GCSE
COMBINED SCIENCE: SYNERGY
8465/2F

Foundation Tier Paper 2 Life and Environmental Sciences

Mark scheme

June 2023

Version: 1.0 Final

2 3 6 G 8 4 6 5 / 2 F / M S

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the examiner make their judgement
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent (for example, a scientifically correct answer that could not reasonably be expected from a student's knowledge of the specification).

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**.
Alternative words in the mark scheme are shown by a solidus eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name **two** magnetic materials.

[2 marks]

Student	Response	Marks awarded
1	iron, steel, tin	1
2	cobalt, nickel, nail*	2

3.2 Use of symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, or uses symbols to denote quantities in a physics equation, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. At any point in a calculation students may omit steps from their working. If a subsequent step is given correctly, the relevant marks may be awarded.

Full marks are **not** awarded for a correct final answer from incorrect working.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

An error can be carried forward from one question part to the next and is shown by the abbreviation 'ecf'.

Within an individual question part, an incorrect value in one step of a calculation does not prevent all of the subsequent marks being awarded.

3.6 Phonetic spelling

Marks should be awarded if spelling is not correct but the intention is clear, **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do <u>not</u> accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

3.11 Numbered answer lines

Numbered lines on the question paper are intended to support the student to give the correct number of responses. The answer should still be marked as a whole.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and, if necessary, annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level.

The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.1	to obtain energy		1	AO2 4.2.1.1 4.2.1.5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.2	receptors		1	AO1 4.2.1.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.3	a reflex action		1	AO1 4.2.1.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.4	a synapse		1	AO1 4.2.1.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.5	motor neurone		1	AO1 4.2.1.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.6	can find food quickly / easily	allow can find sugar quickly / easily allow can find more food / sugar allow can go straight to food / sugar	1	AO3 4.4.2.2 4.1.4.3

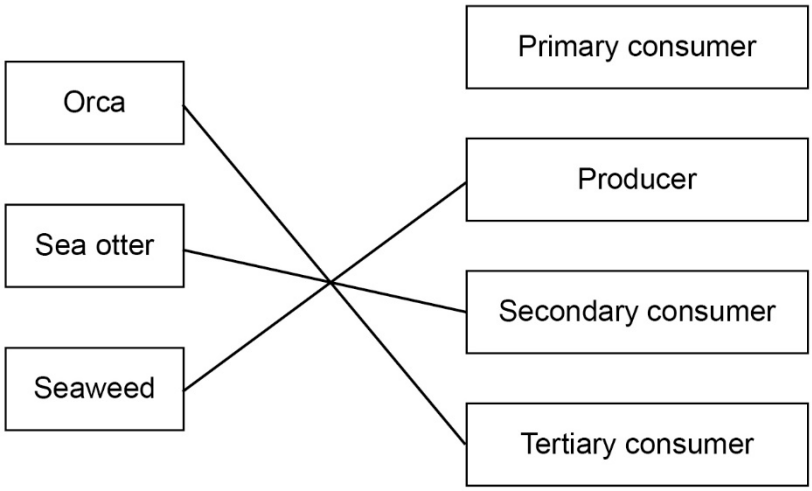
Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.7	S		1	AO1 4.1.4.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.8	radio waves		1	AO1 4.1.4.3

Total Question 1	**8**

Question 2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.1	habitat		1	AO1 4.4.2.1

Question	Answers	Mark	AO/ Spec. Ref.
02.2	**Organism** **Description**  do **not** accept more than one line from a box on the left	1 1 1	AO2 4.4.2.1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.3	any **two** from: • carbon dioxide (concentration) • light (intensity / colour / wavelength) • (water) temperature	ignore sun allow water do **not** accept oxygen	2	AO1 4.2.2.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.4	any **one** from: • (over)fishing • pollution	 allow humans eat fish allow example of pollution such as release of sewage / oil into ocean allow litter / plastics thrown into oceans	1	AO3 4.4.2.1 4.4.2.6

Question	Answers	Mark	AO/ Spec. Ref.
02.5	**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
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking**.**	1–2	AO2
	No relevant content	0	4.4.2.1 4.4.2.2 4.4.2.3
	Indicative content • (decrease in fish) causes decrease in seal numbers • (because) seals will not have enough food / fish to eat • (so) orca will not have enough seals to eat • (so) orca numbers decrease as not enough seals to eat • orca will eat more sea otters • (so) number of orcas stays the same • (so) number of sea otters decreases • number of orcas will decrease • (because) less seals and sea otters to eat • less sea otters to eat sea urchins • (so) increase in the number of sea urchins • sea urchins will eat more seaweed • (so) seaweed will decrease • (decrease in fish) means less (microscopic) algae eaten • (so) increase in (microscopic) algae • humans will not have enough food / fish to eat • (so) human numbers decrease through lack of food / starvation For **Level 3** linked statements about organisms in both sides of the food web are needed		

Total Question 2	**13**

Question 3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.1	from the incomplete combustion of hydrocarbon fuels		1	AO1 4.4.1.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.2	acid rain		1	AO1 4.4.1.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.3	temperature	ignore pressure	1	AO1 4.4.1.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.4	can cause respiratory problems	allow named respiratory problem such as asthma	1	AO1 4.4.1.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.5	$PM_{2.5}$		1	AO3 4.4.1.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.6	the soot particle is too small (to be seen using a light microscope)	allow the soot particle is very small / tiny allow electron microscope has a greater magnification than a light microscope allow electron microscope has a greater resolution than a light microscope	1	AO3 4.1.3.1 4.4.1.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.7	(industrial processes) 160 (millions of kilograms) **and** (road transport) 40 (millions of kilograms)		1	AO2 4.4.1.6
	(difference =) 160 – 40	allow correct use of incorrectly determined emission value(s)	1	
	= 120 (millions of kilograms)		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.8	any **three** from: • industrial processes emitted a greater mass of particulates than road transport in 1990 • industrial processes emitted a greater mass of particulates than road transport in 2020 • there is a decrease in the mass of particulates emitted from road transport (between 1990 and 2020) • there is a decrease in the mass of particulates emitted from industrial processes (between 1990 and 2020) • the lowest mass of particulates emitted is from road transport in 2020 • the highest mass of particulates emitted is from industrial processes in 1990 • there is a greater difference in the mass of particulates emitted from industrial processes (than from road transport) between 1990 and 2020	allow the converse of these statements if neither mark awarded allow **1** mark for industrial processes releases more emissions if neither mark awarded allow **1** mark for there was a lower mass of particulates emitted in 2020	3	AO3 4.4.1.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.9	mucus cilia	must be in this order	1 1	AO1 4.3.3.3 4.4.1.6

Total Question 3	**14**

Question 4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.1	any **two** from: • large surface area • thin wall (of small intestines) • good / rich blood supply • blood supply close to small intestine wall	 allow long / folded allow has villi / microvilli allow walls are one cell thick do **not** accept references to cell walls allow has many capillaries	2	AO1 4.2.1.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.2	digestion active transport diffusion	must be in this order	 1 1 1	 AO1 AO2 AO2 4.2.1.5 4.1.3.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.3	any **one** from: • (starch molecules are too) large • (starch molecules are) insoluble	 allow (starch molecules) do not dissolve	1	AO1 4.1.3.3 4.2.1.5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.4	black		1	AO1 4.2.1.5 RPA7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.5	time taken for starch to break down		1	AO2 4.2.1.5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.6	60 s		1	AO3 4.2.1.5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.7	any **one** from: • discard it • do not include it in the mean • repeat the test	ignore reference to ignoring anomalous result unqualified allow do not use it	1	AO3 4.2.1.5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.8	test for starch every 30 seconds		1	AO3 4.2.1.5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.9	any **one** from: • an enzyme is needed to break down starch • the enzyme speeds up the breakdown of starch	ignore starch not broken down after 20 minutes ignore the starch took 300 seconds to break down allow the starch did not break down without an enzyme	1	AO3 4.2.1.5

Total Question 4	**12**

Question 5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.1	growth combustion decomposition	must be in this order	1 1 1	AO2 4.4.1.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.2	microorganisms	allow decomposer / fungi / bacteria / microbes allow detritivores allow named detritivore eg worms	1	AO1 4.4.1.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.3	stomata root hairs	must be in this order	1 1	AO2 AO1 4.1.3.3 4.2.2.2 4.2.2.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.4	more space / light / water	allow more nutrients (from the soil) **or** more mineral ions	1	AO2 4.4.2.2 4.2.2.5
	(so) less competition (between trees) **or** (so) more / faster photosynthesis (to produce glucose for growth)		1	
		alternative route: less competition (between trees) (1) (so) more / faster photosynthesis (to produce glucose for growth) (1)		

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.5	any **one** from: • the trees will be bigger • can make a greater profit	 allow the farmer can sell / harvest trees earlier	1	AO3 4.4.2.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.6	trees (use carbon dioxide when they) photosynthesise		1	AO3 4.2.2.5 4.4.1.2
	(so) reduces carbon dioxide in the atmosphere	allow (so) removes carbon dioxide from atmosphere	1	4.4.1.4 4.4.1.5
	(so) less global warming	allow (so) reduces greenhouse effect	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.7	any **two** from: • the number of species decreased (between 1970 and 2020 in forest A / B) • a greater decrease in species in forest **B** (between 1970 and 2000) • the difference (in the number of species) in forest **A** was 2 • the difference (in the number of species) in forest **B** was 6 • forest **B** is more biodiverse than forest **A** in 1970 • forest **A** is more biodiverse than forest **B** in 2000	allow more (species) in 1970 allow forest B had more species than forest A in 1970 allow forest A had more species than forest B in 2000	2	AO3 4.4.2.5

Total Question 5	**14**

Question 6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.1	double helix	ignore polymer	1	AO1 4.4.3.1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.2	chromosomes move to opposite ends of the cell		1	AO1 4.1.3.4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.3	6 picograms		1	AO2 4.1.3.4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.4	$\frac{48}{16}$ = 3 (divisions) = 8 (cells) **or** alternative route after 16 hours = 2 cells (1) after 32 hours = 4 cells (1) after 48 hours = 8 cells (1)		1 1 1	AO2 4.1.3.4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.5	any **one** from: • viruses • carcinogens	ignore ionising radiation or named example allow named example such as tobacco / cigarettes / smoking / benzene / asbestos / vinyl chloride ignore references to genetics	1	AO1 4.3.1.2 4.3.3.10 4.4.4.1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.6	any **three** from: • the number of cancerous cells increase up to day 6 **or** the number of non-cancerous cells increase up to day 6 **cancerous cells** • the number of cancerous cells increase up to 1000 (thousand cells) • the number of cancerous cells increase slowly up to day 2 • the cancerous cells increase rapidly from day 2 • the increase in the number of cancerous cells is greater (than the number of non-cancerous cells) **non-cancerous cells** • the number of non-cancerous cells increase slowly up to day 2 • the number of non-cancerous cells increase up to 340 (thousand cells) • the number of non-cancerous cells increase rapidly between day 2 and day 4 • the number of non-cancerous cells increase more slowly after day 4	for **3** marks reference to both cell types required. allow the number of non-cancerous cells remains constant up to day 2 if no other marks awarded allow **for 1** mark: number of (cancerous / non-cancerous) cells increase **or** there is a positive correlation	3	AO3 4.1.3.4 4.3.2.7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.7	acceptable extrapolation correct value from extrapolation	 if no extrapolation allow value in range 380 to 400 (thousand) allow a tolerance of +/- ½ a small square	1 1	AO3 4.3.2.7

Total Question 6	**12**

Question 7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.1	$\frac{28.6}{4.4}$ = 6.5		1 1	AO2 4.1.3.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.2	any **four** from: (similarities) • cell **A** and cell **B** have cytoplasm • cell **A** and cell **B** have a cell membrane (differences) • cell **A** has a cell wall • cell **A** does not have a nucleus • cell **A** has plasmids • cell **A** does not have mitochondria	for **4** marks reference to both similarities **and** differences is required allow bacterial cell for cell **A** allow liver cell for cell **B** ignore references to size / shape allow both cells have DNA allow both cells have ribosomes allow converse if clearly describing cell **B** allow cell **A** has DNA free in the cytoplasm allow cell **A** has a single strand of DNA allow description, such as (small) rings of DNA allow cell **A** does not have membrane-bound organelles if no other marks awarded allow for **1** mark cell **A** is a prokaryotic cell **and** cell **B** is a eukaryotic cell	4	AO2 4.1.3.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.3	any **one** from: • a group of the same / similar cells • a group of cells performing the same / similar function •	ignore a group of cells unqualified ignore examples of tissue functions ignore a group of cells working together	1	AO1 4.2.1.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.4	the sugar solution was less concentrated than inside the cell		1	AO3 4.1.3.3 RPA4

Question	Answers	Mark	AO/ Spec. Ref.
07.5	**Level 3**: The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.1.3.3 RPA4
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content method steps • use different concentrations of sugar solution • remove skin of potato • valid method of cutting potatoes • blot potato pieces to remove excess liquid (before measuring mass) • measure mass of potato pieces at start • place potato pieces in sugar solutions for a period of time • measure the mass of potato pieces after they have been in the sugar solution • calculate the change in the mass of the potato pieces • repeat experiment several times and calculate mean • calculate percentage change in mass control variables • use the same volume of different concentrations of sugar solution • cut same size / shape potato pieces such as using a cork borer • leave potato pieces in the sugar solution for a specific length of time • have solutions at the same temperature • same type / variety of potato For **Level 3** the independent variable, the dependent variable and control variable(s) must be considered		

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.6	all three data points plotted correctly smooth curve through all data points	allow a tolerance ± ½ a small square	1 1	AO2 4.1.3.3 RPA4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.7	correct reading consistent with their line	allow a tolerance ± ½ a small square if no line drawn allow 0.23 (mol/dm^3)	1	AO3 4.1.3.3 RPA4

Total Question 7	**17**

Question 8

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.1	the density of the liquids		1	AO2 4.1.1.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.2	any **one** from: • volume / depth of liquid • temperature of the liquid • the block used	 ignore shape of block	1	AO3 4.1.1.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.3	any **one** from: • difficult to line up ruler and wooden block • parallax error • block may move • refraction of light • liquid surface not level	ignore human error allow there is a gap between ruler and beaker / block allow description of eye position when reading ruler	1	AO3 4.1.1.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.4	the lower the density of the liquid the greater the distance between liquid surface and bottom of the block	allow the greater the density of the liquid the smaller the distance of the block below the surface	1	AO3 4.1.1.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.5	$\rho = \frac{m}{V}$		1	AO1 4.1.1.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.6	$0.85 = \frac{30.6}{\text{volume}}$ $\text{volume} = \frac{30.6}{0.85}$ 36 (cm^3)		1 1 1	AO2 4.1.1.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.7	the density decreases because the water particles / molecules are further apart	If incorrect box ticked no marks can be awarded	1 1	AO3 4.1.1.1 4.1.1.2

Total Question 8	**10**