AS
BIOLOGY
7401/2

Paper 2

Mark scheme

June 2019

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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

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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. (Reference to) hydrolysis of peptide bonds; 2. Endopeptidase act in the middle of protein/polypeptide **OR** Endopeptidase produces short(er) polypeptides/ increase number of ends; 3. Exopeptidases act at end of protein/polypeptide **OR** Exopeptidase produces dipeptides/amino acids; 4. Dipeptidase acts on dipeptide/between two amino acids **OR** Dipeptidase produces (single) amino acids;	4	Accept chain/chain of amino acids/peptide for polypeptide Accept digest/breakdown/ break for 'act' Mark points 2, 3 and 4 **reject** answers where substrate or product is incorrect eg 'Endopeptidase produces dipeptides' Ignore references to source and location of enzymes
01.2	1. No significant difference (in protein absorption); 2. (because ± 2) SDs overlap; 3. (So mean) <u>percentage</u> absorbed not affected by <u>percentage</u> in diet; 4. Amount of protein (in diet) is not a limiting factor **OR** Something else is limiting factor eg amount of protease; 5. (But) small range of protein in diet **OR** (Should) Investigate wider range;	3 max	Ignore reference to 'significance' unless qualified, eg 'difference' 2. Accept error bar for SD
01.3	1. More/remaining/undigested (protein) broken down; 2. (So more) amino acids absorbed; 3. (Because) protein/food passes again through stomach/ileum;	3	1. Accept all (protein) broken down
TOTAL		**10**	

Question	Marking Guidance	Mark	Comments
02.1	1. Increases/more oxygen dissociation/unloading **OR** Deceases haemoglobin's affinity for O_2; 2. (By) decreasing (blood) pH/increasing acidity;	2	1. Accept more readily 1. Accept releases more O_2 2. Reject if reference made to active site
02.2	1. High(er) affinity for O_2 (than haemoglobin) **OR** Dissociates oxygen less readily **OR** Associates more readily; 2. Allows (aerobic) respiration when diving/at low(er) pO_2 **OR** Provides oxygen when haemoglobin unloaded **OR** Delays anaerobic respiration/lactate production;	2	1. Accept holds O_2 at lower ppO_2 2. Accept acts as an oxygen store
02.3	Correct answer for 2 marks 10.8 to 11 (mins) **OR** 10 minutes and 48 seconds = 2 marks;; Accept for 1 mark, 10.48 minutes **OR** Reference to 2057.7 to 2058 (10 700 ÷ 5.2, time oxygen would last if its mass was 1 kg) **OR** Reference to 56 to 56.3 (10700 ÷ 190, oxygen in 1 kg of seal) **OR** Reference to 988 (5.2 x 190, oxygen used min^{-1} by the seal) **OR** Incorrect answer with correct answer shown in working	2	
TOTAL		**6**	

Question	Marking Guidance	Mark	Comments
03.1	Watson **and** Crick **OR** Crick **and** Watson;	1	Correct spelling Ignore first/given/fore names
03.2	DNA polymerase;	1	Correct spelling
03.3	**Role of single-stranded DNA fragments** 1. Template; 2. Determines order of nucleotides/bases; **Role of DNA nucleotides** 3. Forms complementary pairs / A – T, G - C **OR** Forms complementary (DNA) strand;	3	3. Ignore forms complementary bases 3. Accept sequence/ chain for strand
TOTAL		**5**	

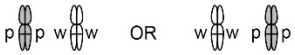
Question	Marking Guidance	Mark	Comments
04.1	1. Bind to antigen **OR** Are markers; 2. (Antibodies) cause clumping/agglutination **OR** Attract phagocytes;	2	1. Accept opsonin for 'marker' 1. Accept form (antibody-antigen) complexes/are complementary to antigen 2. **Reject** clotting
04.2	Correct answer for 2 marks 110/111/111.1;; Accept for 1 mark, correct readings from graph (5.1 **and** 2.1)	2	
04.3	1. Mean (antibody concentration) increases; 2. 1st injection protects some mice/1 mouse/2 mice **OR** 1st injection causes primary (immune) response/memory cell production; 3. 2nd/3rd injection protects most/all mice **OR** 2nd/3rd injection causes secondary (immune) response **OR** 2nd/3rdinjection uses memory cells; 4. Because antibody at/above protective level/2.1; 5. Antibody decreased (rapidly after 3rd injection); 6. No mice protected after 180 days **OR** Injections/vaccine not effective in long term **OR** Booster required (when antibody below protective level/after 120/180 days); 7. One mouse (after first injection) has big response/already had meningitis/antigen;	4 max	2. and 3. Accept correct reference to number of unprotected mice 4. Accept converse

04.4	1. Inject vaccine (again)/meningitis antigen/ inactive antigen/dead/living bacteria/ pathogen/use a booster; 2. (Memory cells present if) faster/more rapid production/higher concentration antibody (than 1st injection) **OR** Immune response is quicker (than 1st injection) **OR** Symptoms do not develop; 3. Add enzyme attached to (second) antibody against memory cell; 4. Colour change shows memory cell present;	2	Mark as pairs, 1 and 2, 3 and 4 Accept for inject, introduce, give, use 1. Must refer to antigen or cell, 'disease' or 'meningitis' is not enough 2. Accept converse 2. Must be a comparison 4. Ignore to detect (meningitis) antibodies

TOTAL		**10**	

Question	Marking Guidance	Mark	Comments
05.1	1. Initial **and** final mass (of beaker and all contents); 2. Number of (groups of) xylem vessels;	2	1. Accept change in mass/weight 1. Ignore volume 1. Reject change in mass of celery/beaker/water alone 2. Accept amount for 'number'
05.2	Prevent evaporation/water loss **OR** (So) evaporation/water loss/transpiration only from celery;	1	
05.3	1. Water evaporates/is transpired (from leaves/ stalk/celery/plant); 2. Water potential gradient/lower water potential creates tension/pulls up water **OR** Osmosis creates tension/pulls up water; 3. Hydrogen bonds/cohesion/adhesion maintains column;	3	2. Accept negative pressure for tension
05.4	1. Cut away from body; 2. Against hard/non-slip/flat surface;	2	1. Accept description of cutting technique to avoid cutting fingers 2. Accept named hard surface eg tile/board
05.5	Median (no mark) 1. (Presence of) outliers/80/70 **OR** Small sample size/8 (measurements); 2. 41; Accept for 1 mark, Mean of 47 OR Mode of 35	2	1. Accept anomalies / extremes for 'outliers'
TOTAL		**10**	

Question	Marking Guidance	Mark	Comments
06.1	1. Wash hands **to** remove/kill microbes **OR** Wear gloves/apron **to** prevent contamination; 2. Burning Bunsen close by **to** create upward current of air; 3. Disinfect bench/work on disinfected cloth **to** kill microbes/prevent contamination; 4. Flame instrument/equipment **to** sterilise/kill microbes/prevent contamination; 5. Lift lid slightly **to** prevent entry of microbes;	3 max	Each **must** include an explanation 3. Accept use sterile/ antiseptic/bleach for 'disinfect' 4. Accept autoclave/ use alcohol/steam/boil for flame 4. Accept scalpel/ inoculating loop/wire loop/loop/forceps/ spreader for instrument 1. 3. 4. & 5. Accept microorganisms/ spores/bacteria/fungi/ contaminants for 'microbes'
06.2	Mitosis given first 1. One division, two divisions in meiosis; 2. (Daughter) cells **genetically** identical, daughter cells **genetically** different in meiosis; 3. Two cells produced, (usually) four cells produced in meiosis; 4. Diploid to diploid/haploid to haploid, diploid to haploid in meiosis; 5. Separation of homologous chromosomes only in meiosis; 6. Crossing over only in meiosis; 7. Independent segregation only in meiosis;	2 max	Differences must be given as comparisons Ignore references to asexual / sexual reproduction, growth, repair & replacement 2. Reference to 'genetically' needed once 4. Accept same number chromosomes in mitosis, but half the number in meiosis
06.3	28;	1	Automarking

06.4	1. Separation of homologous chromosomes (occurred) **OR** (Independent) segregation (occurred); 2. (Arrangement/separation/segregation of chromosomes is) random/ (almost) equally frequent (in tubes 1 and 2); 3. Crossing over occurred in tube 3/10 tubes; 4. (Crossing over) is rare/infrequent/in <u>only</u> 10 tubes;	3 max	1. Accept description of homologous chromosome movement for 'separation' 1. Accept alleles for 'chromosomes' 1. Accept as a labelled diagram of chromosomes eg  3. Accept as labelled diagram of crossing over 3. and 4. "Crossing over occurred in only 10 tubes" = 2 marks
TOTAL		**9**	

Question	Marking Guidance	Mark	Comments
07.1	**Type of selection** 1. Directional; **Reason:** 2. One extreme selected/removed/favoured/ chosen **OR** One extreme allowed to breed;	2	2. Ignore references to adaptations/ natural selection 2. Accept large fish/small fish for 'extreme'
07.2	1. As a baseline/control; 2. To show effect of no selection **OR** To show what happens in a normal population**/**naturally **OR** To show effect of/ compare with tank A/tank C;	2	2. Ignore reference to type of selection 2. Accept not removing/not catching/not fishing for 'selection' 2. Accept genetic drift for 'no selection' 2. Accept no fishing/no selection/no caught fish for 'normal population' 2. Accept to compare with other results
07.3	Correct answer for 2 marks (How much greater) 1.6 to 1.7;; Accept for 1 mark, 1.2 : 1 **and** 2 : 1 Accept for 1 mark, 4.1 : 3.4 **and** 4.8 : 2.4	2	Accept $\frac{5}{3}$ for 2 marks

07.4	**Not supported because** 1. (Sea) fishing reduces (mean) mass of fish; 2. Because large fish removed **OR** Because small fish escape/put back **OR** Because fishing (model) like Tank C; **But** 3. Information from (only) one species **OR** Sea fishing catches other/different (types of) species; 4. No statistical test; 5. Size of tank may affect fish growth; 6. Fish in tanks are all same age/sea fish not all the same age; 7. No measure of number of fish (removed)/ only measured mean mass **OR** No measure of (total) yield of fish **OR** No measure of reproductive success of fish; 8. Removal of 90% of population is unlikely to be replicated in the sea fishing; 9. Sea fish do not have life cycle of one year **OR** Sea fish do not reproduce all at the same time;	3 max	2 max for "But"

TOTAL		**9**	

Question	Marking Guidance	Mark	Comments
08.1	1. Comparing (measurable/observable) features/characteristics; 2. Comparing amino acid sequences/primary structures (of a/named/the same protein);	2 max	Must have idea of comparison/ differences/similarities Ignore courtship/ behaviour/mutations/ number of chromosomes/allele frequency/species richness/index of diversity Accept comparing amount of antibody bound to antigen/protein (in different species)
08.2	36 to 36.4;	1	
08.3	B, A, C;	1	
08.4	1. Student's t-test; **2.** Comparing mean of data sets/histograms **OR** Comparing (2) means **OR** Data are normally distributed;	2	Accept average for 'mean' 2. Ignore difference between means
TOTAL		**6**	

Question	Marking Guidance	Mark	Comments
09.1	**Iron ions** 1. Haemoglobin binds/associates with oxygen **OR** Haemoglobin transports/loads oxygen; **Sodium ions** 2. <u>Co-transport</u> of glucose/amino acids (into cells); 3. (Because) sodium moved out by active transport/Na – K pump; 4. Creates a sodium concentration/diffusion gradient; 5. Affects osmosis/water potential; **Phosphate ions** 6. Affects osmosis/water potential; 7. Joins nucleotides/in phosphodiester bond/in backbone of DNA/RNA/in nucleotides; 8. Used in/to produce ATP; 9. Phosphorylates other compounds (usually) making them more reactive; 10. Hydrophilic/water soluble part of phospholipid bilayer/membrane;	5 max	Must have MP1 for 5 max 3 max for sodium and 3 max for phosphate 1. Ignore reference to 2^+ or 3^+ in Fe^{2+} or Fe^{3+} Accept 5. OR 6. – **not** both Accept for 1 mark, Sodium ions cause water reabsorption in kidneys OR Sodium ions establish resting potential (in neurones) OR Sodium ion diffusion creates action potential 8. Reject 'energy produced'

09.2	1. Phospholipid (bilayer) allows movement/diffusion of non-polar/lipid-soluble substances; 2. Phospholipid (bilayer) prevents movement/diffusion of polar/ charged/lipid-insoluble substances **OR** (Membrane) proteins allow polar/charged substances to cross the membrane/bilayer; 3. Carrier proteins allow active transport; 4. Channel/carrier proteins allow facilitated diffusion**/**co-transport; 5. Shape/charge of channel / carrier determines which substances move; 6. Number of channels/carriers determines how much movement; 7. Membrane surface area determines how much diffusion/movement; 8. Cholesterol affects fluidity/rigidity/permeability;	5 max	1. and 2. Accept correct named examples 1 and 2 Ignore water 1. Accept phospholipid (bilayer) allows movement/diffusion of O_2/CO_2 1. Accept water-insoluble 2. Accept water-soluble 4. Accept aquaporins allow osmosis 6 and 7 accept correct reference to faster/slower/rate for 'how much movement' 7. Accept microvilli / Golgi (apparatus) / ER / rER 7. Accept surface area to volume for 'surface area' 8. Accept cholesterol affects vesicle formation/ endocytosis/exocytosis/phagocytosis;
TOTAL		**10**	