A-level
BIOLOGY
7402/2

Paper 2

Mark scheme

June 2021

Version: 1.0 Final

216A7402/2/MS

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.

Further copies of this mark scheme are available from aqa.org.uk

Copyright information

AQA retains the copyright on all its publications. However, registered schools/colleges for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Copyright © 2021 AQA and its licensors. All rights reserved.

Level of response marking instructions

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 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. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in 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 and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 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.

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

Question	Marking Guidance	Mark	Comments
01.1	1. Phosphorylation of glucose using ATP; 2. Oxidation of triose phosphate to pyruvate; 3. Net gain of ATP; 4. NAD reduced;	4 max	Accept all mark points in diagrams. 2. Accept removal of hydrogen from triose phosphate for oxidation. 3. Accept any description that indicates a net gain e.g., 4 produced, 2 used. 4. Accept $NADH/NADH_2/NADH + H^+$ produced.

Question	Marking Guidance	Mark	Comments
01.2	1. Less/no reduced NAD/coenzymes **OR** Fewer/no hydrogens/electrons removed (and passed to electron transfer chain); 2. Oxygen is the final/terminal (electron) acceptor;	2	1. Accept less/no FAD reduced.

Question	Marking Guidance	Mark	Comments
02.1	1. Higher concentration of potassium ions inside **and** higher concentration of sodium ions outside (the neurone) **OR** potassium ions <u>diffuse</u> out **OR** sodium ions <u>diffuse</u> in; 2. (Membrane) more permeable to potassium ions (leaving than sodium ions entering) **OR** (Membrane) less permeable to sodium ions (entering than potassium ions leaving); 3. Sodium ions (actively) transported out and potassium ions in;	3	1. Accept 'more' for 'higher concentration'. 1. Accept 'sodium ions can't <u>diffuse</u> in (due to alternative explanation). 2. Accept for 'less permeable to sodium ions' is 'impermeable to sodium ions' or 'sodium gates/channels are closed' (alternative explanation). 1, 2 and 3 reference to <u>ions</u> or Na^+ and K^+ is required. If mentioned once allow for all mark points. 1, 2 and 3. If an answer provides two or three of these mark points **without** any reference to <u>ions</u> – award **one** maximum mark. 3. Accept 3 Na^+ out and 2 K^+ in but reject if numbers used are incorrect.

Question	Marking Guidance	Mark	Comments
02.2	1. Myelination provides (electrical) insulation; 2. (In myelinated) saltatory (conduction) **OR** (In myelinated) depolarisation at nodes (of Ranvier); 3. In non-myelinated depolarisation occurs along whole/length (of axon);	3	1. Reject thermal insulation. 1. Accept description of (electrical) insulation. 3. Accept action potentials for depolarisation. 2 and 3. 'Messages' or 'signals' disqualifies first of these marks credited.

Question	Marking Guidance	Mark	Comments
02.3	1. No/less ATP produced; 2. No/less <u>active</u> transport **OR** Sodium/potassium pump inhibited; 3. Electrochemical gradient not maintained **OR** (Facilitated) diffusion of ions causes change to 0 mV **OR** (Results in) same concentration of (sodium and potassium) ions (either side of membrane) **OR** No net movement of (sodium and potassium) ions;	3	2. Accept Na^+ not/fewer moved out **and** K^+ not/fewer moved in. 3. Accept reaches electrical equilibrium/balance. 3. Accept concentration gradient of sodium and potassium ions not maintained.

Question	Marking Guidance	Mark	Comments
03.1	1. Tip produces IAA; 2. IAA diffuses (into shoot); 3. (More) <u>elongation</u> of <u>cells</u> on one side (than other);	3	1. Accept source/release for produces but ignore contains/stores IAA. 1 and 2. Accept auxin for IAA. 2. Accept IAA diffuses down. 3. Accept (more) <u>elongation</u> of <u>cells</u> on left side. 3. Reject any reference to shaded/dark side or away from light.

Question	Marking Guidance	Mark	Comments
03.2	1. Size of shoot/tip; 2. Number of shoot tips; 3. Size/type of agar (block); 4. (Shoots) at same stage of growth/development; 5. Time (period) tips kept on agar **OR** Time (period) agar/block kept on (cut shoot) **OR** Time (period shoots) kept in dark; 6. Temperature; 7. (Repeat several times and) calculate a mean; 8. Compare/read degree of curvature (on calibration curve) to determine (IAA) concentration **OR** Higher the degree of curvature the higher the IAA concentration;	5 max	**Mark points 1 to 6 = max 3.** 1 to 6. Ignore pH, species, carbon dioxide, humidity, nutrients, water and light. 3. Accept 'amount of agar'. 4. Accept (Shoots/plants) are same age.

Question	Marking Guidance	Mark	Comments
03.3	1. (IAA) is not broken down by light **OR** (IAA) is produced in the dark **OR** Light/dark does not affect (IAA) production; 2. (IAA) moves away from light **OR** (IAA) moves to shaded side;	2	2. IAA accumulates on shaded side is not enough on its own, idea of movement is required.

Question	Marking Guidance	Mark	Comments
04.1	1. Males have one allele; 2. Females need two recessive alleles **OR** Females must be homozygous recessive **OR** Females could have dominant and recessive alleles **OR** Females could be heterozygous/carriers;	2	1 Accept males only need one allele. 1 and 2. Ignore references to X and Y chromosomes. 1 and 2. Accept r as recessive allele and R as dominant allele. If no reference to allele, accept for **one mark** male needs one recessive gene whereas females need two recessive genes.

Question	Marking Guidance	Mark	Comments
04.2	1. Box 2. All females red-eyed, all males white-eyed.	1	Reject if more than one box with tick. Ignore crossed-out ticks.

Question	Marking Guidance	Mark	Comments
04.3	1. The (two) genes are linked **OR** Autosomal linkage;	3	1. Accept that the genes are on the same chromosome.

	2. No crossing over (occurs) **OR** (Linked) genes are close together; 3. No Gl and no gL (gametes produced) **OR** No Ggll and no ggLl (offspring produced) **OR** Only GL and gl (gametes produced);		1. Accept 'Alleles are linked' (accept symbols for alleles) but reject if context suggests alleles of the 'same gene'. 2. Accept crossing over less likely to occur. 1 2, and 3. Ignore reference to independent assortment.
Question	**Marking Guidance**	**Mark**	**Comments**
04.4	1. Correct answer of 8×10^{10} **= 3 marks**;;; 2. Correct answer **not** in standard form = **2 marks** **OR** 1.6×10^{13} = **2 mark** **OR** 1.6×10^{11} = **2 mark** **OR** 6.4×10^{11} = **2 mark** **OR** Shows 8×10^{10} in the working **= 2 marks;;** 3. 1.28×10^{12} = **1mark** **OR** 3.2×10^{11} = **1 mark** **OR** 8×10^{11} = 1 **mark** **OR** 8×10^{9} = 1 **mark** **OR** Shows 1.6×10^{11} in the working = **1 mark** **OR** Shows 200^{4} in the working = **1 mark**;	3	If no other mark is credited accept for **one mark** working which shows multiplication by 200 for 4 generations. This could be shown in a variety of ways e.g. multiplied by 400 divided by 2 for 4 generations.

Question	Marking Guidance	Mark	Comments
05.1	1. Changes tertiary structure; 2. No longer complementary (to receptor);	2	1. Reject change in tertiary structure of receptor. 2. Reject 'active site' or reference to enzyme or substrate.

Question	Marking Guidance	Mark	Comments
05.2	1. Less/no AKT activated; 2. Fewer/no vesicles move to membrane **OR** Fewer/no (channel) proteins in membrane; 3. Less/no glucose diffuses into cell (so high blood glucose);	3	2. Accept 'fuse with membrane'.

Question	Marking Guidance	Mark	Comments
05.3	1. High concentration of glucose in blood/filtrate; 2. Not all the glucose is (re)absorbed at the proximal convoluted tubule; 3. Carrier/co-transport proteins are working at maximum rate **OR** Carrier/co-transport proteins/ are saturated;	3	1. Accept tubule for filtrate. 2. Reject no glucose is (re)absorbed. 3. Accept all carrier/co-transport proteins are 'in use' but reject all carriers are 'used up'. 3. Accept symport for carrier protein. 3. Accept not enough carrier proteins to absorb all the glucose.

Question	Marking Guidance	Mark	Comments
06.1	1. Produce healthy (blood) cells; 2. No MDS/faulty/cancerous (blood) cells; 3. Stem cells divide/replicate;	3	1 and 2. Produce only healthy/normal (blood) cells = **two marks.** 1. Accept produce 'normal' /non-MDS cells. 2. Accept no (cancerous) tumour. 1 and 3. Ignore reference to totipotent/pluripotent/ multipotent/unipotent 3. Accept 'clone' for divide.

Question	Marking Guidance	Mark	Comments
06.2	1. (AZA) reduces methylation (of DNA/cytosine/gene); 2. (Tumour suppressor) gene is transcribed/expressed; 3. Prevents rapid/uncontrollable cell division **OR** Cell division can be controlled/stopped/slowed;	3	1. Reject any reference to mutation. 2. Accept mRNA produced for transcription/transcribed. 2. Ignore gene is 'switched on' or activated but allow protein is formed. 3. Ignore growth.

Question	Marking Guidance	Mark	Comments
06.3	1. Effect of AZA can be compared; 2. Unethical not to treat (control group);	2	1. Comparison on its own is not enough for a mark.

Question	Marking Guidance	Mark	Comments
06.4	1. Correct answer of 29/28.8 = **2 marks**;; 2. Working shows 0.74 **and** 0.58 = **1 mark** **OR** 58/57.6 = **1 mark** **OR** 28 = **1 mark**;	2	

Question	Marking Guidance	Mark	Comments
07.1	1. Correct answer of 625 = **2 marks**;; 2. Shows 625 but decimal point incorrect = **1 mark** **OR** Working shows 40 = **1 mark** **OR** 1600/1.6 = **1 mark** **OR** 667/666.6 = **1 mark**;	2	

Question	Marking Guidance	Mark	Comments
07.2	(Cell/membrane has a) <u>phospholipid</u> <u>bilayer</u> **OR** No channel/carrier protein (for uptake) **OR** No need for channel/carrier protein (for uptake);	1	

Question	Marking Guidance	Mark	Comments
07.3	1. Both are more effective than the <u>control</u>; 2. Differences in the means not (likely to be) due to chance **OR** <u>Significant</u> difference (in effectiveness between both types); 3. (As) SDs do not overlap; 4. HBsAg (reduced), not zero **OR** Replication (reduced), not zero; 5. Not (investigated in) humans **OR** (Investigated in) mice; 6. shRNA (more effective as) 7.5% (of control) compared with 50% for lhRNA; 7. No indication of sample size/number;	5 max	**Mark points 4 to 10 = 4 max.** 1. Accept both (results) are below the <u>control</u>. 2. Reject 'results are significant'. 2. Accept significantly higher or significantly lower in correct context. 3. Accept error bars do not overlap. 6. Accept 42.5% difference. 6. Accept (mean) concentration for %.

	8. Long term effects not known **OR** Side effects not known; 9. No statistical test to determine significance; 10. (Investigated) in vitro **OR** Not (investigated) in vivo;		8. Accept 'could be toxic' for side effects not known. 10. Accept not done inside an organism or not done in liver (organ) but 'only tested in liver cells' is insufficient unless qualified. Ignore only 'one study' or 'no repeats'.
Question	**Marking Guidance**	**Mark**	**Comments**
08.1	1. (Requires DNA fragment) DNA polymerase, (DNA) nucleotides and primers; 2. Heat to 95 °C to break hydrogen bonds (and separate strands); 3. Reduce temperature so primers bind to DNA/strands; 4. Increase temperature, DNA polymerase joins nucleotides (and repeat method);	4	1 and 4. Accept Taq polymerase for DNA polymerase. 2. Accept temperature in range 90 to 95 °C. 3. Accept temperature in range 40 to 65 °C. 4. Accept temperature in range 70 to 75 °C.
Question	**Marking Guidance**	**Mark**	**Comments**
08.2	1. (Initially) number (of molecules) doubling is low **OR** Doubles each cycle to produce exponential increase; 2. Plateaus as no more nucleotides/primers;	2	1. First alternative relates to idea of low numbers i.e., 2, 4, 8, 16, 32 etc. 2. Accept 'levels out' or 'flattens' for plateaus. 2. Accept enzyme/polymerase (eventually) denatures.

Question	Marking Guidance	Mark	Comments
09.1	1. Method of randomly determining position (of quadrats) e.g. random numbers table/generator; 2. Large number/sample of quadrats; 3. Divide total percentage by number of quadrats/samples/readings;	3	1. Ignore line/belt transect. 2. Accept many/multiple/lots but ignore several. 2. Ignore point quadrat. 2. Accept squares/frames (of a grid) for quadrats. 2. If a specified number is given, it must be 10 or more.

Question	Marking Guidance	Mark	Comments
09.2	1. Increase in variety/diversity of species/plants/animals; **OR** Increase in number of species/populations; 2. Provides more/different habitats/niches **OR** Provides greater variety/types of food;	2	1. Accept increase in biodiversity or species richness. 2. Ignore shelter/homes/environments. 2. Ignore 'more food' but accept 'more food sources'. 2. Accept 'less hostile' (environment).

Question	Marking Guidance	Mark	Comments
09.3	1. Significant (difference/decrease) with **C** (compared with **A**); 2. No significant (difference/decrease) with **B and D** (compared with **A**); 3. Reference to less than 5%/0.05 probability that difference is (less likely) due to chance **OR** Reference to more than 95%/0.95 probability that difference is not due to chance; 4. Species of algae not known **OR** Species of algae may differ (on other reefs); 5. Only done off (coast of) Florida **OR** Not done on other reefs;	5 max	**Mark points 4 to 9 = 4 max.** 1 and 2. Accept names of fish species present as alternatives to sets **B**, **C** and **D**. 1 and 2. Award both marks if answer states **only C** is significantly (different/lower). 1 and 2. 'Results are significant/not significant' disqualifies first of these marks credited. 3. Accept equal to specified probabilities.

	6. Only done at 16 to 18 metres **OR** Not done (on reefs) at other depths; 7. Only 34 weeks; 8. Concrete/artificial reef could affect results/growth **OR** Natural reef results/growth may differ; 9. Cage may allow other fish/animals to enter;		8. Accept any reference to composition of reef being different (from natural).
Question	**Marking Guidance**	**Mark**	**Comments**
10.1	1. Variation/differences due to mutation/s; 2. (Reference to) allopatric (speciation); 3. Smaller/different lakes have different environmental conditions **OR** Smaller/different lakes have different selection pressures; 4. Reproductive separation/isolation **OR** No gene flow **OR** Gene pools remain separate; 5. Different alleles passed on/selected **OR** Change in frequency of allele/s; 6. Eventually different species/populations cannot breed to produce fertile offspring;	4 max	2. Ignore sympatric speciation. 3. Accept different populations for different lakes.
Question	**Marking Guidance**	**Mark**	**Comments**
10.2	1. Correct answer of 10/10.4 **= 2 marks**;; 2. Working shows 14,112 = **1 mark** **OR** 13.09/13.1 = **1 mark**;	2	1. Ignore any numbers after 10.4

Question	Marking Guidance	Mark	Comments
10.3	1. (Growth/increase of) algae/surface plants/algal bloom blocks light; 2. Reduced/no photosynthesis so (submerged) plants die; 3. Saprobiotic (microorganisms) aerobically respire **OR** Saprobiotic (microorganisms) use oxygen in respiration; 4. Less oxygen for fish to respire;	4	3. Accept: Saprobiont/saprophyte/ saprotroph 3. Neutral: decomposer
Question	**Marking Guidance**	**Mark**	**Comments**
10.4	1. Capture/collect sample, mark and release; 2. Ensure marking is not harmful (to fish) **OR** Ensure marking does not affect survival (of fish); 3. Allow (time for) fish to (randomly) distribute before collecting a second sample; 4. (Population =) number in first sample × number in second sample divided by number of marked fish in second sample/number recaptured;	4	2. Accept examples e.g., marking should not be toxic.

Question	Marking Guidance	Mark	Comments
10.5	1. Less chance of recapturing fish **OR** Unlikely fish distribute randomly/evenly;	1	Accept 'harder to capture marked fish' (recaptured fish) but ignore 'harder to capture fish'. Accept that fish may remain in one area. Accept fish may congregate.