AQA

A-LEVEL
Biology

7402/1 - Paper 1

Mark scheme

June 2018

Version/Stage: 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.

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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. The (individual) chromosomes are visible because they have condensed; 2. (Each) chromosome is made up of two chromatids because DNA has replicated; 3. The chromosomes are not arranged in homologous pairs, which they would be if it was meiosis;	2 max	Both parts of each answer are required – evidence and explanation. 1. For 'they' accept 'chromosomes/chromatin/DNA' 1. Accept 'tightly coiled' or 'short and thick' for condensed but do not accept 'contracted'. 2. Accept 'sister chromatids' for 'two chromatids'. 3. Accept not meiosis because bivalents/chiasmata/crossing over not seen. Ignore references to nucleus/nucleolus/nuclear membrane.
01.2	Automarked q – ☑ prophase	1	
01.3	1. Water moves into the cells/cytoplasm by osmosis; 2. Cell/cytoplasm gets bigger;	2	1. Reject water moving into chromosomes/nucleus. 2. Accept idea of cell/cytoplasm has greater volume/swells/expands. 2. Ignore references to pressure changes, turgidity and chromosomes being more dilute. 2. Ignore references to changing water/fluid contents of the cell. 2. Allow ECF for 'nucleus expands' but not for 'chromosomes expand'.

Question	Marking Guidance	Mark	Comments
01.4	Differences in base sequences OR Differences in histones/interaction with histones OR Differences in condensation/(super)coiling;	1	Answer must be in context of differences in arrangement of chromosomes not just related to the properties of the stain. Accept spec section 8 ideas e.g. different methylation/acetylation Accept different genes Reject different alleles
01.5	(Two chromosomes that) carry the same genes;	1	Reject 'same alleles' Accept 'same loci' (plural) or 'genes for the same characteristics'
01.6	(Prokaryotic DNA) is 1. Circular (as opposed to linear); 2. Not associated with proteins/histones ; 3. Only one molecule/piece of DNA OR present as plasmids;	2 max	Max 1 if prokaryotic DNA only found as plasmids OR if prokaryotic DNA is single stranded. Ignore references to nucleus, exons, introns or length of DNA. Do not credit converse statements. Ignore descriptions of eukaryotic DNA alone.

Question	Marking Guidance	Mark	Comments
02.1	1. Method to ensure all cut surfaces of the eight cubes are exposed to the sucrose solution; 2. Method of controlling temperature; 3. Method of drying cubes before measuring; 4. Measure mass of cubes at stated time intervals;	3 max	Credit valid method descriptions to fulfil mp1, 2 and 3 (no explanation is required). 2. Accept 'at room temperature' for method 4. Accept time intervals between every 5 minutes with maximum of every 40 minutes. 4. Accept 'weigh the cubes at stated time intervals'
02.2	Yes or No (no mark) Calculation of rate per mm^2 for both sets of data, accept answers in the range 1.6×10^{-5} to 1.8×10^{-5} **and** 1.5×10^{-5} to 1.6×10^{-5};;; Both correct = 3 One correct = 2 Neither correct – look below for max 2 Allow 1 mark for calculation of surface area of two (sets of) cubes 7350 (mm^2) and 14700 (mm^2) Allow 1 mark for calculation of both rates of osmosis shown in first 40 minutes – between 0.12 and 0.13 **and** between 0.22 and 0.23 If surface area and/or rate of osmosis is incorrect then, allow 1 mark for (their) calculated rate divided by (their) calculated surface area	3	Accept answers not given in standard form or to any number of significant figures ≥2sf as long as rounding correct.

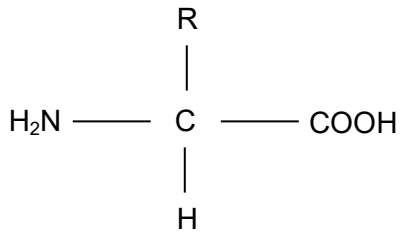
Question	Marking Guidance	Mark	Comments
03.1	(A measure of) the number of (different) species in a community;	1	For 'community' accept 'habitat/ecosystem/one area/environment' Reject 'in a population'.

Question	Marking Guidance	Mark	Comments
03.2	**Yes, natural best, because** 1. Peak of (mean) bee numbers in natural habitat is highest; 2. The (mean) number of bees was higher in the natural habitat until day 200; 3. (Mean) species richness in natural habitat higher at all times; **No, natural not best, because** 4. Lowest (mean) number of bees after day 220; **Yes, town worst, because** 5. Peak of species richness higher in <u>both</u> natural and farmland OR Species richness lowest in town from day 125; **No, town not worst, because** 6. (Mean) species richness is lower in farmland until day 125; 7. Similar (mean) number of bees to farmland; OR (Mean) number of bees lower in farmland until day 140; **General, no, because** 8. Index of diversity of bees not measured OR The number of bees of each species is not known;	4 max	1. For accept description for 'peak'. 2. For 'day 200' accept any day between 190 and 210. 2. For 'until day 200' accept 'for 200 days'. 4. For 'day 220' accept any day between 210 and 230. 5 and 6. For 'day 125' accept any day between 115 and 135. 6. For 'until day 125' accept 'for 125 days'. 7. For 'day 140' accept any day between day 130 and 150. 7. For 'until day 140' accept 'for 140 days'

Question	Marking Guidance	Mark	Comments
03.3	1. Must not harm the bees OR Must allow the bee to be released unchanged; 2. Must allow close examination OR Use a key (to identify the species);	2	2. Accept method that allows close examination 2.Ignore references to DNA sequencing 2. Accept 'use photographs/specimens (to identify species)'
03.4	1. Collect at more times of the year **so** more points on graph/better line (of best fit) on graph; 2. Counted number of individuals in each species **so** that they could calculate index of diversity; 3. Collected from more sites/more years **to** increase accuracy of (mean) data;	2 max	Both suggestion and explanation is required for each mark point. 1. The explanation must relate to the graph. 3. For 'accuracy' accept 'representative'.
03.5	1. *A. chlorogaster* and *A. piperi* are more closely related (to each other than to *P. pruinosa*); 2. Because they are in the same genus;	2	1. Must be a comparative statement. 1. Accept *A. chlorogaster* and *A. piperi* share a more recent/closer common ancestor (than they do with *P. pruinosa*); Ignore references to *A. chlorogaster* and *A. piperi* not being related to *P. pruinosa* or not having a common ancestor with *P. pruinosa*.

Question	Marking Guidance	Mark	Comments
04.1	1. Reduces activation energy; 2. Due to bending bonds OR Without enzyme, very few substrates have sufficient energy for reaction;	2	1. Accept 'reduces E_a'. 2. Accept 'Due to stress/pressure/tension on bonds' OR 'Due to weakening bonds'. 2. Ignore references to 'breaking bonds'.
04.2	1.93×10^{11};; Allow 1 max for $578/3.0 \times 10^{-9}$ 1.93×10^{x} when $x \neq 11$ Correct answer with incorrect standard form e.g. 19.3×10^{10}	2	Accept any number of significant figures ≥2, if rounding correct ($1.926^{\bullet} \times 10^{11}$). Same principle applies to one max answers.
04.3	31.4;; Allow 1 max for 0.44 **and** 1.4 32.8 33.1 30 29.3	2	Accept any number of significant figures ≥2, if rounding correct (31.4284714). Same principle applies to 1 max answers. 32.8 = Both readings at 2.5 mmol dm^{-3} (0.44/1.34) 33.1 = Both readings at 2.5 mmol dm^{-3} (0.44/1.33) 30 = Incorrect reading for C (0.42/1.4) 29.3 = Incorrect reading for C (0.41/1.4)

Question	Marking Guidance	Mark	Comments
04.4	1. (Binding) alters the tertiary structure of the enzyme ; 2. (This causes) <u>active site</u> to change (shape); 3. (So) More (successful) E-S complexes form (per minute) OR E-S complexes form more quickly OR Further lowers activation energy;	3	Max 1 if lyxose acting as an inhibitor OR if answer linked to lower rate of reaction OR if lyxose used an energy source/respiratory substrate 3. Accept 'acts as a co-enzyme' 3. Accept description for E-S complexes.

Question	Marking Guidance	Mark	Comments
05.1		1	Accept other correct representations.
05.2	1. More than one codon codes for a single amino acid; 2. Suitable example selected from Table 1;	2	1. Accept 'triplet' or 'sequence of 3 bases/nucleotides' for 'codon'. 1. Reject 'production/produces' for 'codes for'. Do not infer mp1 from mp2.
05.3	1395;	1	Accept 1398 and 1401 (for those that include start and/or stop codons) Allow 2796 or 2802 or 2790 Ignore 'bases/base pairs/bp/bps' written after the numerical answer.
05.4	☑CAA → CGA	1	

Question	Marking Guidance	Mark	Comments
05.5	1. (Both) negatively charged to positively charged change in amino acid; 2. Change at amino acid 300 does not change the shape of the <u>active site</u> OR Change at amino acid 300 does not change the tertiary structure OR Change at amino acid 300 results in a similar tertiary structure; 3. Amino acid 279 may have been involved in a (ionic, disulfide or hydrogen) bond **and** so the shape of the active site changes OR Amino acid 279 may have been involved in a (ionic, disulfide or hydrogen) bond **and** so the tertiary structure changed; OR Amino acid 279 may be in the active site **and** be required for binding the substrate;	3	2. and 3. Reference to 'shape' of active site only needed once. 3. Both parts are required for each mark option. 3. For 'a bond' reject peptide bond.

Question	Marking Guidance	Mark	Comments
06.1	1. 1 long and 1 short chromosome, each made up of 2 chromatids held (by centromere), in each cell of 1st division; 2. 1 long and 1 short (separate) chromosome in each cell of 2nd division;	2	2. Allow ECF for correct chromosomes shown in each cell from candidate's 1st division cells. 2. Ignore drawing of centromere.
06.2	<table><tr><td>52</td><td>4</td></tr></table> ;; Allow 1 mark for numbers totalling 56 except 14/42 - repetition of observed values. If table is blank, award 1 mark for evidence of 56.	2	Both 52 and 4 required in table for two marks, do not credit 52 or 4 for one mark. Award 1 max for answers not given as whole numbers.
06.3	1. There is a less than 0.05/5% <u>probability</u> that the <u>difference</u>(s) (between observed and expected) occurred by <u>chance</u>; 2. Calculated value is greater than critical value so the null hypothesis can be rejected; 3. (The scientists can conclude that) the proportion of plants that produce 2n gametes does change from one breeding cycle to the next;	2 max	1. Reject 'results (without reference to difference) occurring by chance'. Overall max 1 with this statement. 1. Accept 'there is a greater than 0.95/95% <u>probability</u> that the difference did **not** occur by <u>chance</u>'. 1. and 2. Ignore 'difference is significant' 2. Do not accept 'P value' for 'critical value'.

Question	Marking Guidance	Mark	Comments
06.4	1. The scientists selected/used for breeding plants that produced 2n gametes; 2. (So these plants) passed on their alleles (for production of 2n gametes to the next generation); 3. The frequency of alleles for production of 2n gametes increased (in the population).	3	For 'production of 2n gametes' accept 'abnormal meiosis'. 1. Answer must be in context of the scientists selecting plants to breed. Accept 'artificial selection' or 'selectively bred'. 2 and 3. Both mark points can be awarded if one correct reference is made to alleles (in either context). 3. Do not accept 'number' for frequency. Accept converse answers linked to plants that produce n gametes.

Question	Marking Guidance	Mark	Comments
07.1	1. (Antivenom/Passive immunity) antibodies bind to the toxin/venom/antigen and (causes) its destruction; 2. Active immunity would be too slow/slower;	2	1. For 'bind' accept 'attach', ignore 'attack'. 1. For 'destruction of toxin' accept agglutination or phagocytosis. 1. Ignore reference to antibodies 'neutralising toxin/stopping damage' 1. Reject reference to 'killing' toxin/venom. 2. Accept 'passive immunity is faster', not simply 'passive immunity is fast'.
07.2	1. May be different form of antigen/toxin (within one species) OR Snakes (within one species) may have different mutations/alleles; 2. Different antibodies (needed in the antivenom) OR (Several) antibodies complementary (to several antigens);	2 max	No mark points are available for answers related to collecting venom from different species of snake.
07.3	1. Horses **because** more antivenom/antibodies could be collected (as more blood collected); 2. 4550 (cm^3) v 26 (cm^3) (blood collected);	2	2. Accept 175 rabbits needed to (collect the volume of blood from) one horse.

Question	Marking Guidance	Mark	Comments
07.4	1. (So) the animal does not suffer from the venom/vaccine/toxin; 2. (So) the animal does not suffer anaemia/does not suffer as a result of blood collection; 3. (So) the animal does not have pathogen that could be transferred to humans;	1 max	Accept 'To fulfil licence/legal requirements'. Accept '(So) the animal does not have pathogen that could result in it producing other antibodies (not wanted in the antivenom)'. For 'pathogen' accept correct form of pathogen.
07.5	1. B cells specific to the venom reproduce by mitosis; 2. (B cells produce) plasma cells and memory cells; 3. The second dose produces antibodies (in secondary immune response) in higher concentration **and** quickly OR The first dose must be small so the animal is not killed;	3	1. Accept in context of primary or secondary immune response. 1. Credit idea of specificity if given once in relation to T or B cell. 1. Accept a description for specificity. 1. Accept 'clone' for 'reproduce by mitosis'. 1. 'Clonal selection of B cells' = MP1. 3. Accept 'a lot of antibody' for 'higher concentration of antibody'.

Question	Marking Guidance	Mark	Comments
08.1	**EITHER** 1. The radioactively labelled carbon is converted into sugar/organic substances during photosynthesis; 2. Mass flow/translocation in the phloem throughout the plant only in plants that were untreated/**B**/control OR Movement of sugar/organic substances in the phloem throughout the plant only in plants that were untreated/**B**/control; **OR** 3. Movement in phloem requires living cells/respiration/active transport/ATP; 4. Heat treatment damages living cells **so** transport in the phloem throughout the plant only in plants that were untreated/**B**/control OR Heat treatment stops respiration/active transport/ATP production **so** transport in the phloem throughout the plant only in plants that were untreated/**B**/control;	2	Do not mix and match – award either mp1 and mp2 or mp3 and mp4. 1. For 'organic substance' accept named organic substance, eg glucose, sucrose, amino acid. 2. Accept 'translocation/mass transport in the phloem past the heat treatment only in the untreated plant/**B**/control'. 2. Accept converse for heat-treated plant/**A** ie Movement of sugar/organic substances/mass flow/translocation in the phloem stops (beyond the heat treatment) in treated plants/**A**.
08.2	1. (The water content of the leaves was) not different because (means $\pm$ 2) standard deviations overlap; 2. Water is (therefore) still being transported in the xylem (to the leaf) OR Movement in xylem is passive **so** unaffected by heat treatment;	2	1. For 'not different' accept 'difference is not significant' or 'difference due to chance'.

Question	Marking Guidance	Mark	Comments
08.3	1. Heat treatment has a greater effect on young leaves than old; 2. Heat treatment damages the phloem; 3. Fe^{3+} moves up the leaf/plant; 4. (Suggests) Fe^{3+} is transported in the xylem in older leaf; 5. In young leaf, some in xylem, as some still reaches top part of leaf; 6. (Suggests) Fe^{3+} is (mostly) transported in phloem in young leaf OR Xylem is damaged in young leaf OR Xylem is alive in young leaf; 7. Higher ratio of Fe^{3+} in (all/untreated) old leaves than (all/untreated) young; 8. All ratios show there is less Fe^{3+} in the top than the lower part of leaves; 9. (But) no statistical test to show if the difference(s) is significant;	4 max	1. Accept description of no/little/(slight) increase effect in old leaves and change in young leaves. 7. Accept 'more at the top' for 'higher ratio'. 9. Accept '(But) no standard deviations to show if the difference(s) is significant'.

Question	Marking Guidance	Mark	Comments
09.1	1. (DNA) helicase causes breaking of hydrogen/H bonds (between DNA strands); 2. DNA polymerase joins the (DNA) nucleotides; 3. Forming phosphodiester bonds;	3	1. Reject 'helicase hydrolyses hydrogen bonds'. 2. Reject if suggestion that DNA polymerase joins the complementary nucleotides or forms H bonds. 2. Reject if joining RNA nucleotides or forming RNA.

Question	Marking Guidance	Mark	Comments
09.2	1. (Treatment **D** Antibody binds to cyclin A so) it cannot bind to DNA/enzyme/initiate DNA replication; 2. (Treatment **E**) RNA interferes with mRNA/tRNA/ribosome/polypeptide formation (so cyclin A not made); 3. In Treatment **F** added cyclin A can bind to DNA/enzyme (to initiate DNA replication) OR Treatment **F** shows that it is the cyclin A that is being affected in the other treatments OR Treatment **F** shows that cyclin A allows the enzyme to bind (to DNA) OR (Some cells in **D** or **E**) can continue with DNA replication because they have a different cyclin A <u>allele</u> OR (Some cells in **D** or **E**) can continue with DNA replication because the antibody/RNA has not bound to all the cyclin A protein/mRNA OR (Some cells in **E**) can continue with DNA replication because they contain previously translated cyclin A;	3	1. For 'bind to enzyme' accept 'activate'. 1. Idea of 'initiate DNA replication' must be linked to start not just less replication. 1. and 3. For 'enzyme' accept named enzyme. 3. Context needed for Treatment **F** but it does not need to be named.

Question	Marking Guidance	Mark	Comments
10.1	1. Named structures – trachea, bronchi, bronchioles, alveoli; 2. Above structures named in correct order OR Above structures labelled in correct positions on a diagram; 3. Breathing in – diaphragm contracts **and** external intercostal muscles contract; 4. (Causes) volume increase and pressure decrease in thoracic cavity (to below atmospheric, resulting in air moving in); 5. Breathing out - Diaphragm relaxes **and** internal intercostal muscles contract; 6. (Causes) volume decrease and pressure increase in thoracic cavity (to above atmospheric, resulting in air moving out);	6	1, 2. Reject mp1 if structures from other physiological systems are named but award mp2 if the correct structures are in the correct order. 4. and 6. For thoracic cavity accept 'lungs' or 'thorax'. 4. and 6. Reference to 'thoracic cavity' only required once. If idea of thoracic cavity is missing or incorrect, allow ECF for mark point 6. 5. Accept diaphragm relaxes **and** (external) intercostal muscles relax **and** lung tissue elastic (so recoils).

Question	Marking Guidance	Mark	Comments
10.2	1. Both contain ester bonds (between glycerol and fatty acid); 2. Both contain glycerol; 3. Fatty acids on both may be saturated or unsaturated; 4. Both are insoluble in water; 5. Both contain C, H and O **but** phospholipids also contain P; 6. Triglyceride has three fatty acids **and** phospholipid has two fatty acids plus phosphate group; 7. Triglycerides are hydrophobic/non-polar **and** phospholipids have hydrophilic and hydrophobic region; 8. Phospholipids form monolayer (on surface)/micelle/bilayer (in water) **but** triglycerides don't;	5 max	All statements **must** be clearly comparative or linked by the candidate, not inferred from separate statements. Accept mark points shown on adjacent annotated diagrams. 5. Must relate to element. 7. Accept 'non-polar' for hydrophobic and 'polar' for hydrophilic.

Question	Marking Guidance	Mark	Comments
10.3	1. Glucose **and** galactose; 2. Joined by condensation (reaction); 3. Joined by glycosidic bond; 4. Added to polypeptide in Golgi (apparatus);	4	1. Ignore α or β for glucose