National Qualifications 2014

X707/75/02

Biology
Section 1—Questions

FRIDAY, 16 MAY

9:00 AM – 11:00 AM

Instructions for the completion of Section 1 are given on Page two of your question and answer booklet X707/75/01.

Record your answers on the answer grid on Page three of your question and answer booklet.

Before leaving the examination room you must give your question and answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

SQA ©

SECTION 1

1. Which structural feature is found in a plant cell and not in an animal cell?

A Nucleus

B Cell wall

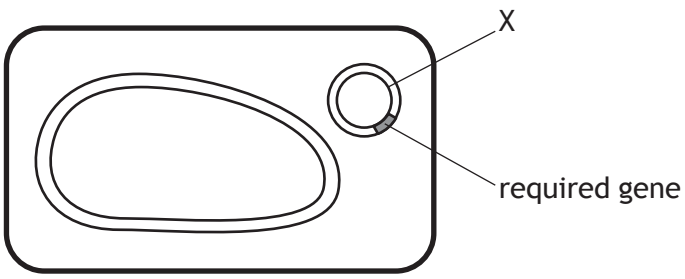
C Cell membrane

D Cytoplasm

2. Which line in the table below identifies the direction of diffusion of the three substances during muscle contraction?

	Substance		
	Glucose	*Oxygen*	*Carbon dioxide*
A	out	out	in
B	in	out	in
C	out	in	out
D	in	in	out

3. The diagram below represents a genetically engineered bacterial cell.



The structure labelled X is a

A chromosome

B plasmid

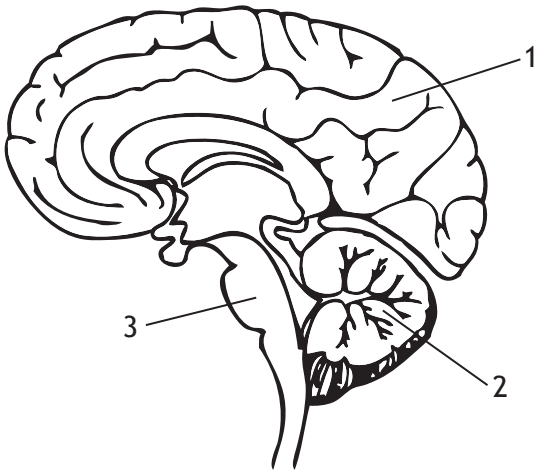
C ribosome

D nucleus.

4. The light energy for photosynthesis is captured by

A water
B hydrogen
C chlorophyll
D oxygen.

5. The diagram below represents the human brain.



Which line in the table below identifies structures 1, 2 and 3 of the human brain?

	Structure 1	*Structure 2*	*Structure 3*
A	medulla	cerebrum	cerebellum
B	cerebrum	medulla	cerebellum
C	cerebellum	cerebrum	medulla
D	cerebrum	cerebellum	medulla

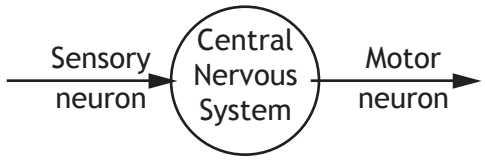
6. Proteins have different functions. Which of the following statements identifies a **protein** and its function?

A Hormones carry oxygen around the body.
B Enzymes carry chemical messages around the body.
C Antibodies defend the body against disease.
D Cellulose provides strength and structure to a plant cell wall.

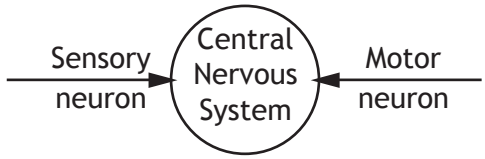
[Turn over

7. Which of the diagrams below identifies neurons and the direction of travel of nerve impulses?

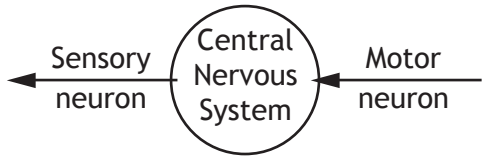
A



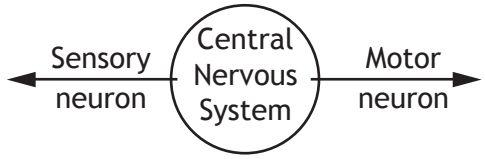
B



C



D



8. Which of the following pairs of human cells have the same number of chromosomes?

A Liver cell and sperm cell

B Kidney cell and sperm cell

C Kidney cell and liver cell

D Liver cell and egg cell

9. The table below shows the results of an investigation into the effect of temperature on egg laying in adult red spider mites.

Feature	*Temperature* (°C)		
	20 °C	25 °C	30 °C
Average length of egg laying period (days)	24	18	12
Average number of eggs laid per female during egg laying period	72	72	72

As the temperature increases, the average number of eggs laid per female per day

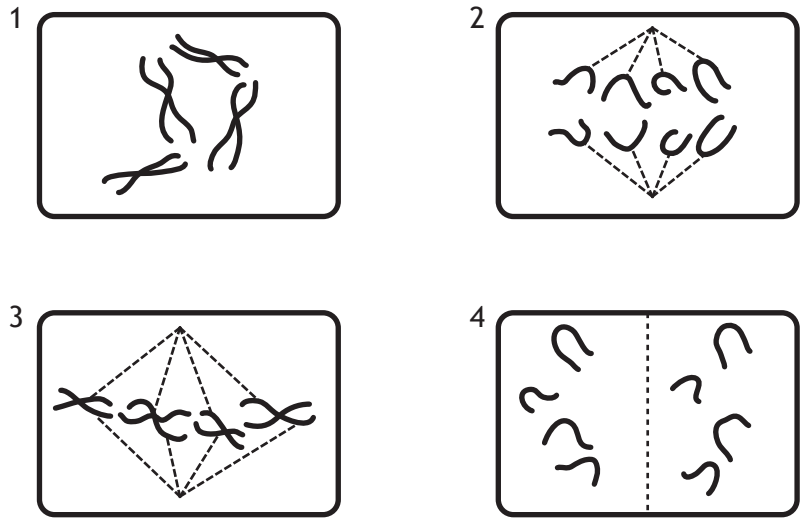
A increases

B decreases

C stays the same

D halves.

10. The following diagrams show a cell at four different stages of mitosis.



The correct order of the stages of mitosis is

A 1,3,2,4

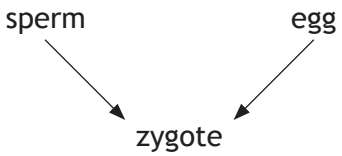
B 2,3,4,1

C 3,2,1,4

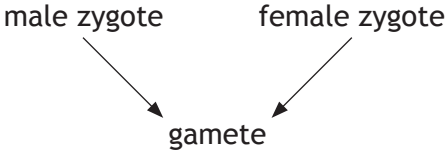
D 4,1,2,3.

11. Which of the following diagrams represents the process of fertilisation in plants?

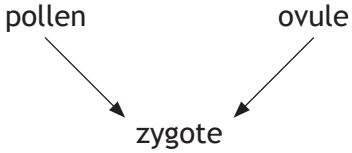
A



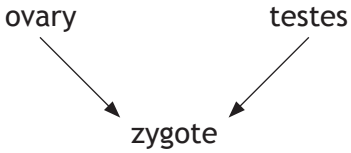
B



C



D

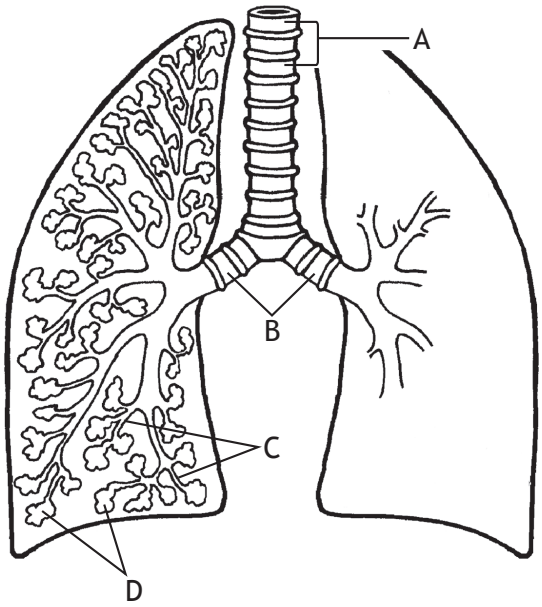


12. Variation in a characteristic can either be discrete or continuous. The range of heights and weights for a group of students were measured and recorded. Ear lobe types were also examined and categorised into groups.

Which line in the table below identifies the type of variation shown by each of these human characteristics?

	Height	*Weight*	*Ear lobe types*
A	continuous	continuous	discrete
B	discrete	continuous	continuous
C	discrete	discrete	continuous
D	continuous	discrete	discrete

13. The diagram below shows part of the human respiratory system.



Which letter identifies the alveoli?

14. Which line in the table below identifies abiotic and biotic factors?

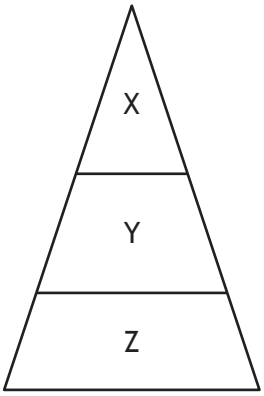
	Abiotic factor	*Biotic factor*
A	light intensity	pH
B	temperature	predation
C	grazing	light intensity
D	predation	grazing

[Turn over

15. A rabbit feeds on grass, is eaten by foxes and is a habitat for fleas.
The statement above describes the rabbit's

A ecosystem
B community
C niche
D prey.

16. The diagram below shows the pyramid of energy for a food chain.



There is a lot less energy at level X in the pyramid because

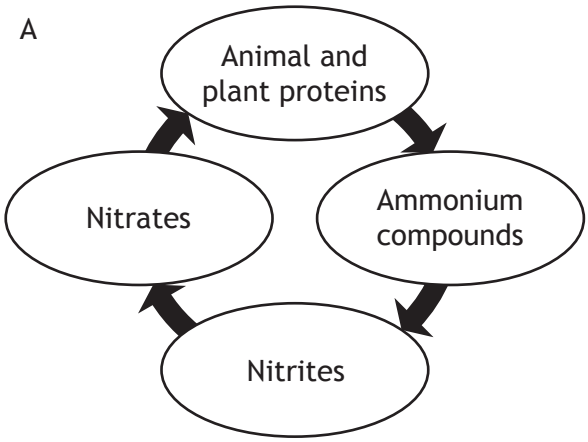
A there are fewer organisms at this level
B energy is stored at each level
C energy is lost at each level
D the organisms are bigger at this level.

17. In which of the following would competition **not** occur?

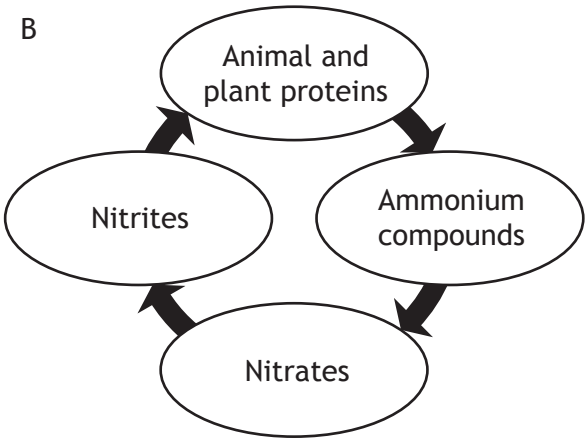
A Rabbits grazing in a field
B Owls and foxes hunting for mice
C Daisies and dandelions growing in a lawn
D Algae and fish in a loch

18. The following diagrams represent part of the nitrogen cycle. Which diagram shows the correct sequence of events in the nitrogen cycle?

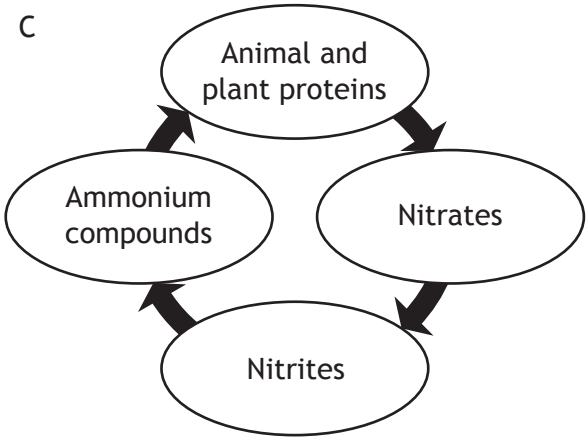
A



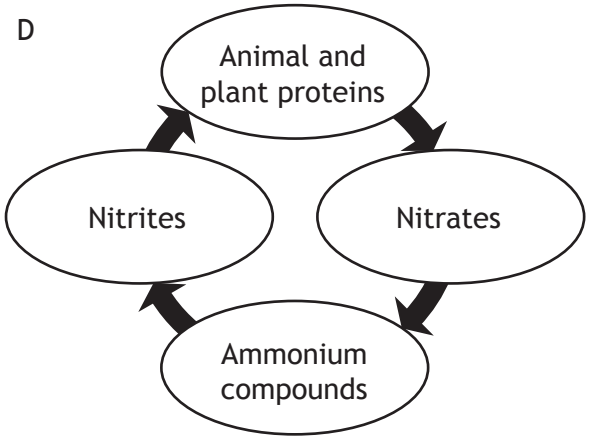
B



C



D



19. Students used a quadrat to estimate the number of buttercups in a field.

They threw the quadrat randomly three times in the area.

In order to improve the reliability of their results they could have

A asked another group of students to check that they had counted correctly

B thrown the quadrat ten times instead of three

C only thrown the quadrat when conditions were at an optimum

D used a smaller quadrat for each of their samples.

[Turn over for Question 20 on *Page ten*

20. The table below compares the rate of extinction of mammal species over two different time periods.

Time period (years)	*Rate of extinction per 100 years*
1500 – 1900	4·5
1900 – 2000	90

The ratio of extinction rates between 1900 – 2000 compared to 1500 – 1900 is

A 1:20

B 1:2

C 2:1

D 20:1.

[END OF SECTION 1. NOW ATTEMPT THE QUESTIONS IN SECTION 2 OF YOUR QUESTION AND ANSWER BOOKLET]

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FOR OFFICIAL USE

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National Qualifications 2014

Mark

X707/75/01

Biology
Section 1—Answer Grid and Section 2

FRIDAY, 16 MAY

9:00 AM – 11:00 AM

X7077501

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth

Day Month Year

D D M M Y Y

Scottish candidate number

Total marks — 80

SECTION 1 — 20 marks

Attempt ALL questions in this section.

Instructions for the completion of Section 1 are given on Page two.

SECTION 2 — 60 marks

Attempt ALL questions in this section.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers and rough work is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting. Any rough work must be written in this booklet. You should score through your rough work when you have written your final copy.

Use **blue** or **black** ink.

Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

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SECTION 1— 20 marks

The questions for Section 1 are contained in the question paper X707/75/02.
Read these and record your answers on the answer grid on Page three opposite.
Do NOT use gel pens.

1. The answer to each question is **either** A, B, C or D. Decide what your answer is, then fill in the appropriate bubble (see sample question below).

2. There is **only one correct** answer to each question.

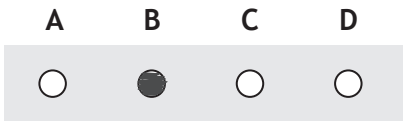
3. Any rough working should be done on the additional space for answers and rough work at the end of this booklet.

Sample Question

The thigh bone is called the

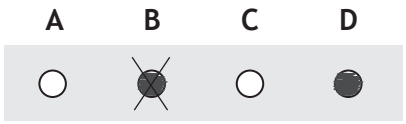
A humerus
B femur
C tibia
D fibula.

The correct answer is **B**—femur. The answer **B** bubble has been clearly filled in (see below).

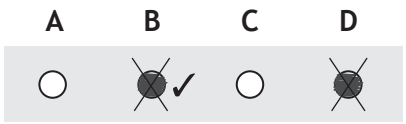


Changing an answer

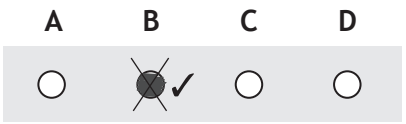
If you decide to change your answer, cancel your first answer by putting a cross through it (see below) and fill in the answer you want. The answer below has been changed to **D**.



If you then decide to change back to an answer you have already scored out, put a tick (✓) to the **right** of the answer you want, as shown below:



or



SECTION 1 — Answer Grid

0BJ20AD1

	A	B	C	D
1	○	○	○	○
2	○	○	○	○
3	○	○	○	○
4	○	○	○	○
5	○	○	○	○
6	○	○	○	○
7	○	○	○	○
8	○	○	○	○
9	○	○	○	○
10	○	○	○	○
11	○	○	○	○
12	○	○	○	○
13	○	○	○	○
14	○	○	○	○
15	○	○	○	○
16	○	○	○	○
17	○	○	○	○
18	○	○	○	○
19	○	○	○	○
20	○	○	○	○

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[Turn over for Question 1 on *Page six*

DO NOT WRITE ON THIS PAGE

SECTION 2 — 60 marks

Attempt ALL questions

MARKS | DO NOT WRITE IN THIS MARGIN

1. A group of students carried out an investigation into the variety of cell types.



The types of cell they examined are shown in the box below.

Animal	Plant	Bacterial	Fungal

(a) (i) Identify the type(s) of cell which have a cell wall. **1**

_____

(ii) Identify the type(s) of cell which have a plasmid. **1**

_____

(iii) Some organelles are found in all cells.

Choose one of the following organelles and tick (✓) the appropriate box.

Describe the function of the chosen organelle. **1**

Ribosome ☐ Mitochondria ☐

Function _____

_____

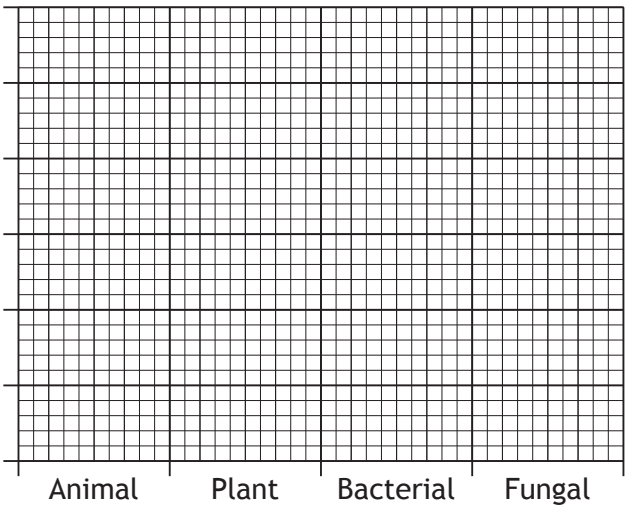
1. (continued)

(b) The students then measured a number of cells and calculated the average cell sizes. The results are shown in the table below.

Type of cell	*Average size of cell* (μm)
Animal	24
Plant	48
Bacterial	3
Fungal	7

On the graph paper below, complete the vertical axis and draw a bar chart to show the average size of the cells shown in the table. **2**

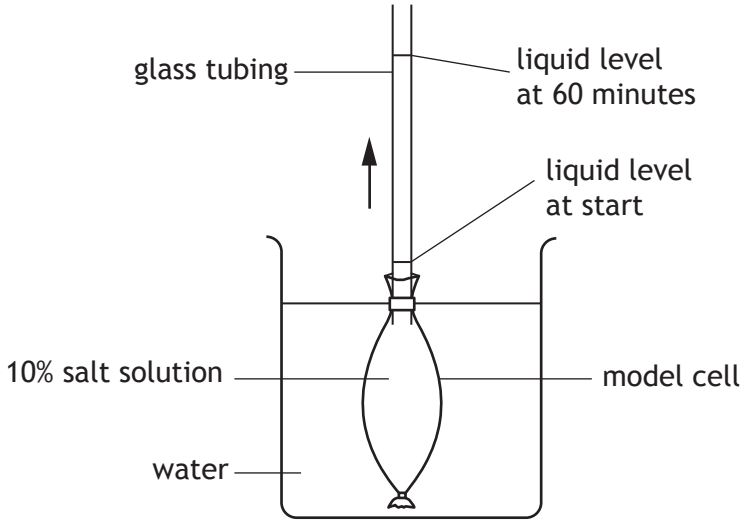
(Additional graph paper, if required, can be found on *Page twenty-six*)



Total marks 5

[Turn over

2. The apparatus shown below was used to investigate the movement of water into and out of a model cell. The model cell had a selectively permeable membrane.



The liquid level in the glass tubing was measured every 10 minutes for 60 minutes.

The results are shown in the table below.

Time (minutes)	*Liquid level* (mm)
0	10
10	22
20	32
30	40
40	48
50	56
60	64

(a) Name the process which caused the liquid level to rise. **1**

_____

2. (continued)

(b) Explain how this process caused the liquid level to rise. **2**

(c) Calculate the average rate of movement of liquid in the glass tubing. **1**

Space for calculation

_____ mm per minute

(d) When the investigation was repeated, the average rate of movement of liquid was slower.

Suggest **one** difference in the way that the investigation was set up that could have caused this change in results. **1**

Total marks 5

[Turn over

MARKS DO NOT WRITE IN THIS MARGIN

3. (a) Hydrogen peroxide can damage cells and lead to cell death. Catalase is an enzyme which breaks down hydrogen peroxide into oxygen and water.

Scientists in New Zealand investigated the link between the level of catalase in sheep livers and the fat in their meat. The hypothesis was that the higher the level of liver catalase, the greater the fat content of the meat.

In the investigation, they examined 9 sheep with a high percentage of fat and 15 sheep with a low percentage of fat. The sheep with the high percentage of fat had an average catalase level of 4800 K/g and those with the lower percentage of fat had an average catalase level of 3600 K/g.

The scientists concluded that their hypothesis was correct.

(i) Name the substrate of catalase. **1**

_____

(ii) Identify an aspect in the planning of the investigation that would suggest that the hypothesis might not be proven correct. **1**

_____

_____

(iii) A further investigation proved that the hypothesis was correct.

Describe how this investigation could help farmers to select only sheep with a low percentage of fat, to provide meat for consumers following a low fat diet. **1**

_____

_____

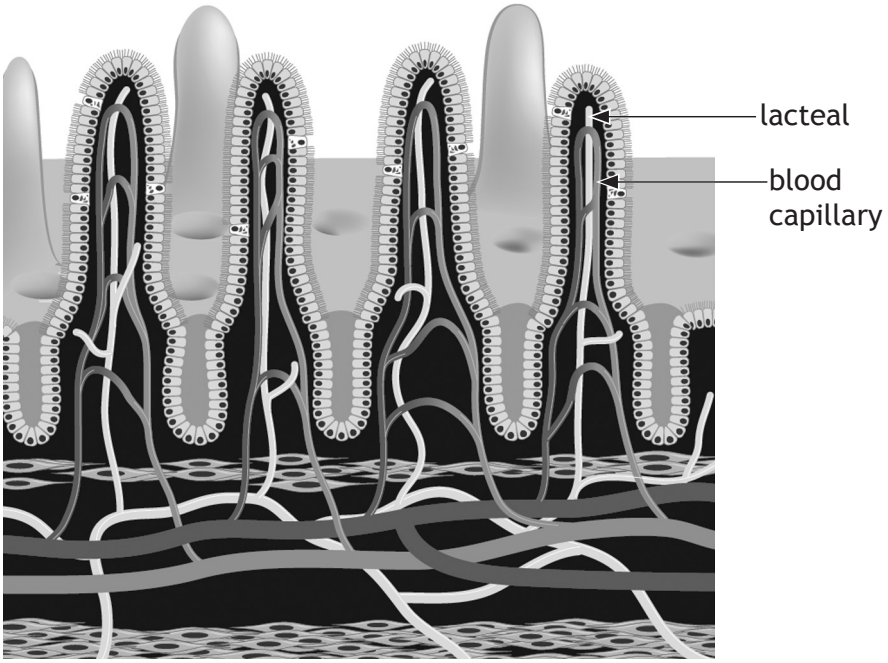
(b) The optimum temperature for the activity of catalase is 37°C.

Predict what would happen to the activity of catalase if the temperature was lowered to 34°C. **1**

_____

Total marks 4

4. The following diagram shows a cross-section of some villi in the small intestine.



Explain why the **structure and number** of villi make absorption an efficient process in the small intestine. **3**

MARKS | DO NOT WRITE IN THIS MARGIN

5. Photosynthesis is a two stage process.

Stage 1 — Light reactions

Stage 2 — Carbon fixation

(a) The table below shows some statements about photosynthesis.

Complete the table to show which stage each statement refers to by placing a tick (✓) in the Stage 1 or Stage 2 box.

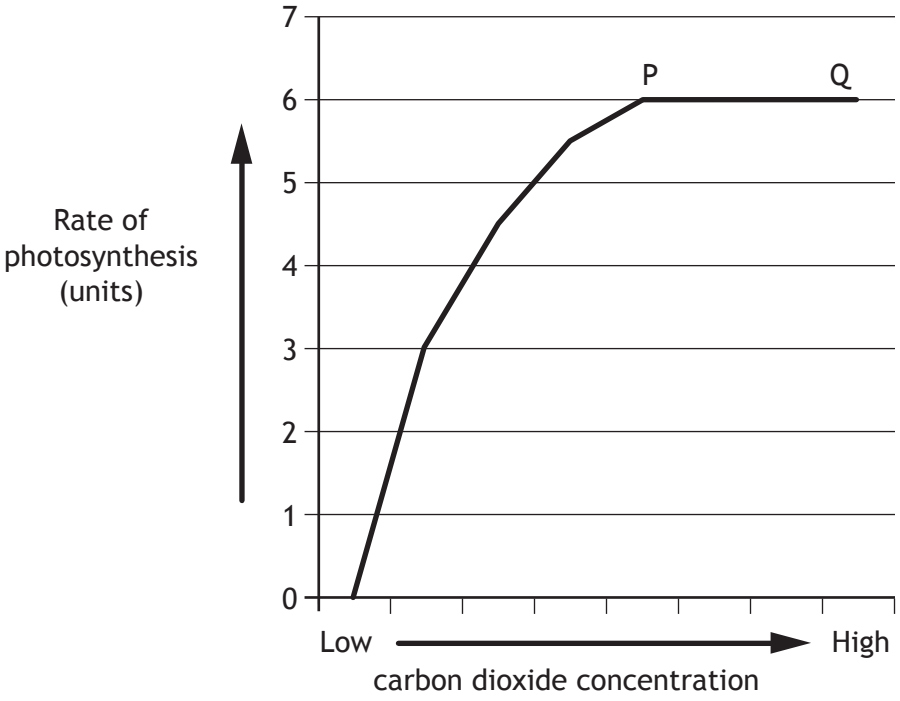
The first two statements have been completed for you. **2**

Statement	*Stage 1*	*Stage 2*
Carbon dioxide required		✓
Light energy required	✓	
Water required		
Sugar produced		
ATP + Hydrogen required		
Oxygen produced		

(b) Explain why high temperatures (above 50°C) would prevent the photosynthesis reactions from taking place. **2**

5. (continued)

(c) The graph below shows how the rate of photosynthesis is affected by the concentration of carbon dioxide.



State two environmental factors which could limit the rate of photosynthesis between points P and Q. **1**

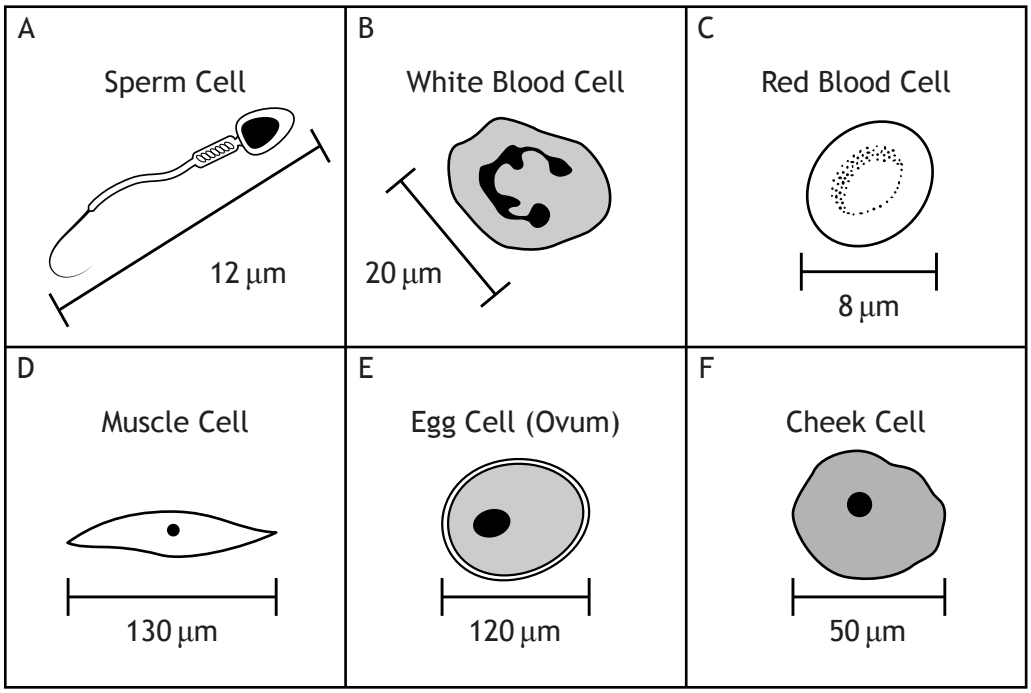
1 _____

2 _____

Total marks 5

[Turn over

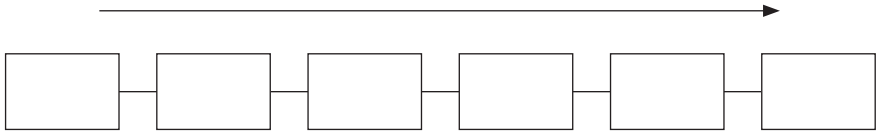
6. The diagrams below show examples of some types of specialised cells from the human body.



The cells are not drawn to the same scale.
(μm = micrometre)

(a) Put letters in the boxes below to arrange the cells in order of size. **1**

increasing size



(b) Choose one of the following cell types by (circling) it.

sperm cell egg cell red blood cell

Describe the function of the chosen cell and explain how its specialisation allows it to carry out that function. **2**

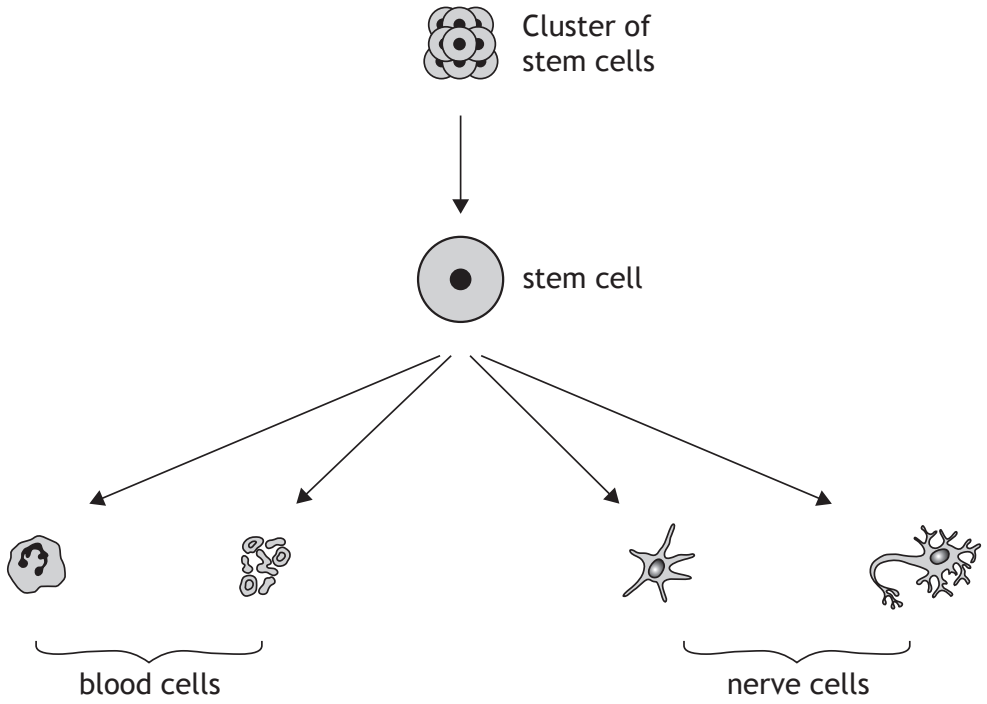
Function _____

Explanation _____

_____

6. (continued)

(c) The diagram below shows some stages in the development of blood cells and nerve cells.



Describe the feature of stem cells which gives them the potential to develop into many different types of cells, such as blood and nerve cells. **1**

(d) Which of the following statements refer to processes involving stem cells?

Tick (✓) the correct box(es). **1**

Growth of new skin	☐
Transmission of nerve impulses	☐
Muscle contraction	☐
Repair of broken bones	☐
Production of insulin	☐

Total marks 5

MARKS | DO NOT WRITE IN THIS MARGIN

7. Muscle tissue can be dark or light in colour.

Dark tissue cells use oxygen to release energy.

Light tissue cells do not use oxygen to release energy.

(a) Name the process by which energy is released in the dark tissue cells. **1**

_____

(b) (i) Name the substance which muscle cells break down to produce pyruvate. **1**

_____

(ii) When pyruvate is being formed, enough energy is released to form two molecules of a high energy compound.

Complete the word equation below to show how this compound is generated. **1**

_____ + _____ ⟶ _____

(c) The table below shows the average percentage of dark and light tissue cells. These cells were found in the muscles of athletes training for different events at the 2014 Commonwealth games in Scotland.

Type of Athlete	*Average percentage of dark tissue cells* (%)	*Average percentage of light tissue cells* (%)
cyclist	60	40
swimmer	75	25
shot putter	40	60
marathon runner	82	18
sprinter	38	62

(i) Using information in the table, identify which type of athlete would be likely to produce the most lactic acid in their muscle cells. Justify your answer. **2**

Type of athlete _____

Justification _____

_____

7. (continued)

(ii) A sample of muscle tissue from an athlete was examined and found to contain a total of 360 cells.

90 of these cells were light tissue cells.

Identify which type of athlete the sample was taken from. **1**

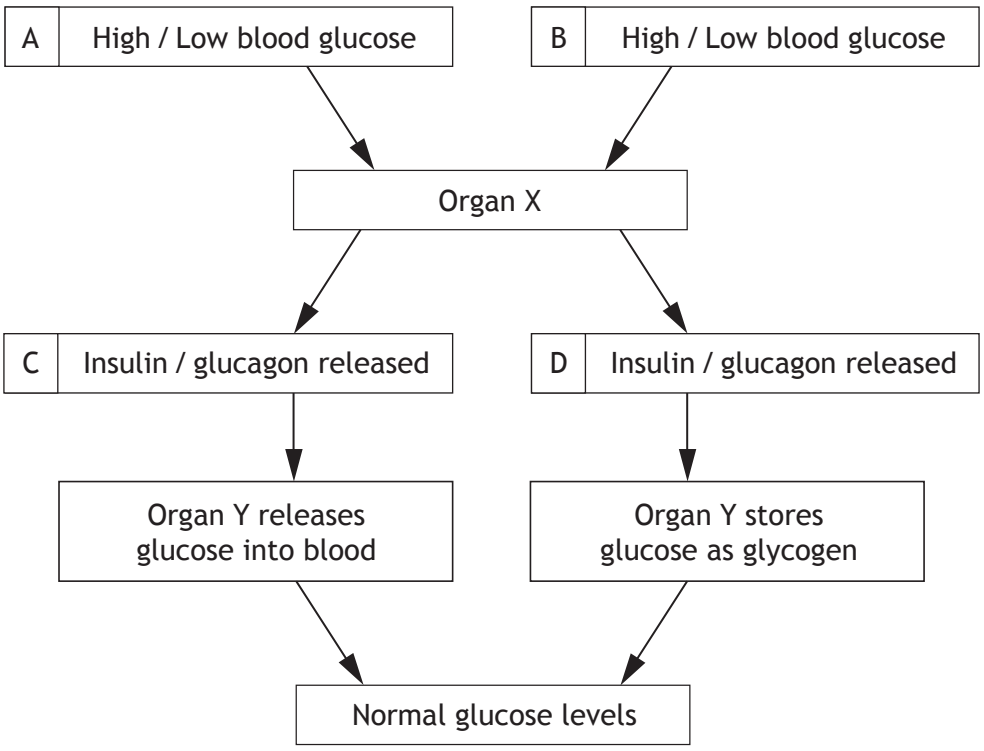
Space for calculation

Type of athlete _____

Total marks 6

[Turn over

8. (a) The regulation of glucose in the blood is represented in the diagram below.



(i) The diagram above has two options in each of the four boxes A, B, C, D.

Circle the correct option in each box. **2**

(ii) Identify organs X and Y. **2**

Organ X _____

Organ Y _____

(b) Insulin and glucagon are hormones.

Describe two features of hormones. **2**

1 _____

2 _____

Total marks 6

9. Coat colour in Labrador dogs is an inherited characteristic. Black coat (**B**) colour is dominant to chocolate coat colour (**b**).



(a) A homozygous black Labrador was crossed with a Labrador with a chocolate coloured coat.

Complete the diagram below to show the genotypes of each of the parents and the F_1 phenotype. **2**

Parents: black coat X chocolate coat

Genotypes: [ ] [ ]

F_1 genotype: All Bb

F_1 phenotype: [ ]

(b) (i) Explain what is meant by polygenic inheritance. **1**

_____

_____

(ii) State the type of variation shown by polygenic inheritance. **1**

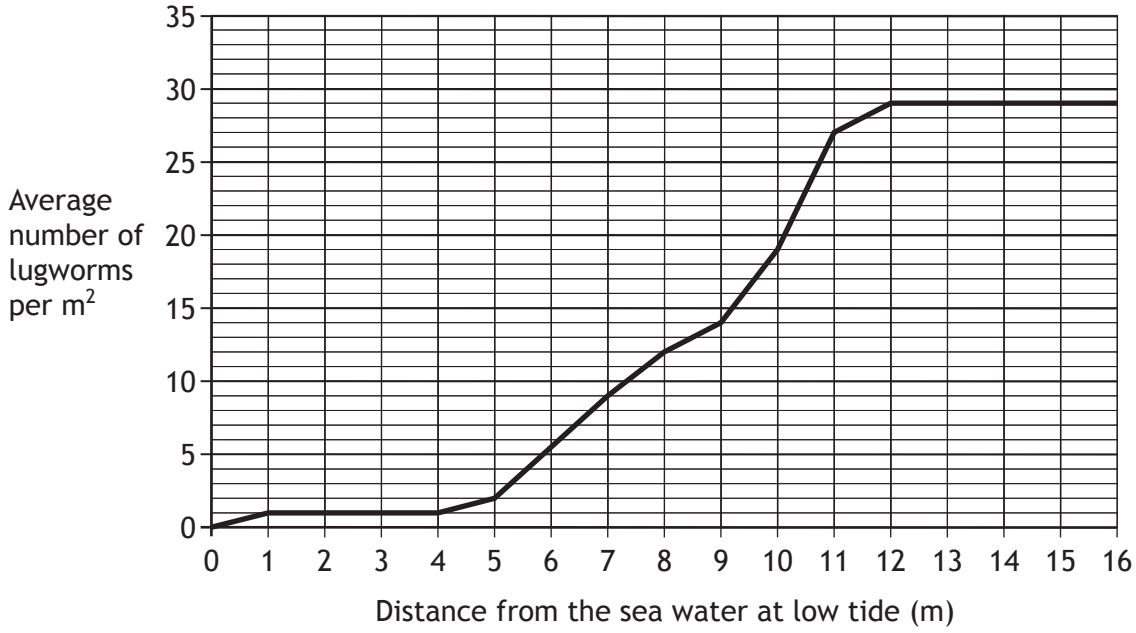
_____

Total marks 4

[Turn over

10. (a) Lugworms live on the seashore in dark moist burrows under the sand.

The graph below shows the average number of lugworms at different distances from the seawater at low tide.



(i) Describe the relationship between the distance from the seawater at low tide and the average number of lugworms per m^2. **2**

(ii) Calculate how many times greater the average number of lugworms at 11 metres is compared to 7 metres from the seawater at low tide. **1**

Space for calculation

_____ times greater

10. (continued)

(b) Dover sole and rex sole are different species of flatfish and are predators of lugworms. Curlews, which are a species of wading bird, also feed on lugworms.

(i) Complete the table below by placing a tick (✓) in the correct box to show the type of competition that would occur between the different predators. **1**

Predator	*Type of Competition*	
	Intraspecific	*Interspecific*
rex sole and curlew		
curlew and curlew		
rex sole and dover sole		

(ii) A curlew gains an average of 165 kilojoules (kJ) of energy daily, by feeding on lugworms.

Select, from the following list, the value of the energy which is used for growth each day by the curlew.

Tick (✓) the correct box. **1**

165 kJ ☐

148·5 kJ ☐

16·5 kJ ☐

0 kJ ☐

Total marks 5

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

11. During a woodland survey, a group of students measured some abiotic factors. Readings they took included the temperature of the soil and the air.

(a) Name one abiotic factor, other than temperature, which they could have measured in the woodland and describe the method of measuring this factor. **2**

Abiotic factor _____

Method _____

_____

_____

(b) (i) During the survey, the students sampled the leaf litter in the woodland using pitfall traps.

However, when they checked the pitfall traps four days after setting them up, the students discovered that they were all empty.

Describe an error the students might have made which would explain why there were no invertebrates in the traps. **1**

_____

_____

_____

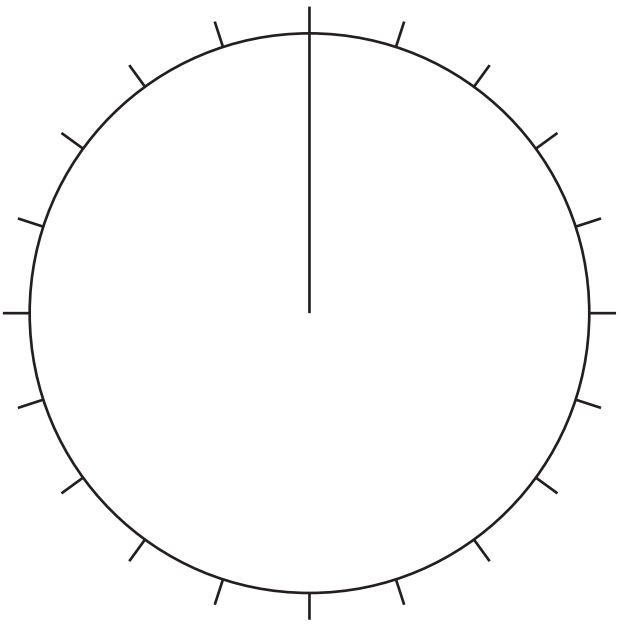
11. (b) (continued)

(ii) The error was corrected and the students set out the pitfall traps once again. The table below shows the types of invertebrates and numbers found.

Invertebrates	*Number found*
Woodlice	35
Beetles	20
Slugs	0
Spiders	30
Snails	15

Use the information in the table to complete the pie chart below. **2**

(An additional pie chart, if required, can be found on *Page twenty-six*.)



(c) The students saw a large number of butterflies in the woodland.

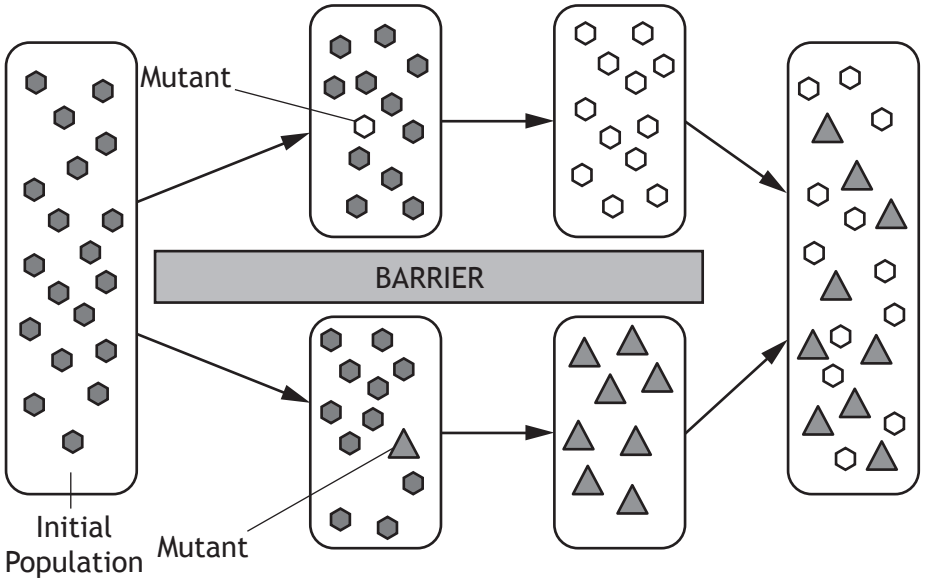
Give a reason why no butterflies were collected with the invertebrates. **1**

_____

_____

Total marks 6

12. The following diagram shows the stages in the formation of a new species.



(a) Using the information in the diagram, describe how new species are formed. **4**

12. (continued)

(b) Choose either mutation or species and tick (✓) the appropriate box.
Give a definition of the chosen term. **1**

Mutation ☐ Species ☐

Definition _____

_____

_____

(c) In any population, variation exists. Explain why variation is important for the survival of a population. **1**

_____

_____

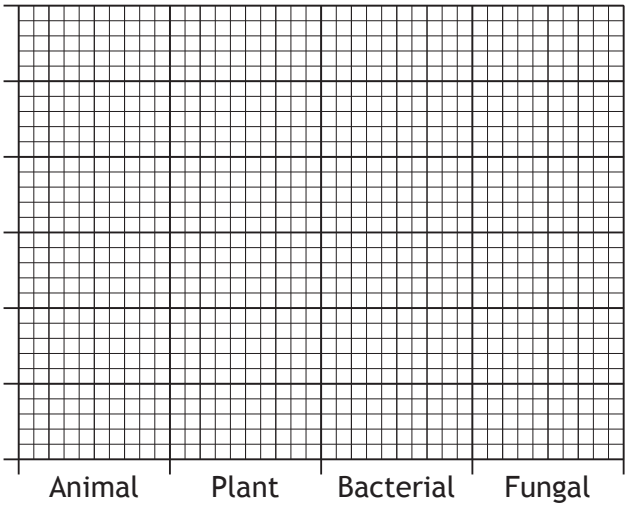
Total marks 6

[END OF QUESTION PAPER]

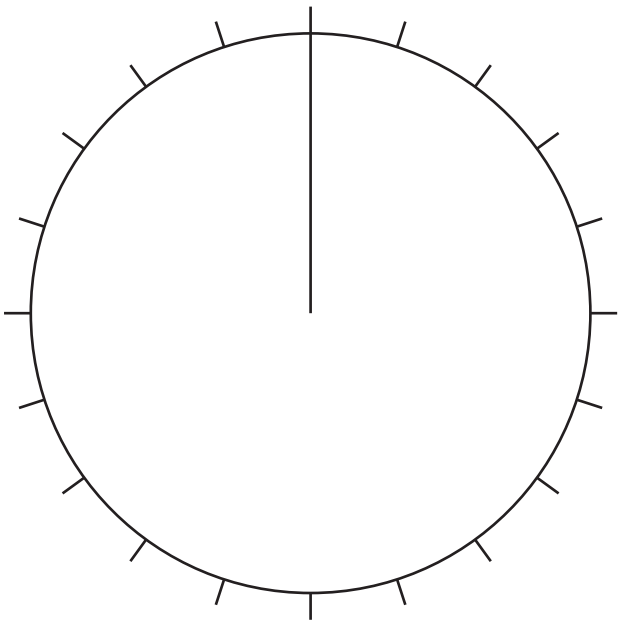
MARKS | DO NOT WRITE IN THIS MARGIN

ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR QUESTION 1(b)



ADDITIONAL PIE CHART FOR QUESTION 11(b)



MARKS | DO NOT WRITE IN THIS MARGIN

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

MARKS | DO NOT WRITE IN THIS MARGIN

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

ACKNOWLEDGEMENTS

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