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 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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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 not 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. (Colonisation by) pioneer species; 2. Pioneers/species/organisms change the environment/habitat/conditions/factors; 3. (Environment becomes) less hostile for other/new species **OR** (Environment becomes) more suitable for other/new species **OR** (Environment becomes) less suitable for previous species; 4. Change/increase in diversity/biodiversity; 5. (To) climax community;	4 max	2. Accept example of change e.g. forms soil/humus/organic matter/nutrients. 2. Must convey idea of change being caused by pioneers/species/organisms 3. Accept previous species out-competed. 4.Ignore increase in genetic diversity.
01.2	0.155;	1	Accept standard form e.g. 15.5×10^{-2}
01.3	1. Answer of 180/178/177.5 = **2 marks**;; 2. Incorrect answer but shows use of numbers 57 **and** 127 (with decimal points in any position) within the calculation = **1 mark**;	2	1. Ignore any numbers following 177.5

Question	Marking Guidance	Mark	Comments
02.1	1. Change in (sequence of) amino acid(s)/primary structure; 2. Change in hydrogen/ionic/disulfide bonds; 3. Alters tertiary/3^0 structure;	3	1. Reject amino acids are formed. 1. Reject amino acids code. 3. Reject active site. 3. Ignore quaternary. 3. Ignore 3D.
02.2	1. Produce healthy (red blood) cells **OR** Produce (normal) polypeptide/haemoglobin; 2. No sickle/faulty/SCD (red blood) cells (produced) **OR** No defective polypeptide/haemoglobin; 3. Stem/marrow cells (continuously) divide/replicate **OR** Less chance of rejection (from brother/sister);	3	1. Produce only healthy (red blood) cells is only equivalent to mark point 1. 1. Accept produce 'normal'/non-SCD cells. 1. and 3. Ignore type of stem cell e.g. pluripotent. 3. Differentiate is not equivalent to divide/replicate.
02.3	(For gene therapy) 1. No destruction of bone marrow **OR** No destruction of stem cells; 2. Donors are not required; 3. Less/no chance of rejection (own stem cells); (Against gene therapy) 4. Sickle/faulty (red blood) cells still produced 5. Immune response against genetically modified cells/virus **OR** Long-term effect not known (as is new treatment) **OR** Virus could cause side effects;	3 max	**Max 2 marks** for marking points 1, 2 and 3 1. Accept no destruction of faulty bone marrow unless context indicates this is against gene therapy. 2. Stating 'only own cells used' is **not** equivalent. 5. Accept 'virus could cause problems' or 'risk(s) with virus'.

Question	Marking Guidance	Mark	Comments
03.1	1. Tip produces IAA; 2. Affects concentration of IAA **OR** Affects (shoot) length/growth/elongation; 3. Mitosis/division occurs in shoot tips; 4. Affects (shoot) length/growth/elongation;	2 max	**Mark in pairs** 1 and 2 or 3 and 4. 1 and 2. Accept auxin for IAA. 1. Ignore contains/stores IAA. 1. Accept affects amount of IAA. 2. Accept affects independent variable. 2 and 4. Ignore affects results.
03.2	1. For respiration; 2. Provide ATP/energy (for growth);	2	1.Ignore photosynthesis. 1. Ignore aerobic/anaerobic (respiration). 1. Reject glucose used in photosynthesis. 2. Reject produce energy. 2. Do **not** credit photosynthesis provides ATP.
03.3	1. To prevent/reduce evaporation; 2. (Which) alters concentration of (IAA) solution **OR** (Which) alters water potential;	2	1. Accept evaporation of (IAA/glucose) 'solution'. 2. Accept auxin for IAA. 1. Ignore contamination.
03.4	1. Increase in IAA <u>concentration</u> the higher/greater the <u>mean</u> (change in) length; 2. (High) IAA stimulates <u>cell</u> <u>elongation</u>; 3. In roots, growth/elongation less/inhibited;	3	1, 2 and 3. Accept auxin for IAA. 3. Accept decrease in (mean) change in length but reject 'decreases length' on its own.

			3. Accept ‘opposite results or ‘negative correlation’.
03.5	0.4 **and** 39.6;	1	Both numbers required and must be in order shown.

Question	Marking Guidance	Mark	Comments
04.1	1. Lower (force of contraction) in mouse/**B** (than control/100%) below 29 °C **OR** Lower (force of contraction) in rabbit/**D** (than control/100%) below 26.5 °C; 2. Higher (force of contraction) in mouse/**B** (than control/100%) above 29 °C **OR** Higher (force of contraction) in rabbit/**D** (than control/100%) above 26.5 °C; 3. Only (used) mouse **and** rabbit **OR** No other organism/species used; 4. Body temperature of mouse/rabbit higher (than temperatures investigated); 5. Only used one/0.5 pH (below typical pH) **OR** (Should) use more pH values; 6. (Used) isolated muscle tissue; 7. No stats test to see if (difference is) significant;	4 max	1. Accept any temperature below 29 °C for mouse/**B** or any specified temperature below 26.5 °C for rabbit/**D.** 2. Accept any temperature above 29 °C for mouse/**B** or any temperature above 26.5 °C for rabbit/**D.** 1. and 2. Accept 27 °C for 26.5 °C and accept 28.5 °C for 29 °C. 3. Accept only two animals/species used. 4. Accept body temperature of mouse/rabbit not known 7. Ignore SD.
04.2	1. (Less/No) tropomyosin moved from binding site **OR** Shape of tropomyosin not changed so binding site not exposed/available; 2. (Fewer/No) actinomyosin bridges formed; 3. Myosin head does not move **OR** Myosin does not pull actin (filaments) **OR** (Less/No) ATP (hydrol)ase (activation);	3	1 and 2. Reject active site only once. 1. Ignore troponin. 2. Accept actin and myosin do not bind. 3. Reject ATP synthase. Do not penalise reference to calcium rather than calcium ions. Credit all mark points even if context relates to what happens when calcium ions are present.

04.3	1. Regenerates/produces NAD **OR** oxidises reduced NAD; 2. (So) glycolysis continues;	2	1. Reject NADP and any reference to FAD. 1. Accept descriptions of oxidation e.g. loss of hydrogen. 2. Accept description of glycolysis e.g. glucose to pyruvate. 2. Accept 'for oxidising/converting triose phosphate to pyruvate'.

Question	Marking Guidance	Mark	Comments
05.1	1. (Attaches to receptors on target cells and) activates/stimulates enzymes; 2. Glycerol/amino acids/fatty acids into glucose;	2	1. Reject 'produces enzymes'. 2. Reject 'glucagon converts' as context suggests enzyme action. 2. Ignore lipids/fats/proteins but reject glycogen. 2. Reject occurs in pancreas.
05.2	1. Correct answer of 3.24 = **2 marks**;; 2. Incorrect but multiplies by 34 (with decimal point in any position) = **1 mark** **OR** Incorrect but shows sequence 324 = **1 mark** **OR** 3.2 = **1 mark**;	2	
05.3	1. (More) insulin binds to receptors; 2. (Stimulates) uptake of glucose by channel/transport <u>proteins</u> **OR** Activates enzymes which convert glucose to glycogen;	2	2. Accept activates enzymes for glycogenesis. 2. Reject active transport. 2. Accept carrier proteins or GLUT 4 for channel proteins. 2. Accept insulin stimulates addition of channel proteins in membranes.
05.4	1. Less/no ATP is converted to cyclic AMP/cAMP; 2. Less/no kinase is activated; 3. Less/no glycogen is converted to glucose **OR** Less/no glycogenolysis;	3	If no indication of less/no for any of the mark points award **max 2 marks**. Accept all marks in context of adrenaline. Ignore gluconeogenesis.

Question	Marking Guidance	Mark	Comments
06.1	$GgX^{R}X^{r}$;	1	1. Accept alleles in any order. 1. Accept GgRr with alleles in any order.
06.2	If it were recessive all flies of 3 and 4 would be grey **OR** 3 and 4 produce 9/black (fly) **OR** Grey parents produce black (fly);	1	
06.3	1. (Fly) 3 (and 4) produce 9/black (fly) **OR** (Fly) 9 would not be black **OR** (Fly) 9 would be grey **OR** Grey parents/male produce black **female** (fly); 2. (Fly) 3 would pass dominant allele to 9; 3. (Fly) 2 (and 1) produce 5/grey (fly) **OR** Black **female** produces grey **male** **OR** (Fly) 5 could not be grey **OR** (Fly) 5 would be black; 4. (Fly) 5 would receive recessive allele from 2;	2 max	**Mark in pairs** 1 and 2 or 3 and 4. 2. Accept allele for grey colour would be passed on by 3. 4. Accept allele for black colour would be passed on by 2.
06.4	1. $GgX^{r}X^{r}$ **and** $ggX^{R}Y$; 2. $GgX^{R}X^{r}$, $ggX^{R}X^{r}$, $GgX^{r}Y$ **and** $ggX^{r}Y$; 3. Grey-bodied red-eyed female, black-bodied red-eyed female, grey-bodied white-eyed male, black-bodied white-eyed male **and** ratio 1 : 1 : 1 : 1;	3	1 and 2. Accept the following alternative notations for sex-linked crosses e.g. for mp 1 Ggrr and ggRY or Ggrr and gg R- or Ggrr and ggR i.e. space for Y

	If 1, 2 and 3 incorrect **allow one mark** for correct gametes from incorrect dihybrid parental genotypes.		chromosome. 2 and 3. Accept any order of genotypes and phenotypes. 3. Accept sequence of phenotypes does not need to mirror genotypes but must be correct. 3. Accept alternative ratios in correct proportions e.g. 4:4:4:4
06.5	1. Correct answer of 48% = **2 marks**;; 2. Incorrect answer but shows understanding that 2pq = heterozygous/carriers = **1 mark** **OR** Incorrect answer but shows understanding that $1 – (p^2 + q^2)$ = heterozygous/carriers = **1 mark**;	2	1. Accept 0.48 for 1 mark. 2. Accept understanding of 2pq by using a calculation involving 2 x two different numbers.

Question	Marking Guidance	Mark	Comments
07.1	☑ NADP, ADP, Pi and water;	1	
07.2	1. Chlorophyll absorbs light **OR** Light excites/moves electrons in chlorophyll; 2. Electron/s are lost **OR** (Chlorophyll) becomes positively charged;	2	1. Ignore photosystems. 2. Ignore site/molecule from where electrons are lost. 2. Accept electrons go to electron transport/carrier chain for 'electrons lost'.
07.3	Ink and (leaf) pigments would mix **OR** (With ink) origin/line in different position **OR** (With pencil) origin/line in same position **OR** (With pencil) origin/line still visible;	1	
07.4	1. Level of solvent below origin/line; 2. Remove/stop before (solvent) reaches top/end;	2	1. Reject water or any named aqueous solution. 1. Accept named organic solvent.
07.5	Accept any answer in range of 0.58 to 0.62;	1	Accept 0.58 or 0.62. Ignore any numbers which follow numbers in range.
07.6	(Absorb) different/more wavelengths (of light) for photosynthesis;	1	Accept wider/larger range of wavelengths. Accept frequency for wavelength. Accept light-dependent reaction /photophosphorylation /photoionisation for photosynthesis.

Question	Marking Guidance	Mark	Comments
08.1	1. (Short) single strand of DNA; 2. Bases complementary (with DNA/allele/gene);	2	
08.2	1. Restriction endonuclease/enzyme; 2. (Cuts DNA at specific) base sequence **OR** (Breaks) phosphodiester bonds **OR** (Cuts DNA) at recognition/restriction site;	2	2. Accept palindromic sequence.
08.3	(So DNA) probe binds/attaches/anneals;	1	
08.4	1. (Lane 1 has DNA fragments) of known sizes/lengths; 2. Compare (position of viral fragment/s);	2	
08.5	3, 4, 5 with these numbers in any sequence;	1	All three numbers required. Reject if more than three numbers given.

Question	Marking Guidance	Mark	Comments
09.1	1. Use a grid **OR** Divide area into squares/sections; 2. Method of obtaining random coordinates/numbers e.g. calculator/computer/random numbers table/generator; 3. Count number/frequency in a quadrat/section; 4. Large sample **and** calculate mean/average number (per quadrat/section); 5. Valid method of calculating total number of sundews, e.g. mean number of plants per quadrat/section/m^2 multiplied by number of quadrats/sections/m^2 in marsh;	5	1. Accept use of tape measures/map/area with coordinates. 1. Accept Belt transect. 2. If transect method used accept quadrats at regular intervals or current mark point 2. 3. Accept % cover in quadrat/section. 3. Ignore amount/abundance. 4. Accept large sample **and** calculate mean %. 4. Accept large sample **and** method of calculating mean. 4. Accept many/multiple for large sample but ignore several. 4.If a specific number is given it must be 10 or more. 5. Do not allow 'scale up' without further qualification. 5. Do not award if % cover determined.
09.2	1. Digestion/breakdown of proteins; 2. Provides amino acids **OR** (Sundew can) produce a **named** (organic) nitrogen-containing compound e.g. proteins, amino acids, DNA, ATP; 3. Digestion/breakdown of **named (**organic) phosphate-containing compound e.g. DNA, RNA; 4. Provides **named** (organic) phosphate-containing product e.g. nucleotides	2 max	**Mark in pairs** 1 and 2, or 3 and 4. Ignore carbohydrates, lipids or named carbohydrate/ lipid. 2. Ignore if nitrate or ammonium ions given as products. 4. Accept phosphate as a named product.

	OR (Sundew can) produce a **named** phosphate-containing compound e.g. ATP, DNA;		

Question	Marking Guidance	Mark	Comments
10.1	1. (Refers to) saltatory conduction **OR** (Nerve) impulses/depolarisation/ions pass to other neurones **OR** Depolarisation occurs along whole length (of axon); 2. (Nerve) impulses slowed/stopped; 3. (Refers to) <u>neuromuscular</u> junction **OR** (Refers to) <u>sarcolemma</u>;	3	1. Accept suitable description that refers to (transmission) from node to node (of Ranvier). 1 and 2. Accept action potentials for impulses. 1. Accept action potential for depolarisation. 1, 2 and 3. Reject first mark awarded if answer refers to messages/signals for impulses. Reject even if impulse/s also referred to.
10.2	1. Slower/fewer impulse(s) along sympathetic/parasympathetic (pathway/neurones); 2. (Impulses) from cardiac centre **OR** (Impulses) from medulla; 3. To SAN;	3	1. Accept action potentials for impulses. 1.Reject no impulses. 1, 2 and 3. Ignore 'information' but reject first mark awarded if answer refers to messages/signals for impulses. Reject even if impulse/s also referred to.
10.3	1. It/DNA is <u>complementary</u> to (m)RNA; 2. Binds to mRNA (for huntingtin); 3. Prevents <u>translation</u>;	3	1. Accept (transcription) results in <u>complementary</u> (m)RNA. Ignore miRNA/siRNA/transcriptional factors. 3. Ignore transcription.

10.4	1. Small sample size **OR** Only 46; 2. Only four-months **OR** short period (of trial); 3. Huntingtin/protein reduced **OR** Huntingtin/protein still produced **OR** Huntingtin/protein not removed; 4. Allele/gene/mutation/mRNA (for Huntington's) still present **OR** (May be) temporary **OR** Drug treatment repeated; 5. Brain already damaged **OR** Brain damage may continue;	2 max	3. Accept huntington for huntingtin. Ignore miRNA/siRNA/transcriptional factors.
10.5	1. (Drug/DNA) will directly/quickly reach <u>brain</u> **OR** (Cerebrospinal) fluid bathes the <u>brain</u>; 2. (Drug/DNA) not destroyed by acid **OR** (Drug/DNA) not digested (by enzymes);	2	2. Reject protein is digested. 2. Ignore location of enzymes. 2. Accept Drug/DNA denatured.
10.6	1. (Increased) methylation of DNA/gene/allele**;** 2. Inhibits/prevents transcription; **OR**	2 max	**Mark in pairs** but if no mark credited allow one mark for any reference to transcription or gene expression being affected.

	3. Decreased methylation of DNA/gene/allele; 4. Stimulates/allows transcription; **OR** 5. Decreased acetylation of histone(s); 6. Inhibits transcription; **OR** 7. Increased acetylation of histone(s); 8. Stimulates/allows transcription;		1. Reject acetylation of DNA. Accept gene expression for transcription but ignore gene switched on/off. Ignore methylation of histones. Accept DNA-histone complex as equivalent to histone(s). .