Published

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Mark scheme abbreviations:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>;</td>
<td>separates marking points</td>
</tr>
<tr>
<td>/</td>
<td>alternatives answers for the same point</td>
</tr>
<tr>
<td>R</td>
<td>reject</td>
</tr>
<tr>
<td>A</td>
<td>accept (for answers correctly cued by the question, or extra guidance)</td>
</tr>
<tr>
<td>AW</td>
<td>alternative wording (where responses vary more than usual)</td>
</tr>
<tr>
<td>underline</td>
<td>actual word given must be used by candidate (grammatical variants accepted)</td>
</tr>
<tr>
<td>max</td>
<td>indicates the maximum number of marks that can be given</td>
</tr>
<tr>
<td>ora</td>
<td>or reverse argument</td>
</tr>
<tr>
<td>ecf</td>
<td>error carried forward</td>
</tr>
<tr>
<td>I</td>
<td>ignore</td>
</tr>
<tr>
<td>mp</td>
<td>marking point (with relevant number)</td>
</tr>
</tbody>
</table>
1 must have correct spellings of Plasmodium and Vibrio cholera

<table>
<thead>
<tr>
<th>feature</th>
<th>malaria</th>
<th>tuberculosis</th>
<th>cholera</th>
</tr>
</thead>
<tbody>
<tr>
<td>name of pathogen</td>
<td><em>Plasmodium</em> ;</td>
<td><em>Mycobacterium</em></td>
<td><em>Vibrio cholerae</em> ;</td>
</tr>
<tr>
<td>type of organism</td>
<td>protoctist / protoctistan ; A protist / protozoan / sporozoan</td>
<td>bacterium ;</td>
<td>bacterium ;</td>
</tr>
<tr>
<td>mode of transmission</td>
<td>by, a vector or (feeding or biting by) <em>Anopheles</em> / mosquito ;</td>
<td>via, (airborne) droplets / aerosol(s) (infection) ;</td>
<td>drinking water and food contaminated with human faeces</td>
</tr>
</tbody>
</table>

[6]

[Total: 6]

2 (a) (i) phagocytosis / endocytosis ; R pinocytosis I engulfing [1]

(ii) E transcription ;
F translation ; A post translation(al) modification [2]

(iii) B (phagocytic / endocytic) vacuole / phagosome ; A vesicle
R incorrectly qualified vacuole or vesicle (e.g. permanent / large / secretory / Golgi / excretory)
I food / pathogenic
G (80S) ribosome ; A rough endoplasmic reticulum R RER / rough ER
I 70S or any other type of incorrect S as a qualification
H Golgi (body / apparatus / complex) ;
J mitochondrion ; A mitochondria [4]

(b) I fusion of lysosomes with phagosome and diffusion of products of digestion

1 bacteria are, killed / destroyed / broken down / digested ; A hydrolysed
A cell wall broken down
R bacteria are cut up
2 (by hydrolytic) enzymes ;
3 any example, e.g. carbohydrase / lysozyme / protease / nuclease ;
4 killed by, hydrogen peroxide / *H*₂*O*₂ / free radicals / AW ;
5 AVP ; e.g. correctly named substrate for enzyme
murein / peptidoglycan, polysaccharide(s), polypeptides, nucleic acids, lipids
e.g. correctly named bonds broken
glycosidic, peptide, ester, phosphodiester [max 3]

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(c) 1 idea that only, a few / some / small number / AW, with correct specificity ;
2 (different) T-lymphocytes are specific to different antigens ;
3 (T cell) receptor is, complementary (in shape to antigen) ;
4 AVP ;
e.g. this may be during a primary immune response so no memory cells
e.g. disease state (HIV/AIDS and leukaemia) or treatment where few
T-lymphocytes in the body [max 2]

[Total: 12]

3 (a) (i) N ciliated ; A pseudostratified I columnar / cuboidal R cilia [1]
(ii) O mucous glands ; A mucus glands / serous glands [1]
(iii) P cartilage ; [1]

(b) I more air can enter unqualified
1 more air / oxygen, reaches the, alveoli / gas exchange surface ;
2 more gas exchange / greater absorption of oxygen / excretes more carbon
dioxide ; AW
A maximises oxygen obtained
3 satisfies increased demand for oxygen / AW ;
4 trachea / bronchi / airways, widen / AW ;
e.g. dilate / expand / enlarge A diameter of lumen increases
5 reduces resistance to air flow ; R rate of air flow increases [max 2]

(c) collagen has
three polypeptides / a quaternary structure ;
I more than one polypeptide unqualified
glycine is every third amino acid ; I at regular intervals R roughly / approximately
(triple) helix / helical (shape) ; I regular coils’ R alpha helix [max 2]

[Total: 7]

4 (a) transpiration is an inevitable consequence because
1 stomata open ;
2 for diffusion in of carbon dioxide / carbon dioxide required for photosynthesis ;
3 water vapour, diffuses out / moves out down the water potential gradient ;
A description of water potential gradient / high to low water potential
A vapour pressure gradient / water vapour gradient
allow water vapour if it is clear that evaporation has occurred
A water evaporates anddiffuses out
R water evaporates out
I water (vapour) concentration gradient [3]
(b) 1 adhesion of water to, cellulose/lining/walls (of xylem vessels);  
&A adhesive force  
2 ref to, hydrophilic/polar, property of cellulose (fibres);  
&A hydrophilic/polar, parts of lignin  
3 cohesion between water molecules; cohesive force  
4 maintains column of water/prevents water column breaking/AW;  
5 ref. to transpiration pull/AW; I transpiration unqualified  
[&max 3]  

(c) mp3 – units for rates of transpiration must appear once correctly in the whole answer to award this point  
1 rate (of transpiration) of all trees is 0 at, 06.00/start; A no transpiration  
2 rates (of transpiration) increase and decrease (in all three); A peaks  
3 highest rates:  
emergent trees at 14.30 at 8.5 kg h\(^{-1}\)  
canopy trees at 14.30 at 3.5 kg h\(^{-1}\)  
suppressed trees at 13.00 at 1.6–1.7 kg h\(^{-1}\);  
must have units at least once  
accept kg/h or kg per hour  
4 emergent trees (always) have highest rate or suppressed trees have lowest rate;  
&A emergent trees have higher rate than, canopy and suppressed, trees  
5 rate of emergent trees is, much/AW, higher than rates for canopy and  
suppressed trees;  
6 emergent trees have, steeper/steepest, increase in (transpiration) rate;  
&A emergent trees have, steeper/steepest, decrease in (transpiration) rate  
[&max 4]  

(d) following factors may be given in answers, any three of these factors = 1 mark  
light, intensity/wavelength I ‘more light’  
humidity  
wind speed/air movement  
size of tree/height/area of leaves  
water availability/depth or length of roots  
transpiration rate for emergent trees is higher because … accept ora for  
suppressed trees  
accept vapour pressure gradient/water vapour pressure gradient/water vapour  
diffusion gradient for water potential gradient  
1 high(er) light intensity for emergent trees increase in stomatal aperture; ora  
&A more sunlight  
&A stomata open more  
1 more stomata open  
2 lower humidity for emergent trees so steeper water potential gradient; ora  
&A description of water potential gradient  
3 higher temperature/AW, for emergent trees so higher rate of,  
evaporation/diffusion; ora  
4 higher wind speed for emergent trees so, steeper water potential  
gradient/lower humidity; ora  
&A ref. to diffusion shells/descriptions of water potential gradient  
5 emergent trees have longer roots so take up more water;  
6 emergent trees have more leaves so, greater surface area/more stomata  
per unit area (of leaf);  
[&max 4]  
[Total: 14]
5  (a)  (i)  *if draw other stages mark first one only – either left to right or top to bottom*

![Diagram](image.png)

- four chromatids/daughter chromosomes, drawn as single structures between equator and poles;
- V shaped, chromatids/daughter chromosomes, in correct orientation;
- spindle (fibres) attached to all four, centromeres/kinetochores/apex, and centrioles; R if these extend between chromatids [max 3]

(ii)  
1. attach to the, centromeres (at prophase); A kinetochores
   - *I if attach at metaphase*
2. attach to, centrioles; A centrosome/MTOC
3. arrange the chromosomes on the, equator/metaphase plate;
4. pull/move, (daughter) chromosomes, apart/to the poles;
   - A separates for moves apart A (sister/identical) chromatids
   - I ends R homologous chromosomes [max 2]

(b)  (i)  
1. produces/makes/synthesises, haemoglobin; I fills up
2. produces/makes/synthesises, carbonic anhydrase; I fills up
3. loss/AW, of the nucleus;
4. loss/AW, of (named) organelles;
   - e.g. ribosomes/(R)ER/mitochondria
5. becomes biconcave/described;
6. AVP; e.g. cell surface/antigens/named antigens
   - ref. to cytoskeleton [max 3]

(ii)  *cell Y*

1. remains/stays as a, stem cell;
2. divides/undergoes mitosis;
   - I ref. to becoming a type of blood cell/platelet
   - R if it becomes a cell other than a blood cell/platelet [max 1]
(c) (i) 13.5 ;

(ii) 1 low(er) partial pressure of oxygen (at high altitude) ;
A $pO_2/\text{ppO}_2$
2 less oxygen in, inhaled air/lungs/alveoli ;
3 so haemoglobin, is not fully saturated/has lower saturation (with oxygen) (than at sea level)/lower affinity for oxygen ;
4 idea that more red blood cells so, higher concentration of/more haemoglobin ;
5 allows, same/similar/enough, volume of oxygen to be transported in the blood as at sea level ;
6 volume of oxygen transported in the blood is less ;
7 less oxygen for (aerobic) respiration/lack leads to anaerobic respiration ;
8 any consequence, e.g. fatigue, altitude sickness ;

[Total: 14]

6 (a) fluid
phospholipids (and proteins), move/AW ;

mosaic
proteins/glycoproteins, scattered/AW (in the phospholipid bilayer) ;
A different types of proteins
I pattern unqualified

(b) 7 nm ; A any size or range within 6 nm and 10 nm
A 7 nanometres

(c) cholesterol ;
unsaturated fatty acids ; A phospholipid tails
carbohydrate chains added to protein(s)/glycoproteins ;
A oligosaccharides for carbohydrate chains
carbohydrate chains added to lipids/glycolipids ;
glycocalyx ;
channel protein(s)/AW ; A aquaporin(s) ;
carrier proteins/AW ;
peripheral/extrinsic, proteins ;
attachment to, cytoskeleton/microfilaments ;
receptor(s) ;
antigen(s) ;
AVP ;

[Total: 7]