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# AS Level Biology

## Topic 5: Exchange Surfaces and Mass Transport

AQA Biology (7401) | Question Paper | 100 marks

**Instructions**

- Answer **all** questions.
- In calculations show your working and give your answer to an appropriate number of significant figures.
- In extended-response questions you should write in clear, well-organised continuous prose.
- There are 17 questions in this paper. The total mark is **100**.

Name: _____ Class: _____

Date: _____ Teacher: _____

**1.** This question is about surface area to volume ratio and exchange.

(a) Explain why small organisms, such as single-celled organisms, do not need specialised exchange surfaces. **(2)**

(b) Explain why large, multicellular organisms need specialised exchange surfaces and transport systems. **(3)**

(c) A cube has sides of 2 cm. Calculate its surface area to volume ratio. Show your working. **(3)**

**2.** This question is about the features of efficient exchange surfaces.

(a) State three features that an efficient gas exchange surface should have. **(3)**

(b) Explain how a steep concentration gradient is maintained across the gas exchange surface in the lungs. **(2)**

**3.** This question is about gas exchange in single-celled organisms and insects.

(a) Explain how gases are exchanged in a single-celled organism such as an amoeba. **(2)**

(b) Describe how oxygen reaches the respiring tissues in an insect. **(3)**

(c) Explain how an insect reduces water loss through its spiracles. **(2)**

**4.** This question is about gas exchange in fish.

(a) Name the organs used for gas exchange in a fish. **(1)**

(b) Explain how the structure of the gills provides a large surface area for gas exchange. **(2)**

(c) In the counter-current system, water and blood flow in opposite directions across the gill lamellae. Explain how this maximises the diffusion of oxygen into the blood. **(3)**

**5.** This question is about gas exchange in plants.

(a) Name the structures in a leaf through which gases enter and leave. **(1)**

(b) Name the cells that control the opening and closing of a stoma. **(1)**

(c) Explain how the structure of a leaf is adapted for efficient gas exchange. **(3)**

(d) A plant adapted to dry conditions is called a xerophyte. State two features that help a xerophyte to reduce water loss. **(2)**

**6.** This question is about the human gas exchange system.

(a) Name the tiny air sacs in the lungs where gas exchange occurs. **(1)**

(b) Describe three ways in which an alveolus is adapted for efficient gas exchange. **(3)**

(c) Describe the path taken by a molecule of oxygen from an alveolus into the blood. **(2)**

**7.** This question is about ventilation in humans.

(a) Describe the changes that bring about inspiration (breathing in). **(4)**

(b) Explain why expiration is described as a passive process during normal quiet breathing. **(2)**

**8.** Tidal volume is the volume of air breathed in or out in one normal breath. Pulmonary ventilation rate is calculated using tidal volume and breathing rate.

(a) State the equation used to calculate pulmonary ventilation rate. **(1)**

(b) A person has a tidal volume of 0.5 $dm^3$ and a breathing rate of 15 breaths per minute. Calculate their pulmonary ventilation rate. State the units. **(2)**

(c) During exercise, the pulmonary ventilation rate increases. Explain why. **(2)**

**9.** This question is about lung disease and risk factors.

(a) In a disease such as fibrosis, the alveolar walls become thickened with scar tissue. Explain how this reduces the efficiency of gas exchange. **(2)**

(b) In emphysema, the walls between alveoli break down. Explain how this reduces gas exchange. **(2)**

(c) Scientists found a positive correlation between smoking and the risk of lung disease. Explain why a correlation does not prove that smoking causes lung disease. **(2)**

**10.** This question is about digestion and absorption in mammals.

(a) Explain why large biological molecules in food must be digested (hydrolysed) before they can be absorbed. **(2)**

(b) Name the enzyme that digests starch and name the products. **(2)**

(c) Name the products formed when a triglyceride (lipid) is fully digested by lipase. **(2)**

**11.** This question is about the absorption of the products of digestion in the ileum.

(a) Explain how the ileum is adapted to provide a large surface area for absorption. **(2)**

(b) Amino acids are absorbed into the epithelial cells of the ileum by co-transport with sodium ions. Outline how this occurs. **(3)**

**12.** This question is about the structure of haemoglobin and the transport of oxygen.

(a) State the role of haemoglobin in the blood. **(1)**

(b) Haemoglobin has a quaternary structure. Explain what this means. **(2)**

(c) Name the reaction that occurs when haemoglobin binds to oxygen, and name the product. **(2)**

**13.** The graph of percentage saturation of haemoglobin against partial pressure of oxygen produces an S-shaped (sigmoid) oxygen dissociation curve.

(a) Explain why haemoglobin becomes loaded (saturated) with oxygen in the lungs. **(2)**

(b) Explain why haemoglobin releases (unloads) oxygen at the respiring tissues. **(2)**

(c) The Bohr effect describes how an increase in carbon dioxide concentration shifts the dissociation curve to the right. Explain how this is an advantage during exercise. **(3)**

**14.** Different organisms have haemoglobins with different oxygen affinities, adapted to their environments.

(a) An animal living in an environment with a low oxygen concentration has haemoglobin with a high affinity for oxygen. Explain why this is an advantage. **(2)**

(b) A very active animal with a high metabolic rate has haemoglobin with a lower affinity for oxygen. Explain why this is an advantage. **(2)**

**15.** This question is about the mammalian circulatory system and the heart.

(a) The mammalian circulatory system is described as a double circulatory system. Explain what this means. **(2)**

(b) Explain the advantage of a double circulatory system over a single one. **(2)**

(c) Explain why the muscle wall of the left ventricle is thicker than that of the right ventricle. **(2)**

**16.** This question is about the structure of blood vessels.

(a) Explain how the structure of an artery is adapted to withstand and maintain high blood pressure. **(2)**

(b) Explain how the structure of a capillary is adapted for efficient exchange of substances. **(2)**

(c) Explain why veins contain valves. **(1)**

**17.** This question is about mass transport of water in plants.

(a) Name the tissue that transports water and mineral ions from the roots to the leaves in a plant. **(1)**

(b) Define the term *transpiration*. **(1)**

(c) Explain how the cohesion-tension theory accounts for the movement of water up the xylem. **(3)**

(d) State one factor that would increase the rate of transpiration from a plant. **(1)**