



GCSE
BIOLOGY
8461/2H

Paper 2 Higher Tier

Mark scheme

June 2019

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1 9 6 G 8 4 6 1 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 error / 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 not 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	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	primary consumer		1	AO2 4.7.2.1 4.7.4.1
01.2	<p>correct shape: 4 tiers with largest at bottom and smallest at top</p> <p>correctly labelled:</p> <p>dragonfly / nymph</p> <p>+ hydra</p> <p>+ daphnia</p> <p>+ algae</p>	<p>in this order or allow:</p> <p>3rd-order or tertiary consumer or apex / top predator or (trophic level) 4</p> <p>2nd-order or secondary consumer or (trophic level) 3</p> <p>1st-order or primary consumer or herbivore or (trophic level) 2</p> <p>producer or (trophic level) 1</p> <p>allow for 2 marks inverted pyramid if correctly labelled</p>	<p>1</p> <p>1</p>	AO2 4.7.4.2
01.3	<p>any one from: (Daphnia biomass smaller because)</p> <ul style="list-style-type: none"> • non-digestible parts (of algae) or lost in faeces • not all absorbed • lost in urine / urea • used in respiration or lost as carbon dioxide / CO₂ • algae not all eaten or eaten by other organisms • some algae decompose 	<p>ignore waste</p> <p>allow excretion</p> <p>allow (to supply energy) for movement / warmth</p> <p>allow used to supply energy</p>	1	AO1 4.7.4.3
01.4	<p>14</p> <p>14 000</p>	<p>an answer of 14 000 scores 2 marks</p> <p>allow evidence of an incorrectly calculated mean × 1000</p> <p>allow 1.4×10^4</p>	<p>1</p> <p>1</p>	AO2 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	(volume of pond =) 1.875 or $2.5 \times 1.5 \times 0.5$ 14 000 \times 1.875 26250 2.625×10^4	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 an incorrect answer for one step does not prevent allocation of marks for subsequent steps allow ecf from Question 01.4 allow 2.63×10^4 or 2.6×10^4	1 1 1 1	AO2 4.7.2.1
01.6	increased (growth / reproduction of) algae (more algae so) more food for Daphnia	allow fertiliser toxic to Hydra (1) (so) fewer Daphnia eaten (1)	1 1	AO2 4.7.2.1 4.7.3.2 4.7.4.1
01.7	(Hydra have) less food because (graph shows) fewer Daphnia (with more fertiliser)	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)	1 1	AO3 4.7.2.1 4.7.3.2
Total			14	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	chromosome(s)	allow gene(s) / allele(s)	1	AO1 4.6.1.4 4.1.2.1
02.2	X = sugar Y = nucleotide Z = base		1 1 1	AO1 4.6.1.5
02.3	double helix		1	AO1 4.6.1.4
02.4	3		1	AO2 4.6.1.5
02.5	any two from: <ul style="list-style-type: none"> • diagnosis of inherited / genetic disorder • gene therapy or treatment of inherited disorders • understanding (human) evolution or • understanding ethnic origins (of a person) or • understanding ancestry • tracing human migration patterns 	allow descriptions or named examples allow research / understand genetic disorders allow other examples – eg identification of criminals (1) paternity determination (1)	2	AO1 4.6.1.4
Total			8	

Question	Answers	Extra information	Mark	AO / Spec.
03.1	named example of tropism – eg geotropism / gravitropism	allow hydrotropism or chemotropism or thermotropism	1	AO1 4.5.4.1
	correct corresponding stimulus – eg gravity	allow water or chemical or 'heat'	1	
03.2	Level 3: The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.		5–6	AO1 AO2 4.5.4.1
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan 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 <ul style="list-style-type: none"> • several seedlings in each batch or one pot of seedlings in each batch • measure heights of shoots • leave some in dark with light from one side / direction in box with hole • control(s) with all-round light or rotating on clinostat or in dark • control variable(s) eg same temperature / water / soil type • after suitable time (at least several hours) • record appearance of seedlings re. light direction • re-measure heights of shoots • detail of how bent shoots were measured – eg use thread or straighten them out • calculate mean height increase for each group • use ruler / protractor to estimate angle of bending <p>for level 3 a reference to comparing the growth of plants with light from one direction with plants either in darkness or in full light along with a control variable is required</p>			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	leaves / plant receive(s) / absorb(s) more light (so) more photosynthesis (so plant) produces more glucose	allow starch / carbohydrate / sugar / organic material / other named organic substance if no other mark awarded allow 1 mark for any two of the mark points with no reference to 'more'	1 1 1	AO2 4.5.4.1 4.7.2.1 4.4 4.4.1.2 AO1
Total			11	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	ciliary muscles contract		1	AO1 4.5.2.3
	(so ciliary muscles have a) smaller diameter		1	
	(so) suspensory ligaments loosen / slacken	do not accept 'relax'	1	
	(so) lens thickens or lens becomes more curved / rounded	allow lens becomes fatter ignore lens becomes bigger	1	
	(thicker) lens is more convergent	allow light rays bent (inwards) more or light refracted more	1	
	light rays / image focused on retina	allow light rays meet on retina	1	
04.2	eye(-ball) is (too) short or lens cannot be thickened enough	allow ciliary muscles (too) weak or lens not (sufficiently) elastic	1	AO1 4.5.2.3
	(so) light 'focuses' behind retina	allow (so) image forms behind retina	1	
04.3	convex / converging lens	allow shape described eg thicker in middle	1	AO1 4.5.2.3
	light rays bent / refracted (inwards) more	allow changes direction of light rays further inwards	1	
	light rays focused on retina	allow light rays brought to a point on retina or light rays converge on retina or focused /clear image forms on retina	1	
Total			11	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	same kingdom + phylum + class + order or same order or they have the top four groups the same	allow both Poales	1	AO3 4.6.4
05.2	Rr / rR	do not accept RR or rr ignore heterozygous do not accept homozygous	1	AO3 4.6.1.6 4.6.3.3
05.3	C ^W C ^W		1	AO3 4.6.1.6
05.4	parental genotypes / gametes correct for both parents: C ^R C ^W C ^R C ^W / C ^R and C ^W genotypes of offspring correctly derived in a Punnett square: C ^R C ^R C ^R C ^W C ^W C ^W correct identification of phenotypes from their cross: C ^R C ^R = red C ^R C ^W = pink C ^W C ^W = white	allow R and W throughout allow own symbols if defined allow correctly derived genotypes from incorrect gametes allow colours correctly identified from different offspring, only if pink and other colour(s) are given	1 1 1	AO2 4.6.1.6
05.5	answer correctly derived from Question 05.4 to match stated phenotypes	allow 50(%) if no offspring given in Question 05.4 allow to match genotypes if no phenotypes given	1	AO2 4.6.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	(several groups) so many / several plants can be produced	allow each (group) will give a new plant	1	AO1 4.1.2.3 4.6.1.3 4.6.2.5
	(nutrients) for making protein / amino acids or for making chlorophyll or for providing energy or for respiration	allow other examples do not accept making energy ignore for growth	1	
	(add hormones) so differentiation occurs or so roots / shoots develop	allow for the formation of different tissues / organs / named allow to stimulate cell division	1	
	(sterile conditions) to prevent growth / entry of microorganisms / named type or prevent decay / disease	ignore to kill microorganisms ignore contamination unqualified	1	
	(temperature = 20 °C) so optimum / good growth	allow reference to enzymes working well ignore enzymes not denatured ignore reference to pathogens / microorganisms	1	
05.7	(all new plants have been) produced by asexual reproduction / mitosis or produced without (fusion of) gametes	ignore produced from one parent	1	AO2 4.1 4.1.2.2 4.6.1.1 4.6.2.5
	(so) all are genetically identical / clones or all are $C^R C^W$ / heterozygous	allow all are the same genotype / alleles / genes / DNA	1	
Total			14	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	pituitary		1	AO1 4.5.3.3
06.2	ADH		1	AO1 4.5.3.3
06.3	high(er) concentration of blood causes (more) ADH / hormone release	allow ecf for name of hormone from Question 06.2 ignore name of gland allow low(er) water potential of blood causes (more) ADH / hormone release allow alternative descriptions in terms of – eg low(er) water concentration / level or high(er) osmotic pressure or high(er) solute concentration / level	1	AO2
	(and hormone / ADH causes) increased permeability of kidney tubules (to water)	allow increased permeability of collecting duct / distal convoluted tubule	1	AO1
	(so) increased water reabsorption	allow more water taken back into blood ignore reference to urine	1	AO1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	<p>changes in concentrations / levels of substances / urea are minimised</p> <p>(so) less / no chance of causing damage to body cells / tissues</p> <p>not repeatedly puncturing skin or blood not in contact with machine</p> <p>(so) less / no chance of infection or less / no chance of blood clots or no need to take anti-clotting drugs</p>	<p>allow converse if clearly describing dialysis explanation must match reason</p> <p>allow no change in concentration / level of substances / urea allow correctly named substances</p> <p>allow eg less / no osmotic stress or not poisoned by urea</p> <p>allow blood does not leave the body</p> <p>allow less / no chance of microorganisms entering body</p> <p>allow only one operation so less chance of infection for 2 marks allow dialysis requires anti-clotting drugs and so may lose more blood if cut for 2 marks</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>AO3 4.5.3.3</p>
Total			9	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	Level 2: The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.		3–4	AO1 AO2
	Level 1: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.		1–2	
	No relevant content		0	
	Indicative content <ul style="list-style-type: none"> • use of quadrat • (quadrat) of given area / dimensions – eg 0.25 m² or 1 m × 1 m • quadrats are placed randomly • method of obtaining randomness – eg random coordinates from a calculator or throw over shoulder or throw with eyes closed • suitable number of quadrats (10 or more or a large number) • count number of plants (in each quadrat) • calculation of mean per quadrat or per unit area • determination of area of field (length × width) • population = mean per m² × area of field 			4.7.2.1
07.2	more bacteria so more divisions / reproduction (per unit time)		1	AO2 4.1.1.6
07.3	any three from: <ul style="list-style-type: none"> • add (more) sugar • add (more) amino acids / protein • add (more) oxygen • increase temperature • remove toxins / waste or maintain pH • stir the culture 	} if neither point given, allow add (more) nutrients allow in range 26 °C to 40 °C allow maintain optimum temperature if no other mark awarded allow 1 mark for add more food	3	AO3 4.1.1.6 4.4.2.3 4.7.2.3 4.7.4.3 4.7.5.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4		an answer in the range of 2.9 to 3.4 scores 4 marks an answer in the range of 2.08 to 3.77 scores 3 marks		AO2 4.1.1.6 4.6.2.4
	tangent drawn to the curve at 12 hours	do not accept if there is an incorrect tangent at 7 hours	1	
	calculation of rate at 7 hours $\frac{\Delta y}{\Delta x}$	allow an answer that correctly rounds to a value in range 10.0 to 11.7	1	
	calculation of rate at 12 hours $\frac{\Delta y}{\Delta x}$	allow an answer that correctly rounds to a value in range 3.1 to 4.8	1	
	3.3	allow in range 2.9 to 3.4 if both rates are in the correct ranges	1	
07.5	can use the glyphosate / weed killer to kill weeds but not kill / affect crop	allow only kills weeds	1	AO1 4.6.2.4 4.7.1.3 4.7.5.4
	(so) less competition for light / water / minerals / ions	allow less competition for nutrients ignore food / carbon dioxide / space	1	AO2
	(so) crops have high(er) yield	allow crops grow better / well	1	AO1
Total			15	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<p>08.1</p>	<p>(blood glucose increases after meal causing) insulin secretion</p> <p>insulin causes <u>glucose</u> to enter cells / liver / muscles</p> <p>(insulin causes) <u>glucose</u> conversion to glycogen</p> <p>(so) blood glucose decreases causing glucagon secretion</p> <p>glucagon causes glycogen to be converted to <u>glucose</u></p>	<p>ignore incorrect organ secreting insulin / glucagon</p> <p>allow (blood glucose increases after meal causing) insulin increase</p> <p>} allow <u>glucose</u> converted to glycogen in cells / liver / muscles for 2 marks</p> <p>allow increase in glucagon when blood glucose is low</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>4.5.1 4.5.3.2</p> <p>AO2</p> <p>AO1</p> <p>AO1</p> <p>AO2</p> <p>AO1</p>
<p>08.2</p>	<p>cells / liver / muscles absorb less glucose</p> <p>(so) glucose concentration in blood remains high</p> <p>(high blood glucose stimulates / causes) <u>pancreas</u> to release more insulin</p>	<p>allow cells / liver / muscles convert less glucose to glycogen</p> <p>do not accept no absorption / conversion of glucose</p> <p>allow (so) glucose concentration in blood does not decrease</p> <p>allow more insulin is released from <u>pancreas</u> to 'try' to reduce blood glucose</p>	<p>1</p> <p>1</p> <p>1</p>	<p>AO2 4.5.3.2</p>

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	any three from: <ul style="list-style-type: none"> • age • height and mass • proportion of males and females or group size • (same) severity of diabetes • (same) activity (during investigation) • (same) type of meal • dose of drug • (similar) blood glucose concentrations at start • other health conditions or other drugs being taken 	allow BMI allow sex of the participants allow how much / type of food / drink consumed before allow may not have followed drug-taking regime beforehand	3	AO3 4.5.3.2
08.4	Mean = 177.2 ± 15.4		1	AO2 4.5.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	Level 3: A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.		5–6	AO3
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.		3–4	
	Level 1: Relevant points are made. They are not logically linked.		1–2	
	No relevant content		0	
	Indicative content Pro: <ul style="list-style-type: none"> • Met + A gives larger (%) reduction (in blood glucose) than Met alone • so statement is supported • Met + B gives larger (%) reduction (in blood glucose) than Met alone • so statement is supported • Met + A SD does not overlap with Met SD • so difference is significant Con: <ul style="list-style-type: none"> • Met + B SD overlaps with Met SD • so difference is not significant • difference in results could be due to chance <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> • number of people used is not very large • number of people in each group is different • so may not be representative or may not be repeatable / reproducible • so anomalies will have a bigger impact on smaller groups • 30 minute / starting levels of blood glucose are different • all 30 minute / starting levels are higher in the 2-drug trial • so may cause different % reductions • no information about control variables or named eg • concentration of drugs not given / may differ • so results may not be valid for level 3 an inclusion of a discussion of significance is required			4.5.3.2
Total			18	