GCSE
COMBINED SCIENCE: SYNERGY
8465/2H

Higher Tier Paper 2 Life and Environmental Sciences

Mark scheme

June 2021

Version: 1.0 Final Mark Scheme

2 1 6 G 8 4 6 5 / 2 H / 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 his or her judgement
- the Assessment Objectives, level of demand 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.

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**. Different terms in the mark scheme are shown by a / ; 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 planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, 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. Full marks can, however, be given for a correct numerical answer, without any working shown.

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

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **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.

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 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.

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.

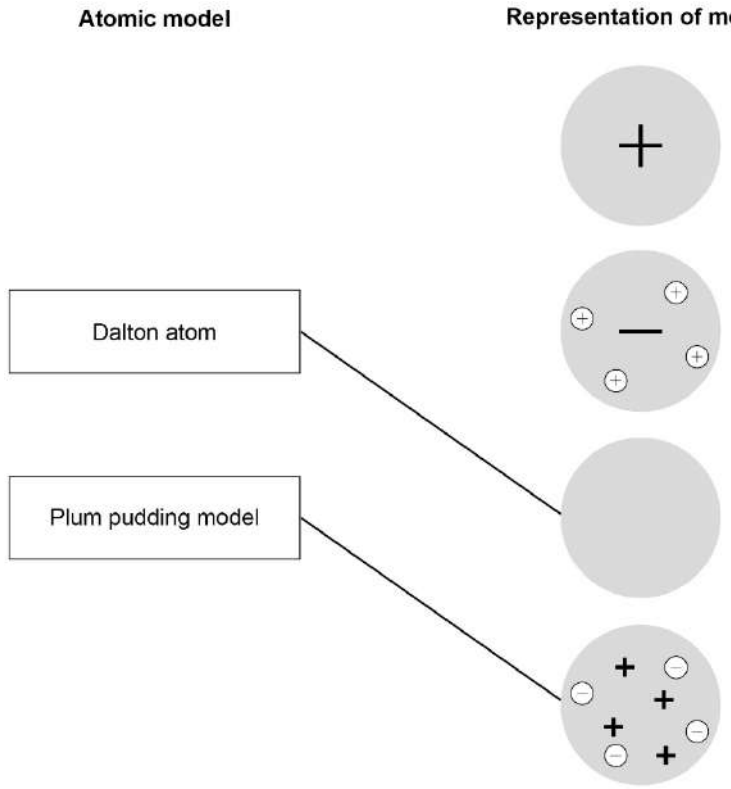
You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

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	 do **not** accept more than one line form a box on the left		1 1	AO1 AO2 4.1.2.1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.2	a helium nucleus		1	AO1 4.3.2.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.3	$\frac{8\ 288\ 000}{700}$ **or** 8 288 000 : 700 11 840 (:1)		1 1	AO2 4.1.2.1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.4	most of the (alpha) particles pass straight through	allow most of the (alpha) particles are **not** deflected / repelled / bounced back	1	AO3 4.1.2.1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.5	some of the (alpha) particles bounce back **or** some of the (alpha) particles are deflected		1	AO1
	(because the charged) alpha particles were repelled (by the charged nucleus)		1	AO2 4.1.2.1 4.3.2.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.6	79 protons **and** 79 electrons		1	AO2
	118 neutrons		1	AO2
	protons in the nucleus		1	AO1
	neutrons in the nucleus		1	AO1
	electrons are arranged in energy levels (around the nucleus)	allow electrons are arranged in shells (around the nucleus)	1	AO1 4.1.2.3 4.1.2.4 4.1.2.5

Total Question 1		**13**

Question 2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.1	microorganisms that cause disease	allow microbes / bacteria / virus / fungi that cause disease	1	AO1 4.3.1.1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.2	**A**		1	AO3 4.3.3.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.3	**D**	no marks if **D** not chosen	1	AO3 4.3.3.6
	(very) small percentage of resistant bacteria	allow little / least increase in bacterial resistance do **not** accept small percentage of antibiotic are resistant	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.4	$\frac{297}{55\,000\,000}$ **or** 0.0000054 **or** 5.4×10^{-6} $\left(\frac{297}{55\,000\,000}\right) \times 100\,000$ **or** $0.0000054 \times 100\,000$ **or** $5.4 \times 10^{-6} \times 100\,000$ = 0.54	alternative method $\frac{55\,000\,000}{100\,000}$ (1) $\frac{297}{550}$ (1) = 0.54 (1)	1 1 1	AO2 4.3.3.6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.5	any **one** from: • use of different / new antibiotics • reduction in use of methicillin • increase in staff disinfecting / washing hands between every patient • making visitors wash / disinfect hands • isolating patients with MRSA • testing patients for MRSA before entering hospital • increased use of protective clothing / gloves	ignore reference to hygiene unqualified allow use of PPE	1	AO3 4.3.3.6 4.3.3.1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.6	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form 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 **how a vaccine works:** • vaccine would contain a weak / dead form of bacteria / microorganism / microbe / MRSA • reference to immune system / white blood cells • vaccine stimulates white blood cells • reference to antibodies • white blood cells produce antibodies • (antibodies) specific to MRSA / microorganism / microbe / bacteria **when MRSA bacteria enter the body (immunity):** • reference to more rapid response if pathogen re-enters • reference to memory cells • reference to production of specific antibodies • (white blood cells produce) antibodies quicker / immediately • (white blood cells produce) more antibodies • (so) will kill bacteria immediately • person will not develop disease / MRSA For **level 3** there must be reference to MRSA and immunity			4.3.3.5

Total Question 2		**14**

Question 3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.1	any **one** from: • as bottle sizes may be different • so that the (nutritional information) can be compared		1	AO3 4.2.1.5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.2	cow highest mass / proportion of fat	no marks if cow not chosen allow most fat allow highest amount of fat and sugar ignore references to protein do **not** accept highest mass / proportion of carbohydrate	1 1	AO3 AO2 4.2.1.5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.3	(oat milk and soy milk) contained starch (but) in cow and almond milk all the carbohydrate is sugar (so there is no starch present)	allow cow and almond milk do not contain starch	1 1	AO2 AO3 4.2.1.5 RPA7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.4	any **one** from: • time the test tubes in the water bath • the concentration of Benedict's solution		1	AO1 4.2.1.5 RPA7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.5	the colour change (of the mixture)	allow the colour (of the mixture) at the end of the test	1	AO1 4.2.1.5 RPA7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.6	2 cm^3 of Benedict's solution **and** 2 cm^3 of water		1	AO1 4.2.1.5 RPA7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.7	(fat is broken down by the enzyme) lipase (to break fats down into) fatty acids **and** glycerol	 allow bile emulsifies fats to increase surface area (for lipase)	1 1	AO1 4.2.1.5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.8	(to form) small / soluble molecules (so they can be) absorbed into the blood	 allow absorbed through gut wall allow a description of absorption allow fat molecules are too large to be absorbed into the blood for **2** marks	1 1	AO1 4.2.1.5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.9	the liver breaks down the amino acids into urea (which is) carried in the blood to kidneys where it is excreted in the urine		1 1	AO1 4.2.1.5

Total Question 3		**14**

Question 4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.1	mitochondria / mitochondrion		1	AO1 4.1.3.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.2	there is a higher concentration (in the cytoplasm / cell) than inside structure **A**	allow there is a higher concentration (of oxygen) outside structure **A** allow (oxygen moves) from a higher concentration (in the cytoplasm / cell) to a lower concentration (in structure **A**) allow oxygen moves down a concentration gradient (from the cytoplasm / cell) into structure **A** ignore oxygen moves along a concentration gradient	1	AO2 4.1.3.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.3	an increase in the thickness of the exchange surface		1	AO1 4.1.3.3 4.2.1.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.4	both use glucose (as a substrate)	ignore references to oxygen	1	AO1 4.2.1.1
	aerobic (respiration) produces carbon dioxide and water (vapour) **and** anaerobic (respiration) produces lactic acid		1	
	both are exothermic reactions **or** both transfer / release energy	do **not** accept produce / make / create energy	1	
	aerobic (respiration) releases / transfers a larger amount of energy (respiration) than anaerobic (respiration)	allow anaerobic (respiration) releases / transfers a smaller amount of energy than aerobic (respiration) allow aerobic (respiration) involves the mitochondria but anaerobic (respiration) takes place in the cytoplasm	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.5	pulmonary vein		1	AO1 4.2.1.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.6		allow converse if clearly describing left ventricle ignore reference to pressure		AO2 4.2.1.3
	there is a lower concentration of oxygen (in right ventricle) **or** there is a higher concentration of carbon dioxide (in right ventricle)	do **not** accept blood is not oxygenated do **not** accept blood has no oxygen	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.7	because it needs to pump blood a greater distance **or** because it needs to pump blood with greater force	allow because it needs to pump blood around the whole body	1	AO3 4.2.1.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.8	< 25		1	AO3 4.2.1.3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.9	some blood will go directly to the body without going to the lungs		1	AO3
	(so) the blood going to the body cells will not have as much oxygen	allow (so) oxygenated and deoxygenated blood will mix	1	AO2
	(so) lower / reduced rate of respiration	do **not** accept no respiration	1	AO2
	(so) less energy transferred / released	do **not** accept produce / make / create energy	1	AO2 4.2.1.3 4.2.1.1

Total Question 4		**15**

Question 5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.1	smooth line through all points except that at 15 kJ		1	AO3 4.1.1.4 RPA2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.2	as the energy transfer to the heater increases the temperature (of the copper) increases		1	AO3 4.1.1.4 RPA2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.3	not all of the energy provided increases the temperature of the copper block (because) some energy is transferred to the surroundings		1 1	AO2 AO3 4.1.1.4 RPA2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.4	heat sink **D** is (matt) black heat sink **D** has a large(r) surface area **D** emits infrared radiation at the greatest rate **or** **D** emits most infrared radiation in a given time	 allow thermal energy for infrared radiation	1 1 1	AO3 AO2 AO3 4.1.1.4 4.1.4.3 4.2.1.2 RPA6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.5	5.0 g = 0.0050 kg		1	AO2 4.1.1.4
	89 = 0.0050 × 386 × ∆θ	allow correct substitution of incorrectly / not converted value of mass	1	RPA2
	$\Delta\theta = \frac{89}{0.0050 \times 386}$		1	
	∆θ = 46 (°C)		1	
	final temperature = 66 (°C)	allow correct calculation using incorrectly / not converted value of mass	1	

Total Question 5		**12**

Question 6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.1	platelets		1	AO1 4.2.1.4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.2	increase in time taken for blood to clot	allow decrease in clotting of the blood allow blood will not be able to clot allow blood does not stop flowing out of cuts	1	AO2 4.2.1.4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.3	5.1×10^9 per cm^3 $= 5.1 \times 10^{12}$ per dm^3 **or** 4.25 dm^3 = 4250 cm^3		1	AO2 4.2.1.4
	$5.1 \times 10^{12} \times 4.25$ $= 2.1675 \times 10^{13}$ **or** $4250 \times 5.1 \times 10^9$ $= 2.1675 \times 10^{13}$	allow correct calculation using incorrectly / not converted value from step 1	1	
	$\frac{2.0 \times 10^{11}}{2.1675 \times 10^{13}} \times 100$		1	
	= 0.92…(%)		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.4		ignore nucleus		
	(red blood cells) do **not** have chromosomes	allow (red blood cells) do **not** have DNA / genes allow (red blood cells) do **not** have genetic material	1	AO2
	(so chromosomes) cannot replicate and separate into two new cells		1	AO3 4.2.1.4 4.1.3.4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.5	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.		5−6	AO3 4.2.1.4 4.3.3.9
	Level 2: Some logically linked reasons 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 (allow converse points if clearly referring to red blood cells from stem cells) Blood donations **advantages** • it is an easier / quicker process • blood can be donated / collected regularly so good supply • blood available for emergencies / immediately • can store blood longer than it takes to make (red) blood cells using stem cells • the components of the blood can be used for different treatments • the components of the blood can be used to treat more people / different people • known to work / tested treatment • free / inexpensive **disadvantages** • relies on volunteers / donors • inconvenience / discomfort for donors • may not have enough blood / a regular supply of blood • may not have enough of the right blood component • blood may be wasted / not needed • risk of infection from donated blood • not patient's own cells so may be rejected For **level 3** advantages and disadvantages supported by own knowledge			

Total Question 6		**14**

Question 7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.1	(at 20 cm) light intensity ∝ 0.0025 **or** 2.5×10^{-3}		1	AO2
	(at 40 cm) light intensity ∝ 0.000625 **or** 6.25×10^{-4}		1	AO2
	increasing the distance by a factor of 2, causes a decrease in the light intensity by a factor of 4	allow doubling the distance causes the light intensity to be divided by 4 allow doubling the distance quarters light intensity	1	AO3 4.2.2.6 RPA10

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.2	(pH of the water became) more alkaline	allow pH of the water increased ignore pH became less acidic	1	AO3
	(because algal cells) used carbon dioxide (from the solution) for photosynthesis		1	AO2
	as the distance increases the (change in) rate of photosynthesis decreases	allow as the light intensity decreases the (change in) rate of photosynthesis decreases	1	AO3
	as the distance increases the rate of change in pH decreases	allow as the light intensity decreases the rate of change in pH decreases	1	AO3 4.2.2.5 4.2.2.6 RPA10

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.3	$6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$	allow **1** mark for correct formulae right-hand side allow **1** mark for correct formulae left-hand side allow **1** mark for correct balancing if all formulae correct	3	AO1 AO2 4.2.2.5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.4	glucose is converted into amino acids (amino acids) used in protein synthesis **or** glucose is used in respiration to provide energy (1) (for) synthesis of / protein / amino acids / cellulose (1) **or** glucose is used to make cellulose (1) (which can be) used to make cell walls (1)	allow used to produce proteins do **not** accept produce / make / create energy	1 1	AO1 4.2.1.5 4.2.2.5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.5	any **one** from: • provides protection from consumers • provides supply of carbon dioxide • provides supply of amino acids / nitrates	allow other useful molecules which could diffuse	1	AO3 4.2.2.5 4.4.2.2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.6	any **one** from: • they cannot gain enough glucose • they cannot gain enough oxygen	allow the algae provided extra glucose allow the algae provided extra oxygen do **not** accept the coral does not have any glucose / oxygen	1	AO3 4.2.2.5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.7	decrease in light intensity	allow no light allow decrease in light	1	AO3
	(so) rate of photosynthesis decreases meaning less oxygen produced	allow (so) of photosynthesis stops meaning no oxygen produced	1	AO2
	(and) oxygen is being used in respiration by algae / coral		1	AO2 4.2.2.5 4.2.2.6 4.2.1.1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.8	the rate of photosynthesis is equal to the rate of respiration		1	AO3 4.2.2.5 4.2.2.6 4.2.1.1

Total Question 7		**18**