

Mark schemes

- 1**
- (a) 1. (Overall) outward pressure of 3.2 kPa; 2. Forces small molecules out of capillary. 2
- (b) Loss of water / loss of fluid / friction (against capillary lining). 1
- (c) 1. High blood pressure = high hydrostatic pressure; 2. Increases outward pressure from (arterial) end of capillary / reduces inward pressure at (venule) end of capillary; 3. (So) more tissue fluid formed / less tissue fluid is reabsorbed. *Allow lymph system not able to drain tissues fast enough* 3
- (d) 1. Water has left the capillary; 2. Proteins (in blood) too large to leave capillary; 3. Increasing / giving higher concentration of blood proteins (and thus wp). 3
- [9] (a) 1. Contraction of internal intercostal muscles;
- 2**
2. Relaxation of diaphragm muscles / of external intercostal muscles; 3. Causes decrease in volume of chest / thoracic cavity; 4. Air pushed down pressure gradient. 4
- (b) 19(%); 1
- (c) 1. Muscle walls of bronchi / bronchioles contract; 2. Walls of bronchi / bronchioles secrete more mucus; 3. Diameter of airways reduced; 4. (Therefore) flow of air reduced. 4
- [9]
- 1 (a) 1. Water potential becomes lower / becomes more negative (as sugar enters phloem);
- 3**
2. Water enters phloem by osmosis; 3. Increased volume (of water) causes increased pressure. 3
- (b) 1. Rate of photosynthesis related to rate of sucrose production; 2. Rate of translocation higher when sucrose concentration is higher. 2

- (c) 1. Rate of translocation does not fall to zero / translocation still occurs after 120 minutes;
 2. But sucrose no longer able to enter cytoplasm of phloem cells.

2

[7]

4

- (a) 1. Trachea and bronchi and bronchioles;
 2. Down pressure gradient;
 3. Down diffusion gradient;
 4. Across alveolar epithelium. *Capillary wall neutral*
 5. Across capillary endothelium / epithelium.

4 max

- (b) (About) 80.0%.

1

- (c) 1. (Group **B** because) breathe out as quickly as healthy / have similar FEV to group **A**;
 2. So bronchioles not affected;
 3. FVC reduced / total volume breathed out reduced.

Allow this marking point for group C

3

[8] (a) (Simple) diffusion;

5

Reject: facilitated diffusion.

1

- (b) 1. Thin/small **so** short diffusion pathway;
Reject: thin membrane/wall/cells.
 2. Flat/long/small/thin **so** large surface area to volume ratio/surface area : volume;
Accept: small volume to surface area ratio.

2

- (c) 1. High/50% saturation (with oxygen) below (pO_2 of) 0.2 kPa;
*Accept: fully saturated **or** above 50% saturation below 0.2kPa.*
Accept: any number between 0.08 and 0.2 kPa
 2. (Oxygen) for respiration;

2

- (d) 1. Water potential higher in worm
OR
 Lower water potential in seawater;
Accept: correct reference to water potential gradient if direction of water movement is given.
Accept: ψ for water potential.
 2. Water leaves by osmosis (and worm dies); *Reject: worm/cells burst.*

2

[7]

6

- (a) 1. Lower affinity for oxygen / releases more oxygen / oxygen is released quicker /

oxygen dissociates / unloads more readily;

Q Neutral: the organism / body has a lower affinity for oxygen / releases more oxygen

- 2. (To) muscles / tissues / cells

- 3. (For) high / rapid respiration;

Q Reject: 'produces more energy' on its own

Neutral: reference to partial pressure

Accept: (for) respiration to produce more energy in the form of ATP / release more energy

3

- (b) (i) 1. Small SA:VOL;

Neutral: small limbs / small ears / extremities

Neutral: small SA

Accept: large VOL:SA

Neutral: reference to fat / blubber / insulation

- 2. (So) reduces heat loss / (more) heat retained;

Note: MP2 is independent of MP1

2

- (ii) 1. Brain is the same, others fall;

Note: 1. might not be given in the same sentence

Assume that 'other organs fall' = all three organ categories fall

Accept: 'blood flow is reduced to all organs except for the brain'

- 2. Brain controls other organs / remains active / needs constant supply of oxygen;

Accept: 'seal would die' = brain remains active

- 3. Lungs not used / are used less / seal is not breathing / heart rate decreases / heart pumps less / blood diverted to muscles;

Reject: seal is not respiring

3

[8]

7

- (a) 1. Water and blood flow in opposite directions;

Accept: diagram if clearly annotated

- 2. Maintains concentration / diffusion gradient / equilibrium not reached / water always next to blood with a lower concentration of oxygen;

Must have the idea of 'maintaining' or 'always' in reference to concentration / diffusion gradient

Accept: constant concentration / diffusion gradient

3. Along whole / length of gill / lamellae;

Accept: gill plate / gill filament

3

(b) 1. (Thicker lamellae so) greater / longer diffusion distance / pathway; **Q Neutral:**
'thicker' diffusion pathway

2. (Lamellae fuse so) reduced surface area;

Accept: reduced SA:VOL

2

(c) (i) Correct answer of **5.1** or **5.14(2857)** (dm³) = 2 marks;;

Allow 1 mark max for an answer of 5 if the correct answer of 5.1 or 5.14(2857) is not shown

One mark for incorrect answers that show **36** or **0.4 × 90** or **90 ÷ 7**;

2

(ii) 1. Increased metabolism / respiration / enzyme activity;

Accept: enzymes work more efficiently

2. Less oxygen (dissolved in water);

Neutral: references to increased kinetic energy (of water molecules)

1 max

[8] (a) (i) (Simple) diffusion;

8

Reject facilitated diffusion

Accept lipid diffusion

1

(ii) 1. Thin walls / cells;

1. *'Short diffusion pathway' alone is an explanation not a description*

1. *Accept squamous epithelia / one cell thick*

2. (Total) surface area is large;

2. *Ignore references to 'volume ratio'*

2

(b) 1. Loss of elasticity / elastic tissue / increase in scar tissue;

1. *Accept elastin*

2. Less recoil;

2

[5]

FOR

9

1. (If the husband smokes) there's a greater risk of dying from lung cancer / emphysema/ cervical cancer;
2. The more the husband smokes, the greater the risk of dying from lung cancer /emphysema;
3. Suitable use of figures from the table to illustrate answer;

AGAINST

4. Little difference in risk of dying of stomach / heart disease;
5. Other factor (than husband smoking) / named factor might cause death;
6. Only one sample / further studies needed;

4 max

[4] (a) (i) (We should maintain biodiversity to)

10

*Prevent extinction / loss of populations / reduction in populations / loss of habitats / save organisms for future generations (idea of);
Neutral: references to 'playing God' / animal rights*

1

(ii) A suitable example of how some species may be important financially e.g.

1. medical / pharmaceutical uses;
2. commercial products / example given;
3. tourism;
4. agriculture;
5. saving local forest communities;

1 max

(b) 1. Fewer plant species / decrease in plant diversity;

Accept: converse arguments for islands with a high percentage of forest remaining 1. Neutral: fewer plants

2. Fewer habitats nesting sites / niches / food sources / varieties / less protection from predators / hunters / environment;

2. Neutral: fewer homes

2. Neutral: less food

2

(c) 1. Number of (individuals / birds of) each species;

1. *Neutral: number of species*

2. Total number of individuals / birds of all species;

2. Accept: 'total number of birds' as given context for 'all species' in the investigation

2

- (d) 1. (Larger birds have) a low(er) SA:VOL;
Neutral: reference to fat / feathers
2. (So) less heat loss / more heat retained;
MP2 is independent of MP1

2

[8] (a) Hydrolysis (reaction);

11

Accept phonetic spelling

1

- (b) 1. Too big / wrong shape;
Wrong charge - neutral
Accept insoluble
2. To fit / bind / pass through (membrane / into cell / through carrier / channelprotein);
3. Carrier / channel protein;
Accept carrier / channel protein not present

3

- (c) Foreign / (act as) antigen / non-self;
Reject foreign cells

1

- (d) 1. Dose to be given;
Accept: interaction with other drugs
2. No (serious) side effects;
3. How effective;
4. Cost of drug;

2 max

[7

-] (a) 1. Phagocyte attracted to bacteria by chemicals / recognise antigens on bacteria as

12

- foreign;
2. Engulf / ingest bacteria;
3. Bacteria in vacuole / vesicle;
4. Lysosome fuses with / empties enzymes into vacuole;

5. Bacteria digested / hydrolysed;
 1. Accept names chemical e.g. toxin
 2. Allow description of engulfing
 3. Accept: bacteria in phagosome
 5. Neutral: Break down
 5. Accept digestive enzymes destroy bacteria
 5. Do not accept "destroy bacteria" as it is in question stem

4 max

- (b)
1. Microvilli provide a large / increased surface area;
 2. Many mitochondria produce ATP / release or provide energy (for active transport);
 3. Carrier proteins for active transport;
 4. Channel / carrier proteins for facilitated diffusion;
 5. Co-transport of sodium (ions) and glucose or symport / carrier protein for sodium (ions) and glucose;
 6. Membrane-bound enzymes digest disaccharides / produce glucose;
 1. Reject villi on epithelial cells
 1. Accept brush border
 2. Accept large SA:vol ratio
 3. Need idea of "lots"
 4. Reject: energy produced
 5. Accept Na⁺K⁺ pump
 6. Neutral: Channel proteins
 7. Accept named example

6

[10] (a) (i) Diffusion;

13

Ignore references to structures, membrane components etc
Allow simple diffusion
Reject facilitated diffusion

1

- (ii)
1. (Thin / flat body) so short distance for diffusion / short diffusion pathway;
Ignore references to membrane, wall, body surface
 2. (Thin / flat body so) large surface area to volume ratio;
'It' refers to flatworm's body

2

- (b) (i) A group of tissues;
Ignore references to function Group = more than one

1

- (ii) 1. (Carbon dioxide enters) via stomata;
Reject stroma
2. (Stomata opened by) guard cells;
3. Diffuses through air spaces;
Allow concentration gradient. Reject along gradient unless direction made clear
4. Down diffusion gradient;

3 max

[7] (a) Cell wall;

14

Starch (store);

Chloroplast;

Accept: phonetic spelling

2 max

- (b) Insoluble;

Reduces / 'stops' water entry / osmosis / does not affect water potential / is osmotically inactive;

Accept: description for first point e.g. 'does not dissolve'.

2

- (c) Light sensitive eyespot / eyespot detects light;

Flagellum enables movement towards light;

Chloroplast / chlorophyll absorbs light / for photosynthesis;

Do not penalise references to 'many chloroplasts'.

3

[7

- 1 (a) 1. (Simple / facilitated) diffusion from high to low concentration / down concentration

15

gradient;

Q Do not allow across / along / with concentration gradient

2. Small / non-polar / lipid-soluble molecules pass via phospholipids / bilayer;

Reject: named molecule passing through membrane by an incorrect route

Accept: diagrams if annotated

OR

Large / polar / water-soluble molecules go through proteins;

3. Water moves by osmosis / from high water potential to low water potential / from less to more negative water potential;
4. Active transport is movement from low to high concentration / against concentration gradient;
*Only penalise once if active transport is not named
e.g. 'movement against the concentration gradient involves proteins and requires ATP' = 2 marks*
5. Active transport / facilitated diffusion involves proteins / carriers;
*Accept: facilitated diffusion involves channels
Reject: active transport involves channels*
6. Active transport requires energy / ATP;
7. Ref. to Na⁺ / glucose co-transport;
Credit ref. to endo / exocytosis as an alternative

5 max

- (b)
1. Many alveoli / alveoli walls folded provide a large surface area;
Neutral: alveoli provide a large surface area
 2. Many capillaries provide a large surface area;
 3. (So) fast diffusion;
*Neutral: greater / better diffusion
Neutral: fast gas exchange
Allow 'fast diffusion' only once*
 4. Alveoli or capillary walls / epithelium / lining are thin / short distance between alveoli and blood;
*Reject: thin membranes / cell walls
Accept: one cell thick for 'thin'*
 5. Flattened / squamous epithelium; *Accept: endothelial*
 6. (So) short diffusion distance / pathway;
 7. (So) fast diffusion;
 8. Ventilation / circulation;
Accept: descriptions for ventilation / circulation
 9. Maintains a diffusion / concentration gradient;
 10. (So) fast diffusion;
*Do not double penalise if description lacks detail
e.g. thin membranes so a short diffusion distance = 1 mark*

5 max

16

- (a) Measure with eyepiece graticule / scale;

Calibrate with stage micrometer / scale on slide / object of known size;
Repeats and calculate the mean;

OR

Use a ruler to estimate the field diameter under microscope;
How many droplets go across the field;
Repeats and calculate mean;

Accept references to radius

3

- (b) (i) Two mark for correct answer of 4 : 1;;
One mark for incorrect answer but working shows that candidate has clearly attempted to compare values of $r^2 / 6^2$ and $3^2 / 36$ and 9;

Idea of comparing ratios

A ratio of 1 : 4 should gain 1 mark

2

- (ii) Small droplets have a larger surface area to volume ratio;
More surface for lipase (to act), leading to faster digestion of triglycerides;
Fatty acids are produced more quickly so pH will drop more quickly in curve Y / with bile salts / less fatty acids in curve Z / without bile salts so pH drop more slowly;

3

[8]

17

- (a) Loading / uptake / association of oxygen at high $p.O_2$;

In lungs (haemoglobin) is (almost) fully saturated / in lungs haemoglobin has a high affinity for oxygen;

Unloads / releases / dissociates oxygen at low $p.O_2$;

Unloading linked to higher carbon dioxide concentration;

Allow converse for second marking point in tissues i.e. haemoglobin has low affinity / releases most of its oxygen.

Mark for haemoglobin having high affinity for oxygen must be 'in lungs'.

3 max

- (b) (i) Larger the mammal the more to the left / steeper / 'higher' is the curve / the higher the affinity for oxygen; *Allow converse.*

Ignore references to Bohr shift

1

- (ii) Smaller mammal has greater surface area to volume ratio;

Smaller mammal / larger SA:Vol ratio more heat lost (per unit body mass);

Allow converse explanation for larger mammals or lower surface area to volume ratio.

Smaller mammal / larger SA:Vol ratio has greater rate of respiration / metabolism;

Allow suitable named mammal as alternative to smaller or larger mammal.

Oxygen required for respiration so (haemoglobin) releases more oxygen / oxygen released more readily / haemoglobin has lower affinity;

4

[8] (a) (i) Through alveolar epithelium;

18

Through capillary epithelium / endothelium;

Accept: Through lining / wall of alveolus and capillary for 1 mark

Accept: squamous epithelial cells for 'epithelium'

Neutral: alveolar endothelium

Neutral: references to diffusion

Q *Correct use of terminology;*

2

(ii) (Thicker alveolar wall) – no mark

Neutral: less diffusion

(So) Longer diffusion pathway / slower diffusion;

Neutral: references to surface area

1

(b) (i) (In alveolus)

Need the idea of air moving and oxygen concentration

Brings in air containing a high(er) oxygen concentration;

Neutral: reference to carbon dioxide concentration

Removes air with a low(er) oxygen concentration;

2

(ii) Circulation of blood / moving blood;

Neutral: blood Neutral: short diffusion pathway

1

(c) Long time between decrease in mining and increase in cases;

Graph shows fluctuations;

Correlation does not prove causation / there may be other causes of miner's lung;

Improved diagnosis methods;

Do not know number of cases / baseline before 1990;

Not all cases reported / not all individuals with miner's lung visit a doctor;

Accept: correct use of figures from graph for the first marking point:
e.g. cases do not increase until after 2000 / 2001-2004 / 10 years
later.

2 max

[8] (a) (i) Mitochondrion;

19

Neutral: cristae

1

(ii) (Site of aerobic) respiration / ATP production / energy release;

Q Reject: anaerobic respiration

Q Reject: energy produced

Active transport / transport against the concentration gradient;

Accept: energy produced in the form of ATP

2

(b) 89 – 91 gains 2 marks;

Correct answer gains 2 marks outright

Principle of:

$\frac{\text{correct measured length}}$

magnification

gains 1 mark;

89-91 (mm) / 1000 or 8.9-9.1 (cm) / 1000 gains 1 mark

2

(c) Suitable explanation given e.g.

Accept: converse arguments

Reduced surface area; (So) less absorption;

Neutral: structure **Z** incorrectly named

(Membrane-bound) enzymes less effective;

(So) proteins / polypeptides not digested;

Reduced surface area for absorption gains 2 marks

Cell membranes damaged;

(So) Fewer / less effective carrier / channel proteins;

Accept: references to diffusion and active transport for 'absorption'

Carrier / channel proteins damaged;

(So) less absorption;

Reject: active transport if linked to channel proteins

2

[7]