Describe the journey of an oxygen molecule from the point at which it is inhaled through the nose to its utilisation in a bone cell in the foot.

Cover the following in your answer:

* Major respiratory structures through which the molecule would pass
* Movement of the molecule from air to blood
* Major heart structures and blood vessels through which the molecule would pass
* Transport of the molecule in the blood
* Use of the molecule inside the cell

(15)

Nose, pharynx, larynx, trachea, bronchi, bronchioles, alveolus [3]

Diffusion [1] Molecule moves from high concentration in air to lower concentration in the blood [2]

Pulmonary vein, left atrium, left atrioventricular valve (bicuspid), left ventricle, aorta, femoral artery [3]

Carried in the blood either dissolved in the plasma (3%) or combined with haemoglobin as oxyhaemoglobin (97%) [2]

Used in cellular respiration [1] mitochondrion [1]

Glucose + oxygen + 38 ADP 🡪 carbon dioxide + water + 38ATP (+heat) [2]

Describe in detail how a meal of fish and chips would be digested and absorbed.

(15)

* Correctly identifies food types: fish – protein, chips – carbohydrate, batter – fat (lipid)
* Physical digestion/chewing mixes food with saliva, increases surface area and converts to a bolus
* Chemical digestion by salivary amylase in mouth converts carbohydrates to smaller units
* Peristalsis moves the bolus from the oesophagus to the stomach
* Mechanical digestion in stomach – wringing action of the stomach mixes chyme with the gastric juice
* Chemical digestion in stomach – gastric protease activated by HCl converts proteins to polypeptides
* In small intestine, various enzymes are secreted by the pancreas and the intestinal wall
* Amylase converts carbohydrates to monosaccharides
* Protease converts polypeptides to amino acids
* Lipase converts lipids to fatty acids and glycerol
* Bile, made in the liver and stored in the gall bladder, emulsifies lipids increasing the surface area available for lipases to act
* The main sites of absorption are the intestinal villi
* Amino acids and monosaccharides are absorbed into the capillaries
* This occurs by active transport
* Fatty acids and glycerol are absorbed into the lacteals
* This occurs by diffusion.

(i) Draw a schematic representation of a cell and the organelles that it contains. Explain the function of each organelle.

(6)

(ii) Carefully explain the difference between diffusion, osmosis and phagocytosis. Give an example of how a cell would benefit from each.

(9)

1. One mark for each organelle that is correctly represented in drawing and for which the correct function is given. (maximum of 6 marks)

* Nucleus – stores DNA and control chemical reaction within cell
* Ribosomes – synthesise protein
* Endoplasmic reticulum – transport materials within the cell
* Mitochondria – aerobic respiration
* Golgi body – modifies and packages proteins for secretion
* Centriole – forms spindle fibres during cell division
* Lysosomes – contain digestive enzymes and material that has been phagocytosed
* Vacuole – storage site, e.g. for fat
* Flagella – whip-like tail that allows movement in spermatozoa
* Cilia – hair-like structure that beat to move particles along, generally covered in mucous
* Microvilli – folds in the cytoplasm that increase the surface area of the cell

(ii)

* Diffusion and osmosis are examples of passive transport, they do not require energy
* Diffusion is the movement of molecules from a high concentration to a low concentration
* Osmosis is the movement of water across a semi-permeable membrane
* In osmosis water moves from low solute concentration to high
* Active transport requires energy in the form of ATP
* Phagocytosis is the ingestion of a solid particle by enfolding it within the cell membrane
* Diffusion allows nutrients to enter the cell and wastes to leave (or any other reasonable benefit)
* Osmosis allows the cell to control the amount of water that enters and leaves the cell by moving ions across the cell membrane (or any other reasonable benefit)
* Phagocytosis is used by some cells to attack and kill pathogens (e.g. bacteria) (or any other reasonable benefit)

(a) Discuss the structure of arteries, veins and capillaries and relate this to their function.

(10)

(b) When blood vessels are damaged the flow of blood needs to be stopped. Describe the process of blood clotting.

(4)

(c) What is inflammation? Explain why it occurs in the body.

(6)

1. Arteries (1 mark each)
   * carry blood away from the heart / to the cells
   * relatively small lumen
   * thick, muscular walls
   * elastic walls / wrinkled inner wall
   * high blood pressure

Veins (1 mark each)

* carry blood to the heart
* contain valves to assist with the transport of blood
* thin walled blood vessels / little muscle / large lumen
* low blood pressure
* skeletal muscle pump assists return of venous blood

Capillaries (1 mark each)

* Walls only one cell thick
* High surface area
* Chemicals diffuse across wall
* Deliver nutrients to cells and remove wastes
* Muscle spasm to reduce blood flow
* Platelets stick to opening and each other, plugging the hole
* Clotting factors in the plasma form a mesh of threads that trap more material
* The threads contract pulling the damaged wall closer together
* Occurs when tissue is damaged
* Redness, heat, pain and swelling occur
* Mast cells release…
* Histamine – increases blood flow / capillary walls become leaky
* Heparin – prevents blood clotting
* Phagocytes are attracted to the area to consume pathogens (protection)
* Pain receptors are stimulated (awareness of injury)

Explain how a foetus is able to survive without a fully functional digestive or respiratory system. Also discuss the changes that a foetus must undergo at birth in order to survive outside the uterus.

(10)

Role of placenta (1 mark each)

* Placenta supplies oxygen and nutrients
* Placental removes carbon dioxide and other wastes
* Maternal and foetal blood do not mix
* Chemicals diffuse between maternal and foetal blood supply
* Placenta has a very high surface area to increase rate of diffusion

At birth (Any 6, to a maximum of 2 from each section, 1 mark each point)

* Foramen ovale is the opening between the right and left atria in the foetus
* The foramen ovale must close
* due to the pressure of the blood in the left atrium
* The ductus arteriosus connects the pulmonary artery and aorta in the foetus
* The blood flow through the ductus arteriosus will reduce
* Until it becomes only fibrous tissue
* The ductus venosus joins the umbilical veins to the liver in the foetus
* The ductus venosus gradually constricts
* as blood flow from the umbilical veins is shut off when the umbilical cord is cut