edexcel

GCSE (9-1) Biology

Sample Assessment Materials

Pearson Edexcel Level 1/Level 2 GCSE (9-1) in Biology (1BI0)

First teaching from September 2016

First certification from June 2018

Issue 1

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Contents

Introduction

The Pearson Edexcel Level 1/Level 2 GCSE (9-1) in Biology is designed for use in schools and colleges. It is part of a suite of GCSE qualifications offered by Pearson.

These sample assessment materials have been developed to support this qualification and will be used as the benchmark to develop the assessment students will take.

General marking guidance

- All candidates must receive the same treatment. Examiners must mark the last candidate in exactly the same way as they mark the first.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than be penalised for omissions.
- Examiners should mark according to the mark scheme – not according to their perception of where the grade boundaries may lie.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification/indicative content will not be exhaustive.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, a senior examiner must be consulted before a mark is given.
- Crossed-out work should be marked **unless** the candidate has replaced it with an alternative response.

Subject specific marking guidance

Symbols, terms used in the mark scheme

- Round brackets ( ): words inside round brackets are to aid understanding of the marking point but are not required to award the point
- Curly brackets { }: indicate the beginning and end of a list of alternatives (separated by obliques) where necessary to avoid confusion
- Oblique /: words or phrases separated by an oblique are alternatives to each other and either answer should receive full credit.
- ecf: indicates error carried forward which means that a wrong answer given in an early part of a question is used correctly to a later part of a question.

You will not see 'owtte' (or words to that effect). Alternative correct wording should be credited in every answer unless the ms has specified specific.

The Additional Guidance column is used for extra guidance to clarify any points in the mark scheme. It may be used to indicate:

- what will not be accepted for that marking point in which case the phrase 'do not accept' will be alongside the relevant marking point
- it might have examples of possible acceptable answers which will be adjacent to that marking point

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9–1)

Centre Number	Candidate Number

Biology

Paper 1

Foundation Tier

Sample Assessment Materials for first teaching September 2016	Paper Reference
Time: 1 hour 45 minutes	**1BI0/1F**

You must have:	Total Marks
Calculator, ruler	

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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S 5 0 0 4 1 A 0 1 3 2

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Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Eye colour is controlled by genes.

The allele for brown eyes, B, is dominant to the allele for blue eyes, b.

(a) A female with blue eyes and a male with brown eyes are about to have a child.

Complete the Punnett square to determine the phenotype of the child.

(2)

		man	
		B	B
woman	b		
	b		

Phenotype of child .....

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(b) A scientist recorded the eye colour of 30 people.

The results are shown in Figure 1.

blue	green	blue	brown	brown	brown	hazel	blue	
brown	hazel	blue	blue	hazel	green	brown	brown	
blue	green	brown	brown	blue	hazel	blue	brown	brown
brown	blue	brown	brown	brown				

Figure 1

(i) Complete the tally chart, in Figure 2, for this data.

(2)

eye colour			
blue	brown	green	hazel
total.....	total.....	total.....	total.....

Figure 2

(ii) Give another appropriate method of displaying this information.

(1)

.....

.....

A section of one allele for eye colour has the following DNA sequence:

ATGGCTAAGTA

(c) (i) Which sequence is the complementary DNA strand?

(1)

- ☒ **A** ATGGCTAAGTA
- ☒ **B** CGTTAGCCTGC
- ☒ **C** TACCGATTCAT
- ☒ **D** GCAATGGACG

(ii) Give **one** way in which a second allele for eye colour might be different.

(1)

.....

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Figure 3 outlines a method that can be used to extract DNA from fruit.

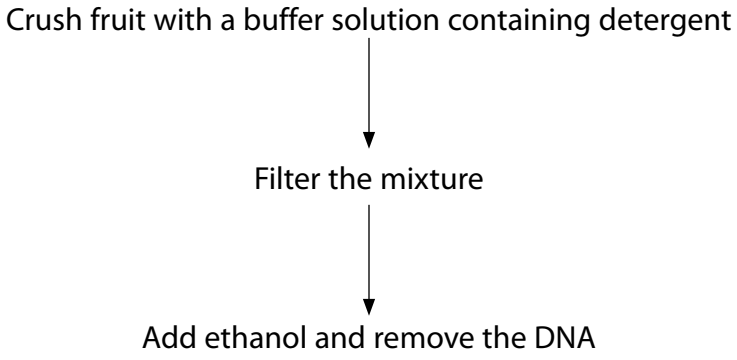

Figure 3

(d) (i) Give a reason for filtering the mixture.

(1)

.....

.....

(ii) What is the role of the ethanol?

(1)

- ☒ **A** denature the enzymes
- ☒ **B** disrupt cell membranes
- ☒ **C** supercoil the DNA
- ☒ **D** to precipitate the DNA

(Total for Question 1 = 9 marks)

2 Antibiotics can be used to treat Chlamydia, which is a sexually transmitted infection.

(a) What type of pathogen causes Chlamydia?

(1)

☒ **A** bacteria

☒ **B** fungus

☒ **C** protist

☒ **D** virus

Figure 4 shows the number of new cases of Chlamydia diagnosed each year, in a region of the UK, between 2000 and 2008.

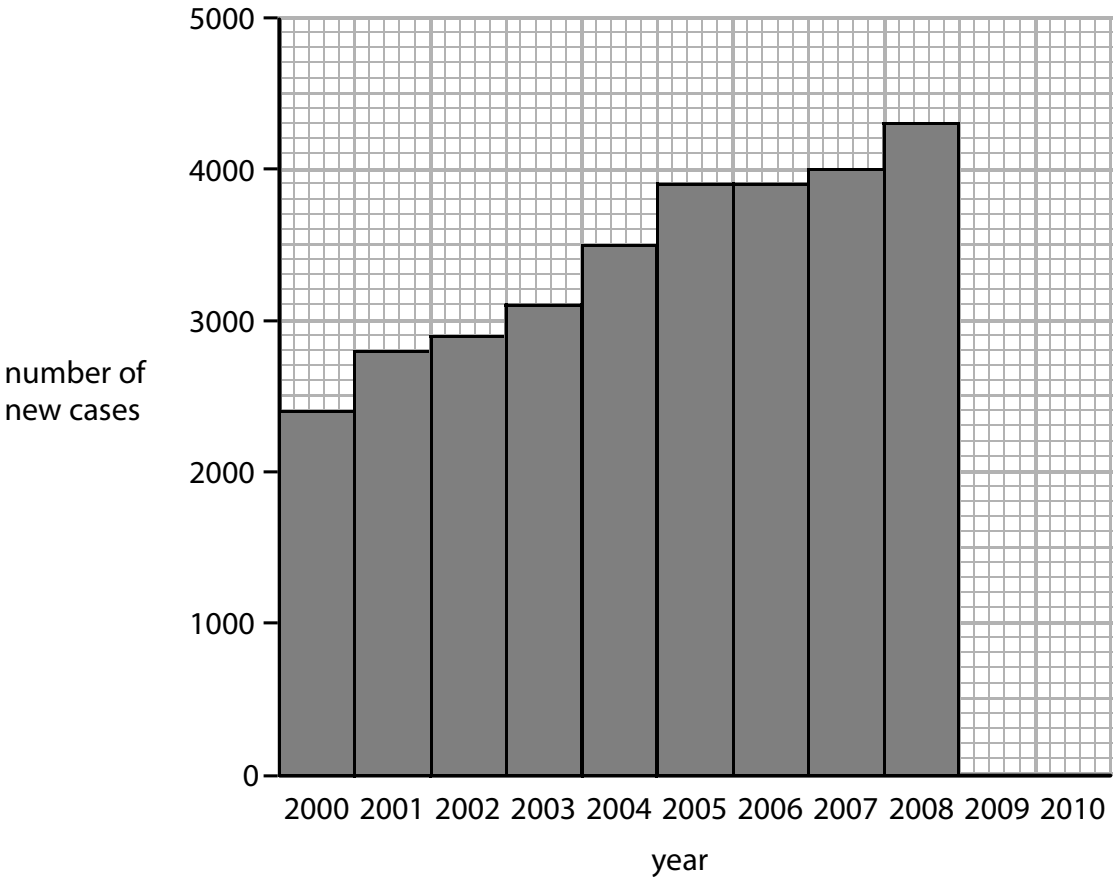

Figure 4

(b) (i) In 2009 there were 4800 new cases diagnosed.

In 2010 there were 4100 new cases diagnosed.

Plot this data on the graph in Figure 4.

(1)

(ii) Describe the trend in cases between 2000 and 2010.

(2)

People infected with Chlamydia are more likely to be infected with the STI Gonorrhoea.

(iii) Explain how people become infected with both Chlamydia and Gonorrhoea.

(2)

HIV is a sexually transmitted infection.

(c) Explain how infection with HIV can lead to AIDS.

(2)

(Total for Question 2 = 8 marks)

3 The sugar molecule glucose can be detected by a chemical test.

(a) Use words from the box to complete the sentences.

(2)

blue-black	iodine	brick red
Biuret	lilac	Benedict's

The ..... reagent is added to a tube containing a solution of glucose.

The tube is heated and the colour changes to a ..... colour.

Sugary drinks have been linked to tooth decay.

Tooth decay occurs when the enamel on teeth is dissolved.

A scientist investigates the effect of five different drinks on artificial tooth enamel.

She places 10 g of artificial tooth enamel into 100 ml of each drink. These are left for seven days.

The percentage change of mass for each sample of enamel is calculated.

Figure 5 shows the results.

drink	cola	milk	lemonade	squash	milkshake
percentage change of mass (%)	–3.4	0.0	–2.8	–0.6	–1.6

Figure 5

(b) (i) Which drink is most likely to cause tooth decay?

(1)

- ☒ **A** cola
- ☒ **B** lemonade
- ☒ **C** milkshake
- ☒ **D** squash

(ii) Explain why it might be better to drink milk rather than a milkshake.

Use data from Figure 5.

(2)

.....

.....

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.....

The scientist is concerned that the conclusions from this experiment might **not** show the real effect of sugary drinks on teeth.

(iii) Give **two** ways in which the scientist could improve the investigation.

(2)

1 .....

.....

2 .....

.....

The sugar content of drinks is not the only dietary factor that can affect health.

(iv) Give **one** other dietary factor that a person should consider when choosing a drink.

(1)

.....

.....

(Total for Question 3 = 8 marks)

4 Figure 6 shows a diagram of a cell.

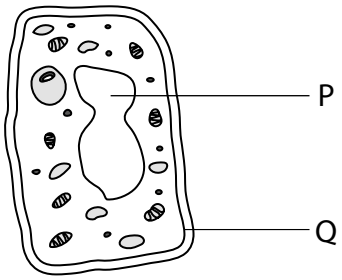

Figure 6

(a) (i) Which row of the table identifies both structure P and structure Q?

(1)

		structure P	structure Q
☒	**A**	nucleus	cell membrane
☒	**B**	nucleus	cell wall
☒	**C**	vacuole	cell membrane
☒	**D**	vacuole	cell wall

(ii) Plant cells have a cell wall and a large vacuole.

Draw one straight line from each structure to its function.

(2)

structure	**function**
	where respiration occurs
cell wall	contains cellulose to provide support
	where photosynthesis occurs
large vacuole	controls the cell
	stores cell sap

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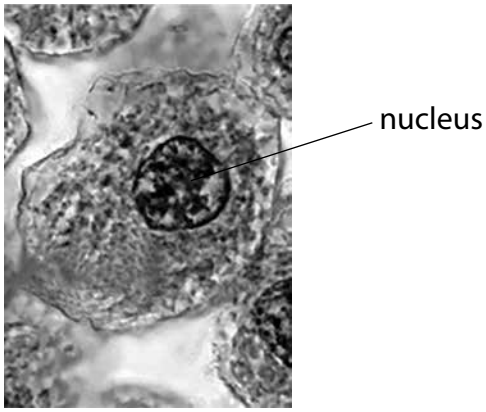
Figure 7 shows an image of an animal cell taken using a microscope with a 10× eyepiece lens and a 40× objective lens.



(Source: © Ed Reschke/Getty Images)

Figure 7

(b) (i) The total magnification of the animal cell is

(1)

- ☒ **A** ×50
- ☒ **B** ×140
- ☒ **C** ×400
- ☒ **D** ×4000

(ii) The diameter of the cell is 15 μm.

Use Figure 7 to estimate the diameter of the cell nucleus.

(1)

diameter of nucleus = ... μm

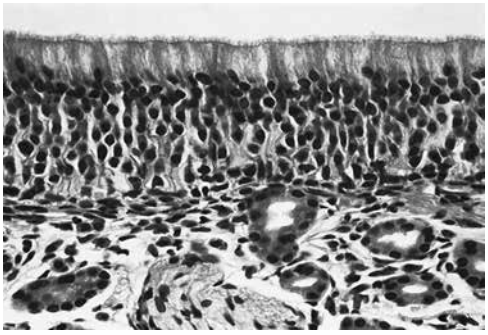
(iii) Give the measurement of 15 μm in mm.

(1)

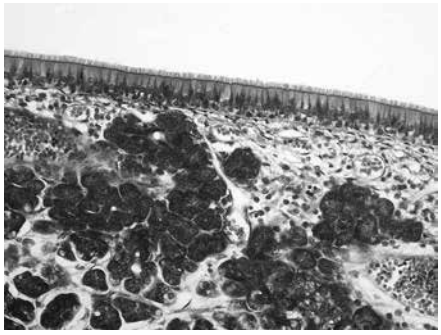
..... mm

The development of electron microscopes has increased our understanding of cells and their features.

Figure 8 shows two images of ciliated epithelium, one taken using a light microscope and one using an electron microscope.



Light microscope



Electron microscope

(Science photolibrary Epithelium C022/2228 ©Steve Gschmeissner/Science Photolibrary

Figure 8

(c) Explain how the electron microscope image helps us to understand more about ciliated epithelium.

(3)

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(Total for Question 4 = 9 marks)

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5 Cell division processes are used to produce body cells and gametes.

The nucleus of a daffodil cell has 46 chromosomes.

(a) (i) State the number of chromosomes in each pollen grain from this daffodil.

(1)

.....

.....

(ii) Humans share 35% of their DNA with a daffodil.

The human genome contains 6600 million bases.

Calculate the number of bases that are the same as a daffodil.

(2)

number of bases = ... million

(b) Figure 9 shows the development of a human embryo from a fertilised egg.

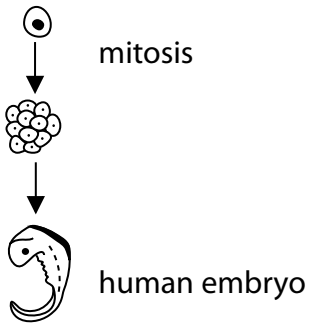

Figure 9

(i) Explain how many cells are produced from one fertilised egg, after two cell divisions by mitosis.

(2)

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(ii) Which process occurs causing the divided cells to become specialised?

(1)

- ☒ **A** meiosis
- ☒ **B** cloning
- ☒ **C** differentiation
- ☒ **D** cytokinesis

A student wanted to observe dividing cells under a microscope.

The student squashed the root tip of an onion plant on a microscope slide.

(c) (i) Describe how the student should use a light microscope to view the squashed root tip.

(3)

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(ii) Even though the slide was at the correct magnification, the student could not see the chromosomes in the dividing cells.

State what could be done to the slide to make the chromosomes more visible.

(1)

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(Total for Question 5 = 10 marks)

6 Figure 10 shows the human eye.

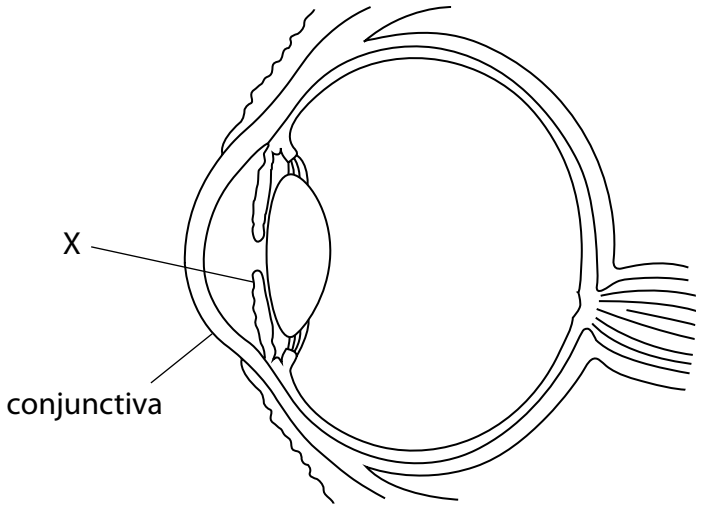

Figure 10

(a) (i) What is the part labelled X?

(1)

- ☒ **A** cornea
- ☒ **B** pupil
- ☒ **C** lens
- ☒ **D** iris

The conjunctiva is a membrane that covers the eyeball and inner surface of the eyelid.

(ii) Describe how the conjunctiva helps protects the eye from infection.

(2)

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.....

Cataracts are caused by cloudy patches that develop on the lens. The chance of being affected by cataracts is related to age.

Figure 11 shows the percentage of people affected by cataracts in different age categories.

age category / years	percentage chance of being affected by cataracts (%)
0–14	3.8
15–44	6.5
45–59	30.7
> 60	59.0

Figure 11

(b) (i) Explain one conclusion that can be made about the occurrence of cataracts, using the data above.

(2)

.....

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In a survey of one of the age categories, 80 people out of 256 showed signs of developing cataracts.

(ii) Calculate which age category the 256 people are most likely to be taken from.

(2)

Age category .....

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The retina is a light receptor consisting of rod and cone cells.

(c) Describe how the information detected by the retina is transmitted to the brain.

(2)

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(Total for Question 6 = 9 marks)

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7 Figure 12 shows the times when *Homo sapiens* and some of their ancestral species are thought to have lived.

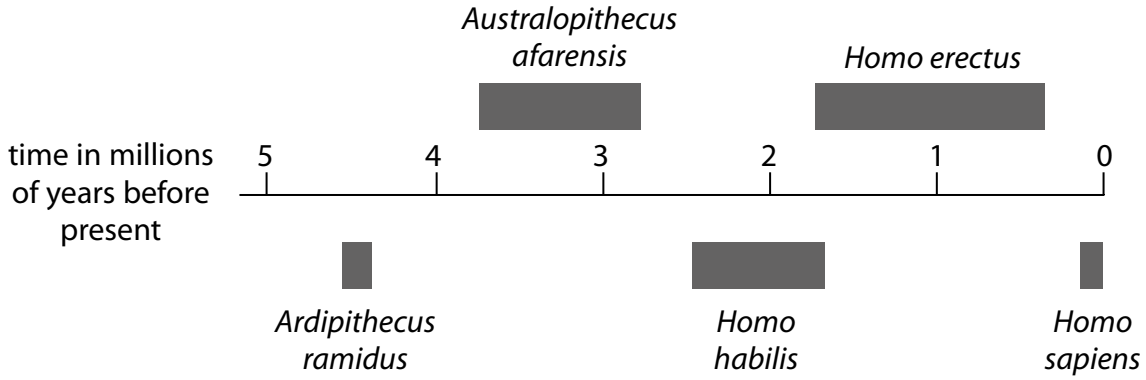

Figure 12

(a) Fossil remains of *Ardipithecus ramidus* were discovered in Ethiopia.

(i) Calculate the number of years *Ardipithecus ramidus* is thought to have inhabited the Earth.

(2)

Answer .....

(ii) Describe the evidence that scientists might have used to show that *Ardipithecus ramidus* inhabited the Earth earlier than *Homo habilis.*

(2)

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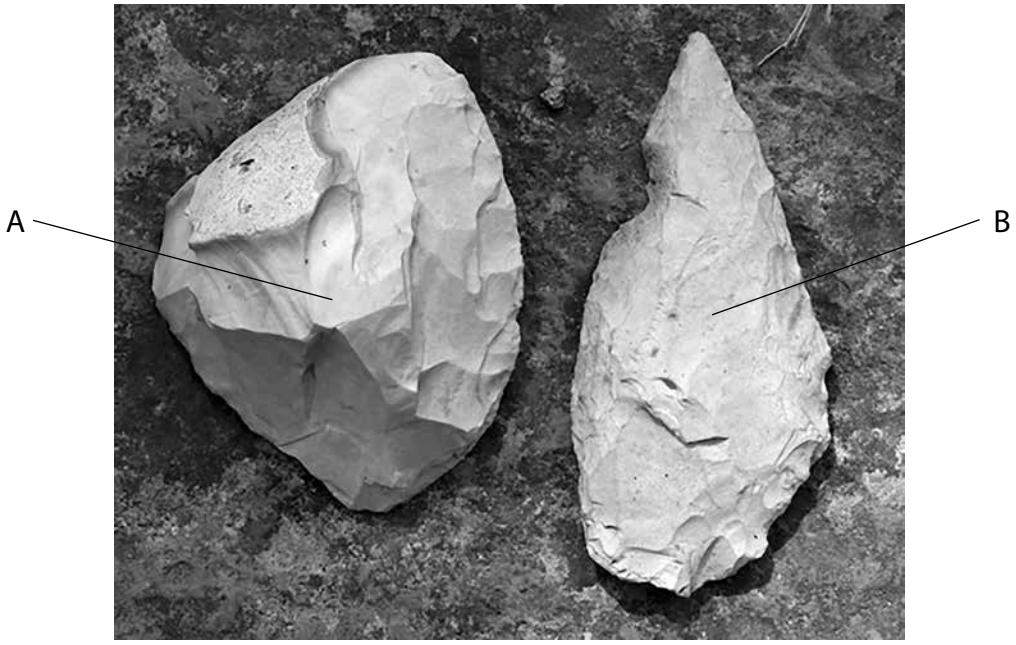
(iii) Suggest an explanation for the extinction of *Homo habilis*.

(2)

(iv) Figure 13 shows two stone tools, one used by *Homo habilis* and one used by *Homo erectus*.



(Source: Frederic Surmely/look at sciences/Science Photo Library)

Figure 13

Explain which stone tool was most likely to be used by *Homo erectus*.

Use information from Figure 12 and Figure 13.

(2)

(b) The population of humans on Earth has increased significantly, leading to food shortages.

The growth of drought-resistant crop plants could lead to an increase in food supply.

Describe how drought-resistant crop plants can be produced.

(3)

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(Total for Question 7 = 11 marks)

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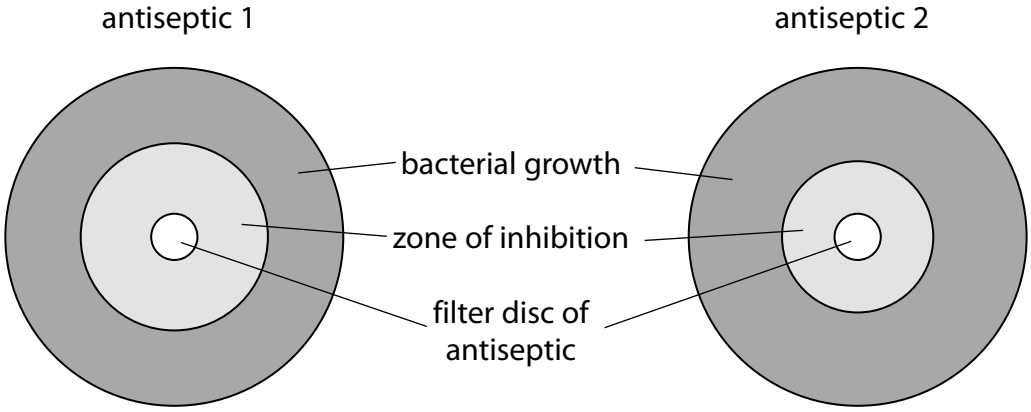
8 *Streptococcus pyogenes* is a bacterium that causes communicable infections.

(a) Scientists tested the ability of two antiseptics to kill *Streptococcus pyogenes* bacteria.

They spread *Streptococcus pyogenes* bacteria on two agar jelly plates and placed a small disc of filter paper containing antiseptic in the centre of each dish.

Figure 14 shows the results of the test after 24 hours of incubation.



antiseptic 1 zone of inhibition	
radius (mm)	12
area (mm^2)	452

Figure 14

(i) Calculate the area of the zone of inhibition for antiseptic 2.

Give the answer to 3 significant figures.

($\pi = 3.14$)

(3)

zone of inhibition for antiseptic 2 = ... mm^2

(ii) Give the antiseptic that is the most effective.

(1)

.....

.....

(iii) Both plates were incubated for 24 hours.

State **two** other variables the scientist would need to control during the test.

(2)

1 .....

.....

2 .....

.....

(b) The wire loop used to spread bacteria on an agar plate was heated in a Bunsen burner flame before being used.

(i) Explain why this aseptic precaution was used.

(2)

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.....

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.....

(ii) State **one** additional aseptic technique which would have been used for this investigation.

(1)

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.....

(c) Garlic is a plant that produces antiseptic chemicals.

Explain **one** benefit to garlic plants of producing antiseptic chemicals.

(2)

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(Total for Question 8 = 11 marks)

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9 The ratio of waist-to-hip measurements can be used to determine the risk of a person developing cardiovascular disease.

(a) Calculate the waist-to-hip ratio for a person with a waist measurement of 830 mm and a hip measurement of 0.99 m.

Give your answer to two decimal places.

(2)

Answer = ...

(b) Dieting can reduce the effects of cardiovascular disease.

A scientist is planning to test a new diet for weight loss.

She selects 40 obese people to take part in the test.

All the obese people are between 20 and 30 years of age.

(i) State **two** other factors the scientist should control when selecting the people.

(2)

.....

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(ii) Devise a plan the scientist could use to test the effectiveness of the new diet using the 40 obese people.

(3)

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Smoking is a lifestyle factor that can cause many diseases.

Figure 15 shows the trends in smoking between 1960 and 2010 for men and women.

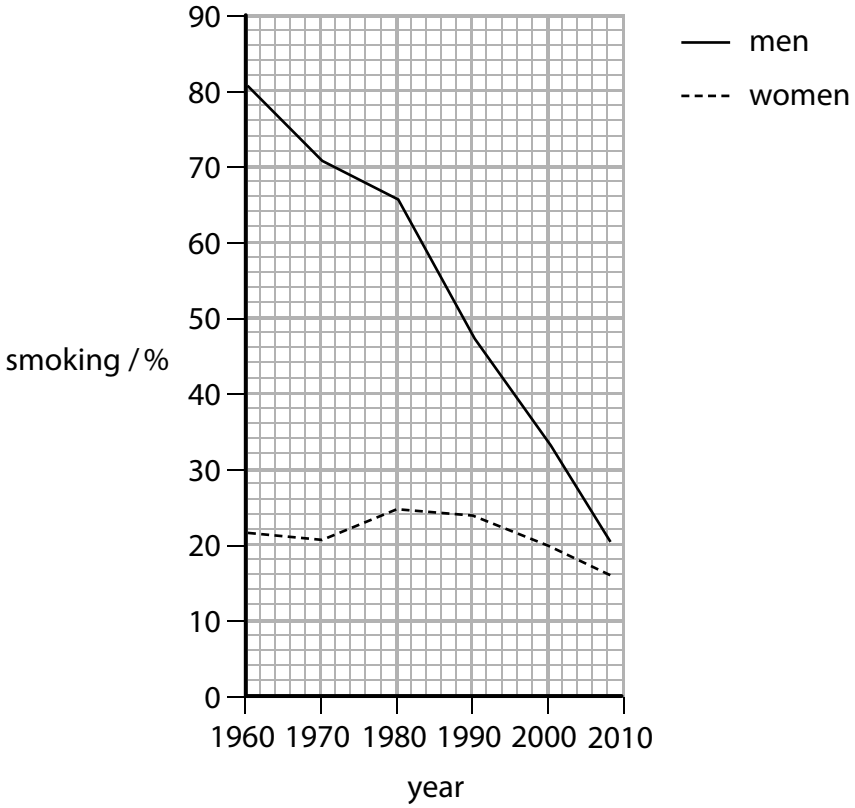

Figure 15

*(c) Explain how the changes in the trends for smoking may affect the occurrence of cardiovascular disease.

(6)

(Total for Question 9 = 13 marks)

10 Gregor Mendel investigated the genetics of peas.

He did not know about genes but showed that inherited characteristics can be dominant or recessive.

(a) Explain how Mendel used homozygous tall and homozygous short pea plants to show that the tall allele is dominant to the short allele.

(2)

.....

.....

.....

.....

*(b) Figure 16 shows a drosophila fruit fly.

(Source: Science Photo Library)

Figure 16

The brown body colour of a drosophila fruit fly is dominant to black body colour and is not sex-linked.

Explain how Gregor Mendel could have used a brown drosophila fruit fly and a black drosophila fruit fly to show that brown body colour is dominant to black body colour.

(6)

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(c) Figure 17 shows a strawberry plant that has produced several runners and new strawberry plantlets are growing at the end of each runner. This is an example of asexual reproduction.

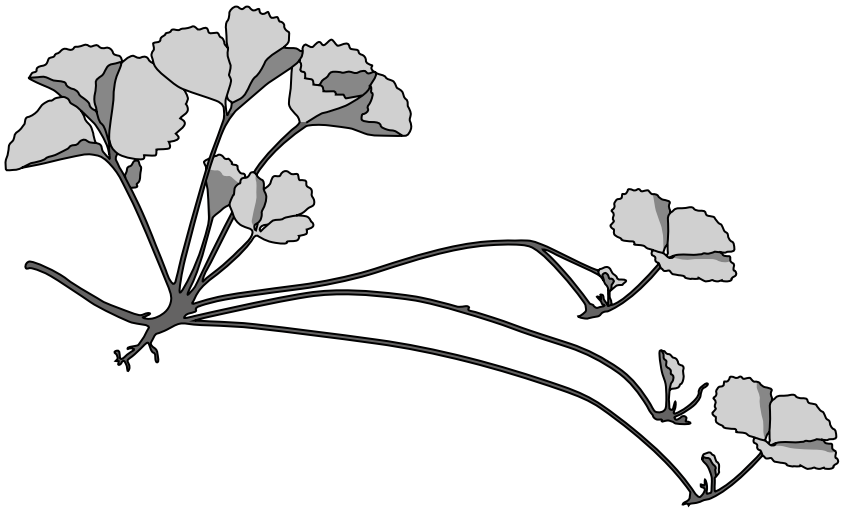

Figure 17

(i) Explain why asexual reproduction in strawberries is beneficial to strawberry farmers.

(2)

Strawberry fruits, containing seeds, are produced after a flower is fertilised.

(ii) Explain why seed production is an advantage to the strawberry plant.

(2)

(Total for Question 10 = 12 marks)

TOTAL FOR PAPER = 100 MARKS

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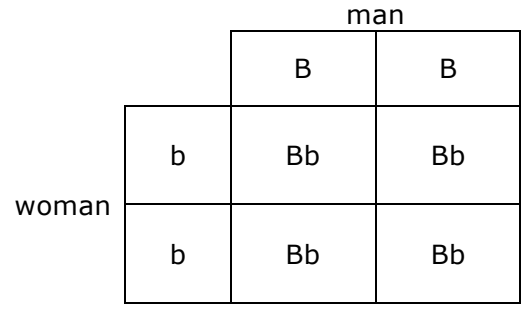
Paper 1 Foundation

Question number	Answer	Mark
1(a)	A completed Punnett square, including: • offspring alleles correct (1)  • phenotype of child: brown eyes (1)	**(2)**

Question number	Answer	Additional guidance	Mark
1(b)(i)	• All four columns correct (tally and total) (2) • One or two correct columns (1)	blue: 9 brown: 14 green: 3 hazel: 4	**(2)**

Question number	Answer	Mark
1(b)(ii)	Could be displayed as a bar chart/pie chart	**(1)**

Question number	Answer	Mark
1(c)(i)	C	**(1)**

Question number	Answer	Additional guidance	Mark
1(c)(ii)	Any one from: • mutation in the base sequence (1) • different base sequence (1) • different sequence length (1)	different amino acid sequence	**(1)**

Question number	Answer	Mark
1(d)(i)	To remove insoluble material	**(1)**

Question number	Answer	Mark
1(d)(ii)	D	**(1)**

Question number	Answer	Mark
2(a)	A	(1)

Question number	Answer	Mark
2(b)(i)	2009 bar plotted at 4800 and 2010 bar plotted at 4100	(1)

Question number	Answer	Additional guidance	Mark
2(b)(ii)	An answer that combines points of interpretation/evaluation to provide a logical description: • overall trend increases until 2009 (1) • decrease in the number of cases in 2010/correct manipulation of the data (1)	e.g. in 2010 it decreased by 700 cases (1)	(2)

Question number	Answer	Mark
2(b)(iii)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • Chlamydia and Gonorrhoea are STI infections spread by the same mechanism (1) • individuals aren't using a barrier contraception method (1)	(2)

Question number	Answer	Mark
2(c)	An explanation that combines identification – knowledge (1 mark) and reasoning/justification – understanding (1 mark): • HIV destroys {white blood cells/cells of the immune system} (1) • therefore a reduced immune response makes the individual more susceptible to other communicable diseases (1)	(2)

Question number	Answer	Mark
3(a)	• Benedict's (1) • brick red (1) Answers must be in the correct order	(2)

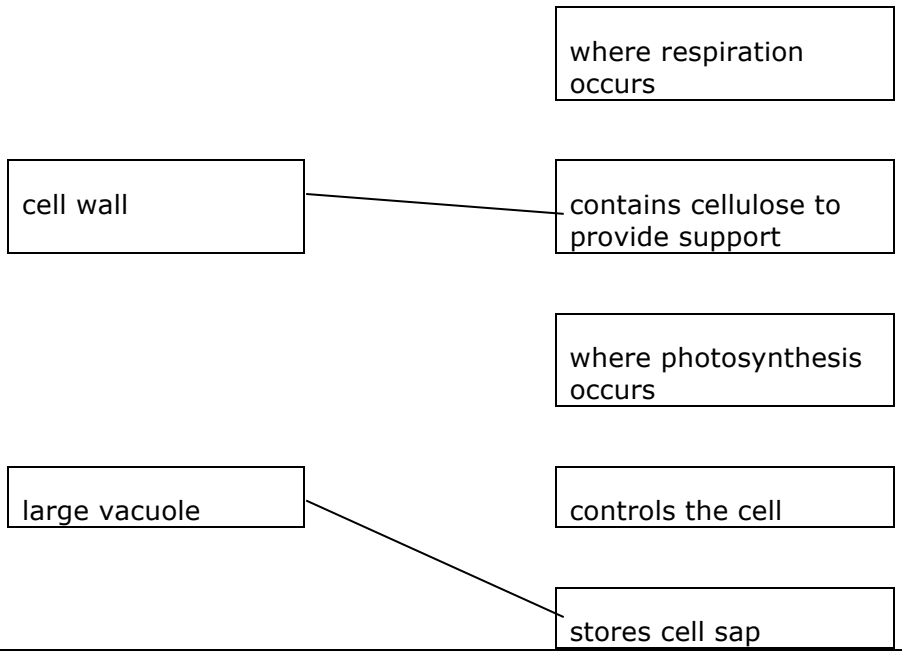
Question number	Answer	Mark
3(b)(i)	A	(1)

Question number	Answer	Mark
3(b)(ii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • milk does not change the mass of the enamel/milkshake reduces the mass of the enamel (1) • so therefore milk causes less tooth decay (1)	**(2)**

Question number	Answer	Mark
3(b)(iii)	Any two of the following points: • use real teeth (1) • clean the teeth (1) • expose the teeth for shorter time periods repeatedly (1)	**(2)**

Question number	Answer	Additional guidance	Mark
3(b)(iv)	Any one from: • energy content • fat content • vitamin and mineral content • caffeine level • alcohol content	accept other dietary factors	**(1)**

Question number	Answer	Mark
4(a)(i)	C	(1)

Question number	Answer	Mark
4(a)(ii)	One mark for each correct line  	(2)

Question number	Answer	Mark
4(b)(i)	C	(1)

Question number	Answer	Additional guidance	Mark
4(b)(ii)	5 (μm) ± 1.5	approximately a third of the diameter of the cell	(1)

Question number	Answer	Mark
4(b)(iii)	0.015 (mm)	(1)

Question number	Answer	Mark
4(c)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (2 marks): • higher magnification can be used (1) • so the cilia are more visible (1) • and the sub-cellular structures are visible (1)	**(3)**

Question number	Answer	Mark
5(a)(i)	23 (chromosomes)	**(1)**

Question number	Answer	Additional guidance	Mark
5(a)(ii)	6600 million ÷ 100 (1) × 35 = 2310 million (1)	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
5(b)(i)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • one cell produces two daughter cells for every division by mitosis (1) • two cell division steps produces four cells (1)	**(2)**

Question number	Answer	Mark
5(b)(ii)	C	**(1)**

Question number	Answer	Mark
5(c)(i)	An answer that combines knowledge (1 mark) and understanding (2 marks) to provide a logical description: • place the slide on the stage of the microscope and look through the eyepiece lens (1) Plus two from: • turning the focusing wheel/knob will obtain a clear image (when looking through the eyepiece lens) (1) • start by using the lowest objective lens magnification (1) • increase the magnification of the objective lens and refocus (1)	**(3)**

Question number	Answer	Mark
(c)(ii)	Use a stain (1)	(1)

Question number	Answer	Mark
6(a)(i)	D	(1)

Question number	Answer	Mark
6(a)(ii)	An answer that combines the following points of understanding to provide a logical description: • (the conjunctiva)forms a physical barrier between the inside of the eye and the environment (1) • and the lysozyme on the conjunctiva kills micro-organisms that enter the eye (1)	(2)

Question number	Answer	Mark
6(b)(i)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • occurrence of cataracts increases with age (1) • manipulation of the data, e.g. doubles between 45–59 and > 60 (1)	(2)

Question number	Answer	Mark
6(b)(ii)	$\frac{80}{256} \times 100 = 31\%$ (1) 45–59 category (1)	(2)

Question number	Answer	Mark
6(c)	An answer that combines knowledge (1 mark) and understanding (1 mark) to provide a logical description: • information is transmitted as an electrical signal (1) • and the signal travels down a sensory neurone from the receptor to the brain/signal travels along the optic nerve (1)	(2)

Question number	Answer	Mark
7(a)(i)	• 4.6 million – 4.4 million (1) • 0.2 million years/200 000 years (1)	(2)

Question number	Answer	Additional guidance	Mark
7(a)(ii)	An answer that combines knowledge (1 mark) and understanding (1 mark) to provide a logical description: • (scientists might look for) differences in the structural features of the fossil (1) • and *Ardipithecus ramidus* would be deeper in the rock layer than *Homo* {*habilis*/stone tools} (1)	e.g. *Ardipithecus ramidus* smaller cranial capacity	**(2)**

Question number	Answer	Additional guidance	Mark
7(a)(iii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • likely to be out-competed by *Homo erectus* (1) • {for resources essential for survival/due to the presence of a new selection pressure} (1)	accept: named resources accept: named selection pressure, e.g. climate change, environmental change, disease	**(2)**

Question number	Answer	Additional guidance	Mark
7(a)(iv)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • stone tool B because it is more {sophisticated/worked} (1) • and *Homo erectus* lived more recently than *Homo habilis* (1)	accept: data quoted from the timeline	**(2)**

Question number	Answer	Mark
7(b)	An answer that combines the following points of application of knowledge and understanding to provide a logical description: • genetic variation means that some plants will be tolerant of drought conditions and these can be selected (1) • cross-pollinate these plants and grow the seeds under drought conditions (1) • select offspring and repeat over several generations (1)	**(3)**

Question number	Answer	Additional guidance	Mark
8(a)(i)	• radius 10 mm ± 1 mm (1) • area = πr^2 (1) • answer 314 (mm^2) (1) answer must be to 3 significant figures	if radius outside range but area calculated max 2 marks award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Additional guidance	Mark
8(a)(ii)	antiseptic 1 (1)	ecf from (a)(i)	**(1)**

Question number	Answer	Mark
8(a)(iii)	Any two of the following points: • volume of antiseptic (1) • incubation temperature (1) • same type of agar (1) • amount of bacteria (1)	**(2)**

Question number	Answer	Mark
8(b)(i)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • the Bunsen burner flame kills all microorganisms on the loop (1) • so only the desired bacteria are transferred to the loop/no unwanted microorganisms spread to the agar plate (1)	**(2)**

Question number	Answer	Mark
8(b)(ii)	Any one from: • keep the lids on the agar plates after growth (1) • use agar sterilised in an autoclave first (1) • work close to a Bunsen flame to create an uplift (1)	**(1)**

Question number	Answer	Mark
8(c)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • prevents damage to the plant (1) • because the chemicals produced by garlic kills pathogens/pests (1)	**(2)**

Question number	Answer	Additional guidance	Mark
9(a)	• 830 mm = 0.83 m (1) • 0.83/0.99 = 0.8383… = 0.84 to two d.p. (1) OR • 0.99 m = 990 mm (1) • 830/990 = 0.8383… = 0.84 to two d.p. (1) Answer must be given to 2 decimal places	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
9(b)(i)	Any two of the following points: • similar BMI (1) • same gender profile (1) • similar amount (and type) of exercise (1)	**(2)**

Question number	Answer	Mark
9(b)(ii)	An answer that combines the following points to provide a plan: • weigh the 40 obese people (1) • half follow the new diet and half keep their normal diet (1) • after a fixed time period re-weigh the 40 people (1)	**(3)**

Question number	Indicative content	Mark
***9(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 (3 marks) and AO3 (3 marks)** AO3: Interpretation and evaluation from the graph • the trend is downwards • women are less likely to smoke than men • the trend for men is decreasing more steeply than for women • the decreasing trend in smoking should lead to a decrease in the occurrence of cardiovascular disease • the decrease of cardiovascular disease in men would be greater than in women AO2: Link between reducing smoking and cardiovascular disease: • less damage to alveoli so reduced effect on surface area of lungs • less fatty deposits build up in arteries so less chance of a heart attack or stroke • effect of nicotine raising heart rate and blood pressure is reduced • the risk of blood clotting is reduced so lower chance of heart attack or stroke	**(6)**

Level	Mark	Descriptor
	0	No awardable content
Level 1	1–2	• Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3) • The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
Level 2	3–4	• Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (AO3) • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
Level 3	5–6	• Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3) • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)

Question number	Answer	Mark
10(a)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • Mendel crossed homozygous tall and homozygous short pea plants and produced all tall offspring (1) • therefore all the offspring had a heterozygous genotype, with one tall and one short allele showing that the tall allele is dominant (1)	**(2)**

Question number	Indicative content	Mark
***10(b)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 (6 marks)** • cross the brown fruit fly and black fruit fly • identify the phenotype of the offspring • all the phenotype will be brown body • remove the parent flies • cross brown offspring • identify the phenotypes of the 2nd generation offspring • $\frac{1}{4}$ will be black body and $\frac{3}{4}$ will be brown body • the results would show the same ratio as Mendel's pea plant crosses	**(6)**

Level	Mark	Descriptor
	0	No awardable content
Level 1	1–2	• The explanation attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO2) • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3–4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO2) • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5–6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO2) • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

Question number	Answer	Mark
10(c)(i)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • asexual reproduction is a rapid reproduction technique allowing the production of more plants • as there is no requirement for cross pollination/higher crop yield/increased profit)	**(2)**

Question number	Answer	Mark
10(c)(ii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • introduces variation into the population • which allows for natural selection of fitter plants/increased chance of the population surviving	**(2)**

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9-1)

Centre Number	Candidate Number

Biology

Paper 2

Foundation Tier

Sample Assessment Materials for first teaching September 2016
Time: 1 hour 45 minutes

Paper Reference
1BI0/2F

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Plants need light for photosynthesis.

Part of the photosynthesis equation is shown below.

..... + carbon dioxide → glucose + ...

(a) Which of the following would complete the photosynthesis equation?

(1)

		reactant	product
☒	**A**	water	chlorophyll
☒	**B**	chlorophyll	oxygen
☒	**C**	water	oxygen
☒	**D**	oxygen	water

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A scientist investigates the effect of light intensity on photosynthesis.

He sets up the equipment shown in Figure 1.

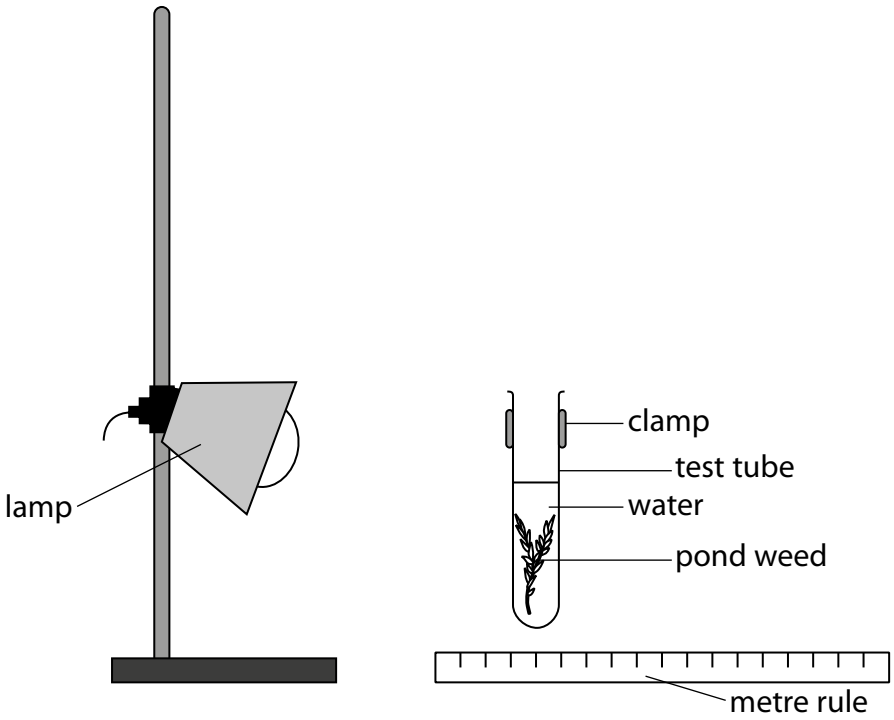

Figure 1

He places the lamp 10 cm from the test tube and records the number of bubbles produced in five minutes.

He repeats the procedure with the lamp at a distance of 20 cm and 30 cm away from the test tube.

The scientist wants to repeat his investigation at each distance.

(b) (i) State **three** variables that should be kept constant to improve the results.

(3)

1 .....

.....

2 .....

.....

3 .....

.....

The scientist noticed that the temperature of water near the light increased.

(ii) Give **one** improvement the scientist could make to reduce the effect of this increase in temperature.

(1)

.....

.....

(c) Figure 2 shows the results of the investigation.

distance (cm)	number of bubbles counted			
	test 1	test 2	test 3	mean
10	42	37	44	41
20	23	24	22	
30	10	11	12	11

Figure 2

(i) Calculate the mean result for a distance of 20 cm.

(1)

.....

The number of bubbles counted for test 2 at 10 cm was anomalous.

(ii) State how the scientist could deal with this anomaly.

(1)

.....

.....

(iii) Give a conclusion about the effect of light intensity on photosynthesis.

(1)

.....

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(Total for Question 1 = 8 marks)

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2 Figure 3 shows a pair of human lungs.

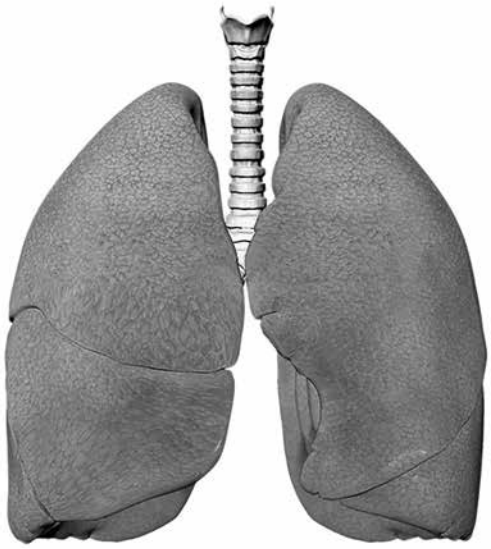

Figure 3

(a) (i) Where does gas exchange take place in the lungs?

(1)

- ☒ **A** alveolus
- ☒ **B** bronchus
- ☒ **C** bronchiole
- ☒ **D** trachea

A person had emphysema. This reduces the number of alveoli in the lungs.

(ii) Explain how emphysema would affect the amount of oxygen carried in the bloodstream.

(2)

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(b) Figure 4 is a table that shows the surface area (SA) to volume (V) ratio in three different sized cubes.

cube size (cm)	surface area / SA (cm^2)	volume / V (cm^3)	SA : V ratio
2	24	8	
4	96	64	1.5 : 1
6	216	216	1 : 1

Figure 4

(i) Calculate the SA : V ratio for the 2 cm cube.

(2)

.....

(ii) Give **one** reason why it is important that human lungs have a high surface area to volume ratio.

(1)

.....

.....

Oxygen is involved with aerobic respiration in cells.

(iii) Which is the correct equation for aerobic respiration?

(1)

☐ **A** oxygen + carbon dioxide → glucose + lactic acid

☐ **B** carbon dioxide + water → oxygen + lactic acid

☐ **C** glucose + oxygen → carbon dioxide + water

☐ **D** glucose + water → carbon dioxide + oxygen

(Total for Question 2 = 7 marks)

3 (a) Plankton, krill and cod are found in the Arctic ocean.

Figure 5 shows the mass of organisms in an area of the Arctic ocean.

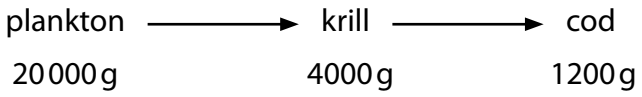

Figure 5

(i) Draw an accurate pyramid of biomass for this food chain.

(2)

(ii) Give **two** reasons why all the biomass from the krill is not transferred to the cod.

(2)

1 .....

.....

2 .....

.....

(b) Large amounts of krill are now being caught to produce krill oil as a dietary supplement for humans.

(i) Explain how this will affect the cod.

(2)

.....

.....

.....

.....

(ii) Give **one** other factor that could affect the number of krill in the Arctic ocean.

(1)

.....

.....

(Total for Question 3 = 7 marks)

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4 Thermoregulation is an important process of the human body.

Figure 6 shows a model of human skin.

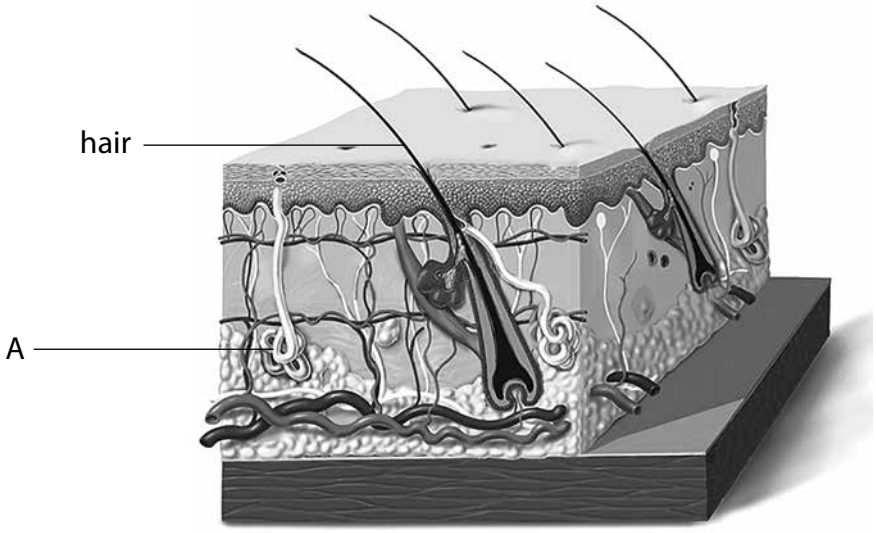

Figure 6

(a) Explain how part A is involved in thermoregulation.

(2)

.....

.....

.....

.....

(b) Which part of the brain contains the thermoregulatory centre?

(1)

☒ **A** cerebellum

☒ **B** cerebral cortex

☒ **C** hypothalamus

☒ **D** medulla

(c) Figure 7 shows how the internal temperature of a fish and an otter changes when the external temperature changes.

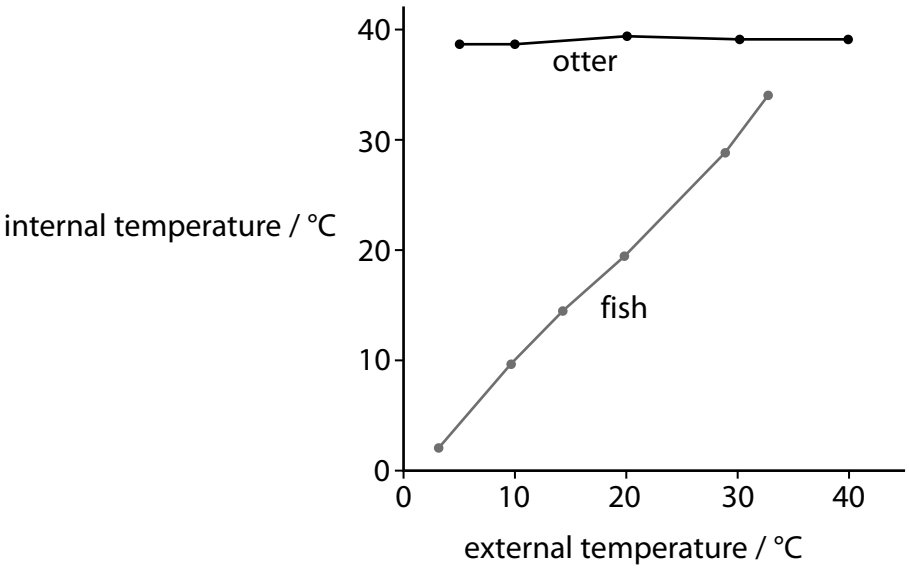

Figure 7

(i) Describe how the internal temperature of the fish changes in response to the external temperature.

(2)

.....

.....

.....

.....

(ii) Explain why it is important that the temperature of the otter is maintained at about 37 °C.

(2)

.....

.....

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(d) Shivering is one way in which humans can regulate their body temperature.

Explain how shivering helps to regulate body temperature.

(3)

(Total for Question 4 = 10 marks)

5 Scientists can measure how much water is lost by the leaves of a plant.

(a) (i) What is the movement of water molecules from an area with a low solute concentration to an area with a high solute concentration called?

(1)

- ☒ **A** active transport
- ☒ **B** diffusion
- ☒ **C** osmosis
- ☒ **D** transpiration

(ii) What structure transports water through the stem of the plant?

(1)

- ☒ **A** guard cell
- ☒ **B** phloem
- ☒ **C** stomata
- ☒ **D** xylem

(b) A scientist measured the rate of water loss from a plant shoot using a potometer.

Figure 8 shows the equipment used in the experiment.

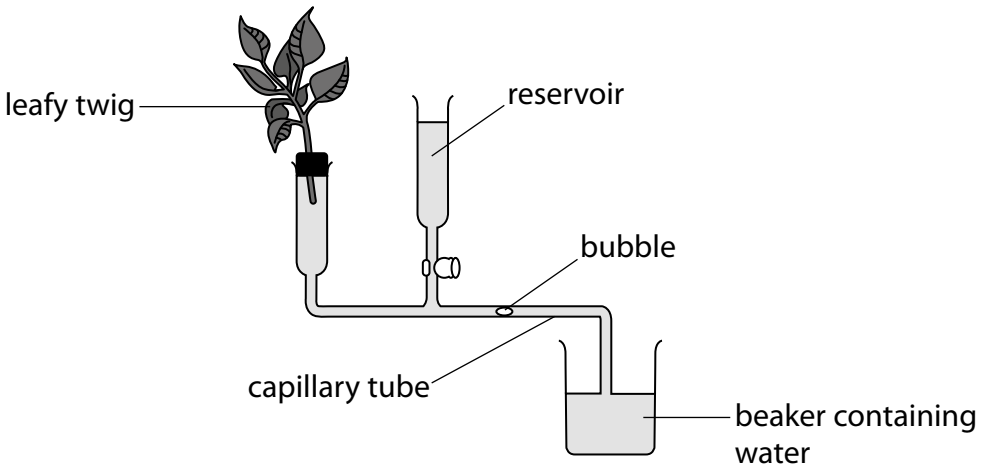

Figure 8

The volume of water lost from the plant can be calculated by measuring the distance a bubble moves along the capillary tubing.

(i) Calculate the rate of water loss from the plant in mm^3/s if the volume of water lost was 12 mm^3 in 10 minutes.

(3)

rate of water loss = ... mm^3/s

(ii) Explain how the water loss would change if the plant only had one leaf.

(2)

The scientist wants to extend the investigation by considering other factors that affect transpiration rate.

(iii) State **two** variables, other than temperature, that she could investigate.

(2)

1

2

(c) Explain the effect of increasing air temperature on the rate of transpiration in a plant.

(2)

(Total for Question 5 = 11 marks)

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6 (a) A scientist wanted to estimate the number of earthworms in a field using a quadrat.

The scientist placed the quadrats at random on the surface of the area being sampled and then watered the area with a very dilute solution of mustard.

This causes the earthworms to come to the surface to be counted.

(i) Give a reason why the quadrats were placed at random.

(1)

.....

.....

The skin of the earthworm acts as a gas exchange surface.

(ii) Describe the gases that are exchanged across the skin of the earthworm as a result of the earthworm respiring.

(2)

.....

.....

.....

(iii) What is the method in which gases are exchanged across the skin of the earthworm?

(1)

☒ **A** active transport

☒ **B** diffusion

☒ **C** osmosis

☒ **D** transpiration

(b) A student wants to estimate the number of daisy plants in a 500 m^2 field.

She uses a 1 m^2 quadrat to sample the field.

Figure 9 shows the results for the number of daisy plants counted in six areas sampled with the quadrat.

sample number	number of daisy plants	mean diameter of daisy plants / cm
1	5	7
2	2	2
3	6	9
4	3	3
5	4	5
6	4	6

Figure 9

(i) Calculate the mean number of daisy plants for the six samples.

(1)

mean number of daisy plants = ...

(ii) Describe how the student could use this calculated mean to estimate the total number of daisy plants in this field.

(2)

.....

.....

.....

.....

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Sample 2 was taken in an area where there were many overhanging trees.

(iii) Explain how these trees may have affected the distribution of daisy plants growing in this area.

(2)

(iv) Give **two** abiotic factors that could affect the distribution and size of daisies growing in this field.

(2)

(Total for Question 6 = 11 marks)

7 Figure 10 shows a diagram of the heart.

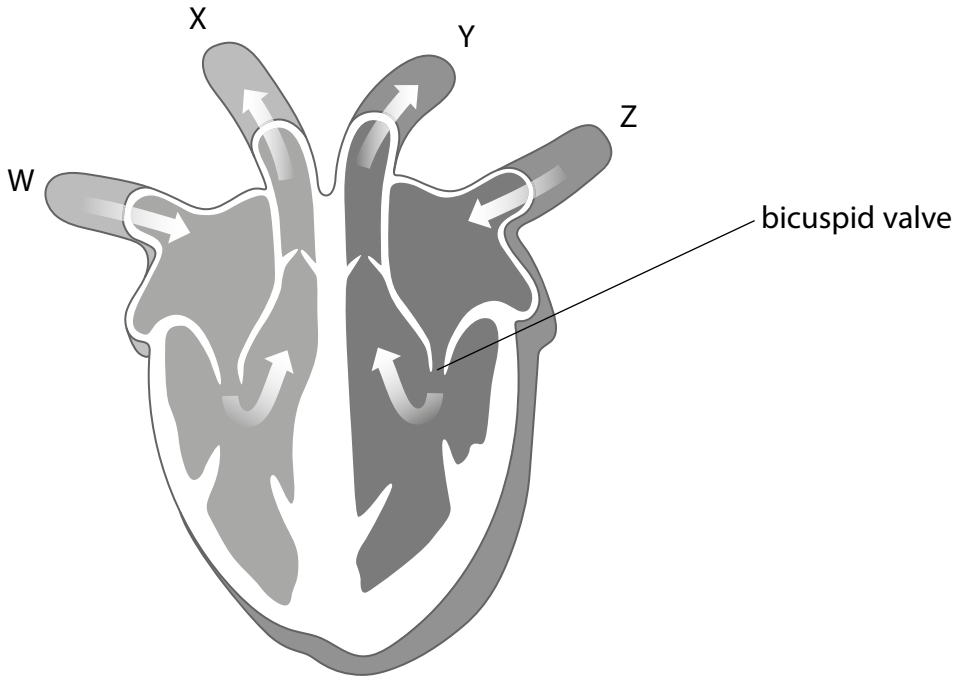


Figure 10

(a) (i) Vessel X takes

(1)

- ☒ **A** deoxygenated blood to the body
- ☒ **B** deoxygenated blood to the lungs
- ☒ **C** oxygenated blood to the body
- ☒ **D** oxygenated blood to the lungs

(ii) Give **one** reason why the wall of the left ventricle is thicker than the right.

(1)

.....

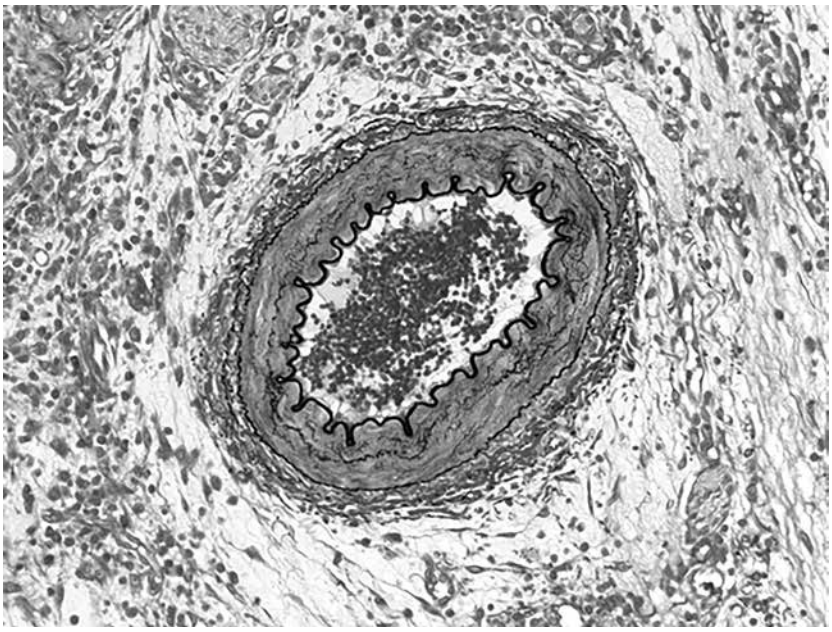
.....

Valves in the human heart may become damaged and no longer function.

(iii) Describe what would happen to the flow of blood in the left side of the heart if the bicuspid valve did not function effectively.

(2)

Figure 11 shows a photomicrograph of a blood vessel.



(Source: Microscape/Science Photo Library)

Figure 11

(b) Explain how the structure of this blood vessel is related to its function.

(2)

Figure 12 shows a diagram of the circulatory system of a fish.

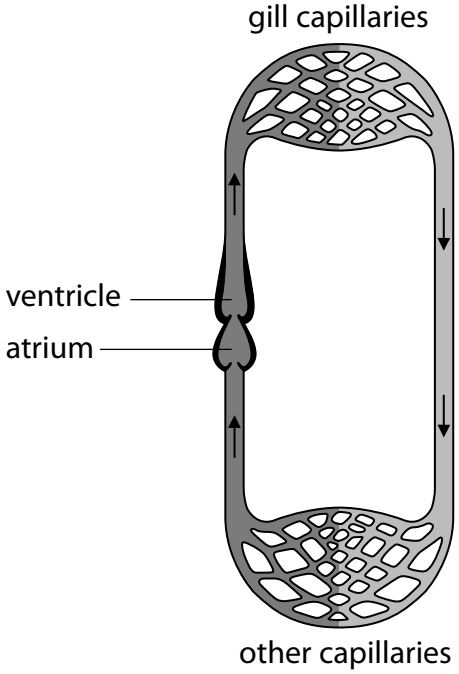


Figure 12

(c) Describe the differences between the structure of the circulatory system of a fish and the human circulatory system.

(4)

(Total for Question 7 = 10 marks)

8 (a) Blood tests can be used to check a person's blood glucose and hormone levels.

Figure 13 shows the results of two blood tests done on three people to check their blood glucose levels. Person 1 is healthy.

	blood glucose level (mmols/l)	
	after fasting for 12 hours	**two hours after drinking 75 g glucose**
person 1	5.4	6.4
person 2	5.6	9.0
person 3	7.8	12.1

Figure 13

(i) Compare the glucose levels of person 1 with the glucose levels of person 2 after fasting for 12 hours.

(1)

.....

.....

(ii) Compare the glucose levels of person 2 with the glucose levels of person 1, two hours after drinking 75 g glucose.

(1)

.....

.....

Person 3 cannot produce the hormone that controls blood glucose levels.

(iii) State the hormone that person 3 cannot produce.

(1)

.....

.....

(b) Figure 14 shows the level of progesterone for a female during five different stages of the menstrual cycle.

days in the menstrual cycle	progesterone level (nmol/l)
1–9	1.85
10–14	1.48
15–17	14.28
18–23	35.27
24–28	17.11

Figure 14

(i) Describe the changes in progesterone levels during the 28-day cycle.

(2)

(ii) Explain why progesterone levels changed following day 14.

(2)

Figure 15 shows the effectiveness of different methods of contraception in the prevention of pregnancy during their first year of use.

It shows percentages for typical use (some mistakes when used) and perfect use (no mistakes when used).

		percentage of women with unintended pregnancies within the first year of use (%)	
contraceptive method	**type of contraceptive**	**typical use**	**perfect use**
diaphragm	barrier	16	6
female condom	barrier	21	5
male condom	barrier	15	2
intra uterine device	hormonal	8	0.3
combined pill	hormonal	8	0.2
mini pill	hormonal	8	0.3
combined patch	hormonal	8	0.2

Figure 15

*(c) Compare and contrast the data for different contraceptive methods and types, to advise a young adult as to the best method of contraception to avoid pregnancy.

(6)

(Total for Question 8 = 13 marks)

9 A gardener investigated the ability of four types of compost to hold water.

50 cm^3 of water was added to each type of compost.

(a) Figure 16 shows the volume of water retained by four different types of compost.

type of compost	A	B	C	D
mass of compost /g	500	500	1000	1000
volume of water retained / cm^3	15	29	45	34
total mass of compost after water was added /g cm^{-3}	515	529	1045	1034

Figure 16

(i) Calculate the percentage change in mass for compost B.

(2)

..... %

(ii) Explain which compost would be best to use in a pot containing strawberry plants to be grown during a hot summer.

(2)

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(iii) State **one** way to improve this investigation in order to compare the results without having to calculate the percentage change in mass.

(1)

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(b) (i) Strawberries can be preserved by freezing them.

State how freezing helps to preserve strawberries.

(1)

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When the strawberries are frozen they become soft.

(ii) Describe the features of a plant cell that help to maintain its structure.

(2)

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Figure 17 shows a photomicrograph of a root cell.

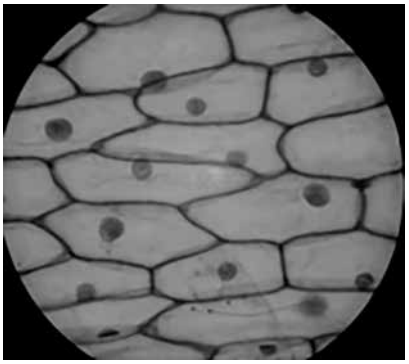

Figure 17

(iii) Draw and label a single plant cell from this photomicrograph.

(3)

(Total for Question 9 = 11 marks)

10 A student wanted to investigate the effect of light on the growth of cress seedlings.

The student had three pots of seedlings grown in different conditions.

Pot A was placed in a window with light from one direction only.

Pot B was placed in a cupboard with no light.

Pot C was placed with light from above.

Figure 18 shows the seedlings at the end of the investigation.

(a) (i) Label the pots of cress seedlings A, B and C.

(2)

(Source: Nigel Cattlin/Science Photo Library)

Figure 18

(ii) What is the response shown by the cress seedlings in Pot A?

(1)

☒ **A** negative gravitropism

☒ **B** negative phototropism

☒ **C** positive gravitropism

☒ **D** positive phototropism

(iii) State the plant hormone that causes the cress seedlings to grow towards the light.

(1)

.....

.....

(b) The student wanted to find out where the hormone that caused the response to directional light was found.

The student had two growing plant shoots and placed them both in a window with light coming from one direction.

Describe a method the student could use to show that the hormone was found in the tip of the plant shoot.

(2)

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Figure 19 shows examples of two plants growing in a desert environment.

(Source: Steve Allen/Science Photo Library)

(Source: Pascal Goetgheluck/ Science Photo Library)

Figure 19

*(c) Explain the adaptations that desert plants have that allow them to survive in this extreme environment.

(6)

(Total for Question 10 = 12 marks)

TOTAL FOR PAPER = 100 MARKS

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Paper 2 Foundation

Question number	Answer	Mark
1(a)	C	(1)

Question number	Answer	Mark
1(b)(i)	• temperature of water (1) • start each experiment with the same amount of carbon dioxide (1) • start each experiment with the same amount of water (1)	(3)

Question number	Answer	Mark
1(b)(ii)	Any one improvement from: • use a heat shield (1) • use a water bath (1)	(1)

Question number	Answer	Additional guidance	Mark
1(c)(i)	• $\frac{23+24+22}{3}$ (1) • $69 \div 3 = 23$ (1)	award full marks for correct numerical answer without working	(1)

Question number	Answer	Mark
1(c)(ii)	repeat the reading to get concordant results/calculate the mean without the anomalous result	(1)

Question number	Answer	Mark
1(c)(iii)	{as light intensity decreases/distance from the lamp increases} the rate of photosynthesis decreases	(1)

Question number	Answer	Mark
2(a)(i)	A	(1)

Question number	Answer	Mark
2(a)(ii)	an explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • emphysema will reduce the amount of oxygen carried into the bloodstream (1) • because there is reduced alveoli, which are the gas exchange surface between the lungs and blood capillaries (1)	(2)

Question number	Answer	Additional guidance	Mark
2(b)(i)	24 ÷ 8 (1) 3 : 1 (1)	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
2(b)(ii)	maximise gas exchange/maximise oxygen uptake	**(1)**

Question number	Answer	Mark
2(b)(iii)	C	**(1)**

Question number	Answer	Additional guidance	Mark
3(a)(i)	An accurately drawn pyramid of biomass: • pyramid shaped with all three stages shown (1) • accurate dimensions for the diagram (1)	6 small squares cod 2 large squares krill 10 large squares plankton	**(2)**

Question number	Answer	Mark
3(a)(ii)	Any two of the following points: • not all the krill is eaten (1) • parts of the krill cannot be digested (1) • the krill has used some biomass to provide energy for movement/heat/respiration (1)	**(2)**

Question number	Answer	Mark
3(b)(i)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • number of cod would decrease (1) • due to {smaller amount/limited/no} food supply (1)	**(2)**

Question number	Answer	Additional guidance	Mark
3(b)(ii)	Any one from: • predation (1) • competition (1) • disease (1) • pollution (1)	accept other environmental factors	**(1)**

Question number	Answer	Mark
4(a)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • part A is the sweat (eccrine) gland which releases water on to the surface of the skin (1) • where heat is removed by evaporation (of the water) (1)	**(2)**

Question number	Answer	Mark
4(b)	C	**(1)**

Question number	Answer	Additional guidance	Mark
4(c)(i)	An answer that combines points of interpretation/evaluation to provide a logical description: • the internal temperature of the fish increases as the external temperature increases (1) • at a linear rate (1)	Allow manipulation of figures from 2–34°C / correct reference to data	**(2)**

Question number	Answer	Mark
4(c)(ii)	An explanation that combines identification – knowledge (1 mark) and reasoning/justification – understanding (1 mark): • otters need an optimum temperature of 37 °C as this is the optimum temperature for enzyme action (1) Plus one point from: • because at lower temperatures enzymes work too slowly (1) • because at higher temperatures enzymes are denatured (1)	**(2)**

Question number	Answer	Mark
4(d)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks): • shivering stops the body temperature falling when external temperature drops (1) • because increased muscle contraction (1) • generates heat via respiration/friction (1)	**(3)**

Question number	Answer	Mark
5(a)(i)	C	**(1)**

Question number	Answer	Mark
5(a)(ii)	D	**(1)**

Question number	Answer	Additional guidance	Mark
5(b)(i)	10 mins = 600 s (1) 12 ÷ 600 (1) 0.02 (mm^3/s) (1)	award full marks for correct numerical answer without working maximum of 2 marks if conversion not completed	**(3)**

Question number	Answer	Mark
5(b)(ii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • transpiration would be reduced (1) • as less evaporation from the surface of the leaf (1)	**(2)**

Question number	Answer	Mark
5(b)(iii)	Any two of the following points: • humidity (1) • air speed (1) • light intensity (1)	**(2)**

Question number	Answer	Mark
5(c)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • transpiration rate is increased (1) • because water molecules have more energy/move faster (1)	**(2)**

Question number	Answer	Mark
6(a)(i)	To obtain a representative sample of the field (1)	**(1)**

Question number	Answer	Mark
6(a)(ii)	An answer that combines the following points of understanding to provide a logical description: • Oxygen moves from the air across the skin into the worm/bloodstream (1) • Carbon dioxide move from inside the worm/bloodstream to the air (1)	**(2)**

Question number	Answer	Mark
6(a)(iii)	B	**(1)**

Question number	Answer	Mark
6(b)(i)	$\frac{5+2+6+3+4+4}{6} = 4$ (1)	**(1)**

Question number	Answer	Mark
6(b)(ii)	An answer that combines the following points of understanding to provide a logical description: • divide the field area by the quadrat size (1) • multiply by the mean number of daisies (1)	**(2)**

Question number	Answer	Mark
6(b)(iii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • less daisy plants are likely to be growing in this area (1) • because the trees would cause lower light levels for photosynthesis/lower mineral levels for growth/less water available for photosynthesis (1)	**(2)**

Question number	Answer	Mark
6(b)(iv)	Any two of the following: Temperature (1) pH (1) pollutants (1) water (1)	**(2)**

Question number	Answer	Mark
7(a)(i)	B	**(1)**

Question number	Answer	Mark
7(a)(ii)	to pump blood around the body under higher pressure	**(1)**

Question number	Answer	Mark
7(a)(iii)	An answer that combines the following points of understanding to provide a logical description: • blood would flow backwards from the ventricle to the atrium/blood will leak through (1) • less (oxygenated) blood would be pumped to the body (1)	**(2)**

Question number	Answer	Mark
7(b)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • the blood vessel has thick walls/small lumen (1) • to carry oxygenated blood/to carry blood under higher pressure (1)	**(2)**

Question number	Answer	Mark
7(c)	• the fish heart has two chambers rather than four chambers (1) • the fish heart only has one ventricle and one atrium rather than two ventricles and two atria (1) • only deoxygenated blood flows through the fish heart (1) • the fish heart shows a single circulatory system rather than a double circulatory system (1)	**(4)**

Question number	Answer	Mark
8(a)(i)	• person 2 had a slightly higher blood glucose level than person 1 after fasting (by up to 0.2 mmols/l) (1)	**(1)**

Question number	Answer	Mark
8(a)(ii)	• person 2 had a much higher blood glucose level than person 1 two hours after taking glucose (up by 2.6 mmols/l) (1)	**(1)**

Question number	Answer	Mark
8(a)(iii)	Insulin (1)	**(1)**

Question number	Answer	Mark
8(b)(i)	An answer that combines points of interpretation/evaluation to provide a logical description • levels remain low up until day 14 then rise (1) • they continue to rise to day 23 and drop at day 24 (1)	**(2)**

Question number	Answer	Mark
8(b)(ii)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • as ovulation occurs (1) • the levels of progesterone released from the corpus luteum increases to maintain the lining of the uterus (1)	**(2)**

Question number	Indicative content	Mark
8(c)*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO3 (6 marks)** • during typical use the barrier methods are considerably less effective than hormonal methods • during perfect use the barrier methods are less effective than hormonal methods • manipulation of data from the table to show these relationships • perfect use of both barrier and hormonal methods are significantly more effective • manipulation of data from the table to show this relationship • the use of the combined pill and combined patch are the most effective contraceptive method • with perfect use only 0.2% result in pregnancy pregnancies and with typical use 8% result in pregnancy • the least effective contraceptive method is the female condom • 21% pregnancy with typical use and 16% pregnancy with perfect use • the most effective method of contraception is a hormonal method • the combined pill or combined patch are the most effective • perfect use is more effective than typical use • it may be easier to use the combined patch rather than the combined pill as it is less effected by digestive problems	**(6)**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Deconstructs scientific information but understanding and connections are flawed. An unbalanced or incomplete argument that provides limited synthesis of understanding. • Judgements are supported by limited evidence. (AO3)
Level 2	3–4	• Deconstructs scientific information and provides some logical connections between scientific concepts. An imbalanced argument that synthesises mostly relevant understanding, but not entirely coherently. • Judgements are supported by evidence occasionally. (AO3)
Level 3	5–6	• Deconstructs scientific information and provide logical connections between scientific concepts throughout. A balanced, well-developed argument that synthesises relevant understanding coherently. • Judgements are supported by evidence throughout. (AO3)

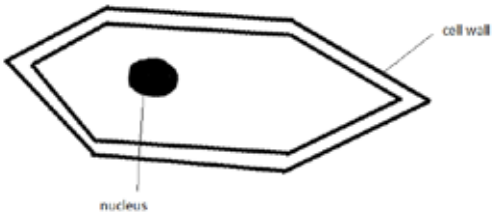
Question number	Answer	Additional guidance	Mark
9(a)(i)	29 ÷ 500 = 0.058 (1) 0.058 × 100 = 5.8 (1)	award full marks for correct numerical answer without working	**(2)**

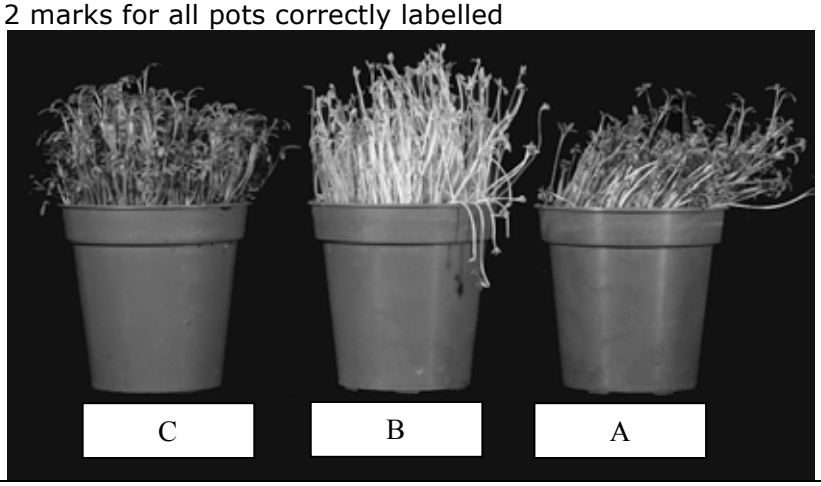
Question number	Answer	Mark
9(a)(ii)	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (1 mark): • compost B (1) as it has the highest percentage of water retained • and there is a higher amount of water loss in the plants due to higher temperatures causing a {larger rate of evaporation of water/higher transpiration rates} (1)	**(2)**

Question number	Answer	Additional Guidance	Mark
9(a)(iii)	Use the same starting mass of compost (1)	accept any other relevant improvement	**(1)**

Question number	Answer	Mark
9(b)(i)	{Microorganism/pathogen} growth is {very slow/inhibited} (1)	**(1)**

Question number	Answer	Mark
9(b)(ii)	An answer that combines the following points of understanding to provide a logical description: • the cell wall is made up of cellulose which gives the cell its rigidity (1) • and a vacuole for maintaining turgor pressure (1)	(2)

Question number	Answer	Mark
9(b)(iii)	• nucleus drawn and labelled (1) • cell wall drawn and labelled (1) • cell drawn with nucleus and cell wall clearly shown as on the photomicrograph (1)  	(3)

Question number	Answer	Mark
10(a)(i)	1 mark for 1 or 2 correctly labelled pots 2 marks for all pots correctly labelled  	(2)

Question number	Answer	Mark
10(a)(ii)	D	(1)

Question number	Answer	Mark
10(a)(iii)	Auxin	(1)

Question	Answer	Mark

number		
10(b)	An answer that combines the following points to provide a logical description of the method: • remove the tip from one of the plant shoots and leave the other (1) • measure the changes in growth and direction of movement (1)	**(2)**

Question number	Indicative content	Mark
***10(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 (6 marks)** Adaptations • these desert plants have: o spines o small leaves o thick waxy cuticles o fleshy/swollen stem plant survival • spines, small leaves o reduced surface area o deter animals from eating for water o less water lost by evaporation o moist air trapped in curled leaves • thick waxy cuticle less water lost by evaporation • stem collects and stores water	**(6)**

Level	Mark	Descriptor
	0	No awardable content
Level 1	1–2	• The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3–4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5–6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9–1)

Centre Number	Candidate Number

Biology

Paper 1

Higher Tier

Sample Assessment Materials for first teaching September 2016

Time: 1 hour 45 minutes

Paper Reference

1BI0/1H

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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S 5 0 0 4 2 A 0 1 2 8

PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Figure 1 shows the times when *Homo sapiens* and some of their ancestral species are thought to have lived.

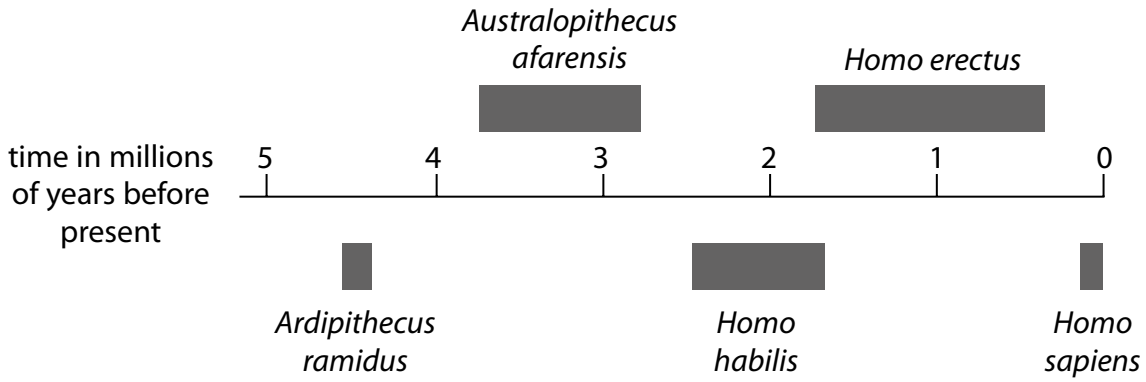

Figure 1

(a) Fossil remains of *Ardipithecus ramidus* were discovered in Ethiopia.

(i) Describe the evidence that scientists might have used to show that *Ardipithecus ramidus* inhabited the Earth earlier than *Homo habilis.*

(2)

(ii) Suggest an explanation for the extinction of *Homo habilis*.

(2)

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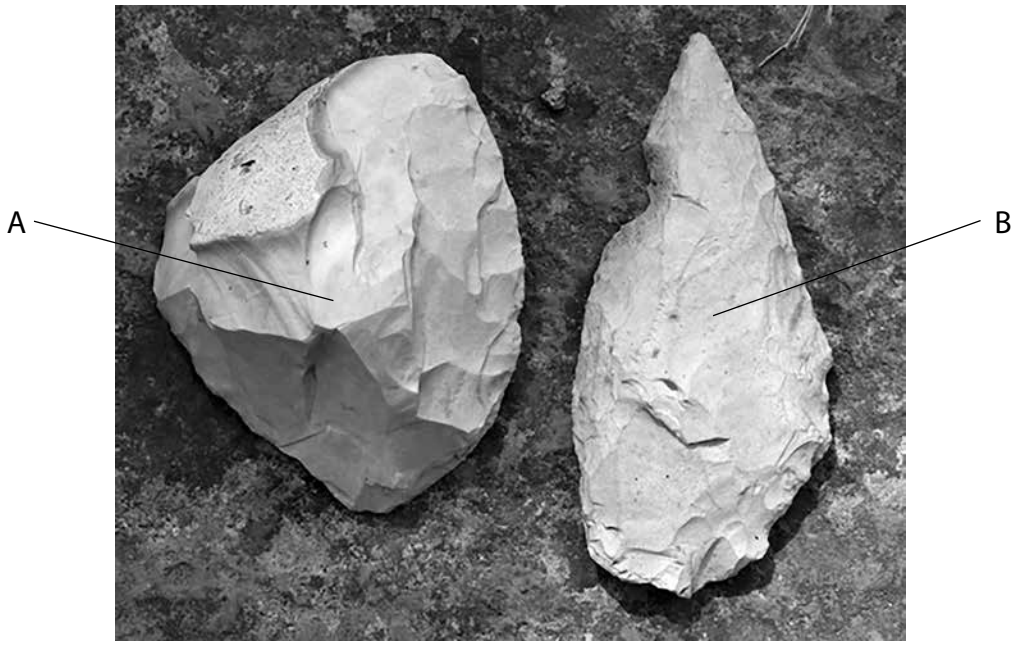
(iii) Figure 2 shows two stone tools, one used by *Homo habilis* and one used by *Homo erectus*.



(Source: Frederic Surmely/look at sciences/Science Photo Library)

Figure 2

Explain which stone tool was most likely to be used by *Homo erectus*.

Use information from Figure 1 and Figure 2.

(2)

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(b) The population of humans on Earth has increased significantly leading to food shortages.

The growth of drought-resistant crop plants could lead to an increase in food supply.

Describe how drought-resistant crop plants can be produced.

(3)

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(Total for Question 1 = 9 marks)

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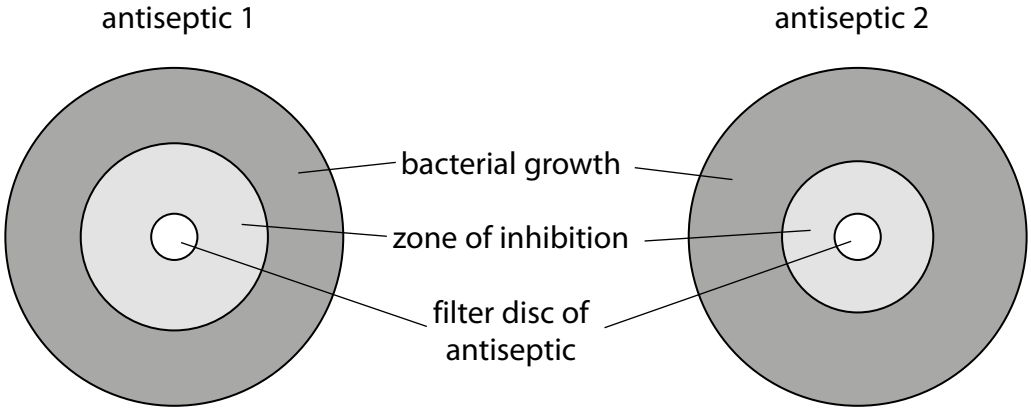
2 *Streptococcus pyogenes* is a bacterium that causes communicable infections.

(a) Scientists tested the ability of two antiseptics to kill *Streptococcus pyogenes* bacteria.

They spread *Streptococcus pyogenes* bacteria on two agar jelly plates and placed a small disc of filter paper containing antiseptic in the centre of each dish.

Figure 3 shows the results of the test after 24 hours of incubation.



antiseptic 1 zone of inhibition	
radius (mm)	12
area (mm^2)	452

Figure 3

(i) Calculate the area of the zone of inhibition for antiseptic 2.

Give the answer to 3 significant figures.

($\pi = 3.14$)

(3)

zone of inhibition for antiseptic 2 = ... mm^2

(ii) Explain which antiseptic is the most effective.

(2)

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(iii) After the bacteria were spread on the plates, both plates were incubated for 24 hours at 37 °C.

Give a reason why the plates were incubated at 37 °C.

(1)

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(b) The wire loop used to spread bacteria on an agar plate was heated in a Bunsen burner flame before being used.

Explain why this aseptic precaution was used.

(2)

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(Total for Question 2 = 8 marks)

3 The ratio of waist-to-hip measurements can be used to determine the risk of a person developing cardiovascular disease.

(a) Calculate the waist-to-hip ratio for a person with a waist measurement of 830 mm and a hip measurement of 0.99 m.

Give your answer to 2 decimal places.

(2)

Answer = ...

(b) Dieting can reduce the effects of cardiovascular disease.

(i) Which statement gives a reason why dieting can be used to reduce weight in obese people?

(1)

☒ **A** Dieting increases metabolism and growth rate

☒ **B** Dieting reduces energy consumption

☒ **C** Dieting decreases metabolism

☒ **D** Dieting increases energy consumption

(ii) A scientist is planning to test a new diet for weight loss.

She selects 40 obese people to take part in the test.

All the obese people are between 20 and 30 years of age.

State **two** other factors the scientist should control when selecting the people.

(2)

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(iii) Devise a plan the scientist could use to test the effectiveness of the new diet using the 40 obese people.

(3)

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(Total for Question 3 = 8 marks)

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4 Gregor Mendel investigated the genetics of peas.

He did not know about genes but showed that inherited characteristics can be dominant or recessive.

(a) Explain how Mendel used homozygous tall and homozygous short pea plants to show that the tall allele is dominant to the short allele.

(2)

(b) Figure 4 shows a strawberry plant that has produced several runners and new strawberry plantlets are growing at the end of each runner. This is asexual reproduction.

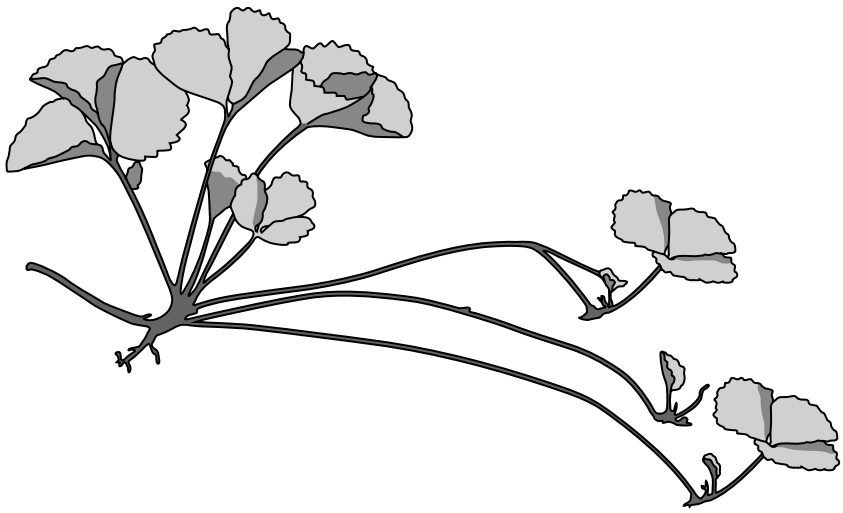

Figure 4

(i) Explain why asexual reproduction in strawberries is beneficial to strawberry farmers.

(2)

(ii) Strawberry fruits, containing seeds, are produced after a flower is fertilised.

Explain why seed production is an advantage to the strawberry plant.

(2)

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(c) Duchenne muscular dystrophy is a sex-linked recessive genetic disorder caused by a mutation on a single gene on the X-chromosome.

The letter D can be used for the dominant allele and the letter d for the recessive allele.

Figure 5 shows the inheritance of Duchenne muscular dystrophy in a family.

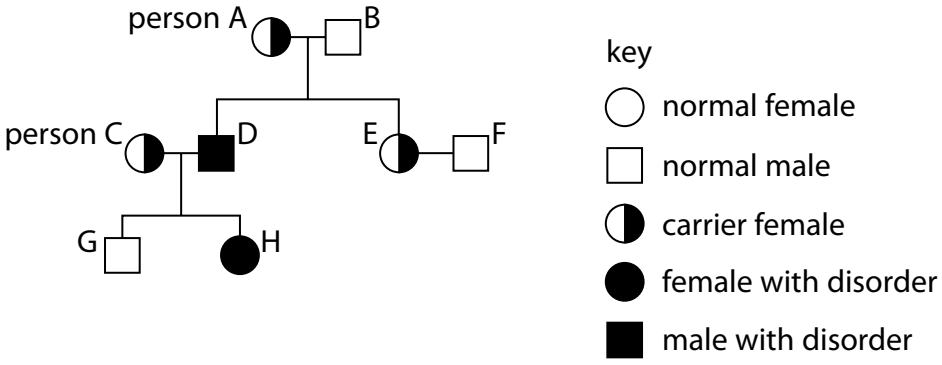

Figure 5

(i) What is the percentage chance of any child from person A inheriting the mutated allele?

(1)

- ☒ **A** 0%
- ☒ **B** 25%
- ☒ **C** 50%
- ☒ **D** 75%

(ii) Explain the conclusion that can be made about the genotype of person C.

(2)

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(Total for Question 4 = 9 marks)

5 Diffusion, active transport and osmosis can be used to move substances into and out of cells.

(a) A student was investigating osmosis in potato cubes.

He used the following method:

cut a potato into equal-sized cubes

- record the mass of each potato cube
- place each potato cube into different concentrations of salt solution
- remove the potato cubes after 30 minutes
- dry the potato cubes and record the final mass of each cube.

He plots his results on a graph shown in Figure 6.

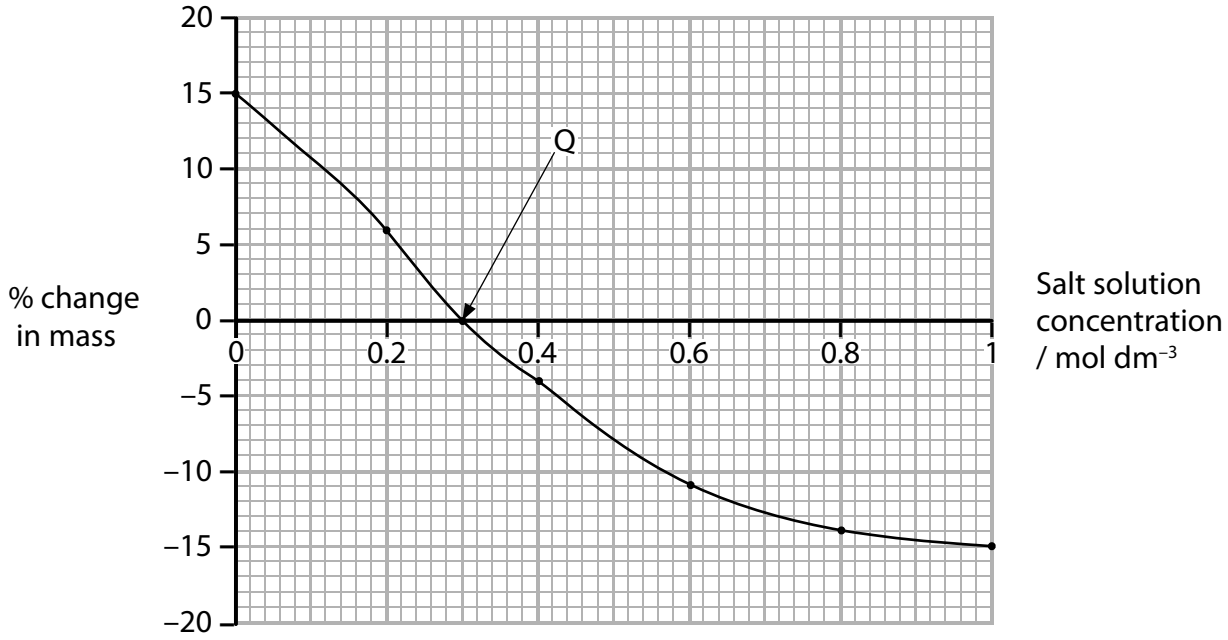

Figure 6

The method controls a number of variables.

(i) Name **one** other variable that needs to be controlled during the student's investigation.

(1)

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(ii) Give a reason why the potato cube must be dried.

(1)

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(iii) Explain the conclusion that can be made about point Q on Figure 6.

(2)

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(iv) Give one way that the student could obtain more data to increase the accuracy of point Q.

(1)

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(b) Osmosis is one method that single-celled organisms, such as bacteria, use to obtain molecules from their environment.

Which of the following is a correct description of a process involving the transport of molecules?

(1)

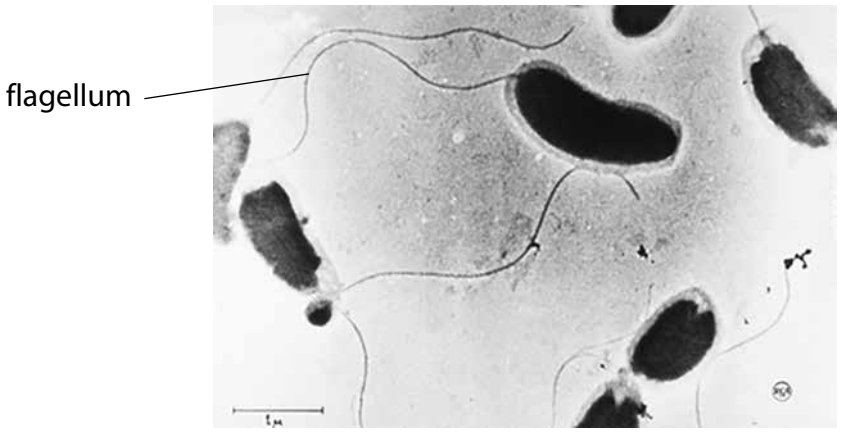
☒ **A** Diffusion is used to transport molecules against the concentration gradient

☒ **B** Active transport is used to obtain molecules in a low concentration environment

☒ **C** Active transport moves substances along the concentration gradient

☒ **D** Diffusion uses energy to transport molecules into cells

(c) Figure 7 shows some *Vibrio cholerae*, the bacteria that cause cholera.



Magnification ×8000

(Source: Corbis)

Figure 7

The length of one flagellum on Figure 7 is 68 mm.

Calculate the length of the flagellum in μm.

(3)

..... μm

(Total for Question 5 = 9 marks)

6 (a) DNA is composed of four different DNA nucleotides.

(i) Which diagram represents the arrangement of the sugar, phosphate and the base in a DNA nucleotide?

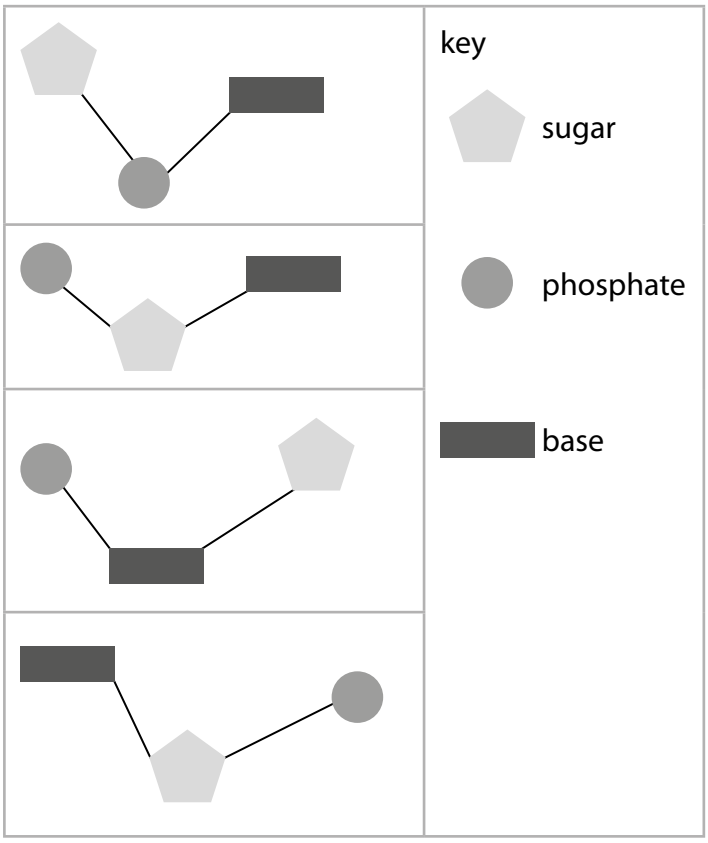
(1)

☐ **A**

☐ **B**

☐ **C**

☐ **D**



(ii) An allele starts with the DNA sequence ATGCATGTACCG.

Give the sequence of the complementary DNA sequence.

(1)

.....

.....

(iii) The length of one DNA nucleotide was measured at 3.3×10^{-10} metres.

Calculate the approximate length of a gene containing 250 nucleotides in nanometres.

(2)

..... nm

(b) The DNA of an organism determines its phenotype.

White tigers are produced because of a mutation of a single allele which usually produces the normal orange and yellow fur pigmentation.

The mutated allele is recessive.

Samba, a male white tiger, was bred with Rani. They had three offspring; two offspring have white fur and one has a normal fur pigmentation.

(i) State the genotype of Rani.

(1)

.....

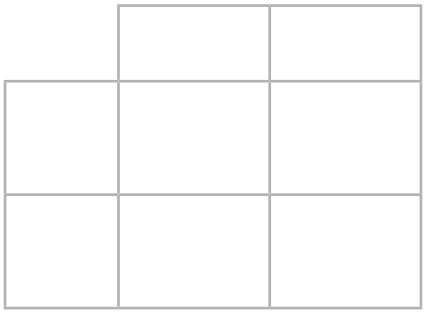
.....

(ii) The offspring with normal fur pigmentation was bred with a tiger that was heterozygous.

Use A/a to represent the alleles for fur pigmentation.

Predict, using the Punnett square, the percentage probability of the offspring from this cross having normal fur pigmentation.

(2)



percentage probability = ... %

(c) Explain how two parents with a dominant phenotype can produce offspring expressing a recessive characteristic.

(2)

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.....

(Total for Question 6 = 9 marks)

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7 Figure 8 shows a diagram of the human eye.

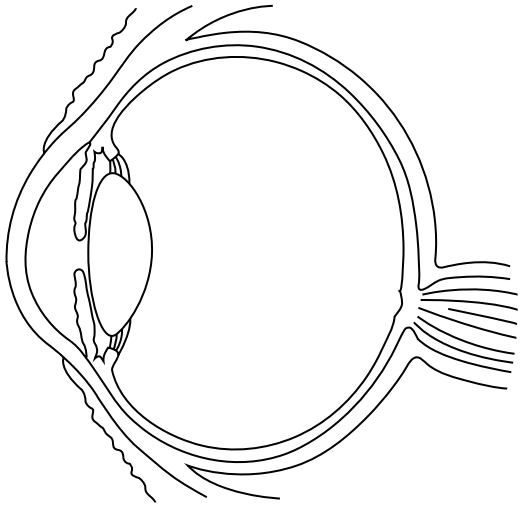

Figure 8

(a) (i) Which structure of the eye contains the light receptor cells?

(1)

- ☐ **A** iris
- ☐ **B** lens
- ☐ **C** cornea
- ☐ **D** retina

(ii) The optic nerve transfers electrical signals from the eye to the central nervous system.

(1)

The optic nerve is a

- ☐ **A** relay neurone
- ☐ **B** motor neurone
- ☐ **C** sensory neurone
- ☐ **D** reflex neurone

(iii) Name the region of the central nervous system responsible for vision.

(1)

.....

.....

(b) Macular degeneration is a defect of the eye that occurs when some cells of the retina begin to break down.

Embryonic stem cell therapy has been used to improve the vision of some patients with macular degeneration.

Explain how embryonic stem cells could be used to treat macular degeneration.

(2)

(c) Some research has shown that increased use of computers and other digital media can affect eyesight and reaction times.

A scientist wanted to test if prolonged use of a computer affected reaction time.

The scientist tested the reaction times of 10 people under the same environmental conditions.

These people then used a computer for three hours.

The scientist tested their reaction time again.

Give **three** ways that the scientist could improve this method to determine if prolonged use of a computer affects reaction time.

(3)

1

2

3

(d) Figure 9 shows the reaction times of five people.

person	1	2	3	4	5
reaction time/seconds	0.258	0.685	0.236	0.246	0.268

Figure 9

(i) Calculate the mean reaction time in milliseconds.

(2)

..... ms

(ii) Give the name of the mathematical term which is used to describe the reaction time value of person 1.

(1)

.....

.....

(Total for Question 7 = 11 marks)

8 Phenolphthalein is an indicator. It is pink in alkaline solutions and turns colourless as the pH decreases.

It can be used to measure the activity of the enzyme lipase on the breakdown of lipids.

Samples of milk containing phenolphthalein were incubated with lipase at different temperatures.

The time taken for the phenolphthalein to turn colourless was recorded and used to calculate the rate of enzyme activity.

Figure 10 shows these results.

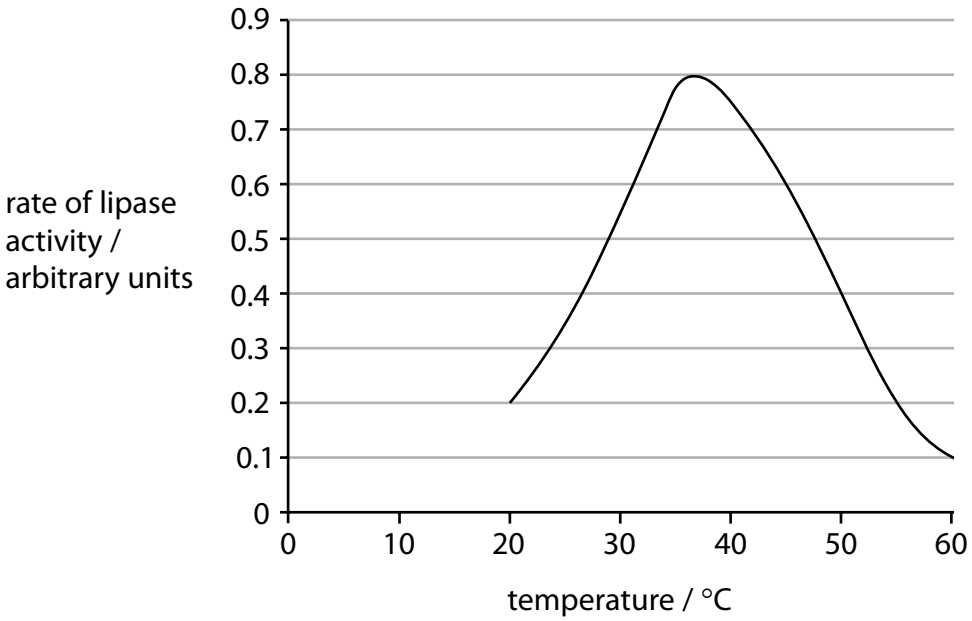

Figure 10

(a) (i) Explain why phenolphthalein turns colourless when lipase breaks down the lipids in milk.

(2)

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DO NOT WRITE IN THIS AREA

(ii) Describe the effect of temperature on the activity of lipase, as shown in Figure 10.

(2)

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(iii) Explain why the activity of lipase changes above a temperature of 40 °C.

(2)

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(b) A student investigated the time taken for amylase to breakdown a 10% starch solution into glucose at 37 °C. The student repeated the investigation five times.

Figure 11 shows the results.

time taken for amylase to produce glucose (s)				
test 1	**test 2**	**test 3**	**test 4**	**test 5**
120	125	110	115	118

Figure 11

(i) Calculate the rate of amylase enzyme activity for the 10% starch solution.

(3)

rate = ... s^{-1}

The investigation was done at 37 °C.

(ii) State **one** other variable that the student should have controlled during this investigation.

(1)

.....

.....

(c) Different enzymes catalyse specific reactions.

Explain why enzymes can only catalyse specific reactions.

(2)

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(Total for Question 8 = 12 marks)

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9 When bacteria divide they replicate their genome and synthesise their cell wall.

Figure 12 outlines the stages of bacterial replication.

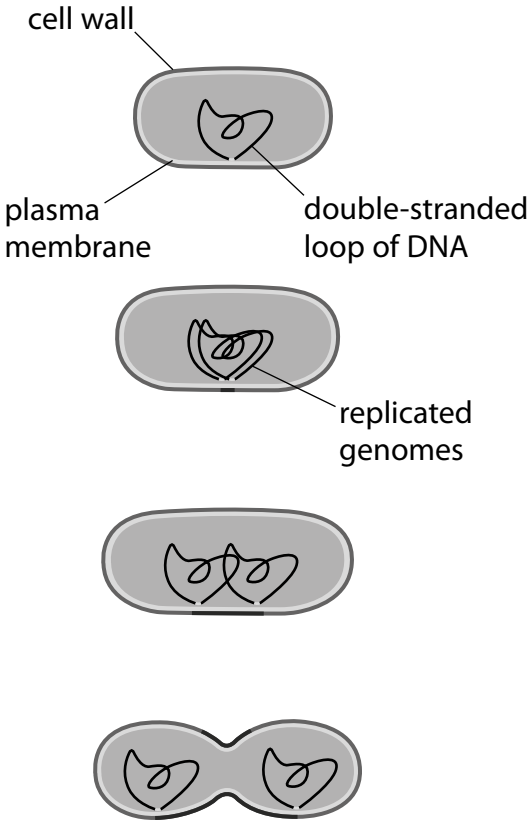

Figure 12

(a) Penicillin inhibits the synthesis of the cell wall in bacteria.

Explain the effect of penicillin on bacterial and human cells.

(3)

(b) Penicillin, isolated from a fungus, was the first antibiotic used to treat bacterial infections and is still widely used today.

Scientists have genetically engineered bacteria to produce large amounts of penicillin.

Describe how scientists would produce a genetically modified bacterium that produces penicillin.

(4)

*(c) MRSA is a bacterium that has evolved to become resistant to antibiotics.

With reference to Darwin's theory of evolution by natural selection, explain how MRSA bacteria have evolved to become resistant to antibiotics.

(6)

(Total for Question 9 = 13 marks)

10 There are different types of white blood cell in the body. One type is called CD4+ T-Helper cells.

The normal range of these cells in the blood is between 5×10^8 and 1.2×10^9 cells/dm^3

An AIDS patient has a CD4+ T-Helper cell count of 1.5×10^8 cells/dm^3

(a) Explain why the CD4+ count of 1.5×10^8 cells/dm^3 has led to the diagnosis of AIDS.

(2)

*(b) Some sexually transmitted infections (STIs) can be diagnosed by testing urine samples.

These tests use monoclonal antibodies that bind to an antigen on the pathogen.

Describe how a monoclonal antibody can be developed and used to detect an STI using a urine sample.

(6)

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(c) The antigens on pathogens can be proteins with a specific amino acid sequence.

Explain how the order of amino acids in a protein is determined by the sequence of the gene.

(4)

(Total for Question 10 = 12 marks)

TOTAL FOR PAPER = 100 MARKS

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Paper 1 Higher

Question number	Answer	Additional guidance	Mark
1(a)(i)	An answer that combines knowledge (1 mark) and understanding (1 mark) to provide a logical description: • (scientists might look for) differences in the structural features of the fossil (1) • and *Ardipithecus ramidus* would be deeper in the rock layer than *Homo* {*habilis*/stone tools} (1)	e.g. *Ardipithecus ramidus* smaller cranial capacity	**(2)**

Question number	Answer	Additional guidance	Mark
1(a)(ii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • likely to be out-competed by *Homo erectus* (1) • {for resources essential for survival/due to the presence of a new selection pressure} (1)	accept: named resources accept: named selection pressure, e.g. climate change, environmental change, disease	**(2)**

Question number	Answer	Additional guidance	Mark
1(a)(iii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • stone tool B because it is more {sophisticated/worked} (1) • and *Homo erectus* lived more recently than *Homo habilis* (1)	accept: data quoted from the timeline	**(2)**

Question number	Answer	Mark
1(b)	An answer that combines the following points of application of knowledge and understanding to provide a logical description: • genetic variation means that some plants will be tolerant of drought conditions and these can be selected (1) • cross-pollinate these plants and grow the seeds under drought conditions (1) • select offspring and repeat over several generations (1)	**(3)**

Question number	Answer	Additional guidance	Mark
2(a)(i)	• radius 10 mm ± 1 mm (1) • area = πr^2 (1) • area 314 (mm^2) (1) answer must be to 3 significant figures	if radius outside range but area calculated max 2 marks award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Additional guidance	Mark
2(a)(ii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • antiseptic 1 has a larger zone of inhibition (1) • so more of *Streptococcus pyogenes* have been killed (1)	ecf from (a)(i)	**(2)**

Question number	Answer	Additional guidance	Mark
2(a)(iii)	• to provide optimal growth conditions	*S. pyogenes* grow at body temperature	**(1)**

Question number	Answer	Mark
2(b)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • the Bunsen burner flame kills all microorganisms on the loop (1) • so only the desired bacteria are transferred to the loop/no unwanted microorganisms spread on the agar plate (1)	**(2)**

Question number	Answer	Additional guidance	Mark
3(a)	• 830 mm = 0.83 m (1) • 0.83/0.99 = 0.8383… = 0.84 to two d.p. (1) OR • 0.99 m = 990 mm (1) • 830/990 = 0.8383… = 0.84 to two d.p. (1) • Answer must be given to 2 decimal places	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
3(b)(i)	B	**(1)**

Question number	Answer	Mark
3(b)(ii)	Any two of the following points: • similar BMI (1) • same gender profile (1) • similar amount (and type) of exercise (1)	**(2)**

Question number	Answer	Mark
3(b)(iii)	An answer that combines the following points to provide a plan: • weigh the 40 obese people (1) • half follow the new diet and half keep their normal diet (1) • after a fixed time period re-weigh the 40 people (1)	**(3)**

Question number	Answer	Mark
4(a)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • Mendel crossed homozygous tall and homozygous short pea plants and produced all tall offspring (1) • therefore all the offspring had a heterozygous genotype with one tall and one short allele showing that the tall allele is dominant (1)	**(2)**

Question number	Answer	Mark
4(b)(i)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • asexual reproduction is a rapid reproduction technique allowing the production of more plants • as there is no requirement for cross pollination/higher crop yield/increased profit	**(2)**

Question number	Answer	Mark
4(b)(ii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • introduces variation into the population • which allows for natural selection of fitter plants/increased chance of the population surviving	**(2)**

Question number	Answer	Mark
4(c)(i)	C	**(1)**

Question number	Answer	Mark
4(c)(ii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • genotype is X^DX^d/she must have one dominant and one recessive allele (1) • because her daughter must have received the recessive allele and her son has inherited a dominant allele (1)	**(2)**

Question number	Answer	Mark
5(a)(i)	Any one variable from • temperature • amount of drying • type of potato • age of potato	(1)

Question number	Answer	Mark
5(a)(ii)	To get an accurate reading of mass	(1)

Question number	Answer	Mark
5(a)(iii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): any **one** identification point from: • there is no change in mass at 0.3 mol dm^{-3} (check once drawn) (1) • this is the isotonic salt concentration in the potato (1) **Plus** reasoning/justification • because there is no net movement of water/no salt concentration gradient (1)	(2)

Question number	Answer	Mark
5(a)(iv)	• repeat the test using intermediate concentrations (between 0.2 and 0.4 mol dm^3)	(1)

Question number	Answer	Mark
5(b)	B	(1)

Question number	Answer	Additional guidance	Mark
5(c)	• 68 ÷ 8000 (1) • 0.0085 (1) • 8.5 (µm) (1)	award full marks for correct numerical answer without working	(3)

Question number	Answer	Mark
6(a)(i)	B	(1)

Question number	Answer	Mark
6(a)(ii)	TACGTACATGGC	(1)

Question number	Answer	Additional guidance	Mark
6(a)(iii)	• 3.33×10^{-10} equals 0.33 nm (1) • $0.33 \times 250 = 82.5$ (nm) (1)	maximum one mark if no conversion to nm award full marks for correct numerical answer without working	(2)

Question number	Answer	Additional guidance	Mark
6(b)(i)	• heterozygous	accept alleles showing heterozygous genotype	(1)

Question number	Answer	Mark
6(b)(ii)	• correct Punnett square (1) • 75% normal fur pigmentation (1)	(2)

	A	a
A	AA	Aa
a	Aa	aa

Question number	Answer	Mark
6(c)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • both parents must be heterozygous for the recessive allele (1) • so the offspring must inherit the recessive allele from each parent (1)	(2)

Question number	Answer	Mark
7(a)(i)	D	(1)

Question number	Answer	Mark
7(a)(ii)	C	(1)

Question number	Answer	Mark
7(a)(iii)	cerebrum	(1)

Question number	Answer	Mark
7(b)	An explanation that makes reference to: identification – knowledge (1 mark) and reasoning /justification – knowledge (1 mark): • embryonic stem cells can be stimulated to produce cells of the retina (1) • which can be transplanted into a patient's eye to replace the damaged cells (1)	(2)

Question number	Answer	Mark
7(c)	Any **three** improvements from the following: • vary the time for computer usage (1) • the activity used on the computer must be the same for each person (1) • control the intake of food/drink/drugs before and during the test (1) • repeat the test at different times of the day (1) • repeat the test using more people (1)	(3)

Question number	Answer	Additional guidance	Mark
7(d)(i)	• $\frac{0.258+0.685+0.236+0.246+0.268}{5}$ = 0.339 (1) • 339 (ms) (1)	award full marks for correct numerical answer without working	(2)

Question number	Answer	Mark
7(d)(ii)	• it is the median value	(1)

Question number	Answer	Mark
8(a)(i)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • fatty acids are formed when the lipids are broken down by lipase (1) • and fatty acids are acidic (so the pH decreases) (1)	**(2)**

Question number	Answer	Mark
8(a)(ii)	An answer that combines up to a maximum of **two** points to provide a logical description: • as the temperature increases from 20 °C to 37 °C the rate of lipase activity increases (from 0.2 to 0.8) (1) • the rate of lipase activity is optimal at 37 °C (1) • above 37 °C the rate of lipase activity decreases (from 0.8 to 0.1) (1)	**(2)**

Question number	Answer	Mark
8(a)(iii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • an increase in temperature above 40 °C causes changes in the shape of the active site of the enzyme (1) • therefore the enzyme becomes denatured and no longer functions (1)	**(2)**

Question number	Answer	Additional guidance	Mark
8(b)(i)	• mean= 588/5 = 117.6 (1) • rate = 1 ÷ 117.6 (1) • 0.0085 (1)	award full marks for correct numerical answer without working accept 1000/t accept 10/t	**(3)**

Question number	Answer	Mark
8(b)(ii)	Any one variable from: • concentration of the enzyme • volume of enzyme solution • volume of starch solution • pH of the solutions	**(1)**

Question number	Answer	Mark
8(c)	An explanation that makes reference to: identification – knowledge (1 mark) and reasoning /justification – knowledge (1 mark): • the active site of an enzyme has a specific shape because of the order of the amino acids (1) • the substrate must have a shape which is complementary to the active site (1)	**(2)**

Question number	Answer	Mark
9(a)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (2 marks): • penicillin prevents the bacteria from dividing as they cannot make a new cell wall (1) • because humans cells do not have a cell wall (1) • they are unaffected by penicillin (1)	**(3)**

Question number	Answer	Mark
9(b)	An answer that combines knowledge (2 marks) and understanding (2 marks) to provide a logical description: • use restriction enzymes to remove the gene and cut the plasmid (1) • use of ligase to join DNA molecules together (1) • cut the gene from the genome of the fungus and extract a plasmid from the bacteria (1) • insert the recombinant plasmid back into the bacteria (1)	**(4)**

Question number	Indicative content	Mark
*9(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • bacteria reproduce rapidly generating a large population • there is variation among a bacterial population • some bacteria develop a resistance to antibiotics through mutation • antibiotic treatment exerts a selection pressure • bacteria resistant to antibiotics survive • antibiotic resistance inherited • non-resistant bacteria do not survive • levels of antibiotic resistance in a population of bacteria increase	**(6)**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure that is clear, coherent and logical. (AO1)

Question number	Answer	Mark
10(a)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • the CD4+ count is significantly below the normal range because the HIV has destroyed the {white blood cells/CD4+ cells} (1) • so the person is more susceptible to opportunistic infections and classified as having AIDS (1)	**(2)**

Question number	Indicative content	Mark
***10(b)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 (6 marks)** • isolate an antigen from the pathogen which causes the STI • inject the antigen into a mouse/rodent • collect lymphocytes producing an antibody to the STI antigen • fuse the B-lymphocyte with a myeloma cell • production of a hybridoma • hybridoma produces a monoclonal antibody against the antigen of the STI • attach the monoclonal antibody to coloured bead/indicator • incorporate into a test strip.	**(6)**

Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	• The explanation attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO2) • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3-4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO2) • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5-6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO2) • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

Question number	Answer	Additional guidance	Mark
10(c)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (3 marks): • a single strand of messenger RNA is transcribed from the gene in the nucleus (1) • messenger RNA molecule binds to the ribosome (1) • the triplet code from the mRNA is matched by a complementary tRNA anticodon at the ribosome (1) • tRNA transfers amino acids to the polypeptide chain in a specific order (1)	to gain maximum marks the process must be in a logical sequence	**(4)**

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9-1)

Centre Number	Candidate Number

Biology

Paper 2

Higher Tier

Sample Assessment Materials for first teaching September 2016
Time: 1 hour 45 minutes

Paper Reference
1BI0/2H

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Figure 1 shows a diagram of the heart.

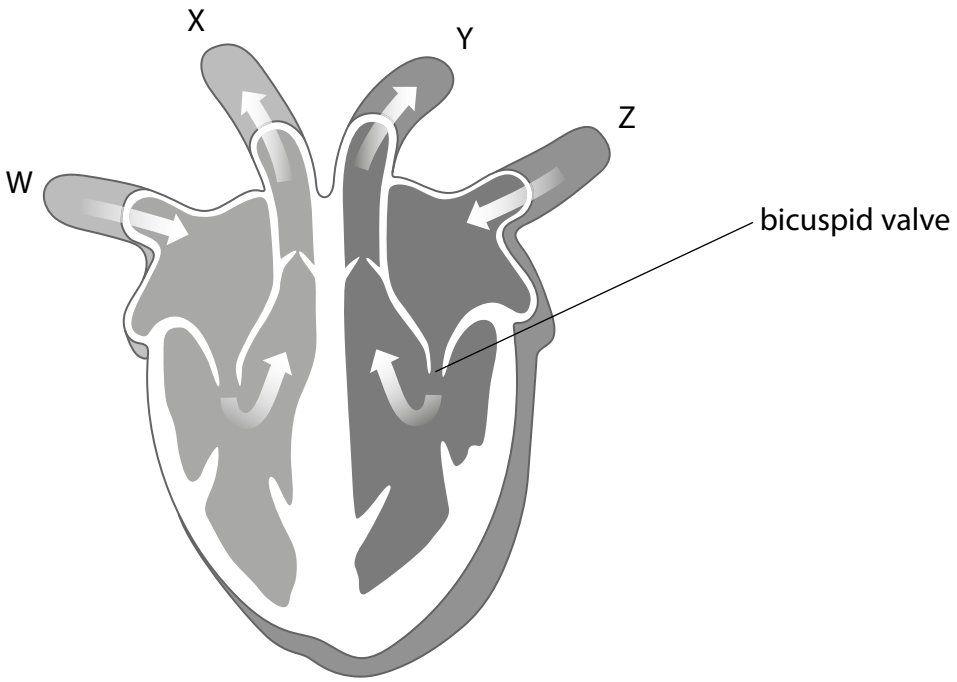


Figure 1

(a) (i) Vessel X takes

(1)

- ☒ **A** deoxygenated blood to the body
- ☒ **B** deoxygenated blood to the lungs
- ☒ **C** oxygenated blood to the body
- ☒ **D** oxygenated blood to the lungs

(ii) Give one reason why the wall of the left ventricle is thicker than the right.

(1)

.....

.....

Valves in the human heart may become damaged and no longer function.

(iii) Describe what would happen to the flow of blood in the left side of the heart if the bicuspid valve did not function effectively.

(2)

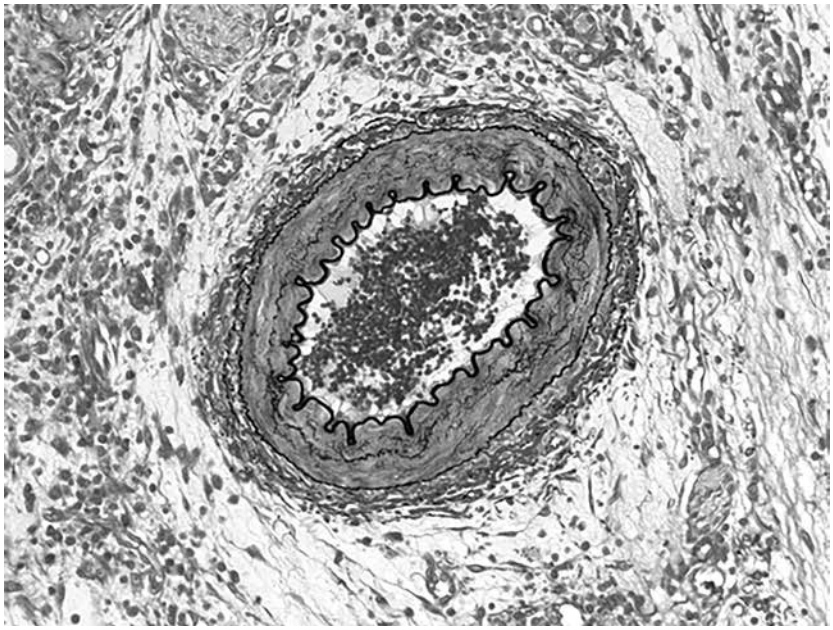
.....

.....

.....

.....

Figure 2 shows a photomicrograph of a blood vessel.



(Source: Microscape/Science Photo Library)

Figure 2

(b) Explain how the structure of this blood vessel is related to its function.

(2)

Figure 3 shows a diagram of the circulatory system of a fish.

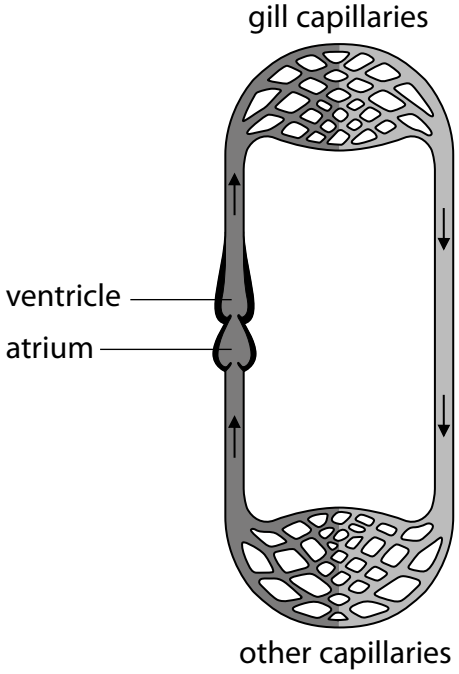


Figure 3

(c) Compare the differences between the structure of the circulatory system of a fish and the human circulatory system.

(4)

(Total for Question 1 = 10 marks)

2 Blood tests can be used to check a person's blood glucose and hormone levels.

Figure 4 shows the results of two blood tests carried out on three people to check their blood glucose levels. Person 1 is healthy.

	blood glucose level (mmols/l)	
	after fasting for 12 hours	**two hours after drinking 75 g glucose**
person 1	5.4	6.4
person 2	5.6	9.0
person 3	7.8	12.1

Figure 4

(a) (i) Compare the glucose levels of person 1 with the glucose levels of person 2 after fasting for 12 hours.

(1)

.....

.....

(ii) Compare the glucose levels of person 3 with the glucose levels of person 1, two hours after drinking 75 g glucose.

(1)

.....

.....

Person 3 cannot produce the hormone that controls blood glucose levels.

(iii) State the hormone that person 3 cannot produce.

(1)

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.....

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(b) Figure 5 shows the level of progesterone for a female during five different stages of the menstrual cycle.

days in the menstrual cycle	progesterone level (nmol/l)
1–9	1.85
10–14	1.48
15–17	14.28
18–23	35.27
24–28	17.11

Figure 5

(i) Describe the changes in progesterone levels during the 28-day cycle.

(2)

(ii) Explain why progesterone levels changed following day 14.

(2)

(iii) Use Figure 5 to explain if the female is pregnant.

(2)

(Total for Question 2 = 9 marks)

3 A gardener investigated the ability of four types of compost to hold water.

50 cm^3 of water was added to each type of compost.

Figure 6 shows the volume of water retained by four different types of compost.

type of compost	A	B	C	D
mass of compost /g	500	500	1000	1000
volume of water retained / cm^3	15	29	45	34
total mass of compost after water was added /g cm^{-3}	515	529	1045	1034

Figure 6

(a) (i) Calculate the percentage change in mass for compost B.

(2)

.....%

(ii) Explain which compost would be best to use for a pot containing strawberry plants to be grown during a hot summer.

(2)

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(iii) State **one** way to improve this investigation in order to compare the results without having to calculate the percentage change in mass.

(1)

.....

.....

(b) One method of preserving strawberries is by using them to make jam.

Figure 7 shows a method for making strawberry jam.

Procedure:

Measure 2 kg of crushed strawberries. Place in a bowl.
Add sugar, mix well, and allow to stand for 10 minutes.
Transfer to a saucepan and heat until boiling.
Stir apple pectin into fruit and continue stirring over a high temperature until the gel point is reached and there is a reduction in the water content.
Pour jam into sterilised jars, leaving 1 cm of space at the top and cover.

Figure 7

(i) Explain why reducing the water content of the strawberries will help to preserve them.

(2)

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(ii) Give a reason for sterilising the jars before adding the jam.

(1)

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.....

(Total for Question 3 = 8 marks)

4 A student wanted to investigate the effect of light on the growth of cress seedlings.

The student had three pots of seedlings grown in different conditions.

Pot A was placed in a window with light from one direction only.

Pot B was placed in a cupboard with no light.

Pot C was placed with light from above.

Figure 8 shows the seedlings at the end of the investigation.

(a) (i) Label the pots of cress seedlings A, B and C.

(2)

(Source: Nigel Cattlin/Science Photo Library)

Figure 8

(ii) What is the response shown by the cress seedlings in Pot A?

(1)

- ☒ **A** negative gravitropism
- ☒ **B** negative phototropism
- ☒ **C** positive gravitropism
- ☒ **D** positive phototropism

(iii) State the plant hormone that causes the cress seedlings to grow towards the light.

(1)

.....

.....

(b) The student wanted to find out where the hormone that caused the response to directional light was found.

The student had two growing plant shoots and placed them both in a window with light coming from one direction.

Describe a method the student could use to show that the hormone was found in the tip of the plant shoot.

(2)

.....

.....

.....

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(c) Figure 9 shows a cross section through a pine leaf.

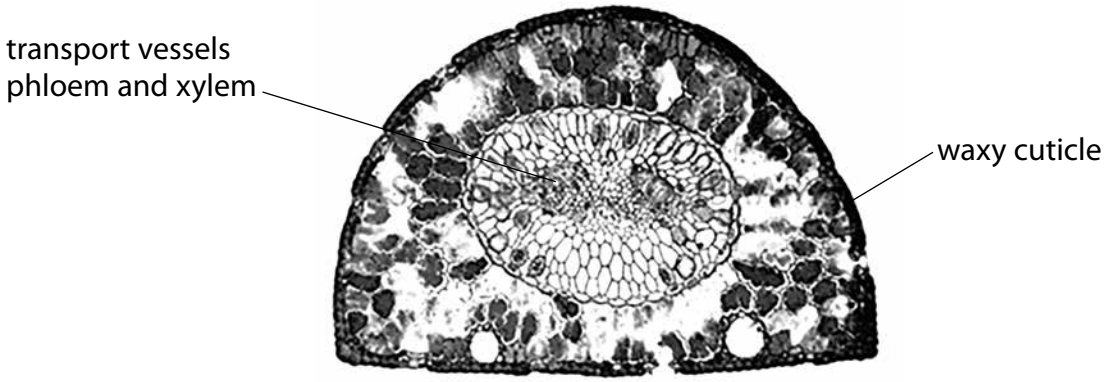

Figure 9

(i) Explain why the waxy cuticle is important for this pine leaf.

(2)

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.....

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.....

(ii) The transport vessels are labelled on Figure 9.

Which row of the table is correct for the movement of sucrose through the plant?

(1)

		method of transport of sucrose through the plant	structure through which sucrose is transported
☒	**A**	transpiration	xylem
☒	**B**	transpiration	phloem
☒	**C**	translocation	xylem
☒	**D**	translocation	phloem

(Total for Question 4 = 9 marks)

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5 A scientist investigated the effect of light intensity on the rate of photosynthesis of the aquatic *Cabomba* plant.

A lamp was used as a source of light. The lamp was placed at different distances (*d*) from the *Cabomba* plant, and the number of bubbles produced in 60 seconds was counted.

The number of bubbles produced in 60 seconds was used to calculate the rate of photosynthesis.

The light intensity was then calculated using the inverse square law $\left(\frac{1}{d^2}\right)$.

Figure 10 shows the scientist's results.

distance (*d*) of lamp from *Cabomba* (cm)	light intensity (arbitrary units)	bubbles produced in 60 seconds
5	0.0400	79
10	0.0100	21
15	0.0044	12
20	0.0025	7
25		5
30	0.0011	4

Figure 10

(a) (i) Calculate the light intensity when the lamp is 25 cm from the *Cabomba* plant.

(2)

light intensity = ... arbitrary units

(ii) Use information from Figure 10 to describe the effect of light intensity on the rate of photosynthesis.

(2)

.....

.....

.....

.....

(iii) Give another method of measuring light intensity rather than calculating it.

(1)

.....

.....

(iv) The scientist counted the number of bubbles produced by the *Cabomba* plant.

Another scientist stated that this was not the best method of measuring the volume of gas produced.

Explain how you could improve the method to measure the volume of gas released more accurately.

(2)

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(b) Explain what would happen to the levels of gas produced if the light intensity decreased to 0.0001 arbitrary units.

(2)

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.....

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.....

(Total for Question 5 = 9 marks)

6 Figure 11 shows the equipment used for measuring respiration in peas.

A B C

(Source: Martin Shields/Science Photo Library)

Figure 11

- Respirometer A contains germinating peas.
- Respirometer B contains peas that are not germinating.
- Respirometer C contains glass beads.

All three respirometers are placed in a water bath at 25 °C for 30 minutes.
The reduction in oxygen levels in each respirometer is measured using a data logger.

(a) Explain why the respirometers are placed in a water bath at 25 °C.

(2)

.....

.....

.....

.....

(b) A student recorded the change in oxygen levels in the germinating peas over a 30-minute period.

The results are shown below.

A 10 mins (–0.8) ml, 20 mins (–1.6) ml, 30 mins (–2.4) ml

B 10 mins (–0.1) ml, 20 mins (–0.1) ml, 30 mins (–0.1) ml

C No change

(i) Complete the table for these results.

(2)

(ii) Calculate the rate of oxygen consumption per second for the results in respirometer A.

(2)

..... ml/second

(iii) Explain why respirometer A has the highest rate of oxygen consumption.

(2)

.....

.....

.....

.....

(c) Some respirometers read the movement of a bubble along capillary tubing.

Carbon dioxide can affect the measuring of oxygen used in this type of respirometer.

State a chemical that could be placed in the respirometer that would stop carbon dioxide affecting the experiment.

(1)

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.....

(Total for Question 6 = 9 marks)

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7 A diabetic athlete is advised to estimate the number of grams of carbohydrate in his meals in order to calculate the number of units of insulin he will need to inject to lower his blood glucose concentration.

Each unit of insulin he injects reduces his blood glucose concentration by 1.5 mmol dm^{-3}.

He needs to inject 1 unit for every 10 grams of carbohydrate he consumes.

Figure 12 shows the estimated carbohydrates in the breakfast eaten by the athlete.

food consumed	estimated carbohydrate /grams
orange juice	25
2 slices brown toast	68
350 grams baked beans	38
tea with sugar	25

Figure 12

(a) (i) Calculate how many units of insulin the athlete would need to inject to control the rise in blood glucose levels.

Give your answer to two significant figures.

(2)

..... units of insulin

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(ii) The athlete miscalculated his carbohydrate intake to be greater than his actual intake.

Explain how the increase in the number of units injected would affect his blood glucose concentrations.

(2)

.....

.....

.....

.....

(b) (i) A patient visits his doctor because he is putting on weight but does not think he is increasing his calorie intake.

The patient has a height of 1.9 m and a body mass of 120 kg.

What is his BMI?

(1)

- ☒ **A** 0.0083
- ☒ **B** 33.2
- ☒ **C** 0.016
- ☒ **D** 66.4

The doctor diagnosed this person with an underactive thyroid gland.

*(ii) Explain why an underactive thyroid could cause this patient to have an increased body mass.

(6)

(Total for Question 7 = 11 marks)

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8 (a) Figure 13 shows a food chain for organisms in a stream.

algae ⟶ stonefly larvae ⟶ water beetles ⟶ birds

Figure 13

(i) In the food chain there is 2.1×10^4 J of energy in the biomass of stonefly larvae. 90% of the energy is lost between each trophic level of the food chain.

Calculate the energy value that enters the birds.

(2)

..... J

(ii) State the impact of this energy loss on the length of the food chain.

(1)

.....

.....

(b) A group of students investigated the level of pollution in two different streams, A and B.

Figure 14 shows the student's results.

indicator species	total number in	
	stream A	stream B
Mayfly nymph	4	0
Caddis fly larva	29	0
Stonefly larvae	74	1
Water louse	34	4
Bloodworm	10	45
Sludge worm	2	100

Figure 14

Mayfly nymphs, caddis fly lavae and stonefly larvae are indicators of clean water.

(i) Calculate the percentage of organisms in stream A that are clean water indicators.

Give your answer to two significant figures.

(2)

.....

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(ii) Use the results to explain which stream is more polluted.

(2)

The student investigated a third stream, which is very slow flowing and runs through an area where intensive farming methods are used.

Figure 15 shows the thick layer of algae formed on top of this stream.

Figure 15

(c) Explain the effect of this algal growth on the organisms in the stream.

(4)

(Total for Question 8 = 11 marks)

9 The kangaroo rat is a mammal that can survive in desert environments and can tolerate much higher concentrations of sodium ions in their bloodstream than humans.

Figure 16 shows an image of the kangaroo rat.

(Source: Richard R. Hansen/Science Photo Library)

Figure 16

(a) The name of the process that controls water levels in the body is

(1)

☒ **A** diffusion

☒ **B** osmosis

☒ **C** osmoregulation

☒ **D** thermoregulation

(b) (i) Explain how the blood entering the nephron of the kangaroo rat is filtered to remove excess sodium ions and water.

(3)

The kangaroo rat has a longer loop of Henle than most mammals.

(ii) Explain why this adaptation is beneficial to the kangaroo rat.

(2)

The volume of ADH stored in the pituitary gland of the kangaroo rat was measured.

Figure 17 shows the average results for 500 kangaroo rats.

concentration of sodium chloride fed to kangaroo rats (mol dm^{-3})	volume of ADH stored in the pituitary gland (arbitrary units)
0.00	45
0.25	40
0.50	10
0.75	8
1.00	8

Figure 17

*(iii) Explain how ADH helps to control the levels of water and sodium ions in the bloodstream.

(6)

(Total for Question 9 = 12 marks)

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10 Tropical fish excrete ammonia, which is an alkali.

The pH level of water in a tropical fish tank needs to be maintained between 6.6 and 7.4 for the fish to survive.

This is the optimum pH range for the bacteria that are responsible for the conversion of ammonia into nitrites and then nitrates.

Nitrosomonas bacteria convert ammonia into nitrites.

Nitrobacter bacteria convert nitrites into nitrates.

(a) (i) *Nitrosomonas* bacteria are an example of

(1)

- ☒ **A** nitrogen fixing bacteria
- ☒ **B** nitrifying bacteria
- ☒ **C** denitrifying bacteria
- ☒ **D** *Helicobacter* bacteria

(ii) Explain why *Nitrosomonas* and *Nitrobacter* bacteria are needed in tropical fish tanks.

(2)

An aquatic plant in the fish tank had a concentration of nitrates higher than the water in the fish tank.

(iii) Explain how this aquatic plant can uptake nitrates from the water in the fish tank.

(2)

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Leguminous plants have nodules on their roots that have colonies of nitrogen-fixing bacteria.

Clover is a leguminous plant.

(b) Describe how a quadrat could be used to sample the population of clover in a 500 m^2 field.

(3)

The nitrogen-fixing bacteria provide nitrates for the plants and release any excess into the soil.

(c) Explain how leguminous plants such as clover could be used to reduce the amount of artificial fertilisers.

(4)

(Total for Question 10 = 12 marks)

TOTAL FOR PAPER = 100 MARKS

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Paper 2 Higher

Question number	Answer	Mark
1(a)(i)	B	**(1)**

Question number	Answer	Mark
1(a)(ii)	to pump blood around the body under higher pressure	**(1)**

Question number	Answer	Mark
1(a)(iii)	An answer that combines the following points of understanding to provide a logical description: • blood would flow backwards from the ventricle to the atrium/blood will leak through (1) • less (oxygenated) blood would be pumped to the body (1)	**(2)**

Question number	Answer	Mark
1(b)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • the blood vessel has thick walls/small lumen (1) • to carry oxygenated blood/to carry blood under higher pressure (1)	**(2)**

Question number	Answer	Mark
1(c)	• the fish heart has two chambers rather than four chambers (1) • the fish heart only has one ventricle and one atrium rather than two ventricles and two atria (1) • only deoxygenated blood flows through the fish heart (1) • the fish heart shows a single circulatory system rather than a double circulatory system (1)	**(4)**

Question number	Answer	Mark
2(a)(i)	• person 2 had a slightly higher blood glucose level than person 1 after fasting (by up to 0.2 mmols/l) (1)	**(1)**

Question number	Answer	Mark
2(a)(ii)	• person 3 had a much higher blood glucose level than person 1 two hours after taking glucose (up by up to 5.6 mmols/l) (1)	**(1)**

Question number	Answer	Mark
2(a)(iii)	Insulin	**(1)**

Question number	Answer	Mark
2(b)(i)	An answer that combines points of interpretation/evaluation to provide a logical description: • levels remain low up until day 14 then rise (1) • they continue to rise to day 23 and drop at day 24 (1)	**(2)**

Question number	Answer	Mark
2(b)(ii)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • as ovulation occurs (1) • the levels of progesterone released from the corpus luteum increases to maintain the lining of the uterus (1)	**(2)**

Question number	Answer	Mark
2(b) (iii)	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (1 mark): • progesterone levels fall after day 23 to 17.11 (1) • so uterus wall thickness is not maintained and therefore pregnancy has not occurred (1)	**(2)**

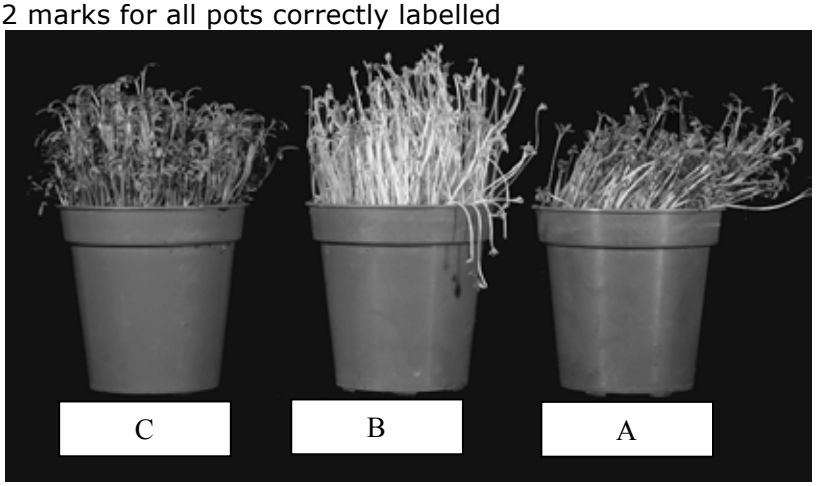
Question number	Answer	Additional guidance	Mark
3(a)(i)	29 ÷ 500 = 0.058 (1) 0.058 × 100 = 5.8 (1)	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
3(a)(ii)	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (1 mark): • compost B (1) as it has the highest percentage water retained • and there is a higher amount of water loss in the plants due to higher temperatures causing a {larger rate of evaporation of water/higher transpiration rates} (1)	**(2)**

Question number	Answer	Additional Guidance	Mark
3(a)(iii)	Use the same starting mass of compost (1)	accept any other relevant improvement	**(1)**

Question number	Answer	Additional guidance	Mark
3(b)(i)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • by reducing the water content it reduces the number of microorganisms that can reproduce (1) • because there is a reduction of microorganisms this reduces the decay process/preserves the food (1)	accept bacteria/pathogens for microorganisms	**(2)**

Question number	Answer	Mark
3(b)(ii)	to kill unwanted micro-organisms	**(1)**

Question number	Answer	Mark
4(a)(i)	1 mark for 1 or 2 correctly labelled pots 2 marks for all pots correctly labelled  	(2)

Question number	Answer	Mark
4(a)(ii)	D	(1)

Question number	Answer	Mark
4(a)(iii)	Auxin	(1)

Question number	Answer	Mark
4(b)	An answer that combines the following points to provide a logical description of the method: • remove the tip from one of the plant shoots and leave the other (1) • measure the changes in growth and direction of movement (1)	(2)

Question number	Answer	Mark
4(c)(i)	An explanation that makes reference to: identification – knowledge (1 mark) and reasoning /justification – knowledge (1 mark): • it surrounds the pine leaf (1) • so prevents water loss from the pine leaf/prevents dehydration (1)	(2)

Question number	Answer	Mark
4(c)(ii)	D	(1)

Question number	Answer	Additional guidance	Mark
5(a)(i)	25 × 25 = 625 (1) 1 ÷ 625 = 0.0016 (1)	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
5(a)(ii)	An answer that combines points of interpretation/evaluation to provide a logical description: • as light intensity decreases the rate of photosynthesis also decreases (1) • after 20 cm away when light intensity appears to have little effect on the rate of photosynthesis (1)	**(2)**

Question number	Answer	Mark
5(a)(iii)	use a light meter/lux meter	**(1)**

Question number	Answer	Additional guidance	Mark
5(a)(iv)	An explanation that combines identification – improvement of the experimental procedure (1 mark) and justification/reasoning which must be linked to the improvement (1 mark): • collect the gas/oxygen produced in a graduated gas syringe (1) • to reduce the errors generated when counting bubbles which maybe of different sizes (1)	accept alternative gas collection method with measuring cylinder and beehive shelf accept leave the apparatus for a longer amount of time	**(2)**

Question number	Answer	Mark
5(b)	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (1 mark): • the volume of gas produced would decrease to below four bubbles (1) • because light is needed for photosynthesis (1)	**(2)**

Question number	Answer	Mark
6(a)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • same temperature to act as control (1) • to provide the optimum temperature for enzyme action in the peas (1)	**(2)**

Question number	Answer	Additional guidance	Mark
6(b)(i)	• headed table with units (1) • accurately completed table (1)	negative values do not need to be shown if table heading states oxygen used/lost accept time in row 1 as an alternative	**(2)**

	A	B	C
O_2 used /ml at 10 mins	0.8	0.1	0.0
O_2 used /ml at 20 mins	1.6	0.1	0.0
O_2 used /ml at 30 mins	2.4	0.1	0.0

Question number	Answer	Additional guidance	Mark
6(b)(ii)	2.4 ÷ (30 × 60) (1) = 0.0013 (ml/second) (1)	accept 1.6 ÷ (20 × 60) accept 0.8 ÷ (10 × 60) award full marks for correct numerical answer without working maximum one mark if no unit conversion	**(2)**

Question number	Answer	Mark
6(b)(iii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • the peas in respirometer A are germinating so using up oxygen (1) • during the process of respiration to release energy for growth (1)	**(2)**

Question number	Answer	Additional guidance	Mark
6(c)	Any one improvement from: soda lime (1) • cotton wool soaked with potassium hydroxide (1)	accept other relevant chemical that would remove carbon dioxide	**(1)**

Question number	Answer	Additional guidance	Mark
7(a)(i)	• 156 ÷ 10 (1) • 16 units (1) Answer to two significant figures	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
7(a)(ii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • an increase in the units of insulin injected would cause more blood glucose to be converted to glycogen and stored in the liver/muscles (1) • leading to blood glucose levels becoming critically low/person would become hypoglycemic (1)	**(2)**

Question number	Answer	Mark
7(b)(i)	B	**(1)**

Question Number	Indicative content	Mark
***7(b)(ii)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • the thyroid gland produces thyroxine • thyroxine helps to regulate metabolic rate • low levels of thyroxine should stimulate the production of TRH • TSH being produced and more thyroxine being released • an underactive thyroid would cause less thyroxine to be produced • metabolic rate to drops • less energy (calories) are available for tasks • more fat storage so the person gains body mass	**(6)**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Question number	Answer	Additional guidance	Mark
8(a)(i)	• $2.1 \times 10^4 = 21\,000 \times 0.1 =$ 2 100 in the water beetle (1) • 210 J in the bird (1)	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
8(a)(ii)	it limits the length of the food chain	**(1)**

Question number	Answer	Additional guidance	Mark
8(b)(i)	• 107 ÷ 153 (1) • 0.699 3464 × 100 = 70% (1) Answer to 2 significant figures	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Additional guidance	Mark
8(b)(ii)	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (1 mark): • stream B is more polluted that stream A (1) Plus one from: • (because) stream A contains stonefly larvae/mayfly larvae/caddis fly larvae (which are indicators of clean water) (1) • (because) stream B contains larger numbers of blood worm and sludge worm (which are indicators of polluted water) (1)	accept other correct indicators from the table. accept higher oxygen levels in place of clean water accept lower oxygen levels in place of polluted water	**(2)**

Question number	Answer	Mark
8(c)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (3 marks): • plants growing on the bottom of the stream will be unable to receive sunlight due to the thick layer of algae (1) • these plants will not be able to photosynthesise and will die and start to decompose (1) • the microorganisms decomposing the plants will respire, removing oxygen from the water (1) • the stream will become anoxic/oxygen depleted and other respiring organisms (plants and animals) will not be able to survive so biodiversity will be reduced (1)	**(4)**

Question number	Answer	Mark
9(a)	C	(1)

Question number	Answer	Mark
9(b)(i)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks): • ultrafiltration occurs in the glomerulus where the liquid part of the blood passes into the Bowman's capsule (1) • reabsorption takes place as it travels through the proximal convoluted tubule into the loop of Henle (1) • finally urine production occurs in the collecting duct and excess fluid and sodium ions are removed (1)	(3)

Question number	Answer	Mark
9(b)(ii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • the kangaroo rat lives in the desert so it needs to retain as much water as possible (1) • as most water is reabsorbed in the loop of Henle, a longer loop gives more surface area for water reabsorption (1)	(2)

Question Number	Indicative content	Mark
*9(b)(iii)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 (6 marks)** water content • increased ADH causes more water to be reabsorbed into the bloodstream • prevents dehydration • decreased concentrations of ADH cause less water reabsorption • greater volume of urine produced • at 0.0 mol/dm^{-3} of sodium ions the volume of ADH stored is at its highest • so the lowest amount of ADH is released • water levels in the body are regulated sodium ions • as sodium ion concentration increases the levels of ADH stored decrease • at 0.25 mol/dm^{-3} ADH stored reduced by 5 au • so a small amount of water is reabsorbed • at 0.50 mol/dm^{-3} ADH stored reduced by a further 30 au • a greater amount of water is reabsorbed • the volume of ADH stored remains stable at 8 au • causing the maximum amount of water to be reabsorbed • preventing dehydration when sodium levels are high	**(6)**

Level	Mark	Descriptor
	0	No awardable content
Level 1	1–2	• The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3–4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5–6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the

		context of the question. • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

Question number	Answer	Mark
10(a)(i)	B	**(1)**

Question number	Answer		Mark
10(a)(ii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • the bacteria convert the ammonia into nitrites then nitrates maintaining the pH (1) • (this prevents an increase in pH) which would cause enzymes to denature and kill the fish (1)		**(2)**

Question number	Answer	Mark
10(a)(iii)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • the aquatic plant will take up nitrates by active transport (1) • against the concentration gradient/from where there is a low concentration to where there is a high concentration of nitrates (1)	**(2)**

Question number	Answer	Additional guidance	Marks
10(b)	An answer that combines the following points of application of knowledge and understanding to provide a logical description: • a description of the use of a quadrat either by random sampling or using a belt transect (1) • a sample size 10–100 and count the number of clover plants in each quadrat (1) • multiplication factor dependent on the number of quadrats sampled (1)	to gain maximum marks steps must be in a logical sequence	**(3)**

Question number	Answer	Mark
10(c)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (3 marks): • clover/leguminous plants could be used in crop rotation (1) • where at intervals (2–3 years) a field is planted with clover/leguminous plants and left fallow (1) • the clover/leguminous plants will have colonies of nitrogen fixing bacteria which will produce nitrates (1) • the nitrates will increase the fertility of the soil and negate the need for artificial fertilisers (1)	**(4)**

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