



# Cambridge International AS & A Level

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**BIOLOGY**

**9700/02**

Paper 2 AS Level Structured Questions

**For examination from 2022**

MARK SCHEME

Maximum Mark: 60

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**Specimen**

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This document has **16** pages. Blank pages are indicated.

**Generic Marking Principles**

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

**GENERIC MARKING PRINCIPLE 1:**

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

**GENERIC MARKING PRINCIPLE 2:**

Marks awarded are always **whole marks** (not half marks, or other fractions).

**GENERIC MARKING PRINCIPLE 3:**

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

**GENERIC MARKING PRINCIPLE 4:**

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**GENERIC MARKING PRINCIPLE 5:**

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

**GENERIC MARKING PRINCIPLE 6:**

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

**Science-Specific Marking Principles**

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	<p><u>'List rule' guidance</u> (see examples below)</p> <p>For questions that require <b>n</b> responses (e.g. State <b>two</b> reasons ...):</p> <ul style="list-style-type: none"> <li>• The response should be read as continuous prose, even when numbered answer spaces are provided</li> <li>• Any response marked <i>ignore</i> in the mark scheme should not count towards <b>n</b></li> <li>• Incorrect responses should not be awarded credit but will still count towards <b>n</b></li> <li>• Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should <b>not</b> be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response</li> <li>• Non-contradictory responses after the first <b>n</b> responses may be ignored even if they include incorrect science.</li> </ul>

6	<p><u>Calculation specific guidance</u></p> <p>Correct answers to calculations should be given full credit even if there is no working or incorrect working, <b>unless</b> the question states 'show your working'.</p> <p>For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.</p> <p>For answers given in standard form, (e.g. <math>a \times 10^n</math>) in which the convention of restricting the value of the coefficient (<math>a</math>) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.</p> <p>Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.</p>
7	<p><u>Guidance for chemical equations</u></p> <p>Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.</p> <p>State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.</p>

Mark scheme abbreviations:

;	separates marking points
/	separates alternatives within a marking point
<b>R</b>	reject
<b>I</b>	ignore mark as if this material was not present
<b>A</b>	accept (a less than ideal answer which should be marked)
<b>COND</b>	indicates mark is conditional on previous marking point
<b>OWTTE</b>	or words to that effect (accept other ways of expressing the same idea)
<b>AW</b>	alternative wording (where responses vary more than usual)
<b><u>UNDERLINE</u></b>	actual word given must be used by candidate (grammatical variants accepted)
<b>max</b>	indicates the maximum number of marks that can be awarded
<b>ECF</b>	credit a correct statement that follows a previous wrong answer
<b>MP</b>	marking point (with relevant number)
<b>( )</b>	the word / phrase in brackets is not required, but sets the context
<b>ORA</b>	or reverse argument

**Examples of how to apply the list rule**

State three reasons ... [3]

**A**

1. Correct	✓	<b>2</b>
2. Correct	✓	
3. Wrong	✗	

**B (4 responses)**

1. Correct, Correct	✓, ✓	<b>3</b>
2. Correct	✓	
3. Wrong	ignore	

**C (4 responses)**

1. Correct	✓	<b>2</b>
2. Correct, Wrong	✓, ✗	
3. Correct	ignore	

**D (4 responses)**

1. Correct	✓	<b>2</b>
2. Correct, CON (of 2.)	✗, (discount 2)	
3. Correct	✓	

**E (4 responses)**

1. Correct	✓	<b>3</b>
2. Correct	✓	
3. Correct, Wrong	✓	

**F (4 responses)**

1. Correct	✓	<b>2</b>
2. Correct	✓	
3. Correct CON (of 3.)	✗ (discount 3)	

**G (5 responses)**

1. Correct	✓	<b>3</b>
2. Correct	✓	
3. Correct Correct CON (of 4.)	✓ ignore ignore	

**H (4 responses)**

1. Correct	✓	<b>2</b>
2. Correct	✗	
3. CON (of 2.) Correct	(discount 2) ✓	

**I (4 responses)**

1. Correct	✓	<b>2</b>
2. Correct	✗	
3. Correct CON (of 2.)	✓ (discount 2)	

Question	Answer	Marks
1(a)	<p>assume in context of transmission electron micrograph unless otherwise stated</p> <p>any <b>one</b> from:</p> <p>idea that can see internal structures ;  <b>A</b> example of named cell structure  cannot see surface contours / AW ;  <b>A</b> not 3-D appearance  AVP ; e.g. ref. to small(er) depth of field</p>	1
1(b)	<p>any <b>two</b> from:</p> <p>(flattened) sacs have layered appearance / no connection between membranes / AW ; ora  not, connected to / contiguous with / continuous with, (outer membrane of) nuclear envelope ; ora  swellings at end of sacs (for vesicle formation) / vesicles at ends of sacs ;  no ribosomes ; ora</p>	2
1(c)	<p>correctly stated formula ; e.g. actual diameter = image <math>\frac{\text{length}}{\text{magnification}}</math></p> <p>correct actual diameter of <b>X–Y</b> calculated from measurement from printed copy ;  <b>A</b> 213 nm (for 10 mm)  <b>A</b> 223 nm (for 10.5 mm)  <b>A</b> 234 nm (for 11 mm)  <b>A</b> 245 nm (for 11.5 mm)  <b>A</b> 255 nm (for 12 mm)</p>	2



Question	Answer	Marks
2(a)(i)	<p>accept points from a diagram</p> <p>max <b>three</b> from:</p> <p>1 detection of / recognition of / binding to, bacterium / pathogen / <i>M. tuberculosis</i> / foreign antigens / antibodies complexed to antigens <b>or</b> (macrophage) has receptors for (foreign / pathogen) antigen ;</p> <p>2 engulfs / envelops, pathogen / bacterium / AW ; <b>A</b> phagocytosis occurs <b>A</b> endocytosis occurs <b>A</b> pseudopodia form</p> <p>3 forms, vacuole / vesicle / phagosome ;</p> <p>4 ref. to lysosome fusion ; <b>A</b> secondary lysosome formation</p> <p>5 ref. to hydrolytic / digestive, enzymes ; <b>A</b> named examples <b>A</b> hydrolases</p> <p>6 ref. to antigen presentation ;</p> <p>7 AVP ; e.g. (response is) non-specific / innate</p>	3
2(a)(ii)	<p>any <b>one</b> from:</p> <p>suggestion that <i>M. tuberculosis</i> produces inhibitors for / deactivates, lysosomal / hydrolytic, enzymes ; escapes out of, phagosome / AW ; forms resistant spore / is resistant to digestive enzymes / AW ; AVP ; e.g. suggestion of macrophage malfunction</p>	1



Question	Answer	Marks
2(b)	<p><i>any three from:</i></p> <ol style="list-style-type: none"> <li>1 production of mucus by, mucous glands / goblet cells ;</li> <li>2 sticky / AW, mucus</li> </ol> <p><b>or</b></p> <ol style="list-style-type: none"> <li>3 mucus traps, pathogens / bacteria / microorganisms ;</li> <li>4 mucus acts as a barrier (to prevent entry) ;</li> <li>5 mucus increases distance to reach cells ;</li> <li>6 cilia on ciliated epithelial cells ;</li> <li>7 <b>A</b> ciliated epithelium</li> </ol> <p>6 cilia, waft / move, mucus / AW ;</p> <p>7 <i>idea that</i> (contaminated) mucus is moved, away from alveoli / away from lung tissue / towards back of mouth / AW ;</p>	3
2(c)	<p><i>any one from:</i></p> <p>blood / plasma / circulatory system ; lymph / lymph system ; within, neutrophils / macrophages / phagocytes ; <b>A</b> white blood cells / leucocytes</p>	1
2(d)	<p><i>any one from:</i></p> <p>eating contaminated, meat / beef</p> <p><b>or</b></p> <p>eating, meat / beef, from infected cattle ;</p> <p>drinking, raw / unpasteurised, milk, from infected cows</p> <p><b>or</b></p> <p>drinking contaminated milk ;</p>	1

Question	Answer	Marks
2(e)	<p><i>rifampicin binds to RNA polymerase so mRNA is not synthesised so, polypeptides / proteins / enzymes, not synthesised ; A no transcription and translation</i>  <b>or</b>  <i>rifampicin prevents, elongation of, RNA transcript / mRNA / polynucleotide chain / addition of (RNA) nucleotides, so, polypeptides / protein / enzymes, not synthesised ;</i>  <b>A prevents movement of RNA polymerase along DNA strand</b></p> <p>ref. proteins / enzymes, required for, growth / replication / (essential) metabolism (so cell dies without these proteins) ;</p>	<b>2</b>
2(f)	<p><i>any two from:</i></p> <p>rate of increase in cases of MDR-TB greater than rate of increase of TB ; AW ora manipulated data to support ;</p> <p>ref. to decrease ; e.g. for TB between 2011 and 2013 but for MDR-TB between, 2013 and 2014 / after 2013</p> <p><b>or</b></p> <p>decreases over two years for TB whereas only one year for MDR-TB ;</p> <p>reported cases of TB shows a plateau between 2009 and 2012 but no plateau for MDR-TB ; <b>A</b> MDR-TB plateaus later</p>	<b>2</b>

Question	Answer	Marks
2(g)	<p>any <b>three</b> from:</p> <ol style="list-style-type: none"> <li>1 <i>idea that successful, treatment / DOTS strategy, of normal TB will help reduce risk of MDR-TB ;</i></li> <li>2 <i>ref. to accommodation ; e.g. poorly ventilated / close proximity, increases spread ;</i></li> <li>3 <b>A</b> <i>cost of improving accommodation to prevent spread</i></li> <li>4 <i>ref. to education about ways to, prevent spread / minimise risk of antibiotic resistance occurring ;</i></li> <li>5 <i>ref. to particular (social) groups and the link between, HIV infection / HIV/AIDS, and, TB / MDR-TB ;</i></li> <li>5 <i>ref. to minimising use of antibiotics in, agriculture / animals used for food ;</i></li> <li>5 <i>in context of, educating farmers / laws to prevent overuse</i></li> </ol> <p>cost of</p> <ol style="list-style-type: none"> <li>6 <i>vaccination / vaccination programme ; in context of individual or health authorities and with ref. to normal TB or MDR-TB</i></li> <li>7 <i>longer drug treatment (of MDR-TB) means less money available to health authorities ;</i></li> <li>8 <i>research into, new drugs / new antibiotics / different treatment regimes ;</i></li> <li>9 <i>increase in demand for healthcare / training of personnel ; AW</i></li> <li>10 <i>educating, public / health care personnel / veterinary personnel ;</i></li> <li>10 <b>A</b> <i>cost of educating farmers to minimise use of antibiotics if mp5 not gained</i></li> <li>11 <i>AVP ; e.g. suggested reason for individuals not finishing course of treatment</i></li> </ol>	3

Question	Answer	Marks
3(a)	<p>any <b>four</b> from:</p> <ol style="list-style-type: none"> <li>1 <i>disaccharide to monosaccharides ;</i></li> <li>2 <b>Y</b> <i>is water / water required ;</i></li> <li>3 <i>hydrolysis reaction ;</i></li> <li>4 <i>glycosidic bond broken ;</i></li> <li>5 <b>Z</b> <i>is <math>\alpha</math>-glucose ;</i></li> <li>6 <i>detail of enzyme action ; e.g. induced-fit or lock-and-key hypothesis described</i></li> <li>7 <i>AVP ; e.g. (<math>\beta</math>-)1,4(-glycosidic) bond broken <b>R</b> if bond type is incorrectly named</i></li> </ol>	4

Question	Answer	Marks
3(b)(i)	<p><i>intracellular advantage:</i> idea of control / maintaining balance / efficient metabolism ; e.g. if, (enough) glucose / galactose / monosaccharides, present then no need for, uptake / breakdown, of lactose avoids osmotic problems as no build-up of monosaccharides</p> <p><i>disadvantage:</i> loss of product / reduced productivity / product required continuously / slows rate of reaction / ref. to enzyme needing to remain active ;</p>	2
3(b)(ii)	<p><i>any one from:</i> products and enzyme kept separated / AW ; product removed immediately ;</p>	1
3(b)(iii)	<p><i>any one from:</i> inert / unreactive / cannot be digested by lactase / AW ; non-toxic ; insoluble ; long shelf-life ; AVP ; e.g. can create small mesh size suggestion of enzyme attachment to fibres</p>	1

Question	Answer	Marks
3(c)	<p>any <b>three</b> from:</p> <p>accept answers in the context of lactase</p> <ol style="list-style-type: none"> <li>1 ref. to controlled variables ; e.g. constant, pH / temperature</li> <li>2 take samples at timed intervals ; <b>A</b> regular intervals</li> <li>3 determine, substrate / lactose, concentration <b>or</b></li> <li>4 determine, product / glucose / galactose, concentration ; plot graph of, substrate concentration / product concentration, against time ;</li> <li>5 ref. to rate of disappearance of substrate <b>or</b></li> <li>6 ref. to rate of appearance of product ; determine initial rate ;</li> </ol>	3
4(a)	<p>any part of the pathway beyond cortical cells</p> <p>any <b>four</b> from:</p> <ol style="list-style-type: none"> <li>1 correct ref. to, apoplast pathway and symplast pathway / apoplast and symplast ; <b>A</b> apoplastic pathway and symplastic pathway</li> <li>2 cell wall route ;</li> <li>3 further detail ; e.g. between, cellulose fibres / spaces between cells / intercellular spaces (water) does not cross (cell) membranes</li> <li>4 entry into, root hair cell / cell <b>X</b>, by, crossing (partially permeable) cell surface membrane / osmosis ;</li> <li>5 (then) cytoplasmic route / within cytoplasm ;</li> <li>6 from cell to cell via plasmodesmata ;</li> <li>7 vacuolar route ; <b>A</b> (water) crosses, tonoplast / vacuolar membrane</li> </ol>	4

Question	Answer	Marks
4(b)	<p>any <b>two</b> from:</p> <p>(root hair cell) mitochondria needed to, produce ATP / provide energy, for active transport (of mineral ions) ;  ora for cell of cortex  <b>R</b> produce energy  (some) mineral ions enter, root hair cell / cell <b>X</b>, against the concentration gradient / AW ;  (all) mineral ions transported through cortex cell, passively / dissolved in water ;</p>	2
5(a)	<p>any <b>three</b> from:</p> <p>SAN (<i>max two</i>):</p> <ol style="list-style-type: none"> <li>1 pacemaker / sets rate of heart beat / responsible for rhythmic contraction ;</li> <li>2 sends out, impulses / waves of excitation / waves of depolarisation ;</li> <li>3 initiates / brings about / AW, heart beat / contraction of the heart / atrial contraction / atrial systole ;</li> </ol> <p>AVN:</p> <ol style="list-style-type: none"> <li>4 acts to relay impulses to ventricles</li> </ol> <p><b>or</b></p> <ol style="list-style-type: none"> <li>5 conducts / AW, waves of excitation / impulses, to Purkyne fibres ; <b>A</b> bundle of His introduces delay to ventricular, systole / contraction(s)</li> </ol> <p><b>or</b></p> <p>prevents simultaneous contraction of atria and ventricles / AW ;  <b>A</b> allows time for, atria to empty / ventricles to fill</p>	3
5(b)(i)	<p><b>D</b> vein / veins / venule / venules  <b>E</b> artery / arteries  <b>F</b> capillary / capillaries</p> <p>} ;</p>	1
5(b)(ii)	<p>any <b>two</b> from:</p> <p>single layer / one cell thick ;  flattened / thin, cells ;  <b>A</b> squamous / pavement, cells / epithelia  smooth surface (facing lumen) ;</p>	2

Question	Answer	Marks
6(a)	1 A = adenine, T= thymine, C = cytosine, G = guanine ; 2 <u>DNA</u> polymerase ; 3 nucleotides ; 4 complementary base pairing ; 5 DNA ligase ; 6 semi-conservative (replication) ;	<b>6</b>
6(b)(i)	<b>J</b> metaphase ; <b>K</b> prophase ; <b>L</b> telophase ; <b>A</b> anaphase	<b>3</b>
6(b)(ii)	large size / same size as cells in mitosis / same size as the cells labelled in stages of mitosis ; ora	<b>1</b>
6(b)(iii)	1 chromosomes, orientated / arranged / AW, at, spindle equator / metaphase plate ; <i>plus any <b>one</b> from:</i> 2 chromosomes attached to, spindle / spindle fibres, at centromere / kinetochore ; 3 (sister) chromatids still attached at centromere ; 4 spindle fully formed ; 5 nucleolus has disappeared ; 6 nuclear envelope, has disassembled / broken down / AW ;	<b>2</b>

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