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 2017**

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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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)	 ;	**1**
1(b)	*two from* can observe living, specimens / cells **;** (so) the process of mitosis can be seen happening / AW **; R** easier to see mitosis happening **I** to study cell division ease of use, qualified **;** e.g. no need for heavy metal staining, preparation of specimen less time-consuming **I** *ref. to* colour **I** portable	**2**
1(c)	*three from* production of genetically identical cells **;** asexual reproduction **;** repair of damaged tissue **; A** replace damaged cells **R** repair damaged cells replace, dead / worn out / old / non-functioning, cells **;** gamete production *in context* **;**	**3**

Question	Answer	Marks
2(a)	capillary **;** *two from* single celled wall / AW **; A** thin wall *ref. to* wall composed only of one, squamous epithelial / endothelial, cell **;** *ref. to* lumen diameter approx 7 μm **; A** 5–8 μm **A** *ref. to* similarity to dimension of red blood cell in direct contact with tissue fluid **;** *if vein named, allow one mark for, thin wall (relative to lumen)* ***or*** *wide / AW, lumen (relative to wall thickness)*	**3**
2(b)(i)	0.24 s / 0.25 s **;**	**1**
2(b)(ii)	0.08 s / 0.09 s **; A** range	**1**
2(b)(iii)	*four from* *similarity* *ref. to* increases and decreases in pressure at same time **; A** description for part of the graph e.g.starts to rise at same point as RV, returns to minimum at same point as RV *idea that* events in cardiac cycle occur are coordinated **; A** described e.g. impulses pass up both ventricles at the same time, ventricles both contract at same time *difference* reaches higher, blood pressure / peak, (than RV) **;** systolic pressure higher in LV (than RV) left ventricle pumps blood to (whole) body / RV only to lungs) overcome greater resistance / ora for RV walls of left ventricle, thicker / more muscular more force exerted by LV *any two* **;;**	**max 4**

Question	Answer	Marks
3(a)(i)	B-lymphocyte / plasma cell **;** **A** B-cell **/** white blood cell / lymphocyte / leucocyte / **R** beta / β, cells **R** T-lymphocyte / macrophage / neutrophil	**1**
3(a)(ii)	*three from* **I** ref. to receptor 1 antibody complementary (shape) to antigen **; I** matching shape *2 idea that* variable regions different for each antibody **;** 3 (specific) antigen / H / N, binding sites (on antibody) **;** *if mp 2 and 3 not gained, allow one mark for antigen binding regions* 4 sequence of amino acids / primary structure, varies between antibodies / gives specificity **;** 5 *ref. to* difference in, primary structure / amino acid sequence, leading to different, tertiary structure / 3-D shape **;** 6 *ref. to* R group interactions between antibody and antigen **;**	**3**
3(b)(i)	*Vibrio cholerae* **; I** bacterium	**1**
3(b)(ii)	faecal–oral route **;;** *if mode of transmission not named, allow description* *infected person* faeces / sewage, contaminates, (drinking) water / cooking utensils / vegetable plots / crops / food **A** diarrhoea *for faeces* **R** (human) waste unqualified **or** *ref. to* houseflies landing on contaminated faces **;** *uninfected person* eating contaminated food / using contaminated utensils / drinking contaminated water **;** **A** bacteria enters water in context of drinking **R** infected food or water **I** handling contaminated food *need ref. to contaminated once only*	**2**

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Question	Answer	Marks
3(c)(i)	cell wall, breaks / damaged / AW **A** cell wall becomes thinner **or** cell wall weakened **;** *plus one from* detail of change to cell wall e.g. cross links break down, quantity of murein / peptidoglycan, decreases **or** cell membrane, breaks / AW **or** increase in water in cell (so increase in turgor pressure) / AW **;**	**2**
3(c)(ii)	*two from* infect only, *V. cholerae* / cholera bacteria AW **or** do not, infect human cells / infect humans **; A** do not harm human cells do not give side effects / allergic responses, (to humans) **;** able to replicate inside *V. cholerae* (to produce more bacteriophage for treatment) **;** *ref. to* remaining, active / infective / AW, with delivery method used / within gut **;**	**2**
3(c)(iii)	*antibiotics* only effective against bacteria / not effective against viruses **or** do not act on structures possessed by, (measles) virus / *Morbillivirus* **A** named structure e.g. protein coat **or** act on structures that viruses do not have **A** named structure e.g. murein cell wall **or** only act on, living / growing, cells **or** may not be able to reach virus inside (host) cell **;** AW	**1**

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Question	Answer	Marks
4(a)	*codon that* terminates / AW, translation / polypeptide synthesis **R** stops production of amino acids **or** does not specify any amino acid **or** has no complementary, tRNA / anticodon **or** causes the release of the (completed) polypeptide chain **;**	**1**
4(b)	*four from* Asp and Gln R groups, hydrophilic / AW, and Ile R group, hydrophobic / AW **;** *ref. to* R group interactions and, folding / coiling, of polypeptide chain (to give globular structure) **;** *ref. to* (charged / polar R groups) forming, ionic / hydrogen, bonds **;** (amino acids with), hydrophobic / non-polar, R groups, on the inside / AW **;** **A** hydrophobic amino acids (amino acids with), hydrophilic / charged / polar, groups on outside / AW **;** **A** hydrophilic amino acids detail **;** e.g. ionic R groups can interact with water, hydrogen bonds form with water *ref. to* promotes stability / helps to maintain globular structure **;** *in context of interaction with water / formation of (compact) hydrophobic core*	**4**
4(c)	glycosidic **;**	**1**

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Question	Answer	Marks
4(d)	*four from* 1 both, increase and decrease / peak **;** 2 both active, over range of temperature tested / between 20 to 55°C **;** 3 free enzyme lower, optimum temperature / temperature for maximum activity **; ora** 4 (free) 37°C v (immobilised optimum) 46°C**;** 5 free enzyme higher, maximum activity / activity at optimum temperature **; ora** 6 (free) 8.2 / 8.3, a.u. v 7.5 a.u. **;** 7 between 20°C and 39°C the activity of free is higher **; ora** 8 between 39°C and 55°C the activity of free is lower **; ora** *if mp 7 and 8 not gained, allow 1 mark for free activity higher at lower temperatures and lower at higher temperatures (than immobilised) ora* 9 comparative data to support mp 7 or 8 **; A** comparison at one temperature (stated or use of numerical data) 10 AVP **;** e.g. both have same activity at 39°C, similar activity between 20°C and 30°C	**4**
4(e)	substrate concentration that gives half V_{max} / AW **;** **A** description of how to use a graph to derive (must refer to substrate concentration)	**1**
4(f)	*two from* *look for ora throughout* free / low(er) K_m , has higher affinity for substrate **;** free needs a lower concentration of substrate to reach, V_{max} / maximum activity / ½ V_{max} **;** takes lower substrate concentration to saturate active sites in free **;** free active site more, likely to be saturated with substrate / accessible **;** active site (may be) distorted by immobilising **;** *ref. to* substrate passing through matrix when immobilised **;** *ref. to* some product retained within matrix **;**	**2**

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Question	Answer	Marks
5(a)(i)	Golgi (body / apparatus / complex) **;**	**1**
5(a)(ii)	animal cell ✓ plant cell ✓ bacterial cell **;**	**1**
5(b)	magnification = scale bar length / actual length **; A** M = I / A M = I / O or magnification triangle 14 500 **;;** *for 29 mm scale bar length* **A** 14 000 (*for 28 mm*) **or** 15 000 (*for 30 mm*) *allow one mark only for* *incorrect answer but correct calculation using scale bar e.g. 29 000 ÷ 2* *correct answer but units given* *correct measurement and correct calculation but incorrect conversion*	**3**
5(c)	*mark first two only* nucleus **;** mitochondria **;** chloroplasts **;**	**2**
5(d)(i)	*fluid* *idea of* phospholipid (and protein) molecules, move about / diffuse (within their monolayer) **;** *mosaic* protein (molecules), interspersed / scattered / AW **; A** different / AW, proteins **;**	**2**

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Question	Answer	Marks
5(d)(ii)	*any four from* 1 barrier between cytoplasm and, external environment / AW **;** e.g. tissue fluid **A** protects, organelles from damage / from pathogens, **I** keeps cell contents in / membrane surrounds the organelles 2 cell signalling **or** has receptors for, cell signalling substance / hormone / neurotransmitter / AW 3 cell recognition / acts as cell surface antigen **;** 4 cell-to-cell adhesion **;** 5 site for, enzymes / catalysing reactions **;** 6 anchoring the cytoskeleton / AW **;** 7 selection of substances that enter or leave a cell **;** AW 8 formation of <u>hydrogen bonds</u> with water for stability **;** 9 AVP **;** e.g. *ref. to*, changing shape of cell / flexibility of cells e.g. phagocytosis	**4**

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Question	Answer	Marks
6(a)	*mark first two statements given* cellulose, cell wall / lining, allows adhesion of water **;** thick (cellulose) cell wall prevents collapse / *idea of* providing support (under tension) **;** (cell wall impregnated with) lignin, for waterproofing / prevents water loss **;** lignin, rings / spirals / thickening / AW (of walls), prevents collapse / *idea o*f providing support (under tension) **;** **A** lignified walls no cytoplasm / lack of contents / hollow / empty (lumen), gives, less resistance to / unimpeded / uninterrupted / unhindered / ease of, flow **; A** greater volume per unit time / faster rate **R** continuous, smooth **R** dead ack of end walls / continuous tube, so, less resistance to / unimpeded / uninterrupted / unhindered / ease of, flow **;** AW **R** continuous, smooth pits / pores, for lateral movement / for movement around air bubbles / supplies (water) to (surrounding), cells / tissues **;** **R** holes wide / large diameter / large lumen, so large volume of water can be transported **;** *if max 2 not gained, allow one mark for two correct explanations or descriptions where accompanying descriptions and explanations are in context*	**2**

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Question	Answer	Marks
6(b)	*two from* *accept phloem vessels for sieve tubes* only sieve tubes / one type, v, arteries, veins and capillaries (any two) **A** three types**;** sieve tubes are composed of cells v blood vessels composed of tissues **; A** ref. to named tissues sieve tubes, have cytoplasm **or** blood vessels are, hollow / AW**;** sieve tubes have sieve plates **; ora** sieve tubes have companion cells (to fully function) **;** veins have valves **; ora** *ref. to* blood vessels and vasoconstriction **; ora** *idea of transport* open (phloem) v closed (blood vessels) **; A** sieve tubes have plasmodesmata *ref. to* unidirectional flow in blood vessels **; ora**	**2**
6(c)	*three from* mitochondria, synthesise ATP / carry out aerobic respiration **;** more ATP needs to be synthesised / increased ATP synthesis **; A** need to produce large quantities of ATP to provide more (metabolic) energy **; R** *in context of water uptake* for active transport / active uptake **;** *in context of mineral ions* **A** to move mineral ions against the concentration gradient	**3**

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AVP	alternative valid point

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Question	Answer	Marks
1(a)	**C ;** **R** if more than one area given	**1**
1(b)(i)	*three from* two chromatids drawn **;** *must be connected at some point* (sister) chromatid label to correct structure **;** centromere label to correct structure **; A** kinetochore telomere label to end of chromatid **;** DNA <u>and</u> histone (proteins) label to chromatid **;**	**3**
1(b)(ii)	*two from* disassembles / breaks down / disintegrates / AW, at, prophase **; A** prometaphase re-forms / re-assembles / AW**,** after anaphase / at telophase **;** *if mp 1 and 2 not gained, one mark can be awarded for knowledge of disassembles and then reassembles* detail **;** e.g. breakdown into vesicles re-forms from vesicles / vesicles fuse to form new membranes re-forms around both sets of (daughter) chromosomes	**2**

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Question 2

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>
two from
cell (surface) membrane / plasma membrane / phospholipid bilayer, damaged / AW ; A phospholipids are in cell surface membrane (and will be broken down by phospholipase)

cell, bursts / lyses / lysis / ruptures ; haemolysis is neutral

cell contents / AW / haemoglobin, leaks out / AW ; I water
</td><td>2</td></tr>
<tr><td>2(b)</td><td>
allow, fatty acids / fatty acid tails / hydrocarbon chains, for fatty acid residues

both have / similarities (max 3)
glycerol (residue) ;

fatty acids ; I ref. to saturation, R both have, two / three, fatty acids

ester, bonds / linkages ;

C <u>and</u> H <u>and</u> O ;

double bonds ; A both have C=O

differences (max 3)
<table>
<tr><th>triglyceride / fat / oil / lipid</th><th></th><th>phosphatidylcholine / phospholipid</th></tr>
<tr><td>no, choline / nitrogen
A no / small / delta, charges</td><td>or</td><td>has, choline / nitrogen ;
A choline / nitrogen, ion
A charged / ionic</td></tr>
<tr><td>three fatty acid residues
or one extra fatty acid residue ;
A triglyceride has three ester bonds</td><td></td><td>R if comparison includes phosphatidylcholine and the number of fatty acid residues is incorrect</td></tr>
<tr><td>no, phosphate (group) / phosphorus
A no, phosphoester / phosphodiester bond</td><td>or</td><td>has phosphate ;
A has phosphoester / phosphodiester bond</td></tr>
</table>
</td><td>4</td></tr>
</table>

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Question	Answer	Marks
2(c)	smooth endoplasmic reticulum **;** **A** smooth ER **R** SER **R** if more than one organelle given **R** endoplastic *two from* membranous / membranes **;** **A** *ref. to* vesicles, formed / bud off **R** envelope / double membrane tubular **;** **A** cisternae but **R** if described as flattened fluid filled, channels / sacs **;** not associated with ribosomes **;**	**3**

Question 3

Question	Answer	Marks
3(a)	intracellular (enzyme) **;** **R** interacellular	**1**
3(b)(i)	8.5 mmol dm^{-3} **;;** **A** 8–8.7 *max 1 if no units* *allow one mark if only half V_{max} stated* half V_{max} = 0.5 (au)	**2**
3(b)(ii)	*two from* (K_m is the) affinity, of enzyme for its substrate **;** **G** / low K_m enzyme, has a, high(er) affinity for its substrate (than **H**) **; ora** **A** binds more easily *note that if the term 'affinity' is used, then this is also mp1* **G** / low K_m enzyme, needs a lower concentration of substrate to reach, V_{max} / maximum activity / ½ V_{max} (than, **H** / enzyme with high K_m) **; ora** **G** / low K_m enzyme more likely to be saturated with substrate **;** (so) variations in substrate have less effect on rate of reaction (for **G**) **;**	**2**
3(c)	lysosomes **;** *treat as neutral Golgi vesicles* **R** lysozyme **R** if any other organelle named	**1**
3(d)	*any one relevant e.g.* leakage (of substances) through / damage to, (mitochondrial) membranes **A** *ref. to* fewer cristae **or** impaired uptake of substances through transport proteins / AW **or** no / impaired, ATP production / aerobic respiration / oxidative phosphorylation **or** no / low, protein / enzyme, synthesis (from mitochondrial ribosomes) **or** change to, number / distribution / presence, of membrane proteins **or** no mitochondrial replication occurring **;**	**1**

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Question	Answer	Marks
3(e)	*five from* 1 change in nucleotide / base, sequence (of, DNA / gene / *GBA*) **;** *must be in context of DNA, ignore if in context of RNA* 2 (because of) base substitution **; A** substitution of a base 3 altered / AW, <u>mRNA</u> codon **; A** mRNA triplet **R** genetic code **I** triplet code 4 *idea that* a, codon / triplet, specifies a particular amino acid **;** *in context of DNA or RNA* 5 (different) tRNA with different amino acid (brought to ribosome) / tRNA brings Ser instead of Asn / tRNA brings Pro instead of Leu **; R** tRNA makes a different amino acid 6 altered, primary structure **or** altered, sequence / order / arrangement, of amino acids **; R** if describing result of frameshift, deletions or insertions e.g. all amino acids changed from mutation on / missing amino acid / added amino acids 7 affects (folding into) / different, secondary structure **;** *different tertiary structure* 8 *ref. to* different interactions between, R groups / side chains (because of changed primary structure) **; A** *idea of* different bonds forming (*if R-groups not stated*) **I** peptide bonds change *9* *idea that* differences give different shapes of active site *if shape not stated, allow point if linked to idea of 'tertiary structure changes shape'* **or** *idea of* change to complementarity to substrate 10 mutation 1 / asparagine (Asn) to serine (Ser), change less effect on, active site shape / catalysis **or** mutation 2 / leucine (Leu) to proline (Pro), change greater effect on, active site shape / catalysis **;**	**5**

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Question 4

Question	Answer	Marks
4(a)	*two from* (loss of ions) increases / AW, water potential within cell **; ora, A** Ψ for water potential, **I** *ref. to* solutes / solute potential water moves out of cell, down water potential gradient / from high(er) to low(er) water potential **; R** from high to low water potential gradient (out) by <u>osmosis</u> / through the partially permeable membrane **; A** selectively permeable membrane **I** osmotic gradient	**2**
4(b)	*four from* *capillary side sodium ions* 1 sodium ions out (of cell), by active transport / with use of ATP **; A** sodium ions pumped out 2 (so) lowers concentration of sodium ions within cell **or** sodium ion concentration gradient, set up / maintained **;** *intestinal lumen sodium ions and glucose* 3 sodium ions enter by facilitated diffusion **; A** diffusion / high to low concentration, through, SGLT1 / cotransporter **I** glucose enters by facilitated diffusion 4 glucose, cotransported with sodium ions into cell (through SGLT1) **; A** sodium ions cotransported with glucose **A** glucose enters by secondary active transport, **A** *idea of* glucose only able to enter if moving with sodium ions (i.e. sodium drives the process) 5 (cotransport means) glucose enters against concentration gradient **;** *capillary side glucose* 6 glucose out of cell (towards capillary) by <u>facilitated</u> diffusion **; A** by diffusion if stated through, membrane protein / GLUT2 *water uptake from lumen* 7 (higher concentrations of) sodium ions / glucose / solutes, within cell lowers water potential **;** 8 water follows, sodium ions / glucose / solutes (osmotically) **or** so water enters cell (down water potential gradient) **;** *must have idea that it follows inward movement of solutes*	**4**

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Question	Answer	Marks
4(c)	*any one valid e.g.(if not stated artery or vein, assume vein)* high(er) pressure of artery (will not allow drip) **or** artery may be deeper to reach to insert needle for drip / easier to find vein **A** vein more, visible / superficial **or** greater risk / more complications / greater blood loss, associated with intra arterially AW	**1**
4(d)	*one from* no / reduced, polypeptide / protein, synthesis **or** mRNA not translated / no translation / reduced translation **;** **A** detail of translation e.g. tRNA cannot bind **R** DNA not translated no / few, enzyme-catalysed reactions **;**	**1**
4(e)(i)	*three from* 1 volume / AW, decreases over time for all groups **;** 2 *compared to no antibiotic* antibiotic groups, steep(er) / faster, decrease to, 32 / 48 hours **;** 3 *idea that* diarrhoea, stops / is 0 dm^3, at / after, 64 hours, for one dose 1 g / **A**, **or**, multiple dose / **C** **;** **A** recovers after 64 hours / AW 4 after 48 hours, one dose 2 g / **B**, fluctuation / decreases then (slight) increase then decrease / AW **;** 5 no antibiotic / **D**, higher volumes diarrhoea than antibiotics (to approx. 110h) **or** no antibiotic / one dose 2 g / **B**, took 128 hours (for diarrhoea) to, reach 0 dm^3 / stop **;** 6 multiple dose / **C**, higher volumes than, **A** (all readings) / **B** (to 48 hours) **ora or A** has steepest decrease *in context of 16–32 hours or overall*	**3**

Question	Answer	Marks
4(e)(ii)	*alternative ways to refer to decrease in volumes of diarrhoea may be in terms of recovery, destroying bacteria, decreasing loss of glucose and salts* *two from* *support treatment* there is a difference between antibiotic and no antibiotic treatment **or** fast(er) decrease in volume of diarrhoea with antibiotics / AW **or** (generally) faster recovery with antibiotics **;** **I** *ref. to* one dose 2 g use of Fig. 4.3 to support **;** e.g. use (1 dose) 1 g or multiple dose time, to recover / reach 0 dm^3, is halved use of numerical data from Fig. 4.3 *does not support treatment* (in all cases) volume decreased to, same level / zero **or** all patients recovered **;** use of Fig. 4.3 to support **;** e.g. by 128 hours all patients 0 dm^3 one dose of 2 g same trend from 112 hours as no antibiotic one dose of 2 g patients relapse after 64 hours one dose of 2 g took 128 hours (for recovery) *not able to say* limited information available / small number of patients **;** *ref. to* one dose of 2 g antibiotic **;** e.g. does not reach 0 dm^3 until same time as no antibiotic *also see arguments above – allow once only here or for does not support*	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(f)</td><td>
answer may be from point of view of single dose or multiple dose
allow AW – note mp 3 is for starting with susceptible bacteria and mp 4 is for starting with resistant bacteria

penalise once if use virus throughout
<table>
<tr><td></td><td>single dose</td><td>multiple dose</td><td></td></tr>
<tr><td>1</td><td>easier to be sure patient has taken complete dose</td><td>course may not be completed</td><td>;</td></tr>
<tr><td>2</td><td>if (bacteria are all susceptible and) treatment completed, all bacteria killed / no reservoir of bacteria</td><td>treatment may not be completed so some (susceptible) bacteria survive</td><td>;</td></tr>
<tr><td>3</td><td>(susceptible so) no bacteria survive to, <u>mutate</u> / become resistant</td><td>(bacteria replicating so) increased chance of, <u>mutation</u> / becoming resistant</td><td>;</td></tr>
<tr><td>4</td><td>idea that (if resistance is already present) single stronger dose has greater chance of killing resistant bacteria</td><td>weaker dose spread over time, resistant bacteria, more likely to survive / have less chance of being killed</td><td>;</td></tr>
<tr><td>5</td><td>(if all killed with single dose) idea that resistance not transferred (if all killed) e.g. no vertical / horizontal, transmission
this could be suggested as follow up to mp 2 / 4</td><td>if resistant / if develop resistance, this could be transferred
A vertical / horizontal, resistance</td><td>;</td></tr>
<tr><td>6</td><td colspan="2">AVP
e.g.
one dose may mean, no / less, antibiotic enters environment (in faeces)
(more effective so) bacteria passed out for shorter time, so reduces risk of transmission (of pathogen)
idea that multiple low dose antibiotics may increase mutagenesis
suggestion that if resistant and not killed by antibiotic, there may be less of an effect on (good) gut bacteria with single dose</td><td>;</td></tr>
</table>
</td><td>2</td></tr>
</table>

Question	Answer	Marks
4(g)	*three from* 1 *ref. to* different antigens (in context of, flagellum / whole cell / toxin) **;** **A** *ref. to* epitopes instead of antigens 2 specificity **;** *in correct context (B-lymphocytes / plasma cells / antibodies /antigen binding sites)* 3 detail of B-lymphocytes **;** e.g. specific B-lymphocytes activated (by each different antigen) **A** clonal selection form plasma cells that release specific antibody, **A** B-lymphocytes release specific antibody 4 detail of antibody **;** **I** *ref. to* receptor e.g. antibody complementary (shape) to antigen, antigen binding sites on antibody, variable regions different for each antibody	**3**
4(h)	passive natural / natural passive **;**	**1**

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Question 5

Question	Answer	Marks
5(a)	**A** = root hair (cell) **;** **B** = Casparian (strip) **;** **C** = plasmodesmata / plasmodesma **;**	**3**
5(b)	xylem has no cytoplasm / symplast pathway is cytoplasmic (and vacuolar) **;** **A** empty / hollow / no contents **A** cytosol for cytoplasm xylem (vessel elements) are dead cells / symplastic through living cells **;**	**2**
5(c)	*three from* stomata close **; I** stomatal pore smaller / stomata partially open only cuticular transpiration **;** no photosynthesis / carbon dioxide not needed **; I** less photosynthesis transpiration (rate) decreases **; A** less, transpiration / transpiration pull, **A** described in terms of loss of water vapour from leaves evaporation (rate) (from cell walls of spongy mesophyll cells) decreases **; R** evaporation, from leaf surface / through stomata water potential gradient between, soil / root, and leaf becomes less steep **;**	**3**

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Question 6

Question	Answer	Marks
6(a)(i)	**S ;**	**1**
(a)(ii)	pulmonary vein **;** **R ;**	**2**
6(a)(iii)	wall of right atrium **; A** muscle of right atrium	**1**
6(b)	*two from* passes the, impulse / wave of excitation, to the Purkyne fibres / down the septum **; A** Bundle of His **R** nerve impulse allows a (short) delay **;** detail **;** e.g. so atria contract before ventricles allows ventricles to fill so atria have, emptied / contracted, before ventricular contraction begins so atria and ventricles don't contract at the same time	**2**

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Maximum Mark: 60

Published

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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)	actual length = image length / magnification **;** **A** A = I / M M = I / A I = A × M or magnification triangle 2.5 (μm) **;;** *for 40 mm **X**–**Y** length* **A** 2.6 (*for 40 / 41 mm*) **A** 2.4 (*for 38 / 39 mm*) *max 1 for* *incorrect or no answer but correct calculation e.g. 40 000 ÷ 16 000* *correct answer but to more than one decimal place* *correct measurement and correct calculation but incorrect conversion*	**3**
1(b)(i)	mitochondrion **; A** mitochondria *max 1 for function* produces / makes / synthesises / provides / AW, ATP **or** releases / provides / supplies, energy **or** aerobic respiration **;** AVP **;** e.g. part of the urea cycle β-oxidation of fat oxidative phosphorylation	**2**
1(b)(ii)	rough endoplasmic reticulum **;** **A** rough ER **I** RER ribosomes are attached **;** *accept mp2 if organelle identified as endoplasmic reticulum / RER*	**2**

Question	Answer	Marks
2(a)	*two from* 1 to generate a high(er) blood pressure (during systole) **;** **A** force **I** withstands / AW, high blood pressure 2 to overcome high(er) resistance (in systemic circuit than in pulmonary circuit) **;** 3 to transport blood a greater distance / greater distance in systemic circuit **;** 4 *ref. to* right ventricle generating low pressure to avoid damaging (capillaries in the) lungs / AW **;**	**2**
2(b)(i)	**F** (inferior / posterior) vena cava **;** **I** superior **G** pulmonary artery **;**	**2**
2(b)(ii)	diastole **;** **I** ventricular / atrial	**1**
2(c)	*five from* 1 wave of excitation / wave of depolarisation / impulses, from, atrioventricular node / AVN **;** 2 pass(es) down Purkyne fibres (to ventricles) **;** **A** Bundle of His 3 (both) ventricles contract / ventricular systole **;** 4 from the base (upwards) / AW **;** 5 blood pressure in ventricles, increases / becomes higher **;** 6 blood pressure in ventricles greater than in atria **;** 7 atrioventricular / AV / tricuspid and bicuspid, valves close **;** 8 blood pressure in ventricles greater than in, artery / aorta / pulmonary artery **;** 9 semi-lunar / pulmonary and aortic, valves open **;** **A** blood flows through 10 blood flows, into arteries / to lungs and rest of the body **;** *at end of description only* 11 atria relaxing / atrial diastole / blood flows into atria **;**	**5**

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Question	Answer	Marks
3(a)	(cell) thin / squamous / flat / pavement **;** **R** cell wall **I** one cell thick short distance for, diffusion of (named) gases / gas exchange **;** **A** diffusion between (air in) alveolus and (blood in) capillary	**2**
3(b)	*two from* phosphate / 'heads', are, polar / hydrophilic **and**, fatty acids / hydrocarbon chains / 'tails', are, non-polar / hydrophobic **;** **A** hydrophilic / polar, heads **and** hydrophobic tails tails, face away from fluid *or* water / project into air **;** **A** diagram heads form hydrogen bonds with water **;** *max 1 if answer is about a bilayer*	**2**
3(c)	*three from* 1 prevention of infections (of, gas exchange system / named part) **;** **A** in context of a named disease (TB, pneumonia, influenza) 2 prevent (named) pathogen entering, rest of body / blood **;** *3 idea that macrophages* patrol / move around / AW, alveoli / lungs **;** 4 (carry out) phagocytosis / endocytosis **;** **A** are phagocytes 5 engulf / remove / destroy / kill / digest , pathogens **;** 6 macrophages are, antigen presenting cells / APCs **;** **A** description of antigen presentation **A** part of the immune system 7 AVP **;** e.g. reduce excess surfactants **I** *ref. to* mucus	**3**

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Question	Answer	Marks
3(d)(i)	*two from* breakdown / AW, elastin / elastic fibres / elastic tissue **;** makes a pathway, to alveolus / through alveolar wall ***or*** goes through alveolar wall ***or*** to reach, respiratory tract / gas exchange surface / air space **;** to reach, pathogens / site of infection, in alveoli / AW / implied **;**	**2**
3(d)(ii)	*three from* 1 no / less, inhibition of elastase **;** 2 too much / more, elastin / AW, is broken down **;** 3 *ref. to* lack of elastin so, no / less, recoil (during expiration) **;** 4 alveoli, over expand / overstretch / increase in size **;** 5 alveoli burst **;**	**3 max**

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Question	Answer	Marks
4(a)(i)	*Plasmodium* , *ovale* / *falciparum* / *malariae* / *vivax* ;	**1**
4(a)(ii)	*Anopheles* / anopheline ;	**1**
4(b)	*either* 1 numbers of cases have decreased in, all countries / Africa ***or*** number of deaths have decreased in, all countries / Africa ; 2 cases in Africa as a percentage of all countries decreases and, remains constant / reaches a plateau / (small) fluctuations / down + up + down ; 3 deaths in Africa as a percentage of all countries, remains constant / fluctuates (a little) ;	**3**
4(c)	*three from* 1 example of control of breeding of, vector / mosquitoes ; e.g. drainage of stagnant water / sterile males / aerial spraying of insecticide / oil on water / fish in water / *ref. to* bacteria 2 example of reduction of contact between vector and humans ; e.g. bed nets (impregnated with insecticide) / insect repellents 3 earlier, identification of cases / treatment of malaria ; 4 use of (new) drugs to, prevent transmission / prevent spread / treat malaria; **A** development of new drugs for malaria 5 better, awareness of / education about, transmission / control methods ; 6 AVP ; e.g. targeting people at risk (e.g. pregnant women / high drug-resistant areas better screening of blood for transfusion **I** *better access to, healthcare / AW, without further qualification*	**3**

Question	Answer	Marks
4(d)	**A** mosquito for *Anopheles* *four from* 1 no vaccine **;** **A** no effective vaccine 2 any problem in developing a vaccine **;** e.g. *Plasmodium* is eukaryotic / antigens differ in different life stages / intracellular parasite / antigenic concealment / different stages in life cycle 3 drug resistance in *Plasmodium* **;** 4 any example, e.g. chloroquine / artemisinins **;** 5 insecticide resistance in *Anopheles* **;** 6 any example, e.g. DDT / dieldrin / pyrethroids **;** 7 *ref. to* conditions for breeding of *Anopheles* **;** 8 problems with, funding research / AW **;** 9 cost of, drugs / insecticides, to government / health authorities / individuals **;** 10 people with HIV / AIDS are at high(er) risk than others **;** 11 lack of knowledge / lack of education / 'fatalism' / AW **;** 12 inaccessibility of some regions to healthcare **;** 13 infected people not, identified / diagnosed **;** 14 AVP **;** e.g. migration of people with malaria to places without malaria (such as countries where it has been eliminated)	**4**

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Question	Answer	Marks
5(a)	*in context of / from a plant* loss of <u>water vapour</u> **;** **I** evaporation unqualified from, the aerial parts / leaves **;**	**2**
5(b)	*description of Fig. 5.1B – accept if correct unit is used only once* *four from* 1 decrease then increases **;** 2 data with units and minus sign(s) in support **;** i.e. decreases to, –1.35 ± 0.01 MPa at 1400 i.e. –0.35 ± 0.01 MPa at 0600 to –0.58 ± 0.01 MPa at 1800 *explanation to max 3* *overall decrease between 0600 and 1400* 3 water is used *or* lost and is not being replaced **;** 4 *idea of* synthesis of (named) solutes increases (so decreasing water potential) **;** *0600 to 0900 / 0915 accept any specific time within these time frames* 5 *idea that* not enough water supplied from, xylem / transpiration stream **;** 6 (because) stomata are closed / only cuticular transpiration occurs **;** *0900 / 0915 to 1400* 7 *idea that there is a* high loss of water (from cell surfaces), by evaporation / because of high rate of transpiration **;** *0900 to 1400* 8 photosynthesis occurring, stomata open (for CO_2), water vapour diffuses out / rate of transpiration increases **;** *1400 to 1800* 9 less photosynthesis as, stomata closing / lower light intensity 10 (named) solutes converted to, starch / sucrose and transported away **;** 11 AVP **;** e.g. *0900 to 1400* water is used in photosynthesis so water potential decreases	**4**

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Question	Answer	Marks
5(c)	sunken stomata ***or*** stomata in, grooves / crypts / pits **;** trichomes / hairs **;** rolled / curled, leaves **;** **A** folded **R** coiled	**3**

Question	Answer	Marks
6(a)	EGF binds to receptor(s) on cell **A ; ora** **A** has receptor for, EGF / cell signaling compound **A** EGF does not bind to receptor on **B** *idea of* complementary / specific **; ora** **R** antigen to antibody **I** active site	**2**
6(b)	*accept* ***ora*** *one from* more, proteins / polypeptides, are made **;** proteins are required for growth / to provide (named) protein for DNA synthesis / proteins are required for organelles / AW **;** **A** S phase for DNA synthesis during mitosis DNA is highly condensed **;**	**1**
6(c)	*three from* ATP **;** (activated / free / DNA) nucleotides **;** **R** in context of transcription DNA polymerase **;** (DNA) ligase **;** AVP **;** e.g. topoisomerase / gyrase helicase	**3**
6(d)(i)	centromere **; A** kinetochore *one from* holds / joins / AW, (sister) chromatids together **;** attach to spindle	**2**

Question	Answer	Marks
6(d)(ii)	*max 1 if more than one chromosome shown* *two from* separate chromatids that are identical in shape **;** one arm larger than the other on both separate chromatids **;** V-shaped chromatids with centromeres pointing towards the poles **;**	**2**

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