AQA GCSE Biology | 8461

SPECIFICATION POINT 4.7.4.2

Pyramids of biomass

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**11**
Available paper years	**2009–2024**

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.

4.7.4.2 Pyramids of biomass

Answer 01 · Mark scheme

January 2009 | BLY2H | Original Q1 | Legacy

question	answers	extra information	mark
1(a)	the sun / light / sunshine / solar	allow radiation from the sun ignore photosynthesis / respiration apply list principle do **not** allow water / minerals / heat	1
1(b)	2.5 (:1)	correct answer with or without working ignore rounding with correct working do **not** allow other equivalent ratios for both marks evidence of selection of 10(insects) **and** 4(frogs) **or** 50 **and** 20 **or** 1 **and** 0.4 for **1** mark if no other working allow **1** mark for 0.4:(1) on answer line	2
1(c)	any **two** from: • some parts indigestible / faeces • waste / examples of waste eg urea / nitrogenous compounds / urine / excretion • movement / eg of movement • heat • not all eaten / eg of not all eaten • respiration	allow for insects **or** frogs allow energy for biomass allow keeping warm do not accept energy for respiration	2

Question 1 continued on next page…

4.7.4.2 Pyramids of biomass

COMPONENT NUMBER: BLY2H

COMPONENT NAME: Additional Science / Biology

STATUS: Final

DATE: January 2009

Question 1 continued…

question	answers	extra information	mark
1(d)	any **four** from: • (bodies) consumed by animals / named / scavengers / detritus feeders • microorganisms / bacteria / fungi / decomposers • reference to enzymes • decay / <u>breakdown</u> / decompose / rot • respiration • carbon dioxide produced • photosynthesis • sugar / glucose produced • fossilisation / fossil fuels / named • combustion / burning • (burning) produces carbon dioxide	ignore digest(ion) accept other organic molecules must be linked with fossilisation / fossil fuels allow carbon dioxide produced once only	4
Total			**9**

4.7.4.2 Pyramids of biomass

Answer 01 · Mark scheme

January 2009 | BLY2H | Original Q1 | Legacy

COMPONENT NUMBER: BLY2H

COMPONENT NAME: Additional Science / Biology

STATUS: Final

DATE: January 2009

4.7.4.2 Pyramids of biomass

Answer 02 · Mark scheme January 2010 | BLY2H | Original Q1 | Legacy

Question 1

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

4.7.4.2 Pyramids of biomass

Answer 02 · Mark scheme

January 2010 | BLY2H | Original Q1 | Legacy

BLY2H

4.7.4.2 Pyramids of biomass

Answer 03 · Mark scheme

January 2011 | BLY2H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)(i)	6000	award **2** marks for correct answer irrespective of working allow **1** mark for 20 x 300 with incorrect or no answer allow answer in table if answer line blank	2
2(a)(ii)	bar width 6000 **or** to match answer to (a)(i) drawn below slugs	anywhere on scale ignore depth / height of bar label **not** required	1 1
2(b)	any **three** from: • respiration (by hedgehog) • (results in) loss of CO_2 • faeces (of hedgehog) **or** not digested • excreted / urine / urea (by hedgehog) • not all slug(s) are eaten (by hedgehogs) **or** some slugs eaten by other things	ignore reference to size / mass / number of organisms assume reference is to / of hedgehog unless stated otherwise do **not** accept idea that respiration uses / produces energy accept waste for **1** mark if neither faeces nor excretion point made ignore sweat alone ignore some slugs die ignore reference to movement / heat / growth allow references to energy losses by these methods, rather than biomass losses	3
Total			**7**

4.7.4.2 Pyramids of biomass

Answer 03 · Mark scheme

January 2011 | BLY2H | Original Q2 | Legacy

BLY2H

4.7.4.2 Pyramids of biomass

Answer 04 · 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 ignore food chains and arrows	1
	layers appropriately labelled: bean / plant aphid, ladybird	labelled in food chain order must **not** contradict correct pyramid allow correctly labelled inverted pyramid for **2** marks	1
3(a)(ii)	any **two** from: (for aphid / ladybird) • not all digested / faeces • loss in urine • loss of CO_2 • not all eaten	ignore energy ignore loss of CO_2 from bean plant 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 allow mould 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) ignore other parts of the carbon cycle ignore formation of fossil fuels	1
Total			**8**

4.7.4.2 Pyramids of biomass

Answer 04 · Mark scheme

January 2012 | BL1HP | Original Q3 | Legacy

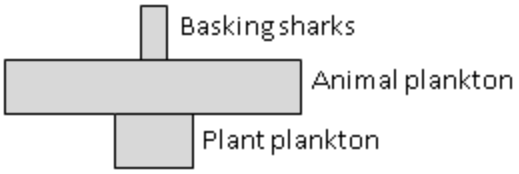
COMPONENT NUMBER: BL1HP

4.7.4.2 Pyramids of biomass

Answer 05 · Mark scheme

June 2013 | BL1HP | Original Q9 | Legacy

Question 9

question	Answers	extra information	mark
9(a)		if more than one box is ticked award no mark	1
9(b)	increasing / higher light / temperature more / increased photosynthesis	ignore references to months other than February – April do **not** accept mineral / ions increase for both marks there must be a reference to 'more' at least once (e.g. 'more light for photosynthesis' gains **2** marks) allow **1** mark for reference to light **and** photosynthesis without an idea of 'more'	1 1
9(c)	increase due to increase in plant plankton / food decrease due to fall in plant plankton / food **or** decrease as eaten by (basking) sharks	ignore references to months other than April – July allow decrease as eaten by predators / animals / fish	1 1
9(d)	 fall due to use / intake by <u>plant</u> (plankton) increase due to decay / decomposition / breakdown of dead (plant / animal) plankton	ignore ref to no change section of graph for fall allow March / April ignore May / February for increase allow any month in range August to November ignore December allow of dead organisms / waste	 1 1 1
Total			**8**

UMS Conversion Calculator: www.aqa.org.uk/umsconversion

4.7.4.2 Pyramids of biomass

Answer 06 · Mark scheme

Question	Answers	Extra information	Mark	AO / spec ref.
1(a)	3-layered triangular pyramid	as blocks or layered triangle, ignore (small) gaps between layers	1	AO2 1.5.1b
	(pyramid) labelled in food chain order	all three labels are required for **2** marks the pyramid must be fully correct	1	
1(b)(i)	C		1	AO3 1.5.1c
1(b)(ii)	shortest **or** fewest stages / transfers / (trophic) levels	allow only if (b)(i) is C or blank	1	AO1 / AO2 1.5.1c
	less losses in waste / faeces / urine / CO_2 / excretion	allow smaller amount uneaten	1	
	less loss in respiration / heat / movement	allow less lost keeping warm do **not** allow energy for respiration do **not** allow respiration makes energy	1	
		allow less loss (of biomass / energy) **or** less transfer (of biomass / energy) to surroundings if neither 2nd nor 3rd point given, for **1** mark		
Total			**6**	

4.7.4.2 Pyramids of biomass

Answer 06 · Mark scheme

June 2014 | BL1HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / spec ref.
2	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 and apply a 'best-fit' approach to the marking.		6	AO1 1.4.1d,f
0 marks	**Level 1 (1-2 marks)**	**Level 2 (3-4 marks)**	**Level 3 (5-6 marks)**	
No relevant content.	At least **one** way in which animals **and / or** plants are adapted to survive.	A description of ways in which animals **and / or** plants are adapted **and** an attempt to link at least **one** adaptation to how it increases the chance of survival.	A description of ways in which animals **and** plants are adapted **and** a description of how at least **one** adaptation increases the chance of survival.	
examples of biology points made in the response: (animals) • (A) change / decrease in surface area / example ○ (decrease in surface area which) reduces area from which sweat / water may be lost • (A) hump with fat / fat stores ○ (fat in hump) to convert to water (via respiration) • (A) long eyelashes ○ (long eyelashes) to keep (wind-blown) dust out of eyes • (A) nocturnal / 'keep out of the sun' ○ reduce sweat loss (in heat of the day) (plants) • (A) decrease in surface area • (A) leaves are spikes ○ (reduced area / leaves are spikes) reduces water loss / transpiration / evaporation • (A) long / wide spread / extensive roots ○ (long / wide spread /extensive roots) to absorb (more) water • (A) fleshy / thick stem ○ (fleshy / thick stem) to store water	**extra information** allow adaptations of specific animals to living in specified dry conditions, eg a desert • (A) change / increase in surface area / example ○ (increase in surface area which) increases area heat may be lost from (by radiation) • (A) changes to thickness of insulating coat ○ (thicker coat on upper surface) increases insulation from sun's heat • (A) thin (layer) / reduced amount of body fat ○ (reduced amount of body fat which) reduces insulating layer • (A) wide feet ○ (wide feet) to reduce pressure / spread weight / prevent sinking allow adaptations of specific plants to living in specified dry conditions, eg a desert • (A) thick wax ○ (thick wax) to reduce evaporation / water loss / transpiration • (A) few(er) stomata ○ (few stomata) to reduce evaporation / water loss / transpiration		
Total			**6**	

4.7.4.2 Pyramids of biomass

Answer 06 · Mark scheme

June 2014 | BL1HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / spec ref.

4.7.4.2 Pyramids of biomass

Answer 07 · Mark scheme

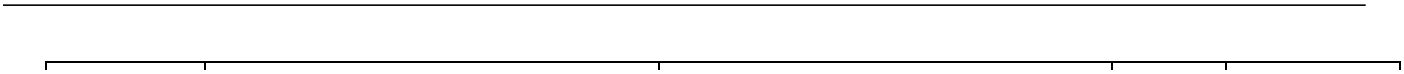
June 2017 | BL1HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	5000	allow **1** mark for 2500 **or** allow **1** mark for (3500 – 1000) x 2 **or** equivalent	2	AO2 1.5.1b/c
1(a)(ii)	Hawks produce faeces		1	AO2 1.5.1c
1(b)	photosynthesis sugar / glucose	 allow starch allow $C_6H_{12}O_6$	1 1	AO1 1.5.1a
Total			**5**	

4.7.4.2 Pyramids of biomass

Answer 07 · Mark scheme

June 2017 | BL1HP | Original Q1 | Legacy



4.7.4.2 Pyramids of biomass

Answer 08 · Mark scheme

June 2018 | 8461/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	*x*-axis: scale + labelled, including units	scale ≥ ½ width of graph paper label: biomass in g/m^2	1	AO2 4.7.4.1 4.7.4.2
	bar widths correct	± ½-square each side allow 1 mark if 3 correct	2	
	all 4 bars correctly labelled	large fish + small fish + invertebrate (animals) + algae **or** (trophic level) 4 + 3 + 2 + 1 **or** tertiary consumer + secondary consumer + primary consumer + producer ignore bar heights	1	
07.2		an answer of 99 scores **3** marks		AO2 4.7.4.3
	$\frac{840 - 10}{840} \times 100$	allow equivalent calculation	1	
	98.809523... / 98.810 / 98.81 / 98.8		1	
	99	allow answer given to two significant figures from an incorrect calculation in step 2	1	
07.3	inedible parts / example **or** egested / faeces **or** respiration / as CO_2	allow eaten by other animals **or** not all organisms eaten allow not digested allow excretion / urine ignore waste ignore energy losses ignore movement	1	AO1 4.7.4.3

4.7.4.2 Pyramids of biomass

Answer 08 · Mark scheme

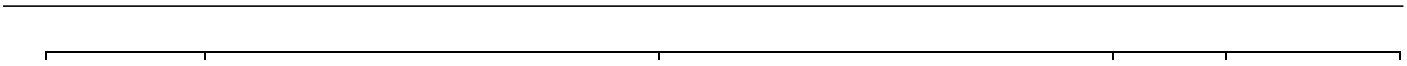
June 2018 | 8461/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4		ignore causes of death for algae and plants		
	bacteria decay organic matter / sewage / algae / dead plants		1	AO1 4.7.2.3
	(by) digestion	allow example such as starch broken down to sugar **or** protein broken down to amino acids	1	AO1 4.2.2.1 4.7.4.1
	(and) bacteria respire aerobically **or** respire using oxygen		1	AO1 4.4.2.1
	(which) lowers oxygen concentration (in water) **or** fish have less oxygen	allow reduced respiration of fish	1	AO2 4.4.2.1
	(so) reduced energy supply causes death of fish	allow toxins in the sewage kill fish ignore pathogens or (pathogenic) bacteria cause disease in fish and kills them	1	AO2 4.4.2.1
Total			**13**	

4.7.4.2 Pyramids of biomass

Answer 08 · Mark scheme

June 2018 | 8461/2H | Original Q7



4.7.4.2 Pyramids of biomass

Answer 09 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	primary consumer		1	AO2 4.7.2.1 4.7.4.1
01.2	correct shape: 4 tiers with largest at bottom and smallest at top correctly labelled: dragonfly / nymph + hydra + daphnia + algae	 in this order **or** allow: 3rd-order **or** tertiary consumer **or** apex / top predator **or** (trophic level) 4 2nd-order **or** secondary consumer **or** (trophic level) 3 1st-order **or** primary consumer **or** herbivore **or** (trophic level) 2 producer **or** (trophic level) 1 allow for **2** marks inverted pyramid if correctly labelled	1 1	AO2 4.7.4.2
01.3	any **one** from: (Daphnia biomass smaller because) • non-digestible parts (of algae) or lost in faeces • not all absorbed • lost in urine / urea • used in respiration **or** lost as carbon dioxide / CO_2 • algae not all eaten **or** eaten by other organisms • some algae decompose	 ignore waste allow excretion allow (to supply energy) for movement / warmth allow used to supply energy	1	AO1 4.7.4.3
01.4	 14 14 000	an answer of 14 000 scores **2** marks allow evidence of an incorrectly calculated mean × 1000 allow 1.4×10^4	 1 1	AO2 4.7.2.1

4.7.4.2 Pyramids of biomass

Answer 09 · Mark scheme

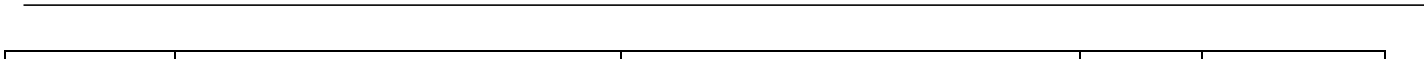
June 2019 | 8461/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5		an answer of 2.625×10^4 **or** 2.63×10^4 **or** 2.6×10^4 scores **4** marks an answer of 26250 scores **3** marks allow ecf from Question **01.4**		AO2 4.7.2.1
	(volume of pond =) 1.875 **or** $2.5 \times 1.5 \times 0.5$	an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps	1	
	$14\,000 \times 1.875$	allow ecf from Question **01.4**	1	
	26250		1	
	2.625×10^4	allow 2.63×10^4 **or** 2.6×10^4	1	
01.6	increased (growth / reproduction of) algae		1	AO2 4.7.2.1 4.7.3.2
	(more algae so) more food for Daphnia		1	4.7.4.1
		allow fertiliser toxic to Hydra (1) (so) fewer Daphnia eaten (1)		
01.7	(Hydra have) less food		1	AO3 4.7.2.1
	because (graph shows) fewer Daphnia (with more fertiliser)		1	4.7.3.2
		allow other valid suggestions, eg fertiliser toxic to Hydra (1) **or** fertiliser causes growth of algae (on surface) which block light and so die and decay **or** eutrophication (1) (decay / eutrophication) uses up oxygen (so lack of oxygen for Hydra) (1)		
Total			**14**	

4.7.4.2 Pyramids of biomass

Answer 09 · Mark scheme

June 2019 | 8461/2H | Original Q1



4.7.4.2 Pyramids of biomass

Answer 10 · Mark scheme

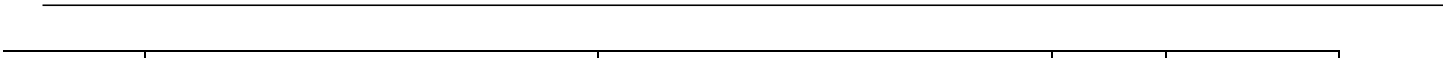
November 2020 | 8461/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	triangular pyramid with 3 levels		1	AO1 4.7.4.1 4.7.4.2
	correct labels: (waste) vegetables / plants; insect(s); dog(s)	do **not** accept additional incorrect labels	1	AO2 4.7.4.2
07.2	any **two** from: • carbon dioxide from respiration (from dog) • urea from excretion (from dog) • not all parts (of insects) are absorbed / digested (by dog)	allow carbon dioxide breathed out (by dog) allow urea in urine (from dog) allow faeces from egestion (from dog) ignore references to loss of energy if no other mark awarded allow **two** factors without descriptions for **1** mark	2	AO1 4.7.4.3
07.3	less land required		1	AO2 4.7.5.1 4.7.3.5
	(so) more space for crops (for humans)	allow more meat (from cows etc) for humans	1	
	less methane (from animals) therefore less global warming	allow less methane from rotting vegetables in landfill	1	
	(therefore) less harmful effects of global warming on (human) food production	allow example such as less flooding of farmland allow may lead to the development of more foods for humans made from insects	1	
Total			**8**	

4.7.4.2 Pyramids of biomass

Answer 10 · Mark scheme

November 2020 | 8461/2H | Original Q7



4.7.4.2 Pyramids of biomass

Answer 11 · Mark scheme

June 2024 | 8461/2H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.1	46 000 **or** 16 400 **or** 12.8 **or** 0.8		1	AO2 4.7.2.1 4.7.4.3 4.7.5.2
	46 000 **and** 16 400 **or** 262 400		1	
	46 000 **and** 209 920 **or** 3593.75		1	
	2191.3 **or** $\frac{46\,000 \times 10\,000}{209\,920}$ **or** $\frac{3593.75 \times 10\,000}{16\,400}$		1	
	2190		1	

4.7.4.2 Pyramids of biomass

Answer 11 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.2	suitable scale, symmetrical around 0 labels for *x*-axis **and** for bars correct values plotted: chickens 2200 maize 4200	 (biomass in) kg (bars) maize and chickens allow a tolerance of ±½ small square ignore height of bars	1 1 1	AO2 4.7.4.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.3	2200 4200 = 0.5238… : 1 **or** 11 : 21 **or** 1 : 1.9	 allow rounded value	1 1	AO2 4.7.4.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.4	lost via egestion / faeces	ignore urine / excretion / waste ignore not digested do **not** accept respiration do **not** accept not eaten do **not** accept movement **or** as heat **or** for keeping warm	1	AO1 4.7.4.3

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.5	lysine and tryptophan		1	AO3 4.4.2.3 4.7.5.2

4.7.4.2 Pyramids of biomass

Answer 11 · Mark scheme

June 2024 | 8461/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.6	any **one** from: • chickens need low amounts of leucine (for growth) • (chicken) proteins contain low amount / proportion of leucine	do **not** accept leucine is not needed (for growth)	1	AO3 4.4.2.3 4.7.5.2

Total Question 7	13

4.7.4.2 Pyramids of biomass

Answer 10 · Examiner comments

November 2020 | 8461/2H | Original Q7

Question 7 (standard, standard/high & high demand)

This question presented students with a novel situation: the development of a new type of food for dogs from insects. This was set in the context of a food chain, the transfer of biomass and, ultimately, in the provision of food security for humans. **07.1** was a relatively straightforward question for students. Problems mainly arose in the labelling with the use of terms such as 'secondary' and 'tertiary' consumers (the latter being entirely inappropriate), or by adding multiple labels that included the names of the organisms, the types of producer and consumer and the numbered trophic levels, but with an error in one of these, and thus this mark could not be awarded. In 07.2 reasons given by students for the incomplete transfer of biomass from the insects to the dogs were largely incorrect, with 1% of students being able to describe two. Some students made inappropriate references to some of these processes occurring in the insects rather than in the dogs.

07.3 related the scenario of insect-based dog food to human food security. Students found this difficult and, although nearly three-quarters scored one mark (usually for stating that more meat would be available for human consumption if dogs were fed on insects), 7% gained further credit. Few realised that if less meat were consumed by dogs, then less land would be required for animal grazing and hence it could be utilised for growing crops. Hardly any suggested that a reduction in farm animals would perhaps reduce methane output and the negative effects of methane on the climate and hence on the growth of crops.

4.7.4.2 Pyramids of biomass

Answer 11 · Examiner comments

June 2024 | 8461/2H | Original Q7

Question 7 (standard/high and high demand)

07.1 Students were provided with data regarding chickens and farmland, and were asked to calculate the area of land needed to provide enough energy from maize seeds for 1000 chickens to grow to full size. The mark scheme is designed to benefit the logical mathematical use of the numbers that were provided in the stem of the question.

Almost 35% of students were able to attain the maximum five marks by calculating the correct answer of 2190 m^2. Students with a final answer showing an error to the power of 10 (such as 2.19, 21.9, 21900 etc.) gained four marks in line with the marking procedure for calculations (section 3.3 of the mark scheme).

A small number of students did not convert their answer to 3 significant figures so could only be awarded four marks. Despite the high level of challenge provided by this calculation, 40% of students were able to gain 1 or 2 marks.

Students are encouraged to show their working out for all calculations.

07.2 Students were asked to complete a pyramid of biomass for maize seeds and chickens, and it was clear that many students had a weak understanding of this. 20% of students gained all three marks, with 40% of students not gaining any mark at all or not attempting the question.

Students used a vast range of different scales, but only those that were symmetrical and used over half the available grid were able to gain marking point 1. A number of students did not notice that they needed to calculate the value for chickens and not simply plot 2.2 kg. This went on to provide problems devising a suitable scale.

07.3 Over 50% of students correctly calculated the ratio of chicken biomass to maize seed biomass. Common errors were using the mean mass of 1 chicken, and not calculating the value for 1000 chickens, inverting the correct values and giving an answer of 21:11 or 1.9:1. Students are reminded to check their ratio reflects the order given in the question.

07.4 Just under a quarter of students correctly articulated what happened to the remaining 20% of the biomass in the maize seeds. It was clear a far greater number of students knew the correct answer but gave vague responses such as ‘waste’ or used colloquial terms which were insufficient for credit at this level.

07.5 85% of students correctly identified lysine and tryptophan as the amino acids found in significantly higher proportions in the QPM seeds.

07.6 Only 15% of students were able to correctly suggest why a diet containing less leucine does not slow down the growth of chickens. Many students did not appear to read all the information provided and incorrectly suggested that leucine was not an essential amino acid, or not essential to growth.

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