National
Qualifications
2018

X740/76/02

Human Biology
Section 1 — Questions

TUESDAY, 15 MAY
1:00 PM – 3:30 PM

Instructions for the completion of Section 1 are given on *page 02* of your question and answer booklet X740/76/01.

Record your answers on the answer grid on *page 03* 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.

SECTION 1 — 20 marks

Attempt ALL questions

1. Each type of human cell has a different structure and function because

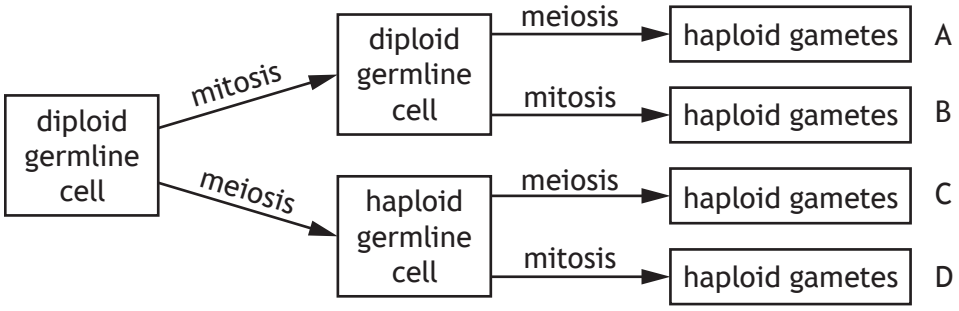
A they contain different genes

B different genes are expressed in each

C some genes are lost during differentiation

D some genes are gained during differentiation.

2. Which pathway describes the production of haploid gametes from diploid germline cells?



3. The table shows the number of dividing and non-dividing cells in samples of three types of tissue.

Type of tissue	*Number of cells dividing*	*Number of cells not dividing*
nerve	8	17
blood	4	16
muscle	1	19

The percentage of connective tissue cells which are dividing is

A 5%

B 20%

C 25%

D 32%

4. A fragment of DNA contained 144 nucleotide base pairs.

What is the total number of deoxyribose sugars in this fragment?

A 48

B 72

C 144

D 288

5. The table shows the positions of bases in the mRNA codons for specific amino acids.

	Second position				
First position	U	C	A	G	*Third position*
U	phenylalanine	serine	tyrosine	cysteine	U
					C
	leucine		stop	stop	A
			stop	tryptophan	G
C	leucine	proline	histidine	arginine	U
					C
			glutamine		A
					G
A	isoleucine	threonine	asparagine	serine	U
					C
	start/ methionine		lysine	arginine	A
					G
G	valine	alanine	aspartic acid	glycine	U
					C
			glutamic acid		A
					G

Which of the following mutations in a section of mRNA would result in the production of a shortened protein?

	Original mRNA codons	*Mutated mRNA codons*
A	..... AUG GCC CAU	..... AUG GCA CAU .....
B	..... CAG UAC GUG	..... CAG UAG GUG .....
C	..... AAU UGG CCA	..... AAU UGU CCA .....
D	..... GUC AAC UCG	..... GUC AAG UCG .....

6. A mature mRNA transcript is produced from a primary mRNA transcript by

A adding exons
B adding introns
C removing exons
D removing introns.

7. DNA probes are short fragments of DNA that

A allow RNA polymerase to begin transcription
B allow DNA polymerase to begin DNA replication
C are used to detect specific sequences in samples of DNA
D bind to specific target sequences in the PCR reaction to amplify DNA.

8. The list shows some of the substances produced during the respiration of glucose in the presence of oxygen.

1 acetyl group
2 pyruvate
3 citrate
4 ATP

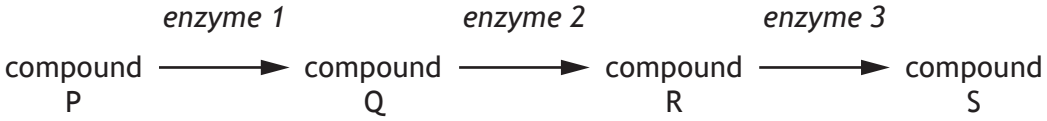
Which of the following sequences shows the order in which these substances are produced?

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

9. In cellular respiration, the products of the electron transport chain are

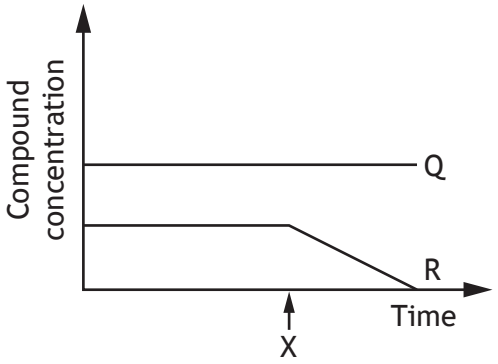
A water and ATP
B oxygen and ATP
C NADH and $FADH_2$
D carbon dioxide and water.

10. The following diagram shows an enzyme-controlled metabolic pathway.

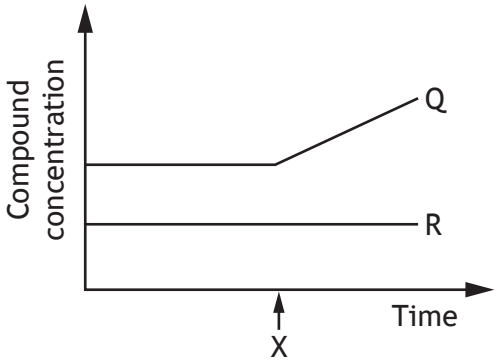


If enzyme 2 is inhibited at time X, which graph predicts the resulting concentrations of compounds Q and R?

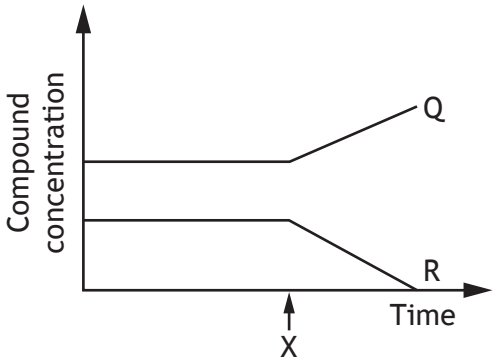
A



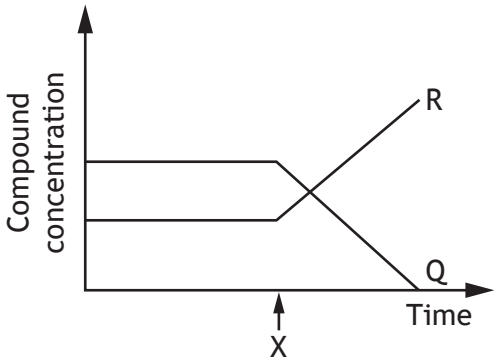
B



C

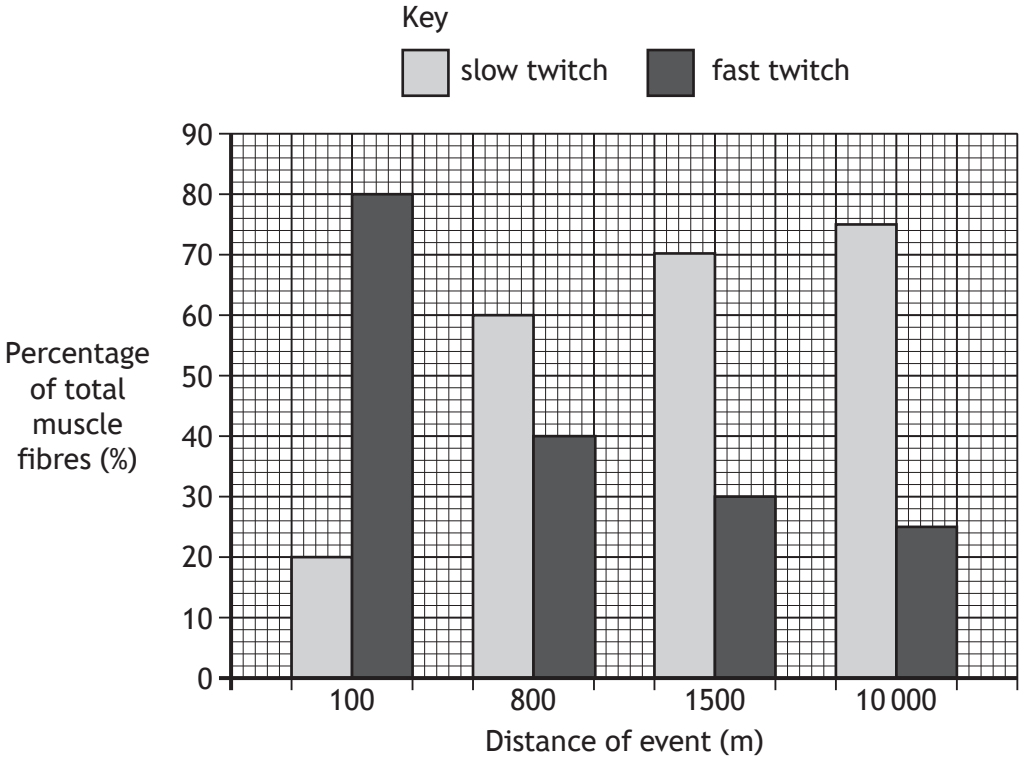


D



[Turn over

11. The graph shows the percentage of slow and fast twitch muscle fibres present in athletes who trained for events of different distances.



Which of the following conclusions can be drawn from this graph?

A Athletes who trained for the 100 m event have 5 times more fast twitch muscle fibres than slow twitch muscle fibres.

B Athletes who trained for the 10 000 m event have 4 times more slow twitch muscle fibres than fast twitch muscle fibres.

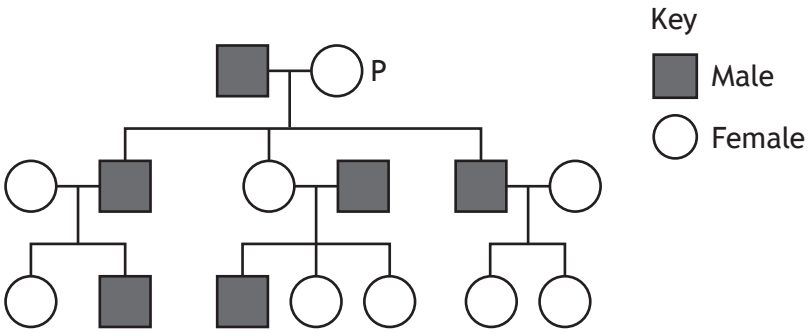
C Athletes who trained for the 800 m event have twice as many slow twitch muscle fibres as athletes in the 1500 m event.

D Athletes who trained for the 100 m event have twice as many fast twitch muscle fibres as athletes in the 800 m event.

12. The mitochondria of human cells contain DNA.

Women can pass mitochondrial DNA to their offspring but men cannot.

The diagram shows a family tree.



Identify the number of individuals in the family tree that have inherited mitochondrial DNA which originated from P.

A 3

B 4

C 5

D 6

13. Thalassaemia is an inherited condition that affects the ability of haemoglobin to carry oxygen. The condition is **not** sex-linked.

The table shows genotypes and phenotypes associated with thalassaemia.

Genotype	*Phenotype*
AA	unaffected
AT	thalassaemia trait
TT	severe thalassaemia

An unaffected man and a woman with thalassaemia trait have a child.

The chance that the child will also have thalassaemia trait is

A 0%

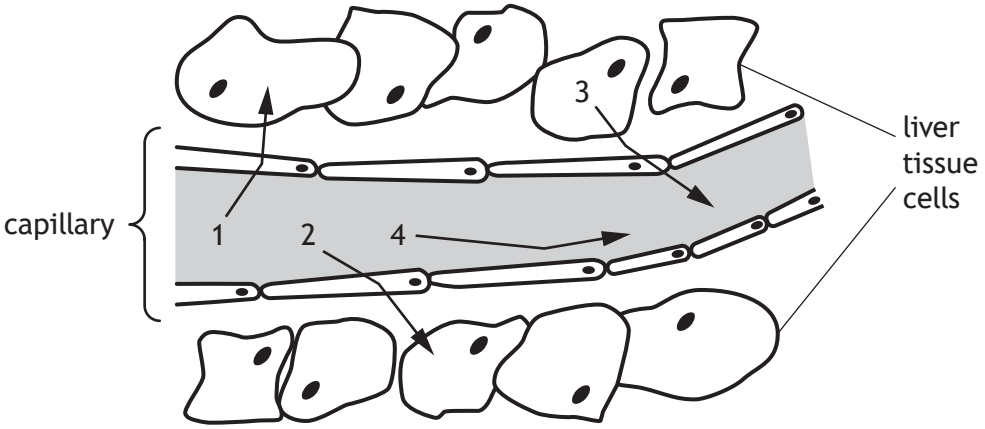
B 25%

C 50%

D 100%

[Turn over

14. The diagram shows the movement of substances between a capillary and the surrounding liver tissue cells.



Which row in the table identifies the substances in the diagram?

	Substance			
	1	2	3	4
A	glucose	carbon dioxide	oxygen	protein
B	oxygen	glucose	carbon dioxide	protein
C	protein	glucose	oxygen	carbon dioxide
D	protein	oxygen	carbon dioxide	glucose

15. During the formation of a thrombus, fibrin

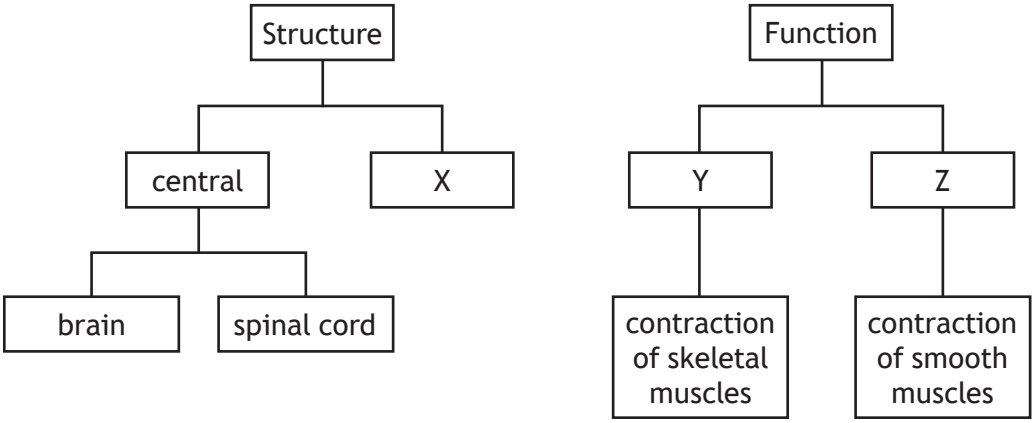
A converts prothrombin to thrombin

B causes the formation of fibrinogen

C forms a meshwork to clot the blood

D causes the release of clotting factors.

16. The diagrams show two ways to classify the nervous system.



Which row in the table identifies X, Y and Z?

	Nervous System		
	X	Y	Z
A	peripheral	somatic	autonomic
B	somatic	autonomic	peripheral
C	autonomic	peripheral	somatic
D	peripheral	autonomic	somatic

17. A child was stung by a wasp. This led to them being afraid of all flying insects.
This is an example of

A discrimination
B generalisation
C internalisation
D reinforcement.

[Turn over

18. An investigation was carried out into the effect of colour on the recognition of shapes. The procedure included the following features.

- Two groups of 20 students were selected.
- Each group was shown the same sequence of shapes but in a different colour.
- One group was shown blue shapes and the other group was shown red shapes.
- The time taken by each student to identify each shape was noted.

Which of the following would improve the reliability of the results?

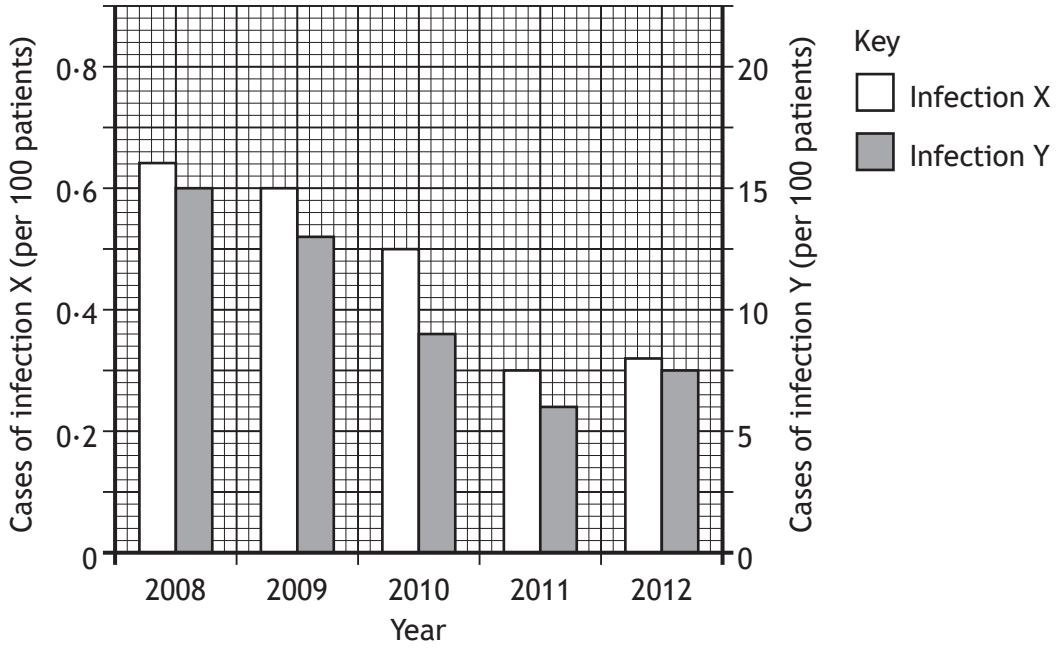
A Showing the same set of shapes to each group.
B Ensuring all the selected students were the same age.
C Having the same number of males and females in each group.
D Repeating the whole procedure with two more groups of students.

19. The virus that causes influenza can evade the specific immune response by

A attacking phagocytes
B attacking lymphocytes
C surviving within phagocytes
D showing antigenic variation.

20. A hospital introduced a programme of handwashing in 2008.

The graph shows the impact of this on the number of cases of two infections.



Which of the following statements is **not** correct?

A The cases of both infections fell by 50% over the 5 year period.

B The number of cases of infection Y was always greater than the number of cases of infection X.

C The highest number of cases of infection X was 0·62 per 100 patients while the highest number of cases of infection Y was 15 per 100 patients.

D The lowest number of cases of infection X was 0·3 per 100 patients while the lowest number of cases of infection Y was 6 per 100 patients.

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

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National Qualifications 2018

Mark

X740/76/01

Human Biology
Section 1 — Answer Grid and Section 2

TUESDAY, 15 MAY
1:00 PM – 3:30 PM

X7407601

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

Scottish candidate number

Total marks — 100

SECTION 1 — 20 marks

Attempt ALL questions.

Instructions for the completion of Section 1 are given on *page 02*.

SECTION 2 — 80 marks

Attempt ALL questions.

Question 13 contains a choice.

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 X740/76/02.

Read these and record your answers on the answer grid on *page 03* opposite.

Use **blue** or **black** ink. Do NOT use gel pens or pencil.

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 digestive enzyme pepsin is most active in the

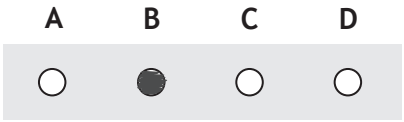
A mouth

B stomach

C duodenum

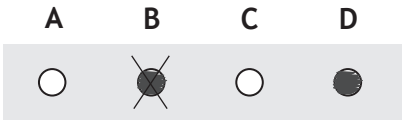
D pancreas.

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

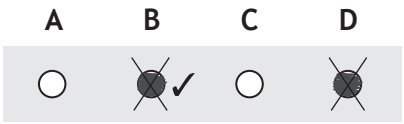


Changing an answer

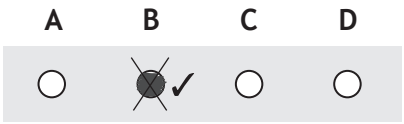
If you decide to change your answer, cancel your first answer by putting a cross through it (see below) and fill in the answer you want. The answer below has been changed to **D**.



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

OBJ20AD1

	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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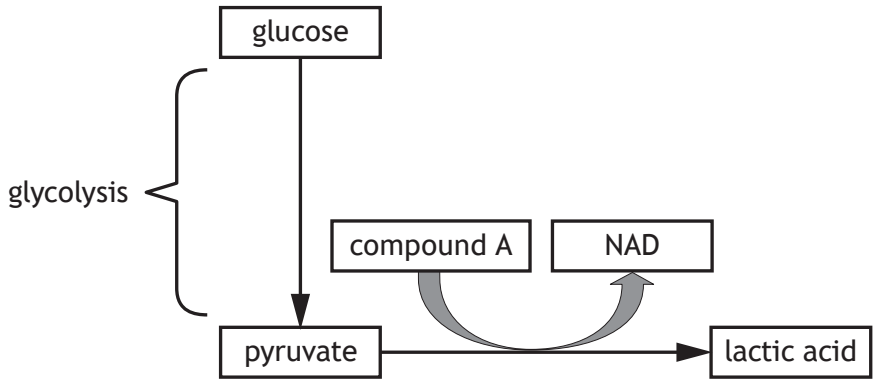
SECTION 2 — 80 marks

Attempt ALL questions

Question 13 contains a choice

1. The diagram represents glycolysis and the metabolic pathway which synthesises lactic acid.



(a) (i) State where glycolysis occurs within a cell. **1**

_____

(ii) Describe what happens during the energy investment phase of glycolysis. **1**

_____

_____

(b) During lactic acid synthesis NAD is regenerated.

(i) Name compound A. **1**

_____

(ii) Explain the importance of the regeneration of NAD for glycolysis. **1**

_____

_____

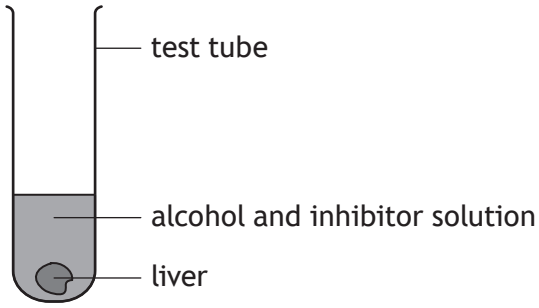
(iii) State the reason why muscle cells produce lactic acid during vigorous exercise. **1**

_____

_____

2. An investigation was carried out into the effect of inhibitor concentration on the activity of an enzyme which breaks down alcohol in liver cells.

Six test tubes were set up, each containing a piece of liver, alcohol and a different concentration of inhibitor, as shown in the diagram.



The test tubes were left for 30 minutes at 37 °C.

The final concentration of alcohol in each tube was then measured.

(a) State **two** variables, not already mentioned, which should be kept constant to make this investigation valid. **2**

1 _____

2 _____

(b) The inhibitor used in this investigation was non-competitive.

Describe how a non-competitive inhibitor works. **1**

_____

_____

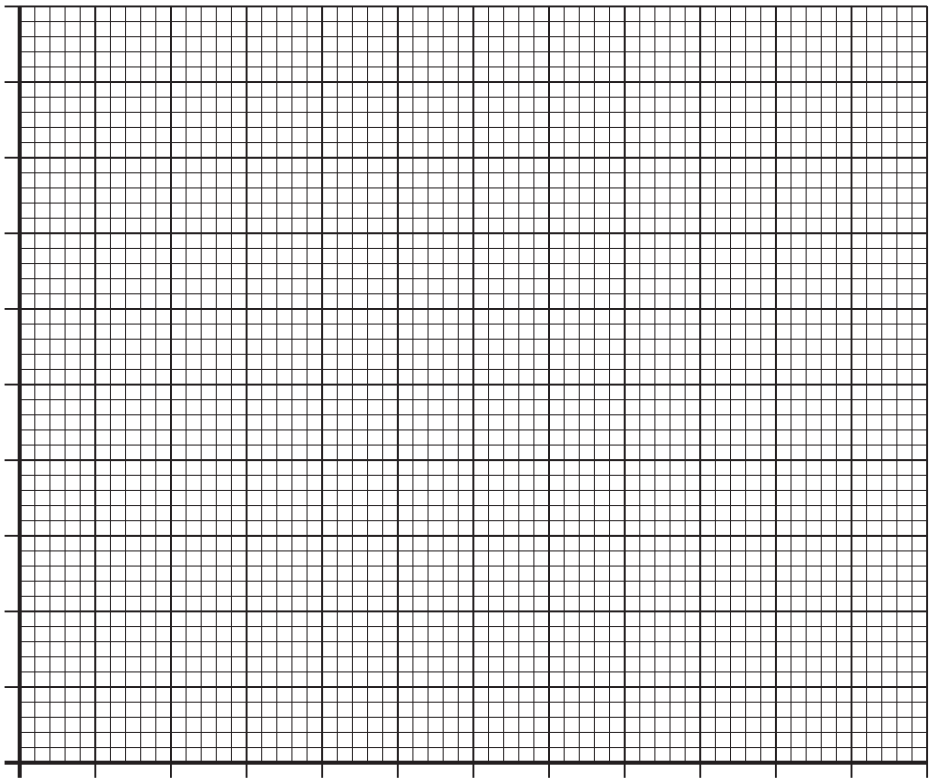
(c) The results of the investigation are shown in the table.

Inhibitor concentration (mM)	*Final alcohol concentration* (% of initial concentration)
0·5	20
1·5	28
2·5	60
3·5	96
4·5	100
5·5	100

2. (c) (continued)

(i) Construct a line graph to show the data in the table. **2**

(Additional graph paper, if required, can be found on *page 27*)



(ii) **Use the data** to describe the relationship between the concentration of inhibitor and enzyme activity. **2**

(d) A second experiment, using increasing concentrations of alcohol, was carried out to show that the inhibitor was non-competitive.

Six test tubes were set up, each containing a piece of liver, an inhibitor concentration of 4·5 mM and different concentrations of alcohol.

Suggest how the results would confirm that the inhibitor was non-competitive. **1**

3. Olfactory genes code for receptors in the nose that detect smells.

The base sequences from the same region of a rat olfactory gene and a human olfactory gene are shown.

Rat	... A T A C G A T T G C A T G C C G A T...
Human	... A T A C G A T T G C A T C C G A T...

The rat olfactory gene codes for a functional protein but the protein coded for by the human olfactory gene is non-functional.

(a) (i) Name the type of single gene mutation that has occurred to change the human base sequence. **1**

_____

(ii) Suggest why the changed sequence of bases in the human gene codes for a non-functional protein. **1**

_____

_____

_____

(b) State the term which describes the comparison of human genome sequence data with the genomes of other species. **1**

_____

3. (continued)

(c) The table shows the number of functional olfactory genes identified in rats, humans and chickens.

Animal	*Number of functional olfactory genes*
rat	1200
human	400
chicken	80

(i) Express, as a simple whole number ratio, the number of functional olfactory genes found in the animals. **1**

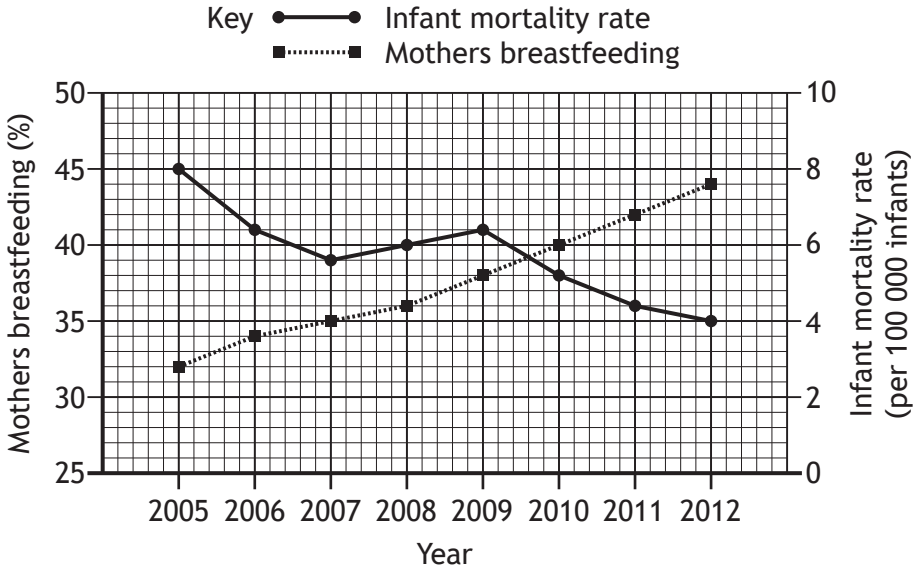
Space for calculation

_____ : _____ : _____
rat human chicken

(ii) Suggest what the number of functional olfactory genes indicates about the sense of smell of these animals. **1**

(d) Describe **two** chromosome structure mutations and the overall consequence of these to the individual. **3**

4. The graph contains information about breastfeeding and infant mortality in a country between 2005 and 2012.



(a) (i) State the infant mortality rate when 35% of mothers were breastfeeding. **1**

_____

(ii) Calculate the percentage decrease in the infant mortality rate between 2009 and 2012. **1**

Space for calculation

_____%

(iii) Predict the percentage of mothers who would be breastfeeding in 2013. **1**

_____%

(iv) Describe evidence from the graph which indicates that the increase in breastfeeding mothers cannot be the only reason for the decrease in infant mortality. **1**

_____

_____

_____

4. (continued)

(b) The table contains information from a Scottish survey comparing the incidence of diarrhoea in breastfed and bottle fed babies.

	Age of baby (months)			
	0–3		4–6	
Feeding method	Breast	Bottle	Breast	Bottle
Incidence of diarrhoea (%)	3·6	21·6	10·2	20·4

(i) Calculate how many times greater the incidence of diarrhoea is when 0–3 month old babies are bottle fed rather than breastfed. **1**

Space for calculation

_____ times greater

(ii) Diarrhoea is a symptom of an intestinal infection.

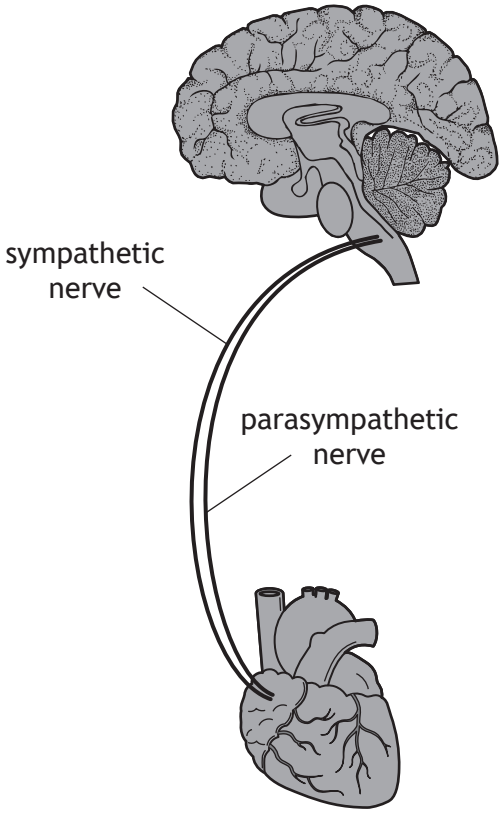
Suggest why there is a greater incidence of diarrhoea in bottle fed babies. **1**

_____

_____

[Turn over

5. The diagram represents part of the autonomic nervous system which links the brain to the heart.



(a) Name the parts of the brain and heart which are linked by the nerves shown in the diagram. **2**

Brain _____

Heart _____

(b) Explain how the sympathetic and parasympathetic nerves control heart rate. **2**

_____

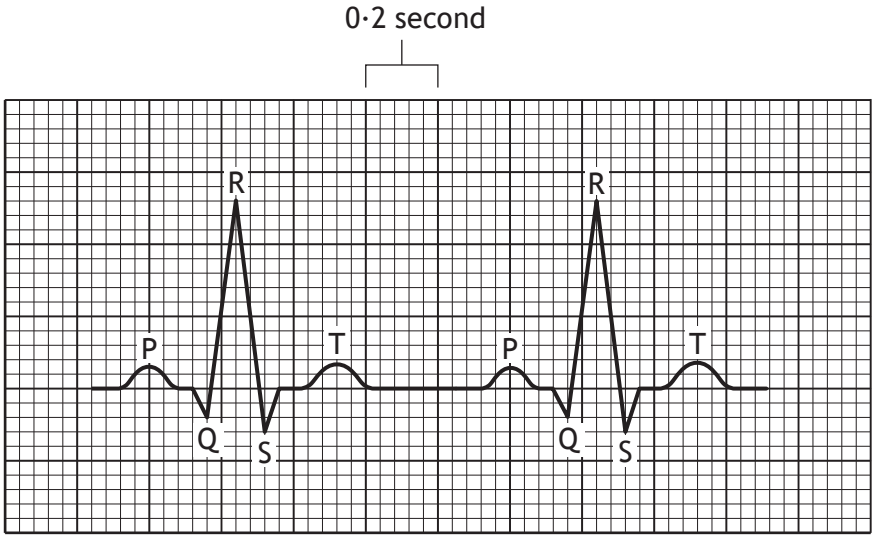
_____

_____

_____

5. (continued)

(c) The diagram shows an electrocardiogram (ECG) of an individual's heart.



(i) Use the diagram to calculate the individual's heart rate. **1**

Space for calculation

_____ beats/min

(ii) Describe what happens in the heart between points Q and S. **1**

_____

_____

[Turn over

6. The table shows the number of males in different age groups with raised cholesterol levels in Scotland between 2004 and 2013.

	Number of males with raised cholesterol levels (per 1000)									
Age group (years)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Under 15	1	1	0	1	0	0	0	2	0	1
15–44	33	33	31	29	21	21	22	16	18	14
45–64	236	232	217	209	132	139	134	137	125	128
Over 64	274	316	295	274	167	166	164	167	171	167

(a) Calculate which age group had the greatest percentage decrease in the number of males with raised cholesterol levels between 2004 and 2013. **1**

Space for calculation

_____ years

(b) (i) Name a type of drug that is used to control cholesterol levels. **1**

_____

(ii) Use the data in the table to identify the year in which this type of drug became widely available. **1**

_____

(c) State **one** role of cholesterol in the body. **1**

_____

_____

7. An office worker and an Olympic swimmer were found to have the same BMI. They each weighed 105 kg and were 1·85 m in height.

(a) (i) Calculate their BMI. **1**

Space for calculation

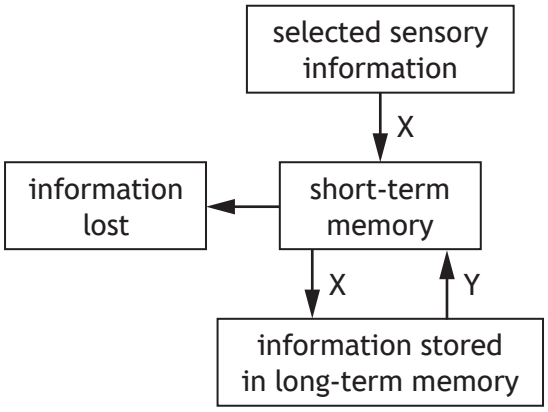
(ii) Suggest why, after calculating their BMI, a health professional advised only the office worker to lose weight. **1**

(b) The office worker developed Type 2 diabetes.

Explain why this condition causes the blood glucose concentration to remain high. **2**

[Turn over

8. (a) The diagram represents the flow of information through memory.



(i) Name process X. **1**

_____

(ii) Explain why information can be lost by displacement from short-term memory. **1**

_____

_____

(iii) Rehearsal increases the chance of information being transferred from short-term to long-term memory.

Describe **one** other way that information can be transferred from short-term to long-term memory. **1**

_____

_____

_____

(iv) Y represents the retrieval of information from long-term memory.

Describe how contextual cues aid the retrieval of information. **1**

_____

_____

_____

(b) State where semantic memories are stored in the brain. **1**

_____

9. (a) The photograph shows cars parked in a street.

The judgement of distance depends on visual cues.

Explain how the following visual cues allow a person to judge how far away each car is from them in the street.

(i) Size _____ **1**

_____

_____

(ii) Superimposition _____ **1**

_____

_____

(b) State the term used for the ability of the brain to judge the distance of an object based on the different images received by each eye. **1**

_____

[Turn over

MARKS

(c) Students carried out the following experiment on the judgement of distance.

1 One student raised their right arm and closed both eyes.

2 A coin was randomly placed on the bench in front of them.

3 The student opened both eyes and immediately lowered their arm trying to touch the coin with their index finger.

4 The distance between the coin and the spot where the index finger landed was measured.

5 Steps 1–4 were repeated, firstly **only** opening the left eye and secondly **only** opening the right eye.

6 Then steps 1–5 were repeated another nine times.

The results are shown in the table.

Attempt	*Distance between coin and spot where finger landed* (mm)		
	both eyes open	*left eye open*	*right eye open*
1	2	4	12
2	2	6	15
3	1	6	16
4	1	8	14
5	1	9	13
6	0	5	14
7	0	4	17
8	1	10	18
9	0	7	
10	1	8	15
Average	0·9	6·7	15·0

(i) Calculate the missing distance for attempt 9. **1**

Space for calculation

_____ mm

9. (c) (continued)

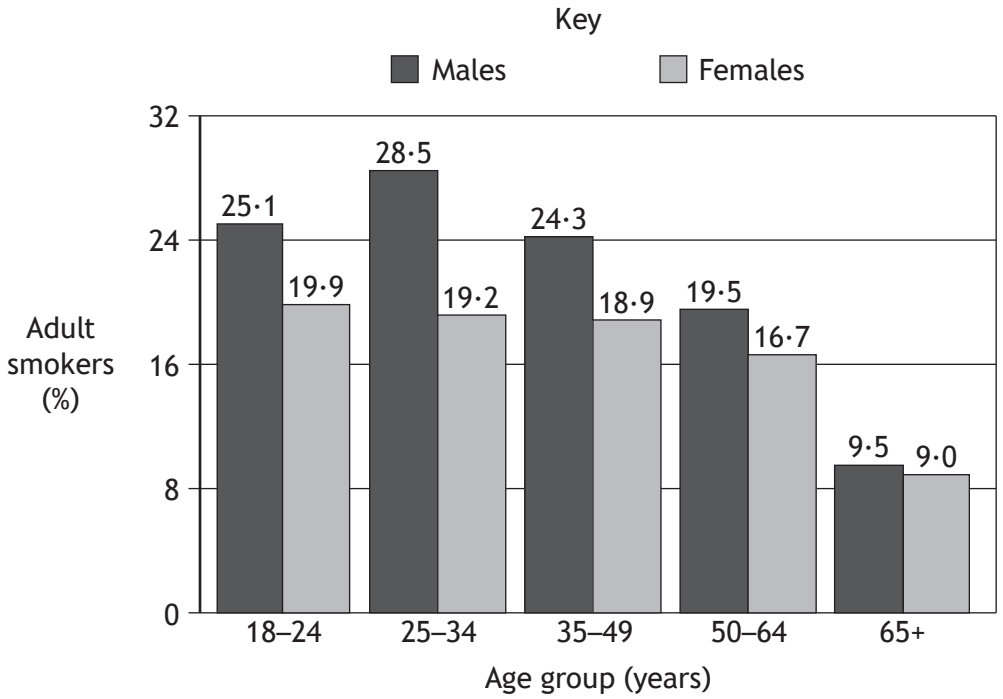
(ii) Suggest a reason why the coin was randomly placed for each attempt. **1**

(iii) The results of the experiment show that two eyes are more accurate than one for judging distance.

State another conclusion which can be drawn from the results. **1**

[Turn over

10. The graph shows the percentage of adult smokers in different age groups in the UK in 2011.



(a) (i) Describe **two** trends shown in the graph. **2**

1 _____

_____

_____

2 _____

_____

_____

(ii) Apart from individuals giving up smoking, suggest a reason for the difference in the percentage of 25–34 year olds and 65+ year olds smoking. **1**

_____

_____

10. (continued)

(b) Smokers can become addicted to the nicotine in tobacco.

Nicotine acts as an agonist of acetylcholine causing an increase in the levels of dopamine.

(i) Describe how nicotine acts as an agonist at a synapse. **1**

(ii) Describe how dopamine reinforces smoking behaviour. **1**

(iii) Describe how repeated exposure to nicotine can lead to nicotine tolerance by desensitisation. **1**

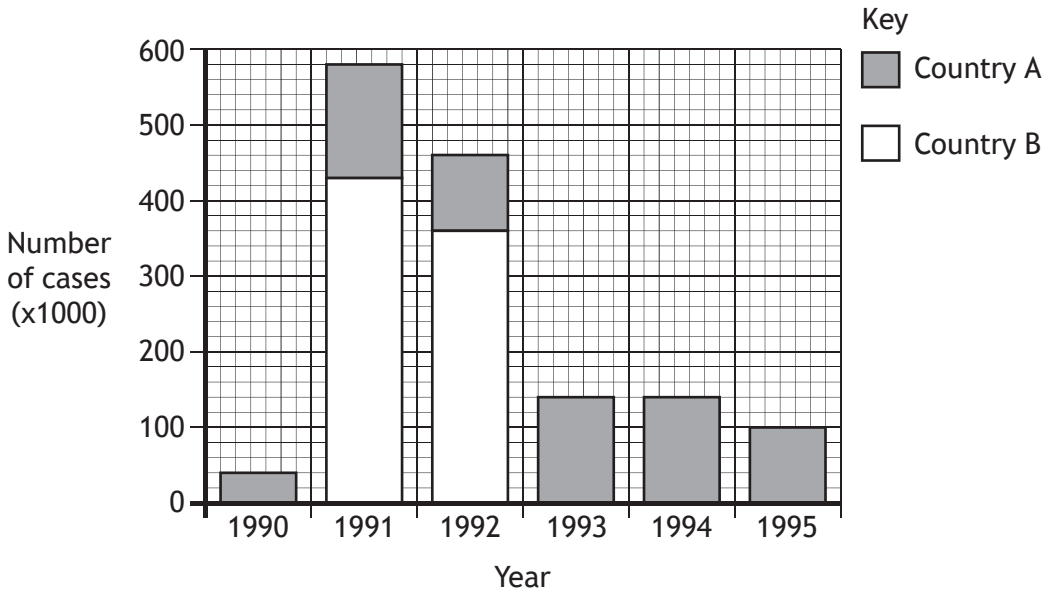
(c) Explain why anti-smoking campaigns often feature a celebrity. **1**

(d) In 2011 there were 36 980 cases of lung cancer in the UK linked to smoking. This was 86% of all lung cancer cases in the UK in 2011.

Calculate the total number of lung cancer cases in the UK in 2011. **1**

Space for calculation

11. The graph compares the number of cases of a water-borne disease in two countries between 1990 and 1995.



(a) (i) Describe how the graph demonstrates that the pattern of the disease was epidemic in country B. **1**

(ii) State the term which describes the pattern of disease in country A. **1**

(iii) Suggest how the pattern of this disease in country A would differ if the disease was sporadic. **1**

11. (continued)

(b) In 1996, a programme of immunisation against this disease was started in country B. Herd immunity was established once 85% of the population was immunised.

(i) Explain why this level of immunisation protected the whole population. **1**

_____

_____

_____

(ii) State **one** reason why it is difficult to immunise 100% of a population against a disease. **1**

_____

_____

[Turn over

12. The non-specific immune system provides resistance to infection by physical, chemical and cellular means.

(a) (i) Name the type of cell which forms a physical barrier in the skin. **1**

_____

(ii) In addition to forming a physical barrier, state another way in which these cells resist infection. **1**

_____

_____

(b) Mast cells initiate the inflammatory response.

Name the chemical which they release and explain how it increases the supply of fluid into the infected tissue. **2**

Chemical _____

Explanation _____

_____

(c) (i) The cellular aspect of the non-specific response is provided by two types of white blood cell.

Complete the table by describing how these cells destroy pathogens. **2**

Type of cell	*How cell destroys pathogens*
Phagocyte	
NK cell	

(ii) State how phagocytes and NK cells stimulate the specific immune response. **1**

_____

_____

13. Answer **either** A **or** B in the space below.

Labelled diagrams may be used where appropriate.

A Give an account of hormonal control of puberty and sperm production in males. **8**

OR

B Give an account of treatments for male and female infertility. **8**

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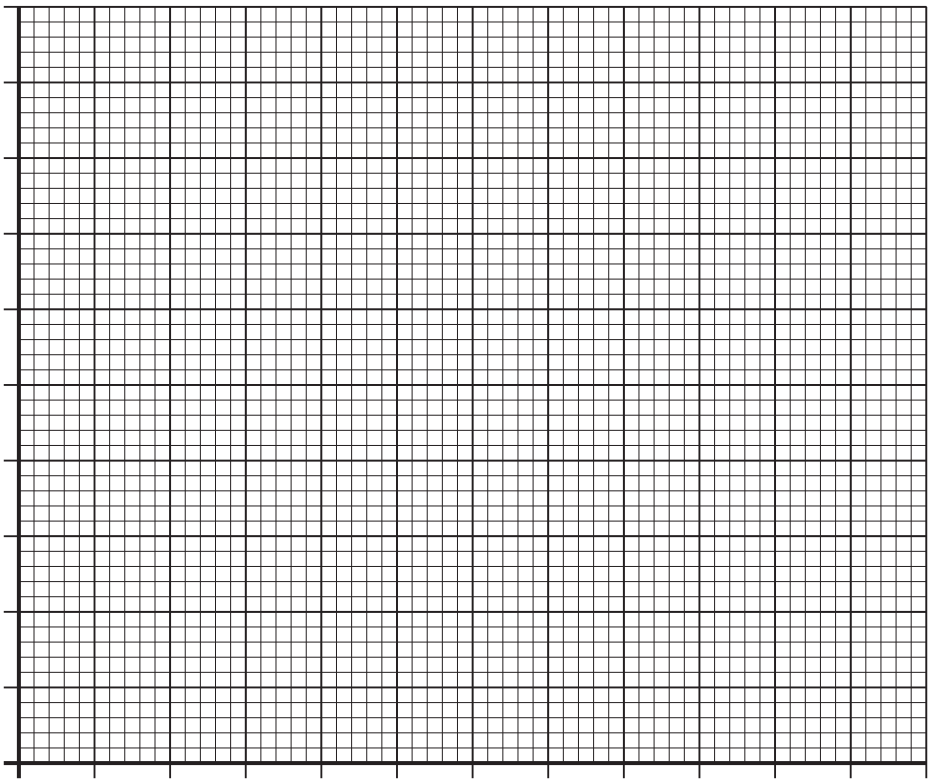
ADDITIONAL SPACE FOR ANSWER to Question 13

[END OF QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional graph paper for Question 2 (c)(i)



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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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ACKNOWLEDGEMENTS

Question 9 (a) – Tupungato/Shutterstock.com