A-level
BIOLOGY
7402/2

Paper 2

Mark scheme

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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 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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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
01.1	1. Circular muscle contracts; 2. Radial muscle relaxes;	2	1 and 2. Accept, for one mark 'both muscles contract' or 'both muscles relax' as names of muscles are in Figure 1. Reject muscles constrict.
01.2	1. High (visual) <u>acuity</u>; 2. (Each) cone is connected to a single neurone; 2. (Cones send) separate (sets of) impulses to brain;	3	2. Accept no retinal convergence. 2. Accept 'bipolar/nerve cell' for neurone. 3. Accept 'optic nerve' for brain. 3. Reject 'signals', 'messages' for 'impulses'. 3. Accept 'action potential'.
01.3	1. Correct answer of 0.6 (%) = **2 marks**;; 2. Incorrect answer but shows number sequence 7065 / 7068 / 7069 / (ignore position of decimal point) = **1 mark** **OR** Final answer number sequence has 64 / 65 (ignore preceding zeros, numbers that follow and position of decimal point) **= 1 mark** **OR** Final answer is 2.58 / 2.6 (%) = **1 mark** **OR** Final answer of 0.43 (%) = **1 mark**;	2	1. Ignore any numbers after 0.6, 2.58, 2.6 and after 0.43.
01.4	1. High (visual) <u>sensitivity</u>; 2. Several rods connected to a single neurone; 3. Enough (neuro)transmitter to reach/overcome threshold **OR**	3	1. Accept retinal convergence. 2. Accept 'bipolar/nerve cell' for neurone 2. Accept 2, 'many' or

	Spatial summation to reach/overcome threshold;		more for 'several' 3. Reject 'signals', 'messages' for 'impulses'. 3. Accept named neurotransmitter. 3. Accept depolarisation, 'action potential' or 'generator potential' for 'to reach threshold'. 3. Generator potentials combine to reach threshold/ depolarisation/action potential/generator potential.

Question	Marking Guidance	Mark	Comments
02.1	1. Lipid soluble; 2. (Diffuse through) phospholipid (bilayer);	2	1. Ignore 'not water soluble' or 'fat soluble'. 1 and 2. Ignore reference to joining to receptors/channels/carriers but reject passage through protein channels/carriers.
02.2	1. Has a (specific) tertiary structure/shape; 2. (Structures are) complementary;	2	1. Accept in context of AR or testosterone. 1. Ignore 3D. 2. Reject reference to antigen. 2. Reject reference to active site, enzyme, substrate or induced fit.
02.3	1. (AR is) a transcription factor; 2. Binds to DNA/promoter; 3. (Stimulates) RNA polymerase;	2 max	1. Ignore 'binds to bases' or 'binds to gene'. 1 and 2. Reject reference to active site, enzyme, substrate or induced fit.
02.4	1. With 16 or fewer than 16 (repeats the association) is significant; 2. With 17 or more than 17 (repeats the association) is **not** significant; 3. With 16 or fewer than 16 (repeats) there is less than a 5% or less than 0.05 probability of being due to chance **OR** With 17 or more than 17 (repeats) there is more than a 5% or more than 0.05 probability of being due to chance **OR** Explanation of a probability value e.g. 0.30 is a 0.30 or 30% probability of being due to chance; 4. With 16 or fewer than 16 (repeats) reject the null hypothesis **OR**	3 max	If none of the marks is awarded allow principle mark of (prostate) cancer more likely with 16 or less than 16 (repeats) **or** (prostate) cancer less likely with 17 or more than 17 (repeats) **OR** Alternative principle mark Correctly links significant/not significant to correct probability value/percentage **or** to rejecting/accepting the null hypothesis. 1. Reject 'the results are significant'. 1. Accept 'difference in results is significant'. 2, 3 and 4. Accept reference to any number of repeats (e.g. 18) between

	With 17 or more (repeats) accept the null hypothesis;		17 to 20 for 17 or more than 17 (repeats). 3. Accept equivalent responses in terms of 95% or 0.95 probability.

Question	Marking Guidance	Mark	Comments
03.1	1. Stirrer distributes heat (energy); 2. Insulation/space/air reduces loss/gain of heat **OR** Insulation/space/air reduces conduction/convection; 3. Water has high (specific) heat capacity;	2 max	1. Accept stirrer ensures equal/even temperature or prevents build up of 'hot spots'. 2. Reject vacuum.
03.2	3.28 / 3.3 (kJ g^{-1}) **= 2 marks;;** Incorrect answer but shows 328 / 33 (ignore any subsequent numbers and decimal point) **= 1 mark** **OR** Incorrect answer of 6.56 / 6.6 (kJ g^{-1}) (ignore any subsequent numbers) **= 1 mark;**	2	
03.3	1. (Light is) reflected; 2. (Light is) wrong wavelength; 3. (Light) misses chlorophyll/ chloroplasts/photosynthetic tissue; 4. CO_2 concentration or temperature is a limiting factor.	2 max	1. Light is not absorbed on its own is not enough. 2. Accept frequency for wavelength. 2. Accept reference to absorbing specified wavelengths/frequencies.
03.4	1. ATP; 2. Reduced NADP;	2	Accept 1 and 2 in either order. 2. Reject Reduced NAD. 2. Accept NADPH/$NADPH_2$.
03.5	Correct answer of 1.31/1.3 × 10^8 (ignoring any subsequent numbers after 1.31) = **2 marks**;; Incorrect answer but shows 2^{16} = **1 mark**	2	

	OR 65536 in any correct numerical form = **1 mark** **OR** Incorrect answer but shows 131 ignoring any subsequent numbers and ignoring any decimal point = **1 mark**;		

Question	Marking Guidance	Mark	Comments
04.1	1. Light/I band only actin; 2. H zone/band only myosin; 3. Darkest/overlapping region actin **and** myosin;	3	1, 2 and 3. Accept any suitable descriptions that distinguishes these regions e.g. 'white band' for 1, 'light grey' for 2 and 'dark grey' for 3. Ignore references to A band.
04.2	1. Use (distilled) water and creatinine solution to produce dilutions (series); 2. Addition of (creatinine-)detecting solution (to each solution); 3. Using a known/specified/constant volume of a solution (e.g. diluted creatinine solution); 4. Record absorbance/transmission of solution/s using a <u>colorimeter</u>; 5. Plot dilution/concentration of (creatinine) solution against absorbance/transmission;	4 max	1. Accept description of dilutions (series). 2 and 3. The addition of a known/specific volume of (creatinine-)detecting solution = 2 marks. 4 and 5. Accept absorption for 'absorbance'. 4 and 5. Accept description of absorbance or transmission. 4. Reject calorimeter. Ignore details provided on 'blank'.
04.3	1. Use same volumes of solutions as used in producing (calibration curve) **OR** Add (creatinine-)detecting solution (to urine); 2. Read off (creatinine) concentration against absorbance/transmission (value) obtained;	2	1. Ignore 'add indicator' on its own. 1. Ignore calorimeter in this part of the question. 2. Ignore 'line of best fit'. 2. Accept 'compare' for 'read off'.

Question	Marking Guidance	Mark	Comments
05	1. Depolarisation of presynaptic membrane; 2. Calcium channels open and calcium ions enter (synaptic knob); 3 (Calcium ions cause) synaptic vesicles move to/fuse with presynaptic membrane **and** release acetylcholine/neurotransmitter; 4 Acetylcholine/neurotransmitter diffuses across (synaptic cleft); 5. (Acetylcholine attaches) to receptors on the postsynaptic membrane; 6. Sodium ions enter (postsynaptic neurone) leading to depolarisation;	5 max	1. Accept action potential for depolarisation. 2. Accept Ca^{2+}. 3 and 4. Accept abbreviations for acetylcholine as term is in the question. 6. Accept Na^{+}. 6. Accept 'action potential' or 'generator potential' for depolarisation.

Question	Marking Guidance	Mark	Comments
06.1	1. Crossing over; 2. Independent segregation/assortment (of homologous chromosomes); 3. Random fusion of gametes **OR** Random fertilisation;	2 max	2. Accept independent assortment of alleles. Accept meiosis as an alternative for 1 or 2 if neither of these marks is awarded. 3 Accept random mating.
06.2	Codominance;	1	Accept incomplete dominance
06.3	1. ttC^RC^W **and** TtC^WC^W; 2. TtC^RC^W, TtC^WC^W, ttC^RC^W **and** ttC^WC^W; 3. Tall pink, tall white, dwarf pink, dwarf white, **and** ratio 1 : 1 : 1 : 1;	3	2 and 3. Accept: any order of genotypes and phenotypes and ignore if on incorrect answer lines. 3. Accept: sequence of phenotypes does not need to mirror genotypes but must be correct. 3. Accept equivalent ratios e.g. 4:4:4:4. Allow equivalent of mark points 2 and 3 for cross using homozygous tall parent i.e. TTC^WC^W. Allow **one mark** for correct dihybrid genotypes of offspring from incorrect parental genotypes.
06.4	1. Correct answer of 42% = **2 marks**;; 2. Incorrect answer but shows understanding that 2pq = pink/heterozygous/carriers = **1 mark** **OR** Answer = 0.42 = **1 mark** **OR** Answer = 16.38 / 16.4 = **1 mark**;	2	1. Accept: 0.42 for 1 mark. 2. Accept $1 – (p^2 + q^2)$ for 2pq or equivalent using numbers. 2. Accept: understanding of 2pq by using a calculation involving 2 × two different

			numbers.

Question	Marking Guidance	Mark	Comments
07.1	1.375 / 1.3746 / 1.38 / 1.4 (times greater);	1	
07.2	1. Potassium nitrate most effective **and** chicken manure least effective; 2. All fertilisers more effective than control; 3. No increase (in growth) with potassium nitrate above 30g; 4. Ammonium sulfate (shows) small/gradual increase after 30g; 5. Chicken manure effectiveness decreases after 45g **OR** Chicken manure effectiveness decreases at 60g; 6 Fertiliser/s provide nitrogen source for protein; 7. No statistical test (to determine if differences are significant); 8. Only shows (results for) spinach;	5 max	1. Accept greatest/highest growth/mass for most effective, and lowest growth/mass for least effective. 7. Accept 'no SDs' (to determine if differences are significant). 7. Accept no (named) stats test, no error bars and no confidence limits. 8. Accept only shows 'one species' or one type of plant.
07.3	1. Weigh and heat; 2. (Until) mass is constant;	2	Accept 'heat until sample remains the same mass' for 2 marks. 1. Ignore temperature. 2. Accept weight for mass.

Question	Marking Guidance	Mark	Comments
08.1	1. Affects/damages basement membrane **OR** More protein channels/carriers in basement membrane; 2. Proteins can pass into the (glomerular) filtrate/tubule;	2	2. Ignore nephron.
08.2	Box 4 The non-homologous section of an X chromosome	1	
08.3	1. Effective as D has lower protein (than B/C); 2. Not fully effective as D has higher protein than A; 3. Do not know all results for other mice in D **OR** Only shows results for 68% of mice; 4. Some of D mice may have been cured **OR** Some of D may have died; 5. Do not know actual/numerical quantity of protein; 6. (Investigation) only on mice **OR** (Investigation) not on humans; 7. Rejection may occur; 8. Only shows results for 20 weeks/short-time period **OR** Long-term effects not known;	4 max	Accept descriptions of each group e.g. A = wild type mice. B = AS mice. C = AS mice that received AS stem cells. D = mice that received wild type stem cells. Accept 'healthy' or 'without AS' for 'wild type'. 6. Accept 'rats' for 'mice'. 7. Accept 'immune response' for rejection. Ignore answers relating to sample size or statistical test.
08.4	1. (Transplanted stem cells) differentiate/specialise; 2. Reduce loss of protein at the glomerulus **OR** Prevents protein moving into filtrate;	2	2. Accept Bowman's/renal capsule.

Question	Marking Guidance	Mark	Comments
09.1	1. Restriction endonucleases/enzymes cuts plasmid; **OR** Restriction endonucleases/enzymes produces 'sticky ends'; 2. Ligase joins gene/DNA and plasmid **OR** Ligase joins 'sticky ends';	2	1. Ignore restriction enzymes cuts out the gene. 1. Reject restriction enzymes **cuts** the **gene**.
09.2	1. Cell division has occurred (before gene added); 2. (Cells producing) gametes do not receive the gene;	2	1. Accept mitosis but reject meiosis. 1. Accept DNA replication has occurred.
09.3	1. No overlap in SDs; 2. Significant increase/difference (in growth/mass) **OR** Increase/difference (in growth/mass) is **not** due to chance;	2	2. Reject 'the results are significant or not due to chance'.
09.4	1. Large sample size **so** representative; 2. 12 months **so** can assess/allow growth; 3. Control (present) for comparison;	2 max	2, Accept long time for 12 months. 2. Accept increase in mass for growth. 3. Accept description of the control.

Question	Marking Guidance	Mark	Comments
10.1	1. Fat (store) used in respiration/metabolism; 2. Less energy/food (store) is required due to low respiration/metabolism **OR** Less energy/food (store) is required due less movement; 3. Gluconeogenesis; 4.Low surface area to volume reduces heat loss **OR** Fat (layer/insulation) reduces heat loss; 5. Long loop of Henle so less water lost; 6. Water provided from respiration; 7. Reduced/no urination; 8. Less evaporation;	3 max	**Mark points 1 to 4 = 2 max**. **Mark points 5 to 8 = 2 max**. 1 and 2. Reject respiration 'uses energy' or 'produces energy'. 3. Accept description in terms of using glycerol, fatty acids or amino acids. 5. Accept thick medulla (in kidney) for long loop of Henle. 8. Accept less sweating.
10.2	1. (Lower metabolism so) less/low CO_2 (in blood); 2. (Detected by) chemoreceptors; 3. (Chemoreceptors) located in aorta/medulla **OR** (Chemoreceptors) located in carotid artery; 4. Fewer impulses to cardiac centre; **OR** Fewer impulses to medulla (oblongata); 5. (More) impulses along parasympathetic/vagus pathway/neurones/nerve **OR** Fewer impulses along sympathetic pathway/neurones/nerve; 6. (To) SAN;	4 max	**If neither mark point 1 or 2 credited = 3 max.** 1. Accept increase in pH or decrease in H ions/acidity for less CO_2. Ignore baroreceptors. 2. Ignore detects oxygen, (concentration). 3. Accept carotid body or aortic body. 4 and 5. Reject (once only) reference to 'an/one impulse'. 4 and 5. Reject 'signals', 'messages' (once only) for 'impulses' 4 and 5. Accept 'action potential/s' for impulses.

10.3	1. Allow passage of protons/H^+; 2. (Energy) released as heat;	2	1. Ignore direction of movement/diffusion/active transport. 2. Accept 'produces heat' but reject 'produces 'heat energy'.
10.4	1. Less snow **so** less camouflage; 2. More hares seen/eaten/killed by predators;	2	1. Accept 'snow melts' 1. Accept description of less camouflage, e.g. more hares seen. 2. Accept description of predation.
10.5	1. Hares which moult earlier (more likely to) survive; 2. Hares which moult earlier (more likely to) reproduce; 3. Pass on (advantageous) <u>allele</u>; 4. Frequency of <u>allele</u> increases (in future populations);	4	1. Accept less likely to be killed for 'survive'. 1. Accept description of survival e.g. not killed/eaten. 1. Accept moult quicker/faster for earlier. 1 and 2. Answers must be in the context of moulting earlier/quicker/faster. Accept rabbits for hares. 2 and 3. Accept 'pass on allele to offspring' or 'to next generation' = 2 marks. 4. 'More alleles' is not enough for a mark.