AQA GCSE Biology | 8461

SPECIFICATION POINT 4.7.2.2

# How materials are cycled

## Mark schemes and examiner comments

| | |
|---|---|
| Tier | **Higher** |
| Question groups | **8** |
| Available paper years | **2010–2023** |

## Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

**Name:** _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

### 4.7.2.2 How materials are cycled

**Answer 01 · Mark scheme** January 2010 | BLY2H | Original Q1 | Legacy

## Question 1

| question | answers | extra information | mark |
|---|---|---|---|
| **1**(a) | three layer triangular pyramid<br><br>soya / beans / food – trout / fish – people / human (in sequence) | either way up (as blocks or triangle)<br><br>ignore reference to producers / herbivores / consumers<br><br>award **1** mark only for a correct food chain with 2 correct arrows showing energy flow | 1<br><br>1 |
| **1**(b) | The trout release energy when they respire<br><br>Some energy will be lost in waste from the trout | | 1<br><br>1 |
| **1**(c) | any **one** from eg<br>• easy / easier to catch / more caught<br>• easy / easier to feed<br>• no / less predation<br>• less energy loss<br>• less movement | <br>allow easy / easier to monitor<br><br>allow control food<br>allow less fishing / poaching<br>allow grow faster<br>ignore less space to move<br><br>do **not** allow easier to farm | 1 |
| **1**(d) | any **two** from:<br>• microorganisms / bacteria / decomposers / microbes / fungi / detritus feeders<br>• decay / rot / decompose / digest / break down<br>• (microorganisms) respire<br>• turned into fossil fuels / named fossil fuels<br>• carbon dioxide / $CO_2$ released | <br><br>ignore biodegrade<br><br>do **not** award this mark if response implies the trout respire | 2 |
| **Total** | | | **7** |

### 4.7.2.2 How materials are cycled

**Answer 01 · Mark scheme**

January 2010 | BLY2H | Original Q1 | Legacy

**BLY2H**

4.7.2.2 How materials are cycled

Answer 02 · Mark scheme

June 2010 | BLY2H | Original Q3 | Legacy

## Question 3

| question | answers | extra information | mark |
|---|---|---|---|
| **3**(a) | B and D | both required in any order | 1 |
| **3**(b) | any **two** from:<br>• carbohydrate / named example<br>• protein / enzyme<br>• amino acid<br>• hormone / named plant hormone<br>• lipid / fat / oil / wax<br>• chlorophyll<br>• DNA<br>• vitamin(s) | do **not** accept compounds restricted to animals<br>allow **2** marks for 2 named examples<br>do **not** allow a general name and a named example for **2** marks (eg award **1** mark only for carbohydrate and starch)<br>allow **2** marks for 2 named examples | 2 |
| **3**(c) | contains minerals / salts / ions / nutrients / named<br>(needed by plants) for health / better growth | ignore 'food'<br>do **not** allow vitamins / glucose / energy etc<br>for / help plant growth is insufficient<br>ignore moisture retention / soil structure<br>ignore more plants<br>allow examples linked to mineral eg contains magnesium to make chlorophyll for **2** marks | 1<br>1 |
| **Total** | | | **5** |

### 4.7.2.2 How materials are cycled

**Answer 02 · Mark scheme**

June 2010 | BLY2H | Original Q3 | Legacy

**BLY 2H**

4.7.2.2 How materials are cycled

Answer 03 · Mark scheme

January 2012 | BL1HP | Original Q3 | Legacy

## Question 3

| question | answers | extra information | mark |
|---|---|---|---|
| 3(a)(i) | triangular pyramid with 3 layers | may be as blocks or as triangle<br>ignore food chains and arrows | 1 |
| | layers appropriately labelled:<br>bean / plant<br>aphid,<br>ladybird | labelled in food chain order must **not** contradict correct pyramid<br><br>allow correctly labelled inverted pyramid for **2** marks | 1 |
| 3(a)(ii) | any **two** from:<br>(for aphid / ladybird)<br>• not all digested / faeces<br>• loss in urine<br>• loss of $CO_2$<br>• not all eaten | ignore energy<br><br>ignore loss of $CO_2$ from bean plant<br><br>if none of first 3 points given then allow waste (materials) / excretion for **1** mark | 2 |
| 3(b) | microorganisms / microbes / bacteria / fungi / decomposers / detritivores / named | do **not** accept germs<br>allow mould<br>ignore aphids | 1 |
| | decay / breakdown / digest / decompose / rot (bean plant) | ignore eat | 1 |
| | respiration (of microorganisms etc / aphids) | allow burning / combustion | 1 |
| | carbon dioxide released (from respiration of microorganisms etc / aphids) | allow carbon dioxide released / produced (from burning / combustion)<br><br>ignore other parts of the carbon cycle<br>ignore formation of fossil fuels | 1 |
| **Total** | | | **8** |

### 4.7.2.2 How materials are cycled

**Answer 03 · Mark scheme**

January 2012 | BL1HP | Original Q3 | Legacy

**COMPONENT NUMBER: BL1HP**

4.7.2.2 How materials are cycled

Answer 04 · Mark scheme

June 2012 | BL1HP | Original Q2 | Legacy

## Question 2

| question | answers | extra information | mark |
|---|---|---|---|
| 2 (a) | **X** respiration<br><br>**Y** combustion / burning | correct order only<br>allow decay / decomposition / rotting<br>ignore breakdown / disintegrate | 1<br><br>1 |
| 2 (b) | any **three** from:<br>• photosynthesise / absorb carbon dioxide<br>• release carbon dioxide / respire<br>• eaten by animals<br>• fed on / decayed by microorganisms | <br>accept are producers **or** produce / make biomass / glucose / other named<br>do **not** accept photosynthesis releases $CO_2$<br><br><br>ignore eaten by microorganisms | 3 |
| 2 (c) | any **two** from:<br>(in tropical rainforest conditions are)<br>• warm(er) / hot<br>• damp / moist / wet / humid<br>• a lot of microorganisms<br>• a lot of material to decay | <br><br><br>ignore rain<br><br><br>allow warm(er) so enzymes work faster for **2** marks | 2 |
| **Total** | | | **7** |

### 4.7.2.2 How materials are cycled

**Answer 04 · Mark scheme**

June 2012 | BL1HP | Original Q2 | Legacy

**BL1HP**

4.7.2.2 How materials are cycled

Answer 05 · Mark scheme

June 2013 | BL1HP | Original Q3 | Legacy

## Question 3

| question | Answers | extra information | Mark |
|---|---|---|---|
| 3 | Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5. | | 6 |

| 0 marks | Level 1 (1-2 marks) | Level 2 (3-4 marks) | Level 3 (5-6 marks) |
|---|---|---|---|
| No relevant content. | For at least one process **either** the organism that carries it out **or** the carbon compound used **or** the carbon compound produced is described<br>**or**<br>for at least one organism **either** the carbon compound it uses **or** the carbon compound it produces is described<br>**or**<br>at least one process is named | For some processes (at least one of which is named) **either** the organisms involved **or** the carbon compounds used **or** the carbon compounds produced are described | For at least one named process an organism **and** either the carbon compound used for the process **or** the carbon compound produced by the process are described<br>**and**<br>for other processes (at least one of which is named) **either** the organism **or** the carbon compounds used **or** the carbon compounds produced are described (as in Level 2) |

**examples of biology points made in the response:**

- (green) plants photosynthesise
- photosynthesis takes in carbon dioxide
- (green) plants use carbon to make carbohydrate / protein / fat / organic compounds / named (e.g. enzymes / cellulose)
- animals eat (green) plants (and other animals)
- (green) plants respire
- animals respire
- respiration releases carbon dioxide
- (green) plants and animals die
- microorganisms decay / decompose / rot / break down / feed on dead organisms
- microorganisms respire

| Total | | | 6 |
|---|---|---|---|

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Answer 06 · Mark scheme

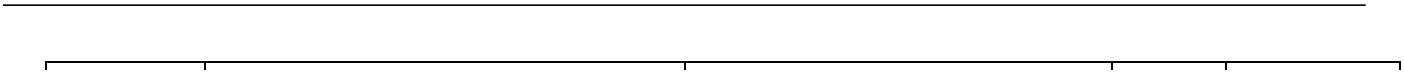
June 2017 | BL1HP | Original Q4 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 4 | any **four** from:<br>(living plants)<br>• take in carbon dioxide<br>• ($CO_2$ taken in) for photosynthesis<br>• (use carbon to make) carbohydrate / fat / protein<br>• (plants) respire<br>• (plant respiration) releases carbon dioxide<br>• store / 'lock up' / sequester carbon<br>• (provide) food for animals | ignore other parts of the carbon cycle eg decay<br>allow examples<br>ignore respiration of animals<br>do **not** allow store carbon dioxide<br>ignore combustion<br>ignore other references to animals / microorganisms | 4 | AO1<br>1.5.1a<br>1.6.2a |
| **Total** | | | **4** | |

### 4.7.2.2 How materials are cycled

**Answer 06 · Mark scheme**

June 2017 | BL1HP | Original Q4 | Legacy



Answer 07 · Mark scheme

June 2022 | 8461/2H | Original Q6

## Question 6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.1** | evaporation | allow vaporisation | 1 | AO1<br>4.7.2.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.2** | osmosis | allow diffusion<br>ignore absorption | 1 | AO1<br>4.7.2.2<br>4.2.3.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.3** | any **two** from:<br><br>• photosynthesis<br>• support<br><br><br><br>• (solvent for) transport<br>**or**<br>translocation<br>**or**<br>for the transpiration <u>stream</u> | <br><br><br>allow turgor<br>allow to fill vacuole<br>allow opening of stomata<br>allow to prevent wilting<br><br>allow (as a) solvent<br><br><br><br>allow (as a) medium for chemical reactions<br>allow hydrolysis / digestion / breakdown of stored food<br><br>allow cooling<br>allow making cytoplasm | 2 | AO1<br>4.7<br>4.7.2.2<br>4.1.1.2<br>4.2.3.2<br>4.4.1.1<br>4.4.2.3 |

4.7.2.2 How materials are cycled

Answer 07 · Mark scheme

June 2022 | 8461/2H | Original Q6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.4 | *substitution*<br><br>$\frac{21\,800}{1\,700\,000} \times 100$<br><br>1.282(3529)<br><br>*comparative efficiency*<br>$\frac{4.098}{1.282}$<br><br>3.196.....<br><br>*significant figures*<br>3.20 | <br><br><br>allow 1.28 **or** 1.3<br><br><br>allow an incorrectly calculated value for efficiency correctly substituted<br><br><br>do **not** accept 3.2<br>do **not** accept if a unit is given | <br><br>1<br><br>1<br><br>1<br><br>1<br><br>1 | <br>AO2<br>4.7.2.1<br>4.7.4.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.5 | less energy lost as heat<br><br><br><br><br>less energy lost in movement | allow less heat lost<br>allow less energy lost keeping warm<br>**or** less energy for maintaining body temperature<br><br>ignore less movement<br><br>ignore less energy lost unqualified<br>ignore controlling diet<br><br>do **not** accept energy used for respiration<br>do **not** accept energy produced / made / created | 1<br><br><br><br><br>1 | AO1<br>4.7.4.3<br>4.7.5.2 |

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Answer 07 · Mark scheme

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| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.6 | any **two** from:<br><br>• increased spread of disease<br>**or**<br>increased use of drugs / antibiotics (to reduce disease)<br>• more antibiotics in meat / milk<br>• (extra) cost of heating / lighting / food / drugs<br><br>• aggressive behaviour (causing harm)<br>**or**<br>'emotional' stress reduces productivity | allow diseases spread (more) easily<br><br>allow (extra) energy used for heating / lighting<br>ignore (extra) cost unqualified<br><br>ignore cruelty / unethical<br>ignore need to clean out barns / sheds<br>ignore need to maintain / build barns | 2 | AO3<br>4.7.5.1<br>4.7.5.2 |

| Total Question 6 | | 13 |
|---|---|---|

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Answer 08 · Mark scheme

June 2023 | 8461/2H | Original Q4

## Question 4

| Question | Answers | Mark | AO / Spec. Ref. |
|---|---|---|---|
| 04.1 | **Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account. | 4–6 | AO1<br>4.7.2.1<br>4.7.2.2<br>4.2.3.2<br>4.4.1.1<br>4.4.1.3<br>4.4.2.1 |
| | **Level 1:** Facts, events or processes are identified and simply stated but their relevance is not clear. | 1–3 | |
| | **No relevant content** | 0 | |
| | **Indicative content**<br>• microorganisms / bacteria / fungi (cause decay)<br>• (named) enzyme used in decay / digestion<br>• digestion **or** large molecules to small molecules<br><br>• respiration by microorganisms<br>• production / release of carbon dioxide<br>• carbon dioxide is released into the air<br><br>• carbon dioxide taken in by stomata / leaves<br>• carbon dioxide used in photosynthesis<br>• making glucose / sugar / starch / cellulose / other named example<br><br>• release of nitrate (ions) into the soil<br>• nitrate (ions) taken in (by roots)<br>• nitrate (ions) taken in by active transport<br>• nitrate (ions) for making amino acids / proteins / DNA / other named example<br><br>For **Level 2**, the response needs to refer to both breakdown and use of nitrogen and carbon compounds | | |

4.7.2.2 How materials are cycled

Answer 08 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec Ref. |
|---|---|---|---|---|
| 04.2 | any **one** from:<br>• use more temperatures<br>• measure pH at smaller time intervals<br>• use a data logger (for continuous monitoring)<br>• measure pH at same time of day<br>• same type of milk<br>• repeat (at each temperature) and calculate a mean **or** repeat (at each temperature) and eliminate anomalies<br>• cover / uncover all beakers | allow example, such as same fat content of milk<br>ignore same pH probe / meter<br>ignore extend beyond 4 days<br>ignore age of milk | 1 | AO3<br>4.7.2.3<br>RPA10 |

| Question | Answers | Extra information | Mark | AO / Spec Ref. |
|---|---|---|---|---|
| 04.3 | points for days 1, 2 and 3 correctly plotted | allow a tolerance of ± ½ small square<br>allow 2 correct plots from days 1, 2 and 3 for **1** mark<br>do **not** accept an incorrect plot for day 0 / 4 | 2 | AO2<br>4.7.2.3<br>RPA10 |
| | correct curved line of best fit | ignore line joined point to point with straight lines<br>ignore extrapolation<br>do **not** accept a single straight line | 1 | |

Answer 08 · Mark scheme

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| Question | Answers | Extra information | Mark | AO / Spec Ref. |
|---|---|---|---|---|
| 04.4 | tangent drawn to the 15 °C curve at 2 days | do **not** accept if there is an incorrect tangent at 2 days | 1 | AO2<br>4.7.2.3<br>RPA10 |
| | $\frac{6.5 - 4.5}{4}$ | allow a tolerance of ± ½ small square | 1 | |
| | 0.5 | | 1 | |
| | $\frac{0.5}{0.3} = 1.67$ | allow any number of decimal places<br>allow answer to student's incorrectly calculated rate divided by 0.3<br>do **not** accept if a unit is given | 1 | |

| Question | Answers | Extra information | Mark | AO / Spec Ref. |
|---|---|---|---|---|
| 04.5 | enzymes more active<br>**or** more bacteria produced | allow enzymes work more quickly<br>ignore enzymes work better | 1 | AO2 |
| | lipids broken down more quickly | allow fats broken down more quickly | 1 | AO2 |
| | <u>fatty acids</u> produced more quickly (which changes pH) | ignore glycerol<br>do **not** accept incorrect products of lipid breakdown, eg amino acids or glycogen<br><br>**alternative route**<br>allow more (kinetic) energy (at higher temperature) (1)<br>molecules move faster<br>**or** more (successful) collisions<br>**or** lipids broken down more quickly (1)<br><u>fatty acids</u> produced more quickly (which changes pH) (1) | 1 | AO1<br><br>4.2.2.1<br>4.7.2.3<br>RPA10 |

| Total Question 4 | 17 |
|---|---|

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**Question 6**

This question was about the water cycle and the efficiency of energy transfer in a simple food chain.

**06.1** Process **X** in **Figure 6** was successfully identified as *evaporation* by the vast majority.

**06.2** Only around half knew that plant roots absorb water by *osmosis*, or by *diffusion*.

**06.3** Although most could give at least one use of water to a plant, such as photosynthesis, support or for transport, only around a quarter could give two uses.

**06.4** In this question, students were given an equation for energy conversion efficiency and had to select data from the food chain in **Figure 7** to calculate how many more times efficient the cow was at converting energy (given as 4.098%) than the grass it ate. Around 60 percent of students were completely successful and scored all 5 marks. The most common errors were to calculate the reciprocal of the comparative efficiency and not to

Answer 07 · Examiner comments — June 2022 | 8461/2H | Original Q6

round the answer to 3 significant figures correctly – i.e. 3.196... to 3 significant figures is 3.20, not 3.2, nor 3.19.

**06.5** Reasons for the greater energy efficiency of raising cows indoors were often expressed inadequately. Many failed to explain that less energy would be *lost* as heat and *lost* in movement indoors compared with outdoors. Thus fewer than half scored any marks.

**06.6** Disadvantages of raising cattle indoors were not well known with only a little over a third having any correct ideas, such as the increased spread of disease, extra costs of heating / lighting / supplying food and potentially aggressive behaviour of the animals in confined conditions resulting in harm to each other. Inadequate answers referred to 'cruelty' or to unqualified extra costs, and the unexpected idea that the grass would not grow so well indoors.

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## Question 4

This question was about decay – both in the natural environment and in a laboratory investigation.

04.1 This was an extended response style of question about the recycling of the elements carbon and nitrogen in tree leaves that fall in the autumn.
High-level answers had to include the role of microorganisms, the release of carbon dioxide, the use of carbon dioxide by trees in photosynthesis and the release and use of nitrate ions for making a named organic nitrogen-containing compound in the trees.
Further details, such as the enzyme-catalysed digestion of compounds in the leaves by the microorganisms, the production of carbon dioxide by their respiration, the use of carbon dioxide by trees to make glucose / starch / cellulose (or other organic substance), the uptake of nitrate via the roots of trees using active transport, were also rewarded. Very few students (only 1 in 20) scored all of the 6 marks available and only a quarter gained half-marks. Many just wrote about 'carbon' (rather than carbon dioxide) and about 'nitrogen' (rather than nitrates) which impeded their ability to score marks.

04.2 Given the results in Table 1 which showed daily recordings of the pH of milk samples at three different temperatures over 4 days, students were required to suggest an improvement to the method of the investigation. Appropriate answers included measuring the pH values at shorter time intervals, the use of more than the three given temperatures, doing repeats at each temperature and calculating means at each time interval. However, only half of the students gave such answers; a common inadequate answer was 'do repeats' with no mention of calculating mean values.

04.3 In this question, students had to plot the data for the pH values obtained at 25 °C on the graph in Figure 6. Just over half scored all 3 marks. There were many errors in plotting points, for example the plotting of values 4.9 and 4.8 as, respectively, 1 small square below 5 and 2 small squares below 5 (the actual scale was 2 small squares for 0.1 units). Some failed to gain marks for plotting as they may have used dots instead of crosses but the dots were then obscured by the line drawn on top of them. Some drew straight lines, point-to-point, instead of following the instruction 'draw a line of best fit', and some drew sketchy lines.

04.4 This was a 4-mark calculation to compare two rates of reaction. Students were instructed to draw a tangent to the 15 °C line at 2 days. Some did not draw a tangent; others drew one that spanned just 1 or 2 cm each way rather than extending to each axis which would, conveniently, have met the y-axis at 6.5 and the x-axis at 4.0, giving a gradient of

$$\frac{6.5-4.5}{4} = 0.5$$

This then had to be divided by the gradient for 5 °C, given as 0.3 in the question, producing a final answer of 1.67 times faster.
Some missed the value 0.3 given in the question and calculated it for themselves. Others subtracted 0.3 from their calculated gradient for 15 °C. There were also errors in reading values from the graph and in forgetting to subtract the lower y-axis value from the higher one. A little over one-third scored full marks.

04.5 An explanation was required for why the pH changed more quickly at 15 °C than at 5 °C. The graph (and data in Table 1) showed quite clearly that the pH decreased with time, but some students wrote about an increase in pH. Some thought that enzymes denatured at 15

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°C, although how that would make the reaction faster was unclear. Although some understood that a decrease in pH must have been caused by acid production, very few thought that fatty acids would have been produced by the breakdown of lipids in the milk (‘amino acids’ being a more common answer). Only 1 in 6 students scored all 3 marks with just under a half scoring at least 2.