

IGCSE and GCSE Biology. Answers to questions

Section 1. Some Principles of Biology. Chapters 1 - 5

Here you will find the answers to the 'in-text' questions which occur in 'IGCSE Biology' (2nd edition) and 'GCSE Biology' (3rd edition) by D.G. Mackean, published by Hodder Education, London, UK. The questions are not included.

Chapter 1 Cells and tissues

Page 4

1. **a** Cytoplasm, nucleus, cell membrane
b Chloroplasts
2. The cell membrane controls substances entering or leaving the cell
3. The red cell has no nucleus
4. The cell membrane is formed from living cytoplasm; the cell wall is formed from non-living cellulose
5. The section must have been taken above the nucleus
6. **a** The magnification in Figure 1.1 is x 60, so presumably x100 would be effective
b The wide part of the cell is 7mm. This is 700 times larger than the real cell, so the cell would measure $7 / 700$ i.e. 0.01 mm
7. Count the nuclei

Page 7

1. (i) animal cells **d, a**
(ii) plant cells **d, a, b, c**
2. (a) In the midrib and veins (sieve tubes)
(b) Palisade cells, epidermis, guard cell, (a vessel is formed by many cells)

Page 9

1. Lungs (organ), root hair (cell), mesophyll (tissue), multipolar neurone (cell)
2. (Fig.36.13) Bone and muscle, (Fig. 19.9) muscle, nerve tissue, bone
3. **a** (Organs) The definition on p.7 says an organ is 'a structure with a special function' so all the labelled structures in Fig. 11.5 could be organs. The exceptions might be the mouth, the pyloric sphincter, the rectum and the anus
b (System) The digestive system

Chapter 2 The chemicals of living cells

Page 13

1. Proteins provide the basic materials (amino acids) for making cytoplasm which forms cells, tissues and organs, and for making enzymes which control all the reactions in the cell.
2. **a** proteins **b** carbohydrates and lipids.
3. **a** carbohydrates; sugar, starch, cellulose
b salts; iron sulphate, sodium chloride
c lipids; butter, olive oil.
4. Carbohydrates would need nitrogen. Plants get nitrogen in the form of nitrates in the soil.
5. Synthesis of starch and cellulose from glucose; synthesis of amino acids from glucose and salts; synthesis of glucose from carbon dioxide and water.

Page 18

1. Only **d** applies to all catalysts.
2. **a** The rate would increase. Most chemical reactions are speeded up by a rise in temperature.
b The rate would fall to zero. Temperatures over 50°C denature most enzymes.
3. Yes. Enzymes are essential for all the processes taking place inside a cell.
4. Dipping the apple into boiling water denatures the enzymes responsible for producing the brown discolouration.
5. The enzyme needs to combine briefly with the molecules of the two reactants, glycine and valine. The same enzyme may still combine with the glycine molecule but will not 'fit' with the serine molecule.

Chapter 3 Energy from respiration

Page 20

1. **a** energy
b Respiration takes place in all the living cells of an organism.
2. **a** Aerobic respiration needs oxygen; anaerobic respiration does not. Anaerobic respiration does not completely oxidise the substance it acts on. Anaerobic respiration produces less energy than aerobic respiration
b $2830 - 118 = 2712$ kJ
3. **a** A food substance and oxygen.
b enzymes.
c carbon dioxide and water.
4. Respiration is a chemical process in all living cells. Resuscitation restores the process of breathing.
5. You need more oxygen to oxidise the lactic acid that has accumulated during vigorous exercise. An increased heart rate delivers the oxygen more rapidly.
6. The 2400 kJ used in 8 hours sleep represents basal metabolism.

Page 24

1. **a** True (of most organisms)
b The organism is more likely to be producing heat
c True
d True in most cases (some micro-organisms may use only anaerobic respiration)
e No. Respiration results in a loss of weight.
f Movement cannot occur without respiration but respiration does not necessarily result in movement e.g. the Plant Kingdom.
2. The purpose of the soda lime is to absorb carbon dioxide so that any volume change can be attributed to uptake of oxygen. The lime water is used to detect the presence of carbon dioxide.
3. **a** In the absence of soda lime there will be a 2cm^3 increase in volume.
b If soda lime is present there will be a decrease in volume of 5cm^3 .
4. In a beaker, the heat generated will be lost to the atmosphere. In a vacuum flask the heat is retained.
5. The boiled wheat will be dead and should not produce carbon dioxide. If carbon dioxide appears, either it comes from something else, e.g. bacteria or the experiment is invalid.

Page 25

1. In the first experiment, the water was boiled to drive out all the dissolved oxygen and the liquid paraffin prevented any further oxygen dissolving in the water. Therefore production of carbon dioxide must have been from an anaerobic reaction. In the second experiment, the presence of oxygen did not affect the anaerobic reaction but it would have been impossible to decide whether the respiration was aerobic or anaerobic.
2. **d**
3. In aerobic respiration, the oxidation of carbon in $\text{C}_6\text{H}_{12}\text{O}_6$ produces carbon dioxide and releases energy. In a similar way the sulphur bacteria could be oxidising H_2S to produce H_2SO_4 with a corresponding release of energy.
The hypothesis could be tested by excluding oxygen from the bacteria. There should be no production of H_2SO_4 .

4. **a** (i) $64.3 \times 134 = 8616.2$ kJ
 (ii) $0.018 \times 2736 = 49.3$ kJ

b The mouse

c The body temperatures of these animals are very similar. Therefore you would not expect the energy expenditure to make up for heat loss per m^2 to be very different.

Chapter 4 How substances get in and out of cells

Page 28

- The cells on the left are in a region of high oxygen concentration and, initially there is little or no oxygen in the red cells. The concentration gradient favours the passage of oxygen into the cells. The cells on the right are in a region of a lower oxygen concentration than exists in the red cells. The diffusion gradient, therefore, favours the diffusion of oxygen out of the cells.
- a** Air freshly breathed in contains more oxygen than the red cells in the capillary. Oxygen will consequently diffuse into the cells. Red cells returning to the lungs contain higher concentrations of carbon dioxide than the air in the alveolus, so carbon dioxide diffuses out.
b If the blood flow increased, the exchange of oxygen and carbon dioxide would also increase.
- Controlled diffusion, endo- and exocytosis, active transport
- In air, the uptake of phosphate goes on at a steady rate for about 20 hours. In nitrogen, (i.e. in the absence of oxygen) the rate of uptake is very low. This result suggests that phosphate uptake is by active transport, a process which needs oxygen to generate the necessary energy.

Page 31

- Water will diffuse from the 5 percent solution into the 10 percent solution.
- The cell membrane in a living cell controls the movement of substances (in this case a red pigment) into or out of the cell. Boiling kills the cell by denaturing its enzymes, and the cell membrane loses its ability to control the loss of pigment.
- If animal cells were studied in water, they would take up water by osmosis till they burst. The concentration of Ringer's solution is the same as the cell's cytoplasm so there is no osmosis.
- The molecules (or ions) of the dissolved substance attract water molecules, leaving fewer 'free' water molecules in the solution. The accumulation of sugar in the plant cell will lower its water potential and it will absorb water by osmosis from its neighbours. This may harm the cell. Starch in the plastids is insoluble and so does not affect the cell's water potential.

Page 34

- a** If a 'stronger' (more concentrated) solution was placed in to cellulose tube you would expect the rate of osmosis to increase. This would accelerate the rise of liquid in the capillary tube.
b So long as the solution in the beaker is weaker (less concentrated) than the solution in the cellulose tube, osmosis will still occur and the water column will rise but more slowly.
c If the sugar solution were in the beaker, water would leave the cellulose tube and the water column would go down.
- Water would continue to enter the cellulose tube until it burst.
- The explanation is given in the caption. When the cell is immersed in water, the water potential of the cell sap is lower than that of the water. So water will enter via the selectively permeable cell membrane and expand the vacuole till it fills the cell.

4. Put the starch solution in the beaker and the iodine solution in the cellulose tube. If the 'in but not out' theory is correct you would expect the starch solution in the cellulose tube to go blue and the iodine solution to remain brown. If the 'molecular size' theory is correct you would expect the starch solution to turn blue but not the iodine solution in the cellulose tube. (In practice this is what happens but since the blue colour first appears on the outside surface of the cellulose tube, it looks as if the tube contents have turned blue).
- 5 When the pressure of the water column equals the 'osmotic pressure' in the cellulose tube, the flow will cease ('Osmotic pressure' is the difference between the water potentials of the sugar solution in the cellulose tube and the water surrounding it).

Chapter 5 Photosynthesis and nutrition in plants

Page 38

1. **a** carbon dioxide, **d** water, **e** chlorophyll, **g** light.
2. The white parts of the leaf do not contain chlorophyll and act as a control.
3. 'Destarching' a leaf means taking steps to ensure that it does not contain starch at the beginning of the experiment. If the leaves already contain starch it cannot be demonstrated that a particular process is necessary for the production of starch.
4. **a** Soda lime absorbs carbon dioxide and so the leaf is deprived of this gas.
b Sodium hydrogen carbonate in solution decomposes to form carbon dioxide. This ensures that the plant has an adequate supply of this gas.
c The polythene bag prevents carbon dioxide in the air from reaching the plant.
5. By using pondweed it is possible to see the bubbles of gas escaping from the leaves. The choice of pondweed might lead to the claim that production of oxygen in light happened only in pondweed.
6. Depriving a plant of water would lead to wilting and, ultimately, to the death of the plant irrespective of the role of water in photosynthesis.
7. Yes. Destarching is achieved by leaving a plant in darkness for 2 or three days for starch to be removed from the leaves. It is assumed that no new starch will be formed in darkness.

Page 39

1. Carbon dioxide from the air. Water from the soil.
2. **a** The palisade cells. They have the greatest number of chloroplasts and are nearest the light source.
b The spongy mesophyll cells. They have fewer chloroplasts and are further from the light source.
c The cells of the epidermis. They have no chloroplasts
3. **a** The energy for photosynthesis comes from sunlight.
b Respiration is the source of energy for all other living processes.

Page 41

1. **a** In bright sunlight a leaf would be taking in carbon dioxide and giving out oxygen.
b In darkness a leaf would be taking in oxygen and giving out carbon dioxide.
2. No. It may just mean that respiration is taking place faster than photosynthesis.
3. You would need to gradually increase the light intensity, (e.g. by moving the light source closer to the tube), until the indicator just changed colour. Ideally then you could use a light meter to measure this intensity.
With the high light intensity in a field, you would expect plants to reach compensation point quickly. In the low light intensity of a wood you might expect plants to take longer to reach compensation point.

Page 44

1. **a** carbon dioxide and water. Chlorophyll must be present.
b nitrate ions. Enzymes must be present.
2. The carbon dioxide molecule would be combined with water to make glucose. Some of this glucose might be respired, releasing the carbon dioxide molecule.

3. **a** Raising the temperature will increase the rate of reactions in photosynthesis. Increasing the light intensity will speed up photosynthesis and so will an increase in the carbon dioxide concentration
b It depends on what the limiting factors are. It would not be cost effective, for example, to increase carbon dioxide concentration if a low light intensity is limiting the rate of photosynthesis.
4. In darkness, from midnight to 4.0 a.m. only respiration will be taking place and so the carbon dioxide concentration will be increasing. From 4.0 a.m. to 8 a.m. photosynthesis will be starting up as the light intensity increases and so more and more carbon dioxide is used by the crop. From 8.0 a.m. to 4.0 p.m. photosynthesis will be at its peak, using up carbon dioxide. As the light intensity diminishes after 4.0 p.m. photosynthesis slows down while respiration stays the same so that more carbon dioxide is released than is retained.

Page 46

1. Magnesium sulphate, potassium phosphate and a soluble calcium salt, e.g. calcium chloride.
2. **a** Calcium and phosphorus. **b** iron.
3. The floating plant needs carbon dioxide and water for photosynthesis and its roots absorb water directly from the pond.
4. **a** Without nitrates, the plant cannot make the proteins which are needed to make the cytoplasm required for growth.
b Phosphates are used to make DNA, which is needed for cell division (growth).
5. **a** The yield is increased from about 6 tonnes per hectare to 7.2 tonnes. A gain of 1.2 tonnes per hectare.
b The yield increases by about 1.5 tonnes per hectare (8.7 - 7.2).
c Increasing the applied nitrogen from 150 to 300 kg per hectare would increase the yield by only about 0.6 tonnes per hectare. The farmer needs to work out whether this is less than the cost of the extra fertiliser.