Cambridge International AS & A Level

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BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **May/June 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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Generic Marking Principles

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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: 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.

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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)(i)	*answers must be comparative* *one from:* *idea that* the sections are orientated differently / cut in different planes / cut at different angles / AW **;** **A** is a cross section / AW, and **B** is a longitudinal section / AW mitochondria show a variety of, sizes / shapes **;** mitochondria, are flexible / change shape **;** **A** and **B** are of, different ages / stages of development **;**	**1**
1(a)(ii)	*two from:* replace, old / worn out / damaged, mitochondria **;** require more mitochondria as cells, enlarge / grow **;** more mitochondria are needed, for new cells / when cell divides **;** **A** so numbers remain the same in the new cells / after cell division **A** *idea that* mitochondria are shared out (between daughter cells) (mitochondria) provide (most), energy / ATP **;** **I** cell needs (much) energy without stating mitochondria provide energy **R** energy production **I** uses of energy	**2**
1(b)	*two from:* nuclear envelope shown as two membranes with closed ends and a gap **;** label to nuclear pore **;**	**2**

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Question	Answer	Marks
1(c)	*four from:* 1 contains / AW, chromosomes / chromatin / DNA / genes / genetic material / inherited material / genetic information **;** 2 (coded) information for synthesis of, polypeptides / proteins **;** **A** controls protein synthesis 3 ref. to sequence(s) of bases (in DNA) **;** 4 transcription (of genes) / production of mRNA **;** 5 contains nucleolus **;** 6 manufacture of ribosomal sub-units **;** **A** makes ribosomes 7 *idea that* DNA is protected from degradation / enzymes / AW **;** 8 AVP **;** e.g. responds to signals that control, gene expression / AW post-transcription modification / modifies mRNA / any example repairs DNA **I** controls cell's activities **I** sends mRNA to cytoplasm / mRNA travels through nuclear pores	**4**

Question	Answer	Marks
2(a)(i)	**A** – (α-) glucose **;** **R** any qualification of glucose other than α, e.g. β-glucose **B** – fructose **;** **I** hexose sugar **I** any qualification of fructose, e.g. α	**2**
2(a)(ii)	glycosidic **;** **R** glucosidic **I** any qualification of glycosidic, e.g. 1–2, 1–6	**1**
2(a)(iii)	hydrolysis **;** **A** acid hydrolysis	**1**

Question	Answer	Marks
2(b)	*two from:* sucrose is, a non-reducing sugar / non-reducing / not a reducing sugar **;** **A** no reducing sugars present no (hydrochloric) acid used (to break down sucrose to reducing sugars) **;** **A** sucrose not hydrolysed (to monomers / monosaccharides / reducing sugars) AVP **;** (sucrose will not reduce) (blue) copper II ions to (red) copper I ions cannot donate electrons *idea that* reactive groups are not available (to react with Benedict's solution / copper ions) no (free), aldehyde / ketone, group	**2**
2(c)	*hydrostatic required once only in the answers* *four from:* 1 diffusion, into phloem sieve tube (element), from companion cell (through plasmodesmata) **;** 2 presence of sucrose (in phloem sieve tube element), lowers water potential / makes water potential more negative **;** **R** if in context of xylem vessels or companion cells 3 water enters (sieve tubes), by osmosis / down water potential gradient (into sieve tubes) **;** 4 increase in, hydrostatic, pressure (in sieve tube elements) **;** **A** turgor pressure 5 low hydrostatic pressure in, storage tissues / root / sink, by removal of sucrose **;** 6 movement of, (phloem) sap / sucrose (in solution), down hydrostatic pressure gradient / from high to low hydrostatic pressure **;** 7 mass flow **;**	**4**

Question	Answer	Marks
3(a)	*four from:* activity increases and decreases / activity peaks, for both **;** **A** both have maximum activity / optimum temperature, at 60 °C activity is 76% at 40 °C for both **;** (overall) activity decreases more steeply for free enzyme after, optimum / maximum / 60 °C **;** **A** ora at 80 °C free enzyme is inactive / (fully) denatured / 0%, but immobilised enzyme, is still active / is partially denatured / 27% **;** for immobilised enzyme, activity is higher (than free enzyme) at all temperatures above 60 °C **;**	**4**
3(b)	*two from:* (alginate / immobilisation), is protective / has stabilising effect **;** **A** enzyme, less / not, exposed (to solution) hydroxide ions do not penetrate the alginate beads **;** shape of active site (of immobilised enzyme) is, less / not, disrupted / AW **;** **A** active site is (more) complementary to substrate **A** few(er) active sites are, altered / changed few(er) bond(s) within (immobilised) enzyme break **;** **A** hydrogen / ionic **R** peptide / disulfide at pH 8 immobilised enzyme is not fully denatured **;** **A** pH 7 / 7.5	**2**

Question	Answer	Marks
3(c)	*explanation must match variable stated* *standardised variable* concentration / volume, of, enzyme / substrate, solution **;** *explanation for standardised variable* *idea that:* concentration / volume, of, enzyme / substrate, influences the probability of collisions between enzyme and substrate molecules / formation of enzyme/substrate complexes **;** **A** number of / frequency of, collisions between substrate and enzyme **or** *standardised variable* use the same method for determining enzyme activity **;** e.g. time when samples are taken *explanation for standardised variable 3* ref. to how enzyme activity is measured by conversion of substrate to product **;**	**2**

Question	Answer	Marks
3(d)	*two from:* 1 (may be able to) obtain more product (per unit time) **;** 2 can use higher temperatures (to obtain more product) / still active at higher temperatures **;** **A** thermostable 3 does not denature (as easily as free) if temperatures increase / AW **;** 4 immobilised enzyme can be reused / immobilised enzyme can be recovered **;** 5 enzyme does not contaminate product **;** **A** no effect on quality of product, e.g. taste 6 less, purification (of product) / downstream processing, needed **;** **A** idea that downstream processing less, complex / difficult 7 longer shelf-life of enzyme / AW **;** **A** durability 8 AVP **;** e.g. allows continuous production (rather than batch) some enzymes are difficult to extract **I** ref. to cost / cost effective unqualified **R** reduces effect of end product inhibition	**2**

Question	Answer	Marks
4(a)	**E** – haem / porphyrin (ring) **;** **I** iron / iron-containing group **A** conjugated group / prosthetic group **F** – α helix **; R** a helix **G** – tertiary structure **;** **A** 3° structure **H** – primary structure **;** **A 1°** structure **J** – quaternary structure / 4° structure / 2α and 2β globins **;** **A** polypeptides for globins	**5**
4(b)(i)	98 (%) **;**	**1**
4(b)(ii)	*four from:* 1 Bohr, shift / effect **;** 2 (at any pO_2 on the left of graph) percentage saturation of haemoglobin decreases / haemoglobin releases more oxygen (to muscle tissue) / increases dissociation of oxyhaemoglobin **;** **A** any comparative data quote for any one value of pO_2 between 1 and 5 kPa 3 (increase in carbon dioxide) increases production of carbonic acid **;** 4 increase in hydrogen ions (in red blood cells) **;** 5 haemoglobin accepts hydrogen ions / formation of haemoglobinic acid (HHb) **;** **A** haemoglobin has an affinity for hydrogen ions 6 decreases the affinity between haemoglobin and oxygen **;**	**4**

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Question	Answer	Marks
5(a)	*five from:* **A** 'cells' for 'lymphocytes' throughout 1 ref. to antigen presentation **;** **A** macrophage presents antigen 2 recognition / binding (in context of B-, or T-lymphocytes) **;** e.g. cell surface receptor specific to toxoid / clonal selection **A** immunoglobulin / antibody on surface of B-lymphocytes 3 T-lymphocytes or B-lymphocytes, divide by mitosis / clonal expansion **;** 4 (some) plasma cells, formed / AW **;** **R** if in context of T-lymphocytes 5 antibody molecules / antibodies, secreted / produced / released **;** **R** if in context of T-lymphocytes 6 T helper cells secrete, cytokines / interleukins **;** 7 ref. to action of cytokines / interleukins **;** e.g. to stimulate, humoral response / B-lymphocytes / to stimulate macrophages / angry macrophages 8 formation of memory cells **;** *only in context of B- / T-lymphocyte activation*	**5**

Question	Answer	Marks
5(b)(i)	*three from:* 1 failure to distinguish between self and non-self / AW **;** 2 specific B-,lymphocytes / cells, are not destroyed (during development) **;** 3 antibodies are produced against, cell surface / ACh, receptors on, muscle cell / neurones / nerve cells **;** 4 antibodies, bind to / block, receptors **;** **A** antibody–antigen, binding / complex *if receptors already given* 5 AVP **;** any detail related to the disease e.g. (chemical) transmitter molecules / acetylcholine, cannot bind (to receptor) impulses are not transmitted across synapse / neurones cannot send impulses ref. to causing, muscle weakness / muscle fatigue ref. to neuromuscular junction does not function	**3**
5(b)(ii)	*two from:* so immune response, occurs all the time / recurs **;** (defective) B-lymphocytes still being produced / AW **;** **I** T (helper) cells **A** not destroyed / remain plasma cells / B-lymphocytes, continue to release antibodies against receptors **;** memory cells / immunological memory, present **;** receptors are always present (on neurones / nerve cells) **;** AVP **;** e.g. no cure	**2**

Question	Answer	Marks
6(a)	**A** – endodermal (cell) **;** **A** endodermis / passage cell **B** – apoplast(ic) **;**	**2**

Question	Answer	Marks
6(b)	*five from:* 1 water potential gradient, between leaves and roots **;** **A** water potential gradient across the root (root hair to xylem / across cortex) 2 diffusion out (via stomata) of water vapour **;** 3 evaporation of water from mesophyll cell, surfaces / walls / membranes **;** 4 (transpiration from leaves) creates transpiration pull **;** 5 tension is, set up / present, in xylem vessels **;** 6 cohesion between water molecules (*in xylem or in roots)* **;** 7 hydrogen bonding between water molecules **;** 8 adhesion of water molecules to cellulose (in wall of xylem vessels) **;** **A** to hydrophilic parts of lignin 9 movement of water from apoplast through endodermis by osmosis **;** 10 AVP **;** e.g. *idea that* water columns extend from centre of root to root hairs (and to soil water)	**5**
6(c)	*two from:* *pathway C is slower* ***accept ora*** *for pathway B is faster* greater resistance **;** water passes across membranes **;** water flows through, cytoplasm / plasmodesmata **;** **A** ora ref. to intercellular spaces **A** protoplast osmosis occurs **;** **R** through plasmodesmata ref. to water passes through vacuoles **;**	**2**
6(d)	*assume answer is about facilitated diffusion unless told otherwise – accept* ***ora*** *for active transport* *two from:* movement is, down a concentration gradient **;** passive / ATP not required / (metabolic) energy not required **;** carrier and channel proteins are involved **;**	**2**

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1(a)	one mark for each label to correct structure on Fig. 1.1 **;** **;** **;** *tonoplast line to anywhere on the vacuolar membrane* **R** if two or more different structures stated for a single label	**3**
1(b)	ref. to conversion of measured (**X**-**Y**) line to μm / AW **;** e.g. line is measured in, mm and then multiplied by 1000 / cm and then multiplied by 10 000 evidence that, 60 (±1 mm) is multiplied by 1000 / 6 cm is multiplied by 10 000 measured diameter is 60 000 μm (and) divide by, magnification / 2000 **;**	**2**
1(c)	*two from:* rough endoplasmic reticulum **;** **A** rough ER / RER smooth endoplasmic reticulum **;** **A** smooth ER / SER endoplasmic reticulum **;** *acceptable only if the other structure is <u>not</u> SER / RER* 80S / larger, ribosomes **;** **A** 25–30 nm range plasmodesma(ta) **;** microtubules **;** **A** microfilaments **A** cytoskeleton lysosome(s) **;** Golgi (body / apparatus / complex) **;** secretory / Golgi, vesicles **;** AVP **;** **;** e.g. chromatin EM detail of chloroplast EM detail of mitochondrion **A** mitochondrion nuclear pore nuclear envelope **R** nuclear membrane	**2**

Question	Answer	Marks
1(d)(i)	*two from:* cell wall, pathway / route / AW **;** **A** involves only cell walls **R** if only in roots movement / AW, through intercellular spaces / spaces between cells **;** further detail **;** e.g. water does not, enter cells / cross membranes / cross cytoplasm / move through plasmodesmata osmosis does not occur membranes not involved **R** osmosis once only	**2**
1(d)(ii)	*four from:* hydrogen bonding (between water molecules) **;** water molecules are polar **;** *movement to spongy mesophyll cells* adhesion / attraction, to, cellulose / cellulose fibres / cell walls **;** *this is in context of leaf cells but also allow for xylem* **R** cell walls of lignin **A** hydrophilic parts of lignin cohesion between water molecules / (water molecules are) cohesive **;** *idea that* movement of water (molecules) towards, spongy / mesophyll, cells, pulls / AW, other water molecules **;** **A** transpiration pull / continuous column / unbroken column **I** continuous stream *movement to intercellular air spaces* water molecules absorb heat (energy) **;** bonds break between water molecules **;** evaporation / water to water vapour **;** **I** latent heat of vapourisation from spongy cell, walls / surfaces **;**	**4**

Question	Answer	Marks
1(d)(iii)	*two from:* transpiration occurs **;** *in context of via stomata or via cuticle* diffuses / moves / AW, to, (external) environment / atmosphere / outside / out of the leaf / from leaf surface **;** **R** evaporation / osmosis **R** from cell surface via (open) stomata (for, gas exchange / carbon dioxide entry / photosynthesis) **;** *accept* Ψ *for water potential* **I** solute potential / ref. to concentration (movement of water vapour) down water potential gradient **;** **A** down water vapour potential gradient **A** high to low water potential / to lower water potential / from higher water potential **R** from high to low water potential <u>gradient</u>	**2**

Question	Answer	Marks
2(a)(i)	A = adenine T = thymine **R** thiamine / thyamine G = guanine C = cytosine *all correct = 2 marks* *one, two or three correct = 1 mark*	**2**

Question	Answer	Marks
2(a)(ii)	*three from:* 1 complementary base pairing / complementary bases / base pairing / base pairs / complementary pairing ; 2 A with T and G with C ; 3 hydrogen bonding / hydrogen bonds ; *in context of between base pairs / holding strands together* 4 ref. to purines with pyrimidines ; 5 double ring (bases) with single ring (bases) ; **A** *idea of* longer base with shorter base 6 two (DNA), strands / polynucleotides ; **A** two chains **A** double helix (as double implies two strands) **7** strands (anti)parallel / distance between strands always the same ;	**3**
2(b)	deoxyribose ; **A** 2-deoxyribose / 2-deoxy-D-ribose	**1**
2(c)	*two from:* (information could be) sequence of amino acids ; **A** idea that a polypeptide/protein has amino acids arranged in an order / AW **I** primary structure / chains of amino acids (different) proteins have, different / specific, sequences (of amino acids) ; (up to) 20 different amino acids in proteins ; **A** approximately 20 *idea that* there is a great variety in protein structure ; **I** have many functions	**2**

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Question	Answer	Marks
3(a)	**A** antibiotic for penicillin throughout *three from:* 1 (penicillin) weakens / AW, the cell wall **;** **I** punches holes / holes made 2 (penicillin) acts, on growing cells / when cell wall being synthesised (during growth) **;** 3 inhibits / binds to / AW, enzymes / transpeptidases (for cross linkage formation) **;** **I** ref. to synthesis of peptidoglycan 4 prevents formation of cross, links / linkages (between, peptidoglycan / murein, molecules) / AW **;** *suggestions why antibiotic is less effective on Gram negative* 5 outer membrane, prevents / interferes with / protects from / AW, entry (of penicillin) **;** **A** idea of, more difficult / further, to reach peptidoglycan layer 6 proteins in outer membrane may pump out antibiotic **;** **A** presence of efflux pumps 7 enzymes may be present (in periplasm) to degrade antibiotic / AW **;** 8 suggestion that antibiotic cannot cross hydrophobic region of (outer) membrane **;** 9 AVP **;** e.g. proportionately, less / lower concentration of, penicillin reaches murein for, enzyme / transpeptidase, inhibition	**3**
3(b)(i)	ATP not required **;** **A** (metabolic) energy not required	**1**

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Question	Answer	Marks
3(b)(ii)	*four from:* 1 channel protein **;** **A** pore protein / has a pore / has a channel 2 channel / pore, can form from polypeptides **or** (protein) has quaternary structure **;** 3 hydrophilic R-groups, on amino acids lining channel / face inwards (towards channel) **;** **A** hydrophilic, lining / channel **A** water-filled, channel / AW **A** idea that passage is through hydrophilic region of protein 4 allows facilitated diffusion **;** **A** diffusion alone if in context of through the protein but **R** if via phospholipid bilayer 5 increases permeability for, movement of water / osmosis **;** **I** faster 6 no (specific) binding sites / (channel) not specific / not selective / allows more than one type of substance through / AW **;** 7 globular **;** 8 AVP **;** e.g. ref. to hydrophobic part of protein, faces / interacts with, hydrophobic, region / core / fatty acid tails ref. to hydrophilic parts of, protein / polypeptide, extend into, external environment / periplasm / aqueous regions / AW	**4**

Question	Answer	Marks
3(b)(iii)	*two from:* translation, cannot / does not, begin / occur **or** polypeptide / protein, synthesis, cannot occur **/** decreases **;** **I** ompF not made **A** chain of amino acids **R** transcription does not occur so translation does not occur **R** if in context of mutation or enzyme inhibition mRNA cannot attach to, ribosome / small subunit / ribosomal subunit **;** (first) tRNA (with UAC anticodon) / tRNA carrying met, cannot bind (to START codon) **;**	**2**
3(c)(i)	(composed of) many / chain of / polymer of / AW, monosaccharides / sugar monomers / sugar units **;** **A** glucose, molecules / residues **A** more than two / many sugars further detail **;** e.g. carbohydrate may be, branched / unbranched *in context of polysaccharide* macromolecule *in context of polysaccharide* glycosidic bonds *in context of between sugar monomers* (sugar monomers) joined by condensation reactions	**2**

Question	Answer	Marks
3(c)(ii)	*three from:* 1 specificity / specific (in correct context) **;** 2 (B / T, -) lymphocytes have receptors complementary to antigen **;** **A** immunoglobulins / antibody *as receptors for B-lymphocyte* **A** surface molecules *as receptors for T-lymphocytes* 3 (different) antigens, stimulate / activate / AW, (different) B-lymphocytes / T-lymphocytes **;** **A** antigens stimulate an immune response 4 *idea that* different antibodies, synthesised / produced / AW, for different (O) antigens / O polysaccharides / lipopolysaccharides **;** 5 memory cells will, not respond to different antigen / only respond to same antigen / AW **;** 6 different O-antigens can, be composed of different sugars **;** **A** can have different shapes	**3**

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Question	Answer	Marks
4(a)	**1 / 4 ;** **3 ;** **5 ;**	**3**
4(b)	*two from:* centromere (of each chromosome) divides **;** **A** sister chromatids separated at the centromere spindle fibres, contract / shorten **;** **A** spindle contracts (sister / identical) chromatids / daughter chromosomes, pulled / move, to opposite poles **;** **A** (sister) chromatids separated **I** chromosomes are at opposite poles centromeres, leading (towards poles) / AW **;** **A** ref. to V-shape / diagram	**2**
4(c)	*one from:* not sectioned to include (nucleus) **;** did not take up the stain / not stained (correctly) / AW **;** AVP **;** e.g. cells may be dead **I** destroyed / eliminated / AW	**1**

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Question	Answer	Marks
5(a)	*three from:* any four named structures **;** mouth / nose / nostrils / nasal passages (count as one structure) pharynx larynx trachea **A** windpipe bronchus / bronchi bronchiole / bronchioles alveolus / alveoli / alveolar ducts / alveolar sacs lungs trachea, branches / divides, into (two main) bronchi **;** correct sequence from bronchus (branching) to bronchioles to (end with) alveoli **;** further detail **; ;** e.g. trachea has, C-shaped / incomplete rings, of cartilage bronchus has cartilage, plates / AW diameters of gas exchange structures / respiratory tubes, decrease (towards alveoli)	**3**

Question	Answer	Marks
5(b)	*two from:* blood pressure, decreases / returns to normal **;** platelets no longer sticky / risk of thrombosis decreases / risk of blood clotting decreases **;** endothelial repair (more likely to be) successful **;** **A** endothelium no longer damaged **A** decreased risk of, atheroma / atherosclerosis **I** less fatty deposits heart rate, decreases / returns to normal **;** **I** heartbeat decreases AVP **;** e.g. increased peripheral circulation / AW blood vessels, not / less, constricted **A** less vasoconstriction **A** blood vessel (lumen) diameter increases / vasodilation occurs	**2**

Question	Answer	Marks
5(c)	*four from:* *assume from point of view of giving up smoking unless stated otherwise* *in lungs / at high partial pressures of oxygen* 1 (so) more oxygen taken up by haemoglobin / haemoglobin more saturated (with oxygen) / AW **;** **A** haemoglobin has, increased / normal, affinity for oxygen 2 before and after data / calculated difference in data, to support, from 10 kPa **;** 3 carbon monoxide no longer binding to haemoglobin / AW **;** **A** carboxyhaemoglobin no longer forming / ora with ref. to smoking **A** haemoglobin has a higher affinity for CO than oxygen 4 more (sites on) haemoglobin available to take up oxygen **;** *in respiring tissues* 5 more oxygen dissociates from (oxy)haemoglobin / AW, at, lower partial pressures / below 4 kPa / in (respiring) tissues (after stopping) **;** **A** haemoglobin less saturated (with oxygen) **A** haemoglobin has, less / decreased, affinity for oxygen 6 before and after data / calculated difference in data, to support **;** 7 ref. to increase in allosteric effect / regains ability for conformational change / AW **;** *health benefits after stopping* 8 more / sufficient, oxygen to, transport / deliver to, tissues / body **or** more oxygen to reach (respiring) tissues **;** **A** less, tired / fatigued **A** more able to, do work / carry out exercise / be mobile **R** more energy unless qualified with link to aerobic respiration	**4**

Question	Answer	Marks
5(d)	*two from:* *non-infectious* not from a pathogen **;** **A** bacteria / viruses / fungi *for pathogens* **A** from lifestyle **A** tar / carcinogen in smoke, causes mutation (in cells of lung) cannot be passed onto another person / not transmissable / AW **;** *disease* abnormal condition (affecting an organism) / condition that reduces the effectiveness of the functions of the organism / AW **;**	**2**

Question	Answer	Marks
6(a)	*three from:* same / similar, shape as, HMG CoA / substrate **;** <u>complementary</u> (shape) to active site (shape) **;** binds / attaches / fits into / active site (of, enzyme / HMG CoA reductase) **;** HMG CoA / substrate, cannot bind (to active site) **;** **A** no / few, enzyme/substrate complexes form mevalonic acid production, decreases / stops **;** **I** product not made AVP **;** e.g. increase in mevinolin concentration increases inhibition / ora	**3**

Question	Answer	Marks
6(b)	*two from:* *treatment of disease* **I** *statements about locating or diagnosis of disease* specific / targeted, therapy / treatment **;** **A** specific to diseased, cells / tissue **A** examples bind to / recognition of, receptors / antigens, on cell surface (of diseased cells) **;** kill the cell by stimulating the immune system / AW **;** **A** correct immune responses e.g. stimulates phagocytosis / activates B-cells attach, radioactive substance / drug (to treat / kill diseased cells) / AW **;** treat infectious diseases / bind to (antigens on) pathogens / recognition of antigens on pathogens **;** **A** viruses **I** bacteria *unless stated that they cause disease* *allow examples such as treatment of ebola or rabies or tetanus (by immunising with antibody)*	**2**

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 **May/June 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.

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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: 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.

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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)	(nucleus of cell) **D** has two nucleoli v **E** has one nucleolus **;**	**1**
1(b)	**A** = (early / mid) prophase **;** **R** late **B** = (mid / late) prophase **;** **R** early **C** = anaphase **;**	**3**
1(c)	**I** name of stage *two from:* ref. to (daughter) chromosomes at poles **;** **A** (sister) chromatids at poles **R** chromatids move to poles **A** two separate groups of (daughter) chromosomes **A** two nuclei form (enclosing chromosomes) **I** there are two nuclei *in context of at each pole* nuclear envelope reassembles (around chromosomes) **;** **A** nuclear membranes reassemble nucleolus reappears / nucleoli reappear **;** (daughter) chromosomes, become diffuse / become long and thin / decondense / uncoil **;** **A** become chromatin **I** disappears spindle, disassembles / AW **;**	**2**

Question	Answer	Marks
2(a)	*too small to see* 35 μm is 0.035 mm (smaller than 0.05 mm) **or** 0.05 mm is 50 μm (larger than 35 μm) **;**	**1**
2(b)	*in context of light microscope* *two from:* 1 resolution / resolving power, poor / not high enough / AW **;** 2 ability to distinguish between two points not high enough / AW **;** 3 ref. to limit of resolution **;** e.g. organelles smaller than, 0.2 μm / 200 nm, not visible **A** organelles smaller than 200 nm (accept range 100–300 nm) 4 organelle too small to interfere with light waves **;** **A** wavelength of light too long **I** organelles are small	**2**
2(c)(i)	ester **;**	**1**

Question	Answer	Marks
2(c)(ii)	facilitated diffusion ; *plus two from:* (diffusion) through (membrane), transport / channel / carrier, protein ; **A** pore **I** transmembrane / integral, protein high to low concentration **or** down, concentration / diffusion, gradient ; passive ; **A** no, ATP / (metabolic) energy, required *if active transport incorrectly stated allow ecf* through (membrane), transport / carrier, protein ; **R** channel protein low to high concentration / against a concentration gradient / requires ATP / requires (metabolic) energy ;	**3**
2(c)(iii)	*four from:* 1 ref. to hormones, released into / arrive at adipocyte in, blood stream ; **A** released by another, cell / tissue (elsewhere in the body) 2 hormone is, (chemical) signal / signalling molecule / messenger molecule ; 3 (adipocyte is) target cell ; **A** (adipose is) target tissue 4 (hormone) binds to / AW, receptor ; *in context of* on cell surface membrane of adipocyte 5 ref.to receptor (shape) complementary to hormone ; **A** specific receptor for hormone 6 (binding) triggers / stimulates, reactions within the cell ; **A** cascade of reactions **I** binding causes a reaction to occur 7 cell signalling results in a response, qualified ; e.g. triglyceride breakdown fatty acids (and glycerol) produced fatty acids leave, the cell / via transport protein	**4**

Question	Answer	Marks
2(d)	*any one valid suggestion:* *e.g.* do not have mitochondria / mitochondria required (to produce ATP) **;** do not have nucleus (so no mRNA produced) **;** no mRNA for enzyme synthesis **;** (required) enzymes not present **;** impermeable to fatty acids / AW **;** have lost / do not have, the required organelles **;**	**1**

Question	Answer	Marks
3(a)	*max 2 if only one section attempted* *three from:* *multilayered epidermis* reduces, cuticular transpiration / loss of water <u>vapour</u> through cuticle **;** increases distance for diffusion (of water vapour to cuticle) **;** ref. to protection from heat from sunlight and reduced evaporation (from spongy mesophyll cells) **;** *stomatal crypts* creates area of moist air / AW **;** **I** traps water minimises effect of, external air currents / wind **;** reduces / less steep, water potential gradient (between intercellular air space and external environment) **;** **A** water vapour potential gradient **A** diffusion gradient if referenced to water vapour ref. to only on lower surface / shaded, and reduced evaporation (from spongy mesophyll cells) **;** **A** lower temperature reduces rate of diffusion of water vapour (out via stomata)	**3**
3(b)	phloem sieve tube element(s) **;** **A** phloem sieve tube (cells) **A** sieve elements **I** companion / transfer, cells	**1**

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Question	Answer	Marks
3(c)	*allow named assimilates* *source* *in context of assimilates* site of synthesis **;** **A** described e.g. photosynthesis in leaf / storage compound breakdown in roots *sink* *in context of, via phloem / from source / from leaf* **I** nutrients / substances, unqualifed *if assimilates / named assimilate, not stated when explaining source* site where assimilates are stored **A** described e.g. roots for storage of starch **or** area where, growth occurs / assimilates are used for growth **A** described e.g. growth in developing buds / growth of immature leaf **or** area that receives, assimilates / AW **;** **A** area where sucrose unloaded **I** place that needs assimilates **I** place where assimilates are used, unless qualified	**2**
3(d)(i)	change in the, sequence / AW, of, bases / nucleotides (in, the DNA / the gene / *cyFBP*) **;**	**1**

Question	Answer	Marks
3(d)(ii)	*one valid suggestion that prevents polypeptide synthesis or prevents synthesis of functional enzyme:* *e.g.* no mRNA produced **;** **A** transcription, does not / cannot, occur mRNA produced unable to attach to ribosome **;** **A** translation, does not / cannot, occur no start codon on mRNA **;** shortened polypeptide chain produced **;** **A** ref. to STOP codon premature chain termination mutation / nonsense mutation **;** polypeptide produced cannot fold to form, tertiary structure / active site **;** **R** changes shape of active site preventing function polypeptide produced cannot form quaternary structure of protein **;**	**1**
3(e)(i)	*accept cell for lymphocyte throughout* *four from:* 1 (primary) immune response **;** 2 cyFBPase / enzyme, is antigen **;** 3 formation of, APC / antigen-presenting cell **;** **A** antigens presented on surface of macrophages 4 antigen, recognition / binding (in context of B-, or T-lymphocytes) **;** 5 detail **;** e.g. clonal selection have receptors, complementary / specific, to, antigen / cyFBPase **A** immunoglobulin / antibody, as receptors for B-lymphocytes **A** surface molecules as receptors for T-lymphocytes 6 divide by mitosis / clonal expansion **;** 7 (specific) B-lymphocytes form plasma cells **;** 8 plasma cells, synthesise / secrete, specific antibody / antibody to cyFBPase **;** 9 T-helper / Th, lymphocyte, secretes, cytokine / interleukin **;** 10 stimulates, humoral / B-lymphocyte, response **;**	**4**
3(e)(ii)	no binding of (monoclonal) antibody to, antigen / cyFBPase / enzyme / AW **;**	**1**

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Question	Answer	Marks
3(f)	*two from:* (less cyFBPase / enzyme, so) less sucrose synthesised **;** **A** no enzyme to synthesise sucrose less sucrose transported (source to sink) **;** **A** less sucrose unloaded at sink **;** ref. to less glucose for synthesis of starch / AW (on context of sucrose hydrolysis) **;**	**2**

Question	Answer	Marks
4(a)	*answers must be in context of <u>oxygen</u>* *three from:* 1 <u>diffusion</u> 2 movement, down a, concentration / diffusion, gradient / from high(er) to low(er) concentration **;** **A** in terms of partial pressure 3 passive (process) **;** 4 through alveolar wall / across alveolar cells / across squamous epithelial cells (of alveolus) / across pavement cells (of alveolus) **;** **A** squamous cells 5 across, endothelium / endothelial cells / capillary wall **;** **A** squamous, epithelium / cells (in context of capillary wall) 6 ref. to diffusion / AW, through the phospholipid bilayer of cell surface membranes / between the phospholipids of the bilayer (of squamous or endothelial cells) **;**	**3**
4(b)(i)	65 / 66 / 67 (%)	**1**

Question	Answer	Marks
4(b)(ii)	1 higher partial pressures in lungs / lower partial pressures in (respiring) tissues **;** **A** correct values / range of values, of kPa **A** in alveoli *advantages of differences (higher v lower partial pressure)* *only higher partial pressure or lower partial pressure explanation required to gain mark* 2 oxygen, binds to v released from, haemoglobin **or** oxyhaemoglobin, is formed v dissociates / AW **;** 3 (so) percentage saturation of haemoglobin (with oxygen) high v low **;** 4 affinity of haemoglobin for oxygen high v low **;** 5 data from Fig. 4.1 to support **;** 6 (body), cells / tissues, need oxygen for aerobic respiration **;**	**3**
4(c)	*idea of* abnormal, change in the body / condition, which produces, poor / ill-, health **or** absence of, good health / well-being **;** **A** disorder / illness further detail **;** e.g. having an adverse effect reduces the effectiveness of functions produces, (specific) signs / symptoms lack of social, physical and mental, well-being can be infectious or non-infectious AW	**2**

Question	Answer	Marks
4(d)	*five from:* 1 base substitution (in gene coding for, β-globin / polypeptide) **;** 2 different / altered, mRNA codon **;** 3 different tRNA brings a different amino acid (to ribosome) / leads to a change in one amino acid (in the polypeptide chain) **;** 4 altered, primary structure / sequence of amino acids (in β-globin) **;** 5 changed, tertiary / quaternary, structure **;** 6 haemoglobin / molecule, less soluble **;** 7 (haemoglobin) molecules, stick together / form fibres **;** 8 (haemoglobin) less able to bind oxygen / AW **;** *points above may be qualified* 9 details **; ;** + e.g. thymine / T, replaces, adenine / A 10 in sixth, codon / triplet **or** sixth amino acid in sequence is changed (non-template strand) GTG instead of GAG / GTA instead of GAA **or** (template strand) CAC instead of CTC / CAT instead of CTT mRNA codon is, GUG instead of GAG / GUA instead of GAA 11 (amino acid change is) valine instead of glutamic acid **;** 12 amino acid with non-polar side chain instead of polar side chain **;** 13 position of amino acid, is to the exterior / faces cytosol **;**	**5**

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Question	Answer	Marks
5(a)(i)	*three from:* 1 papain higher optimum temperature than ficin / ora **or** temperature is higher for papain for percentage of maximum activity of 100 **A** 100% activity / maximum activity / peak of activity **or** (100% of maximum activity) papain 60 °C v ficin 45 °C **;** 2 papain (overall) less steep increase / AW, (to peak) / ora **;** 3 papain steeper decline / AW (after peak) / ora **;** *for mp 2 and 3 allow ecf for a ref. to time, e.g. rapidly / slowly* 4 papain lower activity at all temperatures between 20 °C and, 54 °C / 55 °C **;** 5 papain higher activity at all temperatures above, 54 °C / 55 °C **;** 6 ref. to ficin more active over a greater range of temperatures **;** **A** ref. to activity at temperatures around 100% maximum 7 comparative, extracted / manipulated, data to support mp, 2–6 **;**	**3**
5(a)(ii)	ficin, as higher activity at 37 °C / body temperature **;**	**1**
5(b)	*one from:* (may be able to) obtain more product (per unit time) **;** **A** can use in a continuous system (may be) more, thermostable / tolerant to pH changes / AW **;** **A** idea that enzyme less likely to denature product, not / less, contaminated with enzyme **;** **A** less downstream processing longer shelf-life / AW **;** enzyme, easier to recover / can be reused **;** AVP **;** e.g. ficin may be, costly / difficult, to extract	**1**
5(c)(i)	extracellular (enzyme) **;**	**1**

Question	Answer	Marks
5(c)(ii)	*any one valid example:* e.g. collagen / elastin **;**	**1**

Question	Answer	Marks
6(a)	**A** HIV / AIDS, measles, smallpox **;** **B** cholera, tuberculosis **;** **C** cholera **;** **D** malaria **;**	**4**
6(b)	one mark for each correct column **; ;** nuclear envelope circular / (closed) loop / **A** ring of 80S mitochondria / chloroplasts **A** nucleus murein / peptidoglycan	**2**