ZHONGHUA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2018

SECONDARY 4E

Candidate's Name	Class	Register Number
	4E4	

BIOLOGY 6093 /01

14 September 2018
1 hour

Additional Materials: OTAS

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, index number and class on the OTAS 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 OTAS.

Read the instructions on the 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.

Setter: Ms Rozianna & Mr Goh Tze Mian
Vetter: Mr Tan Li Chun

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Section A

Answer **all** the questions in the OTAS.

1 Which structures are present in a root hair cell?

	nucleus	chloroplast
A	✓	✓
B	✓	×
C	×	✓
D	×	×

key
✓ = present
× = absent

2 Pancreatic tissue from a freshly killed mouse was removed. It was placed in a warm isotonic saline solution and radioactively labelled amino acids were added. Samples of the tissue were later removed, sections cut and the sites of radioactivity determined at regular intervals.

Which of the following represents the order in which radioactivity appeared in the organelles?

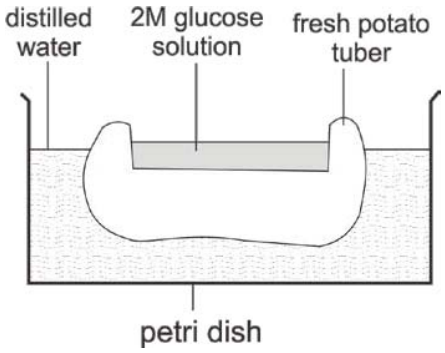
A Golgi apparatus, rough endoplasmic reticulum, secretory vesicles

B Golgi apparatus, rough endoplasmic reticulum, smooth endoplasmic reticulum

C rough endoplasmic reticulum, Golgi apparatus, secretory vesicles

D rough endoplasmic reticulum, smooth endoplasmic reticulum, Golgi apparatus

3 A student created the setup shown below.



However, he forgot all about it and left the setup overnight.

Which of the following correctly states the appearance of the potato tuber after 12 hours?

A The bottom half would be flaccid while the top half will be turgid.

B The bottom half would be turgid while the top half will be flaccid.

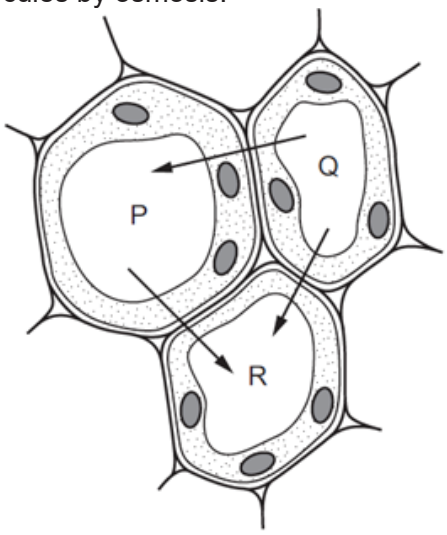
C It would have uniform turgidity.

D It cannot be inferred from the given data.

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4 The diagram shows three plant cells labelled P, Q and R. The arrows show the direction of net movement of water molecules by osmosis.



What is the correct order of salt concentration in the cells, from the highest to the lowest?

	highest	middle	lowest
A	P	Q	R
B	P	R	Q
C	Q	P	R
D	R	P	Q

5 The diagram represents how an enzyme molecule changes in shape.



What explains this change?

A It has been placed in a concentrated salt solution.

B It has been placed in a dilute salt solution.

C It has been heated to 70°C.

D It has been cooled to 5°C.

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6 A student had samples of four types of biological molecules – water, carbohydrates, proteins and fats. 100g of each sample was added to a calorimeter and the temperature change of the water as a result of the combustion of the sample was recorded in the table below.

Which of the samples contained fat?

sample	temperature change /°C
A	0
B	25
C	37
D	70

7 What is the enzyme that controls a reaction in which both the enzyme and the substrate can denature at high temperatures?

A amylase

B insulin

C lipase

D protease

8 As a seed begins to germinate, it uses enzymes to speed up the rate of

A digestion.

B osmosis.

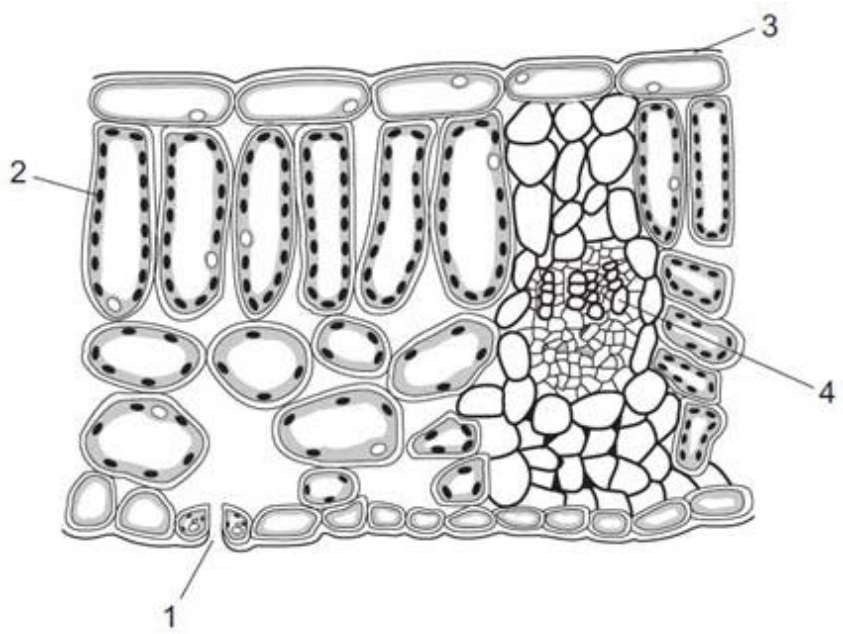
C photosynthesis.

D transpiration.

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9 The diagram below shows the structure of a leaf of a dicotyledonous plant.



What are the functions of the parts labelled on the diagram?

	1	2	3	4
A	gaseous exchange	photosynthesis	reducing evaporation	transport
B	photosynthesis	gaseous exchange	transport	reducing evaporation
C	photosynthesis	reducing evaporation	gaseous exchange	transport
D	transport	reducing evaporation	gaseous exchange	photosynthesis

10 Bread contains dietary fibre, fat, protein and starch.

Which substance contributes least to the energy obtained by a person eating the bread?

A dietary fibre

B fat

C protein

D starch

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11 Which of the following would not be an expected consequence of the removal of the pancreas?

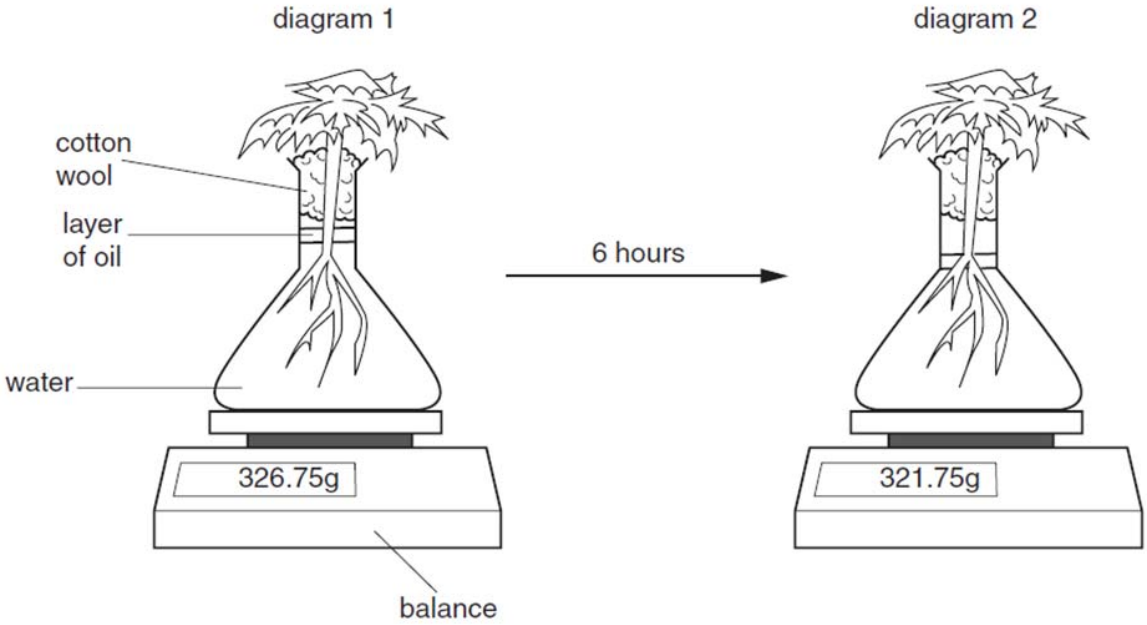
A diabetes

B increased pH of the duodenum

C reduced protein digestion

D reduced glycogen production in liver and muscle cells

12 The diagrams show a plant in a flask of water. It is left for six hours on a warm and windy day in bright sunshine.



Which process explains the result shown in diagram 2?

A active transport of water into the root hairs

B evaporation of water from the flask

C photosynthesis in the leaves of the plant

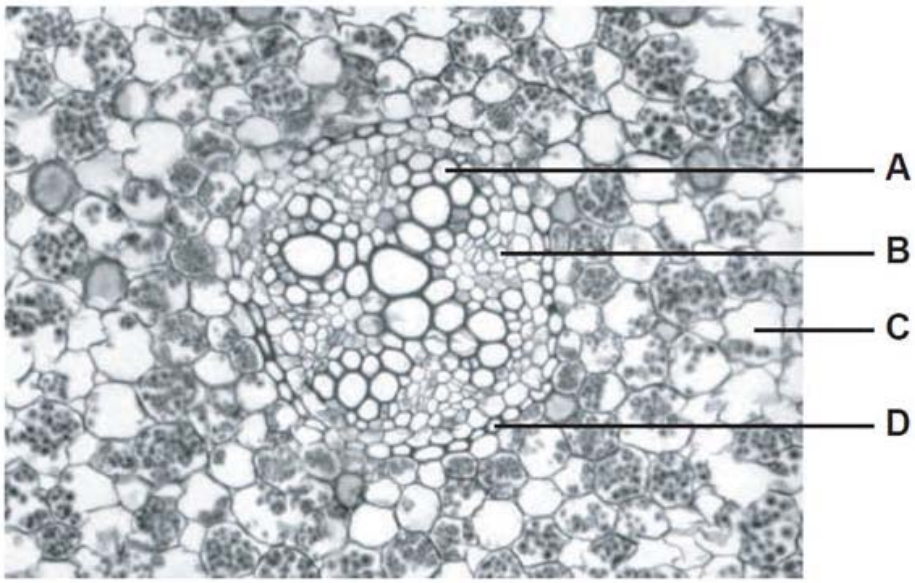
D transpiration from the leaves of the plant

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13 The diagram shows a transverse section from the middle of a root of a dicotyledonous plant.

In which tissue are sugars and amino acids transported?



14 Which of the following would be consequence(s) of a leaky bicuspid valve?

1 A heart attack would occur.
2 There would be reduced blood pressure in the aorta.
3 The heart would stop beating.
4 The blood leaving the aorta would be less oxygenated.

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

15 There is a ring of muscle at the origin of a blood capillary network found near the skin.

Which of the following statements related to this ring of muscles is true?

A When constricted, it will increase blood flow in the capillary network.

B When constricted, it will not affect the blood pressure in the capillary network.

C When dilated, it can cause the skin to turn redder.

D When dilated, it will increase the blood pressure in the preceding arteriole.

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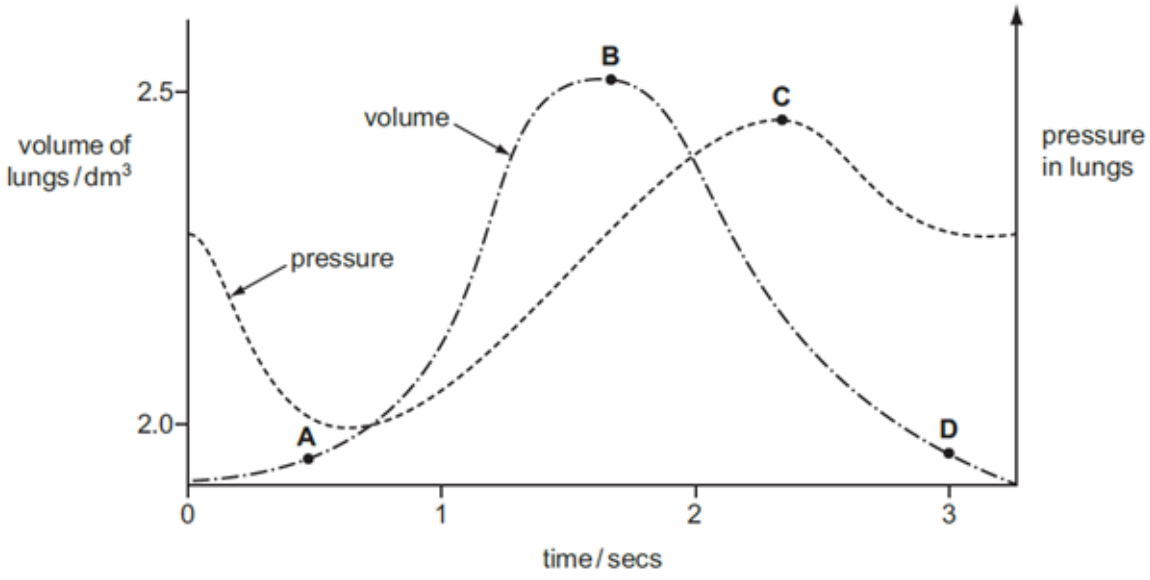
16 The table shows features of some blood vessels.

Which is the pulmonary artery?

	feature			
	muscle layer	lumen	direction of blood flow	blood
A	thick	narrow	away from the heart	deoxygenated
B	thick	wide	away from the heart	oxygenated
C	thin	narrow	towards the heart	oxygenated
D	thin	wide	towards the heart	deoxygenated

17 The graph shows how the pressure and volume inside the lungs change during one complete breath.

At which point are the muscles of the diaphragm starting to contract?



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18 What causes emphysema?

A blockage of the bronchioles

B destruction of the alveolar walls

C inflammation of the walls of the airways

D overproduction of mucus

19 Uric acid is a human metabolic waste product.

Which of the following correctly explains the presence of uric acid in the body?

A It is absorbed from consumed food.

B It is produced in the breakdown of DNA.

C It is produced in the breakdown of excess amino acids.

D It is produced by bacteria found in the large intestine.

20 How is sweat different from urine?

A The production of urine is continuous but that of sweat is not.

B Sweat is always more concentrated than urine.

C Sweat is always more dilute than urine.

D More urea is excreted in urine than sweat.

21 A logistics officer spent twenty minutes in a walk-in freezer to check on the condition of frozen food products. Some changes occurred in the officer's body in response to the decrease in environmental temperature and are listed as follows:

1 brain sends impulses

2 blood vessels in the skin constrict

3 skin temperature changes

4 temperature receptors in the skin detect change

What is the correct sequence of events that took place?

A 2 → 1 → 4 → 3

B 3 → 1 → 4 → 2

C 4 → 1 → 2 → 3

D 4 → 2 → 1 → 3

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22 The table shows the blood flow through the skin, heart muscle and kidneys at rest and during exercise.

region	blood flow / cm^3 per min	
	at rest	during exercise
skin	340	980
heart muscle	190	835
kidneys	930	347

Which of the following statement correctly explains the data in the table?

A The blood flow to the skin is increased during exercise so that the skeletal muscles will receive more oxygen and glucose to sustain aerobic respiration.

B The blood flow to the kidneys is reduced during exercise because sweat is being lost and so the removal of water and nitrogenous waste products can be reduced.

C The blood flow to the heart muscle is increased to pump more oxygenated blood and glucose to the skeletal muscles.

D The blood flow to the kidneys is lower than the skin and heart muscle during vigorous exercise because blood pressure is low.

23 Which of the following does not describe the peripheral nervous system?

A It consists of cranial and spinal nerves.

B It helps in the maintenance of body temperature.

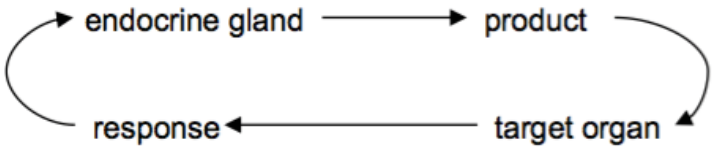
C It sends nerve impulses to and from the central nervous system.

D It is capable of processing stimuli to bring about a reflex action.

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24 The diagram shows the relationship between two organs and the responses they bring about in the body.



If the response of the target organ is controlled by negative feedback, the product of the endocrine gland

A inhibits the target organ with no effect on response.

B stimulates the target organ with no effect on response.

C stimulates the target organ while the response inhibits secretion of the product.

D inhibits the target organ while the response stimulates secretion of the product.

25 A student touched a live electrical wire (with electricity running through it) 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.

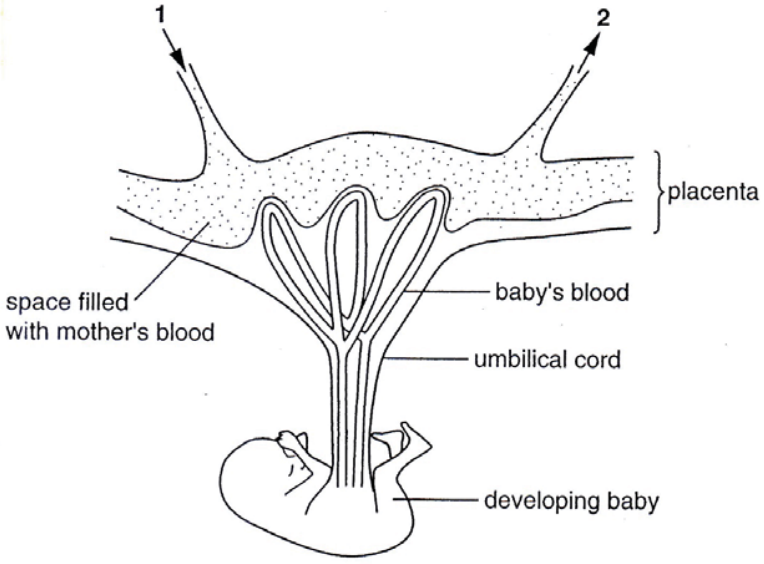
C Motor neurones were stimulated by the electricity and caused the contraction of his hand muscles.

D The electricity stimulated his heat receptors and the dilation of skin arterioles, causing his fist to close.

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26 The diagram shows the distribution of blood vessels in the uterine lining and placenta of a pregnant woman.



Which substance will increase in concentration in the blood as it flows from 1 to 2?

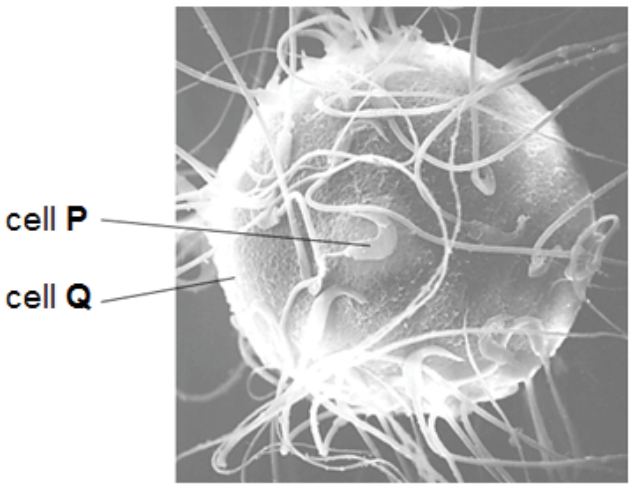
A amino acids

B carbon dioxide

C glucose

D oxygen

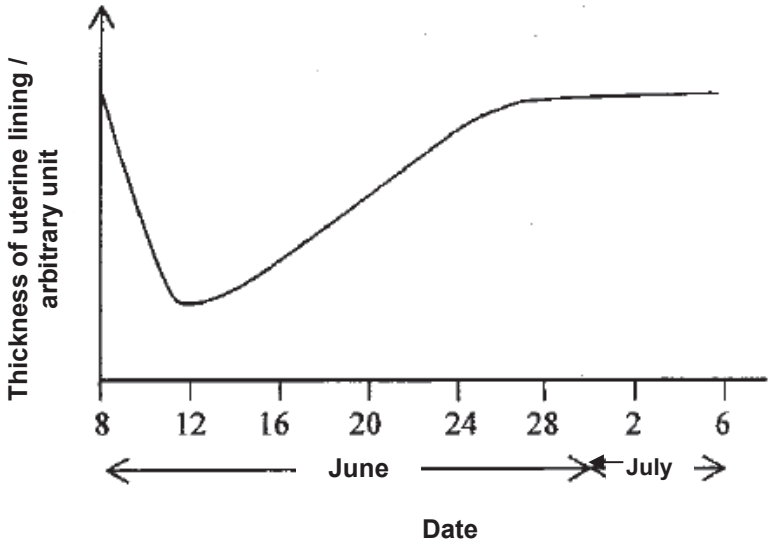
Questions **27** and **28** refer to the photomicrograph showing an event taking place in the oviduct.



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27 The graph shows changes in the uterine lining of a woman from 8th June to 9th July.



Which date will the event in the above photomicrograph most likely take place?

A 10th June **B** 14th June

C 22nd June **D** 30th June

28 Which comparison between cells **P** and **Q** is correct?

A Cells **P** and **Q** can undergo meiotic cell division.

B Cell **P** has a higher concentration of mitochondria than cell **Q**.

C Cell **P** has a smaller number of chromosomes than cell **Q**.

D Cells **P** and **Q** may contain either X or Y chromosomes.

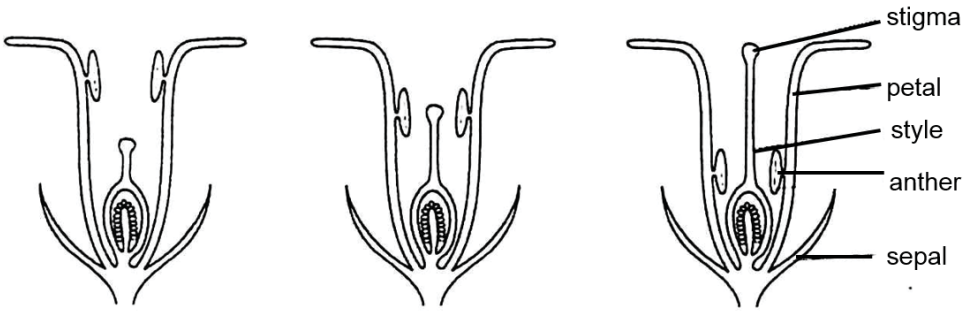
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29 The primrose, *Primula vulgaris*, is a small herbaceous, yellow flowered plant which is common in cooler areas of the Northern hemisphere including alpine and Artic areas. The flowers of the primrose have different flower shapes (polymorphic), which are adaptions for pollination. 'Thrum-eyed' primroses have a short style. 'Pin-eyed' primroses have a much longer styles. Some populations of primrose consist almost entirely of plants with intermediate flowers. These populations are common where there are fewer winged insects.

The diagrams show polymorphic flowers of primroses.

Which of these statements are correct?



1 Cross-pollination will be favoured in pin-eyed primrose.

2 Self-pollination is more likely to occur with intermediate flowers.

3 Primroses with pin-eyed flowers are likely to show more genetic diversity than primroses with intermediate flowers.

4 Primroses with intermediate flowers are likely to be better able at adapting to varying environmental conditions than pin-eyed and thrum-eyed primroses.

A 1 and 2

B 1, 2 and 3

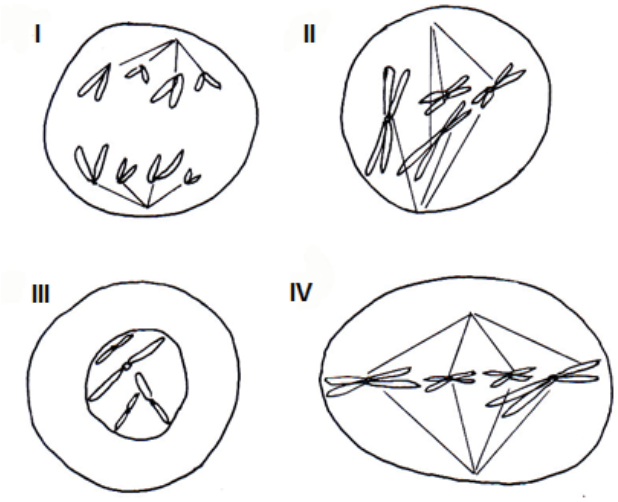
C 2 and 3

D all of the above

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30 The diagrams show four different stages of a type of cell division.



In which structure will the cell division shown above, will occur the slowest?

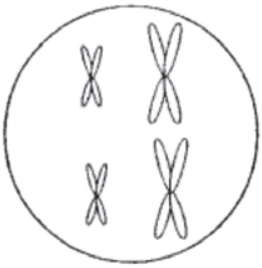
A in the anther sac

B in the bone marrow

C in mature cells of a petal

D in the root cap

31 The diagram represents the nucleus of a cell (where 2n = 4) in late prophase of meiosis.

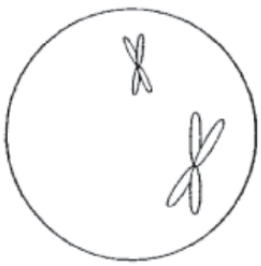


Which diagram represents a cell of the same species in anaphase II of meiosis?

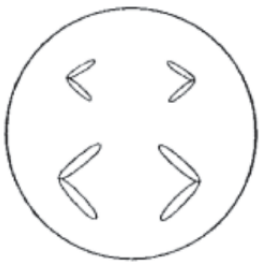
A



B



C



D



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32 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 best explains why these two animals differ greatly in their physical characteristics?

A Different amino acids are used to produce different proteins in both animals.

B Deoxyribose is used in DNA of the octopus but ribose is used in the DNA of starfish.

C The two animals follow different base pairing rules in their DNA strands.

D The DNA sequences in both animals are different, thus code for different proteins in their bodies.

33 Below is a sequence of bases on a messenger RNA molecule.

AUCGAAGUUCGU

It was transcribed from the template strand of a DNA molecule.

What is the sequence of bases on this template strand of DNA?

A TGATGGACCTTG

B ATCGAAGTTCGT

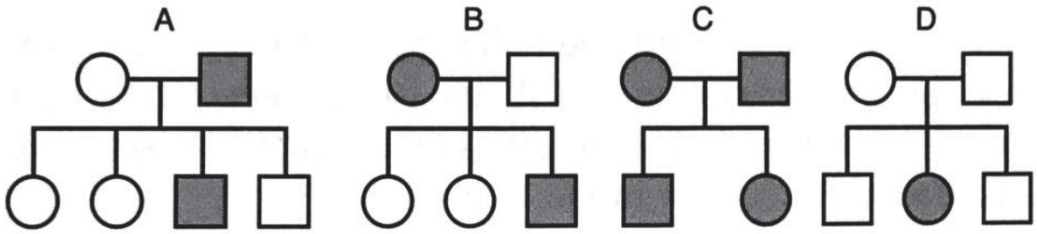
C TAGCTTCAAGCA

D UGCUUGAAGCUA

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34 In each of the pedigree trees shown below, persons with a genetic disease are indicated by shaded boxes.



Which pedigree tree shows an inherited genetic disease as a recessive trait?

35 Sickle-cell anaemia is a disease caused by recessive alleles that results in fatality during adolescence.

If two sickle-cell carriers mate, what percentage of adults would be homozygous?

A 25%
B 33%
C 50%
D 75%

36 Cats have the same inheritance pattern as humans in sex determination. In addition, the gene for cat coat colour lies on the X-chromosome. The allele for orange fur is X^O while the allele for black fur is X. Cats with heterozygous genotype have tortoise-shell coat colour (patches of orange and black).

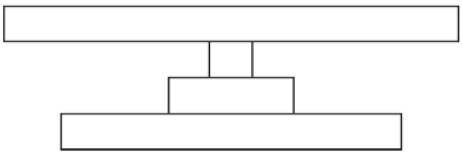
With reference to monohybrid inheritance and sex determination, which offspring cannot be produced when a tortoise-shell female cat is mated with an orange male cat?

A black female
B orange female
C orange male
D tortoise-shell female

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37 The diagram shows a pyramid of numbers.



Which food chain is best represented by this pyramid of numbers?

A grass → antelope → lion → flea

B mahogany tree → caterpillar → finch → lice

C microscopic plants → microscopic animals → small fish → shark

D pond plant → snail → large beetle → fish

38 Which statements about evolution are correct?

1 Phenotypic variation must be present for evolution to take place.
2 Selective breeding and natural selection do not take place at the same time.
3 A change in environmental conditions promotes evolution.
4 Artificial selection caused the removal of harmful mutations during evolution.

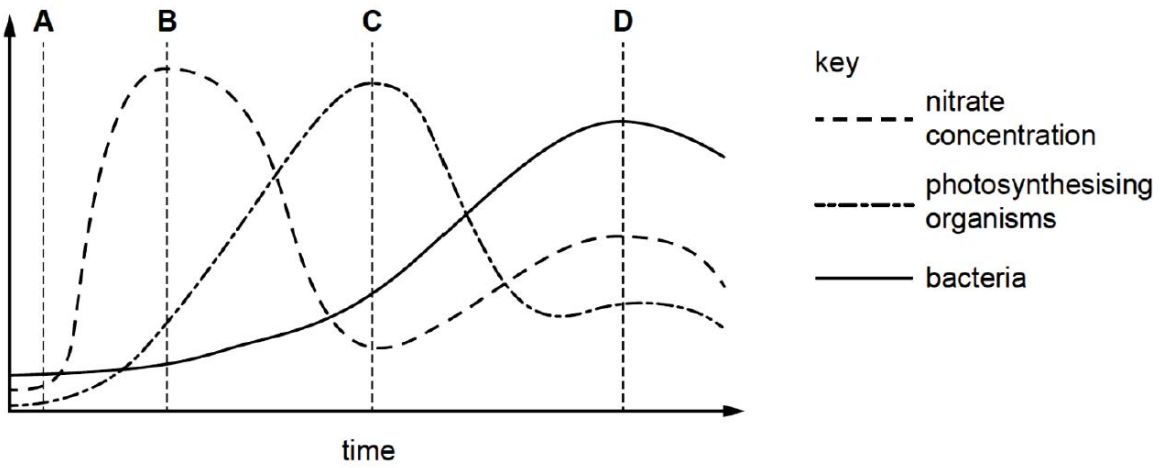
A 1 and 2

B 1 and 3

C 2 and 4

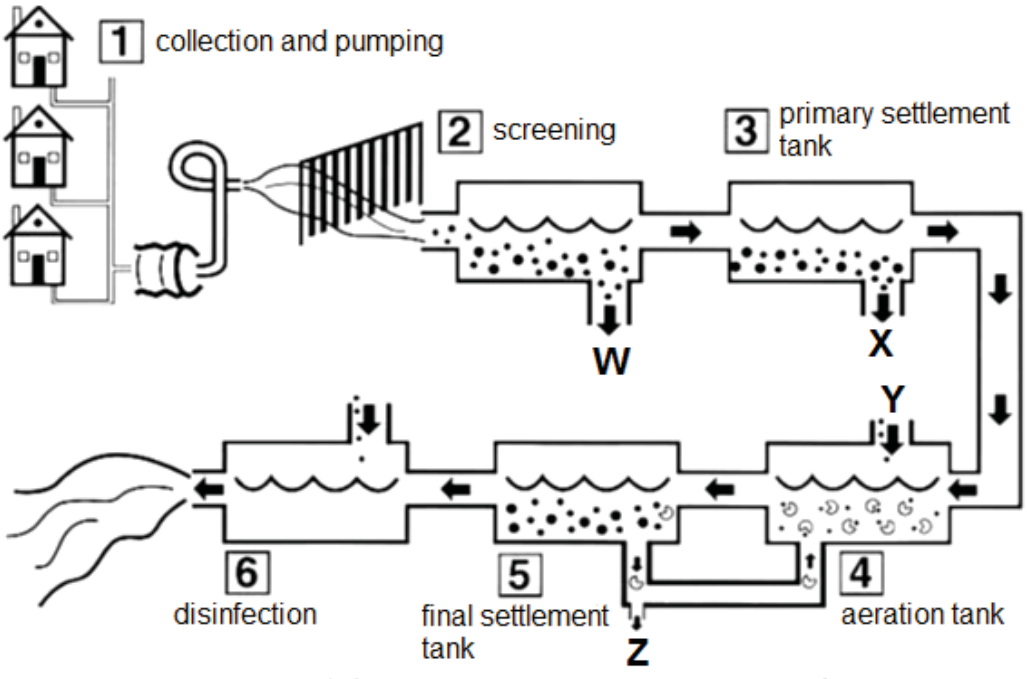
D 3 and 4

39 The graph shows changes in part of a lake after it has been polluted by fertilizer discharge from a nearby farm. At which time will the oxygen concentration in the water be lowest?



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40 The diagram shows how sewage is treated before it is released into water bodies.



Which correctly identifies **W**, **X**, **Y** and **Z**?

	W	X	Y	Z
A	sludge	microbes	oxygen	carbon dioxide
B	sludge	sewage	chlorine	microbes
C	grit and coarse materials	sludge	glucose	methane
D	grit and coarse materials	sludge	microbes	sludge

End of paper

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ZHONGHUA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2018

SECONDARY 4E

Candidate's Name	Class	Register Number
	4E4	

BIOLOGY **6093 /02**

13 September 2018
1 hour 45 minutes

Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces at the top of this page and on all separate answer paper used.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

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 **three** questions, the last question is in the form either/or.

Write your answers on the separate answer papers provided.

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.

All essential working must be shown clearly.

For Examiner's Use	
Section A	/50
B9	/10
B10	/10
B11	/10
Total	/80

Setter: Ms Rozianna & Mr Goh Tze Mian
Vetter: Mr Tan Li Chun

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Section A

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

1 A teacher wants to demonstrate the movement of substances. He placed two colours of candies (**X** and **Y**) in an alternating pattern along the perimeter of a plate. He then filled the plate with water. The final setup is shown in Fig. 1.1.

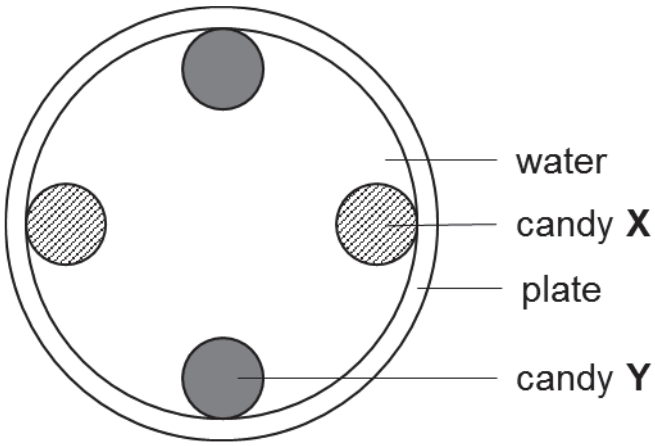


Fig. 1.1

The result of the experiment after 10 minutes is shown in Fig. 1.2.

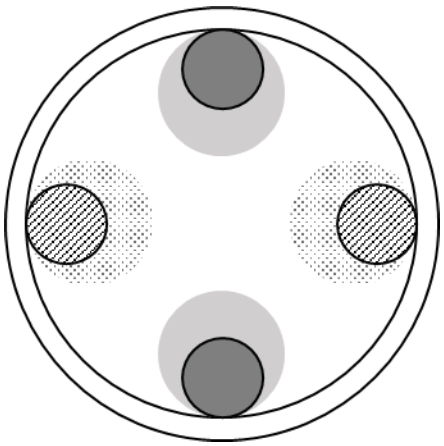


Fig. 1.2

(a) Describe what had happened to cause the colours from the candies to form a pattern in the water.

.....

.....

.....

..... [2]

Total marks:	

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A student suggested to add hot water instead so that the pattern formation occurs faster by *active transport*, since hot water has more energy than room temperature water.

(b) Explain why the student's explanation of *active transport* is incorrect.

.....

.....

.....

..... [2]

The teacher then created a more elaborate setup as shown in Fig. 1.3. He then let the experiment run for 10 minutes.

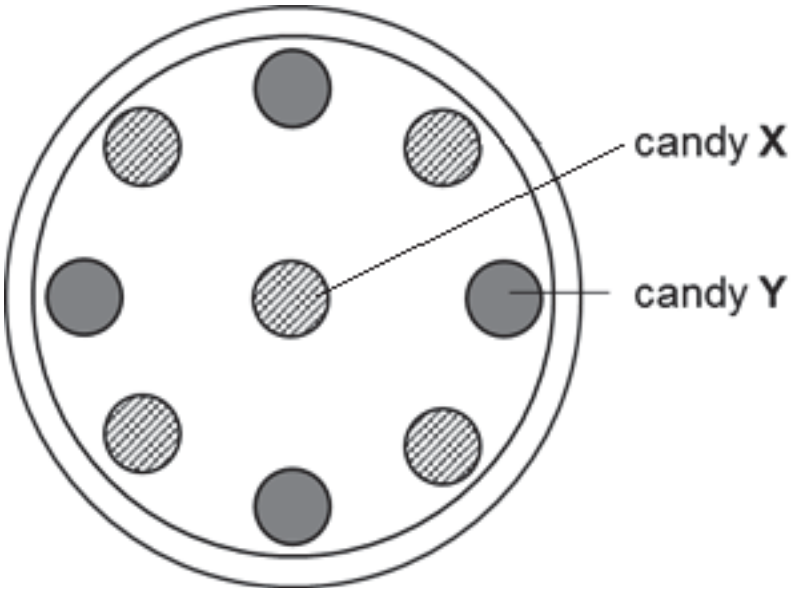


Fig. 1.3

(c) Draw arrows from the labelled candies (**X** and **Y**) on Fig. 1.3, to show the net movements of the colour molecules throughout the experiment. [1]

Total marks:	

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2 Fig. 2.1 shows a plant called the ghost plant. It is called a ghost plant because it is often completely white in colour.

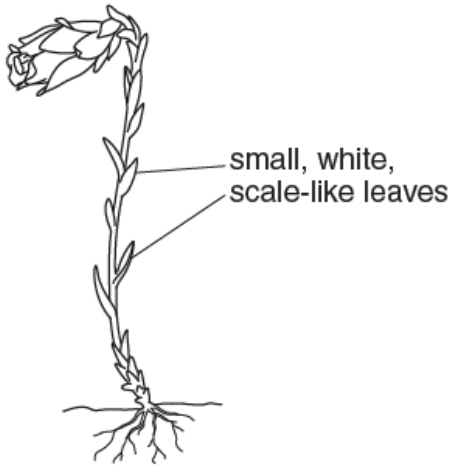


Fig. 2.1

The ghost plant has an unusual feeding relationship with an underground fungus and with a nearby tree, as shown in Fig. 2.2

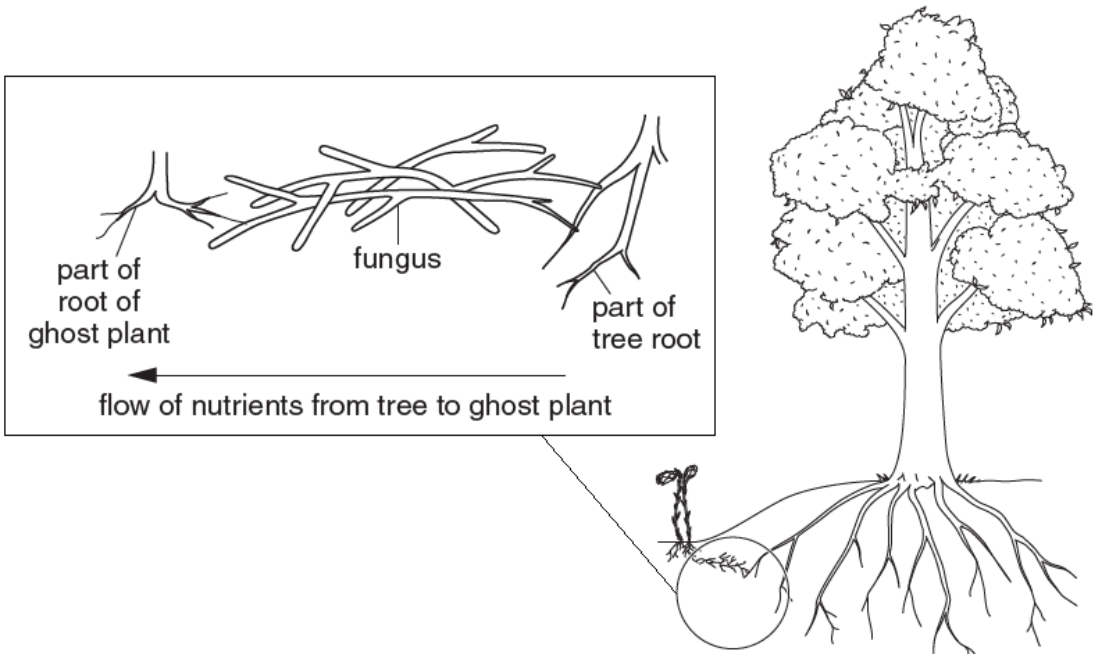


Fig. 2.2

Total marks:	

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(a) The flow of nutrients in the feeding relationship is shown by the arrow on Fig. 2.2.

Suggest one nutrient that flows from the tree to the ghost plant.

..... [1]

(b) Suggest why the leaves of the ghost plant do not possess stomata or large intercellular spaces.

.....

.....

.....

.....

.....

.....

.....

..... [4]

3 Table 3.1 shows the loss of water vapour by two similarly-sized potted plants, A and B, grown in the same environment over a period of 14 hours.

Table 3.1

time of day / hours	water vapour loss / arbitrary units	
	plant A	Plant B
06.00 – 08.00	1.0	5.2
08.00 – 10.00	2.0	13.8
10.00 – 12.00	5.8	14.8
12.00 – 14.00	4.8	9.2
14.00 – 16.00	3.6	6.8
16.00 – 18.00	3.0	4.4
18.00 – 20.00	2.0	1.0

Total marks:	

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(a) Suggest reasons for each of the following:

(i) the difference between the total amount of water vapour lost by plants A and B during the 14-hour period,

.....

.....

.....

..... [2]

(ii) the change in rate of water vapour loss by plant A from 06.00 hours to 12.00 hours.

.....

..... [1]

(b) The leaves of plant B have their lowest temperature at 12.00 hours.

Suggest reasons for this.

.....

.....

.....

..... [2]

4 Fig. 4.1 shows a kidney and its associated structures. The arrows show the direction of flow of fluids in these structures.

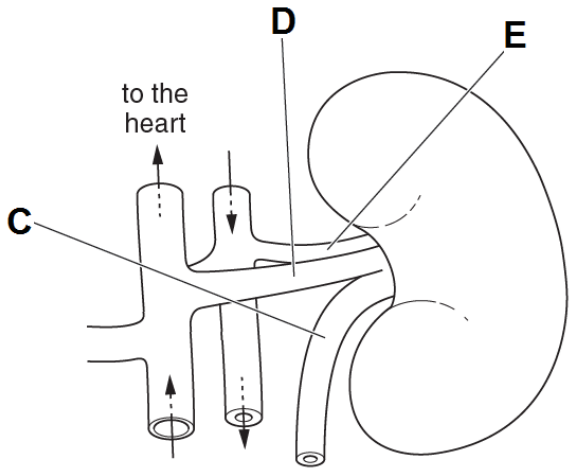


Fig. 4.1

Total marks:	

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(a) Table 4.1 shows the relative concentrations of various substances in structures **C** and **D**.

Complete the table to show the possible concentrations of these substances in structure **E**.

Table 4.1

substance	relative concentration in structure		
	C	**D**	**E**
amino acids	0.00	0.05	
glucose	0.00	0.10	
mineral ions	1.50	0.72	
proteins	0.00	8.00	
urea	2.00	0.03	

[5]

(b) Explain how the relative concentrations of glucose might change in structures **C**, **D** and **E** in a person with diabetes.

.....

.....

.....

.....

.....

..... [3]

Total marks:	

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5 Fig. 5.1 shows a horizontal section of the human eye and the pathway taken by light rays as they leave an object.

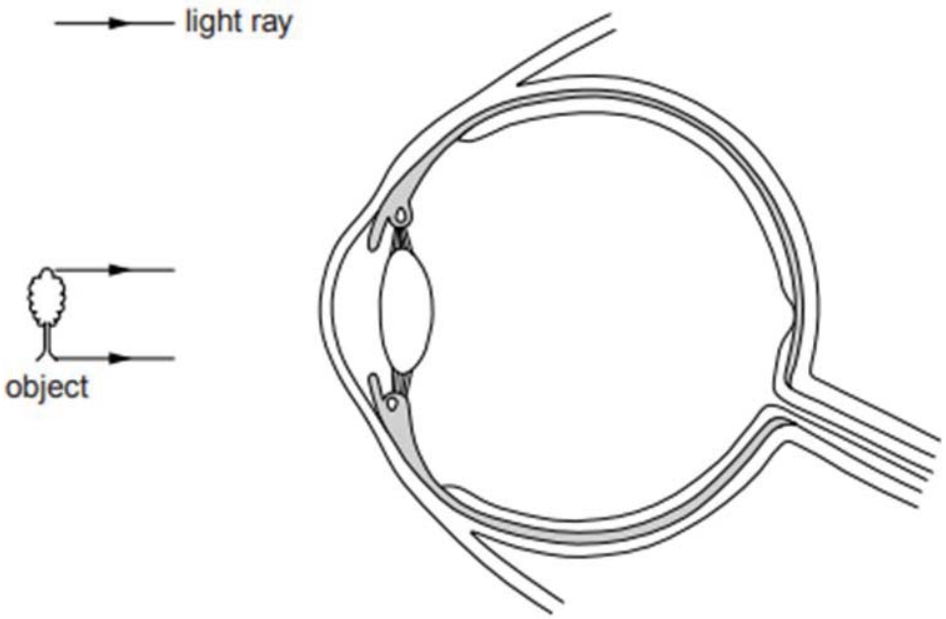


Fig. 5.1

(a) Complete the diagram by continuing the lines from the object to show how the light rays produce a focused image on the retina. [2]

(b) **(i)** State how the appearance of the pupil in the eye will change when a person moves from an area of dim light into an area of bright light.

..... [1]

(ii) Explain how this change is brought about by the structures in the eye.

.....

.....

..... [1]

(c) The change in appearance of the pupil when entering an area of bright light is a reflex action.

(i) Define *reflex action*.

.....

.....

..... [2]

Total marks:	

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(ii) Suggest why one should avoid consuming drugs that prevent this reflex action from occurring.

.....

.....

..... [2]

6 Fig. 6.1 shows a pair of chromosomes during meiosis in a cell in the human testis. The positions of the alleles of some genes are indicated.

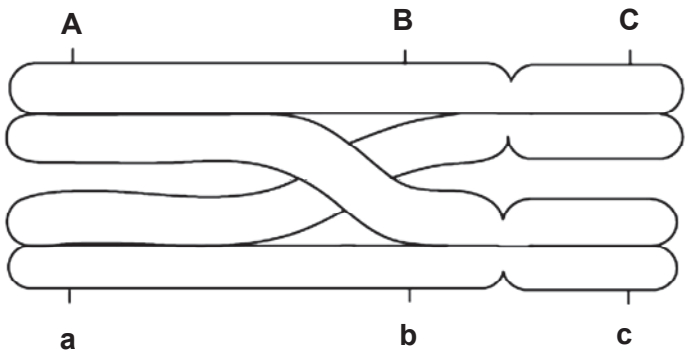


Fig. 6.1

(a) Deduce, with reasons, whether the chromosomes are

(i) autosomes or sex chromosomes

.....

.....

.....

.....

(ii) homologous or non-homologous

.....

.....

.....

..... [4]

(b) State the cell division stage that this cell is undergoing.

..... [1]

Total marks:	

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(c) At the end of meiosis, each of the chromatids in Fig. 6.1 will be in a different haploid cell.

Fig. 6.2 represents the chromatids inside the haploid cells.

Determine the combinations of alleles that would be present on each chromatid by indicating the gene sequence in Fig. 6.2.

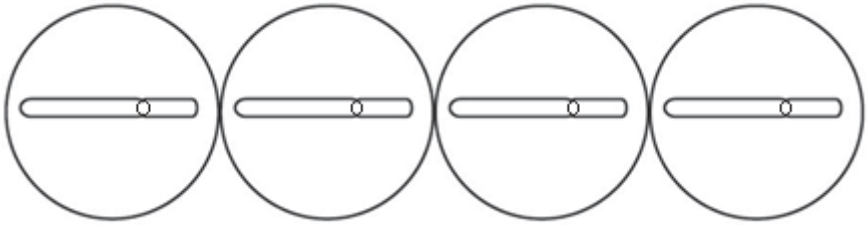


Fig. 6.2

[2]

7 Fig. 7.1 shows a family tree and the blood groups of each individual.

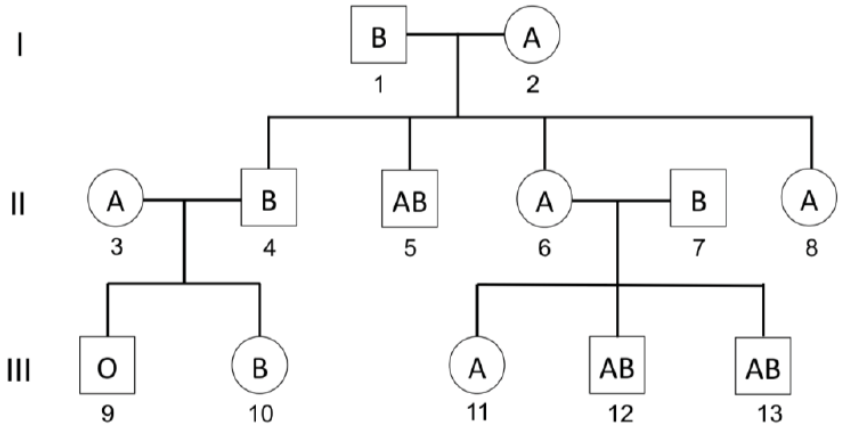


Fig. 7.1

(a) During a blood transfusion in humans, blood group O is considered universal donor. Explain why there is no agglutination in the recipient with blood group AB despite the presence of both antibodies a and b in blood group O.

.....

..... [1]

(b) State the number of heterozygous individuals in generation II.

..... [1]

Total marks:	

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(c) Is it possible for individuals 6 and 7 to have produced an offspring with blood type O? Construct a full genetic diagram in the space below to justify your answer.

[4]

8 An experiment was conducted to study the feeding relationships between four different species, **P**, **Q**, **R** and **S**. The organisms were separated into four different groups and placed into three covered containers.

Table 8.1 shows the contents of these containers at the beginning of the experiment and at the end of two weeks.

Table 8.1

container	contents at the beginning	contents after two weeks
I	**P**	disappeared
	R	unchanged
	S	unchanged
II	**R**	disappeared
	Q	unchanged
	S	unchanged
III	**P**	unchanged
	Q	dead
	S	disappeared

Total marks:	

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(a) Explain the following

(i) the disappearance of species **P** in container **I** and

.....

..... [1]

(ii) the death of species **Q** in bottle **III**.

.....

..... [1]

(b) **(i)** Construct a food chain to show the feeding relationship of the four species of organisms.

..... [1]

(ii) Which species in the food chain will get the least energy? Explain your answer.

.....

.....

.....

..... [2]

(c) Predict what would happen if all four species were placed into one container.

.....

..... [1]

Total marks:	

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Section B

Answer all **three** questions, the last question is in the form **EITHER** / **OR**.

Write your answers in the spaces provided.

9 Peas and beans belong to the same plant group, legumes. Seeds of legumes are known to contain protein.

(a) **(i)** Describe a practical test you could carry out on a fresh pea seed to show it contains protein.

[3]

(ii) Describe an investigation you could carry out using this test to compare the protein content of fresh pea seeds and fresh bean seeds.

[3]

Total marks:	

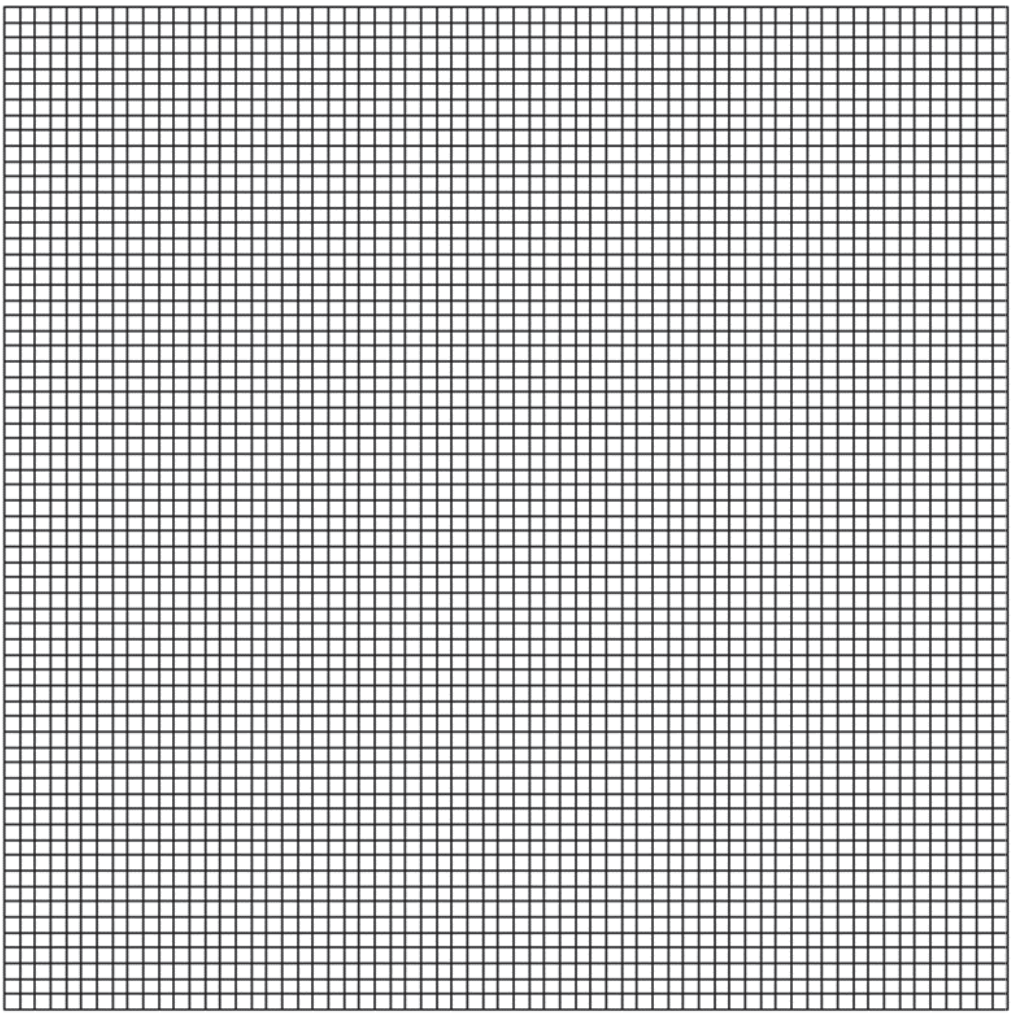
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Seeds of legumes are known to contain higher levels of protein than any other food plants. Table 9.1 shows the approximate masses of protein found in 100 g masses of some fruits and vegetables.

Table 9.1

type of fruit or vegetable	carrot	lentil	pea	potato	soya bean	tomato
mass of protein in g / 100g	1.0	23.5	19.0	5.0	22.0	1.5

(b) (i) Draw a bar chart on the grid below to show the protein content of these foods.



[3]

(ii) Of the types of fruits and vegetables named in Table 9.1, suggest which are legumes.

.....

[1]

Total marks:	

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10 **(a)** Compare and contrast gaseous exchange in humans and plants.

[3]

(b) Explain why the respiration rate of humans is relatively high and constant, while that of plants may vary widely.

[7]

Total marks:	

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EITHER

11 Fig 11.1 shows the flow of energy through a part of the carbon cycle.

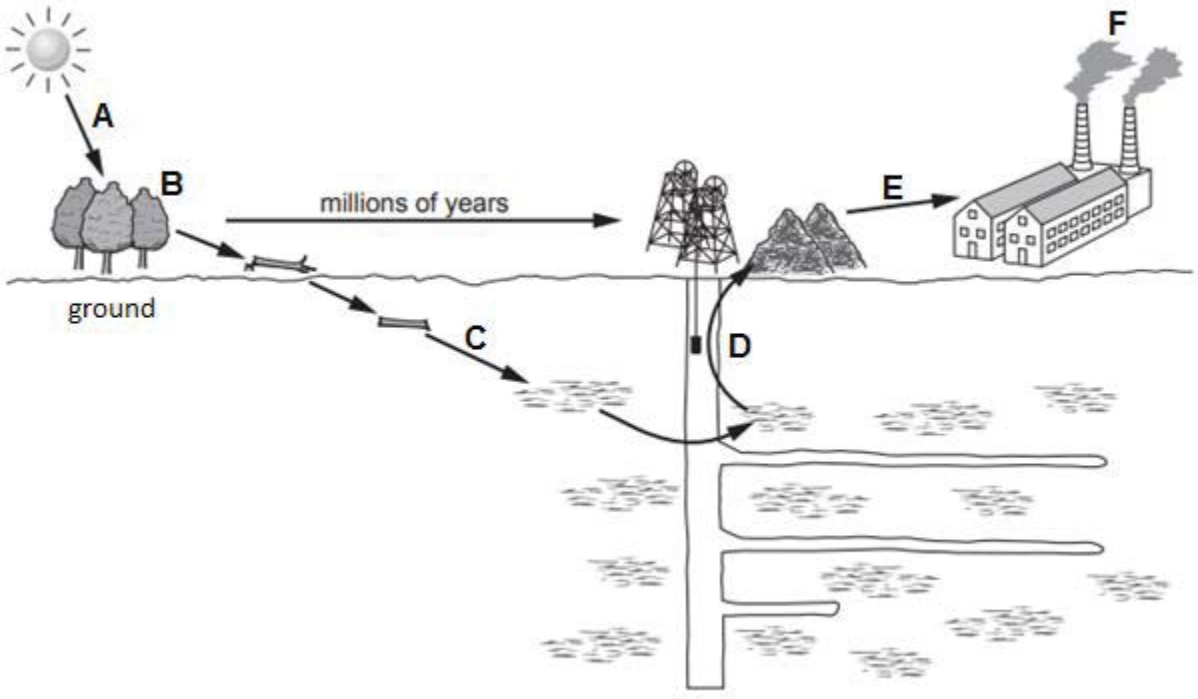


Fig. 11.1

(a) Describe how energy flows through this part of the carbon cycle with reference to what happens at each of the points **A** to **F**.

[7]

Total marks:	

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(b) Describe the harm to the environment as a result of human activities at points **D**, **E** and **F**.

[3]

OR

11 **(a)** In the past, insulin for insulin-deficient patients is extracted from the pancreas of slaughtered cattle and pigs.

In the recent years, human insulin can be produced via the insertion of appropriate genes into microorganism.

Describe how this process is carried out through the use of genetic engineering techniques.

[5]

Total marks:	

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(b) Discuss the advantages and disadvantages of such genetic engineering procedures as compared to the traditional method.

[3]

(c) State two other applications of genetic engineering.

[2]

End of paper

Total marks:	

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Secondary 4E Biology

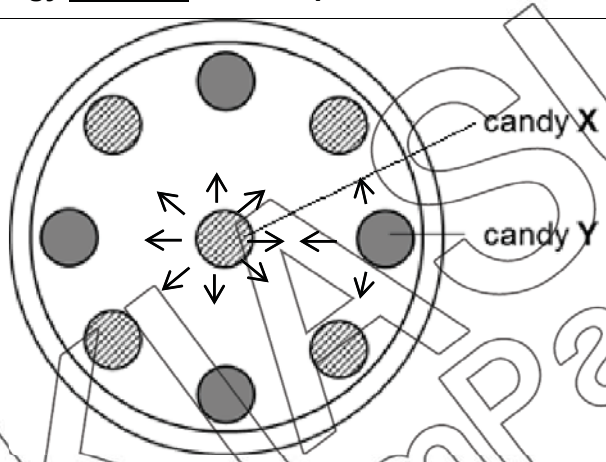
PAPER 1 [40 marks]

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

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2018 PRELIM EXAMINATION
Secondary 4E Biology
PAPER 2 Section A [50 marks]

Qn	Solutions	Marks	Remarks
1a	**Pigment / Colour molecules/particles** dissolved in the water Net movement of molecules from candies to centre of plate via **diffusion**	1 1	A few answers did not include "molecule". Many answers did not include net movement.
1b	Active transport requires a layer of **living cells** which uses **energy released from respiration.**	1 1	Some still have misconception that respiration "produces" energy.
1c	 Candy **X** – all around Candy **Y** – to the sides and towards candy X	1m for correct arrows	

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2a	carbohydrate / sucrose / glucose / sugar ; amino acids ; mineral salts / ions / nitrate ;	Any 1	
2b	1. no chlorophyll ; 2. no photosynthesis ; 3. **carbohydrates** obtained from other organism / cannot make carbohydrates 4. no CO2 requirement ; 5. reduced need for gas diffusion / gas exchange ; 6. ref. reduced / no transpiration / description ;	Max 4	Green colour comes from the pigment, chlorophyll and not chloroplast. Weaker answers just had "food", instead of specifying the nutrient. *Common answers*

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3ai	1 plants may be of different species ; 2 plant B + more / fast(er) transpiration ; 3 plant B + more / big(ger) leaves ; 4 plant B + more stomata / pores / guard cells OR stomata bigger / wider AW ; 5 plant B + better / big(ger) root system / absorbs more water ; 6 plant B + thin(ner) (waxy) cuticle ; 7 plant A + sunken stomata / hairy leaves ;	Max 2	
3aii	1 increased + light (intensity) ; 2 increased + temperature / heat ; 3 reference to wind OR increased + air movement ; 4 decreased + humidity ; 5 stomata / pores / guard cells + open /wider ;	Max 1	
3b	highest / fastest rate of transpiration / evaporation ~~(with) reference to previous 4 hours / between 8:00- 12:00 / from 8:00~~ ; (evaporation) cools (plant /leaves) / removes latent heat / temperature falls ;	1 1	Weaker answers did not link amount of water vapour loss to rate of transpiration / evaporation.

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4a	(amino acids) 0.05 ; (glucose) 0.10 to 0.15 ; (mineral ions) 0.72 to 2.22 ; (proteins) 8.00 ; (urea) 0.03 to 2.03 ;	1 1 1 1 1	
4b	C would contain some / more / high (glucose) / D would contain more / high (glucose) / E would contain more / high (glucose) ; lack of Insulin ; glucose would not be converted into glycogen ; kidney unable to/doesn't reabsorb all glucose ;	Max 3	In summary, **C, D and E have more glucose**. *not often seen*

5a	Rays continue to be parallel until it hits cornea Rays converge at cornea and lens Rays **meet before retina** and continues to hit on retina	½ ½ 1	Weaker answers had rays meeting **on** the retina.
5bi	pupil narrows / decreases in diameter / constricts (Reject contracts)	1	
5bii	**Circular muscles on iris** contract	1	
5ci	A fast / rapid / **immediate** response or reaction to a stimulus Automatic / **involuntary** / no involvement of conscious thought / cannot be controlled [Reject no involvement of the brain]	1 1	

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5cii	Too much light enters the inner part of eye Damage photoreceptors / rods / cones on the retina	1 1	
6ai	Autosomes Both chromosomes are of the same length/size ; OR As it belongs to a male organism, sex chromosomes X and Y have different length /size ;	1 1	
6aii	Homologous; Paired to form bivalent / crossing over between chromosomes ; OR Same gene sequence / same size and shape ;	1 1	
6b	Prophase I	1	

6c	ABC, abc, Abc, aBC	0.5m each	
7a	The antibodies a, b from the donor will be diluted by the high volume of plasma from the recipient.	1	Weaker answers had misconception that agglutination is dependent only on antibodies of recipient + antigen of donor.
7b	6	1	Many students indicated “5”.

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7c	Parental phenotype: A x B Parental genotype: I^AI^O x I^BI^O Gametes **(circled):** I^A I^O I^B I^O Random fertilization: Offspring genotype: I^AI^B I^AI^O I^BI^O I^OI^O Offspring phenotype: AB A B O **There is a** 25% **chance** of the couple having a child with blood group O	1 1 1 1	

8ai	P was eaten up by R	1	
8aii	Species R (source of food) was not available for Q	1	
8bi	S → P → R → Q	1	ECF allowed if evidence shown in ai and aii
8bii	Q; 90% of the energy is lost at every trophic level of the food chain / 10% of the energy is transferred from one trophic level to another;	1 1	
8c	Only species Q will exist in the bottle, while species S, P and R will disappear as there is no predator for Q present in the bottle;	1	

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9ai	seed ground / cut up /crushed ; add biuret solution / sodium or potassium hydroxide + copper sulphate; blue changes to purple/lilac/mauve/violet;	1 1 1	Biuret's = wrong
9aii	**same mass**/volume of each tissue tested ; **same volume**/concentration of reagent added ; left for **same length of time**; deeper/ darker colour = more protein ORA;	Any 2 1	This question is poorly done. Very few answers had the first 2 marks. Many students used "number of drops of Biuret solution" to deduce concentration of protein, which is wrong as the colour change is gradual.

9bi	1. axes fully labelled + linear scale for mass; 2. correct 'plots'; 3. sides of bars ruled + of equal width + space between each bar;	1 1 1	Best scale → 2cm = 5 Any wrong plots = 0m
9bii	pea + (soya) bean + lentil;	1	

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10a	**Compare (similarities)** same gases exchanged – CO_2, O_2 and water vapour ; both require a thin film of moisture to dissolve gases ; gas exchange moves by diffusion ; **Contrast (differences)** muscles in humans / no muscles in plants ; ref. intercostals / diaphragm ; humans need to keep (constant) supply of O_2 (to blood) / remove CO_2 (from blood) / ref. higher metabolic rate / rate of respiration in humans ; ref. production of (some of their own) oxygen by photosynthesis ; lungs / no lungs ; ref. stomata/spongy mesophyll in plants / not in humans / ref. alveoli in humans / no alveoli in plants ; stomata compared to mouth/nose ; intracellular spaces compared to lungs / alveoli ;	Max 3	Answers must have at least one similarity and one difference.

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10b	**(High respiration rate)** humans active / move / muscle N action (or described) / ORA ; requires large quantities of / more N energy / ORA ; high body temperature in humans / ORA ; activity of enzymes / high metabolic rate / ORA ; humans complex / named organs, e.g. brain, kidneys, heart ; **(Constant respiration rate)** homeostasis ; temperature constant in humans / thermoregulation ; rate dependent on external temperature in plants ; rate dependent on stage of life cycle, e.g. germination / growing season ;	4m 3m	R humans are larger This question was very poorly done. Common misconceptions: • breathing rate = respiration rate • photosynthesis can take over the role of respiration • photosynthesis happens in the day and respiration happens only at night

E11a	A – Sun releases light energy B – Light energy is absorbed by chlorophyll by trees / plants B – during photosynthesis to produce organic compounds (carbohydrates) B – light energy transformed into chemical energy C – death of the trees and buried in ground at high pressure	1 1 1 1 1	

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	D – decomposition of remains of trees leading to formation of fossil fuels E – fossil fuel / coal burned in industries / factories F – release of carbon dioxide into atmosphere	1 1 1 max 7	
E11b	D – mining of fossil fuels resulting in depletion of resources / scarring of countryside / damaging habitats [Reject: soil erosion] E and F – combustion of fossil fuels in factories releases oxides of sulfur or oxides of nitrogen resulting in acid rain E and F – combustion of fossil fuels releases carbon dioxide, leading to greenhouse effect	1 1 1	
O11a	Use **restriction enzyme** to cut gene that codes for insulin production in human to **create sticky ends** Use **same restriction enzyme** to cut bacterial **plasmid** to create complementary sticky ends as well Use **DNA ligase** to insert gene of interest into plasmid and join them up Use **heat or electric shock to increase permeability** of bacterial membrane to recombinant plasmid Once inserted into bacterial cell, plasmid replicates when bacterial cell replicates, producing new insulin Use of **fermenter to reproduce bacteria** Max 5	1 1 1 1 1 1 1 1	*seldom mentioned*

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O11b	**Advantages** Mass production of desired proteins is possible ; Risk of disease transmission from cattle or pigs is eliminated ; elimination of hindrance of use due to religious reasons ; Desirable traits can be selected and replicated in offspring ; Cheaper to mass produce ; **Disadvantages** Risk that wrong gene is altered which may cause cancer ; Genetic manipulation may pose yet unknown health risks to recipient ; Expensive to engineer ;	Max 3	Answer must contain at least one advantage and one disadvantage.
O11c	Disease-resistant genes can be inserted into plants to increase crop yield/ grow pest- or disease-resistant crops Desirable characteristics of crop can be genetically selected and selectively grown at various times of the year to provide continuous supply to market / grow seasonal crops at any time of the year *Any other logical answers are accepted, like increasing nutritional value of food or increasing growth rate of organism, as long as the example is not too similar to the production of insulin.*	1 1	

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