Gas Exchange, Membranes and Transport (Topic 2): Edexcel SNAB A Level Biology Exam Questions by Topic

20 questions · 57 marks · about 68 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · AS Paper 1 · June 2017 · Q2(a)(ii) · 2 marks

(ii) Describe why single-celled organisms, such as *Valonia ventricosa*, do not need a specialised gas exchange surface.

(2)

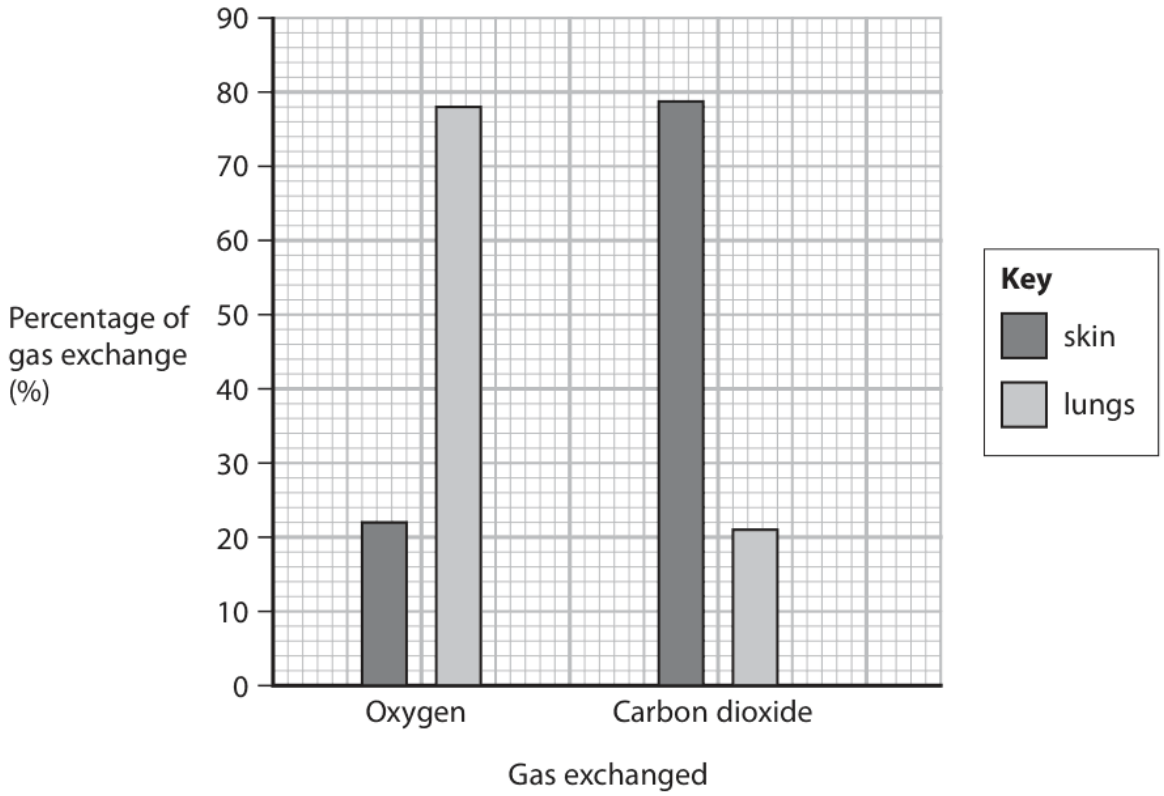
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6 The photograph shows a type of frog (*Nymphargus bejaranoi*) from South America. The bones and organs of this frog are visible through the skin on the underside of the body. The adult frogs of this species are approximately 25 mm in length.



(Source: © Rick & Nora Bowers / Alamy Stock Photo)

This frog can exchange gases across the surfaces of both the skin and the lungs. A scientist investigated the percentage of the gases exchanged at each surface. The graph shows the results of this investigation.



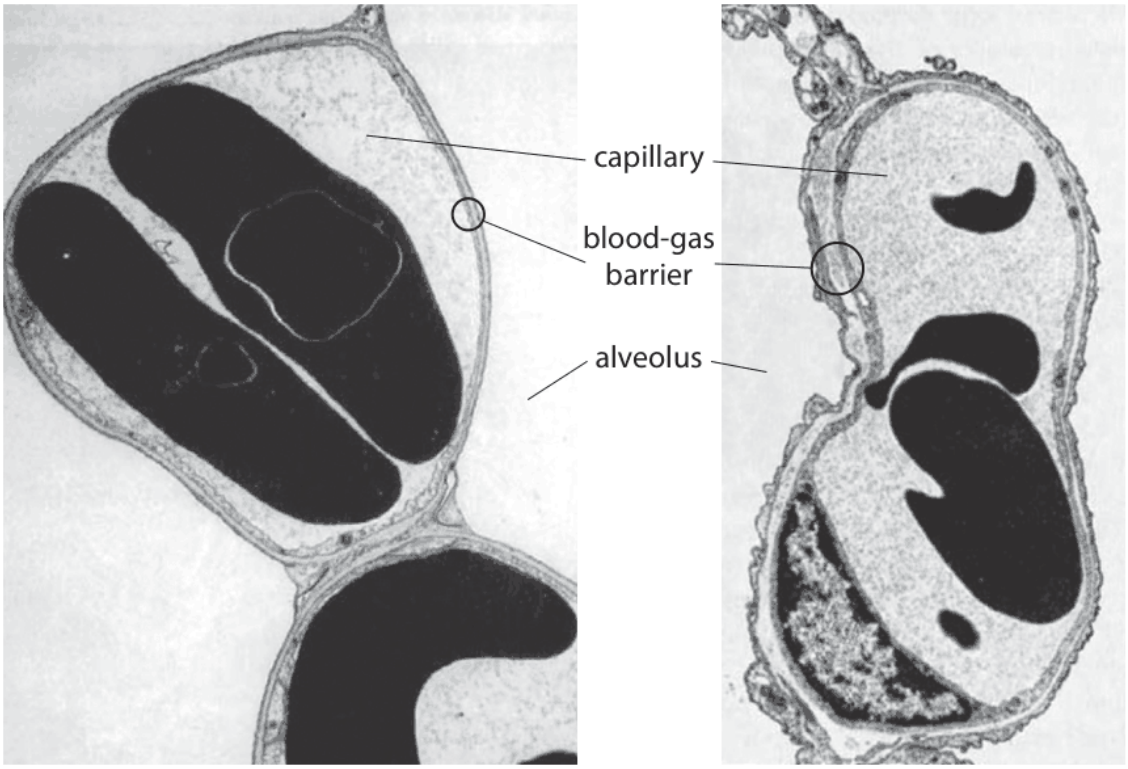
(a) Deduce why the skin and the lungs of this frog are involved in the exchange of oxygen.

(2)

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Question 3 · A level Paper 1 · June 2017 · Q7(b) · 3 marks

(b) The electron micrographs show the blood-gas barriers for a chicken and a dog.



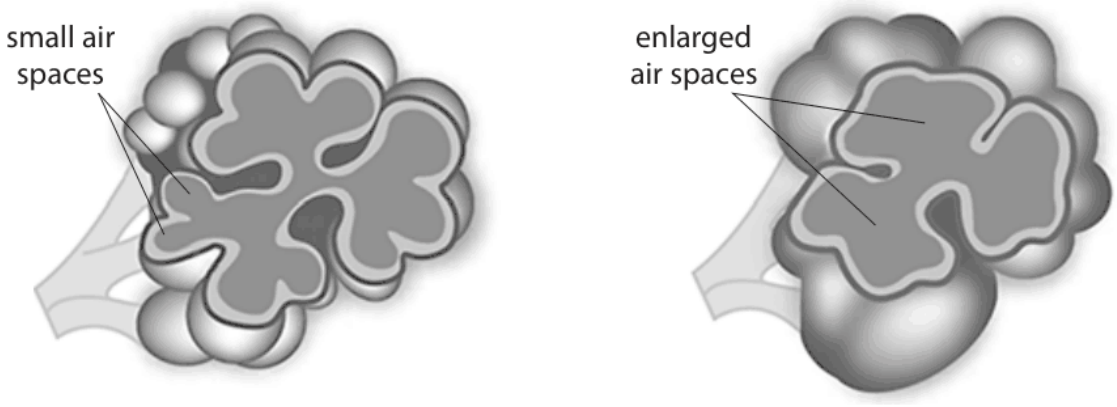
Explain how the blood-gas barrier of the chicken is adapted to give more efficient gas exchange than the blood-gas barrier of the dog.

(3)

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Question 4 · AS Paper 1 · June 2017 · Q2(d) · 2 marks

(d) Emphysema is a disease of the respiratory system that affects the structure of the lungs.



Lung without emphysema

Lung with emphysema

Explain why people with emphysema are given air with a higher concentration of oxygen than atmospheric air.

(2)

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Question 5 · A level Paper 1 · November 2021 · Q6(b) · 3 marks

(b) The red blood cells of individuals with spherocytosis are spherical instead of having a biconcave disc shape.

Explain the effect of spherocytosis on the uptake of oxygen by red blood cells.

(3)

Question 6 · information from earlier in the question

9 Emphysema is a condition that causes changes to the tissues in the lungs.

In an investigation, the surface area for gas exchange and the volume of the lungs of three groups of individuals were determined. The results are shown in the table.

Measurement	Individuals without emphysema	Individuals with mild emphysema	Individuals with severe emphysema
Mean surface area for gas exchange / m^2	118 ± 11	97 ± 8	30 ± 5
Mean total lung volume / cm^3	4772 ± 223	6232 ± 410	6725 ± 384
Mean surface area for gas exchange : volume ratio	247.3 : 1		44.6 : 1

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Question 6 · A level Paper 2 · June 2017 · Q9(c) · 3 marks

(c) Explain why individuals with severe emphysema will tire more easily than healthy individuals.

(3)

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Question 7 · AS Paper 1 · June 2017 · Q2(b) · 4 marks

(b) Mammalian lungs are adapted for rapid gas exchange.

Explain how the structure of the human lungs enables rapid gas exchange.

(4)

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Question 8 · A level Paper 1 · June 2025 · Q5(a) · 3 marks

5 All cells are surrounded by a cell surface membrane.

This membrane controls the movement of substances in and out of the cell.

(a) Describe the fluid mosaic structure of a cell surface membrane.

(3)

Question 9 · A level Paper 2 · June 2019 · Q1(b) · 3 marks

(b) Explain why the phospholipids are arranged in two layers in a cell surface membrane.

(3)

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Question 10 · AS Paper 1 · June 2019 · Q6(b)(ii) · 3 marks

(ii) A cell surface membrane is partially permeable.

The phospholipid bilayer is important in controlling the movement of molecules through the membrane.

Explain how the structure of a phospholipid molecule contributes to the partial permeability of a cell surface membrane.

(3)

Question 11 · A level Paper 1 · June 2024 · Q4(b)(i) · 2 marks

(b) (i) The CFTR protein is produced in cells of the lung and is involved in the transport of chloride ions.

Describe the location of the CFTR protein in the cell membrane of one of these cells.

(2)

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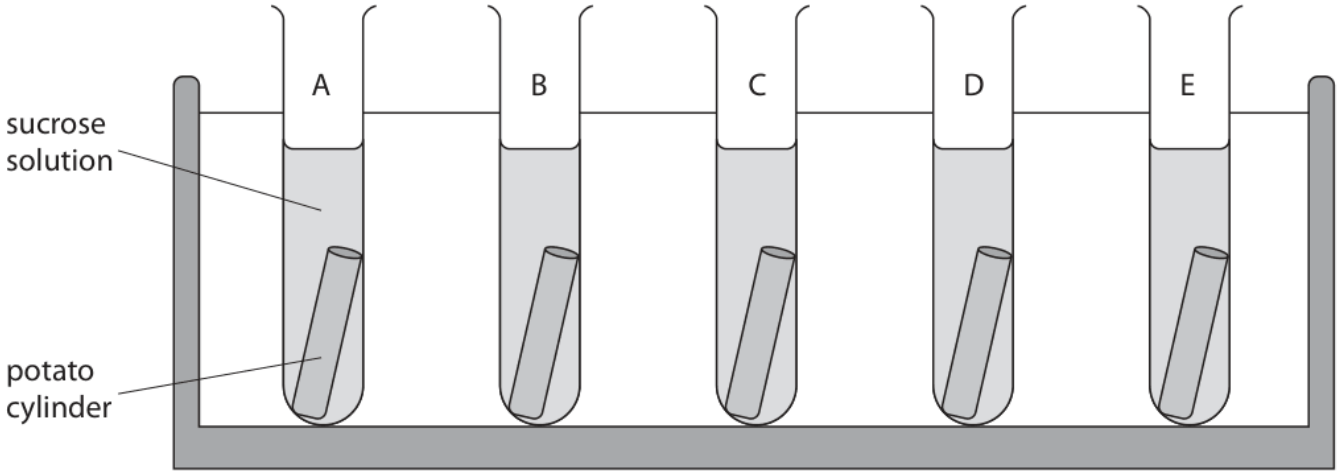
8 The effect of the concentration of sucrose solution on the mass of potato cylinders was investigated.

The cylinders were cut from the same potato and had the same volume. The initial mass of each cylinder was recorded.

The cylinders were left in the same volume of each solution for the same length of time. The final mass of each cylinder was recorded.

The diagram shows the five test tubes, A, B, C, D and E, that were set up in this investigation.

The investigation was then repeated twice.



(a) The table shows the results of this investigation.

Test tube	Concentration of sucrose solution / mol dm^{-3}	Mean initial mass of potato cylinder / g	Mean final mass of potato cylinder / g
A	0.0	2.79	3.82
B	0.4	2.75	2.67
C	0.6	2.68	2.31
D	0.8	2.71	2.21
E	1.0	2.79	2.01

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Question 12 · AS Paper 1 · June 2023 · Q8(a)(ii) · 2 marks

(ii) Explain the change in mass for potato cylinders in test tube E.

(2)

Question 13 · A level Paper 1 · June 2025 · Q5(b)(i) · 2 marks

(b) Water and mineral ions enter a plant through the root hair cells.

(i) Explain how water enters these cells.

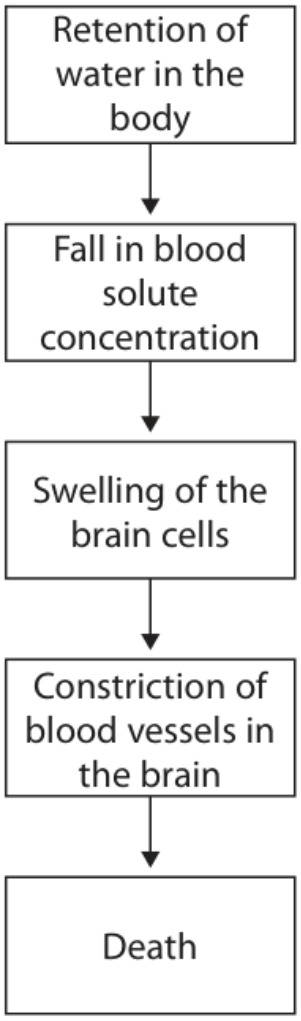
(2)

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Question 14 · information from earlier in the question

(b) MDMA is responsible for swelling of the brain resulting in death in some people.

The diagram shows how MDMA can cause brain swelling and death in some people.



Brain cells regulate their volume using active transport of sodium ions.

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Question 14 · A level Paper 3 · June 2024 · Q6(b)(ii) · 3 marks

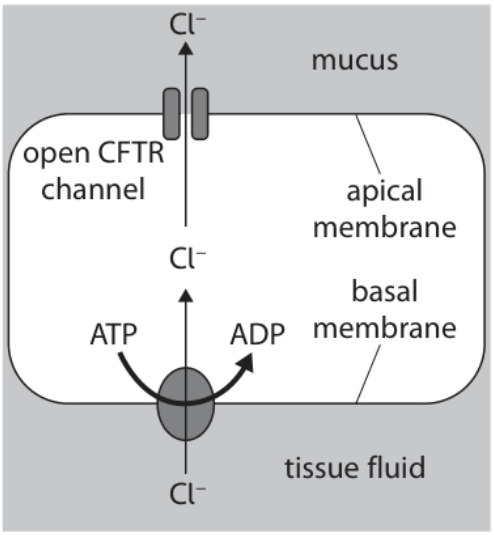
(ii) Explain how the active transport of sodium ions can regulate brain cell volume.

(3)

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Question 15 · AS Paper 1 · June 2022 · Q5(b)(i) · 4 marks

(b) The diagram shows part of the process that occurs when there is a functioning CFTR protein channel in the membrane of an epithelial cell.



(i) Explain how chloride ions move through the two membranes labelled in the diagram.

(4)

Basal membrane

Apical membrane

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Question 16 · AS Paper 1 · June 2022 · Q5(b)(ii) · 3 marks

(ii) The movement of the chloride ions into the mucus would cause the movement of water molecules.

Explain the direction of movement of the water molecules.

(3)

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Question 17 · AS Paper 1 · June 2018 · Q1(b) · 3 marks

(b) Diffusion and active transport are mechanisms by which molecules can enter cells.

Compare and contrast these two mechanisms.

(3)

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Question 18 · AS Paper 1 · November 2021 · Q5(c) · 2 marks

(c) Antigens on the cell membranes of microbes can stimulate endocytosis and exocytosis in white blood cells.

These processes are involved in transport through a cell surface membrane.

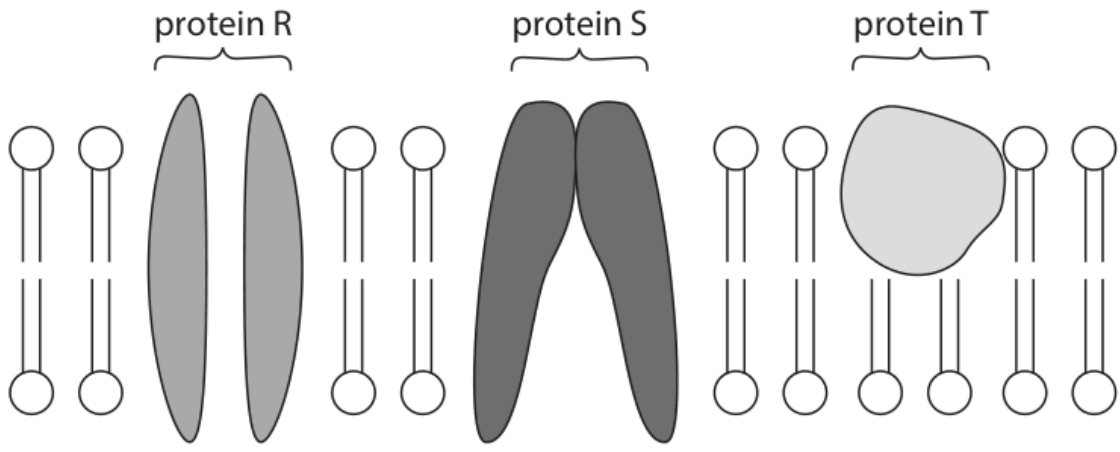
Give two differences between endocytosis and exocytosis.

(2)

Question 19 · information from earlier in the question

3 All cells have a cell surface membrane that allows some ions to move across.

The diagram shows the fluid mosaic model for the cell surface membrane.



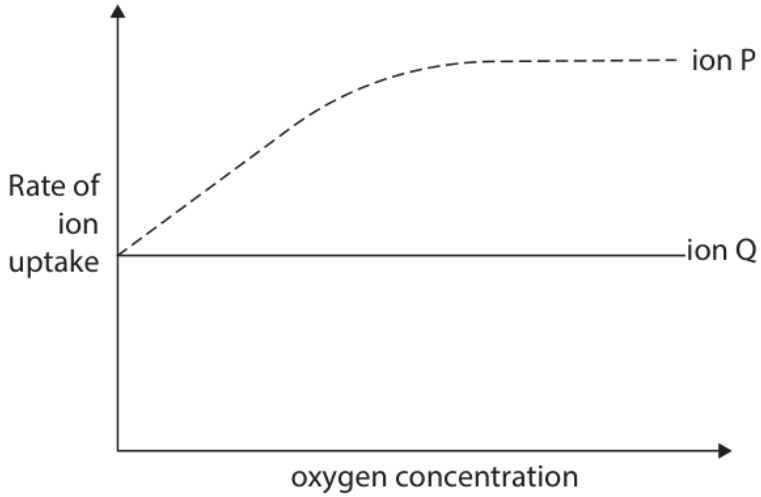
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Question 19 · A level Paper 2 · June 2025 · Q3(b) · 4 marks

(b) An animal cell, containing proteins R, S and T in its cell surface membrane, was placed in a solution containing two ions, P and Q.

The rate of uptake of both ions was measured as the cell was supplied with an increasing concentration of oxygen.

The results are shown in the graph.



Only one of the proteins labelled R, S and T on the diagram on page 8 allows the uptake of ion P.

This protein changes shape to move ion P.

Explain which protein allows the uptake of ion P.

(4)

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Question 20 · AS Paper 1 · June 2016 · Q3(a)(ii) · 4 marks

(ii) Describe the function of carrier proteins in a cell surface membrane.

(4)

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Mark schemes

Question 1 · AS Paper 1 · June 2017 · Q2(a)(ii) · 2 marks

Question Number	Answer	Additional Guidance	Mark
2 (a) (ii)	A description that makes reference to two of the following: • they can rely on diffusion to {take in oxygen / remove wastes} (1) • large surface area to volume ratio (allows diffusion to occur at a sufficient rate) (1) • short diffusion distance (1)		(2)

Question 2 · AS Paper 1 · June 2022 · Q6(a) · 2 marks

Question Number	Answer
6(a)	An explanation that makes reference to two of the following: • gas exchange by {skin/lungs} alone is insufficient / both surfaces are required for sufficient diffusion of oxygen (1) • (because) surface area : volume is too small (1) • metabolic reactions would not be able to occur at required rate with one surface (1)

Additional Guidance	Mark
ALLOW more diffusion of oxygen occurs in lungs than skin ALLOW {skin / lung} surface area is too small ALLOW skin diffusion distance may be too large	(2)

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Question 3 · A level Paper 1 · June 2017 · Q7(b) · 3 marks

Question Number	Answer
7(b)	An explanation that makes reference to three of the following: • thinner blood-gas barrier (1) • because of thinner { alveolar walls / capillary walls / extracellular matrix layer } (1) • therefore a reduced diffusion distance (1) • a faster rate of { diffusion / gas exchange } (1)

Additional Guidance	Mark
ALLOW greater rate	3

Question 4 · AS Paper 1 · June 2017 · Q2(d) · 2 marks

Question Number	Answer
2(d)	An explanation that makes reference to two of the following: • smaller surface area of alveoli (with emphysema) (1) • therefore need a larger concentration gradient (1) • to maintain the rate of diffusion (1)

Additional Guidance	Mark
ALLOW smaller SA:vol Allow smaller surface area for gas exchange ALLOW diffusion gradient	(2)

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Question 5 · A level Paper 1 · November 2021 · Q6(b) · 3 marks

Question Number	Answer
6(b)	An explanation that makes reference to the following • oxygen enters the cells by diffusion (1) • change in shape {reduces surface area to volume ratio / increases diffusion distance} (1) • therefore gas exchange decreases / less oxygen enters the cells (1)

Additional guidance	Mark
	(3)

Question 6 · A level Paper 2 · June 2017 · Q9(c) · 3 marks

Question number	Answer
9(c)	An explanation that makes reference to three of the following points: • { smaller surface area / increased diffusion distance } for gas exchange (1) • therefore reduction in oxygen uptake (1) • therefore less oxygen for aerobic respiration (1) • leading to more anaerobic respiration (causing fatigue) (1)

Additional guidance	Mark
ALLOW smaller SA:vol	(3)

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Question 7 · AS Paper 1 · June 2017 · Q2(b) · 4 marks

Question Number	Answer
2(b)	An explanation that makes reference to the following: • many alveoli provide a large surface area (1) • {alveoli / capillaries} have walls that are one cell thick providing a short distance for diffusion (1) • high concentration gradient maintained by {circulation / ventilation} (1) • extensive capillary network around alveoli provides large surface area for gas exchange (1)

Additional Guidance	Mark
ALLOW thin walls	**(4)**

Question 8 · A level Paper 1 · June 2025 · Q5(a) · 3 marks

Question Number	Answer
5(a)	A description that makes reference to the following: • phospholipid bilayer (1) • description of location of proteins in the membrane (1) • example of one other molecule present (1)

Additional guidance	Mark
e.g. spanning the membrane / extrinsic / intrinsic / embedded / transmembrane / peripheral / integral e.g. glycolipids / glycoproteins / cholesterol	(3)

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Question 9 · A level Paper 2 · June 2019 · Q1(b) · 3 marks

Question Number	Answer
1(b)	An explanation that makes reference to the following: • hydrophilic region (of phospholipid) orientated towards water (1) • (and) hydrophobic regions away from the water (1) • (but need the two layers as) { water-based / aqueous } solution either side of the cell membrane (1)

Additional Guidance	Mark
ALLOW phosphate head / polar region ALLOW hydrocarbon chain / fatty acid tails e.g. separating tissue fluid from cytoplasm	(3)

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Question 10 · AS Paper 1 · June 2019 · Q6(b)(ii) · 3 marks

Question Number	Answer
6(b)(ii)	An explanation which makes reference to the following: • (phospholipid molecule) contains a {polar / hydrophilic} (phosphate) head and {non-polar / hydrophobic} fatty acid chains (1) • allows {fat-soluble/non-polar} molecules to pass through (the membrane) (1) • {polar / ionic} molecules cannot pass through (phospholipid bilayer) (1)

Additional Guidance	Mark
ALLOW tail for fatty acid chain ALLOW charged	(3)

Question 11 · A level Paper 1 · June 2024 · Q4(b)(i) · 2 marks

Question Number	Answer
4(b)(i)	A description that makes reference to the following • (CFTR) is in the phospholipid bilayer (1) • it extends through both layers (of the bilayer) (1)

Additional guidance	Mark
ALLOW intrinsic / integral / transmembrane IGNORE ref to basal and apical membrane	(2)

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Question 12 · AS Paper 1 · June 2023 · Q8(a)(ii) · 2 marks

Question Number	Answer
8(a)(ii)	An explanation that makes reference to the following: • potato lost mass because water was lost by osmosis / water molecules moved from higher concentration (in potato) to lower concentration (in test tube) by osmosis (1) • (E) lost the greatest {mass / water} / (potato in E) was in (a solution with) the {highest sucrose concentration / lowest concentration of (free) water molecules} (1)

Additional Guidance	Mark
ALLOW water molecules moved from {low solute concentration / dilute solution / hypotonic / high water potential} to {high solute concentration / more concentrated solution / hypertonic / low water potential} by osmosis ALLOW water molecules moved down a {concentration / water potential} gradient by osmosis ALLOW E was in a solution with the lowest water potential / greatest difference in solute concentration between potato in E and solution	**(2)**

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Question 13 · A level Paper 1 · June 2025 · Q5(b)(i) · 2 marks

Question Number	Answer
5(b)(i)	An explanation that makes reference to two of the following: • by osmosis (1) • because water molecules move from (an area of) low solute concentration to (an area of) high solute concentration (1) • through a partially permeable membrane (1)

Additional guidance	Mark
ALLOW correct reference to water concentration or from higher to lower water potential ALLOW through aquaporins or phospholipid bilayer ALLOW selectively permeable IGNORE semi-permeable membrane	(2)

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Question 14 · A level Paper 3 · June 2024 · Q6(b)(ii) · 3 marks

Question number	Answer
6(b)(ii)	An explanation that makes reference to the following: • if sodium ions are taken into the cell the solute concentration increases inside the cell (1) • water (molecules) move into the cell by osmosis (1) • (movement of water into the cell) increases the cell volume (1)

Additional guidance	Mark
ALLOW converse argument ALLOW decreasing water potential inside the cell	Choose an item. (3)

Question 15 · AS Paper 1 · June 2022 · Q5(b)(i) · 4 marks

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	An explanation that makes reference to the following: Basal cell membrane • chloride ions move by {active transport / are pumped} (into the cell) (1) • against the concentration gradient / using energy from ATP (1) Apical cell membrane • chloride ions move (out of cell) by {facilitated diffusion / diffusion} (1) • (through an open CFTR protein channel) down the {concentration / electrochemical} gradient (1)		**(4)**

8BN0_01 QPEC Version

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Question 16 · AS Paper 1 · June 2022 · Q5(b)(ii) · 3 marks

Question Number	Answer
5(b)(ii)	An explanation that makes reference to the following: • higher concentration of (chloride) ions in the mucus (than the tissue fluid) • (therefore) water would move into the mucus by osmosis (1) • from a higher concentration (of free water molecules) to a lower concentration in the mucus (1)

Additional Guidance	Mark
ALLOW solute concentration of mucus increases ALLOW reference to movement from high to low water potential ALLOW from an area of lower {chloride ion / solute} concentration to higher {chloride ion / solute} concentration	(3)

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Question 17 · AS Paper 1 · June 2018 · Q1(b) · 3 marks

Question Number	Answer
1(b)	An answer that makes reference to three of the following: <u>Similarities</u> • both move molecules through the {phospholipid bilayer / cell surface membrane} (1) • (in both) molecules can move through proteins (1) <u>Differences</u> • diffusion occurs down a concentration gradient whereas active transport occurs against a concentration gradient (1) • diffusion is {passive / does not require ATP} whereas active transport requires ATP (1)

Additional Guidance	Mark
ALLOW { partially / semi permeable } membrane ALLOW diffusion from high to low concentration and active transport from low to high concentration ALLOW energy for ATP	**(3)**

Question 18 · AS Paper 1 · November 2021 · Q5(c) · 2 marks

Question Number	Answer	Additional Guidance	Mark
5 (c)	An answer that makes reference to the following: • exocytosis involves {molecules / substances} leaving the cell whereas endocytosis involves {molecules / substances} entering the cell (1) • exocytosis involves vesicles fusing with cell surface membrane whereas endocytosis involves the formation of vesicles (from the cell surface membrane) (1)	ALLOW exocytosis involves vesicles fusing with cell surface membrane whereas endocytosis does not involve vesicles fusing with cell surface membrane	**(2)**

8BN0_01 QPEC Version

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Question 19 · A level Paper 2 · June 2025 · Q3(b) · 4 marks

Question Number	Answer
3 (b)	An explanation that makes reference to four of the following: • protein S (1) • (protein S) is a {carrier protein / pump } (1) • (as) oxygen concentration increases more {(aerobic) respiration occurs / ATP is formed } (1) • (so) active transport increases (1) • (therefore) more of ion P can be taken up (1)

Additional Guidance	Mark
ALLOW more rapid changing of shape	**(4)**

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Question 20 · AS Paper 1 · June 2016 · Q3(a)(ii) · 4 marks

Question Number	Answer
3(a)(ii)	A description that makes reference to four of the following: • involved in facilitated diffusion (1) • movement of { large molecules / polar molecules / ions } (1) • (facilitated diffusion) from a high concentration to a low concentration (1) • involved in active transport (1) • needs ATP to move molecules against concentration gradient (1)

Additional Guidance	Mark
ALLOW charged molecules ALLOW needs ATP to move molecules from low concentration to high concentration	(4)

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