A-LEVEL
BIOLOGY

7402/1
Mark scheme

7402
June 2017

Version: 1.0 Final

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 Assessment Writer.

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

Mark scheme instructions 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 and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information in the 'Comments' column 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

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 the same mark are indicated by the use of **OR**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

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 (often prefaced by 'Ignore' in the 'Comments' column of the mark scheme) are not penalised.

3.2 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can usually be gained by correct substitution / working and this is shown in the 'Comments' column or by each stage of a longer calculation.

3.3 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.

3.4 Errors carried forward, consequential marking and arithmetic errors

Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ECF or consequential in the mark scheme.

An arithmetic error should be penalised for one mark only unless otherwise amplified in the mark scheme. Arithmetic errors may arise from a slip in a calculation or from an incorrect transfer of a numerical value from data given in a question.

3.5 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.6 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.

3.7 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient 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.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

Question	Marking Guidance	Mark	Comments
1.1	**One of** RNA/ribonucleic acid(s)/nucleotide(s)/nucleic acid(s)/rRNA/ribosomal RNA/ribosomal ribonucleic acid **and** **one of** protein(s)/polypeptide(s)/amino acid(s)/ peptide(s)/ribosomal protein;	1	Reject DNA, deoxyribonucleic acid, tRNA, transfer RNA, transfer ribonucleic acid, mRNA, messenger RNA, messenger ribonucleic acid. Ignore enzyme(s), base(s).
1.2	1. mRNA binds to ribosome; 2. Idea of <u>two</u> codons/binding sites; 3. (Allows) tRNA with <u>anticodons</u> to bind/associate; 4. (Catalyses) formation of <u>peptide</u> bond between <u>amino acids</u> (held by tRNA molecules); 5. Moves along (mRNA to the next codon)/translocation described;	3 max	Assume 'it' refers to ribosome.
1.3	TGCGTAATA; Any errors = 0 marks	1	
1.4	1. Introns (in pre-mRNA); 2. Removal of sections of (pre-mRNA)/splicing;	2	'Introns removed' scores 2 marks. Reference to 'introns present in mRNA' disqualifies mp1 but allow ECF for mp2. Accept for 1 mark mRNA contains <u>only</u> exons.

Question	Marking Guidance	Mark	Comments
2.1	1. Polysaccharide of α-glucose; **OR** polymer of α-glucose; 2. (Joined by) glycosidic bonds **OR** Branched structure;	2	
2.2	1. Hydrolysed (to glucose); 2. Glucose used in respiration;	2	1. Ignore 'Broken down' 2.'Energy produced' disqualifies mp2
2.3	1. Membrane folded **so** increased/large surface area; **OR** Membrane has increased/large surface area **for** (fast) diffusion/facilitated diffusion/active transport/co-transport; 2. Large number of protein channels/carriers (in membrane) **for** facilitated diffusion; 3. Large number of protein carriers (in membrane) **for** active transport; 4. Large number of protein (channels/carriers in membrane) **for** co-transport;	2 max	1. Accept 'microvilli to increase surface area' 1. Reject reference to villi. Note feature and function required for each marking point and reference to large/many/more. List rule applies.
2.4	3.3×10^{-5} **OR** 3.28×10^{-5} **OR** 3.281×10^{-5};; 1 mark for Evidence of 128 (cells) Correct numerical calculation but not in standard form gains 1 mark (0.00003281 **OR** 0.0000328 **OR** 0.000033);	2	Accept any number of significant figures as long as rounding correct (3.28125×10^{-5} scores 2 marks)

Question	Marking Guidance	Mark	Comments
3.1	1. Co-transport; 2. Uses (hydrolysis of) ATP; 3. Sodium ion and proton bind to the protein; 4. Protein changes shape (to move sodium ion and/or proton across the membrane);	3 max	3. Accept 'Na^+ and H^+ bind to protein' but do not allow incorrect chemical symbols
3.2	1. Tenapanor/(Group)**B**/drug causes a significant increase; **OR** There is a significant difference with Tenapanor/drug/between **A** and **B;** 2. There is a less than 0.05 probability that the difference is due to chance; 3. (More salt in gut) reduces water potential in gut (contents); 4. (so) less water absorbed out of gut (contents) by osmosis **OR** Less water absorbed into cells by osmosis **OR** Water moves into the gut (contents) by osmosis. **OR** (so) water moves out of cells by osmosis;	4	1. and 2. Reject references to 'results' being significant/due to chance once only. 2. Do not credit suggestion that probability is 0.05% or 5. 2. Accept 'There is a greater than 0.95/95% probability that any difference between observed and expected is **not** due to chance
3.3	1. (Higher salt) results in lower water potential of tissue fluid; 2. (So) less water returns to capillary by osmosis (at venule end); **OR** 3. (Higher salt) results in higher blood pressure/volume; 4. (So) more fluid pushed/forced out (at arteriole end) of capillary;	2	For 'salt' accept 'sodium ions'. Do not allow mix and match of points from different alternative pairs 3. Accept higher hydrostatic pressure.

Question	Marking Guidance	Mark	Comments
4.1	1. Binary fission; 2. Replication of (circular) DNA; 3. Division of cytoplasm to produce 2 daughter cells; 4. Each with single copy of (circular) DNA;	2 max	1. Ignore reference to 'chromosome' 2. Ignore 'copy'. 4. Ignore references to number of plasmids
4.2	1. Both denatured (by high temperature); 2. Denaturation faster at 60 °C due to more (kinetic) energy; 3. Breaks hydrogen/ionic bonds (between amino acids/R groups); 4. Change in shape of the active site/active site no longer complementary **so** fewer enzyme-substrate complexes formed/substrate does not fit;	4	3. Ignore references to disulphide bonds 4. Accept '(at 60^0 C) Change in shape of the active site/active site no longer complementary **so** no enzyme-substrate complexes formed/substrate does not fit;
4.3	1. To digest protein; 2. (So) they can absorb amino acids for growth/reproduction/protein synthesis/synthesis of named cell component; **OR** (So) they can destroy a toxic substance/protein;	2	1. For 'digest' accept 'break down' here. 2. Accept '(so) they can destroy antibodies/antibiotics/ viral antigens/bacterial antigens'

4.4	1. Hydrolyse (peptide bonds) to release amino acids; 2. Amino acids can cross (cell) membrane; **OR** Dipeptides cannot cross (cell) membrane; **OR** Maintain concentration gradient of amino acids for absorption; **OR** Ensure (nearly) maximum yield from protein breakdown;	2	2. Ignore references to crossing gut membranes. 2. Accept 'there are carrier proteins for amino acids' 2.Accept 'no carrier proteins for dipeptides'

Question	Marking Guidance	Mark	Comments
5.1	ATP ⟶ ADP + Pi + H2O ☐ ATP + H2O ⟶ ADP + Pi ☐ ADP + Pi ⟶ ATP + H2O ✓ ADP + Pi + H2O ⟶ ATP ☐	1	
5.2	Human ATP synthase has a different <u>tertiary</u> structure to bacterial ATP synthase **OR** Human ATP synthase has a different <u>shape active site</u> to bacterial ATP synthase **OR** Antibiotic cannot enter human cells/mitochondria **OR** Antibiotic not <u>complementary</u> (to human ATP synthase);	1	
5.3	0.75;; One mark for showing 30 g = 0.03 <u>kg</u>; One mark for showing 0.025 <u>mg g^{-1}</u>	2	
5.4	Answer in range 97.0 – 97.8%;; **OR** Answer in range 3288 – 4368%;;	2	1 mark for correct $\log_{10}$ readings from graph converted to actual numbers (16.98 – 19.50 **and** 660.7 – 758.6)

5.5	1. (From Fig 2) New/old antibiotic does not kill all bacteria; **OR** (From Fig 2) Some bacteria are resistant to the new/old antibiotic; 2. Resistant bacteria will reproduce to produce (more) resistant bacteria; 3. (Use of both) one antibiotic will kill bacteria resistant to the other antibiotic; **OR** Unlikely that bacteria are resistant to both the new and the old antibiotic; **OR** Use of both antibiotics (likely to) kill all/most bacteria;	3	Accept use of '**A**' for 'new antibiotic' and '**R**' for 'old antibiotic'. 1. Must relate to the bacteria that are still present – 'some bacteria are killed' or 'the bacteria number is reduced' is insufficient. 2. Accept 'resistant bacteria reproduce to pass on resistance gene/allele' 3. 'Use of both antibiotics will be more effective' is insufficient.

Question	Marking Guidance	Mark	Comments
6.1	1. Concentration of mineral ion/named mineral ion in soil; 2. Soil pH; 3. Temperature; 4. Light intensity/wavelength/duration; 5. Distance between seeds/plants; 6. Volume of water given; 7. CO_2 concentration; 8. Humidity;	2 max	1 and 2. Allow 'growing solution' for 'soil'. 2. pH alone is insufficient. 3. Allow 'colour of light' Reject 'amount' for mps 1, 4, 6 and 7. Ignore O_2 concentration **Three correct = 2 marks** **Two correct = 1 mark** **One or none correct = 0 marks**

6.2	1. 2,4-D causes an increase in release of ions from wild oat cells **and** 2,4-D does not affect/has little effect on the release of ions from wheat cells; 2. (For wheat) Difference is less than LSD/7 **so** <u>difference</u> is not significant; **OR** (For wild oats) Difference is more than LSD/10 **so** <u>difference</u> is significant; 3. Loss of ions from cells (likely to) lead to cell/plant death/damage; **OR** Disruption of cell membrane (likely to) lead to cell/plant death/damage; 4. No evidence here about death of plants as a result of this ion loss; 5. No evidence here of other ecological/environmental impact;	4 max	1. Accept reference to 'concentration of ions in water' or 'disruption of the cell membranes' in place of 'release of ions' 1. Accept 'difference in release of ions from wild oats is 25 **and** difference in release of ions from wheat is 1' 2. Accept '(For wheat) difference is less than LSD **so** greater than 5% probability that <u>difference</u> is due to chance' OR '(For oats) difference is more than LSD **so** less than 5% probability that <u>difference</u> is due to chance' 5. Accept 'development of resistance'

6.3	1. (Maintain temperature) so that the rate of diffusion (of ions out of cells) remains constant **OR** (Maintain temperature) so no change in fluidity of phospholipids/kinetic energy of phospholipids; **OR** (Maintain temperature) so no change in shape/structure/denaturation of membrane proteins; 2. (Shaking) So all surfaces of the leaf discs are exposed (to water)/so all submerged; **OR** To maintain diffusion/concentration gradient (for ions out of leaf discs);	2	1. Ignore references to rate of enzyme catalysed reactions 2. Accept 'so that leaf discs do not stick together'

Question	Marking Guidance	Mark	Comments
7.1	1. Phagosome/vesicle fuses with lysosome; 2. (Virus) destroyed by lysozymes/hydrolytic enzymes; 3. Peptides/antigen (from virus) are displayed on the cell membrane;	3	1. Accept vacuole fuses with lysosome 1. Reject virus fuses with lysosome
7.2	1. Helper T cell/TH cell binds to the antigen (on the antigen-presenting cell/phagocyte); 2. This helper T/TH cell stimulates a specific B cell; 3. B cell clones **OR** B cell divides by mitosis; 4. (Forms) plasma cells that release antibodies;	3 max	1. and 2. 'Helper' is required **once** only. 2. Accept 'This (helper) T cell stimulates a competent B cell' 'T cell stimulates B cell to undergo clonal selection'. This statement achieves mp2 and mp3.
7.3	1. The antibody against virus (antigen) will bind to collagen; 2. This results in the destruction of the (human) cells/collagen;	2	2. Ignore 'attacks'

<table>
<tr><th>Question</th><th>Marking Guidance</th><th>Mark</th><th>Comments</th></tr>
<tr><td>8.1</td><td>1. (Without genetic analysis/X) mackloti and olivaceus have a more recent common ancestor with each other (than with papuana);
2. (Genetic analysis indicates/Y) papuana and mackloti have a more recent common ancestor with one another (than with olivaceus);</td><td>2</td><td>Accept ‘more closely related to’ for ‘more recent common ancestor’</td></tr>
<tr><td>8.2</td><td><table><tr><td>Domain</td><td>Eukaryote</td></tr><tr><td>Kingdom</td><td>Animal</td></tr><tr><td>Phylum</td><td>Chordata</td></tr><tr><td>Class</td><td>Reptilia</td></tr><tr><td>Order</td><td>Squamata</td></tr><tr><td>Family</td><td>Python</td></tr></table>;
All 5 correct = 1 mark
Any errors = 0 marks</td><td>1</td><td></td></tr>
<tr><td>8.3</td><td>Genus/genera;</td><td>1</td><td>If the response has two answers no mark is awarded.</td></tr>
<tr><td>8.4</td><td>1. The (base) sequence of DNA;
2. The (base) sequence of mRNA;
3. The amino acid sequence (of proteins);</td><td>3</td><td>1. Accept ‘DNA hybridisation’</td></tr>
</table>

Question	Marking Guidance	Mark	Comments
9.1	1. Tracheoles have thin walls **so** short diffusion distance to cells; 2. Highly branched/large number of tracheoles **so** short diffusion distance to cells; 3. Highly branched/large number of tracheoles **so** large surface area (for gas exchange); 4. Tracheae provide tubes full of air **so** fast diffusion (into insect tissues); 5. Fluid in the end of the tracheoles that moves out (into tissues) during exercise **so** faster diffusion through the air to the gas exchange surface; **OR** Fluid in the end of the tracheoles that moves out (into tissues) during exercise **so** larger surface area (for gas exchange); 6. Body can be moved (by muscles) to move air **so** maintains diffusion/concentration gradient for oxygen/carbon dioxide;	3 max	1. Do not accept unqualified references to thin membranes. Max 2 if any reference to blood Ignore references to spiracles 5. Accept 'water' for fluid. Accept 'cells' and 'tissues' as interchangeable words.
9.2	1. Damselfly larvae has high(er) metabolic/respiratory (rate); 2. (So) uses more oxygen (per unit time/per unit mass);	2	Idea of 'more/high' is needed for both mark points. 2. Accept 'needs' for 'uses' 2. Ignore references to absorbing/obtaining/uptake of more oxygen
9.3	Mean SA = 9.85 $\underline{mm^2}$/9.9 $\underline{mm^2}$;; Percentage uncertainty of SA = 18.5/18.7/19;; If both answers incorrect 1 mark for Percentage uncertainty of dimensions 11.8/12 and 6.70/6.7 Surface area correctly calculated with correct units but not rounded to appropriate sf (9.8532 $\underline{mm^2}$) Surface area correct (with appropriate sf) but	3 max	Both answers correct = 3 marks 1 answer correct only = 2 Both answers incorrect = max 1

	no/incorrect unit given		
9.4	1. Don't use shading; 2. Only use single lines/don't use sketching (lines)/ensure lines are continuous/connected; 3. Add further labels/annotations; 4. Don't cross label lines; 5. Add magnification/scale (bar);	2 max	Reject 'colour in'. Reject 'use of electron microscopes' Ignore 'use a sharp pencil'

Question	Marking Guidance	Mark	Comments
10.1	1. TEM use electrons **and** optical use light; 2. TEM allows a greater resolution; 3. (So with TEM) smaller organelles/named cell structure can be observed **OR** greater detail in organelles/named cell structure can be observed; 4. TEM view only dead/dehydrated specimens **and** optical (can) view live specimens; 5. TEM does not show colour **and** optical (can); 6. TEM requires thinner specimens; 7. TEM requires a more complex/time consuming preparation; 8. TEM focuses using magnets and optical uses (glass) lenses;	6 max	3. 'clearer' is not equivalent to 'detail' 4. Accept 'Only optical can view live specimens' 5. Accept 'Only optical can show colour' 7. Accept 'TEM requires a more difficult preparation' Ignore references to artefacts
10.2	1. **W** has 4 cells/nuclei since it is at the (end of) 2nd division (of meiosis); 2. **Z** has 2 cells/nuclei since it is at the (end of) 1st division (of meiosis); 3. **W** shows haploid cells/cells containing n chromosomes; 4. (Cells in) **W** contain half the (mass of) DNA of (Cells in) **Z**; **OR** (between **Z** and **W**) chromatids have separated; **OR** In **Z** homologous chromosomes have separated;	4	Ignore '**Z** shows diploid cells/contains 2n chromosomes' 4. Accept '**W** contains half the amount of DNA of **Z**'

10.3	1. Use random sample of seeds (from each population); 2. Use (large enough) sample to be representative of whole population; 3. Indication of what size was measured eg mass; 4. Calculate a mean and standard deviation (for each population); 5. Use the (Student's) t-test; 6. Analyse whether there is a significant difference between (the means of) the two populations;	5 max	1. Accept described, suitable method of random sampling. 1. Reject description of inappropriate method of random sampling (eg random coordinates in the field/use of quadrats) 2. Accept 'running mean does not change' 2. For representative accept 'reliable, reproducible, repeatable' OR a mean close to the true value. 5. Accept 'Use 95% confidence limits' 6. Reject unqualified references to results being significant