O Level Preliminary Examination 2016
Secondary 4 Express

BIOLOGY **5158/01**

Paper 1 **1 hour**

Question Booklet

Additional Material: Optical Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the Optical Answer Sheet.

You are **not** required to hand in this booklet.

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 Optical Answer Sheet.

Read the instructions on the Optical Answer Sheet very carefully.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

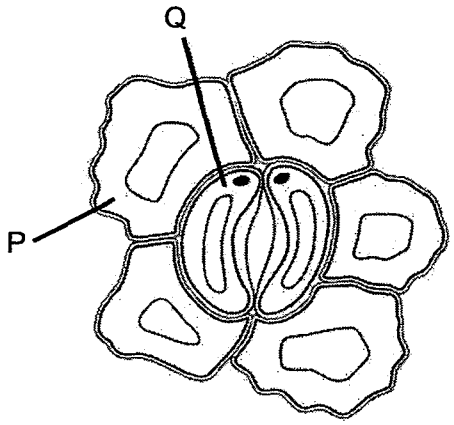
Any rough working should be done in this booklet.

Attempt ALL questions in this section.
Choose the most appropriate answer and shade the corresponding letter on the separate answer sheet provided.

1 The maximum size of a cell is limited by

A its need for enough surface area for exchange with its environment.
B the number of organelles that can be packed inside.
C the materials needed to build it.
D the amount of flexibility it needs to be able to move.

2 The diagram shows cells in the epidermis of a leaf.



To complete the diagram, which structural features should be added to the cells P and Q?

	P		Q	
	Chloroplasts	Nucleus	Chloroplasts	Nucleus
A	√	√	×	×
B	√	×	√	√
C	×	√	√	×
D	×	×	√	√

3 The numbered list shows molecules found in a cell.

I glucose, oxygen, fats
II cellulose, catalase, water
III haemoglobin, oxygen, glycogen

Which of the numbered list has/have one or more molecules containing nitrogen atoms?

A I and II only
B II and III only
C I only
D II only

4 During the production of apple juice, enzymes are used to break down the components of the cell walls. Which carbohydrate will be produced by this hydrolysis?

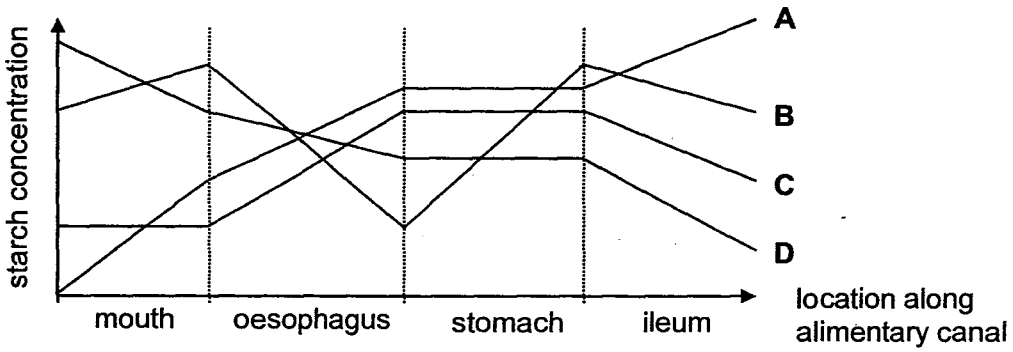
A fructose
B glucose
C starch
D cellulose

5 Glucose yields 17.0 kJ of energy for each gram of glucose.
One tablespoon of glucose contains 25 g.

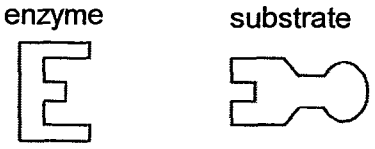
Which of the following activities, when carried out for 20 minutes, uses the same amount of energy as is contained in 2 tablespoons of glucose?

	Activity	Energy used (kJ/min)
A	Playing football	37.5
B	Walking upstairs	38.5
C	Rowing	40.5
D	Running	42.5

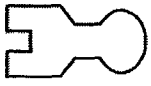
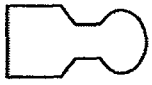
6 Which one of the graphs represents the activity of amylase in starch digestion?



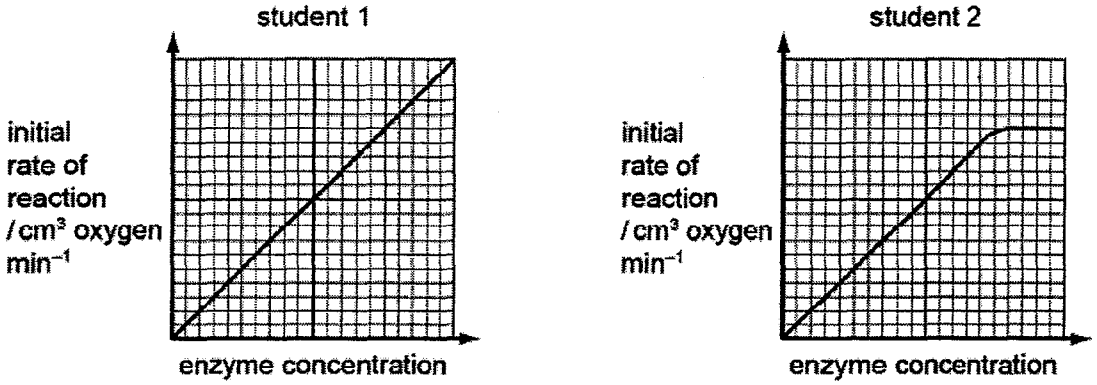
7 The diagram represents the "lock and key" mechanism of an enzyme that works best at pH 2.



Which option shows the enzyme and its substrate if it is placed in the duodenum?

	enzyme	substrate
A		
B		
C		
D		

8 Catalase is an enzyme that catalyses the conversion of hydrogen peroxide into water and oxygen.
Two students investigated the effect of enzyme concentration on the rate of reaction of the enzyme catalase. The students predicted their results would show the same trend.
The graphs show the rates obtained by each student.



Which statement explains the different trend shown by student 2's results?

A Student 2 included a substance that slows down the enzyme.
B Student 2 performed the investigation at a higher temperature.
C Student 2 performed the investigation at pH 6 compared to pH 8.
D Student 2 used a lower concentration of substrate in the investigation.

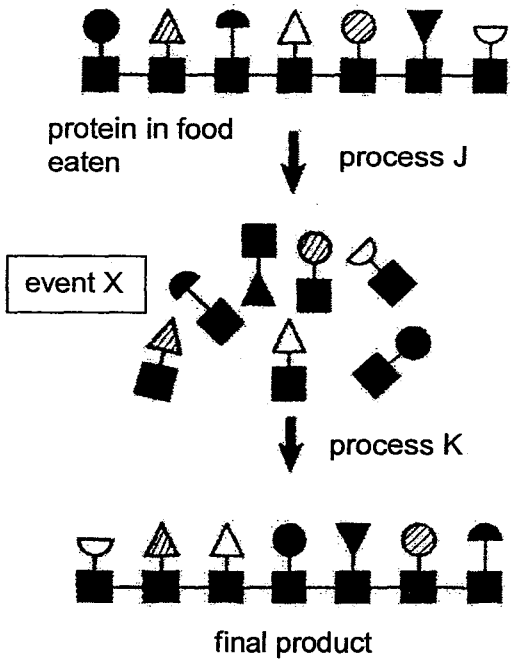
9 Euglena, a single-cell organism has contractile vacuoles for the removal of excess water from its system. The table below shows the average time taken by a single contractile vacuole to fill up or empty when the organism was submerged in three different liquids R, S and T.

Bathing liquid	Time / s
R	189
S	28
T	62

Which of the following correctly identifies the three liquids?

	R	S	T
A	0.3% salt solution	0.1% salt solution	Water
B	Water	0.3% salt solution	0.1% salt solution
C	0.1% salt solution	Water	0.3% salt solution
D	0.3% salt solution	Water	0.1% salt solution

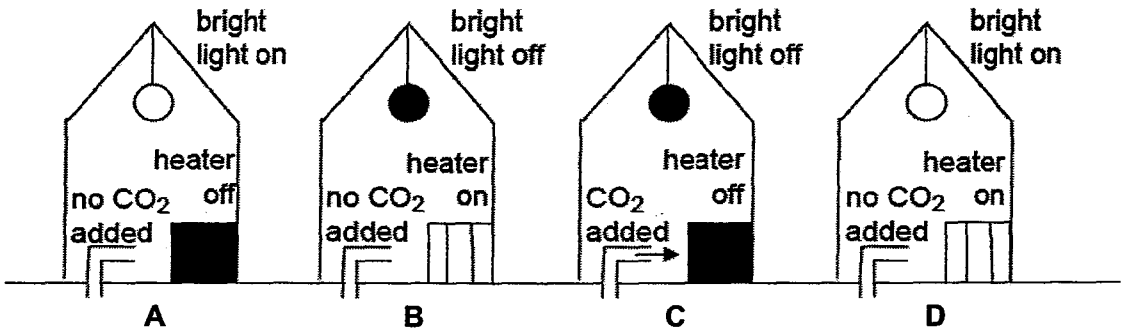
10 Study the figure below.



Which of the following best describes the processes and event illustrated?

	Process J	Event X	Process K
A	Ingestion	Condensation	Assimilation
B	Ingestion	Digestion	Absorption
C	Digestion	Absorption	Assimilation
D	Digestion	Condensation	Hydrolysis

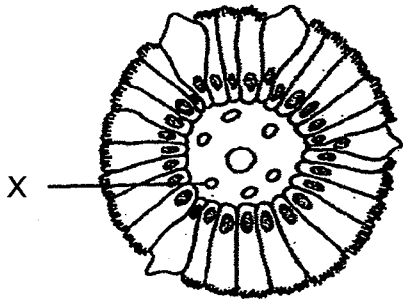
11 The diagram shows four greenhouses set up to grow tomato plants. (The plants are not shown).
In which greenhouse is carbon dioxide concentration definitely the factor limiting photosynthesis?



12 When young leaves are being formed on a plant, large quantities of mineral ions are needed. Where and when is the movement of mineral ions in the plant the greatest?

A Root hair cells on a cool cloudy day
B Xylem vessels on a warm sunny day.
C Companion cells on a hot sunny day
D Sieve tube elements during a warm night

Questions 13 and 14 refer to the diagram below, which shows the transverse section of an intestinal villus.



13 What is/are the function(s) of structure X?

I transport fat
II transport glucose and amino acids
III transport oxygen

A II only
B I and III only
C II and III only
D I, II and III

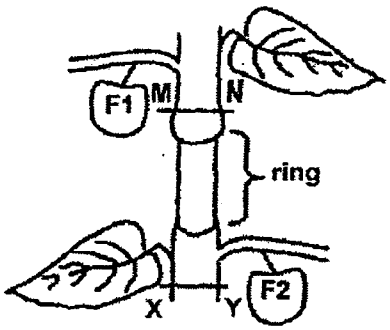
14 Where does the fluid in X come from and towards which organ would the fluid circulate to?

	Vessel that fluid in X came from	Organ that fluid in X will circulate to
A	Hepatic artery	Liver
B	Aorta	Liver
C	Hepatic portal vein	Heart
D	Lacteal	Heart

15 A xerophyte is a plant that can survive in areas where water is scarce. Which of the following is **not** an adaptation of a xerophyte?

A extensive roots
B high stomata density
C hairy leaves
D spiny leaves

16 The diagram below shows a ring of bark being removed from a leafy bark between line MN and XY.



What would be the difference in the development of the fruits labelled F1 and F2 several days after the ring has been cut?

A There was no difference in size between F1 and F2.
B F2 became smaller because no more water was transported to it.
C F1 became bigger because it could receive enough water.
D F2 became bigger because it was nearer the root region so more water was transported to it.

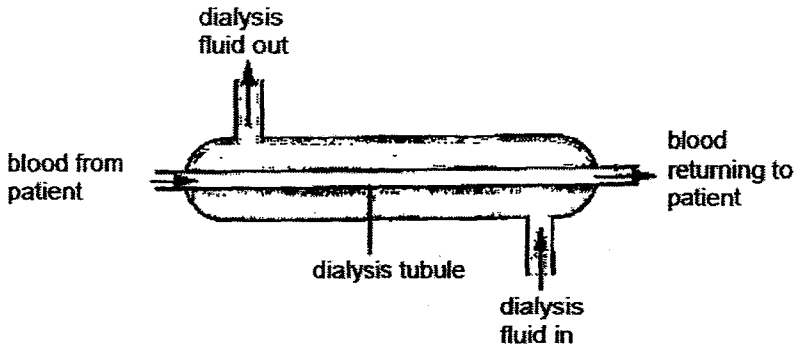
17 The table shows changes in the concentrations of blood components as the blood flows through an organ.

Blood component	Change in concentration
Carbon dioxide	Increased
Glucose	Increased
Oxygen	Reduced
Urea	Increased

Which organ has the blood passed through?

A brain
B kidney
C liver
D stomach

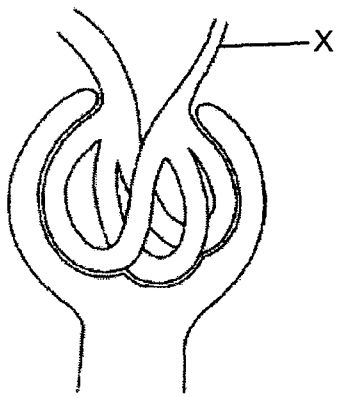
18 The diagram shows a kidney dialysis machine.



Which of the following modification is able to enhance the efficiency of the machine?

A Decrease the length of the dialysis tubule.
B Increase the thickness of the dialysis tubule.
C Increase the speed of blood flow in the machine.
D Increase the speed of dialysis fluid flow in the machine.

19 The diagram shows a glomerulus and Bowman's capsule of a mammalian nephron.

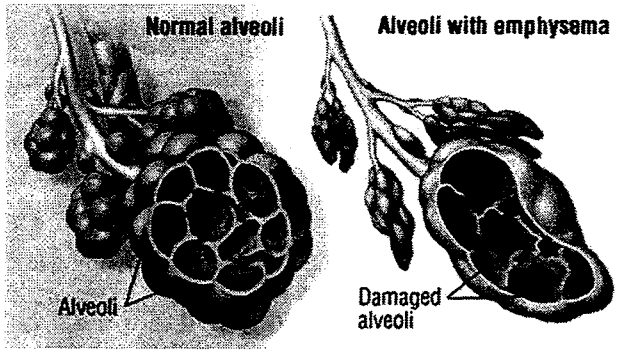


What happens if the diameter of the blood vessel X is enlarged?

A More sodium will appear in the urine.
B Less glucose will appear in the urine.
C Water reabsorption will be decreased.
D The rate of urine production will be reduced.

20 Which chemical(s) in tobacco smoke cause(s) the condition shown below?

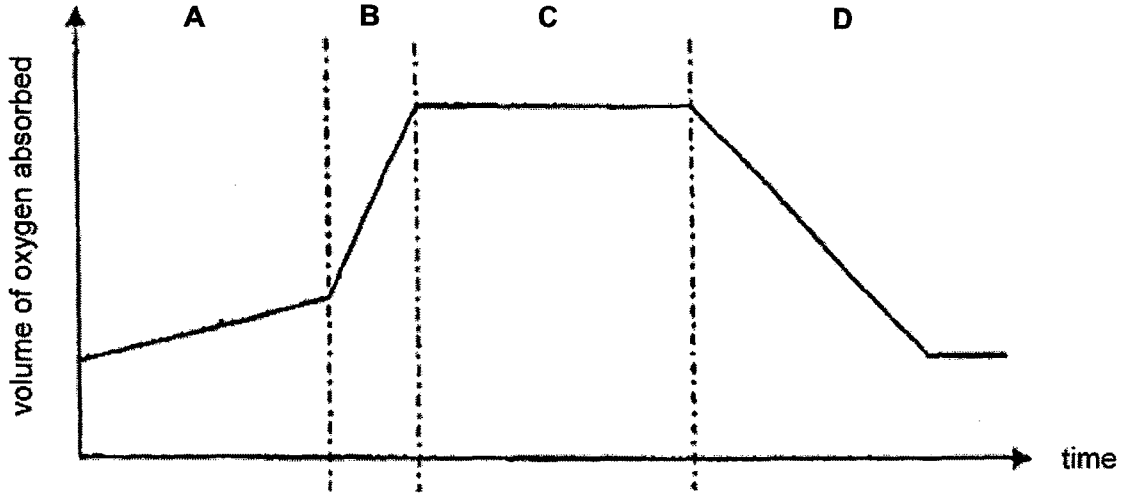
I	Carbon monoxide	II	Tar
III	Nicotine	IV	Irritants



A II and IV only
B III and IV only
C II only
D all of the above

21 The graph shows the volume of oxygen absorbed by the blood as a student plays a game of tennis.

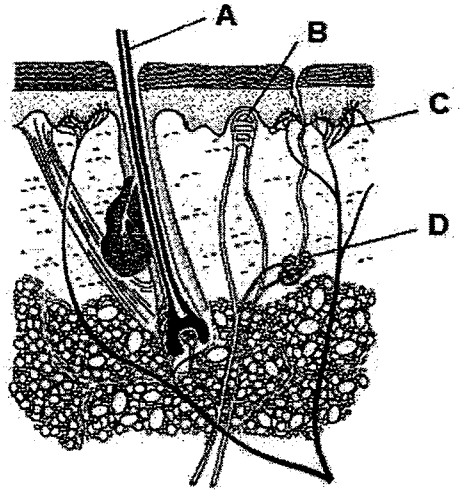
At which period of time does the student respire both aerobically and anaerobically?



22 A student touched a live electrical wire with his hand and his fist immediately closed. Which of the following best explains this?

A Electricity removed the myelin sheath around his neurones and caused his hand muscles to contract.
B His pain receptors were stimulated and his fist closing was the result of a reflex action.
C Motor neurones were stimulated by the electricity and caused the contraction of his hand muscles.
D The electricity stimulated his heat receptors and the dilation of skin arterioles, causing his fist to close.

23 The diagram shows a section through the skin.



Which structure detects changes in skin temperature?

24 Which of the following is a difference between insulin and adrenaline?

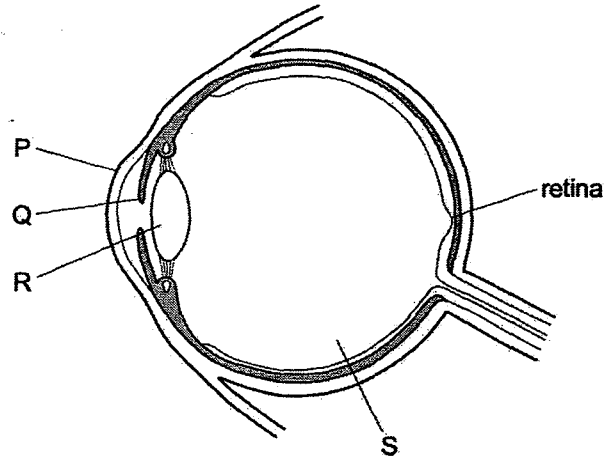
A Insulin is a protein while adrenaline is a steroid.
B Insulin controls blood glucose concentrations while adrenaline is involved in temperature regulation.
C Insulin is secreted in response to a chemical stimulus while the secretion of adrenaline is controlled by the nervous system.
D Insulin is secreted by the Islets of Langerhans in the pancreas while adrenaline is secreted by the kidneys.

25 Which precautions should be taken to prevent the spread of HIV?

I Disinfecting shared stationery
II Medical staff wearing gloves when treating patients
III Not sharing food or cutlery with another person
IV Prevent exchange of body fluids by being in direct contact
V Treatment of blood products to destroy the virus

A I, II and III
B I, III and IV
C II, III and V
D II, IV and V

26 The diagram shows a section through the eye.



Which structure(s) focus light rays onto the retina?

A R only
B P and R
C Q and R
D P, R and S

27 A man diagnosed with testicular cancer had both his testes surgically removed. Which of the descriptions below are likely consequences of the surgery?

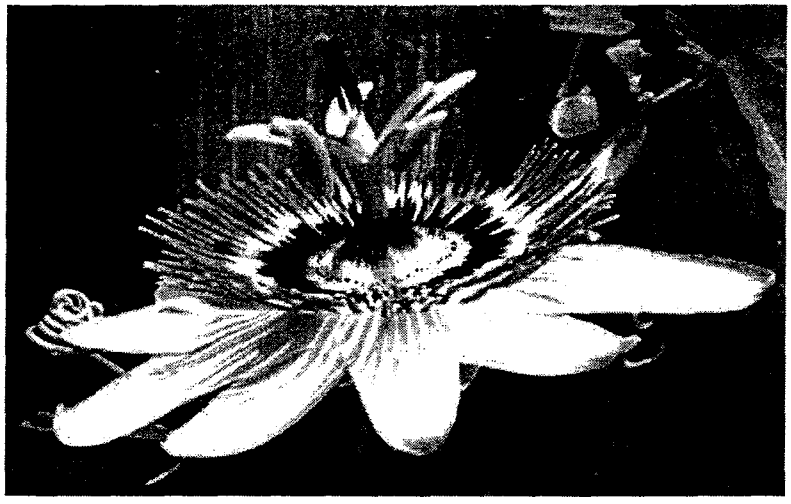
I Absence of meiosis
II Absence of ejaculation
III Decreased level of testosterone in his blood

A I and II only
B I and III only
C II and III only
D All of the above

28 Which of the following statements is true about a woman's fertile period?

A Her fertile period starts only after ovulation has taken place as an ovum has to be present for fertilisation to take place.
B Her fertile period starts a few days before ovulation as sperms are able to survive for a few days.
C Her fertile period starts immediately after menstruation has taken place as a new ovum will start to develop.
D Her fertile period starts a few days before ovulation as the ovum released from the previous cycle will still be intact

29 The photograph below shows the side view of a Passion flower (Passiflora sp.).



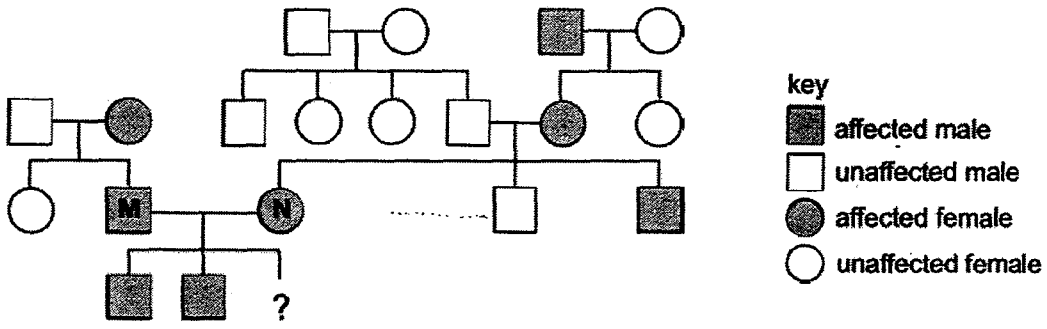
What can be deduced about the Passion flower from the photograph?

A It is likely cross-pollinated.
B It is likely self-pollinated.
C It produces a sweet scent.
D It produces plenty of pollen grains.

30 A plant has 22 chromosomes in its leaf cells. The plant reproduces both sexually and asexually. What is the correct number of chromosomes in the gametes and in cells used for asexual reproduction?

	Number of chromosomes	
	Gametes	Cells used for asexual reproduction
A	11	22
B	11	11
C	22	11
D	22	22

31 The pedigree diagram below shows the inheritance of a dominant mutant allele for a heart disease due to hypercholesterolaemia. Children who inherit the mutant allele from both parents rarely survive beyond puberty.



What is the probability that M and N's third child will be unaffected?

A 0
B 0.25
C 0.5
D 0.75

32 A boy of blood group O has a mother with blood group A and a father with blood group B. If his parents have non-identical twins, what is the percentage that **both** twins will have blood group O?

A 50%
B 25%
C 12.5%
D 6.25%

33 The list gives some of the stages involved in gamete and zygote formation.

I prophase I of meiosis
II prophase II of meiosis
III metaphase I of meiosis
IV fertilisation

During which stages do events occur that increase genetic variation in the zygote?

A II and III only
B II and IV only
C I, II and III
D I, III and IV

34 A short piece of double-stranded DNA, 19 base pairs long, was analysed to find the number of nucleotide bases in each of the polynucleotide strands. Some of the results are shown below.

	Number of nucleotide bases			
	A	C	G	T
Strand 1		**?**		4
Strand 2		7		5

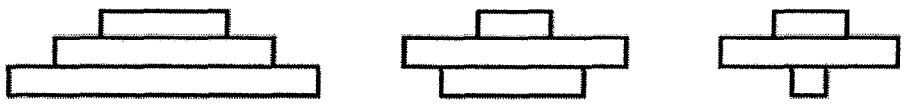
How many nucleotides containing C were present in strand 1?

A 2
B 3
C 5
D 7

35 How does energy flow through ecosystems?

	Energy enters as	Energy is transferred as	Energy leaves as
A	Chemical	Chemical	Heat
B	Chemical	Heat	Chemical
C	Light	Chemical	Heat
D	Light	Heat	Chemical

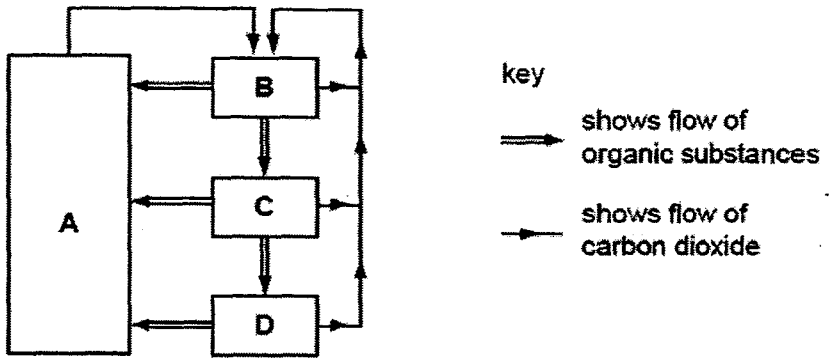
36 Three pyramids of numbers are shown below.



Which of the following food chains **cannot** be represented by any of these pyramids?

A oak tree ⟶ caterpillar ⟶ bird
B grass plants ⟶ rabbit ⟶ fox
C algae ⟶ pond snail ⟶ nematode parasites
D phytoplankton ⟶ zooplankton ⟶ herring

37 The diagram represents the flow of substances within a balanced ecosystem. The boxes are various trophic levels.

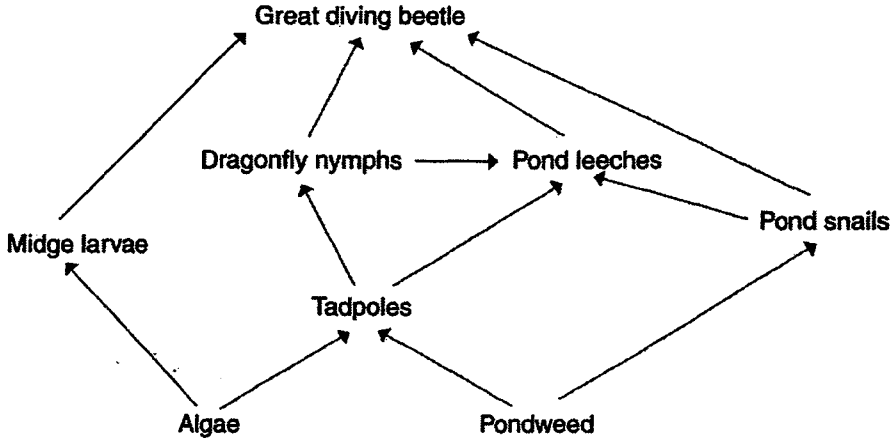


Which box, **A**, **B**, **C** or **D**, represents producers?

38 Which statement about carbon sinks is correct?

A All carbon sinks are fossil fuels.
B The oceans are important carbon sinks.
C Carbon sinks emit more carbon dioxide than they absorb.
D Carbon sinks remove carbon dioxide permanently from the atmosphere

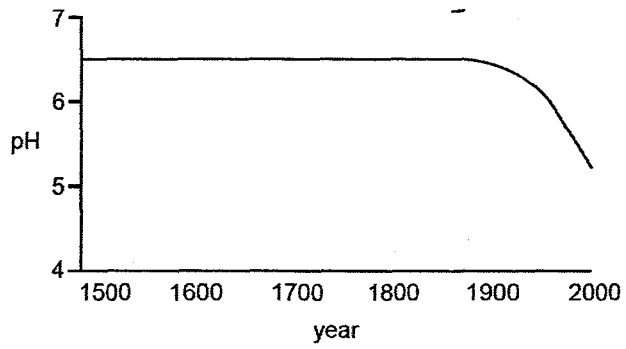
39 The diagram shows a food web in a freshwater pond.



If the population of tadpoles decreased, which other population would decrease the most?

A Dragonfly nymphs
B Great diving beetle
C Pond leeches
D Pondweed

40 The graph shows how the pH of a lake changed in the period 1500 AD to 2000 AD.



What could have caused the change in the pH over the last 100 years?

A Burning of fossil fuels in factories.
B Conversion of nearby woodlands to agricultural land
C Increased growth of plants in the lake
D Use of insecticides on nearby fields

END OF PAPER

Name: _____ Index Number: _____ Class: _____

O Level Preliminary Examination 2016
Secondary 4 Express

BIOLOGY **5158/02**

Paper 2
(SECTION A & B)

Total time for Sections A & B
1 hour 45 minutes

Question and Answer Booklet

Additional Material: Nil

READ THESE INSTRUCTIONS FIRST

Do not open the booklet until you are told to do so.

You are required to **submit this booklet** at the end of the examination.

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams, graphs or rough working.

Answer all the questions in this paper.
Write your answers in the spaces provided

Write an E (for Either) or an O (Or) next to the number 10 in the grid below to indicate which question you have answered.

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

For Examiner's Use		
Section A		
Section B		
9		
10		
11		
Total		/80

SECTION A (50 MARKS)

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

1 Fig.1 shows the parts that make up a cheek cell.

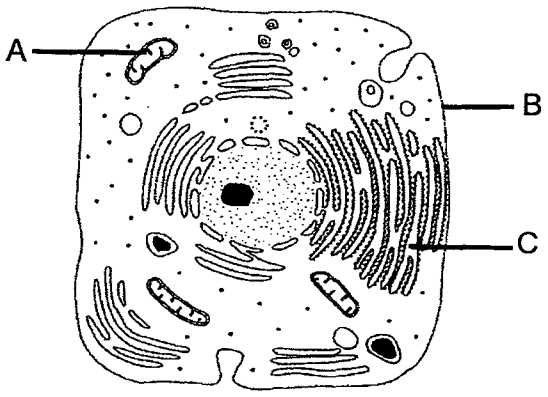


Fig.1

(a) Name the labelled parts of the cell and state the function of each part. [3]

A : .....

.....

B : .....

.....

C : .....

.....

(b) On Fig.1, label
(i) the site of transcription with the letter '**T**',
(ii) the site of translation with the letter '**L**'. [1]

(c) State and explain one difference in cellular components between a cheek cell and

(i) muscle cell [1]

.....

.....

(ii) liver cell [1]

.....

.....

2 Brian collected fluid samples from three regions of a person's alimentary canal and performed food tests on these samples to investigate the process of digestion after the person was given a meal of chicken rice.

Table 2.1 shows his results.

Region	*Reducing sugars test*	*Protein test*
Stomach	A yellow precipitate formed.	Biuret solution turned violet.
Duodenum	A brick-red precipitate formed.	Biuret solution turned violet.
A	Benedict's solution remained blue.	Biuret solution remained blue.

Table 2.1

(a) Explain his observations for the sample from the stomach. [2]

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(b) Fig.2.2 shows the human alimentary canal.

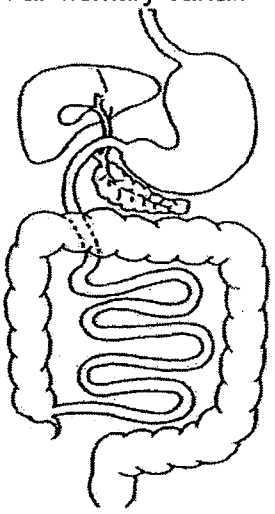

Fig.2.2

Label and identify region **A** on Fig.2.2. [1]

(c) If Brian were to test for the presence of bile salts, which of the three regions would most likely give him a positive result? Give a reason for your answer. [2]

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3 Fig.3 shows an aphid feeding on the stem of a plant. Its mouthparts are hollow tubes which are pushed into the stem.

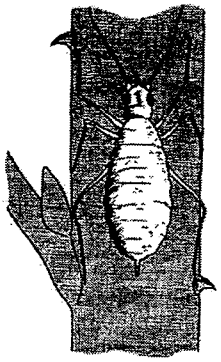

Fig.3

(a) Identify the tissue that the aphid is interested in. Explain its interest in this tissue. [2]

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(b) Suggest why aphids are usually found on young shoots. [1]

.....

.....

(c) Explain why aphids are usually found only during the day. [1]

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4 Fig.4 shows the heart of a fetus. In a fetus, the lungs do not function during gestation.

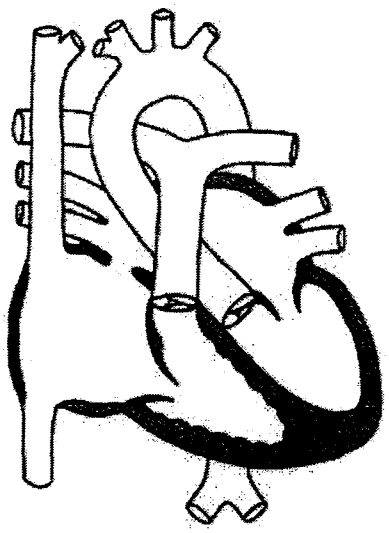

Fig.4

(a) **(i)** In Fig.4, label the structure that separates oxygenated blood from deoxygenated blood. [1]

(ii) On Fig.4, write the letter **F** in the chamber of the heart that first receives oxygenated blood in an adult.

Infer and write the letter **FF** In the chamber of the heart that first receives oxygenated blood in a fetus. [1]

(iii) How is the pulmonary artery structurally different from the vena cava? [1]

.....

.....

(b) If the lungs do not function during gestation, explain how a fetus obtains its oxygen. [2]

.....

.....

.....

.....

.....

(c) If you look carefully at the diagram, there is a hole in the septum between the left and right atria. When a baby is born, it takes its first breath. The hole in the septum of the heart closes quickly. Explain why this is important. [2]

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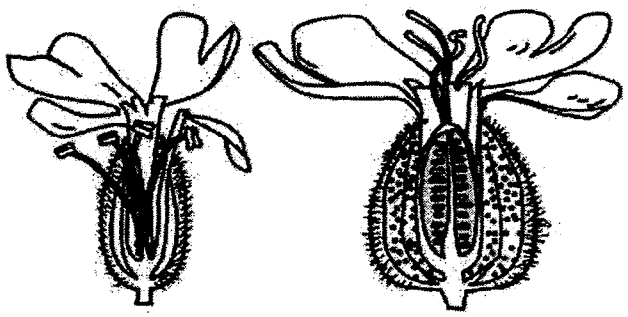
5 Fig.5.1 below shows vertical sections of two types of the Red champion flower (Silene dioica). These flowers always occur on separate plants and are pollinated by insects.



Flower A Flower B

Fig. 5.1

(a) With reference to Fig.5.1 only, state two ways in which flower A differs from that of flower B. [2]

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(b) Suggest the advantage of the Red champion in having flowers A and B on separate plants. [1]

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(c) Fig.5.2 below shows some of the stages of cell division in the anther sac of the Red champion flower to produce pollen grains.

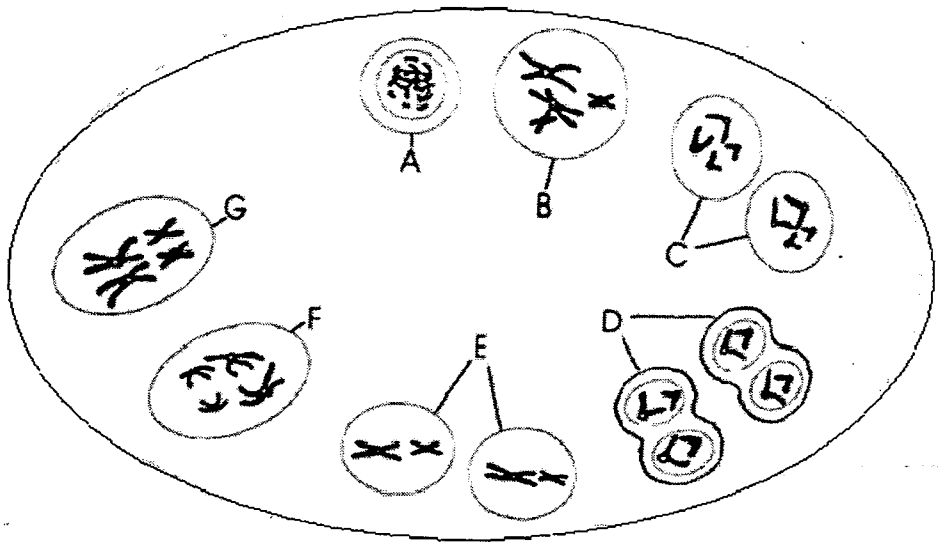

Fig.5.2

(i) Using the letters in Fig.5.2, arrange the stages of cell division into their correct sequence. [1]

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(ii) Name stage C and describe what happens during this stage. [2]

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(iii) Explain how you would expect the pollen grains of this species of flower to look like. [1]

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6 CADASIL is an inherited disorder caused by a dominant allele. CADASIL leads to weakening of blood vessels in the brain.

Fig.6 shows the inheritance of CADASIL in one family.

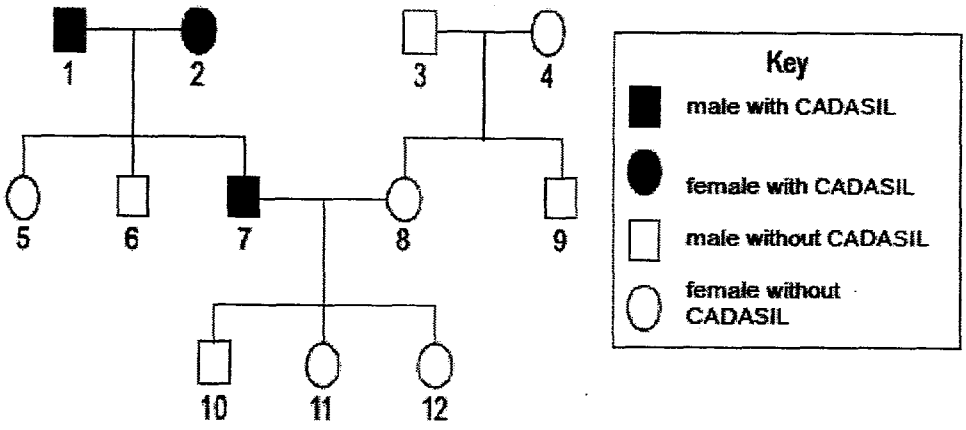

Fig.6

(a) **(i)** What is a dominant allele? [1]

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(ii) What evidence in Fig.6 shows that CADASIL is caused by a dominant allele? [1]

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(b) Person 7 has CADASIL. Is person 7 homozygous or heterozygous for the CADASIL allele? Give evidence for your answer from Fig.6. [2]

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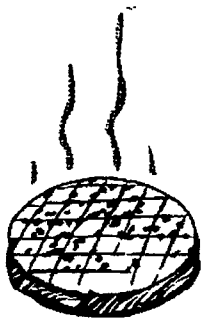
(c) Persons 7 and 8 are planning to have another baby. Use a genetic diagram to find the probability that the new baby will have the disorder.

Use the following symbols to represent alleles:
D : allele for CADASIL
d : allele for not having CADASIL [3]

7 "Fast foods" are now very much part of the culture of the developed world.
Table 7 gives information about a beef burger.

Beef burger



Nutritional analysis/100g	
Energy	1500 kJ
Protein	12 g
Carbohydrates	8 g
Fat	30 g
Fibre	1 g
Sodium	1 g

Table 7

(a) A boy ate little else but beef burgers every day.
With reference to Table 7, explain why the boy might suffer from malnutrition but not starvation. [2]

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(b) Increased demand for cheap beef has had an impact on the natural ecosystems of developing countries. Suggest how this demand affects natural ecosystems and local water supplies. [2]

Natural ecosystems: .....

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Local water supplies: .....

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(c) Why is the production of beef an inefficient use of land in a developing country where there is a large population to feed? [2]

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(d) The carbohydrate in the burger comes from wheat.
Modern varieties of wheat have been produced by selective breeding. Describe an improvement brought about by selective breeding of crop plants such as wheat. [1]

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(e) Genetic engineering is now used to produce new varieties of organisms.

(i) Describe one advantage of this technique compared to selective breeding. [1]

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(ii) Discuss two potential risks in the uses of genetic engineering. [2]

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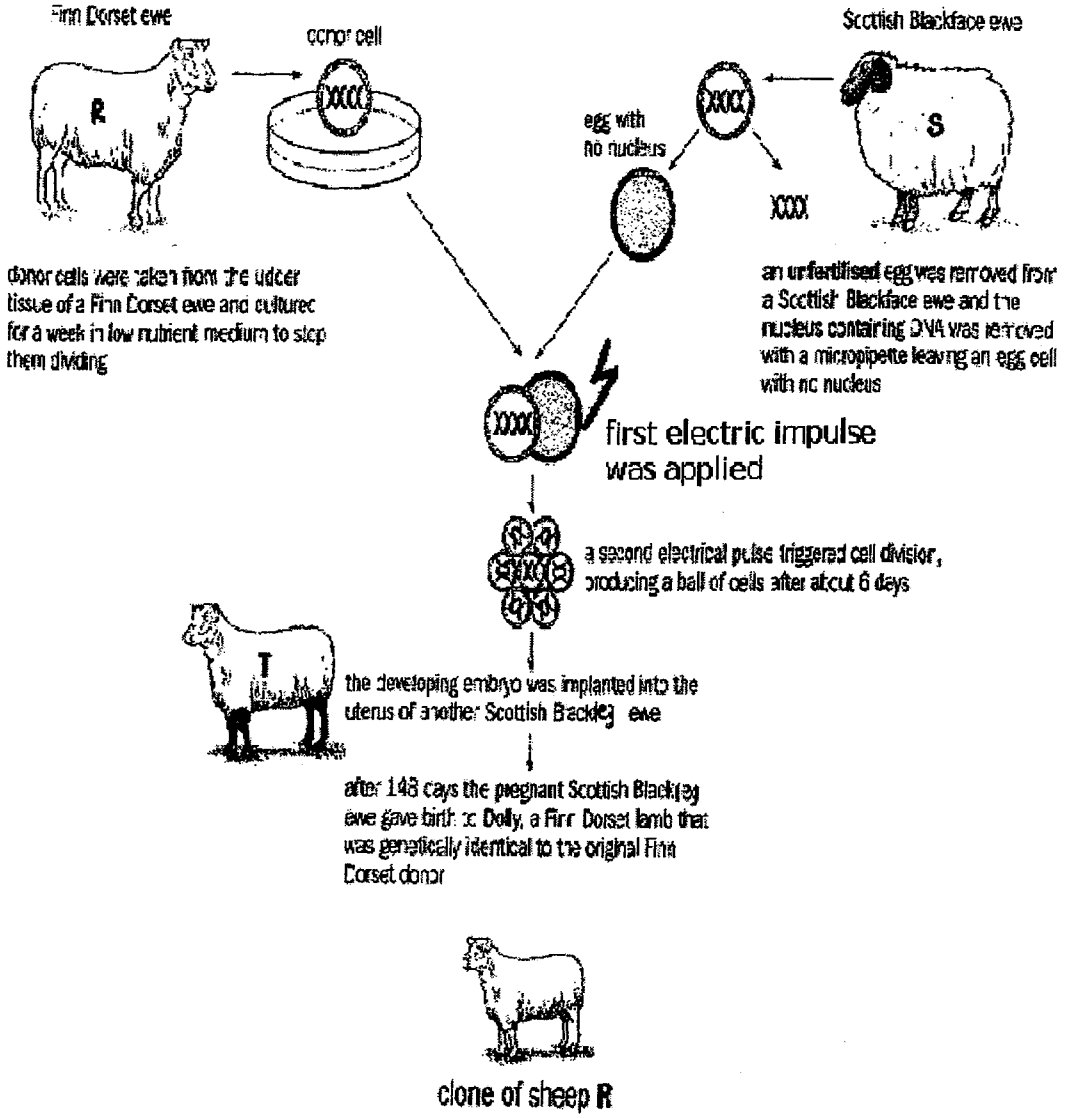
8 The figure below shows the technique to clone a sheep by nuclear transfer.



(a) Suggest why a very gentle first electric impulse is applied to the donor cell and recipient egg cell. [1]

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(b) Name the first process that takes place in the uterus of the surrogate ewe T after embryo transfer. [1]

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(c) Scientists used ewes from different homozygous varieties (R, S and T) in order to check that the procedure was successful at each stage and that the lamb produced was a clone of R.
Suggest what could be deduced about the procedure if the lamb had been born with a black face. [1]

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(d) Suggest one reason why it would be undesirable to produce all farm animals in this way by cloning. [1]

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SECTION B (30 MARKS)

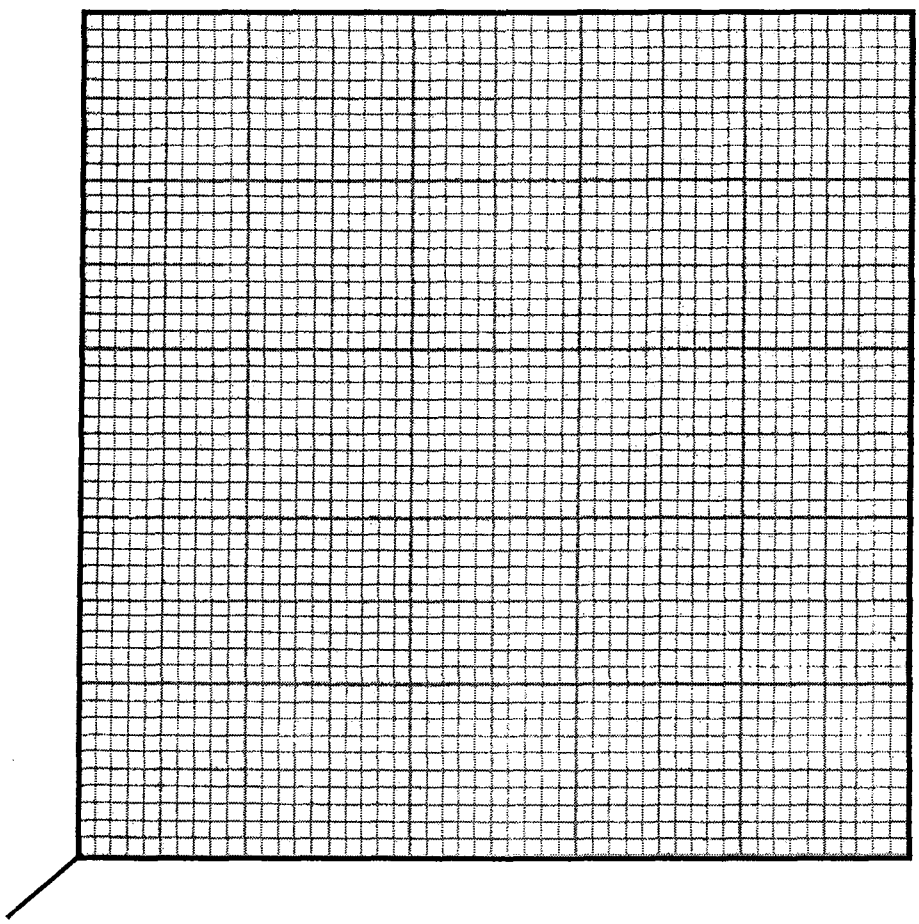
Answer THREE questions in this section.
Question 11 is in the format of an EITHER / OR question. Only one part should be answered.

9 Various studies have shown that low birth weight (below 3000 g) and prematurity in newborns have resulted in an increased risk of high blood pressure later in life. This is a result of low numbers of nephrons in the premature child's kidney which are developed only in the third trimester in pregnancy.

Some data are collected to show the relationship between the mass at birth and the number of nephrons at birth.

Mass at birth / g	Number of nephrons in the kidney per 0.6mm^2
1000	71
1500	83
2000	92
2500	101
3000	107
3500	105

(a) Plot a graph of number of nephrons in the kidney against mass at birth based on the result above. [3]



(b) Describe the relationship between mass at birth and number of nephrons in the kidney. [2]

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(c) Suggest how low protein diet during pregnancy can affect the synthesis of proteins in the fetus resulting in low birth weight of the newborn. [3]

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(d) Explain briefly how low numbers of nephron in the kidney increase the risk of high blood pressure in their adult life. [2]

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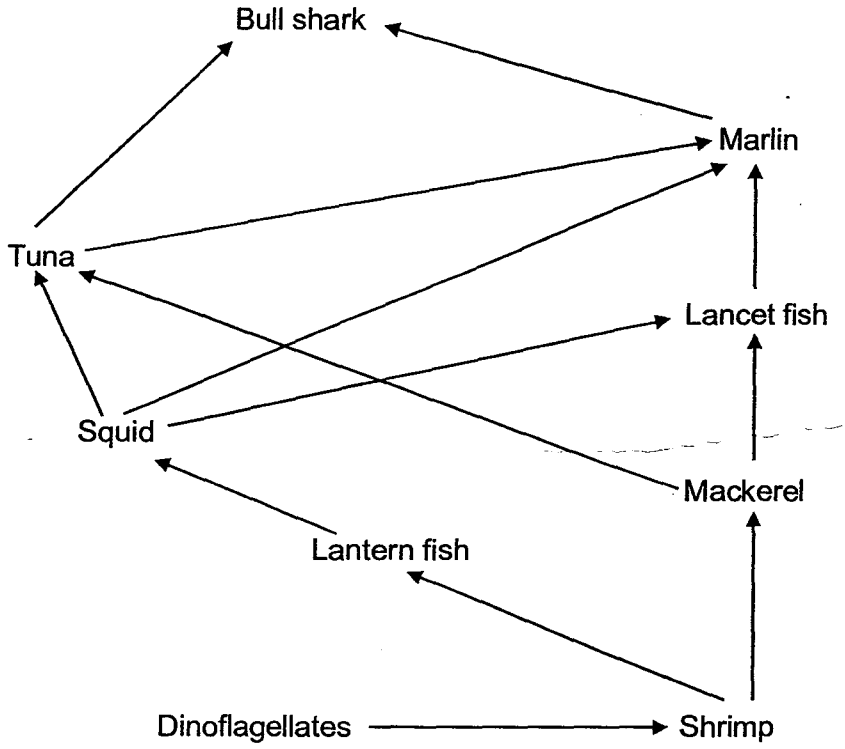
10 Sharks have been over-hunted for their fins due to growing demand for shark's fin soup in Asian countries. Biologists tracking the major species of predatory sharks across the world have raised alarm over the dramatic decline in the populations of the sharks.

The following diagram shows a food web involving several species in the North Atlantic Ocean.



(a) State the feeding relationship between the bull shark and the other featured organisms. [1]

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(b) Identify all tertiary consumers in the food web. [2]

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(c) A commonly held opinion is that it is ideal to continue hunting large sharks such as bull sharks to help increase the population of fish, such as tuna, which both humans and sharks consume. This will help to alleviate the global decline in seafood stocks in oceans.

With reference to the food web, comment on the validity of this opinion. [3]

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(d) Critics of shark-finning point out that consuming shark's fins can be dangerous for human beings, given the high concentrations of heavy metals and other toxins in sharks. Suggest why sharks contain a much higher amount of toxins per unit mass compared to smaller fish. [4]

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11 EITHER

(a) Explain how a plant supports itself in the upright position. [5]

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(b) Transpiration is sometimes described as an "inevitable consequence of gas exchange" in plants.

Explain this statement. [3]

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(c) Explain why the uptake of mineral ions in a waterlogged soil may be inhibited. [2]

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11 OR

Explain the part played by muscles of the human body in each of the following processes:

(a) regulation of body temperature; [5]
(b) breathing [5]

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Preliminary Examinations 2016
Secondary 4 Express Biology

Paper 1 Answers (40 marks)

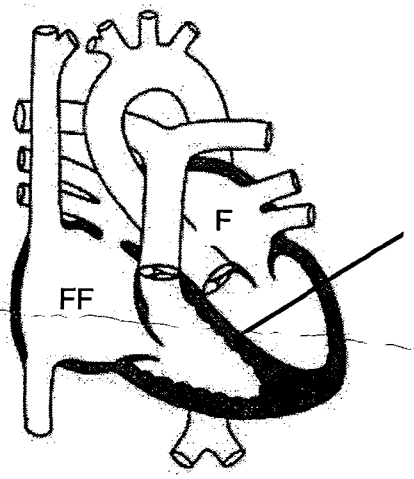
1	A	11	D	21	C	31	B
2	C	12	B	22	B	32	D
3	B	13	C	23	C	33	D
4	B	14	B	24	C	34	B
5	D	15	B	25	D	35	C
6	D	16	A	26	D	36	C
7	C	17	C	27	B	37	B
8	D	18	D	28	B	38	B
9	D	19	D	29	A	39	A
10	C	20	A	30	A	40	A

Sec 4 Biology 5158

Preliminary Exam 2016 Mark scheme

Paper 2 Section A (50 marks)

Qn		Marks
1(a)	A: mitochondrion Involved in the release of energy during cellular respiration B: cell/plasma membrane Controls the movement of substances into and out of the cell; C: rough endoplasmic reticulum Transports proteins made by ribosomes to Golgi apparatus for secretion out of the cell	1 1 1 (3m)
(b)(i)	Label nucleus with letter "T"	½
(ii)	Label free ribosomes with letter "L"	½ (1m)
(c)(i)	More mitochondria in muscle cells as more energy is needed for muscular contractions	1m
(ii)	More smooth endoplasmic reticulum present in liver cells to carry out detoxification of harmful substances; OR More ribosomes present in liver cells for synthesis of plasma proteins eg fibrinogen, prothrombin OR More mitochondria in liver cells to release energy needed for increased metabolism of liver cells	1m
2(a)	Protein digestion only starts in the stomach, some proteins are still undigested, hence positive result for protein test; Some starch molecules have been digested by salivary amylase in the mouth to form maltose, which is sent to the stomach together with other undigested food, hence positive result for some reducing sugars in the stomach	1 1 (2m)
(b)	Label and identify **colon/rectum** on the diagram	1m
(c)	Duodenum; Gall bladder releases stored bile directly into duodenum for emulsification of fats	1 1 (2m)

3(a)	Phloem; Tissue is responsible for transport of manufactured food eg sugars and amino acids up and down the stem/from the leaves to all parts of the plant	1 1 (2m)
(b)	Stem/cortex is thinner / less fibrous tissue above phloem, easier for the mouth part to pierce through to reach the phloem tissue	1m
(c)	Plant is only able to photosynthesise during the day in the presence of light, more manufactured food is transported around the plant in the phloem tissue	1m
4(a)(i) (ii)		1m 1m
(iii)	Pulmonary artery has thicker wall with more muscular and elastic tissue compared to vena cava OR Pulmonary artery has a smaller lumen compared to vena cava	1m
(b)	At placenta in the uterus, oxygen from maternal blood diffuse into fetal blood; oxygenated blood is transported back to the fetus via the vein in the umbilical cord	1 1 (2m)
(c)	The hole has to close quickly to prevent mixing of oxygenated blood with deoxygenated blood, which will result in less oxygen being delivered to the rest of the body cells, baby affected can become breathless/shortness of breath; /will tire easily, suffers from poor growth; /will not be able to lead a normal active life	1 1 (2m)

5(a)	Only male stamens are present in flower A, while only female pistil is present in flower B; Flower A is much smaller than flower A	1 1 (2m)
(b)	Only cross-pollination can take place between flower A and flower B, resulting in greater genetic variation amongst the offsprings produced.	½ ½ (1m)
(c)(i)	A, B, G, F, E, C, D	1m
(ii)	Anaphase II; Centromeres divide; Sister chromatids separate (to become daughter chromosomes), which are pulled towards opposite poles of the cell	½ ½ ½ ½ (2m)
(iii)	Pollen grains are larger with rough surfaces so that they can readily cling onto the hair of insects	½ ½ (1m)
6(a)	A dominant allele expresses itself and gives the same phenotype in both the homozygous and heterozygous conditions / expresses itself even if only one copy of the allele is present	1m
(b)	2 affected parents (1 & 2) are able to produce children who are not affected (5 & 6); If allele is recessive, all children would be affected.	½ ½ (1m)
(c)	Heterozygous; He is affected but has one recessive allele to contribute to his children who are not affected; If he is homozygous, all his children would be affected	½ 1 ½ (2m)

6(d)	Parents: father (7) mother (8) Phenotype: affected not affected Genotype: Dd dd Gametes: D d d d F1 generation Genotype: Dd Dd dd dd Phenotype: affected not affected Ratio: 1 : 1 New baby has a 50% chance of being affected by CADASIL [parents' phenotype and genotype and gametes = 1m, Offspring's genotype and phenotype = 1m Phenotypic ratio / probability = 1m]	(3m)
7(a)	His diet lacks vitamins, minerals / he does not take in enough fibre / he is taking in too much fats compared to carbohydrates and proteins, therefore he suffers from malnutrition; more than enough energy (from fats & carbohydrates) is available in his diet, therefore he does not starve	1 1 (2m)
(b)	Trees are felled to clear land for growing grass for cows, results in deforestation and erosion of soil due to overgrazing / loss of habitats for other organisms; deforestation can lead to reduced rainfall, soil erosion can result in silting of rivers, causing floods / rivers can be polluted by excessive animal droppings	½ ½ ½ ½ (2m)
(c)	Energy is lost at each trophic level in a food chain; Instead of growing crops to feed population directly, more energy is lost when grass is fed to cows which are then fed to man.	1 1 (2m)
(d)	Increased yield / improved resistance to disease, frost, drought / improved flavour (any one improvement)	1m
(e) (i)	Allows transfer of genes between different species / more precise method, only favourable genes are transferred / faster method / requires less space (any one advantage)	1m

(ii)	People may be allergic to transgenic food which they unknowingly eat, allergy can be fatal; Genes that code for an antibiotic resistance may accidentally be incorporated into bacteria that cause diseases to humans; People may deliberately create new combination of genes that they may use in chemical or biological warfare; (any two points)	2m
8(a)	To cause cell membrane to open up in the recipient egg cell so that the donor cell can transfer the chromosomes into the egg cell.	1m
(b)	Implantation	1m
(c)	The chromosomes from the Scottish Blackface eve/egg cell might not have been successfully removed	1m
(d)	There is no genetic variation and the farm animals are thus susceptible to a common disease.	1m

	Section B (30 marks)	
9(a)	Label axis and appropriate scale Correct points plotted Best fit Line	1 1 1 (3m)
(b)	At lower birth weight of between 1500 g to 3000 g, there is a gradual increase in number of neprons in the kidney, from 80 to 107 as the birth weight increases. Beyond 3000 g, the number of nephrons in the kidney decreases slightly from 107 to 105	1 1 (2m)
(c)	Low protein diet during pregnancy suggest low amino acid concentration in maternal blood; Less amino acids will pass through placenta to the fetus for protein synthesis in cells; Decreased protein synthesis will hinder formation of new protoplasm, slowing down growth of fetus, resulting in low birth weight of babies.	1 1 1 (3m)
(d)	Low numbers of nephrons results in decreased rate of removal of excretory products eg. excess water and urea; Less water is removed from blood, resulting in increased blood volume, which causes corresponding increase in blood pressure	1 1 (2m)

10(a)	Bull shark is the top predator of this food web / is at the highest trophic level in this food web / is the 6th or 7th trophic level in this food web	1m
(b)	Squid, lancet fish, tuna	2m
(c)	A fall in number of bull sharks would lead to increasing numbers of their prey, ie marlin and tuna, as they are not killed for food; Populations of the prey of tuna and marlin ie. squid and lancet fish would decrease or may even be wiped out, causing the ecosystem to collapse.; Fisheries or human communities that depend on the various species of marine life for food and livelihoods might in turn be adversely affected if the shark populations fall.	1 1 1 (3m)
(d)	Heavy metals and other toxins are usually present in small amounts in seawater, and first absorbed by plankton and other producers at the bottom of the food chain; The plankton is then eaten by fish and other organisms higher in the food chain and these toxins are then absorbed by these consumers; Many of these toxins are not soluble and are not easily excreted, accumulating in the fatty tissues of the primary consumers; These toxins build up to increasing amounts in the tissues of organisms in successive trophic levels (bioaccumulation); Sharks are predators high up the food chain, they would accumulate very high levels of toxins from the trophic levels that precede them.	1 1 1 1 (4m)
11	EITHER	
(a)	Dicot stems have vascular bundles that are arranged in a ring around a central pith; xylem tissue in vascular bundles provide transport and mechanical support for the plant; inner walls of xylem vessels are thickened with lignin, a hard and rigid substance, to prevent collapse of the vessel; Cells in the cortex and pith continuously take in sufficient water by osmosis to ensure cells remain turgid; turgor pressure within cells allow the plant to remain firm and erect Roots and root hairs of the plant anchor the plant firmly to the soil particles to prevent the plant from toppling over	1 ½ 1 1 ½ 1 (5m)
(b)	Plant needs to take in carbon dioxide for photosynthesis during the day; Stomata remains open to allow carbon dioxide to diffuse in; Water vapour from the cells and excess oxygen from photosynthesis will diffuse out through the open stomata.	1 1 1 (3m)

(c)	Water fills up all air spaces between soil particles in waterlogged soil; Insufficient oxygen available for root cells to carry out cellular respiration; Root hair cells cannot carry out active transport to absorb mineral ions	½ 1 ½ (2m)
11	OR	
(a)	On hot/cold days, smooth muscles in walls of arterioles in skin contract and relax to bring about dilation/constriction of the arterioles and constriction/dilation of shunt vessels; resulting in more/less blood flowing to blood capillaries near surface of skin and more/less heat loss to surrounding by radiation, conduction and convection On extremely cold days, shivering occurs due to spasmodic contractions of skeletal muscles to generate more heat to raise body temperature to normal	½ ½ ½ ½ ½ ½ ½ ½ (5m)
(b)	During inhalation, diaphragm muscles contracts and diaphragm flattens; External intercostal muscles contract while internal intercostal muscles relax; Ribs are raised upwards and outwards, sternum moves up and forward; Volume of thoracic cavity increases; Lungs expand and air pressure in lungs decreases; Atmospheric pressure is higher than pressure in lungs, this causes air to enter the lungs OR During exhalation, diaphragm muscles relaxes and diaphragm arches upwards; Internal intercostal muscles contract while external intercostal muscles relax; Ribs move downwards and inwards, sternum moves down to original position; Lungs are compressed, air pressure inside increases; Air is forced out of lungs to the external environment	1 1 1 ½ ½ 1 (5m)