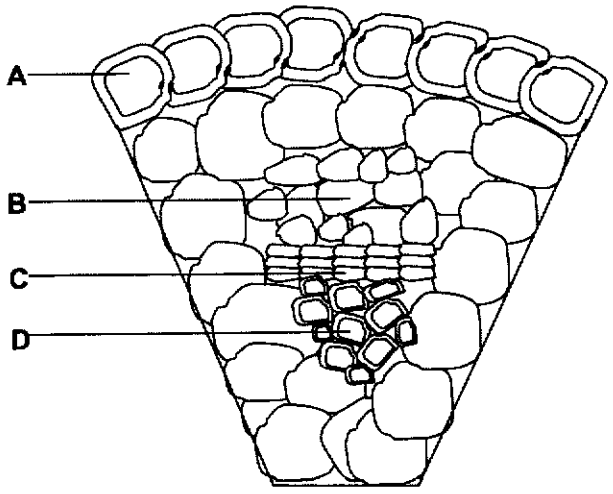
17 In an experiment to investigate transpiration, four identical leafy shoots were given different treatments.

Which shoot will show the greatest water loss?

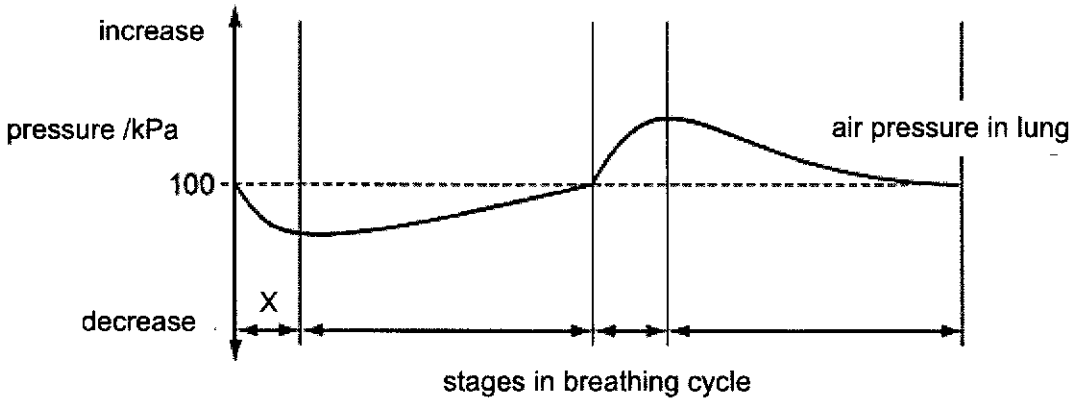
A all leaves removed
B lower and upper leaf surfaces covered with water-proof jelly
C lower leaf surfaces covered with water-proof jelly
D upper leaf surfaces covered with water-proof jelly

18 A leafy shoot is placed in a beaker containing a solution of a coloured dye.
The diagram shows a part of section of the stem after two days.

Which part is now most coloured by the dye?



19 The graph shows changes in the air pressure within the lungs during a breathing cycle.

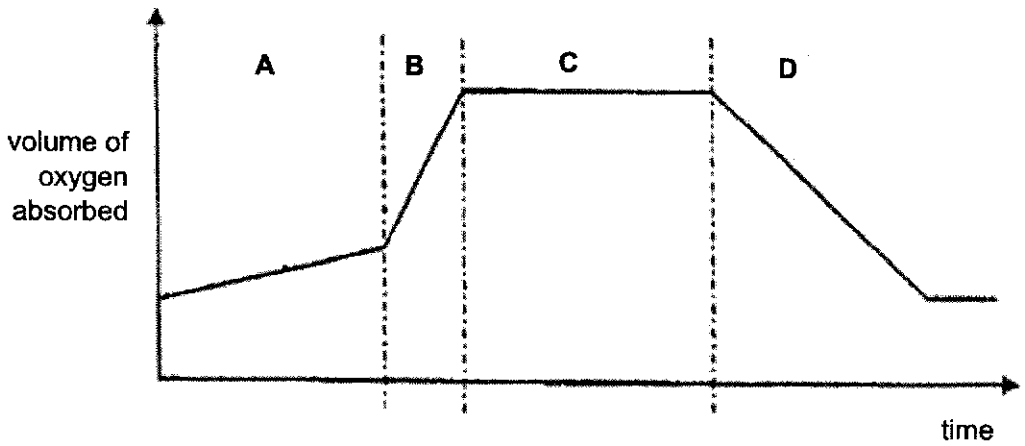


What happens to the diaphragm and internal intercostal muscles at stage X?

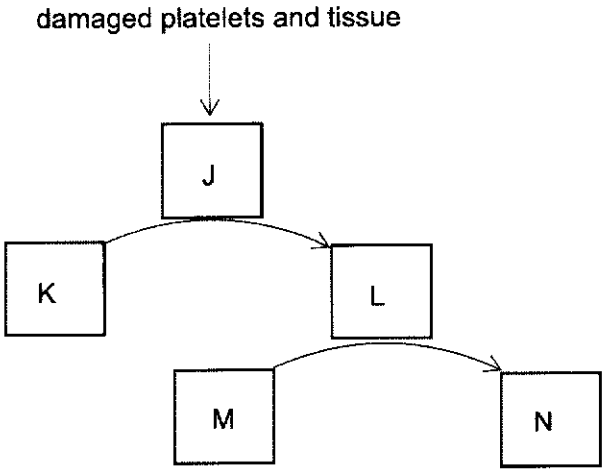
	diaphragm muscles	internal intercostal muscles
A	contract	contract
B	contract	relax
C	relax	contract
D	relax	relax

20 The graph shows the volume of oxygen absorbed by the blood in an athlete during fitness training.

At which period of time does the athlete respire both aerobically and anaerobically?



21 The diagram shows the events that occur during blood clotting.

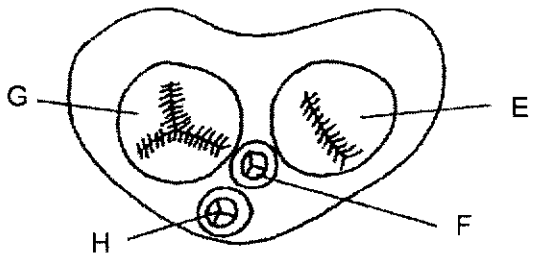


Which of the following correctly represents substances J, K, L and M?

	J	K	L	M
A	fibrinogen	fibrin	prothrombin	thrombin
B	prothrombin	thrombin	fibrinogen	fibrin
C	thrombokinase	prothrombin	thrombin	fibrinogen
D	thrombokinase	fibrinogen	fibrin	thrombin

22 The diagram shows the transverse section of a human heart.

Which valves will open during atrial contraction?



A E and F
B E and G
C F and G
D F and H

23 The table shows the blood groups of four people and the type of blood each received in a transfusion.

individual	blood groups	blood type received in transfusion
W	O	AB
X	B	A
Y	AB	B
Z	A	O

Which individuals are at risk of agglutination?

A W and X only
B W and Y only
C X and Z only
D X, Y and Z

24 Which component of faeces is an excretory waste product?

A bile pigment
B carbon dioxide
C cellulose
D water

Use the following information to answer questions **25** and **26**.

A group of research scientists conducted an experiment to test the reaction time of 10 volunteers. Each volunteer was blindfolded and touched on the left foot by an object. They were instructed to press a button as soon as they felt the touch. Each person did the test 30 times, and an average reaction time was calculated. The results are shown in the table.

individual	average reaction time /s
1	0.8
2	0.5
3	0.3
4	0.4
5	0.5
6	0.6
7	0.8
8	0.7
9	0.7
10	0.5

25 Which is the stimulus in this experiment?

A feeling the touch
B pressing the button
C the skin receptors on the toe
D the touch on the toe

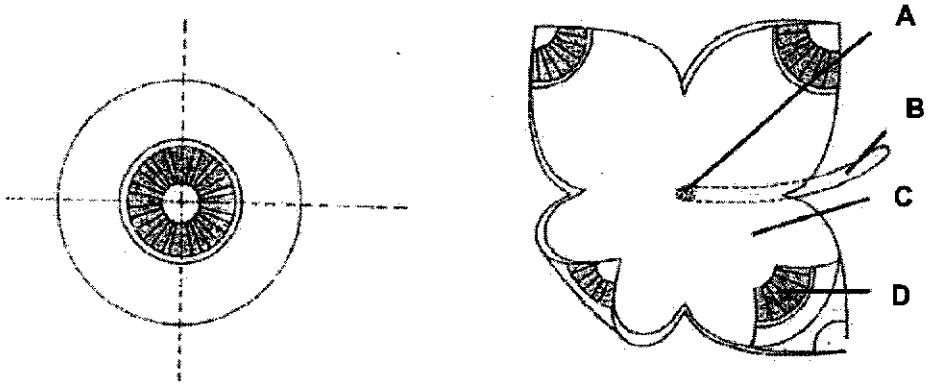
26 Which row best describes the response above?

	type of action	reason
A	reflex	presence of stimulus
B	reflex	response was quick and immediate
C	voluntary	touch was not painful
D	voluntary	response was consciously-controlled

27 Opticians often place drops of a chemical in a patient's eye. This chemical will cause the muscles in the patient's eye to contract to keep the pupil wide open. What muscles are these?

A ciliary muscles in the iris
B circular muscles in the iris
C longitudinal muscles in the pupil
D radial muscles in the iris

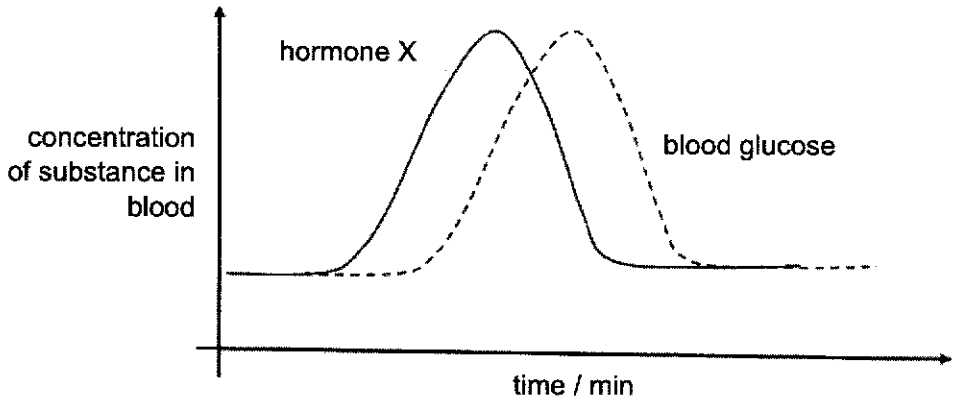
28 An eye is dissected along the dotted lines. The diagrams show the dissected eye.



Which of the following is correctly labelled?

A fovea
B suspensory ligament
C retina
D pupil

29 The graph shows the relationship between the level of hormone X and blood glucose within the human body.



Which of the following correctly identifies hormone X and explains its relationship to blood glucose?

	hormone X	explanation
A	adrenaline	stimulates conversion of glycogen into glucose
B	glucagon	stimulates the conversion of glycogen into glucose
C	insulin	stimulates conversion of glycogen into glucose
D	insulin	stimulates the conversion of glucose into glycogen

30 Which process does **not** require hormonal control?

A control of blood sugar levels
B decrease concentration of salts in blood plasma
C increase in heart rate
D muscular contraction

31 Which of the following statements is **not** true about homologous chromosomes?

A Homologous chromosomes contain the same number of genes.
B Homologous chromosomes have the same shape and length.
C Homologous chromosomes pair up during meiosis.
D Homologous chromosomes pair up during mitosis.

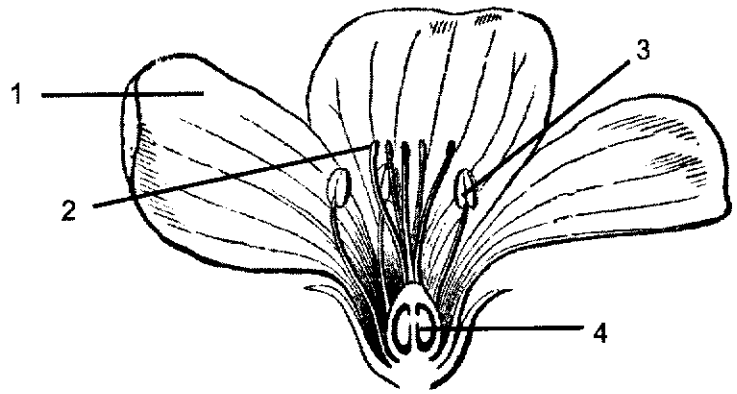
32 Some chemicals, used to prevent cancerous cells from growing, work by preventing the chromosomes from separating.

During which stage of the cell cycle would they act?

A anaphase **B** interphase **C** metaphase **D** prophase

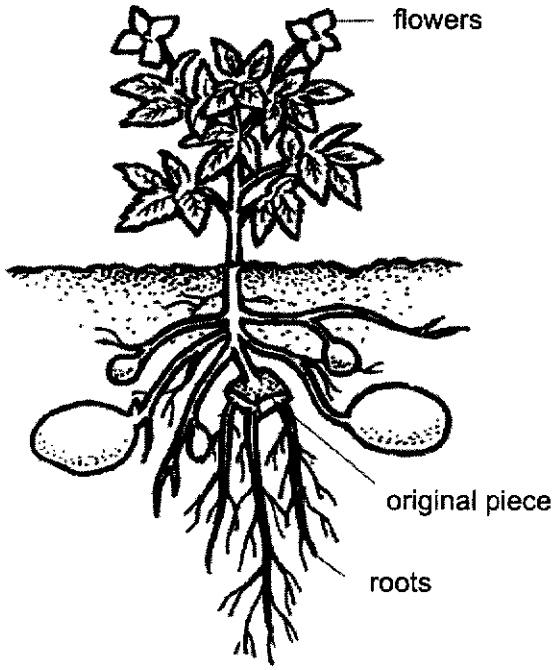
33 The diagram shows a flower.

Which two structures contain haploid cells?



A 1 and 2
B 2 and 3
C 2 and 4
D 3 and 4

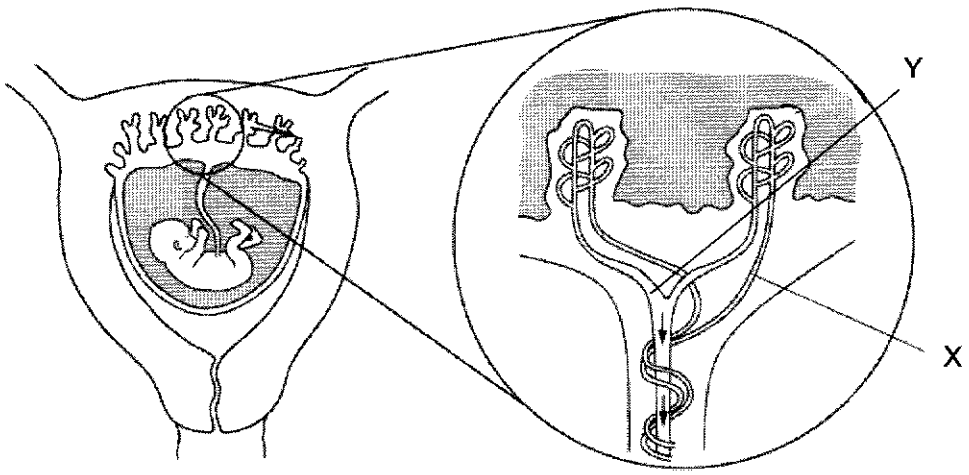
34 The diagram shows a potato plant reproducing by tubers.



Which statement is **not** true about the offspring of the potato plant?

A The offspring are genetically identical to the parent plant.
B The offspring are produced by a single parent.
C The offspring will be more resistant than their parent to disease.
D The offspring will have the same flower colour as the parent plant.

35 The diagram shows a fetus in the uterus.



Which substances will be at a higher concentration at Y than at X?

A carbon dioxide and glucose
B carbon dioxide and urea
C glucose and oxygen
D oxygen and urea

36 A medical officer needs to introduce a publicity campaign to prevent the spread of HIV.

What advice should be included?

A Avoid taking injections.
B Do not kiss other people.
C Have sexual intercourse with one partner only.
D Stay away from people who are have HIV.

37 In a species of mice, black fur and white fur are co-dominant alleles. Heterozygous mice develop grey fur. Two mice with grey fur mated to produce offspring.

What is the chance of their offspring developing grey fur?

A 25%
B 50%
C 75%
D 100%

38 Which substance is made from the genes in the cell?

A glucagon
B glucose
C glycerol
D glycogen

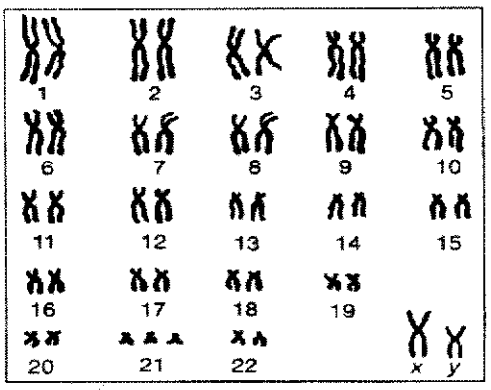
39 The table shows the percentage of nucleotides found in an octopus and a starfish.

source of DNA	adenine (%)	cytosine (%)	guanine (%)	thymine (%)
octopus	28	22	22	28
starfish	28	22	22	28

Which of the following best explains why these two animals differ greatly in their physical characteristics?

A The amino acids used to produce proteins are different in both animals.
B The bases found in the octopus is different from the bases in the DNA of starfish.
C The sequence of DNA are different in both animals and thus code for different proteins in their bodies.
D The two animals follow different base pairing rules in their DNA strands.

40 The diagram shows the karyotype of a human baby.



Which of the following can be inferred from the karyotype above?

A A mutation occurred in meiosis I during the formation of the egg that was fertilised and developed into the baby.
B This individual has Down's syndrome.
C This individual has sickle cell anaemia.
D This individual is a female.

End of paper

West Spring Secondary School

PRELIMINARY EXAMINATION 2020

BIOLOGY **6093/02**

SECONDARY 4 Express

Name _____ ( ) **Date** 15 September 2020

Class _____ **Duration** 1 hr 45 min

Additional Materials: Nil

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on the cover page.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A (50 Marks)
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
Show **all** relevant working.

Section B (30 Marks)
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.

Information for Candidates
You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.
The number of marks is given in [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
Section A	/50
Section B	/30
Total	/80

This document consists of **16** printed pages including the cover page.

Setter: Ms Dolly Khoo **[Turn over]**

Section A

Answer **all** the questions in the spaces provided.

1 Fig 1.1 shows part of the human respiratory system.

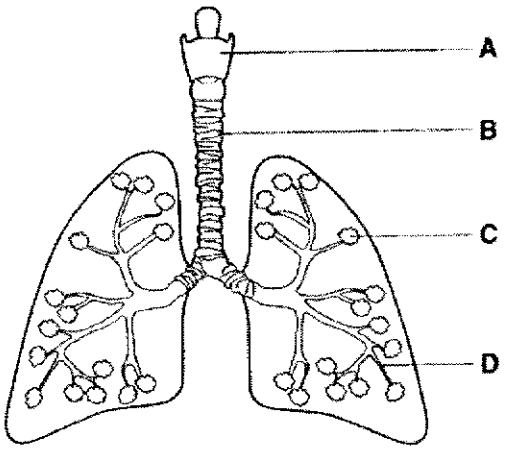


Fig. 1.1

(a) Label structures **A**, **B**, **C** and **D**.

A: ..... **B**: .....

C: ..... **D**: ..... [2]

(b) Describe and explain how **two** structural adaptations of structure **C** aid in the rapid transfer of oxygen on its surface.

.....

.....

.....

.....

.....

..... [4]

(c) Briefly describe **two** ways that smoking cigarettes may affect the respiratory system.

.....

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.....

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..... [2]

[Total: 8]

2 Fig. 2.1 shows how a blocked blood vessel in the heart can be by-passed using an artificial blood vessel.

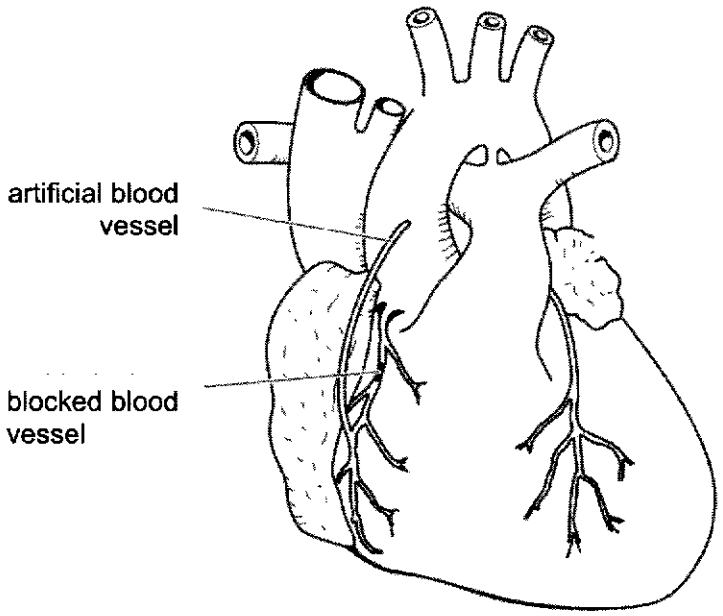

Fig 2.1

(a) Name the blocked blood vessel.

..... [1]

(b) Sometimes, instead of an artificial blood vessel being used for the graft, a vein is taken from elsewhere in the patient's body.

Suggest reasons why a vein might not be as suitable for carrying blood to the heart muscle.

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..... [2]

(c) Fig. 2.2 shows an alternative treatment method for the blocked blood vessel in **(a)** through the use of a stent.

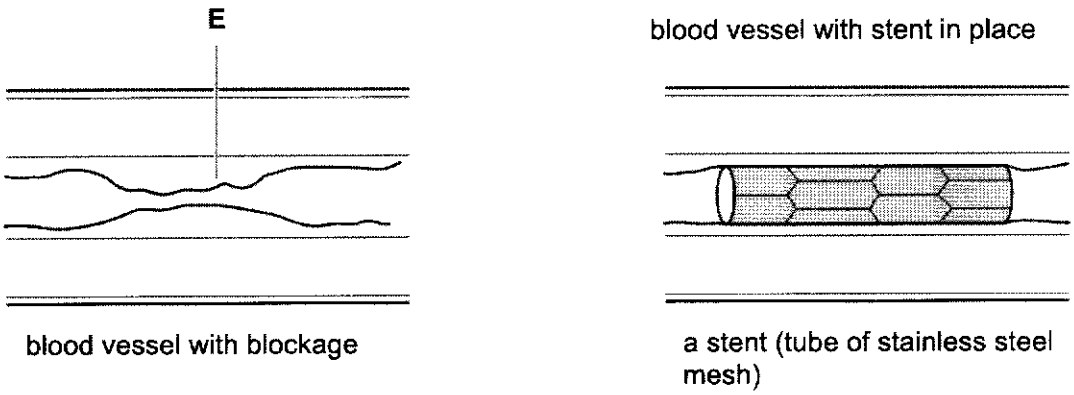

Fig 2.2

(i) Name **two** components of the material that can cause the blockage at **E**.

1 .....

2 ..... [2]

(ii) Suggest why patients are given 'anti-platelet' drugs before inserting the stent.

.....

..... [1]

[Total: 6]

3 **(a)** Explain how changes in a person's protein intake can affect the concentration of their urine.

.....

.....

.....

.....

.....

..... [3]

(b) An experiment was conducted to investigate the effect of diet on the rate of production of urine. Three students each took 1.5 dm^3 of a different drink **F**, **G** or **H**.

Fig. 3.1 shows the volume of urine released by each student over the next 150 minutes.

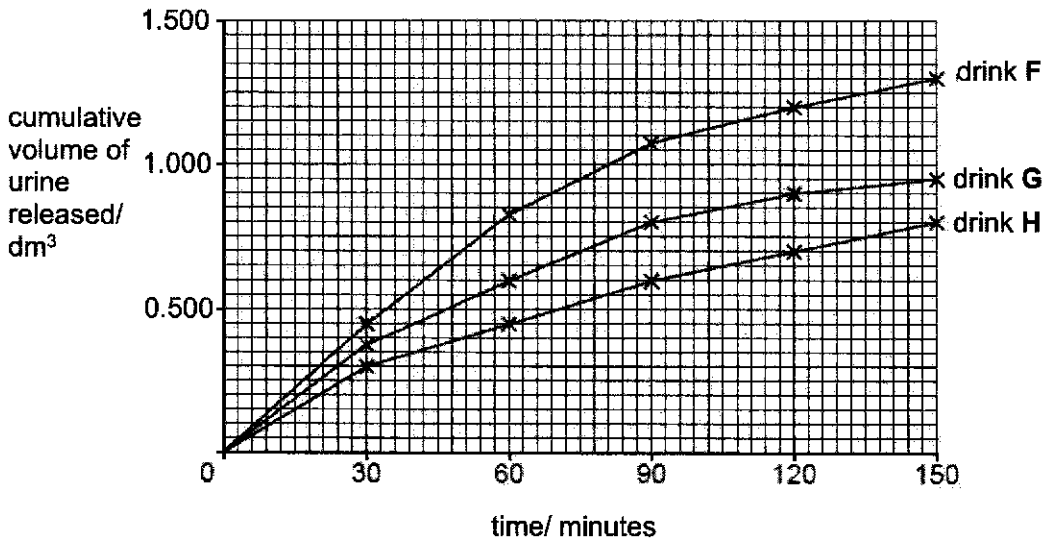

Fig. 3.1

Using information in Fig. 3.1, state and explain which of the three drinks should be avoided on a very hot day.

.....

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.....

.....

.....

.....

..... [4]

[Total: 7]

4 To control mosquito-borne diseases like dengue, chikungunya, and Zika fevers, a strain of genetically modified OX513A *Aedes aegypti* mosquitoes has been developed to reduce the population of wild mosquitoes. A recombinant DNA was created with genes extracted from the *Drosophila melanogaster* (Common fruit fly) and *Trichoplusia ni* (Cabbage looper moth). This recombinant DNA was inserted into the genome of the OX513A mosquito.

Information adapted from the following sources:
https://www.fda.gov/files/animal%20&%20veterinary/published/Oxitec-Mosquito---Draft-Environmental-Assessment.pdf
https://www.nature.com/articles/s41598-019-49660-6

(a) **(i)** The following shows part of the recombinant DNA sequence used in OX513A mosquitoes.

...TGATGTCTAGATTAGATAAAG...

State the complementary DNA sequence.

..... [1]

(ii) Explain why the OX513A mosquitoes are considered *transgenic organisms*.

.....

.....

.....

..... [2]

(b) The OX513A mosquitoes contain the dominant lethal gene which is absent in wild mosquitoes. When the OX513A mosquitoes mate with the wild mosquitoes, the offspring that contains the lethal gene will die in the larval stage.

(i) Using a genetic diagram, explain how the release of OX513A mosquitoes with homozygous dominant for the lethal gene can lead to a reduction in the population of wild mosquitoes.
Use 'D' to represent the dominant lethal allele and 'd' to represent the wild type allele.

[4]

(ii) Suggest **two** possible concerns that may arise from the use of these transgenic mosquitoes.

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..... [2]

[Total: 9]

5 **(a)** Fig. 5.1 shows the changes in the uterus during the menstrual cycle.

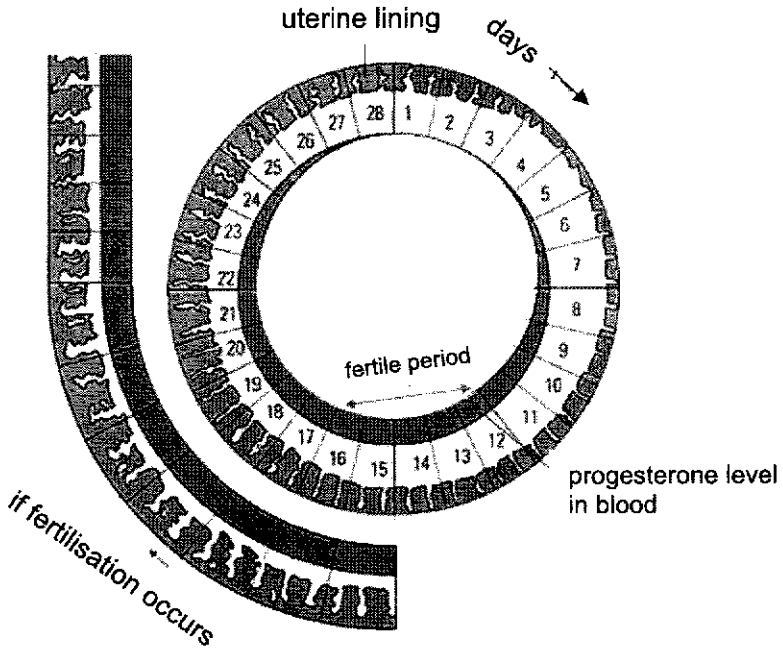

Fig. 5.1

(i) Using information from Fig. 5.1, describe how the thickness of the lining of the uterus changes during the 28 day menstrual cycle.

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..... [3]

(ii) Explain why day 12 to 16 is called the 'fertile period'.

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..... [2]

(iii) Using the information from Fig. 5.1, briefly describe what happens if fertilisation occurs.

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..... [1]

(b) Contrast the pollen grains and the ovules of a plant in terms of numbers and movement. Suggest reasons for the differences.

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..... [4]

[Total: 10]

6 (a) Describe the importance of meiosis in sexual reproduction.

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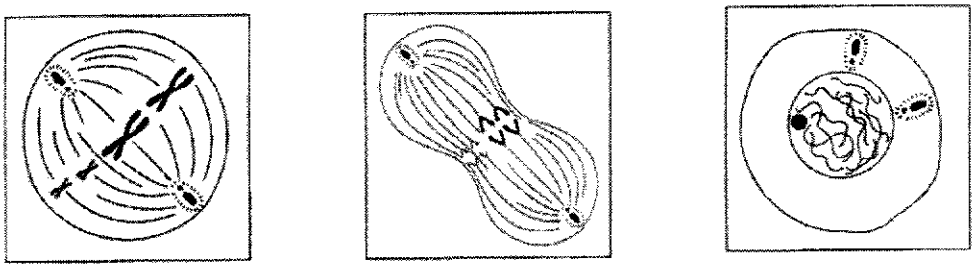
..... [3]

(b) Fig. 6.1 shows three stages in mitosis occurring in a root tip cell.



stage **J** stage **K** stage **L**

Fig. 6.1

Identify the stages of mitosis shown in Fig. 6.1 and explain your answers.

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..... [3]

[Total: 6]

7 Fig. 7.1 shows the inheritance of a coat colour in a family of rats, which is determined by two alleles. The dominant allele is represented by **B** while the recessive allele is represented by **b**.

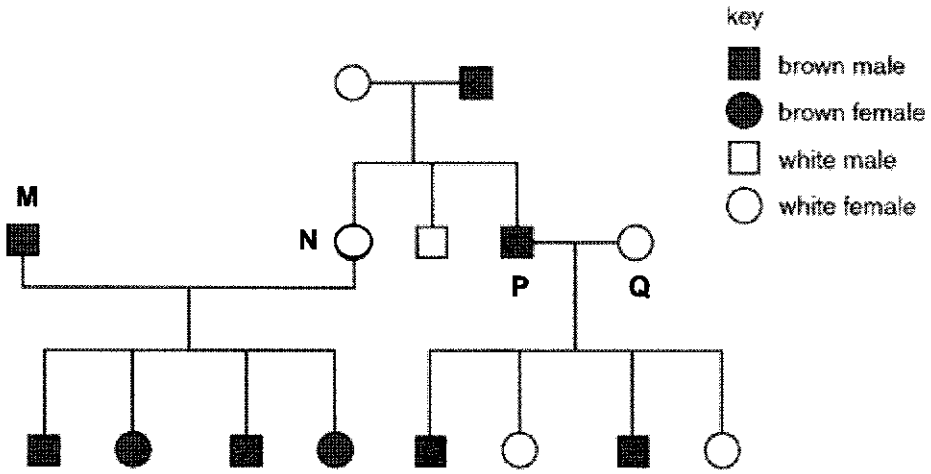

Fig. 7.1

(a) Determine the dominant phenotype. Explain your answer.

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..... [2]

(b) Determine the genotype of **P**. Explain your answer.

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..... [2]

[Total: 4]

Section B

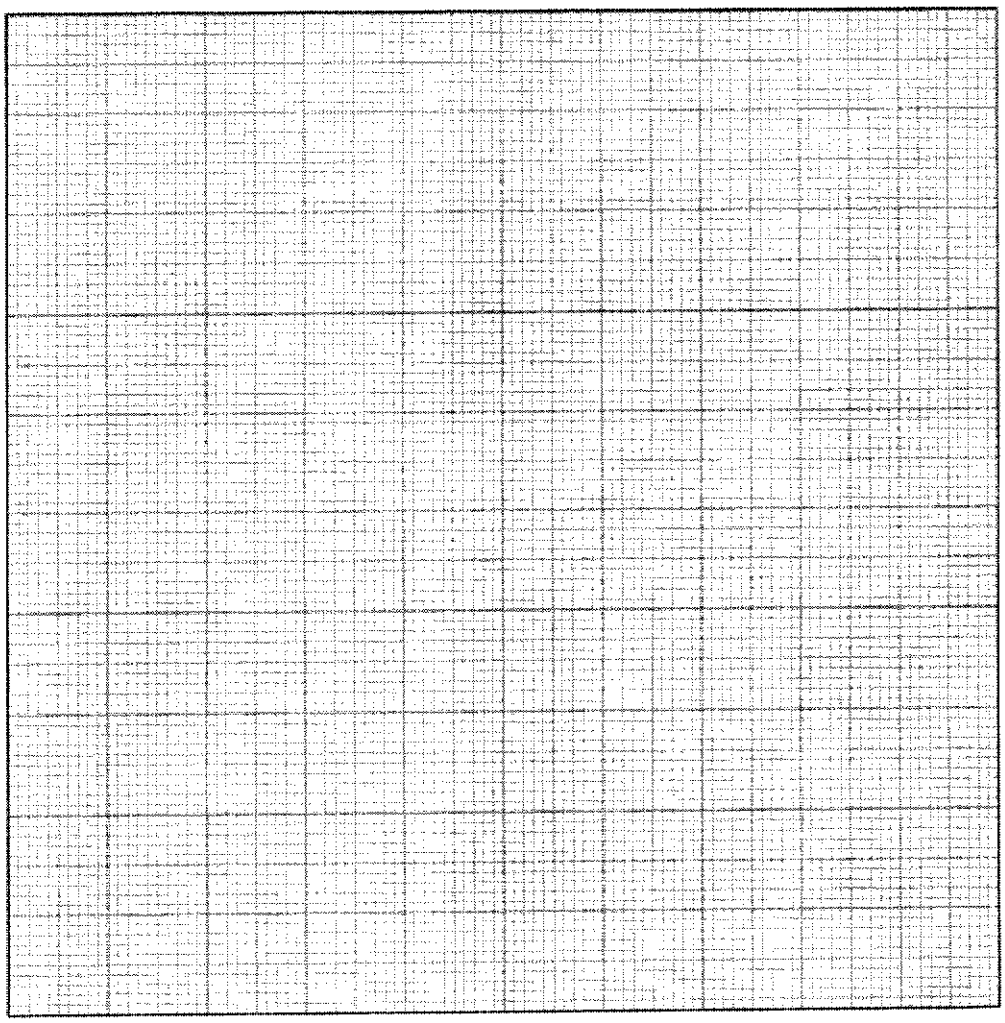
Answer **all** questions.

8 A person exercises vigorously for a period of time. Table 8.1 shows the changes in the rate of heat production and heat loss throughout the period before, during and after the exercise.

Table 8.1

time / min	rate of heat production / arbitrary units	rate of heat loss / arbitrary units
0	0	0
10	175	140
20	320	255
30	224	192
40	105	130
50	50	75

(a) On the same grid, plot the data for the rate of heat production and the rate of heat loss.



[5]

(b) State the period of time in which there is a decrease in body temperature. Explain your answer.

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..... [2]

(c) During exercise, the amount of heat lost from the body increases rapidly.

Describe and explain the mechanisms by which the body increases its heat loss.

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..... [3]

[Total: 10]

9 A young boy is stung on the hand by a wasp. He withdraws his hand immediately and then yells out in pain, after which he looks at the source of the pain.

(a) Explain how the nervous system brings about this response of withdrawal of hand and yelling.

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..... [6]

(b) The boy also brought his hand closer to his eyes to better see where he was stung.

Describe what happens in his eyes to enable him to see the small wound on his hand.

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..... [4]

[Total: 10]

10 Fig. 10.1 shows changes in the relative concentrations of four substances in the blood plasma. These changes happen when the blood flows through the renal artery, the capillaries in the kidney and the renal vein.

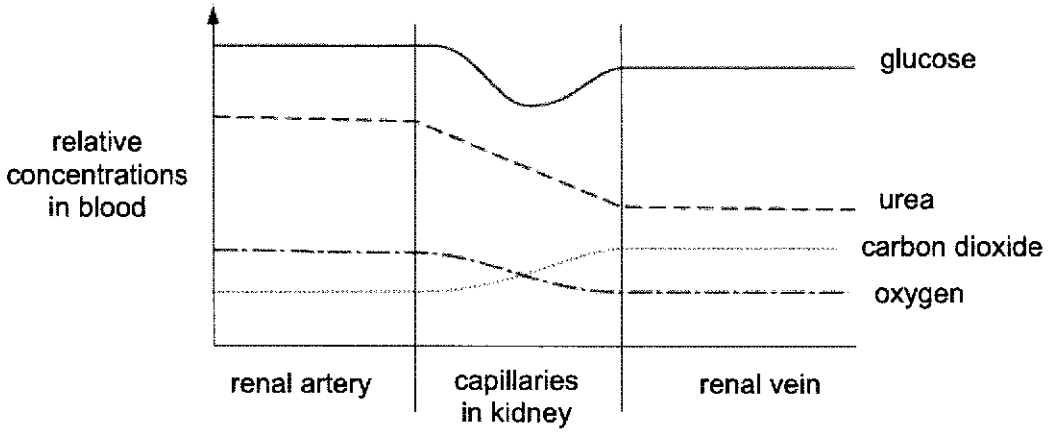

Fig. 10.1

(a) Describe and explain the changes in glucose concentration shown in Fig.10.1.

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..... [5]

(b) Explain the differences in the concentration of oxygen and carbon dioxide gas.

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..... [2]

(c) Explain the difference in the concentration of urea in the renal vein and renal artery.

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.....[3]

[Total: 10]

END OF PAPER

Sec 4 Biology Prelims 2020

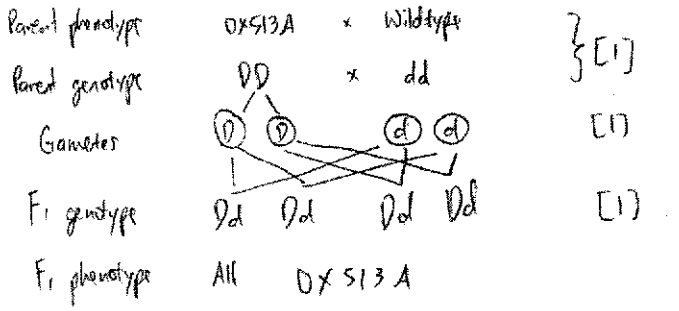
Suggested Mark scheme

P1: MCQ

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

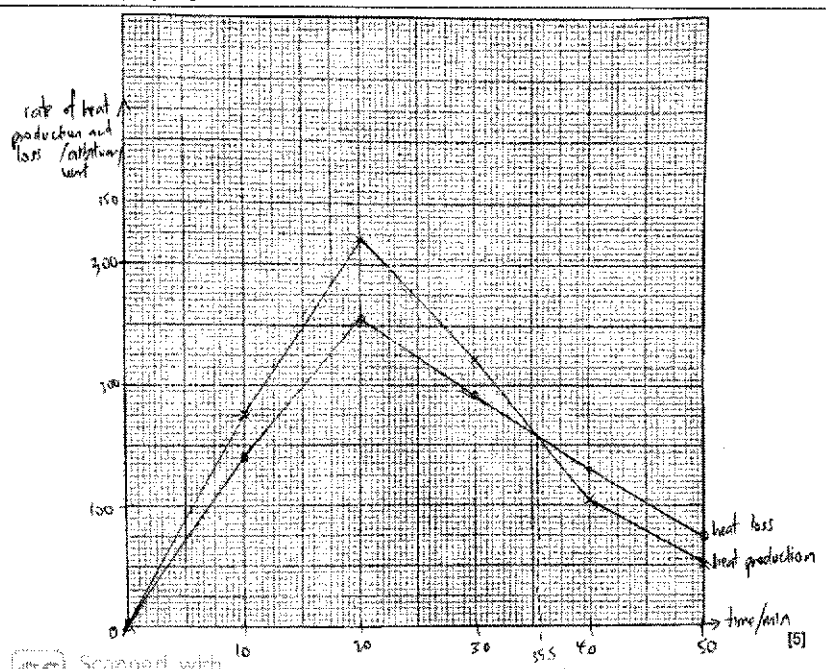
P2: Section A

	Suggested Mark scheme	Remarks
1(a)	A: larynx B: trachea C: alveoli D: bronchioles	
(b)	Wall of alveolus is one cell thick. [1]This ensures faster rate of diffusion of oxygen through it. [1] A thin film of moisture covers the surface of alveolus. [1] This allows oxygen to dissolve in it. [1] The walls of the alveoli are richly supplied with blood capillaries. [1] The flow of blood maintains a steeper concentration gradient of oxygen and ensure faster rate of diffusion. [1] Any 2	
(c)	Tar in smoke is carcinogenic and results in uncontrolled cell division, leading to cancer. [1] Tar paralyses the cilia lining in air passages and reduces the efficiency of gaseous exchange [1] Irritants paralyses the cilia lining in air passages. [1] It increases the risk of chronic bronchitis. [1] The violent coughing caused by irritants can also lead to emphysema / alveolar partition walls break down and the lung loses its elasticity. [1] Any 2	Mention at least once that tar/irritants are found in cigarette smoke
2 (a)	coronary artery [1]	
(b)	veins have thinner muscle layer and are unable to withstand the high pressure of blood ; [1] the presence of valves in the veins will interrupt the flow of the blood in the coronary arteries [1]	
(c)	(i) fat / cholesterol / blood cells / clotted blood	

	Any 2 (ii) Drug prevents clotting of blood. [1]	
3(a)	protein digested to amino acids [1] deamination of excess amino acids to urea [1] higher concentration of urea in urine [1] or protein digested to amino acids [1] there is less deamination of amino acids to urea [1] lower concentration of urea in urine [1]	
(b)	Drink F [1] Results in greatest volume of urine released at 1.30dm^3 after 150min. [1] In a hot day, sweating allows body to lose heat. [1] Drinking F may worsen dehydration/ reduces body's ability to cool down; OWTTE; [1]	
4(a)	(i) ACT ACA GAT CTA ATC TAT TTC (ii) The genes from other organisms like the common fruit fly and cabbage looper were transferred/inserted to the OX513A mosquito genes. 1m for citing at least 1 source of transgene. 1m for definition of transgenic organism.	
(b)	(i) Parental genotype = DD x dd  [1] [1] [1] All offspring will contain the lethal gene, hence will die at larval stage. [1] Students must include all the following labels and details Statement: All offspring are heterozygous dominant Dd and will die. [1] (ii) Disrupt the balance of the ecosystem as mosquitoes is a food source for other animals. /loss in biodiversity Transfer of transgene into wild populations of mosquitoes.	

	Ethical issues on exploiting animals for the experiment. May lead to mutation and creation of resistant mosquitoes. Technology only accessible to richer nations, depriving the poorer of the technology. Any 2	
5(a)(i)	From days 1-4, progesterone levels are low, causing the start of menstruation / the uterine lining is shed and uterine lining thickness decreases. From days 5-24, the uterine lining thickens as progesterone levels increase.[1] Days 22 to 28, the uterine lining thickness starts to decrease as the progesterone levels fall. [1]	
(ii)	During this period, sexual intercourse can lead to fertilisation [1]. The sperms can survive 2-3 days in the female reproductive system while the egg can survive for 2-3 days after ovulation. [1]	
(iii)	Uterine lining remains thick as the progesterone levels remain high.	
(b)	Pollen grains are produced in large numbers compared to ovules which is produced in small numbers in the ovary. [1] Pollen grains are needed to be transferred from the anther of a flower to the stigma of another flower by external agents so large number of pollen grains will increase the chances of pollination of flowers. [1] OWTTE Female gamete in the ovule does not able to move while the male gamete moves towards the ovule. [1] A pollen tube grows through the stigma and style to the ovules in the ovary, releasing/delivering the male gamete into the ovule. [1]	
6(a)	1. Meiosis produces gametes which contain a haploid / half the number of chromosomes as compared to somatic cells. 2. This prevents doubling of chromosomes during fertilisation / maintains chromosome number in future generations. 3. Meiosis introduces genetic variation in gametes during prophase I (crossing over) and metaphase I (independent assortment).	
(b)	Stage J is metaphase, chromosomes have lined up along the equator / metaphase plate. [1] Stage K is anaphase, sister chromatids / sister chromosomes are pulled apart to opposite ends of the cell. [1] Stage L is prophase, chromosomes have begun to condense / irregularly arranged in cell / Nuclear envelop has begun to break down/disintegrated. [1] Rej. Interphase (not part of mitosis)	
7(a)	Brown coat. [1] When individual M, a brown rat mates with N, a white rat, all the offspring are brown in colour. This suggest that brown coat is a dominant allele.	
(b)	Bb. When brown individual P mates with white Q, which is homozygous recessive, some of the offspring has white coat. This suggest that individual P has passed down a recessive allele, hence genotype is Bb.	

Section C

	Suggested mark scheme	Remarks
8(a)	 Scale [1] Line – connect points for line for heat production and loss [1] Accept curve. Axis – x-axis time/min, y-axis rate of heat production/loss / arbitrary units [1] Data points for heat loss [1] and heat production [1] clearly labelled	
(b)	35/36 min to 50 min The rate of heat loss is higher than the rate of heat production/ rate of heat production is lower than rate of heat loss	
(c)	Vasodilation of skin arterioles to increase heat loss near the skin via conduction, convection and radiation. [1] Sweat glands more active to produce more sweat, removing latent heat as water in sweat evaporates. [1] Hair erector muscles relax, ensure that less heat is trapped in the layer of air. [1]	
9(a)	Receptors in the skin is stimulated and nerve impulses are produced [1] The nerve impulses travel along the sensory neurone [1] In the spinal cord, the nerve impulses are transmitted first across a synapse to the relay neurone [1] and then across another synapse to the motor neurone and then to the effector [1] The effector muscles then contracts and causes the hand to withdraw suddenly [1] At the same time, impulses from the relay neurone are transmitted to the brain. [1] The impulses are interpreted by the brain and pain is perceived,[1] causing the person to yell in pain. Any 6	

(b)	As he looked at a near object, ciliary muscles contract, relaxing their pull on suspensory ligaments [1]. Suspensory ligaments slacken, relaxing their pull on the lens [1]. Lens becomes thicker/more convex, decreasing the focal length to focus on the wound [1]. The light rays focus on the photoreceptors of the retina [1]. The stimulus is detected and impulses are transmitted to the brain for interpretation.	
10 (a)	There is a decrease/drop in glucose concentration at the blood capillaries in the kidney; [1] As glucose molecules are forced out of the blood capillaries under high blood pressure into the bowman's capsule during the ultrafiltration; [1] Then concentration of glucose in the blood rises; [1] as glucose is selectively reabsorbed from the filtrate into blood; [1] Final blood glucose concentration lower in the renal vein than renal artery [1] as some for respiration in the kidney cells to release energy / for active transport at the kidney tubules. [1] Any 5	
(b)	There is a decrease in oxygen concentration, but a rise in carbon dioxide concentration. [1] Aerobic respiration taking place in cells in kidney, as oxygen diffuses from the red blood cells to the respiring cells, while carbon dioxide produced diffused back to the blood; [1]	
(c)	Blood leaving the renal vein contains lesser urea than blood entering the kidneys transported by the renal artery; [1] Smaller molecules of urea in the blood plasma is forced out of blood capillaries at the glomerulus during ultrafiltration; [1] Urea is then excreted by the kidney; [1] Not all urea is removed from the blood by the kidney / not reabsorbed from the blood into the nephron; [1] Any 3	