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## **Mark Scheme (Results)**

January 2017

Pearson Edexcel  
International Advanced Subsidiary Level  
in Biology (WBI02)  
Paper 01 Development, Plants and the  
Environment

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## General Marking Guidance

- This mark scheme provides a list of acceptable answers for this paper. Candidates will receive credit for all correct responses but will be penalised if they give more than one answer where only one is required (e.g. putting an additional cross in a set of boxes). If a candidate produces more written answers than the required number (two instead of one, three instead of two etc), only the first answers will be accepted. Free responses are marked for the effective communication of the correct answer rather than for quality of language but it is possible that, on some occasions, the quality of English or poor presentation can impede communication and lose candidate marks. It is sometimes possible for a candidate to produce a written response that does not feature in the mark scheme but which is nevertheless correct. If this were to occur, an examiner would, of course, give full credit to that answer.
- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. **if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.**
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme **to a candidate's response**, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer	Additional Guidance	Mark
1(a)	<p>Drawing mark</p> <p>1. two membranes drawn with inner membrane folded ;</p> <p>Labelling marks</p> <p>2. outer membrane and {inner membrane / cristae} ;</p> <p>Any two from:</p> <p>3. inter-membrane space;</p> <p>4. matrix ;</p> <p>5. stalked particles</p> <p>6. (circular)DNA ;</p> <p>7. (70S)ribosomes ;</p>	<p>1. IGNORE labels when assessing drawing mark</p> <p>1. IGNORE shape of mitochondrion</p> <p>1. IGNORE number of folds</p> <p>IGNORE labels of phosphate granules/lipid droplets</p> <p>DO NOT ACCEPT other structures including granum/stroma/thylakoid/starch grain/nucleus/cytoplasm/mesosome</p> <p>2. NOT cell membrane/cell wall</p> <p>2. NOT cisternae instead of cristae</p> <p>2. ACCEPT double membrane/envelope</p> <p>3. and 4. Need to be labelled in the correct position but no additional drawing needed</p> <p>5. 6. and 7. A drawing (not detailed) to represent them is needed as well as label being in correct position. (Quality of drawing is not being assessed in these marking points).</p> <p>5. Drawn attached to cristae</p> <p>6. and 7. Drawn in matrix and not attached to membrane</p>	(4) EXP

Question Number	Answer	Additional Guidance	Mark
1(b)	1. (loop of) DNA ; 2. (70S / small) ribosomes ;	IGNORE answers about features that they <b>don't have</b> 1. IGNORE plasmid /genetic material	(2) GRAD

Question Number	Answer	Additional Guidance	Mark
1(c)	1. top line = archaea ; 2. middle line = bacteria ; 3. bottom line = eukaryota ;	} ACCEPT either way around 1. ACCEPT archaeobacteria 2. ACCEPT eubacteria 3 ACCEPT eukaryote / eukarya/ eukaryotic	(3) GRAD

Question Number	Answer	Additional Guidance	Mark
1(d)	chloroplast / large vacuole / amyloplast ;	DO NOT ACCEPT any other structure IGNORE plastid ACCEPT sap vacuole/permanent vacuole	(1) GRAD

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	<p>Any two from:</p> <ol style="list-style-type: none"> <li>1. to make the investigation valid ;</li> <li>2. plants would be of same age;</li> <li>3. same soil ;</li> <li>4. same water availability ;</li> <li>5. same temperature ;</li> <li>6. same light (intensity / wave length / exposure/daylength) ;</li> </ol>	<p>IGNORE references to genotype/species</p> <ol style="list-style-type: none"> <li>1. NOT reliable / reproducible / accurate / precise/fair</li> <li>2 -6. ACCEPT similar as eq to same</li> <li>3. ACCEPT idea would receive same quantity of nutrients/minerals</li> </ol> <p>3-6. ACCEPT growth conditions/abiotic factors for 1 mark if none of the named growth conditions are specified</p>	(2) GRAD
2(a)(ii)	<ol style="list-style-type: none"> <li>1. to soften the {stem/(soft) tissues/cell walls /middle lamella/ matrix / hemicellulose / pectate};</li> <li>2. so that the fibres can be {separated/removed/extracted} ;</li> </ol>	<ol style="list-style-type: none"> <li>1. NOT cellulose</li> <li>1. ACCEPT for {fungi/bacteria} to break down/decompose the soft tissues/eq</li> <li>2. ACCEPT easier to extract fibres</li> <li>ACCEPT to leave only fibres/cellulose [For answers in context of decomposition]</li> </ol>	(2) GRAD
2(a)(iii)	soaked in water ;	<p>ACCEPT soaked in same solution without NaOH</p> <p>IGNORE should not be soaked in NaOH</p>	(1) GRAD

Question Number	Answer	Additional Guidance	Mark
2(a)(iv)	to remove the NaOH / so that the fibres were safe to handle / eq ;	ACCEPT to remove the alkali	(1) GRAD

Question Number	Answer	Additional Guidance	Mark
2(a)(v)	<ol style="list-style-type: none"> <li>idea that the {diameter/thickness/radius/shape} varies along the length of a fibre ;</li> <li>to obtain/calculate {a mean / an average} ;</li> </ol>	<ol style="list-style-type: none"> <li>IGNORE fibres are different sizes</li> <li>ACCEPT idea of improved validity/ Reliability</li> <li>ACCEPT to find the smallest diameter/eq</li> </ol>	(2) EXP

Question Number	Answer	Mark
2(a)(vi)	<p>The only correct answer is C</p> <p>A is not correct because there are no units for area</p> <p>B is not correct because units should refer to area not length</p> <p>D is not correct because units should refer to area not volume</p>	(1) COMP

Question Number	Answer	Additional Guidance	Mark
2(b)	<ol style="list-style-type: none"> <li>difficult to compare data / eq ;</li> <li>because the diameter of the fibres in the two groups are not the same / eq ;</li> <li>NaOH reduces the tensile strength / eq ;</li> <li>idea that NaOH does not reduce tensile strength at all diameters ;</li> <li>credit correct manipulation of figures ;</li> </ol>	<ol style="list-style-type: none"> <li>ACCEPT only one diameter/only 0.080 is the same in both groups</li> <li>ACCEPT weakens fibres</li> <li>ACCEPT There are anomalies</li> <li>EXAMPLE the tensile strength of 0.080 diameter is reduced by 244 (<math>\text{Nm}^{-2}</math>)</li> <li>ACCEPT 31.3% decrease</li> </ol>	(3) EXP

Question Number	Answer	Additional Guidance	Mark
3(a)	<ol style="list-style-type: none"> <li>number of cells {decreases /<b>doesn't increase</b>/ eq} ;</li> <li>cell length increase is same as untreated cells / radiation has {very little /no effect} on cell length compared to untreated cells ;</li> </ol>	PIECE TOGETHER answer if needed IGNORE comments about rate of growth 1. IGNORE quoted values 1. ACCEPT <b>in context of <math>\gamma</math> radiation</b> graph alone or as a comparison with untreated group  2. ACCEPT up to 155/160 hours stem length is (slightly) reduced compared to untreated cells / after 155/160 hours length of cells (slightly) increased compared to untreated cells	(2) EXP

Question Number	Answer	Additional Guidance	Mark
3(b)	<ol style="list-style-type: none"> <li><b>idea that <math>\gamma</math> radiation</b> prevents {new cells from being made/mitosis/cell division} so height does not increase as much ;</li> <li>idea that cell elongation is {not affected/affected very little} <b>by <math>\gamma</math> radiation</b> so height still increases ;</li> </ol>	IGNORE comments about mutation IGNORE comments about rate of growth  1. ACCEPT fewer cells so height is lower (than untreated coleoptiles).	(2) EXP

Question Number	Answer	Additional Guidance	Mark
*3(c)	<p>(*QWC - Spelling of technical terms must be correct and the answer must be organised in a logical sequence.)</p> <ol style="list-style-type: none"> <li>1. idea of using coleoptiles tips with and without <math>\gamma</math> radiation ;</li> <li>2. place (coleoptiles) in acid and {acetic orcein /<b>Feulgen's stain/Schiff's reagent</b>/Toluidine blue};</li> <li>3. idea of teasing (cells / coleoptiles) apart ;</li> <li>4. description of mounting (cells / coleoptiles) ;</li> <li>5. description of squashing (cells / coleoptiles) ;</li> <li>6. idea of warming slide to intensify stain ;</li> <li>7. idea of counting number of cells undergoing mitosis and {cells in interphase/total number of cells} ;</li> <li>8. idea of {calculating a percentage /calculate the mitotic index/ counting same number of cells for each tip } ;</li> </ol>	<p>QWC Emphasis is on logical sequence NB use of <u>root</u> tips would only prevent mp1 being awarded</p> <ol style="list-style-type: none"> <li>1. PIECE TOGETHER if necessary</li> <li>2. ACCEPT if done in two stages (ie acid is added then stain added later) 2. IGNORE context of heat</li> <li>3. eg use of needle to break tip / spread cells 3. ACCEPT macerate the tips/coleoptiles</li> <li>4 ACCEPT use of slide with {acid / stain / water} [care: this is sometimes described in two different sentences]</li> <li>5. eg pressing cells/tip/eq with coverslip/second slide</li> </ol>	(6) EXP

Question Number	Answer	Additional Guidance	Mark
*4(a)	<p>(*QWC - Spelling of technical terms must be correct and the answer must be organised in a logical sequence.)</p> <ol style="list-style-type: none"> <li>(phase I) involves (small) number of healthy {people / volunteers} ;</li> <li>(phase II) involves small number of patients / eq ;</li> <li>(phase III) involves {large/larger number} of patients / eq ;</li> <li>reference to a double blind trial ;</li> <li>reference to use of placebo ;</li> <li>idea that neither the patient nor the doctor knows who is receiving the placebo ;</li> </ol>	<p>QWC emphasis is on clarity of expression</p> <p>2.ACCEPT idea that there are more people than in phase I 2.ACCEPT100-300</p> <p>3.ACCEPT &gt; 1000</p> <p>4.5.6. ACCEPT in context of phase II or phase III</p>	(5) EXP

Question Number	Answer	Additional Guidance	Mark
4(b)	<ol style="list-style-type: none"> <li>pre-clinical (to phase I): idea that {animals harmed by drug / not safe to use on people} ;</li> <li>phase I (to phase II): idea that drug had {side effects/showed toxicity} ;</li> <li>phase II (to phase III): idea that {patients were not cured / drug had no effect on condition/drug was less effective than existing drugs} ;</li> <li>phase III onwards: idea that drug was not successful enough compared to the placebo/existing treatment ;</li> </ol>	<p>NB Answers must be related to a stage.</p> <p>2. ACCEPT an example eg nausea/dizziness</p> <p>3. ACCEPT idea of further side effects noted</p> <p>4.ACCEPT long term side effects OR idea of rare side effects/eq that only show in large samples</p>	(3) EXP

Question Number	Answer	Mark
5(a)	<p>The only correct answer is D</p> <p>A is not correct because neither xylem vessels nor sclerenchyma fibres are organs</p> <p>B is not correct because xylem vessels are not an organ and sclerenchyma fibres are not an organ systems</p> <p>C is not correct because xylem vessels are not an organ system</p>	(1) COMP

Question Number	Answer	Mark
5(b)	<p>The only correct answer is A</p> <p>B is not correct because neither guideline points to a xylem vessel</p> <p>C is not correct because the xylem vessel label is pointing to sclerenchyma fibres</p> <p>D is not correct because the labels are the wrong way round</p>	(1) COMP

Question Number	Answer	Mark
5(c)	<p>The only correct answer is C</p> <p>A is not correct because xylem vessels do contain cellulose</p> <p>B is not correct because xylem vessels do contain lignin</p> <p>D is not correct because xylem vessels do contain cellulose and pits</p>	(1) COMP

Question Number	Answer Additional Guidance	Mark
5 (d)	<p>The only correct answer is C</p> <p>A is not correct because xylem vessels are also involved with support</p> <p>B is not correct because sclerenchyma fibres have no transport function</p> <p>D is not correct because xylem vessels are also involved with support and sclerenchyma fibres have no transport function</p>	(1) COMP

Question Number	Answer	Additional Guidance	Mark
5(e)	Any two from  magnesium calcium nitrates ;	ACCEPT correct chemical symbols of ions ACCEPT any other two correct ions e.g. sulfates or sulphates/ phosphates /chloride/ potassium / sodium /iron / manganese /zinc / copper / ammonium	(1) GRAD

Question Number	Answer	Additional Guidance	Mark
5(f)(i)	<p>1. idea that as pressure increases so does rate of flow ;</p> <p>2. {(directly) proportional / linear increase / eq} / credit correct manipulation of figures ;</p>	<p>1.ACCEPT positive correlation</p> <p>2. Example calculation: for a diameter of 200(<math>\mu\text{m}</math>) when pressure increases from 0 - 0.2(au) rate of flow increases by 200(<math>\text{mh}^{-1}</math>)</p>	(2) Expert

Question Number	Answer	Additional Guidance	Mark
5(f)(ii)	1. idea that as diameter increases so does rate of flow ; 2. {non-linear increase / eq} / credit correct manipulation of figures ;	1.ACCEPT positive correlation 2.Example calculation: (at pressure of 0.2) when diameter increases from 100-200( $\mu\text{m}$ ) rate of flow increases by 70( $\text{mh}^{-1}$ )	(2) Expert

Question Number	Answer	Additional Guidance	Mark
6(a)(i)	1. Length of head with correct units ;	ACCEPT a range of 9-10mm / 0.9 - 1.0cm;	(1) expert

Question Number	Answer	Additional Guidance	Mark
6(a)(ii)	1. length of head divided by 2000; 2. (multiplied by 30) to give correct answer;	NB allow error carried forward from (a)(i)  Units must be stated to gain full marks 2. Answer must be expressed to 2 or 3 sig figs EXAMPLE calculations: $(30 \times 9)/2000 = 0.135\text{mm}$ OR $(30 \times 10)/2000 = 0.15\text{mm}$  ACCEPT answers converted to $\mu\text{m}$ or m eg $135 \mu\text{m}$ or $1.35 \times 10^{-4}\text{m}$  Correct answer alone with units gains 2 marks.	(2) expert

Question Number	Answer	Additional Guidance	Mark
6(b)	<ol style="list-style-type: none"> <li>1. sperm has a {flagellum/tail} (but a female gamete does not) ;</li> <li>2. sperm has an acrosome (but a female gamete does not) ;</li> <li>3. no cortical granules in a sperm (but there are in a female gamete ) ;</li> <li>4. no {food store / glycogen/lipid/ eq} in a sperm (but there is in a female gamete) ;</li> <li>5. no zona pellucida in a sperm (but there is in a female gamete) ;</li> </ol>	ACCEPT converse statement throughout ACCEPT secondary oocyte / ovum / egg cell for female gamete throughout 1. ACCEPT idea of a comparison of shape eg sperm is streamlined female gamete is spherical  5. IGNORE follicle cells	(2) EXP

Question Number	Answer	Additional Guidance	Mark
6(c)(i)	<ol style="list-style-type: none"> <li>1. both are forms of nuclear division ;</li> <li>2. mitosis produces two cells but meiosis produces four cells / eq ;</li> <li>3. idea that mitosis produces diploid cells but meiosis produces haploid cells ;</li> <li>4. one division in mitosis but two divisions in meiosis / eq ;</li> <li>5. no {crossing over/independent assortment} in mitosis but there is in meiosis / eq ;</li> <li>6. mitosis produces genetically identical cells but meiosis produces genetically variable cells / eq ;</li> </ol>	PIECE TOGETHER ANSWER A statement about both is needed 1. IGNORE cell division          6. identical needs to be qualified once	(3) EXP

Question Number	Answer	Additional Guidance	Mark
6(c)(ii)	<ol style="list-style-type: none"> <li>1. release of {acrosin/enzymes} from sperm / eq ;</li> <li>2. {sperm/enzymes} digests the {follicular cells /zona pellucida/ eq} ;</li> <li>3. {fusion / penetration / touches /eq} of sperm with female gamete membrane;</li> <li>4. release of cortical granules / eq ;</li> <li>5. zona pellucida {hardens / thickens/eq};</li> <li>6. fusion of sperm nucleus with female (gamete) nucleus / eq ;</li> </ol>	<p>ACCEPT secondary oocyte / ovum / egg cell for female gamete throughout</p> <ol style="list-style-type: none"> <li>1.ACCEPT reference to the acrosome reaction</li> <li>2. ACCEPT jelly layer</li> <li>3.ACCEPT head as eq to sperm</li> <li>4.ACCEPT reference to cortical reaction</li> <li>5. ACCEPT a reference to formation of fertilisation membrane</li> </ol>	(4) EXP

Question Number	Answer	Mark
7(a)	<p>The only correct answer is C</p> <p>A is not correct because Phenotype P is not affected by the environment</p> <p>B is not correct because Phenotype P is not affected by the environment</p> <p>D is not correct because Phenotype P is not affected by the environment</p>	(1) COMP

Question Number	Answer	Mark
7(b)	<p>The only correct answer is D</p> <p>A is not correct because autism is affected most by the genotype and most by the environment</p> <p>B is not correct because autism is affected most by the genotype</p> <p>C is not correct because autism is affected most by the environment</p>	(1) COMP

Question Number	Answer	Additional Guidance	Mark
7(c)(i)	<ol style="list-style-type: none"> <li>1. {Genotype/eq} determines levels of MAOA;</li> <li>2. idea of environmental influence as {stress / maltreatment / abuse / violence/ maternal rejection / lack of continuity in people looking after child / eq} ;</li> <li>3. (only) individuals with low levels of MAOA affected (by environment) / eq ;</li> <li>4. interaction results in antisocial behaviour / convictions / eq ;</li> <li>5. males more affected than females (by this interaction) ;</li> </ol>	PIECE TOGETHER ANSWERS	(3) EXP

Question Number	Answer	Additional Guidance	Mark
7(c)(ii)	<ol style="list-style-type: none"> <li>1. behaviour is affected by other genes / polygenic inheritance/ eq ;</li> <li>2. idea other environmental factors / lifestyle factors/eq may be involved;</li> </ol>	<ol style="list-style-type: none"> <li>1. ACCEPT idea that <b>behaviour can't</b> be easily quantified</li> <li>2.ACCEPT difficult to eliminate/control other environmental factors/difficult to measure stress/abuse/eq</li> </ol>	(2) EXP

Question Number	Answer	Additional Guidance	Mark
8(a)(i)	<ol style="list-style-type: none"> <li>1. idea that overall the number of Iberian lynx have increased ;</li> <li>2. idea that the number of Iberian lynx originally from wild increases (from 2000) to 2006 ;</li> <li>3. idea that the number of Iberian lynx born in captivity increases from 2005;</li> <li>4. credit correct manipulation of figures (to show an increase) ;</li> </ol>	<ol style="list-style-type: none"> <li>1. IGNORE in the wild</li> <li>2. DO NOT ACCEPT in the wild</li> <li>3. ACCEPT after 2004</li> <li>4. Example calculation Total number in breeding programmes increase by 34 overall</li> </ol>	(3) EXP
Question Number	Answer	Additional Guidance	Mark
8(a)(ii)	<ol style="list-style-type: none"> <li>1. idea of more (captive) Iberian lynx {to breed with / reintroduce} ;</li> <li>2. idea that Iberian lynx originally from the wild {increases gene pool/genetic diversity/reduces inbreeding};</li> <li>3. idea that Iberian lynx being born in captivity shows that the {breeding programme is successful / the animals are not stressed} ;</li> <li>4. idea that fewer lynx need to be originally taken from the wild because they are breeding in captivity ;</li> </ol>	<ol style="list-style-type: none"> <li>2. ACCEPT increases number of alleles in population [as alternative to gene pool]</li> </ol>	(3) EXP

Question Number	Answer	Additional Guidance	Mark
8(b)	<ol style="list-style-type: none"> <li>1. idea that enough animals need to remain in the breeding programme to maintain the gene pool;</li> <li>2. idea that enough need to be reintroduced at the same time {to improve chance that breeding (in the wild) will occur/maintain gene pool(in the wild)};</li> <li>3. otherwise there could be {birth defects / disease / e.g. of another consequence of inbreeding} ;</li> </ol>		(3) EXP

Question Number	Answer	Additional Guidance	Mark
8(c)	<ol style="list-style-type: none"> <li>1. idea of exchanging {animals/sperm} between the centres ;</li> <li>2. idea of keeping breeding records ;</li> <li>3. idea of sharing {resources / money /veterinary care /knowledge of husbandry /knowledge of release sites /raising awareness/eq} ;</li> <li>4. idea of {quarantining / not breeding with sick animals / eq } ;</li> <li>5. idea of not releasing too many lynx into one area ;</li> </ol>	<ol style="list-style-type: none"> <li>1. ACCEPT zoos</li> <li>2.ACCEPT stud books</li> </ol>	(3) EXP

