

CHAPTER 4

1 ► D 2 ► A 3 ► D 4 ► B

5 ► a Starch: take a sample of the water in a spotting tile and add a drop of iodine solution. The colour changes from orange to blue-black.

Glucose: take a sample of the water in a test tube and add blue Benedict's solution. Place the tube in a water bath and heat until it boils. A brick-red precipitate results.

- b The starch molecules are too large to pass through the holes in the Visking tubing. Glucose molecules are smaller, so they can pass through.
- c The blood.
- d Large, insoluble food molecules are broken down into small, soluble ones.
- 6 ► a It is body temperature
- b It had been broken down into smaller molecules called peptides (short chains of amino acids) forming the clear solution.
- c The enzyme pepsin does not work in alkaline conditions, it is denatured.
- d The experiment is looking at the effects of pepsin on the egg white. The Control is carried out without the enzyme; all other factors are the same. This shows that it is the enzyme that breaks down the protein. In other words, the egg white does not break down by itself.
- e The enzyme works more slowly at a lower temperature. There are fewer collisions between enzyme and substrate molecules, because they have less kinetic energy.
- f Hydrochloric acid kills bacteria in the food entering the stomach.
- g By alkaline secretions in the bile and pancreatic juice.

Enzyme	Food on which it acts	Products
(amylase)	starch	maltose
(trypsin)	protein	peptides
lipase	fats	(fatty acids and glycerol)

- 8 ► Descriptions of any four of the following:
- length, which increases time and surface area for absorption
 - folds in lining, which increase surface area
 - villi covering lining, which increase surface area
 - microvilli on lining cells, which increase surface area
 - capillary networks in villi, where products are absorbed
 - lacteals in villi, which absorb fats.
- 9 ► The account should include full descriptions of most of the following points:
- digestion of starch to maltose in the mouth, action of saliva in moistening food
 - mechanical digestion by the teeth
 - movement through the gut by peristalsis (diagram useful)
 - digestion of protein by pepsin in the stomach and the role of hydrochloric acid
 - emulsifying action of bile from the liver on fats

- pancreatic enzymes (amylase, trypsin, lipase) and their role in digestion of starch, protein and fats
- adaptations of the ileum for the absorption of digested food (see question 4)
- role of the colon in absorption of water.

10 ► a Energy = $(20 \times 18 \times 4.2) = 1512$ joules = 1.512 kilojoules.

b Energy per gram = $1.512 \div 0.22 = 6.872$ kJ per g.

c There are several errors involved. Some major ones include:

- some of the energy from the burning pasta is used to heat the test tube, thermometer, etc
 - much energy will be lost when heating up the air near the tube, or when transferring the pasta
 - not all the energy in the pasta will be released when it burns
 - some energy will be lost when evaporating the water from the tube
 - measurement errors such as measurement of the volume of water and temperatures (although these are probably small compared with the other reasons).
- d One way is to shield the tube inside (for example) a metal can, to reduce heat losses to the air (or use a calorimeter).
- e Peanuts contain a large proportion of fat, which has a high energy content. Pasta is largely carbohydrate, which contains less energy per gram.

CHAPTER 5

1 ► B 2 ► C 3 ► A 4 ► B

5 ► a Single: fish; double: human or other named mammal.

b i (Either) The blood passes once through the heart in a single system, and twice through the heart in a double system for every complete circulation of the body.

(Or) In a double system the blood flows from the heart through one circuit to the lungs, then back to the heart and out through another circuit to the rest of the body.

ii Double circulatory system pumps the blood twice per circulation so higher pressures can be maintained.

c Diffusion can take place because it has a large surface area compared with its volume and the distances for substances to move inside the cell are short.

6 ► a A red blood cell has a large surface area compared with its volume; contains haemoglobin; and has no nucleus, so more space is available for haemoglobin.

b i Oxygen dissolves in the liquid lining the alveoli and then diffuses down a concentration gradient through the walls of the alveoli and capillaries into the plasma and into the red blood cells.

ii Oxygen dissolves in the plasma and then diffuses down a concentration gradient through the walls of the capillaries into the muscle cells.

c Dissolved in plasma.

- 7 ▶ a** Arteries have thick walls containing much muscle tissue and elastic fibres. These adaptations allow their walls to stretch and recoil under pressure.
- b** Veins have valves, thin walls with little muscle, and a large lumen; arteries have no valves (except at the start of the aorta and pulmonary artery), thick muscular walls with many elastic fibres, and a narrow lumen.
- c** Capillaries have thin walls / walls one cell thick, to allow exchange of materials. They have a very small diameter to fit between other cells of the body.
- 8 ▶ a** A = left atrium, B = (atrioventricular) valves, C = left ventricle, D = aorta, E = right atrium.
- b** To ensure blood keeps flowing in one direction / prevent backflow of blood.
- c** **i** A; **ii** E
- 9 ▶ a** **i** A (red blood cell), identified by its colour (red) and biconcave disc shape.
- ii** B (lymphocyte), identified by its colour (white) and large nucleus (to produce antibodies quickly).
- iii** C (phagocyte), identified by its colour (white), variable shape (shows it is flowing) and lobed nucleus.
- b** Platelets – blood clotting.
- 10 ▶ a** C, heart rate is increasing so more blood can be pumped to muscles.
- b** E, brief jump in heart rate.
- c** A, lowest rate. B, increases from minimum to steady rate.
- 11 ▶ a** **i** Low rate (75 beats/minute) because body is at rest, need for oxygen is low.
- ii** Rate increases because more blood carrying oxygen for respiration needs to be pumped to muscles.
- iii** Rate decreases as need for oxygen is reduced / lactate produced during exercise is removed (repaying oxygen debt).
- b** The shorter the recovery period, the fitter the person.

CHAPTER 6

1 ▶ D **2 ▶** B **3 ▶** C **4 ▶** D

- 5 ▶ a** Changes that take place in the shape of the lens to allow the eye to focus upon objects at different distances away.
- b** The replacement artificial lens cannot change shape.
- c** The ciliary muscles contract and the suspensory ligaments slacken. The shape of the lens becomes more convex, refracting the light more.

6 ▶ a

Function	Letter
refracts light rays	G
converts light into nerve impulses	A
contains pigment to stop internal reflection	B
contracts to change the shape of the lens	E
takes nerve impulses to the brain	D

- b** **i** H
- ii** Contraction of circular muscles in the iris reduces the size of the pupil, letting less light into the eye. Contraction of radial muscles increases the size of the pupil, letting more light into the eye.
- iii** To protect the eye from damage by bright light, and to allow vision in different light intensities.

- 7 ▶ a** **i** Sensory neurone
- ii** Relay neurone
- iii** Motor neurone
- b** The sensory neurone carries impulses from sensory receptors towards the central nervous system. The motor neurone carries impulses out from the CNS to effector organs (muscles and glands). The relay neurone links the other two types of neurone in the CNS.
- c** X: white matter, Y: grey matter, Z: dorsal root ganglion.
- d** Electrical impulses.
- e** The gap between one neurone and another is called a synapse. An impulse arrives at the end of an axon and causes the release of a chemical called a neurotransmitter into the synapse. The neurotransmitter diffuses across the synapse and attaches to the membrane of the next neurone. This starts an impulse in the second nerve cell.
- 8 ▶ a** P: cell body, Q: dendrite, R: axon.
- b** Speed = distance/time
 $= 1.2 \text{ m} / 0.016 \text{ s}$
 $= 75 \text{ m per s}$
- c** Mitochondrion
- d** **i** Insulation / prevents short circuits with other actions (Also speeds up conduction).
- ii** Person would not be able to control their muscle contractions / not be able to coordinate body movements / 'wrong' muscles would contract.

- 9 ▶ a** A wide variety of answers are possible, such as:
- dust in the eye – secretion of tears
 - smell of food – secretion of saliva
 - touching a pin – withdrawal of hand
 - attack by a predator – increased heart rate
 - object thrown at head – ducking.
- b** Nature and role of receptor and effector correctly explained, e.g. for 'dust in the eye' above:
- i** The receptors consist of touch receptors in the eye. They respond by generating nerve impulses (which eventually stimulate the tear glands).
- ii** Tear glands are the effectors. They secrete tears, washing the irritant dust out of the eyes.
- c** Dust enters the eye and stimulates a touch receptor in the surface of the eye. The receptor sends nerve impulses along sensory neurones to the CNS (brain). In the CNS, impulses pass from sensory neurones to motor neurones via relay neurones. Impulses pass out from the CNS to the tear glands via motor neurones. These impulses stimulate the tear glands to secrete tears.