

Surface Area to Volume Ratio Pack

These practice questions can be used by students and teachers and is

Suitable for AQA A Level 7402 Biology Topic Question

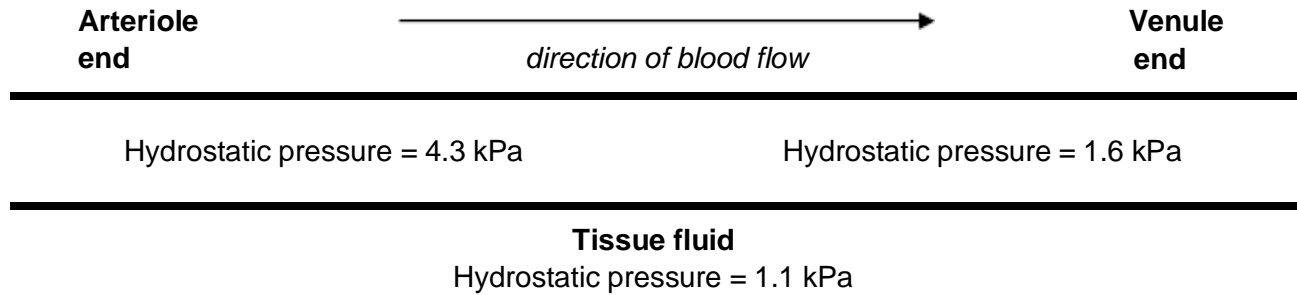
Level: AQA A LEVEL 7402

Subject: Biology

Exam Board: AQA A Level 7402

Topic: Surface Area to Volume Ratio Pack

1 The figure below represents a capillary surrounded by tissue fluid.
The values of the hydrostatic pressure are shown.



(a) Use the information in the figure above to explain how tissue fluid is formed.

(2)

(b) The hydrostatic pressure falls from the arteriole end of the capillary to the venule end of the capillary. Explain why.

(1)

(c) High blood pressure leads to an accumulation of tissue fluid. Explain how.

(Extra space) _____

(3)

- (d) The water potential of the blood plasma is more negative at the venule end of the capillary than at the arteriole end of the capillary. Explain why.

(Extra space) _____

(3)

(Total 9 marks)

2

Breathing out as hard as you can is called forced expiration.

(a) Describe and explain the mechanism that causes forced expiration.

(4)

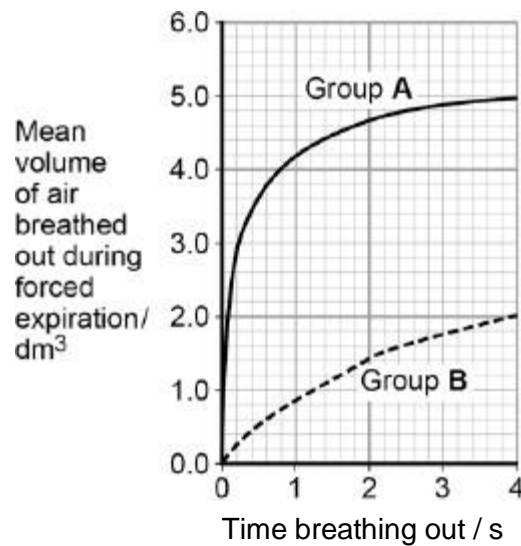
Two groups of people volunteered to take part in an experiment.

- People in group **A** were healthy.
- People in group **B** were recovering from an asthma attack.

Each person breathed in as deeply as they could. They then breathed out by forced expiration.

A scientist measured the volume of air breathed out during forced expiration by each person.

The graph below shows the results.



(b) Forced expiration volume (FEV) is the volume of air a person can breathe out in 1 second.

Using data from the first second of forced expiration, calculate the percentage decrease in the FEV for group **B** compared with group **A**.

Answer = _____%

(1)

(c) The people in group **B** were recovering from an asthma attack.
Explain how an asthma attack caused the drop in the mean FEV shown in the figure above.

(Extra space) _____

(4)

(Total 9 marks)

3

Organic compounds synthesised in the leaves of a plant can be transported to the plant's roots. This transport is called translocation and occurs in the phloem tissue of the plant.

- (a) One theory of translocation states that organic substances are pushed from a high pressure in the leaves to a lower pressure in the roots.

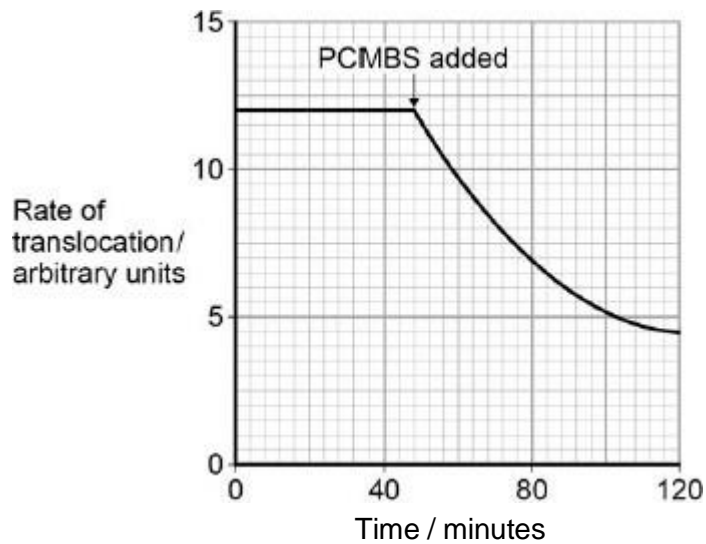
Describe how a high pressure is produced in the leaves.

(Extra space) _____

(3)

PCMBS is a substance that inhibits the uptake of sucrose by plant cells.

Scientists investigated the effect of PCMBS on the rate of translocation in sugar beet. The figure below shows their results.



- (b) During their experiment, the scientists ensured that the rate of photosynthesis of their plants remained constant.
Explain why this was important.

(2)

- (c) The scientists concluded that some translocation must occur in the spaces in the cell walls.
Explain how the information in the figure above supports this conclusion.

(2)

(Total 7 marks)

4

- (a) Describe how oxygen in the air reaches capillaries surrounding alveoli in the lungs. Details of breathing are **not** required.

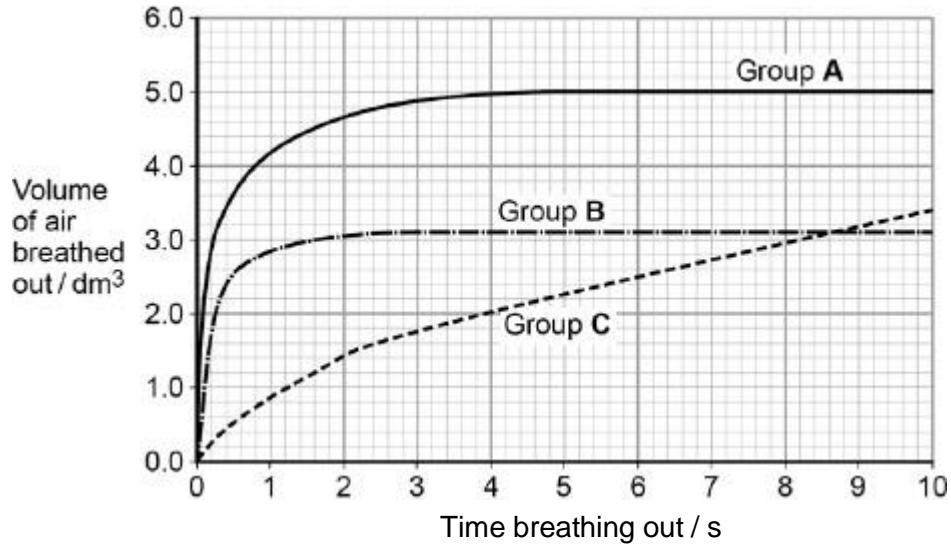
(Extra space) _____

(4)

Forced expiratory volume (FEV) is the greatest volume of air a person can breathe out in 1 second.

Forced vital capacity (FVC) is the greatest volume of air a person can breathe out in a single breath.

The figure below shows results for the volume of air breathed out by three groups of people, **A**, **B** and **C**. Group **A** had healthy lungs. Groups **B** and **C** had different lung conditions that affect breathing.



- (b) Calculate the percentage drop in FEV for group **C** compared with the healthy people.

Answer = _____

(1)

- (c) Asthma affects bronchioles and reduces flow of air in and out of the lungs.
Fibrosis does not affect bronchioles; it reduces the volume of the lungs.

Which group, **B** or **C**, was the one containing people with fibrosis of their lungs? Use the information provided and evidence from the figure above to explain your answer.

(Extra space) _____

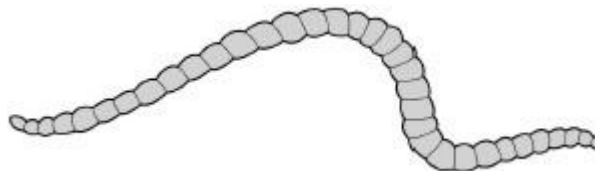
(3)

(Total 8 marks)

5

Tubifex worms are small, thin animals that live in water. They have no specialised gas exchange or circulatory system.

The figure below shows a tubifex worm.



- (a) Name the process by which oxygen reaches the cells inside the body of a tubifex worm.

(1)

- (b) Using the information provided, explain how **two** features of the body of the tubifex worm allow efficient gas exchange.

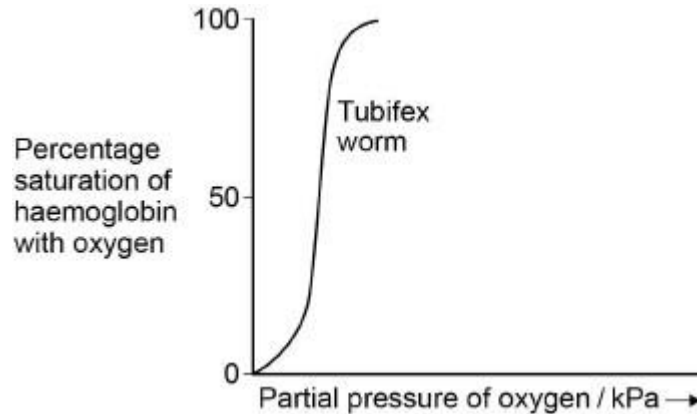
1. _____

2. _____

(2)

- (c) Most species of tubifex worms live at the bottom of ponds, lakes and rivers where the partial pressure of oxygen is low. Pollution of water by sewage can cause the partial pressure of oxygen to fall below 0.2 kPa.

The graph shows the oxyhaemoglobin dissociation curve for a species of tubifex worm found in a river polluted with sewage.



The species of tubifex worm in the graph has 50% saturation of their haemoglobin with oxygen at 0.08 kPa.

Explain how this enables this species to survive in water polluted with sewage.

(2)

- (d) Species of tubifex worm that live in ponds, lakes and rivers **cannot** survive in seawater.

Use your knowledge of water potential to explain why they cannot survive in seawater.

(2)

(Total 7 marks)

6

(a) The oxygen dissociation curve for haemoglobin shifts to the right during vigorous exercise. Explain the advantage of this shift.

(3)

(b) Weddell seals are diving mammals that live in cold environments. A Weddell seal is shown in **Figure 1**.

Figure 1

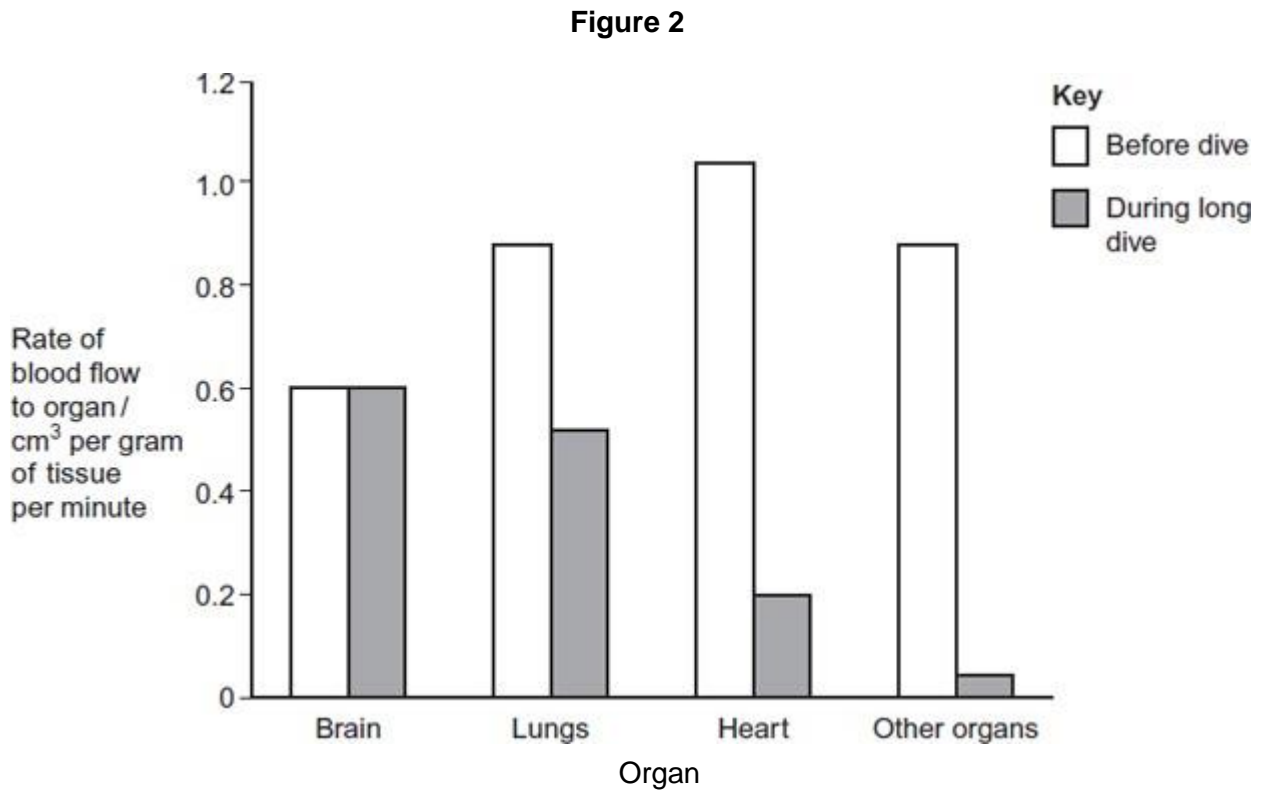


By Jerzysrzelecki (own work)
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(i) Explain how the body shape of a Weddell seal is an adaptation to living in a cold environment.

(2)

- (ii) Weddell seals can remain underwater for long periods of time. **Figure 2** shows the rate of blood flow to different organs of a Weddell seal before a dive and during a long dive.



Describe and explain the changes in the rate of blood flow to the different organs during a long dive.

(Extra space) _____

(3)
(Total 8 marks)

7

- (a) Describe and explain how the countercurrent system leads to efficient gas exchange across the gills of a fish.

(Extra space) _____

(3)

- (b) Amoebic gill disease (AGD) is caused by a parasite that lives on the gills of some species of fish. The disease causes the lamellae to become thicker and to fuse together.

AGD reduces the efficiency of gas exchange in fish. Give **two** reasons why.

1. _____

2. _____

(2)

(c) The table below shows some features of gas exchange of a fish at rest.

Volume of oxygen absorbed by the gills from each dm^3 of water / cm^3	7
Mass of fish / kg	0.4
Oxygen required by fish / $\text{cm}^3 \text{ kg}^{-1} \text{ hour}^{-1}$	90

(i) Calculate the volume of water that would have to pass over the gills each hour to supply the oxygen required by the fish. Show your working.

_____ dm^3

(2)

(ii) The volume of water passing over the gills increases if the temperature of the water increases. Suggest why.

(1)

(Total 8 marks)

8

(a) (i) Name the process by which oxygen passes from an alveolus in the lungs into the blood.

(1)

(ii) Describe **two** adaptations of the structure of alveoli for efficient gas exchange.

1. _____

2. _____

(2)

(b)



© iStock/Thinkstock

The photograph shows a fire-breather creating a ball of fire. Fire-breathers do this by blowing a fine mist of paraffin oil onto a flame. Some of this mist can be inhaled and may eventually lead to fibrosis.

People who have been fire-breathers for many years often find they cannot breathe out properly. Explain why.

(2)

(Total 5 marks)

9

Doctors investigated the effect of the smoking habits of men on their non-smoking wives.

The doctors recruited 540 non-smoking women aged 40 or older. They divided these women into groups according to the smoking habits of their husbands.

After 14 years, the doctors recorded how many of the wives had died and their cause of death.

They used these data to determine the relative risk of a wife dying from a particular disease according to her husband's smoking habit.

In this comparison, they gave the relative risk to the wife of a non-smoker as 1.00. A value greater than 1.00 shows an increased risk compared to the wife of a non-smoker.

The results are shown in the table below.

Cause of death	Relative risk of wife dying		
	Husband non-smoker	Husband smokes 1 to 19 cigarettes /day	Husband smokes more than 19 cigarettes / day
Lung cancer	1.00	1.61	2.08
Emphysema	1.00	1.29	1.49
Cervical cancer	1.00	1.15	1.14
Stomach cancer	1.00	1.02	0.99
Heart disease	1.00	0.97	1.03

A journalist concluded from these data that if a husband smoked, it greatly increased the risk of his wife dying of certain diseases. Evaluate this statement.

(Extra space) _____

(Total 4 marks)

10

(a) There are ethical and economic arguments for maintaining biodiversity.

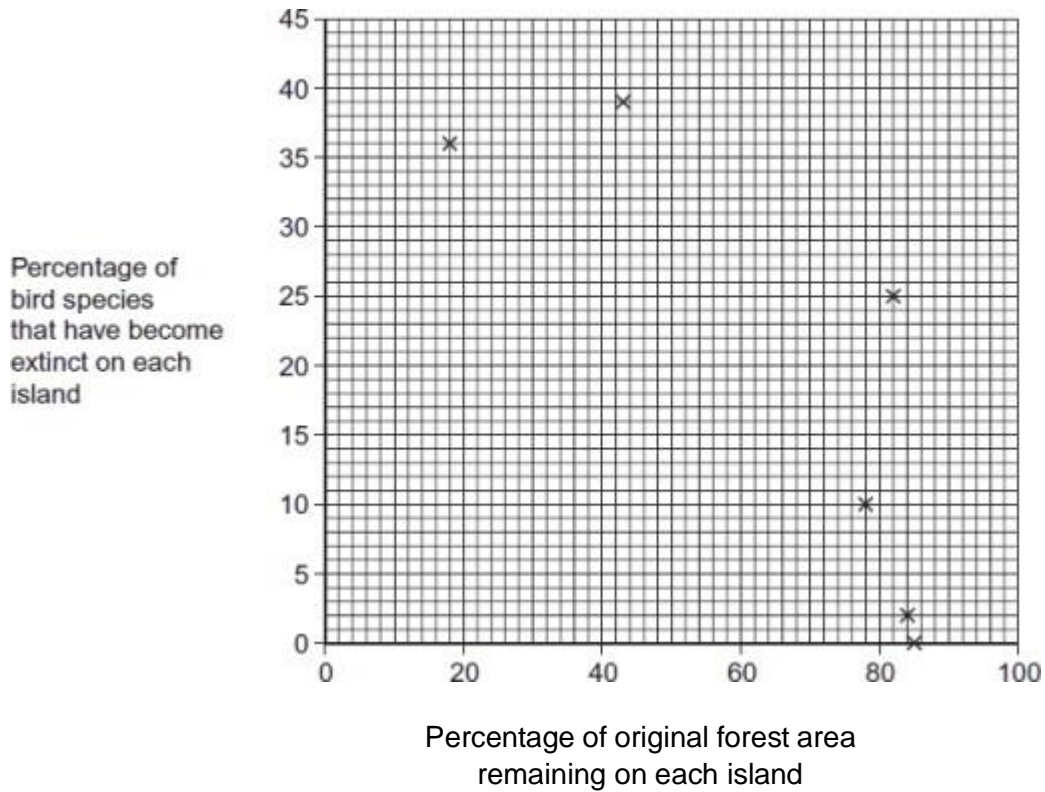
(i) Suggest **one** ethical argument for maintaining biodiversity.

(1)

(ii) Suggest **one** economic argument for maintaining biodiversity.

(1)

Ecologists calculated the percentage of bird species that have become extinct on six islands in the last one hundred years. They also calculated the percentage of original forest area remaining on each island after the same time period. The graph shows their results.



(b) Explain the relationship between the percentage of original forest area remaining and the percentage of bird species that have become extinct.

(2)

(c) What **two** measurements would the ecologists have needed to obtain to calculate the index of diversity of birds on each island?

1. _____

2. _____

(2)

- (d) The ecologists noted that the species of birds surviving on the coldest islands had a larger body size than those surviving on warmer islands.

Explain how a larger body size is an adaptation to a colder climate

(2)

(Total 8 marks)

11

Read the following passage.

Gluten is a protein found in wheat. When gluten is digested in the small intestine, the products include peptides. Peptides are short chains of amino acids. These peptides cannot be absorbed by facilitated diffusion and leave the gut in faeces

Some people have coeliac disease. The epithelial cells of people with coeliac disease do not absorb the products of digestion very well. In these people, some of the peptides from gluten can pass between the epithelial cells lining the small intestine and enter the intestine wall. Here, the peptides cause an immune response that leads to the destruction of microvilli on the epithelial cells. 5

Scientists have identified a drug which might help people with coeliac disease. It reduces the movement of peptides between epithelial cells. They have carried out trials of the drug with patients with coeliac disease. 10

Use the information in the passage and your own knowledge to answer the following questions.

- (a) Name the type of chemical reaction which produces amino acids from proteins.

(1)

- (b) The peptides released when gluten is digested cannot be absorbed by facilitated diffusion (lines 2 – 3). Suggest why.

(Extra space) _____

(3)

(Extra space) _____

(3)

- (c) Explain why the peptides cause an immune response (lines 7 – 8).

(1)

- (d) Scientists have carried out trials of a drug to treat coeliac disease (lines 10 – 11). Suggest **two** factors that should be considered before the drug can be used on patients with the disease.

1. _____

2. _____

(2)

(Total 7 marks)

12 Different cells in the body have different functions.

- (a) Some white blood cells are phagocytic. Describe how these phagocytic white blood cells destroy bacteria.

*(Extra space)*_____

(4)

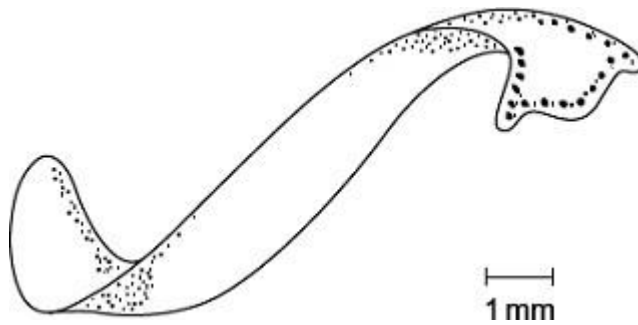
- (b) The epithelial cells that line the small intestine are adapted for the absorption of glucose. Explain how.

(Extra space) _____

(6)
(Total 10 marks)

13

- (a) Flatworms are small animals that live in water. They have no specialised gas exchange or circulatory systems.
The drawing shows one type of flatworm.



- (i) Name the process by which oxygen reaches the cells inside the body of this flatworm.

(1)

- (ii) The body of a flatworm is adapted for efficient gas exchange between the water and the cells inside the body.

Using the diagram, explain how **two** features of the flatworm's body allow efficient gas exchange.

1. _____

2. _____

(2)

- (b) (i) A leaf is an organ. What is an organ?

(1)

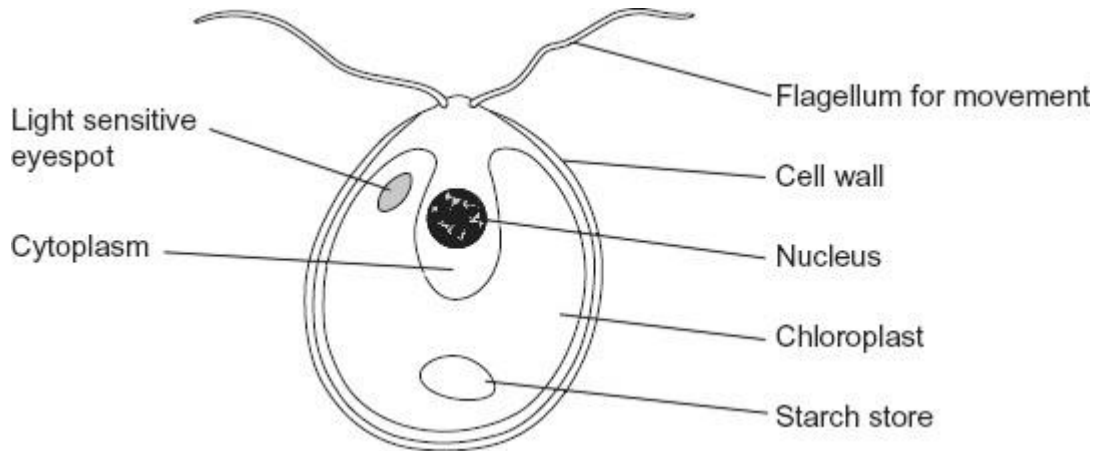
(ii) Describe how carbon dioxide in the air outside a leaf reaches mesophyll cells inside the leaf.

(Extra space)

(3)
(Total 7 marks)

14

The diagram shows an organism called *Chlamydomonas*.



(a) Name **two** structures shown in the diagram that are present in plant cells but are **not** present in animal cells.

1. _____

2. _____

(2)

- (b) *Chlamydomonas* lives in fresh water ponds. Use your knowledge of osmosis to suggest an advantage of using starch as a carbohydrate store.

(2)

- (c) *Chlamydomonas* has adaptations that help it to maintain a high rate of photosynthesis. Use information in the diagram to explain what these adaptations are.

(Extra space) _____

(3)

(Total 7 marks)

15

(a) Many different substances enter and leave a cell by crossing its cell surface membrane. Describe how substances can cross a cell surface membrane.

(5)

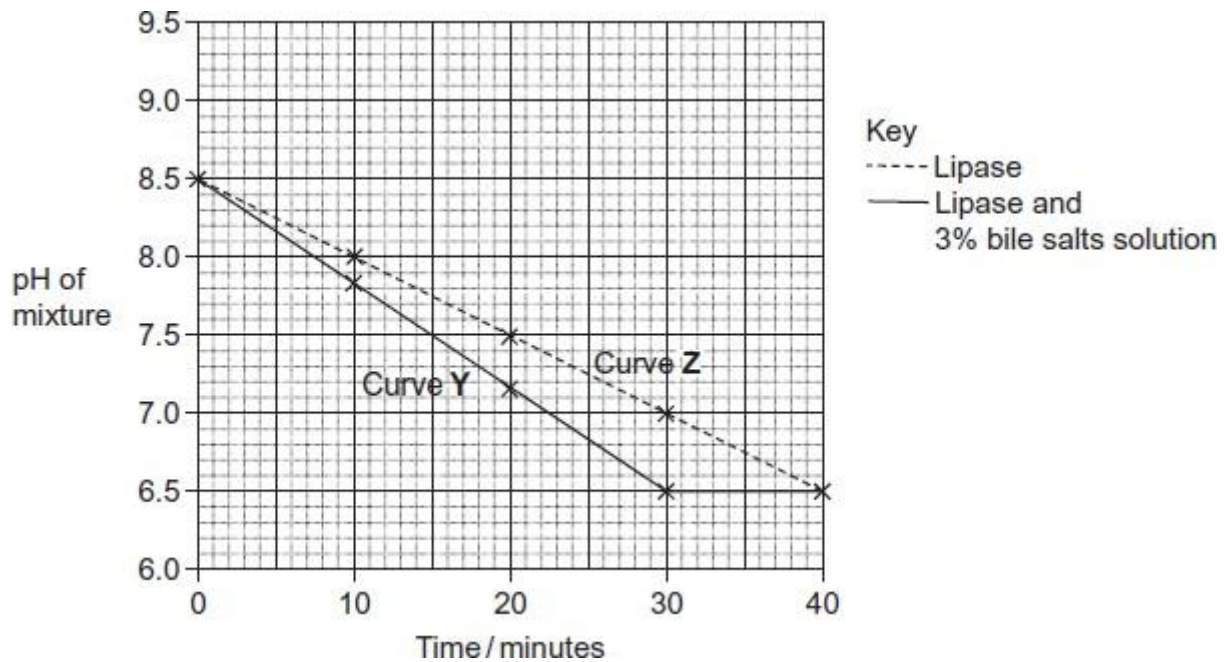
(b) Describe and explain how the lungs are adapted to allow rapid exchange of oxygen between air in the alveoli and blood in the capillaries around them.

(5)

(Total 10 marks)

16

Scientists investigated the effect of lipase and a 3% bile salts solution on the digestion of triglycerides. The graph below shows their results.



The scientists also incubated triglycerides with different concentrations of bile salts. After 30 minutes they measured the diameter of the triglyceride droplets. They used the results to calculate the mean radius of the droplets at each concentration. The table below shows their results.

Concentration of bile salts /%	0	1	2	3	4	5
Mean radius of triglyceride droplet / μm	6	5	4	3	2	1

- (a) Describe how you would use a microscope to find the mean diameter of triglyceride droplets on a slide.

(Extra space) _____

- (b) (i) The ratio of mean radius of triglyceride droplets in bile salts at a concentration of 0% to the mean radius in bile salts at a concentration of 3% is 2 : 1.

What is the ratio of their surface areas? Show your working.

You can calculate the surface area of a droplet from the formula

$$A = 4\pi r^2$$

Where A = surface area

r = radius

$\pi = 3.14$

(2)

- (ii) Use the data in the table to explain the difference between curves **Y** and **Z** in the graph.

(Extra space) _____

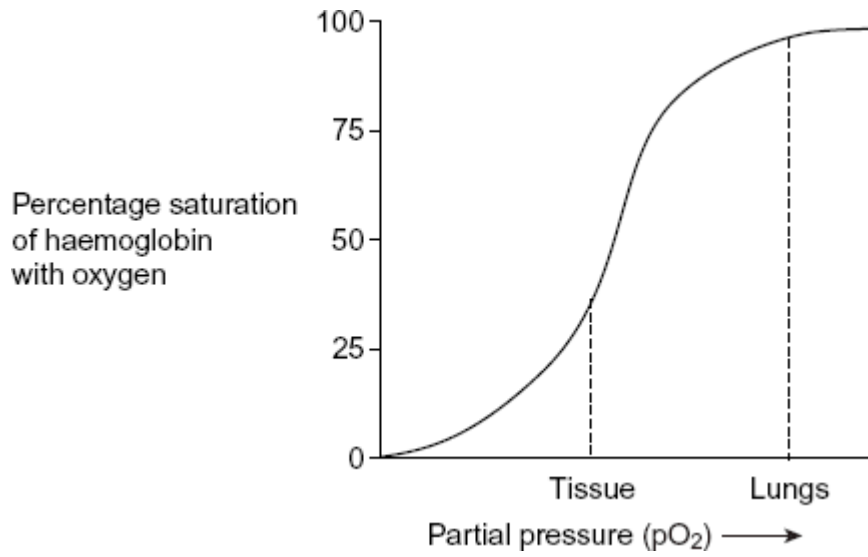
(3)

(Total 8 marks)

17

(a) **Figure 1** shows the oxygen dissociation curve for human haemoglobin.

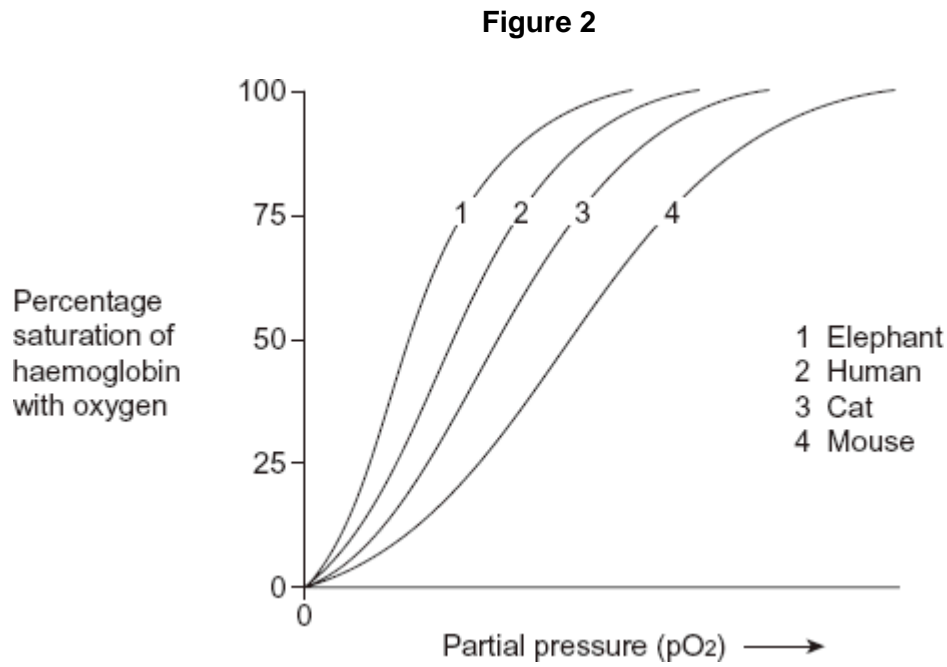
Figure 1



Use **Figure 1** to describe how haemoglobin loads and unloads oxygen in the body.

(3)

(b) **Figure 2** shows oxygen dissociation curves from mammals of different size.



(i) Describe the relationship between the size of mammals and the oxygen dissociation curves of their haemoglobins.

(1)

(ii) Heat from respiration helps mammals to maintain a constant body temperature.

Use this information to explain the relationship between the surface area to volume ratio of mammals and the oxygen dissociation curves of their haemoglobins.

(4)

(Total 8 marks)

18

Miner's lung is a disease caused by breathing in dust in coal mines. The dust causes the alveolar epithelium to become thicker. People with miner's lung have a lower concentration of oxygen in their blood than healthy people.

(a) (i) Describe the path by which oxygen goes from an alveolus to the blood.

(2)

(ii) Explain why people with miner's lung have a lower concentration of oxygen in their blood.

(1)

(b) In healthy lungs, a gradient is maintained between the concentration of oxygen in the alveoli and the concentration of oxygen in the lung capillaries.

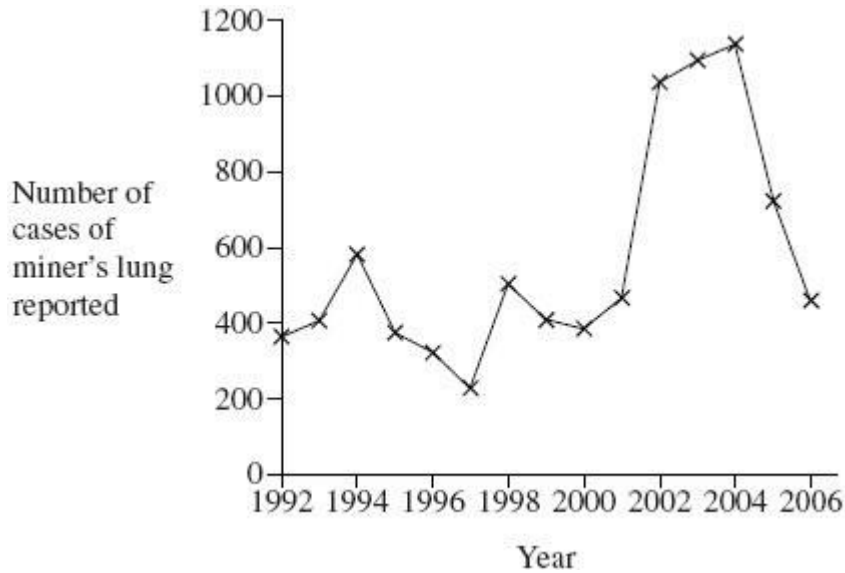
(i) Describe how ventilation helps to maintain this difference in oxygen concentration.

(2)

(ii) Give **one** other way that helps to maintain the difference in oxygen concentration.

(1)

- (c) Scientists investigated the number of cases of miner's lung reported in Britain between 1992 and 2006.



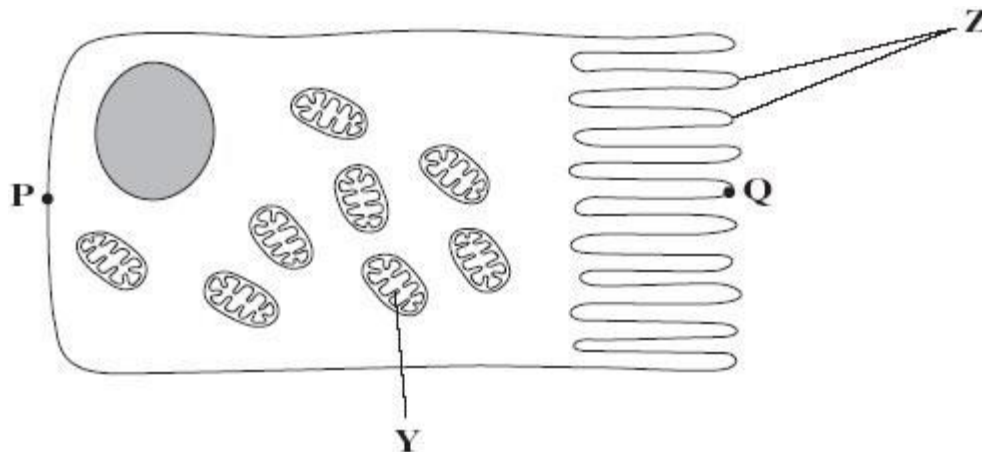
Coal mining in Britain had been dramatically reduced by 1990.

Some scientists concluded that the rise in reported cases of miner's lung after 1992 shows that the disease takes a long time to develop.

Evaluate this conclusion.

(2)
(Total 8 marks)

19 The diagram shows an epithelial cell from the small intestine.



(a) (i) Name organelle Y.

(1)

(ii) There are large numbers of organelle Y in this cell. Explain how these organelles help the cell to absorb the products of digestion.

(2)

(b) This diagram shows the cell magnified 1000 times. Calculate the actual length of the cell between points P and Q. Give your answer in μm . Show your working.

Answer _____ μm

(2)

- (c) Coeliac disease is a disease of the human digestive system. In coeliac disease, the structures labelled **Z** are damaged.

Although people with coeliac disease can digest proteins they have low concentrations of amino acids in their blood.

Explain why they have low concentrations of amino acids in their blood.

(2)
(Total 7 marks)

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]**
- 2**
- (a) 1. Contraction of internal intercostal muscles;
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]**
- 3**
- (a) 1. Water potential becomes lower / becomes more negative (as sugar enters phloem);
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]**
- 5**
- (a) (Simple) diffusion;
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 Reject: 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]

8

- (a) (i) (Simple) diffusion;
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]

9

FOR

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]

10

- (a) (i) (We should maintain biodiversity to)
- 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]

11

- (a) Hydrolysis (reaction);
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 / channel protein);
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]

12

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

13

- (a) (i) Diffusion;
- Ignore references to structures, membrane components etc*
Allow simple diffusion
Reject facilitated diffusion
- (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
- (b) (i) A group of tissues;
- Ignore references to function Group = more than one*

1

2

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]

14

- (a) Cell wall;

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.

15

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

osis / from high water potential to low water potential /from less to more negative water potential;

3

[7]

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

[10]

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]

18

- (a) (i) Through alveolar epithelium;

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]

19

- (a) (i) Mitochondrion;
Neutral: cristae
- (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
- (b) 89 – 91 gains 2 marks;
Correct answer gains 2 marks outright

1

2

Principle of:

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