A-level
BIOLOGY
7402/1

Paper 1

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 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. (ATP to ADP + Pi) Releases energy; 2. (energy) allows ions to be moved against a concentration gradient OR (energy) allows active transport of ions;	2	1. Reject 'produces/makes/creates energy'. 2. For 'ions' accept Na^+ or K^+. 2. Do not accept if this movement is of glucose not ions.
01.2	1. (Maintains/generates) a concentration/diffusion gradient for Na^+ (from ileum into cell); 2. Na^+ moving (in) by facilitated diffusion, brings glucose with it OR Na^+ moving (in) by co-transport, brings glucose with it;	2	1. Accept '(Maintains/generates) a lower concentration of Na+ inside the cell compared with outside the cell'. 2. Accept 'co-transporter' for 'co-transport'.
01.3	1. Folded membrane/microvilli **so** large surface area (for absorption); 2. Large number of co-transport/carrier/channel proteins **so** fast rate (of absorption) OR Large number of co-transport/carrier proteins **for** active transport OR Large number of co-transport/carrier/channel proteins **for** facilitated diffusion; 3. Large number of mitochondria **so** make (more) ATP (by respiration) OR Large number of mitochondria **for** aerobic respiration OR Large number of mitochondria **to** release energy for active transport; 4. Membrane-bound (digestive) enzymes **so** maintains concentration gradient (for fast absorption);	2 max	1. Reject references to 'villi'. 1. Accept 'brush border' for 'microvilli'. 4. Accept named examples of digestive enzymes.

01.4	1. Phospholipids drawn with head and two tails; 2. Correctly positioned as a bilayer on either side of SGLT1;	2	2. Some of every 'head' must extend into the hydrophilic region **and** some of every 'tail' must extend into the hydrophobic region. 2. Reject phospholipids drawn within the protein.
01.5	1. One amine/NH_2 group joins to a carboxyl/COOH group to form a <u>peptide</u> bond; 2. (So in chain) there is a free amine/NH_2 group at one end **and** a free carboxyl/COOH group at the other OR Each amino acid is orientated in the same direction in the chain;	2	Accept on diagram, for example (at least) two amino acids joining by a correctly drawn peptide bond (MP1) with NH_2 at one end and COOH at the other (MP2). 1. Ignore incorrect names of NH_2 and COOH groups. 2. Allow ECF for incorrect naming of groups.

Question	Marking Guidance	Mark	Comments
02.1	1. Triglycerides decrease **because** of the action of lipase OR Fatty acids increase **because** of the action of lipase; 2. Triglycerides decrease **because** of hydrolysis (of triglycerides) OR Fatty acids increase **because** of hydrolysis (of triglycerides); 3. Triglycerides decrease **because** of digestion of ester bonds (between fatty acid and glycerol) OR Fatty acids increase **because** of digestion of ester bonds (between fatty acid and glycerol);	3	Triglycerides decreasing or fatty acids increasing only need to be stated once. Accept 'lower/higher/quoted numbers' for 'decrease/increase'. Only withhold one mark if there is no/incorrect reference to triglycerides decreasing or fatty acids increasing.
02.2	1. To denature the enzymes/lipase; 2. So no further digestion/hydrolysis/catalysis occurred;	2	1. Accept description of denaturation in terms of change in tertiary structure. 2. Accept 'break down' for digestion.
02.3	1. Micelles include bile salts and fatty acids; 2. Make the fatty acids (more) soluble in water; 3. Bring/release/carry fatty acids to cell/lining (of the ileum); 4. Maintain high(er) concentration of fatty acids to cell/lining (of the ileum); 5. Fatty acids (absorbed) by diffusion;	3 max	1. Ignore other correct components of micelles. 2 and 3 only. For 'fatty acids' accept fats/lipids. 5. Reject if absorbed by facilitated diffusion 5. Ignore if micelles themselves are being absorbed. Ignore references to monoglycerides.

Question	Marking Guidance	Mark	Comments
03.1	1. Aortic/semi-lunar valves is closed; 2. Because pressure in aorta higher than in ventricle;	2	1. Accept 'aorta valve' or 'valve to the aorta' or 'valve between the aorta and the ventricle'. 1. Do not accept S-L/A-V valve. 2. Accept 9-10kPa in ventricle and 13kPa in aorta. 2. Ignore incorrect figures.
03.2	1. Elastic recoil (of the aorta wall/tissue); 2. Smooths the blood flow OR Maintains rate of blood flow OR Maintains blood pressure;	2	1. Reject muscle contracting. 1. Ignore reference to muscle relaxing. 2. Ignore reference to preventing backflow of blood.
03.3	1. Peaks/contractions at the same/similar time OR Same/similar pattern; 2. Lower pressure;	2	Mark the answer as a whole. 1. Accept 'shape (of curve)' for 'pattern'.
03.4	167 (beats minute^{-1}) OR 164 (beats minute^{-1}) OR 171 (beats minute^{-1});	1	Full answers 166.6 recurring, 164.383562, 171.428571 Accept any number of decimal places as long as rounding correct.

Question	Marking Guidance	Mark	Comments
04.1	69.3 cm^3 solvent, 29.7 cm^3 water, 1.0 cm^3 acid (box 2);	1	
04.2	1. Temperature; 2. Agitation/mixing/stirring; 3. Source/age/type of blueberries; 4. Crushing of the blueberries; 5. Rinsing of the blueberries prior to mixing; 6. Concentration of ethanol/acid;	2 max	Do not accept pH. Accept 'Filtering method'.
04.3	1. Higher absorbance indicates more anthocyanin OR Higher absorbance indicates more membrane damage/permeability OR (**G** not zero because) some anthocyanin released when blueberries are crushed OR (**G** not zero because) some membrane damage when blueberries are crushed; 2. More membrane damage/permeability results in more anthocyanin release 3. (**E** and **F** greater than water because) phospholipids dissolve in ethanol; 4. (**E** greater than **F** because) acid denatures membrane proteins;	4	For 'anthocyanin' accept 'pigment'. 1. A direct comparative statement is not needed, can be taken from the answer as a whole. 1 and 2. Accept 'most' for 'more'. 4. Accept description of denaturation in terms of change in tertiary structure or breaking of hydrogen/ionic bonds.
04.4	1. Use known concentration of blueberry juice/extract OR Use known concentration of anthocyanin/pigment (solution) OR Use known concentration of (extraction) solvent to be added to blueberries; 2. Prepare dilution series; 3. Compare (results) with colour standards to give score/value/concentration;	3	2. Accept descriptions and 'serial dilutions' 2. Accept dilution series in terms of pigment or solvent. 3. For 'colour standards' accept 'dilutions'.

Question	Marking Guidance	Mark	Comments
05.1	1. Joins (adjacent DNA) nucleotides; 2. (Catalyses) condensation (reactions); 3. (Catalyses formation of) phosphodiester bonds (between adjacent nucleotides);	2 max	1. Reject suggestions that it forms hydrogen bonds or joins complementary bases. 1. Reject 'nucleotide bases'.
05.2	Final answer with 2sf or 3sf in range 31.8 to 34.7%;; 1 mark for 5.5 to 6.1 hours OR Final answer with 2sf or 3sf in range 46.6 to 53.0% OR Correct final answers rounded to more than 3sf OR Final answer with 2sf or 3sf in range 30.8 to 31.7 or 34.8 to 35.6%.	2	
05.3	1. Attachment/association of (inorganic) phosphate (to the enzyme); 2. (Released from) hydrolysis of ATP OR (Released from) ATP to ADP + Pi;	2	1 and 2. For 'phosphate/Pi' accept PO_4^{3-} and P in a circle. 1. Accept 'phosphate goes to the enzyme'. 1. Ignore named bonding or position of phosphate attaching to enzyme but reject formation of E-S complex. 2. For ATP accept adenosine triphosphate. 2. For ADP accept adenosine diphosphate.

05.4	1. Shortens interphase OR Cells begin DNA replication earlier OR DNA replication (starts) faster; 2. Fast(er) **cell** cycle/division/multiplication/mitosis OR Uncontrolled cell division/mitosis; 3. (Resulting in) a mass/group of abnormal/excessive cells;	2 max	1. Accept '**starts** mitosis earlier'. 2. Accept '(May result in) mutation in a tumour suppressor gene' OR '(May result in) mutation in an oncogene'. 2 and 3. Ignore uncontrolled growth; 3. Accept '(Resulting in) **a** growth of abnormal/excessive cells'.

Question	Marking Guidance	Mark	Comments
06.1	1. Reduced surface area; 2. Increased distance for <u>diffusion</u>; 3. Reduced **rate** of gas exchange;	3	1 and 2. Accept description of efficient gas exchange in healthy alveolar epithelium as long as reference made to the damaged tissue changing this.

06.2	See appendix 1 for a flow chart (No) **EITHER** 1. 9 (percent per 5 µg cm^{-3}); 2. 1.42/1.8 (percent per 5 µg cm^{-3}); **OR** 3. 1.8 (percent per 1 µg cm^{-3}); 4. 0.28/0.36 (percent per 1 µg cm^{-3}); **OR** 5. 9% **and** 36/27% increase here; 6. (To be linear) 100 (µg cm^{-3}) would be 180/171% (increase) OR (To be linear) 5 (µg cm^{-3}) would be 1.8% (increase) OR % increase is x4 (0-5 µg cm^{-3} compared with 0-100 µg cm^{-3}) but 5-100 is more than x4 OR % increase is x3 (0-5 µg cm^{-3} compared with 5-100 µg cm^{-3}) but 5-100 is more than x3; **OR** 7. (Using y = mx + c) at 5 (µg cm^{-3}) m = 1.8; 8. (Using y = mx + c) at 100 (µg cm^{-3}) m = 0.36; 9. At 100 (µg cm^{-3}) y would be 186%; 10. At 5 (µg cm^{-3}) y would be 7.8%;; If no correct answers accept for one mark Evidence of incorrect graph reading but division by 19 OR Evidence of incorrect graph reading but division by 95	2	Accept any number of significant figures as long as rounding correct, full answer for mp2 is 1.42105263, for mp4 is 0.28421053. Accept 1 and 2 OR 3 and 4 OR 5 and 6 OR 7 and 8 OR 7 and 9 OR 8 and 10

Question	Marking Guidance	Mark	Comments
07.1	1. $C_{12}H_{22}O_{11}$; 2. Condensation reaction OR With a glycosidic bond;	2	2. Reject if any other named reaction or named bond given. 2. Reject if reaction includes addition of water. Do not credit answers relating to other carbohydrates.
07.2	1. Y shape showing two long and two short (polypeptide) chains correctly positioned; 2. (Alpha-gal) binding site labelled on the end of the branches of the Y of the antibody; 3. Variable region labelled OR Constant region labelled OR Disulfide bridge/bond labelled;	3	Drawing is nothing like an antibody = 0 marks. 2. Accept one or two being labelled, if two both must be correct. 3. Accept description of 'variable region'. 3. Ignore labelling of light and heavy chains. 3. List rule applies.
07.3	1. (Part of tick protein and alpha-gal) have a similar shape/structure; 2. Antibody is <u>complementary</u> to both (tick protein and alpha-gal) OR Antigen-binding site is <u>complementary</u> to both (tick protein and alpha-gal) OR Antibody can form <u>antigen-antibody complex</u> with both (tick protein and alpha-gal);	2	1. Accept '(Part of tick protein and alpha-gal) have the same shape/structure.' 1. Do not credit reference to similar/same **tertiary** structure'. Ignore reference to alpha-gal being a protein. 2. Reject reference to substrates or active sites.

07.4	1. Exposure to tick (protein) is followed by increase in antibody (specific to alpha-gal); 2. (Later) greater/faster increase in antibody suggests there are memory cells; 3. Antibody (specific to alpha-gal) increases during/after allergic reaction; 4. During/after allergic reaction, total antibody increases more than alpha-gal antibody; 5. (So) may be other antibodies (that are causing allergic reaction);	3 max	1 and 2. For 'is followed by' accept 'causes'. 2. Must be in relation to EITHER second exposure to tick (protein) OR to allergic reaction. 3 and 4. Accept 'eating red meat' or 'eating/exposure to alpha-gal' for 'allergic reaction'.

Question	Marking Guidance	Mark	Comments
08.1	Plant v prokaryote 1. (Associated with) histones/proteins v no histones/proteins; 2. Linear v circular; 3. No plasmids v plasmids; 4. Introns v no introns; 5. Long(er) v short(er);	3 max	Alternatives must be written directly opposite one another. Do not award if only half of a mark point is written. 2 and 3. Do not credit if suggestion that prokaryotic DNA only exists as plasmids. Reference to prokaryotic DNA being single stranded = max 2. Reference to prokaryotic DNA not being helical = max 2.
08.2	1. <u>DNA</u> that does not code for protein/polypeptides OR <u>DNA</u> that does not code for (sequences of) amino acids OR <u>DNA</u> that does not code for tRNA/rRNA; 2. (Positioned) between genes;	2	1. Accept the idea of not transcribed for 'does not code for'. 1. Do not credit 'DNA that does not code for **an** amino acid'. 1. Ignore reference to introns. 2. Reject (positioned) 'in introns' or 'between exons'. 2. Accept '(Positioned) at the end of chromosomes' or '(Positioned) in the telomeres'.
08.3	Top to bottom **C T L R**; **OR** Top to bottom **T C L R**;	1	

08.4	1. (Supported) more similar than with any other species; 2. (Not supported) high (intraspecific) variation in species T (compared with variation between T and C); 3. Small sample OR Only five (individuals);	2 max	2. Accept idea that species T has nearly as much variation as between T and C. 2. Accept 'Low/close similarity in species T (in relation to similarity between T and C)'

Question	Marking Guidance	Mark	Comments
09.1	171 (per mm^2);; 1 mark for Mean of 10.7/11 stomata per square OR Square = 0.0625 mm^2 OR 169.8/174.6/176 stomata OR Digits 170$\dot{6}$ /171 with decimal point in the wrong place OR Correct calculation with incorrect rounding	2	Answer – 170.$\dot{6}$, accept any number of decimal places as long as rounding correct. Mean stomata per square = 10.$\dot{6}$, accept any number of decimal places with correct rounding for one mark.
09.2	1. There is no association/correlation/relationship between the concentration of carbon dioxide and the stomatal density OR The concentration of carbon dioxide does not affect the stomatal density; 2. Correlation coefficient;	2	1. Reject 'There is no difference between the carbon dioxide concentration and the stomatal density'. 1. Do not credit 'The stomatal density does not affect the carbon dioxide concentration'. 2. Accept 'Spearman's (rank)' or other named correlation coefficient.

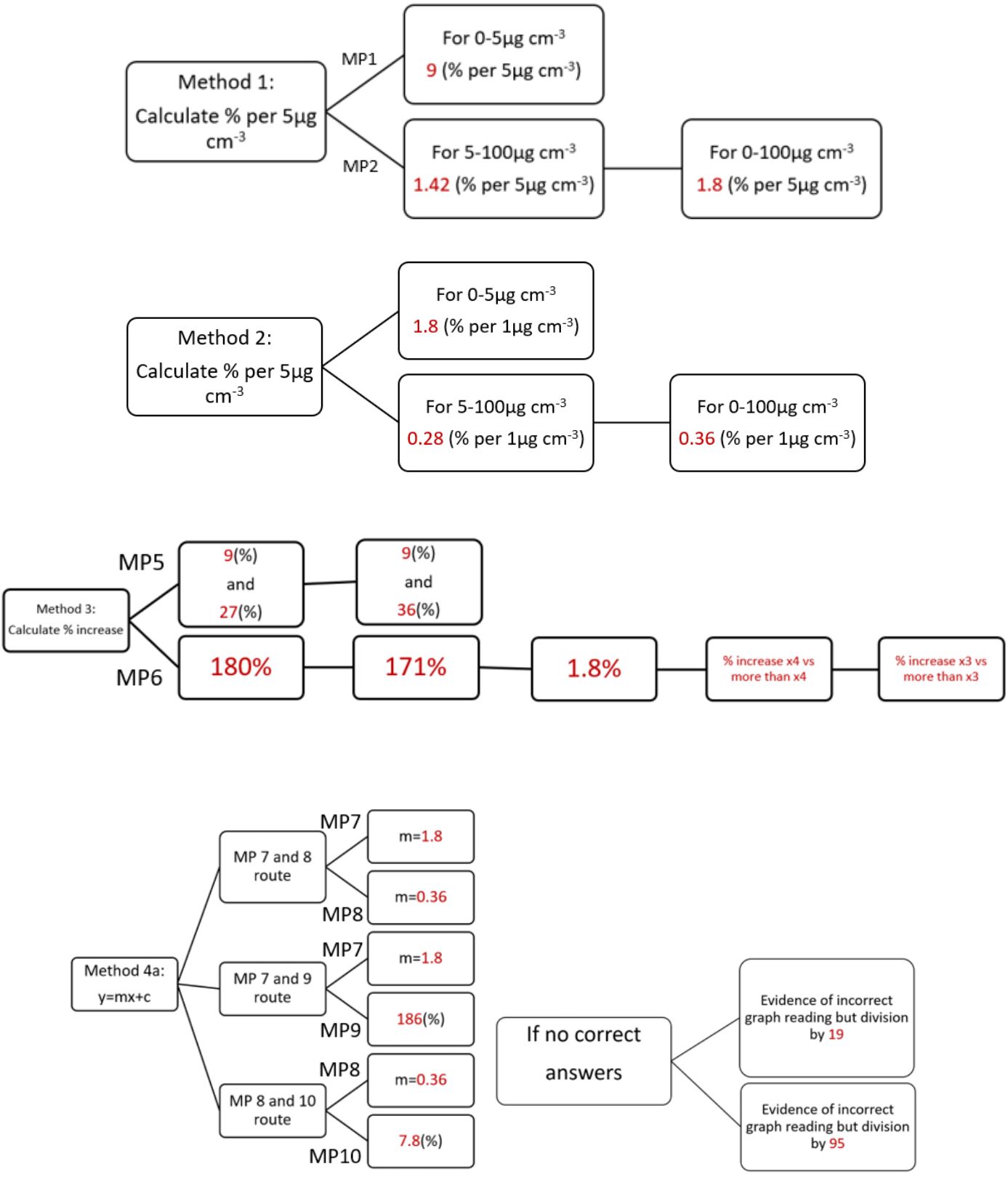
09.3	Final answer in range $2.\dot{6}$ to $2.\dot{7}$;; 1 mark for Stomatal density decrease of 24 to 25 OR Final answer of between $0.2\dot{6}$ to $0.2\dot{7}$ OR Correct calculation with incorrectly rounding taking answer out of correct range	2	Accept any number of sf as long as rounding correct. Ignore minus signs.

09.4	1. Increasing carbon dioxide (concentration) shows decreased stomatal <u>density</u>; 2. Fewer stomata means less transpiration OR Fewer stomata means less evaporation (of water from leaves) OR Fewer stomata means less diffusion of water vapour (from leaves); 3. Same (volume of) carbon dioxide can be absorbed for photosynthesis with smaller number of stomata; 4. Don't know the size of the stomata; 5. Don't know whether leaf size has changed; 6. Don't know if this is true for all species (of plant); 7. Don't know how long the stomata are open for; 8. Don't know if this trend will continue (beyond the concentrations of carbon dioxide shown in Figure 10); 9. Other factors affect transpiration (rate);	4 max	1. Accept 'There is a negative correlation between carbon dioxide (concentration) and stomatal <u>density</u>'. 1. Accept 'stomata per mm^2' for 'stomatal density'. 4, 5, 6, 7, 8. For 'don't know' accept idea that these things may/have change(d). 6. Accept 'types' for 'species'. 6. Accept 'more species (of plant) should be tested' 9. Accept named factors that affect transpiration (rate).

Question	Marking Guidance	Mark	Comments
10.1	1. Hydrogen bonds (between DNA bases) break; 2. (Only) one DNA strand acts as a template; 3. (Free) RNA nucleotides align by complementary base pairing; 4. (In RNA) Uracil base pairs with adenine (on DNA) OR (In RNA) Uracil is used in place of thymine; 5. RNA polymerase joins (adjacent RNA) nucleotides; 6. (By) phosphodiester bonds (between adjacent nucleotides); 7. Pre-mRNA is spliced (to form mRNA) OR Introns are removed (to form mRNA);	5 max	Ignore DNA helicase. 1. Reject hydrolysing hydrogen bonds. 3. For 'align by complementary base pairing', accept 'align to complementary bases' or 'align by base pairing'. 4. Do not credit use of letters alone for bases. 5. Reject suggestions that RNA polymerase forms hydrogen bonds or joins complementary bases.
10.2	1. (mRNA attaches) to ribosomes OR (mRNA attaches) to rough endoplasmic reticulum; 2. (tRNA) anticodons (bind to) complementary (mRNA) codons; 3. tRNA brings a specific amino acid; 4. Amino acids join by peptide bonds; 5. (Amino acids join together) with the use of ATP; 6. tRNA released (after amino acid joined to polypeptide); 7. The ribosome moves along the mRNA to form the polypeptide;	6 max	

10.3	(Definition of gene mutation) 1. Change in the base/nucleotide (sequence of chromosomes/DNA); 2. Results in the formation of new <u>allele</u>; (Has no effect because) 3. Genetic code is degenerate (so amino acid sequence may not change); OR Mutation is in an intron (so amino acid sequence may not change); 4. Does change amino acid but no effect on tertiary structure; 5. (New allele) is recessive so does not influence phenotype; (Has positive effect because) 6. Results in change in polypeptide that positively changes the properties (of the protein) OR Results in change in polypeptide that positively changes a named protein; 7. May result in increased reproductive success OR May result in increased survival (chances);	4 max	For 4 marks at least one mark must be scored in each section of the answer. 1. Accept named mutation for 'change'. 3. Accept description of 'degenerate', eg some amino acids have more than one triplet/codon. 6. For 'polypeptide' accept 'amino acid sequence' or 'protein'.

Appendix 1


Method 1:
Calculate % per 5µg cm-3
MP1
For 0-5µg cm-3
9 (% per 5µg cm-3)
MP2
For 5-100µg cm-3
1.42 (% per 5µg cm-3)
For 0-100µg cm-3
1.8 (% per 5µg cm-3)
Method 2:
Calculate % per 5µg cm-3
For 0-5µg cm-3
1.8 (% per 1µg cm-3)
For 5-100µg cm-3
0.28 (% per 1µg cm-3)
For 0-100µg cm-3
0.36 (% per 1µg cm-3)
Method 3:
Calculate % increase
MP5
9(%) and 27(%)
9(%) and 36(%)
MP6
180%
171%
1.8%
% increase x4 vs more than x4
% increase x3 vs more than x3
Method 4a:
y=mx+c
MP 7 and 8 route
MP7
m=1.8
MP8
m=0.36
MP 7 and 9 route
MP7
m=1.8
MP9
186(%)
MP 8 and 10 route
MP8
m=0.36
MP10
7.8(%)
If no correct answers
Evidence of incorrect graph reading but division by 19
Evidence of incorrect graph reading but division by 95