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**BIOLOGY**

**9700/22**

Paper 2 AS Level Structured Questions

**October/November 2017**

MARK SCHEME

Maximum Mark: 60

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**Published**

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**Mark scheme abbreviations**

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

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

**Question 2**

Question	Answer	Marks												
2(a)	<p><i>two from</i>                      cell (surface) membrane / plasma membrane / phospholipid bilayer, damaged / AW ; <b>A</b> phospholipids are in cell surface membrane (and will be broken down by phospholipase)</p> <p>cell, bursts / lyses / lysis / ruptures ; <i>haemolysis is neutral</i></p> <p>cell contents / AW / haemoglobin, leaks out / AW ; <b>I</b> water</p>	<b>2</b>												
2(b)	<p><i>allow, fatty acids / fatty acid tails / hydrocarbon chains, for fatty acid residues</i></p> <p><i>both have / similarities (max 3)</i>                      glycerol (residue) ;</p> <p>fatty acids ; <b>I</b> ref. to saturation, <b>R</b> both have, two / three, fatty acids</p> <p>ester, bonds / linkages ;</p> <p><b>C</b> <u>and</u> <b>H</b> <u>and</u> <b>O</b> ;</p> <p>double bonds ; <b>A</b> both have C=O</p> <p><i>differences (max 3)</i></p> <table border="1" data-bbox="349 1027 1637 1398"> <tr> <td data-bbox="349 1027 938 1075">triglyceride / fat / oil / lipid</td> <td data-bbox="943 1027 1010 1075"></td> <td data-bbox="1014 1027 1637 1075">phosphatidylcholine / phospholipid</td> </tr> <tr> <td data-bbox="349 1078 938 1193">no, choline / nitrogen <b>A</b> no / small / delta, charges</td> <td data-bbox="943 1078 1010 1193"><b>or</b></td> <td data-bbox="1014 1078 1637 1193">has, choline / nitrogen ; <b>A</b> choline / nitrogen, ion <b>A</b> charged / ionic</td> </tr> <tr> <td data-bbox="349 1197 938 1311">three fatty acid residues <b>or</b> one extra fatty acid residue ; <b>A</b> triglyceride has three ester bonds</td> <td data-bbox="943 1197 1010 1311"></td> <td data-bbox="1014 1197 1637 1311"><b>R</b> if comparison includes phosphatidylcholine and the number of fatty acid residues is incorrect</td> </tr> <tr> <td data-bbox="349 1315 938 1398">no, phosphate (group) / phosphorus <b>A</b> no, phosphoester / phosphodiester bond</td> <td data-bbox="943 1315 1010 1398"><b>or</b></td> <td data-bbox="1014 1315 1637 1398">has phosphate ; <b>A</b> has phosphoester / phosphodiester bond</td> </tr> </table>	triglyceride / fat / oil / lipid		phosphatidylcholine / phospholipid	no, choline / nitrogen <b>A</b> no / small / delta, charges	<b>or</b>	has, choline / nitrogen ; <b>A</b> choline / nitrogen, ion <b>A</b> charged / ionic	three fatty acid residues <b>or</b> one extra fatty acid residue ; <b>A</b> triglyceride has three ester bonds		<b>R</b> if comparison includes phosphatidylcholine and the number of fatty acid residues is incorrect	no, phosphate (group) / phosphorus <b>A</b> no, phosphoester / phosphodiester bond	<b>or</b>	has phosphate ; <b>A</b> has phosphoester / phosphodiester bond	<b>4</b>
triglyceride / fat / oil / lipid		phosphatidylcholine / phospholipid												
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Question	Answer	Marks
2(c)	<p><u>smooth</u> endoplasmic reticulum ; <b>A</b> <u>smooth</u> ER <b>R</b> SER <b>R</b> if more than one organelle given <b>R</b> endoplasmic</p> <p><i>two from</i></p> <p>membranous / membranes ; <b>A</b> <i>ref. to</i> vesicles, formed / bud off <b>R</b> envelope / double membrane</p> <p>tubular ; <b>A</b> cisternae but <b>R</b> if described as flattened</p> <p>fluid filled, channels / sacs ;</p> <p>not associated with ribosomes ;</p>	<b>3</b>

## Question 3

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

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

## Question 4

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

Question	Answer	Marks
4(c)	<p><i>any one valid e.g. (if not stated artery or vein, assume vein)</i>  high(er) pressure of artery (will not allow drip)  <b>or</b>  artery may be deeper to reach to insert needle for drip / easier to find vein <b>A</b> vein more, visible / superficial  <b>or</b>  greater risk / more complications / greater blood loss, associated with intra arterially AW</p>	1
4(d)	<p><i>one from</i>  no / reduced, polypeptide / protein, synthesis  <b>or</b>  <u>mRNA</u> not translated / no translation / reduced translation ; <b>A</b> detail of translation e.g. tRNA cannot bind <b>R</b> DNA not translated   no / few, enzyme-catalysed reactions ;</p>	1
4(e)(i)	<p><i>three from</i></p> <ol style="list-style-type: none"> <li>1 volume / AW, decreases over time for all groups ;</li> <li>2 <i>compared to no antibiotic</i> antibiotic groups, steep(er) / faster, decrease to, 32 / 48 hours ;</li> <li>3 <i>idea that</i> diarrhoea, stops / is 0 dm<sup>3</sup>, at / after, 64 hours, for one dose 1 g / <b>A</b>, <b>or</b>, multiple dose / <b>C</b> ;  <b>A</b> recovers after 64 hours / AW</li> <li>4 after 48 hours, one dose 2 g / <b>B</b>, fluctuation / decreases then (slight) increase then decrease / AW ;</li> <li>5 no antibiotic / <b>D</b>, higher volumes diarrhoea than antibiotics (to approx. 110h) <b>or</b> no antibiotic / one dose 2 g / <b>B</b>, took 128 hours (for diarrhoea) to, reach 0 dm<sup>3</sup> / stop ;</li> <li>6 multiple dose / <b>C</b>, higher volumes than, <b>A</b> (all readings) / <b>B</b> (to 48 hours) <b>ora or A</b> has steepest decrease <i>in context of 16–32 hours or overall</i></li> </ol>	3

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

Question	Answer			Marks																												
4(f)	<p><i>answer may be from point of view of single dose or multiple dose</i>  <i>allow AW – note mp 3 is for starting with susceptible bacteria and mp 4 is for starting with resistant bacteria</i></p> <p><i>penalise once if use virus throughout</i></p> <table border="1" data-bbox="349 352 1917 1142"> <thead> <tr> <th></th> <th>single dose</th> <th>multiple dose</th> <th></th> </tr> </thead> <tbody> <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><i>idea that</i> (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) <i>idea that</i> resistance not transferred (if all killed) e.g. no vertical / horizontal, transmission <i>this could be suggested as follow up to mp 2 / 4</i></td> <td>if resistant / if develop resistance, this could be transferred <b>A</b> 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)  <i>idea that</i> multiple low dose antibiotics may increase mutagenesis  <i>suggestion that</i> 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> </tbody> </table>				single dose	multiple dose		1	easier to be sure patient has taken complete dose	course may not be completed	;	2	if (bacteria are all susceptible and) treatment completed, all bacteria killed / no reservoir of bacteria	treatment may not be completed so some (susceptible) bacteria survive	;	3	(susceptible so) no bacteria survive to, <u>mutate</u> / become resistant	(bacteria replicating so) increased chance of, <u>mutation</u> / becoming resistant	;	4	<i>idea that</i> (if resistance is already present) single stronger dose has greater chance of killing resistant bacteria	weaker dose spread over time, resistant bacteria, more likely to survive / have less chance of being killed	;	5	(if all killed with single dose) <i>idea that</i> resistance not transferred (if all killed) e.g. no vertical / horizontal, transmission <i>this could be suggested as follow up to mp 2 / 4</i>	if resistant / if develop resistance, this could be transferred <b>A</b> vertical / horizontal, resistance	;	6	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) <i>idea that</i> multiple low dose antibiotics may increase mutagenesis <i>suggestion that</i> if resistant and not killed by antibiotic, there may be less of an effect on (good) gut bacteria with single dose		;	2
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4(g)	<p><i>three from</i></p> <p>1 <i>ref. to different antigens (in context of, flagellum / whole cell / toxin) ; A ref. to epitopes instead of antigens</i></p> <p>2 <i>specificity ; in correct context (B-lymphocytes / plasma cells / antibodies /antigen binding sites)</i></p> <p>3 <i>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</i></p> <p>4 <i>detail of antibody ; I ref. to receptor</i>  <i>e.g. antibody complementary (shape) to antigen, antigen binding sites on antibody, variable regions different for each antibody</i></p>	<b>3</b>
4(h)	passive natural / natural passive ;	<b>1</b>

## Question 5

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

## Question 6

Question	Answer	Marks
6(a)(i)	<b>S</b> ;	<b>1</b>
(a)(ii)	pulmonary vein ; <b>R</b> ;	<b>2</b>
6(a)(iii)	wall of right atrium ; <b>A</b> muscle of right atrium	<b>1</b>
6(b)	<i>two from</i> passes the, impulse / wave of excitation, to the Purkyne fibres / down the septum ; <b>A</b> Bundle of His <b>R</b> 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	<b>2</b>