Cambridge International AS & A Level

**Cambridge Assessment International Education**
Cambridge International Advanced Subsidiary and Advanced Level

**BIOLOGY** **9700/21**

Paper 2 AS Level Structured Questions **October/November 2018**

MARK SCHEME

Maximum Mark: 60

**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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Cambridge International is publishing the mark schemes for the October/November 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.



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## Generic Marking Principles

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GENERIC MARKING PRINCIPLE 1:

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- 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.

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| GENERIC MARKING PRINCIPLE 5:<br><br>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:<br><br>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. |

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**Mark scheme abbreviations**

| | |
|---|---|
| **;** | separates marking points |
| **/** | alternative answers for the same point |
| **R** | reject |
| **A** | accept (for answers correctly cued by the question, or by extra guidance) |
| **AW** | alternative wording (where responses vary more than usual) |
| **underline** | actual word given must be used by candidate (grammatical variants accepted) |
| **max** | indicates the maximum number of marks that can be given |
| **ora** | or reverse argument |
| **mp** | marking point (with relevant number) |
| **ecf** | error carried forward |
| **I** | ignore |
| **AVP** | alternative valid point |

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| Question | Answer | Marks |
|---|---|---|
| 1(a) | **A** trachea **;** **A** windpipe **I** *ref.* to cartilage rings<br>**B** bronchiole **;** **I** respiratory / terminal , before bronchiole<br>**C** alveoli **;** **A** alveolus / air sac / alveolar sac | **3** |
| 1(b) | *any one from*<br>lung cancer **;**<br>emphysema **;**<br>chronic bronchitis **;**<br>COPD **;**<br>cystic fibrosis **;**<br>AVP **;** e.g. asthma *must be non-infectious* | **1** |
| 1(c) | *Plasmodium, falciparum* / *vivax* / *ovale* / *malariae* **;** | **1** |
| 1(d) | *any three from*<br>*pathogen*<br>(because) four / several, different, causative species / AW, (with different antigens) **;**<br>(pathogen has) many antigens as it is eukaryotic / many genes coding for antigens **;**<br>*ref.* to mutation changing antigens **;**<br>pathogen has different stages of life cycle (within human) with different antigens **;**<br>**I** *ref.* to antigenic shift<br>antigenic concealment / pathogen spends part of life cycle within host cells / AW **;**<br>**A** short time in blood plasma<br><br>*vaccine*<br>*ref.* to more than one type of vaccine needed **;**<br>suggestion that antigens used have not given the strongest immune response **;**<br><br>*vaccination programme*<br>*ref.* to only trial programmes **;**<br>**A** programmes not global<br>*ref.* to not achieving herd immunity / not enough people (successfully) vaccinated **;**<br>detail **;**<br>e.g. lack of willingness to be vaccinated<br>lack of trained people to give vaccines<br>poor nutrition and poor immune response | **3** |

| Question | Answer | Marks |
|---|---|---|
| 1(e) | *allow* *mosquitoes* / *vectors, for Anopheles*<br>*pathogen* / *parasite, for Plasmodium*<br><br>*any four from (max 1 for list of factors without explanation)*<br>*assume in context of comparison with area **Q***<br><br>*ref.* to a suitable climate for *Anopheles,* e.g. tropical / subtropical / hot and humid **;**<br>presence of *Anopheles* species which carry *Plasmodium* **;**<br>*ref. Anopheles* breeding sites present / (many) water sources (suitable for breeding) **;**<br>difficulty in controlling / lack of control, of *Anopheles* breeding sites **;** AW, e.g. stagnant water not drained<br>lack of / cannot afford, spraying with, insecticide / pesticide ***/*** repellents **;**<br>insecticide-resistant forms of *Anopheles* exist **;**<br>lack of / insufficient use of, mosquito nets **;**<br>mosquito nets not impregnated with insecticide **;**<br><br>lack of, artemisinin drugs / drugs to treat disease **;**<br>drug-resistant forms of *Plasmodium* exist **;**<br>idea of *Plasmodium* requiring temperatures of approximately 20 °C (in vector) **;**<br>**A** area **P** has temperature / conditions for survival of *Plasmodium*<br><br>*ref.* to difficulties in diagnosing disease (so delay / no treatment) **;** e.g. lack of diagnostic tests lack of trained personnel<br><br>AVP **;;**<br>e.g. some countries in area **Q** have *Anopheles* but control is good,<br>*ref.* to feature of *Anopheles* species present in area **P**<br>feed at all times during the day<br>feed only on humans<br>good host for reproduction of *Plasmodium*<br>poor education so people don't know how to protect themselves from malaria | **4** |

| Question | Answer | Marks |
|---|---|---|
| 2(a) | glycosidic **;** **I** any qualification of glycosidic, e.g. β,1–4 | **1** |
| 2(b)(i) | hydrolysis **;** | **1** |
| 2(b)(ii) | *any two from*<br>(lactose) lowers the water potential (in the lumen of the intestine) / AW **;**<br>reduces the water potential gradient (between the intestine and the blood) **;**<br>osmosis occurs ; (must be in the correct context) | **2** |
| 2(c)(i) | *any two from*<br>pack more beads into the column **;**<br>slows the passage of milk through the column **;**<br>more time for enzyme to be exposed to substrate **;**<br>(small beads have a) larger surface area to volume ratio **;**<br>rate of reaction will be faster **/** AW **;**<br>**A** faster reactions<br>will take less time to collect results (at each temperature) **;**<br>fast(er), rate of diffusion of, substrate / product **;** | **2** |
| 2(c)(ii) | *any three from*<br>both have same activity between 0 and 20 °C **;**<br>**A** described with values from **Fig. 2.2**<br>between 20 °C and 40 °C, the activity of **F** increases more steeply than **I** **;**<br><br>**F**, has a lower optimum temperature / peaks at a lower temperature / AW, than **I** **;**<br>**A** optimum temperature, **F** is 40 °C v **I** is 50 °C<br><br>at 70 °C, no activity for **F** but there is activity for **I** **;**<br>**A** 4% for **I** and 0% for **F**<br>**A** denatured for 0%<br><br>above the optimum temperature **I** has a steeper decrease of activity **;**<br><br>**I** is active over a greater range of temperatures (than F) **;** | **3** |

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| Question | Answer | Marks |
|---|---|---|
| 3(a)(i) | *any three from*<br>(polymer / polysaccharide of) β-glucose **;**<br>glycosidic, bonds / linkages **;**<br>**A** glucosidic<br>(β) 1–4 (glycosidic) bonds **;**<br>**R** if 1–6 also given<br>*ref.* to (β) glucose units, linked at 180° to each other / alternately orientated / AW **;**<br>unbranched (polymer) / straight chain / linear **;**<br>able to form hydrogen bonds with parallel chains / AW **;** | **3** |
| 3(a)(ii) | chloroplast / granum / thylakoid / middle lamella / large vacuole / nucleus at edge of cell **;** | **1** |
| 3(a)(iii) | provide energy (for the cell) **;**<br>**R** produce energy<br>any two examples **;;**<br>e.g. biosynthesis **A** named example<br>active transport / proton pumping<br>movement / described, e.g. movement of, vesicles / chromosomes<br>endocytosis / exocytosis | **3** |
| 3(b) | *any two from*<br>water molecules are dipoles **;**<br>**A** polar<br>(each water molecule has) $\sigma$+ hydrogen (atoms) and a $\sigma$– oxygen (atom) **;**<br>the positively charged hydrogen (atom) of one water molecule is attracted to the negatively charged oxygen (atom) of another water molecule **;**<br>weak attraction between water molecules **;** | **2** |
| 3(c) | *any two from*<br>water molecules are polar **;**<br>ions are charged **;**<br>*ref.* attraction between water molecules and ions **;**<br>AVP **;**<br>e.g. oxygen $\sigma$– faces positive ion | **2** |

| Question | Answer | Marks |
|---|---|---|
| 4(a) | correct formula **;**<br>(×) 1200 **;**<br>**A** 1171 (41 000 ÷ 35) 1229 **or** 1228.6 (43 000 ÷ 35)<br>*max 1 if units given* | **2** |
| 4(b)(i) | *any two from*<br>DNA , replication / AW **;**<br>**A** S phase **I** chromosome replication<br>(early interphase) chromosome becomes two chromatids **;**<br>**A** described<br>DNA checked for errors / errors in DNA repaired **;**<br>synthesis of, (growth) protein / enzymes (for growth) **;**<br>cell growth **;**<br>organelle synthesis **;**<br>centrioles replicate **;**<br>AVP **;**<br>e.g. *ref.* to checkpoint(s)<br>nucleotide synthesis | **2** |
| 4(b)(ii) | *any two from*<br>*ref.* target cells are endothelial cells **;**<br>VEGF / cell signalling molecule, binds / AW, to receptor **;**<br>**R** receptor cells<br>*ref.* specificity (of receptors) / VEGF / cell signalling molecule, complementary to receptors **;**<br>suggestion of detail following binding **;**<br>e.g. triggers secondary messenger<br>activates enzymes / enzyme cascade<br>signal transduction<br>phosphorylation events | **2** |

| Question | Answer | Marks |
|---|---|---|
| 4(c) | *any four from*<br>VEGF protein / antigen, injected into, mouse / small mammal **;**<br>time for immune response to occur **;**<br>**A** description of event in immune response<br>plasma cells / B-lymphocytes / splenocytes, extracted from mouse **;**<br>plasma cells / AW, fused with, myeloma / cancer, cells **;**<br><br>(to produce) hybridoma cells **;**<br><br>clone hydridoma cells **;**<br>separate cells and culture in individual wells **;**<br>screen for cells secreting desired antibody **;**<br>hybridoma cells grown in large scale culture / AW **;**<br>AVP **;**<br>e.g. *ref.* to fusogen | **4** |
| 4(d) | *any one from*<br>monoclonal antibodies identified, as foreign / non-self / act as an antigen **;**<br>(monoclonal antibodies) stimulate an, immune / allergic, response **;**<br>AVP **;**<br>e.g. (antibodies destroyed so) not enough antibody (to be effective) | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 5(a) | *any two from*<br>cell wall made from, peptidoglycan / murein **;**<br>**A** not cellulose<br>DNA free in the cytoplasm **;**<br>**or**<br>circular / closed loop, of DNA **;**<br>**or**<br>naked DNA / no histones **;**<br>70s ribosomes **;**<br>AVP **;**<br>e.g. no membrane around flagellum<br>**or**<br>flagellum is <u>not</u> 9+2 (microtubule pattern) **;** | **2** |
| 5(b) | *any two from*<br>transport of sucrose / assimilates / products of photosynthesis (in phloem), is prevented / AW **;**<br>*ref.* starch synthesised in root from transported assimilates / AW **;**<br>starch not converted in leaf to sugars / sucrose, (for transport) **;**<br>idea that pathogen and phloem present in, all organs / many organs / leaves / roots **;**<br>AVP **;**<br>e.g. reason(s) why it cannot be xylem | **2** |

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(c)</td><td>
<table>
<tr><th>feature</th><th>DNA nucleotide with adenine</th><th>RNA nucleotide with adenine</th><th>ATP</th></tr>
<tr><td>contains nitrogen (yes or no)</td><td>yes</td><td>yes</td><td>yes ;</td></tr>
<tr><td>contains a pyrimidine base (yes or no)</td><td>no</td><td>no</td><td>no ;</td></tr>
<tr><td>number of phosphate groups</td><td>1</td><td>1</td><td>3 ;</td></tr>
<tr><td>name of the sugar component</td><td>deoxyribose ;</td><td>ribose</td><td>ribose ;</td></tr>
</table>
</td><td>5</td></tr>
</table>

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| Question | Answer | Marks |
|---|---|---|
| 6(a)(i) | *any three from*<br>haem group containing iron (atom) **;**<br>four haem groups (per molecule of haemoglobin) **;**<br>each iron (atom) / haem / prosthetic group, binds one oxygen molecule **;**<br>**or**<br>four oxygen molecule per haemoglobin molecule **;**<br>cooperative binding / allosteric effect described **;**<br>AVP **;** | **3** |
| 6(a)(ii) | *any two from*<br>*ref.* folding of polypeptide chain(s) / globin(s) fold (to give globular structure) **;**<br>**A** *ref.* to, tertiary structure / quaternary structure<br><br>(so) hydrophilic R groups (of amino acids) are on the outside of the molecule / hydrophobic R groups (of amino acids) on the inside of the molecule **;**<br>**A** hydrophilic and hydrophobic amino acids<br>hydrogen bonds form with water (molecules) **;** | **2** |
| 6(b)(i) | llama = 90.5% human = 78.5% **;** | **1** |
| 6(b)(ii) | *any two from*<br>lower partial pressure of oxygen at high altitude **;**<br>at the same partial pressure the percentage saturation is (much) higher than for humans **;**<br>*ref.* to haemoglobin has a higher affinity for oxygen **;**<br>*idea that* sufficient oxygen delivered to tissues to satisfy demand **;** | **2** |

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| **I** | ignore |
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| Question | Answer | Marks |
|---|---|---|
| 1(a) | bronchiole **;** **I** respiratory / terminal, before bronchiole | **1** |
| 1(b) | (actual diameter) = image / observed, length, ÷ magnification **;**<br>**A** (A =) I ÷ M **or** magnification triangle<br><br>300 µm **;** (12 000 / 40) **A** 275 µm (11 000 / 40) **A** 288 µm (11 500 / 40) **A** 313 µm (12 500 / 40) **A** 325 µm (13 000 / 40) | **2** |

| Question | Answer | Marks |
|---|---|---|
| 1(c) | *any four from*<br><br>*in healthy lungs*<br>**1** correct direction of movement of <u>both</u> respiratory gases **;**<br>e.g. oxygen from alveolus towards blood and carbon dioxide from blood to alveolus **;**<br>oxygen enters the blood system and carbon dioxide leaves<br>**A** red blood cell / haemoglobin, *as ref. to blood*<br><br>**2** diffusion (of, oxygen / carbon dioxide)<br>**or**<br>movement, down a concentration gradient / from high(er) to low(er) concentration **;**<br>**A** implied e.g. oxygen enters blood from a high<u>er</u> concentration<br>**I** diffusion of gases<br><br>**3** detail of pathway **; R** *ref. to* cell walls<br>e.g. across, alveolar wall / squamous (epithelial) cells across endothelium / capillary wall **;**<br>**A** squamous cells *in context of capillary* crosses two layers of cells (*alveolar wall and capillary wall)*<br><br>*comparison healthy with diseased – look for ora*<br>**4** higher rate of exchange / increased rate of diffusion **/** steeper concentration gradient **;**<br>**A** more oxygen to blood per unit time / more carbon dioxide to alveolus per unit time<br>**I** more efficient gas exchange<br>**I** better gas exchange / faster diffusion<br><br>**5, 6** AVP **; ;**<br>e.g. larger surface area (for, gas exchange / diffusion)<br>shorter diffusion distance<br>*ref. to* (greater) ability to, stretch / recoil (for ventilation to maintain gradient) **or** *ref. to* elasticity<br>*(more v fewer elastic fibres is not sufficient)* | **4** |

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| Question | Answer | Marks |
|---|---|---|
| 2(a) | xerophyte / xerophytic **;** **R** succulent / cactus / named | **1** |
| 2(b)(i) | phloem **;** **A** sieve tube(s) **R** phloem sieve / phloem tube<br>**A** sieve tube elements **R** phloem companion cell | **1** |
| 2(b)(ii) | *any two from*<br>**1** for, transport / translocation, } *accept assimilates / products of metabolism, if in context of cardiac glycosides*<br>**or**<br>movement / AW, from source to sink **;**<br><br>**I** *ref. to* transport of, amino acids / sucrose<br><br>**2** *ref. to* source, is place of synthesis / AW<br>**or**<br>sink is / movement to, area where not manufactured / storage area / area where they are required **;**<br><br>**3** as defence mechanism (e.g. against sap feeders) **;** | **2** |
| 2(c)(i) | using / AW, water / $H_2O$ **;**<br>to break bond (between phosphate groups) **;** **R** if bond incorrectly named | **2** |
| 2(c)(ii) | active transport **;** | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 2(c)(iii) | *any four from*<br>**1** (reversibly) binds / attaches / AW, to, allosteric site / site other than active site **;**<br><br>**2** (which) changes, shape / tertiary structure / 3-D structure, of <u>active site</u> **;**<br>**A** active site distorted<br>**I** protein structure<br><br>**3** substrate / ATP, cannot, enter / bind / fit / AW, to active site **;**<br>**A** active site no longer complementary to substrate<br>**A** enzyme substrate / ES, <u>complexes</u> cannot form<br>**A** ES<u>C</u>s cannot form<br>**I** ATP / substrate, cannot bind to enzyme *without a link to <u>active site</u>*<br><br>**4** no / less, hydrolysis of ATP **A** breakdown<br>**or**<br>no / less, energy released **;**<br>**I** no energy, synthesised / created / produced<br><br>**5** $Na^+$ not moved, out <u>and</u> $K^+$ not moved in **;**<br>**I** active transport, stops / decreases | **4** |

| Question | Answer | Marks |
|---|---|---|
| 2(d)(i) | *allow* *systole for contraction and diastole for relaxation*<br>*bicuspid valve or mitral valve for (left) atrioventricular*<br>*aortic valve for semi-lunar valves*<br><br>*any four from (max 3 if whole response based on right side of heart)*<br>*before atrial contraction / during relaxation of the left atrium and left ventricle*<br>**1** atrioventricular valve, opens / is open **A** *following atrial contraction*<br>**or**<br>blood trickling into ventricle / some blood enters ventricle **;**<br><br>**2** atrial contraction, blood flow to ventricles / ventricles fill (with blood)<br>**or**<br>atrial contraction then ventricular contraction **;**<br><br>*ventricular contraction*<br>**3** biscuspid valve closes <u>and</u> semi-lunar valve opens **;**<br>**R** *if occurs before ventricular contraction*<br><br>**4** blood flows into aorta **;**<br>**R** if states 'from atrium' or 'then to lungs'<br>**R** *if occurs before ventricular contraction*<br><br>**5** *ref. to* atrium in relaxation during ventricular contraction **;**<br><br>*pressure changes*<br>**6** contraction of, atrium / ventricle, increases pressure (of that chamber)<br>**or**<br>*ref. to* (blood) pressure differences to cause opening or closing of valves **;**<br>e.g. pressure in atrium greater than in ventricle so atrioventricular valve opens<br>pressure in ventricle greater than aorta so semilunar valves open<br>pressure in ventricle greater than atrium so bicuspid valve closes | **4** |

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| Question | Answer | Marks |
|---|---|---|
| 2(d)(ii) | **I** *ref. to* fibrillation / cardiac cycle rhythm<br><br>*any three from*<br>**1** more powerful contraction of (cardiac) muscle / increased ability for (cardiac) muscle (**A** cardiac cells) to contract **;**<br>**A** stronger contraction / contract strongly / increased contractility<br>**I** contracts more / increased contraction<br><br>**2** blood (pumped) at higher pressure **; I** blood at high pressure<br><br>**3** more force to overcome resistance (in blood vessels) **;**<br><br>**4** more blood reaches lungs to obtain oxygen (per unit time) / more oxygen reaches (rest of) body / tissues (per unit time) (in blood) **;**<br>*allow idea of efficient delivery of oxygen*<br>**A** more oxygenated blood can be delivered to heart, muscle / tissue AW<br><br>**5** less fatigue / increased energy / increased mobility / AW **;** | **3** |

| Question | Answer | Marks |
|---|---|---|
| 3(a) | *any two from*<br>**1** (division that) produces, new / daughter, cells **A** produces more cells<br>**or**<br>(so) replaces, damaged / lost / dead, cells **;**<br><br>**2** new / daughter, cells, genetically identical **;**<br>**A** *ref. to* clone if correct context<br>**A** genetic information not lost<br>**I** same number of chromosomes<br><br>**3** (all) new cells can retain function **;** AW | **2** |
| 3(b) | *any two from*<br>**1** cell cycle continuous / continually divide / AW **;**<br><br>**2** (produce cells that) can, differentiate / specialise / described **;**<br>**A** multipotent / pluripotent **I** totipotent<br>*divide to produce a cell that can divide and a cell that differentiates = 2 marks*<br><br>**3** can produce, cells / tissue, that can still function (as before) **;** | **2** |

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| Question | Answer | Marks |
|---|---|---|
| 3(c) | *any three from*<br>**1** chemicals (released) are cell signalling, molecules / compounds **;**<br><br>**2** liver cells, are target cells **;**<br>**A** liver tissue for liver cells<br><br>**3** binding of, chemicals / cell signalling molecules, to receptors (of liver cells) **;**<br>**R** receptor cells<br><br>**4** *ref. to* specificity (of receptors) / chemicals complementary to receptors **;**<br>*if **R** above, then allow ecf for idea of complementary*<br><br>**5** (specific) response is, cell enters the cell cycle / mitosis / cell division **;**<br>**A** DNA replication<br><br>**6** AVP **;** e.g. *idea of* communication between cells<br>suggestion of detail following binding, e.g. second messenger activated / enzyme cascade /signal transduction / phosphorylation events / enzyme activation<br>**I** cascade of reactions | **3** |

| Question | Answer | Marks |
|---|---|---|
| 4(a) | *any three from*<br>protein coat / capsid **;** **I** protein layer<br>nucleic acid **;**<br>DNA or RNA **;** **R** in nucleus<br>**I** in cytoplasm<br>**I** *ref. to*, double / single, strand<br>acellular / not made of cells **;** **I** absence of named cell structures<br>AVP **;** e.g. *ref. to* capsomeres<br>size 15 nm to 1000 nm *accept any in range*<br>(some) are enveloped / have phospholipid bilayer **I** with glycoproteins | **3** |
| 4(b)(i) | one value in the range 64% – 68% **;**<br>*((940 000 – 980 000) ÷ (1 440 000 – 1 480 000)) × 100* | **1** |
| 4(b)(ii) | *allow women for pregnant women and therapy / treatment, for ART*<br>*any three from*<br>**1** (slight) decrease in (total) number of women living with HIV and<br>(overall) increase in number of women living with HIV receiving ART **;**<br><br>**2** slight decrease / plateau / AW, between 2009 to 2010, in number of women living with HIV receiving, ART / therapy **;**<br><br>**3** proportion / percentage cover(age), of women receiving ART increases (in time period) **;**<br>**A** calculated values (approx. 13% to 66%)<br>**A** number of women receiving ART increases more steeply than decrease in number of women living with HIV<br><br>**4** data to support mp1 or 2 **;** *mp1 two years and, two values / manipulated data, for either curve*<br>*mp2 two values, 2009 compared to 2010* ***or*** *manipulated data*<br>*allow ± 20 000 for extracted values* | **3** |

| Question | Answer | Marks |
|---|---|---|
| 4(b)(iii) | *in context of pregnant and breastfeeding women who are living with HIV*<br>*any three from*<br>**1** *ref. to* mother to child transmission **;** *in context of HIV transmission*<br>**A** (because) HIV can be passed from mother to baby<br>**A** decreases HIV transmission during, pregnancy / labour / birth / breastfeeding<br>**A** reduces, number / proportion, of babies born with HIV (so fewer die)<br>**I** stops transmission *(as this is in context of global transmission this implies in all cases)*<br>**I** makes babies immune to HIV / AW or gives passive immunity<br>*allow idea that ART may be passed across, placenta / breastmilk, to baby and so provide(short-term) protection against any HIV transmitted from mother*<br><br>**2** reduces number of, HIV positive women becoming ill (with HIV/AIDS) /women with HIV/AIDS dying from the disease **;**<br>**A** opportunistic infections / named examples e.g. TB<br><br>**3** example of reduces spread of HIV **;**<br>*in any correct context other than HIV mother to child*<br>e.g. child may grow up without HIV and will not pass on<br>mother less likely to pass on to partner<br><br>**4, 5** examples of, social / economic, effect **;;**<br>e.g. (healthy women) can contribute to work force<br>can be main carer if partner has died (*idea that* children not orphaned)<br>overall financial savings<br>e.g. if infants are not born with HIV then no lifelong ART required<br>ART may be less costly than treating HIV/AIDS<br>makes breastfeeding safer when no other options exist to feed babies<br>HIV negative children will become next workforce generation<br>all women throughout world receive same treatment | **3** |
| 4(c)(i) | (HIV) antigen / p24 **; A** capsid protein / capsomere(s) / protein coat **R** HIV | **1** |
| 4(c)(ii) | (time needed) so, <u>immune response</u> / clonal expansion / production of B-lymphocytes / production of plasma cells, can occur **;**<br>**A** B-cells / splenocytes<br>**R** plasma cells need to multiply<br>**I** *ref. to* antibody production | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 4(c)(iii) | *any one from*<br>immortal / long-lived **;**<br>able to replicate / capable of cell division **;**<br>uncontrolled cell division, can grow / survive, in cell culture **;**<br>cannot grow on, HAT / hypoxanthine-aminopterin-thymidine / step **4**, (culture) medium **;**<br>**A** do not have gene coding for ability to grow on HAT | **1** |
| 4(c)(iv) | hybridoma **;** | **1** |
| 4(c)(v) | *any one from*<br>(check cells for) production / AW, (by hybridoma cells) of, anti-HIVp24 antibody / antibody against p24 **;**<br>**A** the antibody / monoclonal antibody<br>**A** check cells, contain / have / AW, desired antibody / AW<br><br>*idea that* only want cells that produce desired antibody / do not want cells that produce different antibodies / need to remove cells that don't produce the antibody **;**<br>waste of, money / resources, to culture other cells **/** if no antibody produced **;** | **1** |

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)</td><td>polymer – context of a chain / strand<br>(similar) repeating, smaller molecules / subunits<br>or<br>repeating / many, monomers / (RNA) nucleotides ; R branching<br>A idea of nucleotides joined together to form a chain<br>A made of nucleotides to form <u>poly</u>nucleotide<br>‘made of nucleotides’ ‘made of monomers’ not enough<br><br>macromolecule (in context of RNA)<br>large (biological) molecules / 1000 or more atoms / high molecular mass ;<br>A giant / huge, structure I long</td><td>2</td></tr>
<tr><td>5(b)</td><td>add Benedict’s (solution / reagent) and, boil / heat to 95 °C ;<br>A temperature 80 °C and above<br>precipitate / (change from clear blue to) green / yellow / orange / red / brown ;<br>R if a wrong colour included e.g. black / purple</td><td>2</td></tr>
<tr><td>5(c)</td><td><table><tr><th>feature</th><th>DNA nucleotide</th><th>RNA nucleotide</th></tr><tr><td>sugar component</td><td>deoxyribose</td><td>ribose ;</td></tr><tr><td>purine bases</td><td>adenine / A<br>guanine / G</td><td>adenine / A<br>guanine / G } ;</td></tr><tr><td>pyrimidine bases</td><td>cytosine / C<br>thymine / T</td><td>cytosine / C<br>uracil / U } ;</td></tr></table>R thiamine for thymine</td><td>3</td></tr>
</table>

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| Question | Answer | Marks |
|---|---|---|
| 6(a) | *rough endoplasmic reticulum*<br>protein / polypeptide / named protein, synthesis / transport / modification **;**<br>**A** post-translational modification / examples<br>*named protein e.g. haemoglobin, carbonic anhydrase, membrane proteins*<br><br>*Golgi body*<br>modification / processing, of, proteins / lipids<br>**A** post-translational modification / examples / makes proteins functional<br>**or** packaging (molecules) into vesicles<br>**or** formation of, Golgi / secretory, vesicles<br>**or** forms (primary) lysosomes **;**<br><br>*centrioles*<br>formation of, spindle fibres / spindle **or** microtubule organisation **;** | **3** |
| 6(b) | **A** iron / Fe **;**<br>**I** oxidation status of Fe<br>**A** iron atom / iron ion<br>**R** iron molecule<br>**B** carbaminohaemoglobin **;**<br>**C** haemoglobinic acid **;** | **3** |

Cambridge International AS & A Level

**Cambridge Assessment International Education**
Cambridge International Advanced Subsidiary and Advanced Level

**BIOLOGY** **9700/23**

Paper 2 AS Level Structured Questions **October/November 2018**

MARK SCHEME

Maximum Mark: 60

**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.



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## 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.

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| |
|---|
| GENERIC MARKING PRINCIPLE 5:<br><br>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:<br><br>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. |

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**Mark scheme abbreviations**

| | |
|---|---|
| **;** | separates marking points |
| **/** | alternative answers for the same point |
| **R** | reject |
| **A** | accept (for answers correctly cued by the question, or by extra guidance) |
| **AW** | alternative wording (where responses vary more than usual) |
| **underline** | actual word given must be used by candidate (grammatical variants accepted) |
| **max** | indicates the maximum number of marks that can be given |
| **ora** | or reverse argument |
| **mp** | marking point (with relevant number) |
| **ecf** | error carried forward |
| **I** | ignore |

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| Question | Answer | Marks |
|---|---|---|
| 1(a) | *any three from*<br>**1** modification / process / described, of, proteins / polypeptides **;**<br><br>**2** further detail of modification **;**<br>e*xamples of modification*<br>folding of polypeptides / protein folding<br>assembly of polypeptides to form quaternary structure<br>addition of (named) prosthetic group<br>addition of sugars / addition of carbohydrate / glycosylation<br>cutting of polypeptides<br>removal of, methionine / first amino acid<br>making proteins functional<br><br>**3** packaging into vesicles / formation of Golgi vesicles / formation of secretory vesicles **;**<br>**A** 'budding off' / 'breaking off' / transport proteins in Golgi vesicles<br><br>**4** formation of (primary) lysosomes **;**<br><br>**5** AVP **;**<br>e.g. modification of lipids<br>synthesis of, phospholipids / glycolipids<br>synthesis of cell wall polysaccharides | **3** |
| 1(b)(i) | (mitochondria) provide / make / produce, ATP **;**<br>**A** needs a lot of, ATP / energy<br>**R** 'produce / make, energy'<br>(ATP / energy required for) protein synthesis / movement of (secretory / Golgi) vesicles / exocytosis **;** | **2** |

| Question | Answer | Marks |
|---|---|---|
| 1(b)(ii) | *any two from*<br>**1** mitochondria have (circular) DNA **;**<br><br>**2** mitochondria, have / make, (70S) ribosomes (for, protein synthesis / translation) **;**<br>**R** if 80S ribosomes<br><br>**3** mitochondria can divide **;**<br>**R** by mitosis<br><br>**4** AVP **;**<br><br>**5** AVP **;**<br>e.g. (mitochondrial / mt) DNA codes for (some mitochondrial) proteins<br>mRNA transcribed from mtDNA<br>mitochondria produce their own tRNA<br>can replicate DNA<br>**I** mitochondria have a double membrane | **2** |
| 1(c)(i) | *any three from*<br>protein coat / capsid **;**<br>**A** protein layer<br>**R** 'cell wall of protein'<br>nucleic acid (core) **;**<br>**R** if 'in a nucleus'<br><u>DNA or RNA</u> **;**<br>acellular / non-cellular / 'not a cell' **;**<br>size – *accept within range* 15 nm to 1000 nm **;**<br>AVP **;**<br>e.g. (protein coat made of) capsomeres surrounded by, membrane / envelope / (phospho)lipid bilayer<br>**I** antigens / enzymes | **3** |
| 1(c)(ii) | *any one from*<br>(viruses) pass through plasmodesmata **;**<br>**A** 'cytoplasmic strands, through cell walls / between cells'<br>via symplast pathway **;** | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 2(a)(i) | water shown formed from –OH and –H **;**<br>**A** $H_2O$ formed without indicating where from<br>peptide bond shown correctly between C of carboxylic acid and N of amino group **;**<br>complete dipeptide drawn **;**<br>**A** hydrogen 'up or down' | **3** |
| 2(a)(ii) | R group / side chain / variable group / residual group / functional group **;**<br>indicate, different amino acids / type of amino acid **;**<br>**A** specific to each amino acid<br>**A** the two amino acids are different<br>**A** two examples of R groups, e.g. –H and $–CH_3$<br><br>both amino acids have different R groups = 2 marks | **2** |
| 2(b) | *any two from*<br>straight chain / linear, v helix / helical **;**<br>**I** coil(ed)<br>**R** branched / branching<br>β-glucose, not α-glucose **;**<br>**A** β-1:4 glycosidic bond v α-1:4 glycosidic bond<br>(β-)glucose / monomers / residues, are arranged, rotated 180° to each other / AW **;**<br>AVP **;**<br>e.g. more hydrogen bonds | **2** |

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| Question | Answer | Marks |
|---|---|---|
| 2(c) | *any four from*<br>**1** (molecules) form fibrils and fibres **;**<br><br>**2** hydrogen bonding between (cellulose) <u>molecules</u> **;**<br><br>**3** (cellulose molecule) is straight / linear **;**<br><br>**4** (straight chain allows) molecules lie parallel to each other **;**<br>*mp4 dependent on mp3*<br><br>**5** gives strength (to cell wall) to, prevent cell bursting / withstand (turgor) pressure / AW **;**<br>**R** if only in context of a cellulose molecule<br><br>**6** *ref.* to fibres at angles / criss-cross / AW **;**<br><br>**7** *idea of* many gaps, in wall / between fibres, allowing passage of water / named) substances / making cell wall permeable **;**<br>**I** plasmodesmata<br>**R** partially / AW, permeable<br><br>**8** AVP **;**<br>e.g. cellulose is insoluble<br>many –OH groups (for hydrogen bonding) | **4** |

| Question | Answer | Marks |
|---|---|---|
| 3(a)(i) | **D** (nitrogenous organic / nucleotide) base **;**<br>**A** pyrimidine / uracil / cytosine **R** purine<br>**E** ribose **;**<br>**I** pentose<br>**F** phosphate (group) **;** | **3** |
| 3(a)(ii) | *any one from*<br>two, strands / polynucleotides (not one) **;**<br>**A** two chains<br>**R** polypeptides<br>deoxyribose (not ribose) **;**<br>**A** correct ref. to –OH (on C2) instead of –H group on the pentose / sugar<br>thymine (not uracil) **;**<br>**R** thiamine<br>have base pairs **;**<br>(double) helix / helical (not straight chain) **;**<br>longer **;** | **1** |
| 3(b) | *any four from*<br>**1** template RNA binds to (part of) region **X ;**<br>**2** in active site of, telomerase / enzyme **;**<br>**3** DNA / free, nucleotides, pair with / bind to / align with, RNA **;**<br>**4** ref. to complementary, bases / base pairs **;**<br>**5** A–T and C–G and U–A **;**<br>**6** phosphodiester bonds form, between (DNA) nucleotides / AW **;**<br>treat as neutral any *refs.* to likely enzymes, e.g. ligase, etc.<br>**7** telomerase moves, in the direction of the arrow / to the right **;**<br>**8** AVP **;** e.g. hydrogen bonds between bases<br>telomerase acts as a reverse transcriptase | **4** |

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| Question | Answer | Marks |
|---|---|---|
| 3(c) | *prokaryotes*<br>have, circular DNA **;**<br>**A** 'loop of DNA'<br>**I** plasmid(s)<br>do not have telomeres **;**<br>do not have chromosomes **;**<br>AVP **;**<br>e.g. 'DNA has no ends' | **1** |
| 3(d) | *any two from*<br>cancer cells divide, uncontrollable / continuously **; ORA**<br>**A** cancer cells divide but do not undergo cell death<br>telomerase is required to ensure, chromosomes, do not shorten **;**<br>telomerase is, synthesised / produced / found, in cancer cells **; ORA**<br>high levels of telomerase indicate cells that are cancerous / AW **;**<br>AVP **;**<br>e.g. *idea that* gene for telomerase switched on | **2** |

| Question | Answer | Marks |
|---|---|---|
| 4(a) | *any four from*<br>**I** signals<br>**R** nerve impulse first time<br><br>*SAN*<br>**1** acts as a pacemaker / initiates heart beat / initiates cardiac cycle **;**<br>**A** regulates heartbeat<br>**A** described, e.g. as rhythm / emits impulses at regular intervals<br><br>**2** releases / AW, waves of excitation / (electrical) impulses **;**<br>**A** *ref.* to, action potentials / depolarisation<br>**R** nerve impulses<br><br>**3** spread across / AW, atria / atrial walls **or** leads to atrial, systole / contraction(s) **;**<br><br>*AVN*<br>**4** allows a (short) delay / ~0.1 s **;**<br><br>**5** passes the impulse / wave of excitation, to the Purkyne fibres / down the septum **;**<br>**A** Bundle of His<br>**R** nerve impulse<br><br>**6** detail **;**<br>e.g. so atria contract before ventricles<br>allows ventricles to fill / allow atria to empty completely<br>so atria have, emptied / contracted, before ventricular contraction begins<br>so atria and ventricles don't contract at the same time | **4** |
| 4(b) | *any two from*<br>contraction / ventricular systole, begins at the base of the ventricles **;**<br>both ventricles contract at the same time **;**<br>blood is forced, upwards / into arteries / through (named) semi-lunar valves **;**<br>**A** pushed<br>*idea that* so ventricles, empty / pump out most of the blood **;**<br>AVP **;**<br>e.g. so impulses / waves of excitation, travel upwards from the base | **2** |

| Question | Answer | Marks |
|---|---|---|
| 4(c) | *any four from*<br>**1** noradrenaline is, signalling, molecule / compound **;**<br>**A** noradrenaline is the signal<br>**I** noradrenaline is a (neuro)transmitter<br><br>**2** SAN cell is the <u>target</u> cell **;**<br><br>**3** noradrenaline / signalling molecule, binds to (cell surface) receptors (of target cell) **;**<br>**A** 'fits'<br>**R** 'receptor cells'<br><br>**4** receptors are specific to noradrenaline **;**<br>**A** *ref.* to complementary (shapes)<br><br>**5** *ref.* to formation of cAMP / second messenger *or* activating enzyme ;<br><br>**6** response is the opening of channel proteins (so calcium ions enter) **;** | **4** |

| Question | Answer | Marks |
|---|---|---|
| 5(a)(i) | *Mycobacterium*, *tuberculosis* / *bovis* **;** | **1** |
| 5(a)(ii) | *any three from*<br>**1** phagocytes / macrophages / neutrophils / elastase, breaks down / weakens, alveolar walls **;**<br><br>**2** (reduced elastin so) alveoli cannot stretch and recoil / alveoli overstretch **;**<br><br>**3** alveoli burst / one large air sac formed **;**<br><br>**4** surface area (for gas exchange) is reduced **;**<br><br>**5** less oxygen absorbed by blood / reduced oxygen supply (to tissues) / not enough oxygen for (aerobic) respiration / AW **;** | **3** |
| 5(b) | **R** cost<br>*any five from*<br>**1** *Transmission* **;**<br>e.g. aerosol / droplet, infection<br>**I** airborne<br>**A** lack of pasteurised milk<br>overcrowded, housing / living conditions / AW<br>migration / travel, from areas with high rates of TB<br>reservoir of infection in people not, diagnosed / not treated<br><br>***2*** *HIV* / *immunodeficiency* **;**<br>e.g. infection with HIV may activate (dormant) TB (pathogen)<br>immunodeficiency / AW, makes people more susceptible to TB<br>intravenous drug taking increases risk of, immunodeficiency / HIV<br><br>**3** *Diagnosis is difficult* **;**<br>e.g. TB (pathogen) remains dormant / symptomless carriers<br>limited access to health care for diagnosis / AW<br>*idea that* contact tracing is difficult | **5** |

| Question | Answer | Marks |
|---|---|---|
| 5(b) | **4** *Treatment* **;**<br>e.g. treatment is long term / treatment may not start early enough<br>people may not finish the course of treatment<br>limited access to health care for treatment<br><br>**5** *Acquired resistance* **;**<br>e.g. bacterium / TB (pathogen), develops resistance to, antibiotic(s) / drug(s)<br>multi-drug resistance / MDR-TB / XDR-TB<br><br>**6** *Vaccination* **;**<br>e.g. vaccine may not always be effective in providing protection<br>difficult to achieve herd immunity<br>concerns / misconceptions, about vaccination<br>limited access to vaccination (programmes)<br>poor (immune) response in people who are malnourished<br>poor thermostability of vaccine<br><br>**7** *Education* **;**<br>e.g. limited education / low awareness, about prevention for general population<br>limited education / low awareness, for health care professionals | **5** |

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>6(a)(i)</td><td>[A] C E D B F ;</td><td>1</td></tr>
<tr><td>6(a)(ii)</td><td>I early and late except where indicated<br><br>
<table>
<tr><th>event in the cell cycle</th><th>name of the stage in the cell cycle</th></tr>
<tr><td>DNA replication</td><td>interphase / S phase ;</td></tr>
<tr><td>division of centromeres</td><td>anaphase ;<br>R late anaphase</td></tr>
<tr><td>condensation of chromatin</td><td>prophase ;</td></tr>
<tr><td>contraction of spindle fibres</td><td>anaphase ;</td></tr>
<tr><td>organisation of chromosomes at the equator</td><td>metaphase</td></tr>
</table></td><td>4</td></tr>
</table>

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| Question | Answer | Marks |
|---|---|---|
| 6(b) | **I** antibodies have receptors<br>*any three from*<br>**1** clones / AW, of B/T cells consist of very few cells **;**<br>AW = types of / specific / groups of<br><br>**2** (mitosis occurs) during <u>clonal expansion</u> **;**<br><br>**3** many, B cells / plasma cells, to make antibodies **;**<br><br>**4** many, T-helper / $T_h$, cells to secrete, cytokines / lymphokines / interleukins **;**<br><br>**5** many, T-killer cells / T-cytotoxic cells, to kill, infected cells / cancer cells **;**<br><br>**6** memory cells are produced for, secondary response / faster response (when antigen encountered again) **;**<br>**A** during a secondary infection (implying of the same pathogen)<br><br>**7** need to make genetically identical cells **;** | **3** |

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