2024

Name_____

Combined Science

Higher

Biology: Paper 2

AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Biology Paper 2H

Friday 7 June 2019 Afternoon Time allowed: 1 hour 15 minutes

Materials
For this paper you must have:
- a ruler
- a scientific calculator.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

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0 1 Some students investigated the effect of drinking caffeine on reaction time.

They used a drink containing 32.25 mg of caffeine per 100 cm^3

This is the method used.

1. Divide the students into four groups, **A**, **B**, **C** and **D**.
2. Measure and record the reaction time of each student using the ruler-drop test.
3. Students in:
   - group **A** drink 200 cm^3 of water
   - group **B** drink 200 cm^3 of the caffeine drink
   - group **C** drink 400 cm^3 of the caffeine drink
   - group **D** drink 600 cm^3 of the caffeine drink.
4. Repeat step 2 after 15 minutes.

0 1 . 1 Describe how to do the ruler-drop test.

[3 marks]

Question 1 continues on the next page

Turn over ►

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0 1 . 2 **Table 1** shows the mass of caffeine taken in by each student.

Table 1

Group	Mass of caffeine in mg
A	0
B	64.5
C	129.0
D	**X**

Calculate value **X**.

[1 mark]

X = _____ mg

0 1 . 3 Why did group **A** drink water instead of the caffeine drink?

[1 mark]

Do not write outside the box

Table 2 was used to convert the results of the ruler-drop test into reaction times.

Table 2

Distance in cm	Reaction time in s	Distance in cm	Reaction time in s
2	0.064	28	0.239
4	0.090	30	0.247
6	0.111	32	0.256
8	0.128	34	0.263
10	0.143	36	0.271
12	0.156	38	0.278
14	0.169	40	0.286
16	0.181	42	0.293
18	0.192	44	0.300
20	0.202	46	0.306
22	0.212	48	0.313
24	0.221	50	0.319
26	0.230	52	0.326

0 1 . 4 Estimate the reaction time for a student who recorded a distance of 23 cm

[1 mark]

Reaction time = _____ s

Question 1 continues on the next page

Turn over ►

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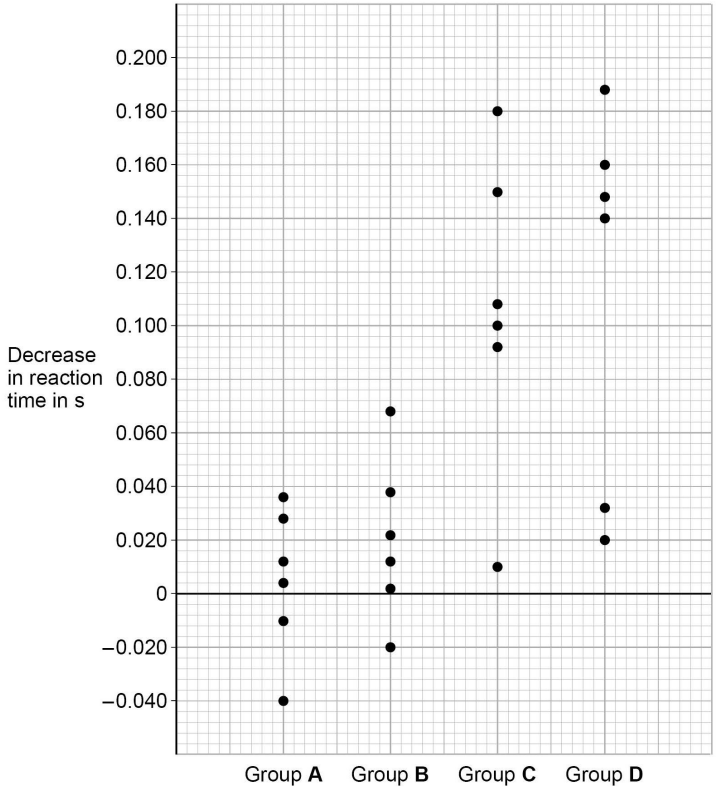
Students calculated the decrease in their reaction time after the drink compared with before the drink.

Figure 1 shows the results for each student.

Figure 1



0 1 . 5 Describe the effect of the mass of caffeine taken in on the decrease in reaction time.

[1 mark]

Do not write outside the box

0 1 . 6 For three students the decrease in reaction time was negative.

Give the reason why the value was negative.

[1 mark]

0 1 . 7 What is the range of results for group **C**?

[1 mark]

0 1 . 8 Suggest **two** variables that should have been controlled in this investigation.

[2 marks]

1

2

0 1 . 9 Explain why the ruler-drop test does **not** involve a reflex action.

[2 marks]

13

Turn over for the next question

Do not write outside the box

0 2 There has been a rapid increase in the percentage of carbon dioxide in the atmosphere since 1960.

0 2 . 1 Carbon dioxide is a greenhouse gas that contributes to global warming.

Name **one** other greenhouse gas.

[1 mark]

0 2 . 2 Global warming causes climate change.

Give **two** effects of climate change.

[2 marks]

1

2

Question 2 continues on page 10

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ANSWER IN THE SPACES PROVIDED

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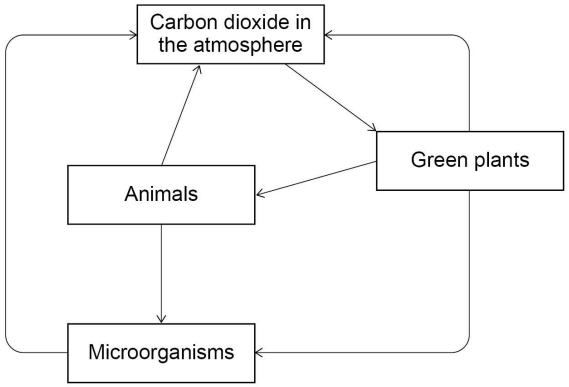
0 2 . 3 Plants take in carbon dioxide from the atmosphere.

Figure 2 shows part of the carbon cycle.

Figure 2



Describe how carbon from the atmosphere is cycled through living organisms.

[6 marks]

Do not write outside the box

9

Turn over for the next question

Do not write outside the box

0 3 . 1 Vectors are used in the process of genetic engineering.

Which **two** statements are correct?

[2 marks]

Tick (✓) **two** boxes.

- Vectors are enzymes used to 'cut open' the DNA molecule. ☐
- Vectors are used to insert genes into cells. ☐
- Vectors are used to isolate the required gene. ☐
- Vectors are used to stimulate cell division. ☐
- Vectors are usually plasmids or viruses. ☐

0 3 . 2 Scientists have genetically engineered a variety of wheat to be resistant to herbicides.

The herbicide resistant variety of wheat will give a higher yield than the non-herbicide resistant variety.

Explain why.

[3 marks]

Do not write outside the box

0 3 . 3 Give **two** examples of genetic engineering in use today.

Do **not** refer to herbicide resistance in your answer.

[2 marks]

1 _____

_____

2 _____

_____

0 3 . 4 Scientists working on the 'Human Genome Project' have now mapped the entire genetic code of humans.

Explain **one** way this could be important for people in the future.

[2 marks]

_____

_____

_____

_____

9

Turn over for the next question

Do not write outside the box

0 4 Animals have adaptations to survive in their environment.

These adaptations may be structural, behavioural or functional.

0 4 . 1 Draw **one** line from each animal adaptation to the type of adaptation it is.

[2 marks]

Animal adaptation	Type of adaptation
 Male palm cockatoos use sticks to beat on hollow branches to attract females.	Structural
 The harmless hornet moth has black and yellow stripes to look like a bee or wasp.	Behavioural
 Sea spiders have automatic muscle contractions that move oxygen around their bodies.	Functional

Do not write outside the box

Plants also have adaptations.

There are more than 28 000 known species of orchid plants.

0 4 . 2 Many orchid plants:

- grow attached to other types of plants
- have brightly coloured flowers
- produce large quantities of pollen
- produce thousands of tiny, light seeds.

Describe how these adaptations help orchid plants to survive and compete.

[4 marks]

Question 4 continues on the next page

Do not write outside the box

A rare orchid has been found in the mountains in China.

The orchid has pale yellow flowers.

DNA analysis of the genome shows that it is an ancestral species.

All other present day orchids evolved from this ancestral species millions of years ago.

0 4 . 3 One present day species has bright purple flowers.

Describe how an orchid with bright purple flowers may have evolved from the ancestral species which has pale yellow flowers.

[4 marks]

Do not write outside the box

0 4 . 4 The DNA code determines the sequence of amino acids which are joined together to form a specific protein.

Table 3 shows part of the amino acid sequence for the colour pigment protein in five orchid species.

The rest of the amino acid sequence is the same for all the species.

Table 3

Species	Amino acid sequence	Flower colour
Ancestral species	ala-leu-gly-isoleu-tyr-gly-ala-leu-gly-ala	pale yellow
Species **A**	ala-isoleu-gly-ala-tyr-gly-ala-tyr-gly-ala	pale yellow
Species **B**	ala-leu-ala-isoleu-tyr-gly-ala-tyr-gly-ala	pink
Species **C**	ala-isoleu-gly-ala-gly-tyr-gly-leu-gly-ala	bright red
Species **D**	ala-leu-gly-isoleu-tyr-tyr-ala-leu-gly-ala	purple

Key:
ala = alanine
gly = glycine
isoleu = isoleucine
leu = leucine
tyr = tyrosine

Suggest which orchid species is most closely related to the ancestral species.

Give a reason for your answer.

[2 marks]

Species _____

Reason _____

_____

_____
12

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 5 Some students estimated the population of daisies in a school field.

This is the method used.

1. Find a place where some daisies are growing.
2. Put the quadrat down.
3. Count and record the number of daisies in the quadrat.
4. Repeat steps 1–3 at four different places in the field.
5. Calculate the mean number of daisies per quadrat.
6. Use the data to estimate the total number of daisies in the field.

0 5 . 1 Which **two** improvements would increase the validity of this method?

[2 marks]

Tick (✓) **two** boxes.

- Do not put any quadrats near trees. ☐
- Repeat for another ten quadrats. ☐
- Use a long tape measure. ☐
- Use a random method to place the quadrats. ☐
- Use the same person to place all the quadrats. ☐

Question 5 continues on the next page

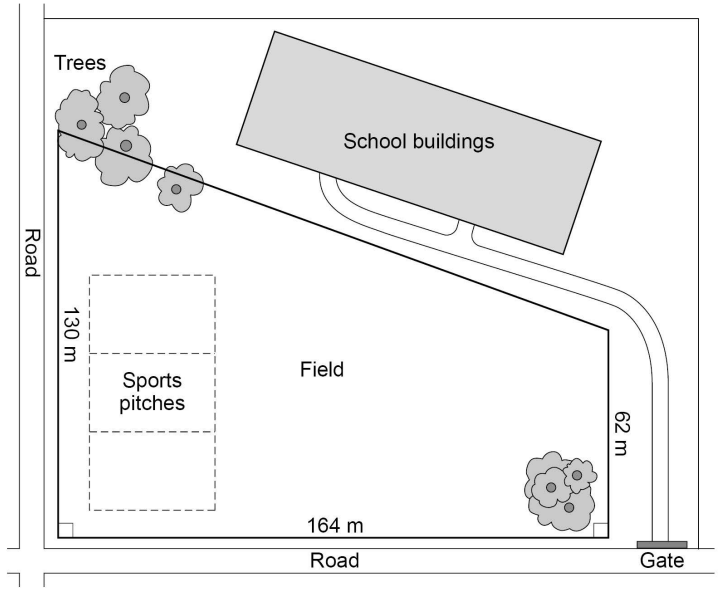
Do not write outside the box

0 5 . 2 With an improved method the students calculated the mean number of daisy plants to be 7.65 per quadrat.

The students used a quadrat measuring 50 cm × 50 cm

Figure 3 shows the school site and the dimensions of the school field.

Figure 3



Do not write outside the box

Calculate the population of daisy plants on the school field.

Give your answer in standard form to 2 significant figures.

[5 marks]

Population of daisy plants = _____

Question 5 continues on the next page

Do not write outside the box

0 5 . 3 The students noticed a very uneven distribution of daisy plants in the field.

Explain how different biotic factors **and** abiotic factors could have caused an uneven distribution of daisy plants.

Use **Figure 3** on page 20.

[6 marks]

13

Do not write outside the box

0 6 This question is about homeostasis.

0 6 . 1 Define the term homeostasis.

[2 marks]

0 6 . 2 Name the hormone released if the blood glucose concentration falls too low.

[1 mark]

Question 6 continues on the next page

Do not write outside the box

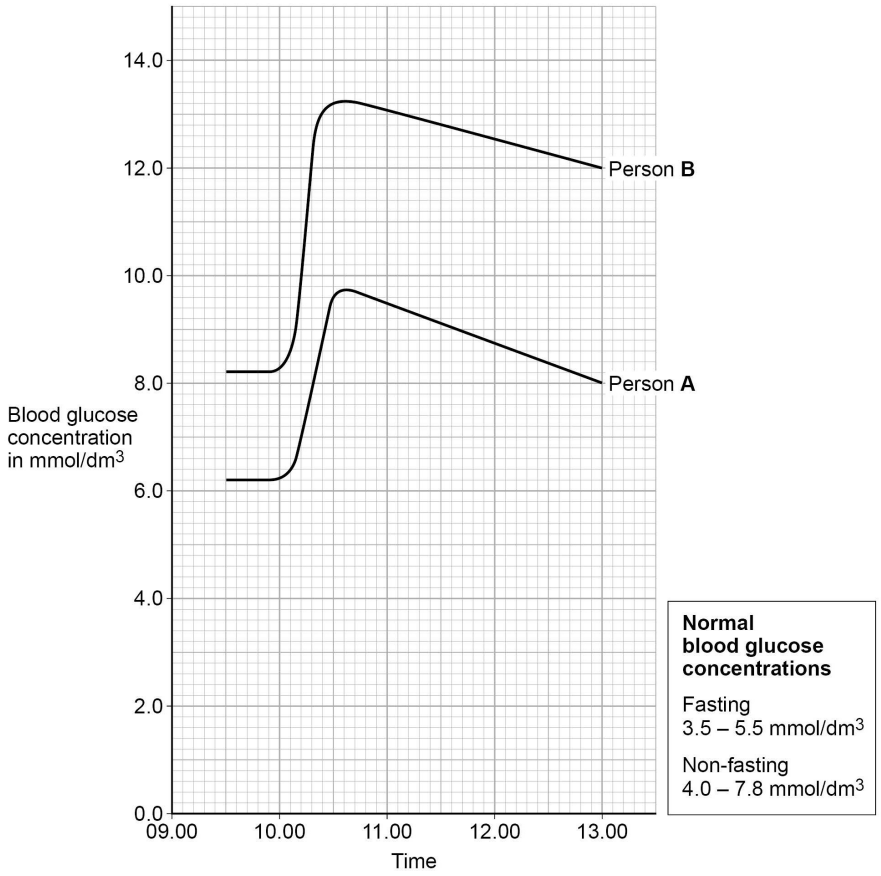
Two people were sent to a hospital to find out if they have diabetes.

This is the method used at the hospital.

- Do not eat or drink after midnight. This is called fasting.
- Measure blood glucose concentration at 9.30 am
- Drink a glucose solution at 10.00 am
- Measure blood glucose concentration for the next 3 hours.

Figure 4 shows the results.

Figure 4



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Person **A** and person **B** have diabetes.

0 6 . 3 Describe how **Figure 4** shows that person **B** has diabetes.

Use data from **Figure 4**.

[3 marks]

Question 6 continues on the next page

Do not write outside the box

0 6 . 4 Person **A** and person **B** had a test to measure the concentration of insulin in their blood when they were fasting.

Table 4 shows the results.

Table 4

Person	Fasting blood insulin concentration in arbitrary units
A	280
B	20
Normal range	50–175

Suggest which type of diabetes person **A** and person **B** have.

Give a reason for each answer.

[2 marks]

Person **A**

Type of diabetes _____

Reason _____

Person **B**

Type of diabetes _____

Reason _____

Do not write outside the box

0 6 . 5 Toxic hypoglycaemia syndrome (THS) has caused the deaths of hundreds of starving children in some tropical countries.

- The starving children have had nothing to eat all day.
- The starving children then eat many lychee fruits.
- The lychee fruits contain a molecule which stops an enzyme in the liver working.
- This enzyme normally converts stored fats into glucose.

Children who have eaten during the day are **not** affected by eating many lychee fruits.

Starving children may die from eating many lychee fruits but children who have eaten during the day are not affected.

Explain why.

[6 marks]

14

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	hold a ruler (just) above the (open) hand of the other student drop the ruler and other student catches it record where the ruler is caught	ignore near the hand do **not** accept give verbal signal ignore timing	1 1 1	AO1 4.5.2
01.2	193.5		1	AO2 4.5.2
01.3	to compare the effect of no caffeine	allow as a control (group) allow to show the effect of caffeine do **not** accept control variable	1	AO3 4.5.2
01.4	0.217 (s)	allow any value in the range 0.2150 to 0.2180	1	AO2 4.5.2
01.5	as mass of caffeine increases the decrease / change in reaction time increases	allow converse ignore caffeine decreases reaction time do **not** accept the greater the increase in reaction time the greater the mass of caffeine	1	AO3 4.5.2
01.6	their reaction time was greater (after the drink)	allow converse allow slower / longer for greater do **not** accept anomalous result	1	AO3 4.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	0.01(0) to 0.18(0) **or** 0.18(0) to 0.01(0) **or** 0.17(0)	allow values in range 0.008 to 0.012 **and** 0.178 to 0.182 allow correct calculation from values in range if no values are given, allow answers in the range 0.166 to 0.174 allow $0.01 \leq C \leq 0.18$ ignore units	1	AO2 4.5.2
01.8	any **two** from: • (same range of) age • (same) sex / gender • (same) height / weight / BMI • all had no caffeine / medication / drugs earlier that day • equally tired or (same) amount of sleep • practice of the ruler drop test • starting point of ruler / hand • same point to take measurement above / below the thumb / finger • using the same hand • (same) number of students in each group	allow height ruler dropped from do **not** accept volume / concentration of caffeine	2	AO3 4.5.2
01.9	not automatic (because) it involves the (conscious part of the) brain	allow it is a voluntary action allow because it involves thinking / decision **or** conscious action	1 1	AO2 4.5.2
Total			**13**	

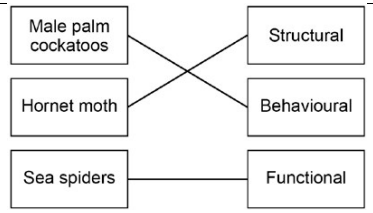
Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	methane	allow CH_4 **or** water (vapour) **or** H_2O allow correct example such as CFCs, nitrous oxide, ozone	1	AO1 4.7.3.5
02.2	any **two** from: • ice caps melting • rise in sea levels • desertification • extreme weather • change in species distribution • change in migration patterns • loss of biodiversity • coral bleaching • crop failure **or** food insecurity • loss of habitat qualified	ignore references to increased temperature and greenhouse gas / effect allow storms **or** droughts **or** flooding allow some species become extinct / endangered allow correct examples such as polar bears losing ice ignore forest fires	2	AO1 4.7.3.5

Question	Answers	Mark	AO/ Spec. Ref
02.3	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	4–6	AO1 4.7.2.2 4.4.1.1
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1-3	4.4.1.3 4.4.2.1
	No relevant content	0	
	Indicative content Photosynthesis • (carbon dioxide is) taken in through stomata / leaves • (carbon dioxide is) used in photosynthesis • to make glucose / carbohydrate • (glucose used) to make other carbon compounds or named example such as proteins, lipids • (glucose) stored as starch Feeding • plants are eaten / consumed by animals • which use the carbon compounds to make other carbon compounds Decay • when plants / animals die they are decomposed / decayed • by microorganisms • which use the carbon compounds to make other carbon compounds Respiration • plants / animals / microorganisms respire • (respiration) releases carbon dioxide back into the atmosphere Level 2 answers must consider photosynthesis and at least one other process in the carbon cycle. Level 2 answers must include some accurate detail.		
Total		**9**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	vectors are used to insert genes into cells		1	AO1 4.6.2.4
	vectors are usually plasmids or viruses		1	
03.2	wheat not affected by spraying / herbicide	allow only weeds affected / killed by spraying / herbicide	1	AO1 AO2 4.6.2.4 4.7.1.1
	(so) wheat gets more light / water / nitrates / ions / minerals	allow less competition for light / water / nitrates / ions / minerals ignore nutrients ignore carbon dioxide ignore space	1	4.4.1.1
	(so) more photosynthesis / glucose / proteins (for more yield)	idea of more needed at least once for mp 2 and 3	1	
03.3	any **two** from: • production of human insulin / medicines • crops resistant to diseases / pests • crops resistant to frost • crops resistant to drought • crops / foods with added nutrients • plants / crops with more / bigger fruits **or** higher yield • crops with improved taste • crops with improved shelf life	allow examples such as potatoes resistant to blight allow examples such as golden rice with vitamin A gene allow examples such as larger tomatoes	2	AO1 4.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	identify genes linked to (certain) disease	allow correctly named diseases such as cancer / diabetes	1	AO1 AO2 4.6.1.3
	so can lead to better prevention / treatment of that disease **or** identify genes causing inherited disorders (1) so may prevent children being born with the disorder by using IVF **or** gene therapy (1) **or** tracing human migration patterns from the past **or** evolution of humans (1) so to better understand the ancient history of humans (1)		1	
Total			**9**	

MARK SCHEME – GCSE COMBINED SCIENCE: TRILOGY – 8464/B/2H – JUNE 2019

Question	Answers	Extra information	Mark	AO / Spec.
04.1	 all correct for **2** marks allow **1** mark for one or two correct line(s) additional lines from a box on the left negates the mark for that box		2	AO2 4.7.1.4
04.2	any **four** from: • growing on other plants means support to absorb more light (for photosynthesis) • bright colours attract pollinators **or** bright colours attract insects to transfer pollen • large quantities of pollen (increases the likelihood of pollen transfer) and so more seeds / reproduction • tiny / light seeds will travel long distances to grow in new areas • many seeds mean many new plants so will out-compete other species	 allow to obtain water / minerals / ions / glucose from the other plant ignore nutrients allow fertilisation for transfer of pollen allow tiny / light seeds will travel away from competitors allow many seeds so more (orchids) will survive	4	AO2 4.7.1.4 4.7.1.1 4.4.1.1

MARK SCHEME – GCSE COMBINED SCIENCE: TRILOGY – 8464/B/2H – JUNE 2019

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	any **four** from: • mutations for purple flower (in ancestral species) • isolation **or** change in environment e.g. area had more insects • (plants with purple flowers) survive and breed • (plants with purple flowers) pass on allele / gene / DNA / mutation • until they were so different they could no longer interbreed (with the ancestral species)	 allow genetic variation gives purple flowers allow purple orchid more suited to a new environment allow genetic material for allele allow breed successfully for interbreed	4	AO2 4.7.1.4 4.7.1.1 4.4.1.1
04.4	species **D** because it has the lowest number of amino acids different (in the sequence) **or** because it has the lowest number of differences in the sequence **or** only one / sixth amino acid is different	must be an attempt at an explanation to gain this mark allow because it has the highest number of amino acids which are the same (in the sequence) allow because it has only one difference in the sequence allow only the glycine / gly has been changed to tyrosine / tyr	1 1	AO3 4.6.4 4.6.1.3 4.6.1.4
Total			**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	repeat for another ten quadrats		1	AO3 4.7.2.1
	use a random method to place the quadrats		1	
05.2		an answer of 4.8×10^5 scores **5** marks an answer of 481 766.4 **or** 481 766 **or** 480 000 scores **4** marks an answer of 15 744 × 4 × 7.65 scores **3** marks an answer of 15 744 (m^2) scores **2** marks		AO2 4.7.2.1
	(area of field =) 62 × 164 + 164 × 68 ÷ 2 **or** equivalent		1	
	15 744 (m^2)		1	
	15 744 × 4 × 7.65	allow use of incorrect area allow $\frac{7.65}{0.25} \times 15744$	1	
	481 766.4	allow 481 766 **or** 480 000	1	
	4.8×10^5	allow incorrect calculation expressed correctly	1	

Question	Answers	Mark	AO/ Spec. Ref
05.3	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3-4	AO2
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content	0	
	Indicative content • trees over / in field • (which) reduce light for photosynthesis • (so) fewer daisies there • trees over / in field • (which) take water / nitrates / ions from the soil • (so) fewer daisies there • trampling on sports pitches • (will) kill plants • (so) fewer daisies there • competition from plants / grasses on field • (will) use up water / nitrates / ions / space • (so) fewer daisies there • gardener may water / fertilise / mow field • (which provides) more water / nitrates / ions • (so) more / fewer daises grow there • more insects / disease / animals in some areas • (may) eat / kill plants • (so) fewer daisies there • school buildings • (which) reduce light for photosynthesis • (so) fewer daisies near school • pollution / toxins from vehicles on roads • (which will) reduce growth • (so) fewer daisies near roads • wrong pH **or** lack of ions **or** poor drainage **or** poor / wet / dry soil in some areas • (which will) slow growth • (so) fewer daisies there Level 3 answers must refer to several factors in accurate detail		4.7.1.1 4.7.1.2 4.7.1.3 4.4.1.1
Total		**13**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	regulation / control / maintenance of internal conditions (of a cell / body) for optimum (cell / enzyme activity)	allow keeping the internal conditions (of a cell / body) the same allow description of optimum functioning (of cell / body)	1 1	AO1 4.5.1
06.2	glucagon	correct spelling only	1	AO1 4.5.3.2
06.3	any **two** from: • fasting blood glucose is higher than normal range • reached a very high concentration after glucose drink • did not return to normal after 3 hours **or** fell slowly after reaching peak. use of correct data in comparison to normal ranges given for any of the above points	 allow ± half a small square for values quoted from the graph ignore references to person A	2 1	AO3 4.5.3.2
06.4	 (person A has Type) 2 (pancreas) producing (lots of) insulin but body cells cannot respond to it. (person B has Type) **I** (pancreas) not producing enough insulin (to control concentration of glucose in the blood)	type of diabetes must be correct allow cells becoming resistant to insulin for respond to insulin. do **not** accept the person has become resistant to insulin	 1 1	AO3 4.5.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	starving children have used up their glycogen stores (so) would need (liver enzyme) to release glucose from fats as enzyme is stopped from working they get low / no glucose (cell) respiration is insufficient (so they die) children that are not starving have glycogen stores in liver / muscle (so) glucagon will continue to release glucose (into the blood for them)	allow starving children have no / low glycogen stores allow no working enzyme leads to hypoglycaemia allow starving children use proteins to release energy (which leads to death)	1 1 1 1 1 1	AO1 AO2 4.4.2.1 4.5.3.2
Total			**14**	

AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Biology Paper 2H

Time allowed: 1 hour 15 minutes

Materials
For this paper you must have:
- a ruler
- a scientific calculator.

Instructions
- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
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- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
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TOTAL	

Information
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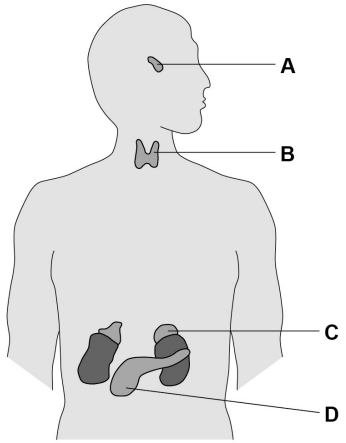
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Do not write outside the box

0 1 **Figure 1** shows glands in the human body.

Figure 1



0 1 . 1 Which organ system includes the glands shown in **Figure 1**?

[1 mark]

_____

0 1 . 2 Which gland produces insulin?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 3 Which gland produces hormones that stimulate the other glands to produce hormones?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Do not write outside the box

0 1 . 4 How do hormones travel from one gland to another gland?

[1 mark]

0 1 . 5 Name **two** glands involved in human reproduction.

Do **not** refer to glands shown on **Figure 1** in your answer.

[2 marks]

1 _____

2 _____

0 1 . 6 Ovulation test kits can help women know when they are most fertile.

Ovulation test kits detect the increase in the hormone that stimulates ovulation.

Which hormone is detected by ovulation test kits?

[1 mark]

Tick (✓) **one** box.

Follicle stimulating hormone (FSH) ☐

Luteinising hormone (LH) ☐

Oestrogen ☐

Progesterone ☐

Do not write outside the box

0 1 . 7 A new contraceptive drug for men is being tested.

The drug:

- is given in one injection
- stops sperm being able to fertilise eggs
- is effective for up to 13 years.

Evaluate the use of the new drug compared with existing contraceptive methods.

[6 marks]

13

Do not write outside the box

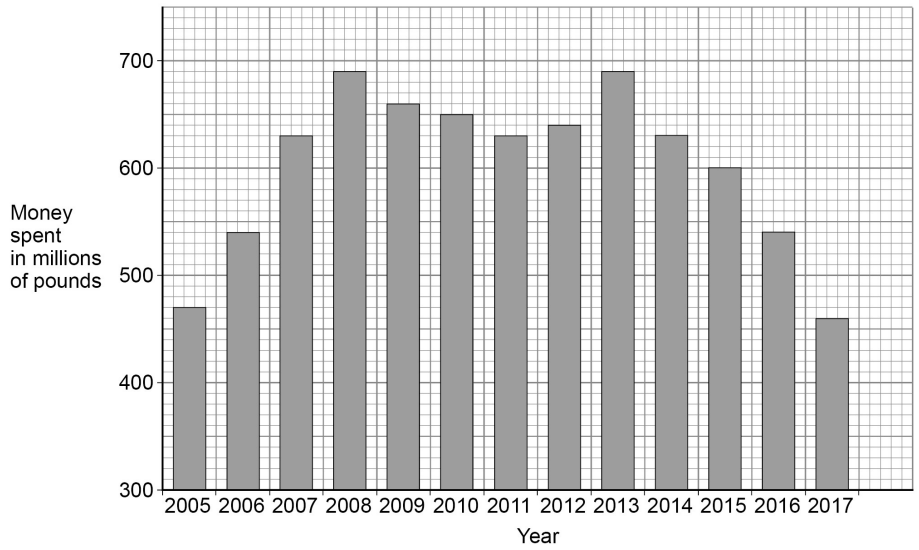
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 2 **Figure 2** shows the money spent on conserving biodiversity in the UK by the government.

Figure 2



0 2 . 1 Describe the trends in the money spent on conserving biodiversity from 2005 to 2011.

Use data from **Figure 2** in your answer.

[2 marks]

Do not write outside the box

0 2 . 2 Calculate the percentage decrease in the money spent on conserving biodiversity from 2013 to 2017.

Use the equation:

$$\text{percentage decrease} = \frac{\text{change in money spent from 2013 to 2017}}{\text{money spent in 2013}} \times 100$$

Give your answer to 2 significant figures.

[3 marks]

Percentage decrease (2 significant figures) = _____ %

0 2 . 3 Conservation of peat bogs can help maintain biodiversity.

Give **two** uses of peat taken from peat bogs.

[2 marks]

1 _____

2 _____

Question 2 continues on the next page

Do not write outside the box

0 2 . 4 Describe **two** ways to **increase** biodiversity in the UK.

Do **not** refer to money spent or to peat in your answer.

[2 marks]

1 _____

2 _____

9

Do not write outside the box

0 3 A fossil was found in rocks. The rocks were formed from mud.

The fossil is of the fungus *Ourasphaira giraldae*.

0 3 . 1 What is the genus of the fungus?

[1 mark]

0 3 . 2 Why was the mud important during the formation of the fossil?

[1 mark]

Tick (✓) **one** box.

- The fungus completely decayed in the mud. ☐
- The mud stopped oxygen reaching the fungus. ☐
- There was water in the mud around the fungus. ☐

Question 3 continues on the next page

Do not write outside the box

The estimated age of the fossil is in the range from 8.9×10^8 years old to 1.1×10^9 years old.

0 3 . 3 Calculate the size of the range of the estimated age of the fossil.

[1 mark]

Size of range = _____ years

0 3 . 4 Humans did **not** exist when the fungus was alive.

Suggest **one** other reason why an accurate estimation of when this species of fungus existed is not known.

[1 mark]

Carl Woese developed the three-domain system of classification.

0 3 . 5 Fungi are **not** in the domain Archaea.

Which domain are fungi classified in?

[1 mark]

Do not write outside the box

0 3 . 6 Which **two** characteristics are features of organisms in the domain Archaea?

[2 marks]

Tick (✓) **two** boxes.

- Can only survive in light ☐
- Can survive in extreme environments ☐
- Cells contain chloroplasts ☐
- Cells do not have a cell wall ☐
- Cytoplasm contains DNA ☐

0 3 . 7 Carl Linnaeus lived in the 1700s.

Carl Linnaeus classified living things into groups depending on their appearance.

Give **three** types of evidence that are used **now** to classify living things.

Do **not** refer to appearance in your answer.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

10

Turn over for the next question

Do not write outside the box

0 4 **Figure 3** shows one species of bird on a bird feeder.

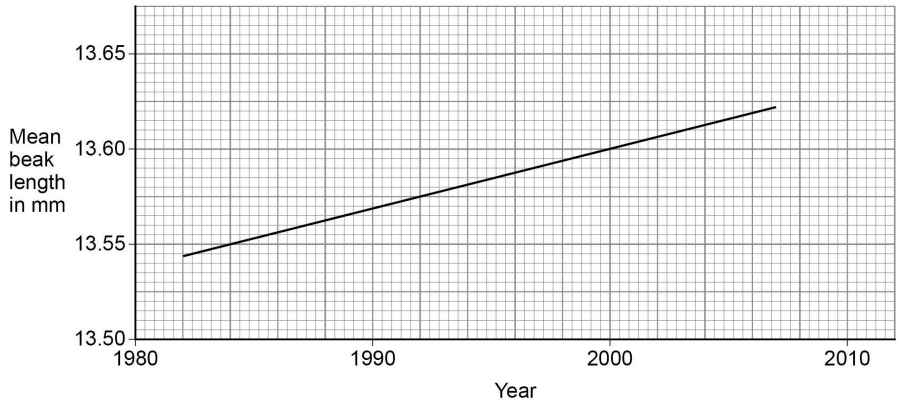
Figure 3

The birds use their beaks to reach nuts inside the bird feeder.

Figure 4 shows the mean beak length of this species of bird in the UK.

This species of bird often visits bird feeders.

Figure 4



Do not write outside the box

0 4 . 1 Determine the rate of change in beak length from 1984 to 2000.

Use **Figure 4.**

[3 marks]

Rate of change = _____ mm/year

0 4 . 2 Explain the process of evolution that could cause the trend in **Figure 4.**

[6 marks]

Turn over ►

Do not write outside the box

0 4 . 3 Birds of this species:

- live for about 3 years
- produce up to 24 eggs every year.

Explain why evolution is easier to study in this species of bird than in humans.

[3 marks]

0 4 . 4 Birds of this species are found in different parts of the world.

Describe evidence that would show two individual birds are the same species.

[3 marks]

15

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 5 Caffeine is a drug that decreases reaction time.

A group of sixteen students investigated the effect of caffeine on reaction time.

The students were all 15-year-old girls.

The group was divided into 8 pairs of students.

This is the method used.

1. Student **A** starts two stopwatches at the same time.
2. Student **A** then gives one of the stopwatches to Student **B**.
3. Student **A** says "stop" at the same time as stopping her stopwatch. Student **B** stops her stopwatch as quickly as possible after Student **A** says "stop".
4. The difference in time shown on the two stopwatches is recorded. This is the reaction time of Student **B**.
5. Student **B** drinks a caffeinated drink.
6. The students wait 15 minutes and then repeat steps 1 to 4.

0 5 . 1 Suggest **one** control variable the students should have used in the investigation.

Do **not** refer to age or sex in your answer.

[1 mark]

Do not write outside the box

0 5 . 2 Suggest **two** sources of random error when using this method to measure a person's reaction time.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

Question 5 continues on the next page

Do not write outside the box

Table 1 shows the results.

Table 1

Student pair	Decrease in reaction time after drinking the caffeinated drink in seconds
1	0.039
2	0.021
3	0.027
4	0.041
5	0.022
6	0.036
7	0.024
8	0.097

0 5 . 3 Why can a mode **not** be determined for the data in **Table 1**?

[1 mark]

_____

_____

0 5 . 4 The students decided the result from pair **8** was anomalous.

The students calculated that the mean decrease in reaction time was 0.030 seconds.

Describe how the students calculated the mean decrease in reaction time.

[1 mark]

_____

_____

_____

Do not write outside the box

0 5 . 5 Caffeine causes the release of adrenaline.

Adrenaline affects heart rate.

Explain how the effect of adrenaline on heart rate might cause reaction time to decrease.

[4 marks]

Question 5 continues on the next page

Do not write outside the box

Adenosine is a different chemical made by the body.

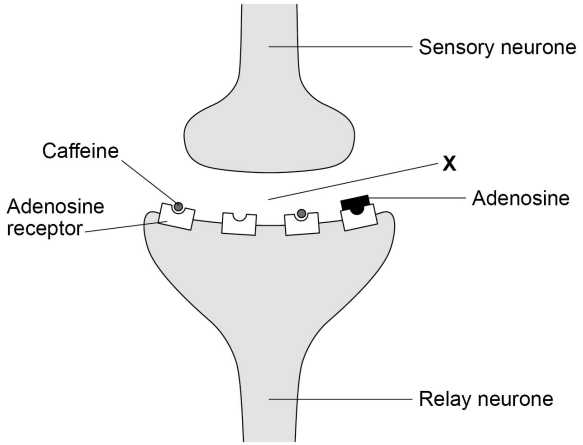
Adenosine binds to receptors on relay neurones.

Adenosine decreases the number of impulses in relay neurones.

Figure 5 shows how caffeine binds to adenosine receptors on a relay neurone.

When caffeine binds to adenosine receptors it blocks the receptor so adenosine cannot bind.

Figure 5



0 5 . 6 Label **X** shows the gap between the sensory neurone and the relay neurone.

What is the name of the gap labelled **X**?

[1 mark]

Do not write outside the box

0 5 . 7 Suggest why reaction time decreases when caffeine binds to adenosine receptors.

[2 marks]

12

Turn over for the next question

Do not write outside the box

0 6 This question is about genetic disorders.

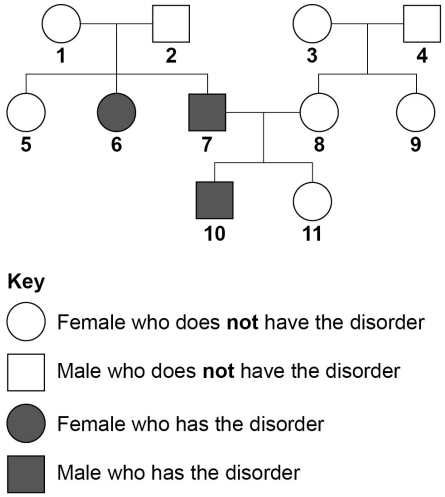
0 6 . 1 Some people are heterozygous for a genetic disorder.

Define the term 'heterozygous'.

[1 mark]

0 6 . 2 **Figure 6** shows the inheritance of a genetic disorder in a family.

Figure 6



Do not write outside the box

Person **7** and person **8** plan to have another child.

Determine the probability that the child will be a **male** who has the disorder.

You should:

- draw a Punnett square diagram
- identify the genotype of person **7** and the genotype of person **8**
- identify the phenotype of each offspring genotype
- use the symbols:

  H = dominant allele

  h = recessive allele

[6 marks]

Probability of having a male child with the disorder = _____

Question 6 continues on the next page

Do not write outside the box

0 6 . 3 Polydactyly is a different inherited disorder.

Two parents do **not** have any alleles for polydactyly in their ordinary body cells.

These parents produced a child with polydactyly.

Explain how polydactyly suddenly occurred in this family.

[4 marks]

11

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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Question number	**Additional page, if required. Write the question numbers in the left-hand margin.**

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Question number	**Additional page, if required. Write the question numbers in the left-hand margin.**

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Question number	**Additional page, if required. Write the question numbers in the left-hand margin.**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	endocrine (system)	ignore hormonal (system)	1	AO1 4.5.3.1
01.2	D		1	AO1 4.5.3.1 4.5.3.2
01.3	A		1	AO1 4.5.3.1
01.4	(in / through / via) blood	allow (in / through / via) bloodstream allow (in / through / via) plasma allow (in / through / via) blood vessels **or** named blood vessel	1	AO1 4.5.3.1
01.5	ovary / ovaries testis / testes	in either order allow testicle(s) allow placenta if no other mark awarded allow gonad(s) for **1** mark	1 1	AO1 4.5.3.1 4.5.3.3
01.6	luteinising hormone (LH)		1	AO2 4.5.3.3

Question	Answers	Mark	AO / Spec. Ref.
01.7	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	5–6	AO3 4.5.3.4 4.3.1.9
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.	3–4	
	Level 1: Relevant points are made. They are not logically linked.	1–2	
	No relevant content	0	
	Indicative content Advantages • non-permanent like condom / diaphragm / IUDs / spermicides / abstinence **or** unlike surgical sterilisation • longer lasting than condom / diaphragm / IUDs / spermicides • no need to remember unlike oral contraceptive • one injection rather than surgery for sterilisation • surgery (for sterilisation) has risks, for example, infection • no other method of long-lasting contraception (rather than sterilisation) relies on men Disadvantages • no protection from sexually transmitted diseases unlike barrier methods **or** named barrier method • not as long lasting as (surgical) sterilisation • at clinical / drug trial stage, so unknown side effects • at clinical / drug trial stage, so unknown efficacy • do not know how long it will last (as info only states 'up to 13 years') • can stop taking a pill **or** using a condom if you change your mind / want to get pregnant, whereas have to wait 13 years with the injection • (minor) risk of infection posed with an injection compared to no risk with the oral contraceptive For **Level 3** references to advantages **and** disadvantages of the new drug compared to named existing methods are required.		
Total		**13**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	increases (from 2005) to 690 million **or** increases to 2008 decreases (from 2008) to 630 million	allow peak in 2008 allow peak at 690 million if no other mark awarded, allow overall increase from 470 million **or** overall increase to 630 million **or** (overall) increase of 160 million **or** increases to 690 and decreases to 630 (without units) for **1** mark	1 1	AO2 4.7.3.1 4.7.3.6
02.2	$\frac{690(\text{million}) - 460(\text{million})}{690(\text{million})} \times 100$ 33.3 (%) 33 (%)	allow $\frac{230(\text{million})}{690(\text{million})} \times 100$ ignore number of decimal places allow calculated value from incorrect graph readings allow calculated answer correctly given to 2 significant figures	1 1 1	AO2 4.7.3.1 4.7.3.6
02.3	compost burning **or** as a fuel	allow improving soil (texture / drainage / quality) ignore farming unqualified ignore as fertiliser	1 1	AO1 4.7.3.3

02.4	any **two** from: • reduce pollution • plant trees • breeding programmes (for endangered species) • rewilding / regeneration of habitats / hedgerows / meadows • (reintroducing) wider field margins • plant a variety of crops • reduce use of pesticide / herbicide / insecticide	ignore references to carbon dioxide, greenhouse gases or global warming allow reduce named example of pollution, eg smoke **or** acidic gases **or** sewage **or** fertiliser allow reduce toxic waste dumping allow afforestation allow reforestation ignore reduce / stop deforestation allow planting wild flower seeds allow reduce monoculture ignore recycling ignore protect / conserve habitat(s) / areas	2	AO1 4.7.3.1 4.7.3.2 4.7.3.4 4.7.3.6
Total			**9**	

MARK SCHEME – GCSE COMBINED SCIENCE: TRILOGY – 8464/B/2H – JUNE 2021

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	*Ourasphaira*	ignore italics ignore capitalisation do **not** accept *Ourasphaira giraldae*	1	AO2 4.6.4
03.2	the mud stopped oxygen reaching the fungus		1	AO2 4.6.3.2
03.3	any **one** from: • 2.1×10^8 (years) • 210 000 000 (years)		1	AO2 4.6.3.2
03.4	any **one** from: • fossil(s) of the fungus may have been destroyed (by geological activity) • fossil(s) of the fungus may not have been found (yet) • dating methods are not precise / accurate • the time at which an organism / fungus evolves from ancestors is difficult to pinpoint	ignore some destroyed ignore some not found (yet) allow point of speciation is not known	1	AO3 4.6.3.2
03.5	eukaryota	allow eukaryote(s)	1	AO1 4.6.4

03.6	can survive in extreme environments cytoplasm contains DNA		1 1	AO1 AO2 4.6.4 4.1.1.1 4.1.1.2 4.6.2.4
03.7	any **three** from: • studies of internal / cell structures with light microscopes • studies of internal / cell structures with electron microscopes • chemical analysis • comparison of biochemical processes • DNA / genetic analysis • studies of evolution(ary relationships)	allow organelles for internal / cell structures if neither mark awarded allow studies of internal / cell structures (with microscopes) for **1** mark	3	AO1 4.6.4
Total			**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	13.55 (mm) **and** 13.60 (mm)		1	AO2 4.6.2.2
	$\frac{13.60\ (mm) - 13.55\ (mm)}{2000 - 1984}$	allow $\frac{0.05}{16}$ allow correct working from other pairs of readings	1	
	0.003125 (mm/year) **or** 3.125×10^{-3} (mm/year)	allow correct answer from other pairs of readings allow a correct answer given to any number of significant figures	1	

Question	Answers	Mark	AO / Spec. Ref.
04.2	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO2
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO1
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content	0	
	Indicative content • there is variation in beak length (in this bird population) • variation is due to mutations • beak length is controlled by gene(s) • birds with longer beaks can reach more nuts / food **or** birds with longer beaks can fight with **or** outcompete birds with shorter beaks • therefore have more energy from food • so can produce more offspring **or** reproduce more • those offspring that inherit the long beak allele more likely to survive • which is natural selection • pass allele / gene (for long beak) on • repeated over many generations • birds are evolving to have longer beaks For **Level 3** detail of process of evolution must be linked to beak length **and** implication of several generations is required.		4.6.2.1 4.6.2.2

04.3		allow converse if clearly referring to human evolution		AO2
	shorter life cycle / span	ignore shorter life	1	AO2
	more offspring		1	AO3
	(so) the genetics of the population changes faster		1	4.6.2.2 4.6.3.1
		allow effect of mutations seen sooner / faster **or** humans can see evolution in birds during the course of a human life(time)		
		allow more fossil evidence		
04.4	similar / same phenotype		1	AO1 4.6.2.2
	similar genotype / DNA (profile)		1	4.6.3.1
	(can reproduce / breed and) produce fertile offspring		1	
Total			**15**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any **one** from: • previous intake of caffeine that day • usual intake of caffeine (on previous days) • concentration of caffeine • volume of caffeine • time of day • amount of sleep • body mass • previous experience of the test • which hand (of student **B**) holds the stopwatch	allow named caffeinated drink for caffeine allow amount / mass / type of caffeine for **1** mark allow fatigue allow (body) weight / BMI	1	AO1 4.5.2 RPA6
05.2	any **two** from: • (student **A**) does not press both start buttons simultaneously • (student **A**) may not say stop and press button simultaneously • student **B** could be distracted • idea that student **B** anticipated student **A** stopping the stopwatch • stopwatch malfunction	allow (stop)watches may not be <u>accurate</u>	2	AO3 4.5.2 RPA6
05.3	no value / result / number occurs more than once **or** all the values / results / numbers are different		1	AO2 4.5.2 RPA6

05.4	add(ed) the other (7) results and divide(d) by 7	allow correctly shown calculation ignore leave out the result for pair 8	1	AO2 4.5.2 RPA6
05.5	(adrenaline) increases heart rate	allow increases blood flow	1	AO1
	(which) increases oxygen / glucose to brain / muscle (cells)		1	AO1
	(which) increases rate of respiration		1	AO2
	(so) releasing more energy for (faster / more) muscle <u>contraction</u>	allow (so) releasing more ATP for (faster / more) muscle <u>contraction</u> do **not** accept energy produced / made / created	1	AO2 4.5.3.6 4.5.2
05.6	synapse	allow synaptic cleft	1	AO1 4.5.2
05.7	fewer adenosine (molecules) can bind to the receptors **or** adenosine has no / less effect on the (relay) neurone		1	AO2
	therefore impulses in relay neurone are more frequent	allow impulses in relay neurone are faster allow there are more impulses in relay neurone allow impulses in relay neurone not delayed / reduced (in number) ignore caffeine binds to adenosine receptors	1	AO3 4.5.2
Total			**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	any **one** from: • (having two) different alleles for a gene / trait / characteristic / disorder • (having) the dominant **and** recessive allele for a gene / trait / characteristic / disorder	ignore examples such as Hh ignore having two different alleles unqualified	1	AO1 4.6.1.4
06.2	father / person 7 **hh**	allow **hh** and **Hh** parental genotypes with each parent unidentified **or** reversed for **1** mark	1	AO2
	mother / person 8 **Hh**		1	AO2
	(possible offspring correctly derived) **hh** (× 2) **Hh** (× 2)	allow correctly derived offspring from incorrect parental genotype(s)	1	AO2
	(each different phenotype identified) **hh** = has the disorder **Hh** = does not have the disorder	allow from incorrectly derived offspring if incorrectly have **HH** = does not have the disorder	1	AO2
	0.5	allow 50% **or** ½ **or** 1:1 **or** 1 out of 2 **or** 1 in 2 do **not** accept 1:2 allow probability of having disorder correctly derived from incorrect parental genotypes	1	AO3
	(probability of male with disorder) 0.25	allow 25% **or** ¼ **or** 1:3 **or** 1 out of 4 **or** 1 in 4 do **not** accept 1:4 allow probability of male with disorder correctly derived from incorrect probability of having the disorder	1	AO3 4.6.1.4 4.6.1.5 4.6.1.6

06.3	caused by mutation	allow description, for example change in the genetic code **or** change in base sequence	1	AO2 4.6.2.1 4.6.1.4 4.6.1.5 4.6.1.3
	during meiosis	allow in (germ) cells prior to meiosis allow in (the formation of) gametes / egg / sperm allow during mitosis between fertilisation and birth	1	4.6.1.1 4.6.1.2
	causing a change in amino acid sequence		1	
	causing a different (specific) protein to be produced **or** causing none of a (specific) protein to be produced	causing a different (specific) enzyme to be produced **or** causing none of a (specific) enzyme to be produced allow polydactyly is caused by a dominant allele so if child has one / the allele (with the mutation) they will have the disorder if no other mark awarded allow parents used donated egg / sperm for **1** mark	1	

Total			**11**

AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Biology Paper 2H

Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator.

Instructions
- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Do not write outside the box

0 1 This question is about the cycling of water and carbon in ecosystems.

0 1 . 1 Which reaction produces water?

[1 mark]

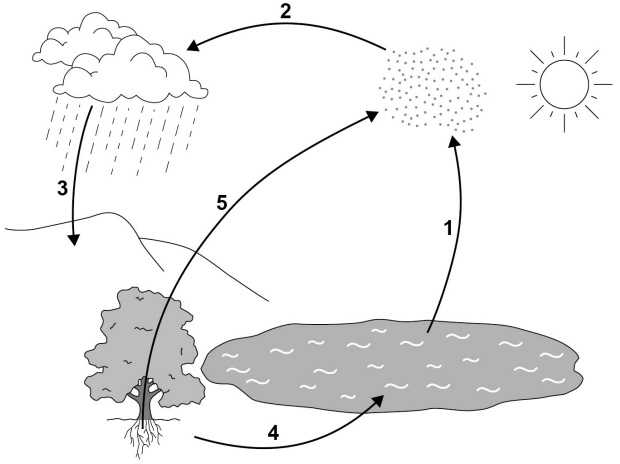
Tick (✓) **one** box.

- Aerobic respiration ☐
- Anaerobic respiration ☐
- Photosynthesis ☐

The water cycle provides water for plants and animals on land before the water goes into lakes and seas.

Figure 1 represents the water cycle.

Figure 1



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0 1 . 2 Name the processes **1** to **5** shown on **Figure 1**.

[5 marks]

1 _____

2 _____

3 _____

4 _____

5 _____

0 1 . 3 In 2007 the population of the world was 6 000 000 000

A study found that 4.5% of the population had severe water shortage.

Calculate how many people had severe water shortage.

Give your answer in standard form.

[3 marks]

_____

_____

_____

_____

_____

Number of people (in standard form) = _____

Question 1 continues on the next page

Do not write outside the box

0 1 . 4 Why do more people have severe water shortage now than in 2007?

[2 marks]

Tick (✓) **two** boxes.

Climate change has increased the area of deserts. ☐

Each person drinks less water. ☐

More water is used to grow crops. ☐

Sea levels have risen because the ice caps are melting. ☐

Some countries have built de-salting factories for seawater. ☐

Leaves on a tree contain carbon compounds.

In autumn the leaves fall to the ground.

0 1 . 5 Microorganisms in the soil recycle carbon from the leaves so that the carbon is used for new plant growth.

Explain how.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

Do not write outside the box

0 1 . 6 What is **one** benefit of fallen leaves for living plants?

[1 mark]

Tick (✓) **one** box.

- Energy is released for living plants. ☐
- Insect pests in the soil are killed. ☐
- Nitrates are released into the soil. ☐
- Oxygen is supplied to root cells. ☐

16

Turn over for the next question

Do not write outside the box

0 2 Water pollution is a problem for humans and wildlife.

Explain how human activities are polluting rivers, lakes and seas.

[6 marks]

6

Do not write outside the box

0 3 On a school field:

- one area of the soil was usually wet
- another area of the soil was usually dry.

Students investigated the effect of water in the soil on the number of buttercup plants growing in each area.

0 3 . 1 Water is an abiotic factor.

Name **one biotic** factor which may affect the number of buttercups growing on the field.

[1 mark]

0 3 . 2 Describe a method to investigate if the amount of water in the soil affects the number of buttercups in the field.

[6 marks]

7

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ANSWER IN THE SPACES PROVIDED

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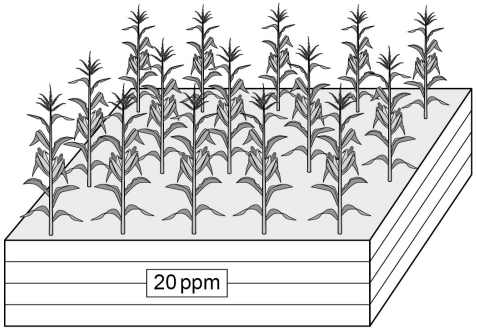
0 4 Scientists investigated the effect of soil nitrate ion concentration on the yield of corn.

This is the method used.

1. Corn plants were grown in a large box of soil.
2. The soil nitrate ion concentration in the box was kept at 0 parts per million (ppm).
3. All the corn from each plant in the box was removed and weighed.
4. The mean mass of corn per plant was calculated.
5. Steps 1 to 4 were repeated for boxes containing soil with different concentrations of nitrate ions.

Figure 2 shows the corn plants in the box with a 20 ppm soil nitrate ion concentration.

Figure 2



0 4 . 1 Give **two** variables the scientists should have controlled in this investigation.

[2 marks]

1 _____

_____

2 _____

_____

Turn over ►

Do not write outside the box

The scientists carried out a valid investigation.

Table 1 shows the scientists' results.

Table 1

Soil nitrate ion concentration in ppm	Mean mass of corn per plant in grams
0	122
10	190
20	256
30	268
40	240
50	184

Do not write outside the box

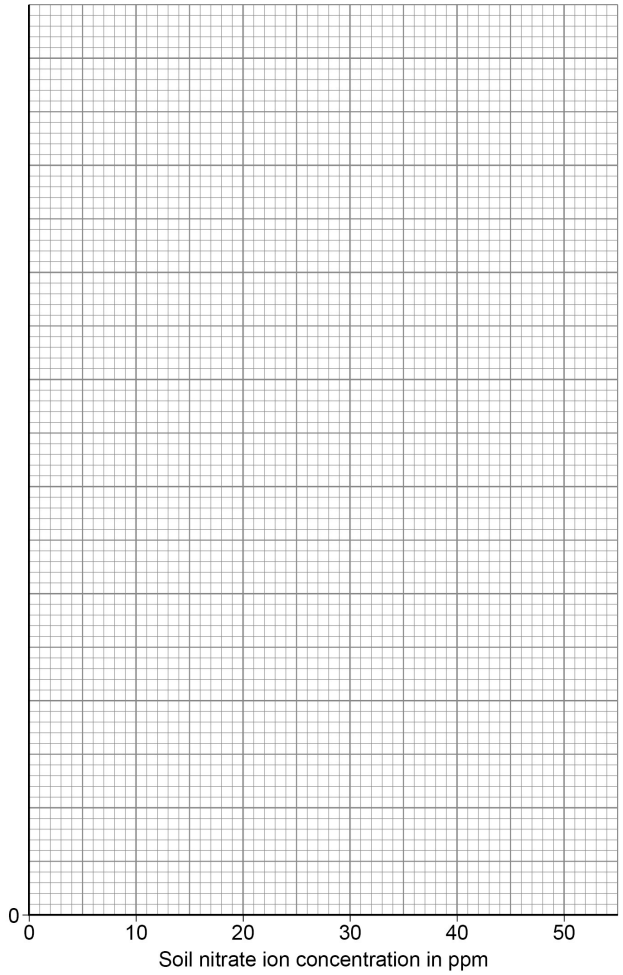
0 4 . 2 Complete **Figure 3.**

You should:

- label the *y*-axis
- use a suitable scale for the *y*-axis
- plot the data from **Table 1**
- draw a line of best fit.

[4 marks]

Figure 3



Turn over ►

Do not write outside the box

Table 1 is repeated below.

Table 1

Soil nitrate ion concentration in ppm	Mean mass of corn per plant in grams
0	122
10	190
20	256
30	268
40	240
50	184

0 4 . 3 Describe the relationship between soil nitrate ion concentration and the mean mass of corn per plant.

Use data from **Table 1** in your answer.

[2 marks]

Do not write outside the box

0 4 . 4 Farmers add nitrate fertiliser to fields where they grow corn.

Nitrate fertilisers are expensive.

Evaluate the economic and environmental implications of adding fertiliser to soil in nitrate ion concentrations ranging from 0 to 50 ppm

[4 marks]

12

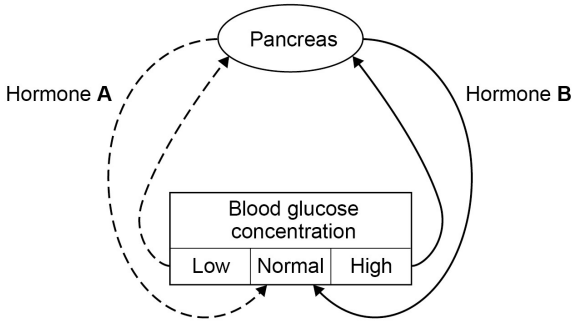
Turn over for the next question

Do not write outside the box

0 5 Blood glucose concentration in the human body needs to be kept within the normal range.

Figure 4 shows that two hormones control blood glucose concentration.

Figure 4



0 5 . 1 Name the type of hormonal control shown in **Figure 4.**

[1 mark]

0 5 . 2 Name hormones **A** and **B** in **Figure 4.**

[1 mark]

A _____

B _____

Do not write outside the box

0 5 . 3 Explain how the two hormones in **Figure 4** keep the blood glucose concentration within the normal range for 3 hours after a meal.

[6 marks]

Question 5 continues on the next page

Do not write outside the box

Female reproductive hormones are used to treat infertility in women.

0 5 . 4 Follicle Stimulating Hormone (FSH) and then Luteinising Hormone (LH) can be injected into a woman to help her become pregnant by sexual intercourse.

Explain how injecting FSH and then LH will help a woman to become pregnant.

[3 marks]

0 5 . 5 In some women the injections of FSH and LH are the first steps for In Vitro Fertilisation (IVF).

Describe the remaining steps in IVF.

[4 marks]

Do not write outside the box

0 5 . 6 There are two different processes of cell division in humans.

Describe **three** differences between cell division to form sperm cells compared with cell division to form liver cells.

[3 marks]

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____

18

Turn over for the next question

Do not write outside the box

0 6 The polar bear is a mammal that lives in arctic habitats.

0 6 . 1 Complete **Table 2** for the classification of the polar bear, *Ursus maritimus*.

[2 marks]

Table 2

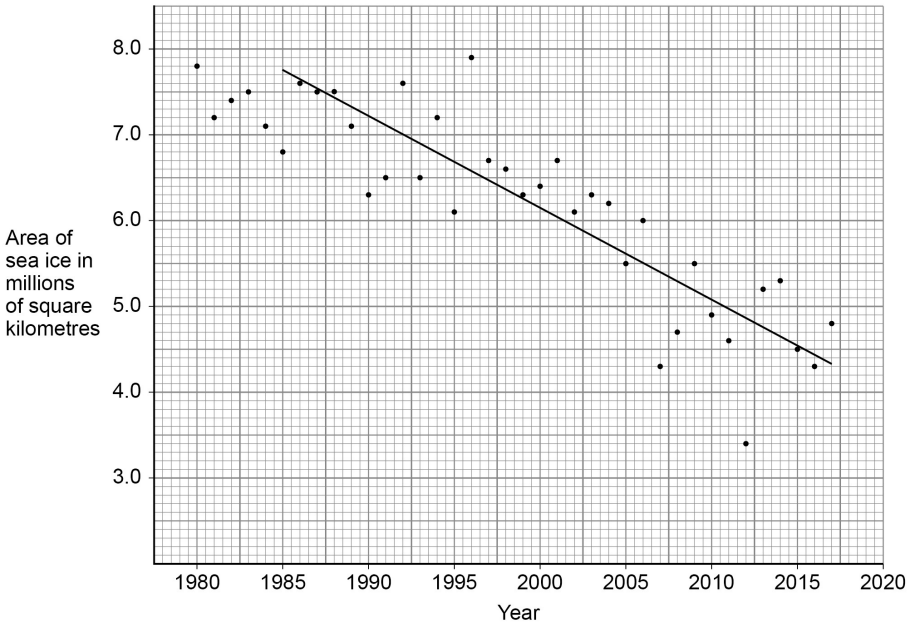
Classification group	Name
Domain	
Kingdom	
	chordata
Class	mammalia
Order	carnivora
	ursidae
Genus	Ursus
Species	maritimus

Do not write outside the box

Scientists have been measuring the area of sea ice in the Arctic since 1980.

Figure 5 shows the area covered by sea ice every September.

Figure 5



0 6 . 2 Determine the annual rate of loss of sea ice between 1985 and 2017.

A trend line has been drawn on **Figure 5** to help you.

[3 marks]

Rate of loss = _____ million square kilometres per year

Question 6 continues on the next page

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The total number of polar bears living on the arctic ice is not known.

The hunting of polar bears has been banned or reduced in some areas.

In some populations the average mass and height of polar bears has decreased.

Polar bears eat seals. Seals live on the sea ice in winter and raise their pups there in early spring. In the summer seals live mainly in the sea catching fish to eat.

Polar bears spend much of the year hunting seals on the sea ice and in the sea nearby. The sea ice area is at its lowest each year in September at the end of summer. The polar bears feed mainly in early spring, and again in autumn to build fat stores to survive the next winter.

During the winter of 2017 scientists measured the metabolic rates of nine female polar bears and found them to be much higher than expected. Cameras attached to the female polar bears showed they had to swim long distances to find seals to eat.

0 6 . 3 Suggest why polar bears find it harder to catch seals in autumn than in spring.

[2 marks]

0 6 . 4 Evaluate what might happen to the population of polar bears in the Arctic in the future.

[4 marks]

11

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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Question number	**Additional page, if required. Write the question numbers in the left-hand margin.**

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Question number	**Additional page, if required. Write the question numbers in the left-hand margin.**

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	aerobic respiration		1	AO1 4.4.2.1 4.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	1. evaporation	allow evaporate(s) / evaporating	1	AO1 4.7.2.2
	2. condensation	allow condense(s) / condensing	1	
	3. precipitation	allow rain(ing) / rainfall allow named precipitation ignore precipitates	1	
	4. draining / drainage	allow run-off / percolation / infiltration allow groundwater / underground flow	1	
	5. transpiration		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3				AO2 4.7.2.2
	$6\,000\,000\,000 \times \frac{4.5}{100}$	allow $6\,000\,000\,000 \times 0.045$	1	
	$270\,000\,000$		1	
	2.7×10^8	allow an incorrectly calculated number of people given in correct standard form	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	climate change has increased the area of deserts		1	AO3 4.7.2.2
	more water is used to grow crops		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	decay / decomposition of leaves	allow leaves are broken down	1	AO2
	respiration (by microorganisms / decomposers)	ignore aerobic / anaerobic ignore respiration by worms / detritivores / insects / leaves	1	AO1
	respiration releases carbon dioxide **or** microorganisms release carbon dioxide		1	AO1
	carbon dioxide is used in photosynthesis (for new plant growth)	do **not** accept carbon dioxide absorbed in the roots	1	AO1 4.7.2.2 4.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	nitrates are released into the soil		1	AO2 4.7.2.2 4.4.1.3

Total Question 1		**16**

Question 2

Question	Answers	Mark	AO / Spec. Ref.
02	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3
	Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO3 AO1
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content	0	

2 cont.	**Indicative content**
	Increase in world population
	• sewage (released into rivers / lakes / seas)
	  ○ causes algae to grow
	  ○ algae block light
	  ○ causing plants to die and decompose
	  ○ leading to lack of oxygen in the water
	  ○ (sewage) could contain pathogens
	
	Need to produce more food for world's population
	• fertilisers (used on farms to increase crop yield, leach into rivers / lakes / seas)
	  ○ causes algae to grow
	  ○ leading to lack of oxygen in the water
	• herbicides / pesticides (used on farms to increase crop yield, run into rivers / lakes / seas)
	  ○ build-up in food chains
	
	Increasing demand for products / energy
	• toxic chemicals **or** named toxic chemicals (run into rivers / lakes / seas)
	  ○ from factories / industry **or** power stations
	  ○ build-up in food chains
	  ○ chemicals may cause mutations **or** chemicals may act as hormones
	  ○ radiation leaks from nuclear (power stations)
	  ○ (oil) spills from extraction / rigs / tankers in oceans
	  ○ acid rain formation
	  ○ acidification of lakes
	  ○ increased carbon dioxide emissions causes acidification of oceans
	
	Buildup of waste products
	• litter / plastics (thrown in rivers / lakes / seas)
	  ○ example of effect on living organisms, such as plastics consumed or plastics build up in stomach or plastics get stuck around beaks
	  ○ (most) plastics are not biodegradable
	  ○ build-up of microplastics in water animals
	
	Consequence of the above is that organisms living in rivers / lakes / seas are harmed / die
	
	For **Level 3** students need to consider different types of pollution
			4.7.3.2
			4.7.2.1

Total Question 2		**6**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	any **one** from: • competition • herbivores • trampling / mowing • pollinators • pathogens	allow other plants / trees (growing in the field) allow named herbivore allow pests allow insects or named pollinator allow infection ignore disease unqualified	1	AO2 4.7.1.3 RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	any **six** from: • mark out (grid) area in wet and in dry area • method for placing quadrat(s) • count / record number of buttercups (in the quadrat) • use at least 5 quadrats in each area • take soil moisture readings • use suitable equipment for readings, eg soil moisture meter • calculate the mean (in each area) • use the mean and area to calculate total number in wet area and total number in dry area **OR** any **six** from (6): • transect between wet area and dry area • place quadrat(s) regularly along transect • count / record number of buttercups (in the quadrat) • use at least 5 quadrats along transect • take soil moisture readings • use suitable equipment for readings, eg soil moisture meter • repeat transects • calculate the mean at each distance along the transects	allow mark out a transect in each of the two areas allow description of a method to place quadrat(s) randomly / systematically do **not** accept throwing quadrats randomly ignore percentage cover of buttercups allow (for each area) total number of buttercups divided by total area sampled, multiplied by total area for **2** marks allow description of a method to place quadrat(s) systematically	6	AO1 4.7.2.1 RPA7

Total Question 3		7

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	any **two** from: • light (intensity) • water • temperature • mass / volume of soil • soil type **or** (soil) pH • other mineral content of the soil • number of plants (in a box) • starting mass / height / age of corn • type / variety of corn • harvested at the same time	do **not** accept nitrate ion concentration allow size of box allow depth of soil ignore fertiliser allow planting density allow species of corn allow harvested when mature	2	AO2 4.7.2.1 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	suitable scale **and** axis labelled (mean <u>mass</u> (of corn) per plant in <u>grams / g</u>) all points plotted correctly suitable line of best fit	max **3** marks for bar chart allow a tolerance of ± ½ a small square allow **1** mark for 4 or 5 correct plots ignore line extended beyond 50ppm ignore line joined point to point with straight lines	1 2 1	AO2 4.7.2.1 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	as (soil) nitrate / concentration increases, (mean) mass (of corn) increases **and** then decreases with a maximum (mean mass of corn) at 30 (ppm)	 allow a maximum consistent with graph in question **04.2** if no other mark awarded, allow **1** mark for (mean mass of corn) increases to 30 (ppm) **or** (mean mass of corn) decreases above 30 (ppm)	1 1	AO2 4.7.1.2 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	any **four** from: (economic) • increasing nitrate / ion (concentration) up to 30 ppm will give high(er) yield / income / sales • greater than 30 ppm will decrease yield / mass / income / sales **and** therefore waste money / fertiliser • any increase in yield / mass / income / sales must be balanced with cost (of fertiliser) • quantity to add will depend on original nitrate (ion concentration) of soil (environmental) • (when it rains) fertiliser / nitrate will enter rivers / lakes / sea / ocean causing pollution	max **3** marks if no reference to environmental implication ignore mass for this marking point only allow greater than 30 ppm, the yield / mass / income / sales / will not increase (as much) **and** therefore waste money / fertiliser allow profit / benefit will depend on yield / mass / income / sales **and** cost (of fertiliser) allow fertiliser / nitrate run-off causes pollution allow eutrophication or description of eutrophication allow description of effect of fertiliser / nitrate pollution eg health impact of fertiliser in drinking water allow environmental implication of (significant) energy use in fertiliser production / transport	4	AO3 4.7.3.2 4.7.2.2 4.1.3.3 4.4.2.3

Total Question 4		12

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	negative feedback (control)	ignore homeostasis	1	AO2 4.5.3.6 4.5.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	A = glucagon B = insulin	both required in correct order correct or phonetic spelling only	1	AO2 4.5.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3 **indirect marking** **view with 5.2**	(when blood glucose concentration is high after a meal) insulin / B is secreted (by the pancreas) causing glucose to enter cells		1	AO2
	(glucose is) converted to glycogen in the liver / muscle (cells for storage)		1	AO1
	(this causes) blood glucose concentration to return to normal so insulin / B secretion slows / stops / decreases		1	AO2
	when blood glucose concentration is low glucagon / A is secreted (by the pancreas)		1	AO2
	(which causes) breakdown of glycogen in the liver (into glucose)	allow (which causes) breakdown of glycogen in the muscle (cells)	1	AO1
	(this causes) blood glucose concentration to return to normal so glucagon / A secretion slows / stops / decreases		1	AO2 4.5.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	FSH causes (several) ova / eggs to mature (in the ovary)	allow singular ovum / egg allow follicle for ovary	1	AO2 4.5.3.3 4.5.3.5
	(then) LH causes ovulation **or** LH causes release of the ova / eggs	allow singular ovum / egg	1	
	so more eggs / ova present therefore higher probability / chance of fertilisation **or** so more eggs / ova present therefore higher probability / chance of sperm fusing with an egg		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	collection of (mature) egg(s) from the ovary	allow follicle for ovary	1	AO1 4.5.3.5
	(which are) fertilised (in the laboratory)	do **not** accept if in fallopian tube allow egg and sperm fuse	1	
	develop into embryo(s) (in the laboratory)	allow develop / divide into small balls of cells (in the laboratory) do **not** accept foetus	1	
	embryo(s) inserted into uterus / womb		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	any **three** from: • meiosis forms sperm **and** mitosis forms liver (cells) • two cell divisions to form sperm **and** one cell division to form liver (cells) • four genetically different sperm cells **and** two genetically identical liver cells • sperm cells have 23 chromosomes **and** liver cells have 46 chromosomes	ignore reproduction max **2** marks if reference to sperm cells dividing allow four genetically different cells formed from meiosis **and** two genetically identical cells formed from mitosis allow sperm cells have 23 chromosomes **and** liver cells have 23 pairs of chromosomes allow haploid (sperm) and diploid (liver cells)	3	AO1 4.6.1.2 4.1.2.2

Total Question 5		18

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	<table><tr><td></td><td>eukaryote / eukaryota</td></tr><tr><td></td><td>animal(ia)</td></tr><tr><td>phylum / phyla</td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td>family</td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr></table>	**2** marks for all 4 correct **1** mark for 2 or for 3 correct ignore italics and upper / lower case letters	2	AO1 AO2 4.6.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2 view with Figure 5	*two readings from graph* 7.75 **and** 4.32	allow in range of 7.7 to 7.8 **and** 4.3 to 4.4 allow two readings from two identified points on the line, allowing a tolerance of ± ½ a small square	1	AO2 4.7.3.5
	calculation of gradient $\frac{3.43}{32}$	allow calculation of gradient using correct readings from graph, $\frac{dy}{dx}$	1	
	correct answer 0.1(071875)	allow correct answer using student's correct readings from graph	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	any **two** from: *in autumn* • no / fewer seals left on ice **or** all / most seals are in the sea • seals are adults / older so swim faster • more <u>competition</u> between polar bears	ignore seals are in the sea unqualified	2	AO3 4.7.3.5

Question	Answers	Mark	AO / Spec. Ref.
06.4	**Level 2:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	3–4	AO3
	Level 1: Some logically linked reasons are given. There may also be a simple judgement.	1–2	AO2
	No relevant content	0	
	Indicative content *may decrease because:* • global warming is melting sea ice • less sea ice each year so less habitat / hunting area • as ice / habitat disappears seals will decrease in number • having to swim longer distances to find seals, wastes energy • increased metabolic rate means more food is required • not building up fat stores in the autumn means fewer will survive each winter • decrease in mass / height may reduce hunting ability / strength • hunting in some / most areas continues • less likely to find mates • eventually the species may become extinct *may increase / maintain numbers if:* • more laws put in place to stop hunting **or** laws to stop hunting will allow bears to reproduce • quotas introduced to reduce hunting • nations / people work to reduce carbon dioxide emissions to halt global warming • (feeding / hunting) behaviour of polar bears changes For Level **2** both increase / maintenance **and** decrease of the polar bear population must be considered		4.7.1.1 4.7.3.5

Total Question 6		**11**