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BL02

Unit 2 Biological Systems and Disease

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 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.

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. Sodium ions are actively transported out of the cell (by the sodium/potassium pump); 2. Creates/maintains a low concentration of sodium ions inside the cell; 3. Glucose moves into cell with sodium ions (through sodium cotransporter/symport protein); 4. Glucose moves into blood by (facilitated) diffusion through a channel protein;	4	1 – 3. Allow Na^+ for sodium ions 1. Allow sodium ions pumped out using ATP/energy Penalise 'sodium' once only 2. Allow creates/maintains a concentration gradient for sodium ions between the lumen and the epithelial cell

Question	Marking guidance	Mark	Comments
01.2	Mark in pairs 1. Feature: **many** microvilli; 2. Explanation: to increase surface area for absorption **OR** To increase the number of transport proteins; 3. Feature: **many** mitochondria; 4. Explanation: to provide energy/ATP for active transport; 5. Feature: **many** transport/carrier/channel proteins; 6. Explanation: to allow (higher rate of) movement of glucose in/out of the cell; 7. Feature: sodium/potassium ion pumps; 8. Explanation: to create/maintain a concentration gradient for sodium ions (between the lumen and the epithelial cell);	4	Explanation must match feature 1. Allow descriptions of microvilli e.g. many folds in the membrane / highly folded membrane 1. Ignore reference to villi 4. Allow Na^+/K^+ pump instead of active transport 6. Allow through cell membrane Ignore features related to the capillary

Question	Marking guidance	Mark	Comments
01.3	1. Inhibitor blocks SGLT (binding site) for glucose/sodium ions **OR** Inhibitor changes the shape of the SGLT (binding site); 2. Reduces the amount of glucose absorbed; 3. (So) blood glucose concentration is maintained at normal level **OR** (So) blood glucose does not reach very high levels;	3	1. Do not allow reference to 'active site' 2. Do not allow stops glucose absorption

Question	Marking guidance	Mark	Comments
02.1	(Phospho/glyco)lipids/proteins;	1	Allow any named transmembrane/surface proteins e.g. gp41 and gp120

Question	Marking guidance	Mark	Comments
02.2	1. RNA used (as a template) to make (HIV/viral) DNA; 2. Codes for HIV/viral proteins;	2	

Question	Marking guidance	Mark	Comments
02.3	110 (nm) = **3 marks;;;** Allow **two** marks for: Correct radius = 55 nm **OR** Correct diameter in μm 0.11/0.110 Allow **one mark** for: Correct radius in μm, not in nm = 0.055	3	

Question	Marking guidance	Mark	Comments
02.4	1. HIV only binds to (specific) receptors/proteins (on some host cells); 2. <u>Complementary</u> (in shape) to HIV (surface/attachment) proteins;	2	1. Allow only T-helper cells have receptors for HIV

Question	Marking guidance	Mark	Comments
02.5	Any **one** from: 1. Inactive HIV virus (in vaccine) might become active; 2. HIV (RNA/proteins) may harm cells / lead to infection; 3. HIV has high rate of mutation so vaccine not effective;	1 max	 2. Do not allow ‘side effects’ unqualified

Question	Marking guidance	Mark	Comments
03.1	1. (**A** =) Difference in solute concentration; 2. (**B** =) Difference in (hydrostatic) pressure;	2	1. Ignore references to water potential 1. Allow description of solute concentration 1. Allow presence of (plasma) proteins in capillary 2. Allow high(er) pressure in capillary

Question	Marking guidance	Mark	Comments
03.2	Net water potential of blood at region **1**: 2.6 kPa **AND** Direction of fluid movement at region **1**: Out of capillary; Net water potential of blood at region **2**: –1 kPa **AND** Direction of fluid movement at region **2**: Into capillary;	2	Allow one mark for both water potentials correct but directions incorrect OR Allow one mark for both directions of fluid movement correct but incorrect water potentials

Question	Marking guidance	Mark	Comments
03.3	Any **two** from: glucose/ions/amino acids/proteins/fatty acids/oxygen/ carbon dioxide/urea/hormones;;	2	Allow other named monosaccharides

Question	Marking guidance	Mark	Comments
03.4	1. Fluid enters the lymph (vessels)/lymphatic (system); 2. (Lymphatic vessels) drain fluid back into the bloodstream (near the heart);	2	

Question	Marking guidance	Mark	Comments
03.5	Answer in range 19075–19085 = **3 marks**;;; Answer in range 19075.5–19085.175 (not rounded) = **2 marks**;; Any answer with 19075–19085 numbers but incorrect order of magnitude = **2 marks**;; **OR** Answer in range 76302–76341= **2 marks** (use of diameter instead of radius);; Incorrect order of magnitude and use of diameter instead of radius = **1 mark**	3	For **3 marks** accept 1.91×10^4

Question	Marking guidance	Mark	Comments
03.6	1. Walls are made up of a single layer of cells/endothelium **so** short diffusion distance; 2. Narrow diameter **so** they permeate tissues/no cell is far from a capillary **OR** Narrow lumen **so** red blood cells are squashed closer to body cells **OR** Narrow lumen **so** blood flow is slowed allowing more time for exchange; 3. Highly branched **so** there is a large surface area for exchange; 4. There are spaces between the (endothelial) cells in the wall **so** fluids/substances can be exchanged;	3 max	Do not allow any reference to cells walls once 1. Allow thin capillary wall Allow one mark for three correct features but not explained correctly

Question	Marking guidance	Mark	Comments
04.1	1. To break the links between cells/cell walls **OR** To separate cells/cell walls **OR** To break down cell walls; 2. To allow the stain to pass/diffuse into the cells; 3. To allow the cells to be (more easily) squashed; 4. To stop mitosis/cell division;	2 max	Ignore references to any bonds 1. Allow breaks down cellulose (in the cell walls) 3. Ignore 'soften tissue' unqualified 3. Allow descriptions of squashed e.g. spread thinly

Question	Marking guidance	Mark	Comments
04.2	Any **two** from: 1. Wear eye protection/glasses/goggles; 2. Wear gloves/lab coat; 3. Keep acid in a fume cupboard; 4. Use forceps/tongs to remove tissue from acid; 5. Add water to (dilute) spills;	1 max	Ignore references to using a dilute acid instead 2. Allow wash HCl off if it gets on skin

Question	Marking guidance	Mark	Comments
04.3	Any **two** from: 1. Use the coarse/fine focus wheel / adjust focus; 2. Change the objective lens / increase the magnification; 3. Clean the objective lens (so nothing interferes with the image); 4. Adjust the condenser (to let more/less light through); 5. Change the field of view (to focus on different cells that might be easier to view)	2 max	4. Allow (for microscopes with a mirror) move lamp closer **OR** use a brighter lamp **OR** move nearer a window or light source

Question	Marking guidance	Mark	Comments
04.4	0.4 **OR** 40(%);	1	

Question	Marking guidance	Mark	Comments
04.5	18 (hours) = **2 marks**;;; **One mark** for: Evidence of (648 × 150) ÷ 90 **OR** (648 ÷ 60) × 100 / 1080 minutes **OR** Correct method using incorrect number of cells from **Table 1**	2	

Question	Marking guidance	Mark	Comments
04.6	1. Chromosomes/centromeres cannot attach (to spindle) **OR** Chromosomes cannot line up (on spindle); 2. Chromatids cannot separate (on spindle); 3. Cell cycle/mitosis is stopped at metaphase/anaphase;	2	If no marks awarded, allow one mark – mitosis stops **so** no new cells form 2. Accept description of 'cannot separate' e.g. chromatids are not pulled to poles

Question	Marking guidance	Mark	Comments
05.1	Rate of water movement in xylem increases as phloem pressure decreases **OR** (Relationship between rate of water movement in xylem and phloem pressure) is inversely proportional;	1	Allow reference to negative correlation

Question	Marking guidance	Mark	Comments
05.2	1. Increase in the rate of transpiration/evaporation (as temperature/light intensity increases/more stomata open); 2. Lower (rate of) water movement from xylem to phloem **OR** Lower water potential gradient between the phloem and xylem (so less water moves in from xylem);	2	1. Allow high rate of transpiration

Question	Marking guidance	Mark	Comments
05.3	Any **one** from: 1. Volume **OR** frequency of water; 2. (Air) humidity; 3. Carbon dioxide concentration; 4. Mineral ion concentration (in soil); 5. Type/pH of soil;	1 max	Ignore light and temperature 1. Ignore ‘amount’

Question	Marking guidance	Mark	Comments
05.4	Any **two** from: 1. Age; 2. Sex; 3. Conditions the aphids were stored in before the start of the investigation; 4. Time that aphids are on the source plants;	2 max	1. Allow stage of development e.g. no aphids with wings 3. Allow examples e.g. temperature **OR** hours in light/dark **OR** factor related to feeding OR aphids not carrying CaMV (before start of investigation)

Question	Marking guidance	Mark	Comments
05.5	1. Significantly higher proportion of infected test plants from source plants with no water **OR** Source plants with no water lead to significantly higher rate of viral transfer; 2. No significant difference in concentration of CaMV in sources plants **OR** Concentration of CaMV in source plants is not the cause for the higher rate of viral transfer;	2	2. For no significant difference, allow difference is due to chance

Question	Marking guidance	Mark	Comments
06.1	1. Bulge/swelling of a blood vessel (due to blood pressure); 2. A blood clot/blockage inside a blood vessel (that restricts blood flow);	2	1. Do not allow reference to bursting of a blood vessel 2. Allow named blood vessel e.g. coronary artery

Question	Marking guidance	Mark	Comments
06.2	1. Diet high in salt/alcohol/carbohydrates/saturated fats; 2. Smoking; 3. Obesity; 4. Lack of exercise;	2 max	Accept other correct risk factors e.g. genetics, age, sex, stress, ethnicity etc Ignore diet unqualified

Question	Marking guidance	Mark	Comments
06.3	Model becomes less effective as age increases;	1	

Question	Marking guidance	Mark	Comments
06.4	1. Same reduction in risk (1.1%) in the 45–54 age group **OR** Similar reduction in risk in the 55–64 age group; 2. Reducing blood pressure reduces the risk more than reducing cholesterol in all other age groups; 3. Reducing blood pressure reduces risk by almost twice as much/much more in the 75–84 age group; 4. Reducing blood pressure and blood cholesterol each lower the risk of CHD more as age increases;	3	If no other marks awarded, allow **one mark** for idea that lowering blood pressure is more effective than lowering blood cholesterol above 55/65 years

Question	Marking guidance	Mark	Comments
06.5	Must have 2 from each for max marks. **For** 1. Very large sample size **so** results likely to be representative; 2. Long-term/10-year study **so** results likely to be valid; 3. Reducing blood pressure is more effective at reducing risk than reducing cholesterol; **Against** 4. Study is 20 years old/new studies may show different results; 5. Study is a model only **OR** Model only predicts reduction in risk; 6. Reduction in risk by reducing blood pressure is never double the figures for reducing cholesterol; 7. No data for people younger than 45 **OR** No data for people over 84; 8. There are other risk factors for developing CHD; 9. No statistical test so don't know if difference in percentage lowering of risk between blood pressure and blood cholesterol are significant;	5 max	3. Allow reduction in risk by reducing blood pressure for 75-84 age group is approximately double 5. As age increases (c-index decreases so) the model becomes less effective 6. Only one age group (75-84) is close to a doubling effect for blood pressure 6. For 45-54 / 55-64 there is no/little difference in lowering of risk between blood pressure and blood cholesterol

Question	Marking guidance	Mark	Comments
07.1	1. B cell binds to (complementary) antigens (on pathogen) **OR** B cell presents (pathogen) antigens on its surface (stimulating T helper cells); 2. Clonal expansion (of B cell) **OR** B cell divides by <u>mitosis</u>; 3. (B cells develop into) plasma cells that release <u>antibodies</u> (complementary to antigens on pathogen); 4. (B cells develop into) memory cells for faster/greater (secondary) immune response;	4	1. Accept B cell forms antigen-antibody complex 2. Accept B cell undergoes clonal selection/expansion 2. Accept B cell becomes activated by helper T cell 4. Allow descriptions of (secondary) immune response e.g. faster/greater production of specific antibodies

Question	Marking guidance	Mark	Comments
07.2	Maximum of 4 from each section **Types of gene mutations:** 1. (Gene mutation) changes the base sequence of DNA/a gene; 2. Occur at random/spontaneously during DNA replication; 3. Base deletion causes a frameshift (so all triplets from the point of mutation are changed); 4. Base substitution causes a change in one triplet (but other triplets are not changed); 5. Base substitution may (be silent and) cause no change in amino acid coded as genetic code is degenerate; **Effect of gene mutations:** 6. Mutation may change the amino acids (coded for) **OR** change the primary structure of the polypeptide; 7. Polypeptide folds/coils differently **so** protein could be non-functional **OR** Named bond in protein structure form in different places **so** protein could be non-functional; 8. A mutation in proto-oncogene **OR** tumour suppressor gene can result in cells dividing too quickly;	6 max	3. Allow descriptions of a frameshift Allow references to insertion, inversion, translocation and their possible effects 6. Allow correct description of nonsense/missense substitution mutations 6. Do not allow reference to amino acid production 7. Allow references to different tertiary structure 7. Allow description of non-functional e.g. enzyme with a different active site shape 7. Do not allow peptide bonds