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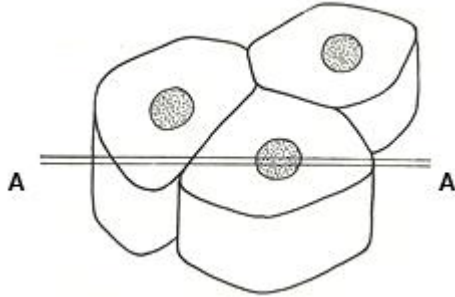
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PRINCIPLES OF BIOLOGY

Cells and tissues -Questions

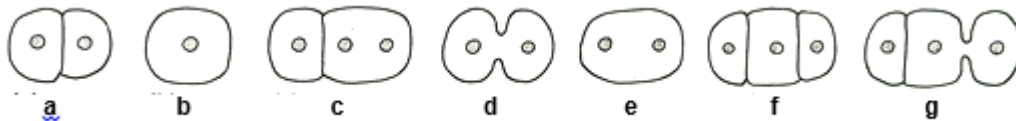
1. The drawing shows a group of three cells. Make an outline drawing to show how the cells would appear under the microscope if a thin section A-A was cut and mounted on a slide.



2. Which one of the following is most likely to be true: To see plant cells with a microscope you usually need a magnification of about
(a) x5, (b) x10, (c) x100, (d) x1000?
3. Which one of the following best describes the function of a cell membrane?
(a) It keeps the cell in shape.
(b) It controls the substances entering and leaving the cell.
(c) It controls the substances entering the cell.
(d) It supports the cell structures.
4. Which of the following structures are (a) in plant and animal cells, (b) in plant cells but not in animal cells?

cell wall, cytoplasm, cell membrane, mitochondria, nucleus, central vacuole, chromosomes, cell sap

5. The drawings below show stages in cell division but in the wrong order. What is the most likely sequence of events?



6. Select the most appropriate words from the list below to complete the following paragraph:
If a cell develops in such a way that it does one particular job very efficiently, it is said to be Such a cell is also said to be to its function. A nerve cell is for conducting impulses. It can do this efficiently because of its and the chemical reactions in its

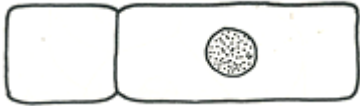
shape, vacuole, adapted, cytoplasm, size, specialised, mature, mitochondria

7. Classify the following under the headings 'Cell structure', 'Tissue', 'Organ' or 'System'.

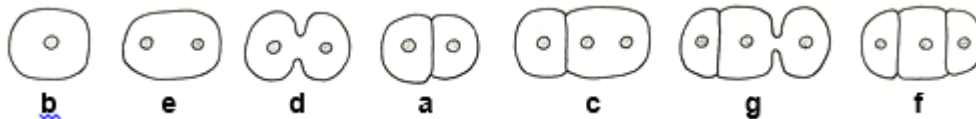
bone, nucleus, skeleton, brain, nerve, mitochondrion, muscle, cytoplasm, epithelium, heart and blood vessels, stomach, alimentary canal, lung, lungs and windpipe

Cells and tissues - answers

1. The section would appear like this



2. The magnification at which plant cells could be seen would be about x 100.
3. Of the choices offered, (b) is the best description of a cell membrane's function: it controls the substances entering and leaving the cell.
4. (a) Plant and animal cells have cytoplasm, cell membrane, mitochondria, nucleus and chromosomes
(b) Only plant cells have a cell wall, central vacuole and cell sap.
5. The most likely sequence is as shown below.



6. If a cell develops in such a way that it does one particular job very efficiently, it is said to be *specialised*. Such a cell is also said to be *adapted* to its function. A nerve cell is *specialised* for conducting impulses. It can do this efficiently because of its *shape* and the chemical reactions in its *cytoplasm*.
7. Cell structure: *nucleus, mitochondrion, cytoplasm*.
Tissue: *bone, nerve, muscle, epithelium*.
Organ: *brain, stomach, lung*.
System: *skeleton, heart and blood vessels, alimentary canal, lungs and windpipe*.

The chemicals of living cells - Questions

1. Apart from food, what other substances do cells need to take in?
2. Water has a high capacity for heat (thermal capacity). This is an advantage in living cells because (Select one of the following statements)
 - a. any rise in temperature is small in comparison with the amount of heat absorbed by a cell

- b. any rise in temperature is large in comparison with the amount of heat absorbed by a cell
 - c. the 75% water in a cell does not retain a lot of heat
 - d. any change in temperature will cause a cell to heat up or cool down quickly.
3. (a) Give three examples of cell structures which contain structural proteins.
(b) What is the other type of protein in a cell?
 4. Name the chemical elements present in a protein.
 5. What name is given to the sub-units which make up all proteins?
 6. A protein molecule which is denatured, has
 - (a) split into smaller molecules
 - (b) changed its shape
 - (c) combined with another molecule
 - (d) been diluted..
 7. What kind of substance is a lipid?
 8. In a cell, where are lipids found?
 9. (a) What are the two types of chemical compound which combine to form a lipid?
(b) What elements are present in a lipid?
 10. (a) Name four examples of compounds which are classed as carbohydrate.
(b) What elements are present in carbohydrates?
 11. Write the formula for glucose.
 12. If



represents a glucose molecule draw (a) a maltose molecule, (b) part of a starch molecule.

13. Select the most appropriate words from the list below to complete the following paragraph
All cells contain which are and act as which chemical reactions. The reactions do notthe which can take part in further reactions.
14. Enzymes will usually react with only one substance. This can be explained by the 'lock and key' theory. If this theory is correct, which of the following substances, represented by P, Q, R and S would be acted on by enzyme A?



A



P



Q

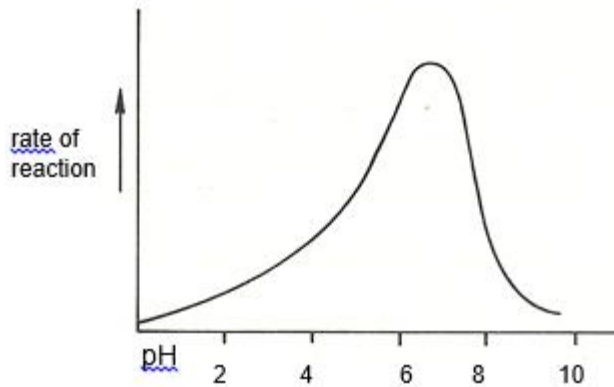


R



S

15. If an enzyme-controlled reaction normally takes place at 10°C, in general terms how will the reaction be affected by (a) a fall in temperature to 2°C , (b) a rise in temperature to 20°C.
(c) a rise in temperature to 65°C?
16. If an enzyme is denatured, why does it no longer work?
17. The graph shows the rate of an enzyme reaction at different levels of acidity or alkalinity (pH). From the graph, what is the optimum pH for this enzyme?
(a) pH 2 (c) pH 10
(b) pH 7 (d) none of these.



18. A protein-digesting enzyme when mixed with starch solution would
 (a) have no action (c) produce glucose
 (b) produce amino acids (d) digest the starch?
19. Select the most appropriate words from the list below to complete the following paragraph.
 All enzymes are produced inside Enzymes which do their work outside cells are called Enzymes which do their work inside cells are called Most of our digestive enzymes are examples of enzymes.

animals, extra-cellular, intra-cellular, cells, digestive, nuclei, catalysts.

20. Give two examples of chemical reactions which are catalyzed by enzymes in the course of brewing
21. What does the enzyme catalase do?
22. Substance A is being investigated to see if it is an enzyme. When substance A is mixed with substance B a reaction takes place. A control experiment is conducted using a sample of A which has been boiled.
 (a) Why is boiling used as a control?
 (b) If the reaction still worked after A had been boiled, what might be your interpretation?
23. In an investigation to compare the rates at which starch is being broken down by an enzyme
 (a) what test is used
 (b) how do you know when the reaction is completed?

The Chemicals of living cells - answers

- Cells need to take in water and salts, in addition to food.
- (a) A high thermal capacity means that any temperature rise is small in comparison with the amount of heat absorbed. This helps to protect the cell against extremes of temperature.
- (a) Cytoplasm, the cell membrane, membrane systems in the cell, the nucleus and mitochondria all contain structural proteins.
 (b) Enzymes are the other type of cell proteins.
- Proteins contain the elements carbon, hydrogen, oxygen, nitrogen and sulphur.

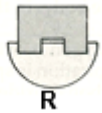
5. All proteins are composed of sub-units called amino acids.
6. (b) A protein which is denatured has changed its shape.
7. A lipid is a fat or oil. It may be combined with other substances, e.g. phospho-lipid or lipo-protein.
8. Lipids are found in cell membranes and other membrane systems in the cell. Some cells may have food reserves in the form of lipid droplets.
9. (a) lipids are formed from the combination of fatty acids with glycerol.
(b) lipids contain the elements carbon, hydrogen and oxygen.
10. (a) Sugars (glucose, fructose, maltose, sucrose), starch, glycogen and cellulose are examples of carbohydrates.
(b) Carbohydrates contain the elements carbon, hydrogen and oxygen.
11. The formula for glucose is $C_6H_{12}O_6$
12. (a) Maltose



- (b) Part of a starch molecule



13. All cells contain enzymes which are proteins and act as catalysts which speed up chemical reactions. The reaction does not use up the enzymes, which can take part in further reactions.
14. Using the lock and key model, enzyme A is most likely to react with substance R.



15. If an enzyme normally works at $10^{\circ}C$, then
 - (a) a fall in temperature to $2^{\circ}C$ will slow down the reaction
 - (b) a rise in temperature to $20^{\circ}C$ will speed up the reaction (by x2)
 - (c) a rise in temperature to $65^{\circ}C$ will denature the enzyme and stop it working (though the reaction may speed up at first).
16. An enzyme which has been denatured has changed its shape and will no longer combine with its substrate (the substance it acts on).
17. (b) The optimum pH is 7 because the rate of reaction is greatest at this pH.
18. (a) A protein-digesting enzyme would have no effect on starch.
19. All enzymes are produced inside cells. Enzymes which do their work outside cells are called extra-cellular. Enzymes which do their work inside cells are called intra-cellular. Most of our digestive enzymes are examples of extra-cellular enzymes.
20. In the course of brewing, enzymes in the grain catalyse the conversion of starch to maltose; enzymes in yeast catalyse the conversion of maltose to alcohol.
21. Catalase speeds up the breakdown of hydrogen peroxide to water and oxygen.
22. (a) Boiling denatures enzymes. If a substance still works after boiling, it cannot be an enzyme.
(b) If the reaction still worked after A had been boiled, either A is not an enzyme or, if it is, it is not necessary for the reaction.
23. (a) The test for starch is iodine solution, which goes blue.
(b) When no blue colour appears after adding iodine, all the starch has gone and the reaction is complete.

Respiration - Questions

1. Select the most appropriate word from the list below to complete the following paragraph:

Respiration is the release of fromand takes place in all of the body.....
In the course of respiration, is broken down toand
If oxygen is used for this process, the respiration is called If oxygen is not used in the process, the respiration is called
Each stage of respiration is speeded up by a particular

Cells, food, carbon dioxide, enzyme, muscles, aerobic, oxygen, water, vitamin, protein, energy, anaerobic.

2. Complete the following equation which summarises aerobic respiration of glucose:

C + ...O... ...CO... +H₂O + 2830

3. What are the products of alcoholic fermentation?
4. In which cell structures does respiration mainly occur?
5. If a person is lying quite still, what does he or she need energy for?
6. Which of the two forms of respiration (aerobic and anaerobic) provides more energy from a given quantity of food?
7. (a) What are the intermediate products of anaerobic respiration in an active muscle?
(b) Which of them is associated with oxygen debt?
(c) In what way is this product associated with the 'oxygen debt'?
8. Which two of the following statements are incorrect?
(a) Anaerobic respiration uses oxygen to release energy from food.
(b) Aerobic respiration releases oxygen from food during oxidation.
(c) Aerobic respiration converts food to carbon dioxide and water.
(d) Anaerobic respiration releases energy from food without using oxygen.
9. (a) Which one of the following would be acceptable evidence that some form of respiration was taking place in a living tissue
(i) oxygen being taken up
(ii) oxygen being given out
(iii) water vapour being produced
(iv) food being used up
(b) Why are the others unacceptable?
10. If a tissue was heated to 65°C for 10 minutes, respiration would cease even if oxygen and food were supplied. Why is this?
11. What name is given to the whole range of chemical changes which are needed just to keep an organism alive ?
(a) basal metabolism (c) catabolism
(b) anabolism (d) metabolism
12. (a) What chemical is normally used to test for the presence of carbon dioxide?
(b) What is the result of the test if carbon dioxide is present?
13. Blood from a donor is sterile and stored in a sealed bag, but it is still kept at 4°C. What is the advantage of keeping it at this low temperature?

Respiration - answers

1. Respiration is the release of energy from food and takes place in all cells of the body. In the course of respiration, food is broken down to carbon dioxide and water. If oxygen is used for this process, the respiration is called aerobic. If oxygen is not used in the process, the respiration is called anaerobic. Each stage of respiration is speeded up by a particular enzyme.
2. $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + 2830 \text{ kJ}$
3. The products of alcoholic fermentation are alcohol and carbon dioxide.
4. Respiration in cells takes place mainly in the mitochondria
5. A person lying quite still needs energy for breathing movements (rib muscles and diaphragm), circulation of blood (heart contraction), temperature maintenance, nerve impulses in the brain and nervous system.
6. Aerobic respiration provides more energy than anaerobic respiration given the same quantity of food.
7. (a) In an active muscle, the intermediate products of anaerobic respiration are pyruvic acid and lactic acid.
(b) lactic acid is associated with oxygen debt.
(c) lactic acid which accumulates in the muscles has to be taken to the liver and oxidised even after the exercise has finished.
8. Statements (a) and (b) are incorrect.
(a) Anaerobic respiration does not use oxygen.
(b) Neither form of respiration produces oxygen.
9. (a) (i) Oxygen being taken up is acceptable evidence of respiration.
(b) (ii) Oxygen is not given out during respiration.
(iii) Water vapour is given off by non-living systems, e.g. wet washing.
(iv) Using up food could be evidence for respiration but the food could be used for
10. growth rather than for energy. Nevertheless, any growth process will almost certainly need energy from respiration, so (iv) is acceptable evidence in most cases.
A temperature of 65°C for 10 minutes would denature the enzymes in most tissues, so respiration would cease. Structural proteins in the cell membranes would also be denatured.
In short, the tissue would be killed by this temperature.
11. (a) Basal metabolism refers to the range of chemical activities needed to maintain basic body functions, e.g. during sleep.
12. (a) Lime water is used to test for carbon dioxide.
(b) If carbon dioxide is present, the lime water goes 'milky'.
Note: pH indicators, such as hydrogencarbonate indicator are sometimes used to detect carbon dioxide, but they are not specific for this gas. Anything which increased the acidity of the indicator would produce a colour change.
13. At 4 °C, enzyme activity is slowed down, so the rate of respiration (and hence usage of food and oxygen) in the blood cells is slowed down. This increases the possible storage time.

How substances get in and out of cells - Questions

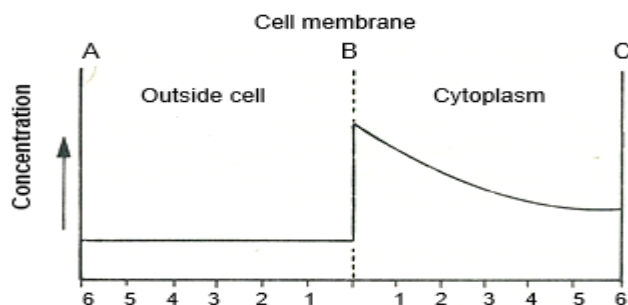
- Containers X and Y each hold one litre of air. X also contains 0.4g of a gas and Y contains 0.6 g of the same gas. The two containers are connected together as shown in the diagram.
 - Which way will the gas diffuse?
 - After a long period of time, what will be the concentration of the gas (in grams per litre) in each container?



- The diagram represents (not to scale) molecules of a salt dissolved in the bottom layer of water in a beaker. Make two similar diagrams to show the distribution of salt molecules (a) after a few minutes, (b) after several hours.



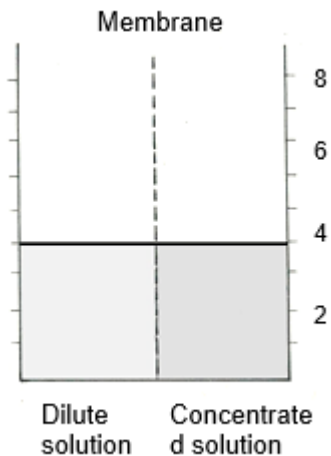
- When a cell is respiring aerobically, which two gases are likely to be diffusing in and out of the cell, and in which direction will they be diffusing?
- The graph shows the concentration of a substance inside and outside a cell.
 - If the substance is free to move by diffusion, which way will it move
 - inside the cell
 - between the cell and the medium outside the cell?
 - If, after some hours, the concentration has not changed, what assumption would you make about the movement of the substance across the cell membrane?



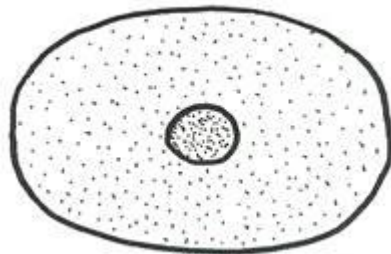
- Which one of the following is the best definition of osmosis?
 - The movement of water from a concentrated solution to a dilute solution across a partially permeable membrane. .

- (ii) The movement of a dissolved substance from a concentrated solution to a dilute solution across a partially permeable membrane.
 - (iii) The movement of water from a dilute solution to a concentrated solution across a partially permeable membrane.
 - (iv) The uptake of water by a living cell.
- (b) Which of the statements is an acceptable description of diffusion?

6. The diagram shows a vessel which contains a concentrated and a dilute solution separated by a partially permeable membrane. Draw a similar diagram to show the liquid levels after an hour or two.



7. Which statement is correct?
- (a) A concentrated solution has a high osmotic potential (water potential).
 - (b) A concentrated solution has a low osmotic potential (water potential).
8. The drawing shows the outline of a human cell. Copy the drawing and make two further drawings to show how the cell would appear if it were to be immersed for a few minutes in a solution with
- (a) a lower osmotic potential (water potential) than its own cytoplasm
 - (b) a higher osmotic potential (water potential) than its own cytoplasm.

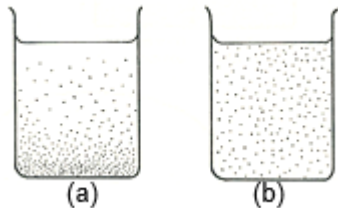


9. Why is it important that a cell membrane does not allow all dissolved substances to diffuse freely through it?

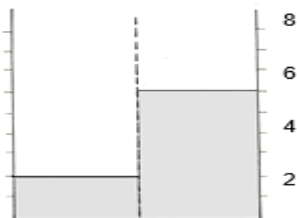
10. The concentration of the tissue fluid, which bathes all cells in the body, is kept more or less constant. Why is this important?
11. When meat is salted, bacteria cannot grow on it. Suggest a reason for this.

How substances get in and out of cells - answers

1. (a) The gas will diffuse from Y to X (i.e. from the region of higher concentration to the region of lower concentration).
(b) Eventually, the gas will be evenly distributed between the two containers so each one will contain 0.5g per litre.
2. The salt molecules will move by diffusion till they are evenly distributed.

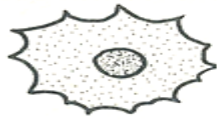


3. When a cell is respiring aerobically, oxygen will be diffusing into the cell and carbon dioxide will be diffusing out.
4. (a) (i) Inside the cell the substance will diffuse from B to C (i.e. down the concentration gradient).
(ii) If the cell membrane were freely permeable, the substance would diffuse out of the cell, from B to A, because its concentration inside is greater than that outside.
(b) If there is no change in the concentration, you might assume that the substance was not free to diffuse across the cell membrane and was being taken up by active transport and diffusing across the cytoplasm by passive diffusion.
5. (a) The best definition of osmosis is (iii) 'The movement of water from a dilute solution to a concentrated solution across a partially permeable membrane'.
(b) An acceptable description of diffusion (at least in solutions) is (ii) 'The movement of a substance from a concentrated solution to a dilute solution'. (The partially permeable membrane is not essential for diffusion to occur.)
6. There will be a rise in level on the right and a corresponding fall on the left as water passes from the dilute to the concentrated solution by osmosis. (The figures need not be the same as shown here.)



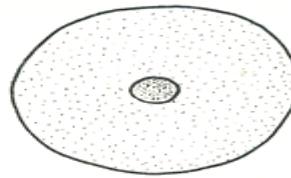
7. (b) A concentrated solution has a low osmotic potential (because it contains effectively fewer free water molecules than a dilute solution).
8. Answer

(a) Lower osmotic potential
(Water potential)



(Cell loses water to more concentrated solution)

(b) Higher osmotic potential
(Water potential)



(Cell gains water from more dilute solution)

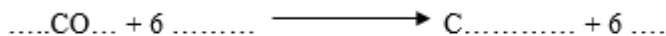
9. If the cell membrane were freely permeable, harmful substances could diffuse in and useful substances could diffuse out.
10. If the tissue fluid became more dilute, the cells would absorb water by osmosis and swell up. If the tissue fluid became more concentrated, the cells would lose water by osmosis, shrink and become dehydrated, possibly to a point where metabolism was no longer possible.
11. The salt lowers the meat's osmotic potential so that water is withdrawn, by osmosis, from bacterial cytoplasm and so kills the bacteria

Photosynthesis and nutrition in plants - Questions

1. Select the most appropriate words from the list below to complete the...following paragraph: A green plant can make all the substances it needs. It builds up carbohydrates by the process of In this process, it combines from the with from the to form The needed for this process comes from, which is absorbed by the in the of leaf cells. The waste product of the process is.....

soil, energy, oxygen, glucose, chloroplasts, mineral salts, cells, photosynthesis, air, respiration, sunlight, water, nitrogen, chlorophyll, carbon dioxide.

2. Complete the following equation which summarizes the process of photosynthesis

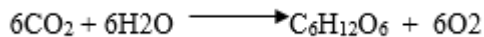


3. What gases will be taken in and given out by a green plant (a) in darkness, (b) in bright sunlight?
4. Is it possible for a plant to be photosynthesizing and respiring at the same time?
5. (a) What carbohydrates does a plant make from glucose?
(b) Which of these carbohydrates is transported round the plant?
(c) Which carbohydrate is the main storage substance?
6. (a) What additional substances does a plant need to make amino acids and proteins from glucose?
(b) Where do these substances come from?
7. What ions must a plant obtain from the soil in order to make (a) ATP, (b) chlorophyll?
8. Name an artificial fertiliser or fertilisers which farmers can use to increase the supply of nitrate, phosphate and potassium to their crops.
9. (a) How would you destarch the leaves of a potted plant?
(b) How would you check that the destarching had been effective?
10. In a school laboratory, what is usually regarded as evidence that photosynthesis has

- occurred in a plant?
11. In designing an experiment to find out whether light is needed for photosynthesis
 - (a) what is the principle of the design
 - (b) what control would you use?
 12. A leaf is detached from a tree and tested with iodine. The leaf turns dark blue.
 - (a) What does this result tell you?
 - (b) Why is this result not sufficient evidence to confirm that photosynthesis had taken place in the leaf?

Photosynthesis and nutrition in plants - answers

1. A green plant can make all the substances it needs. It builds up carbohydrates by the process of photosynthesis. In this process it combines water from the soil with carbon dioxide from the air to form glucose. The energy needed for this process comes from sunlight which is absorbed by the chlorophyll in the chloroplasts of leaf cells. The waste product of the process is oxygen.
2. Answer



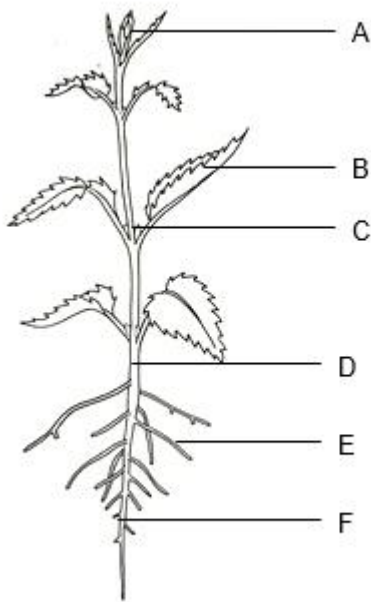
3. (a) In low light intensities a green plant will be taking in oxygen and giving out carbon dioxide
(b) In bright sunlight a green plant will be taking in carbon dioxide and giving out oxygen.
Note: Water vapour will also be escaping from the leaf; more so in sunlight.
4. A plant respire all the time. During daylight photosynthesis and respiration will be going on at the same time.
5. (a) From glucose, a plant makes the carbohydrates sucrose, starch and cellulose.
(b) Carbohydrate is transported round the plant as sucrose.
(c) The main storage carbohydrate in plants is starch.
6. (a) To make amino acids and proteins from glucose, a plant needs a supply of nitrate (for nitrogen) and sulphate (for sulphur).
(b) These substances come from the soil.
7. (a) To make ATP (adenosine triphosphate) a plant needs a supply of phosphate ions.
(b) To make chlorophyll a plant needs a supply of magnesium ions.
8. NPK compound fertiliser contains nitrogen (N) as nitrate, phosphorus (P) as phosphate and potassium (K) in suitable proportions. Alternatively, ammonium nitrate (NH₄NO₃) may be used as a source of nitrogen, and superphosphates as a source of phosphorus.
9. (a) If a potted plant is kept in darkness for 48 hours, all starch in its leaves should have been converted to sugars and conducted out of the leaves. This is destarching.
(b) To check on the destarching, one of the leaves or part of a leaf should be tested with iodine to make sure the leaf is free from starch.
10. The accumulation of starch in a previously destarched leaf is accepted as evidence that photosynthesis has occurred
11. (a) In an experiment to find out whether light is needed for photosynthesis, light should be excluded from a destarched leaf or part of a destarched leaf. After a few hours of sunlight the covered leaf and an exposed leaf (or simply the partly covered leaf) should be tested for starch. Only the parts which received light should go blue with iodine.
(b) The control is the leaf, or part of the leaf, which has not been exposed to light and does not contain starch. Alternatively, if the exclusion of light from the leaf is thought to be the experiment, the parts of the leaf exposed to light constitute the control.
12. (a) If a (suitably prepared) leaf goes blue with iodine, it tells you that starch is present.

(b) Unless the leaf is known to have been free from starch at the beginning of the experiment you cannot conclude that photosynthesis has occurred. The starch might be permanently present in this leaf. Also, in the absence of an experimental design (with a control), there is no telling where the starch has come from. It might have been produced from sucrose which was transported to the leaf from another part of the plant.

FLOWERING PLANTS

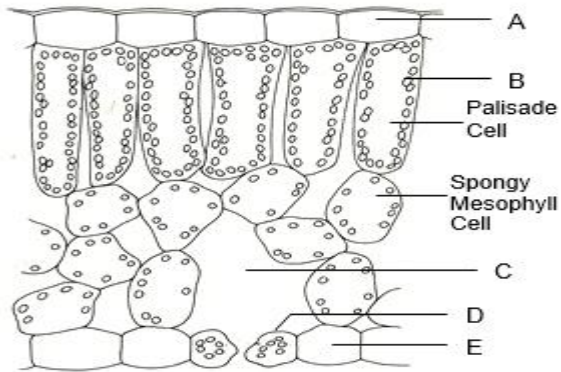
Plant Structure - Questions

1. Name the parts of the plant shown in the drawing.

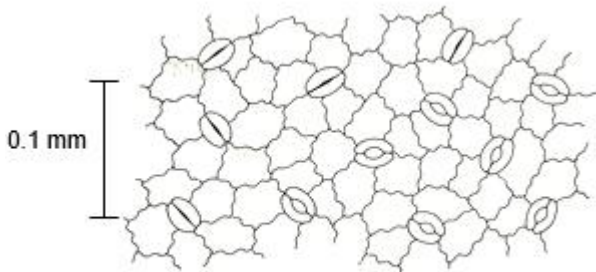


2. Match the structures stem, leaf, root, terminal bud, lateral bud to the following functions:
(a) produces carbohydrates
(b) carries water to leaves
(c) absorbs sunlight
(d) continues growth in height
(e) absorbs mineral salts
(f) makes branches
(g) anchors plant in soil
(h) conducts food to roots
(i) evaporates water
(j) produces new leaves
(k) spaces out leaves
(l) produces flowers
(m) absorbs carbon dioxide
(n) absorbs water.

3. The drawing represents a vertical section through a leaf x 200



- (a) Name the parts indicated by the letters A - E.
- (b) What differences can you see between the palisade cells and the spongy mesophyll cells
- (c) What is the function of C?
- (d) (i) Name the features represented in the diagram, which are thought to adapt the leaf to its function in photosynthesis.
(ii) Say how these features help to promote this process.
- (e) State three other structural features, not shown in the drawing, which are thought to be adaptations to the process of photosynthesis in most leaves.
Explain briefly how these features contribute to the efficiency of photosynthesis.
4. Which of the following are most likely to be true? When the stomata are open, the leaf is
- | | |
|------------------------------|-------------------------------|
| (a) absorbing oxygen | (d) giving off carbon dioxide |
| (b) giving off water vapour | (e) giving off oxygen |
| (c) absorbing carbon dioxide | |
5. Study the diagram below



(a) How many stomata are shown in this drawing of leaf epidermis?

- (b) How many of the stomata are open?
 (c) How many are likely to be open at night?
 (d) What is the magnification of the drawing?
6. (a) What process is responsible for the movement of carbon dioxide into a leaf?
 (b) In what conditions might the same process cause oxygen to enter a leaf?
7. The diagrams represent transverse sections through a root and a stem.
 (a) Say which one represents the stem and which one represents the root, giving your reasons.
 (b) Name the parts of these organs represented by the letters A-J

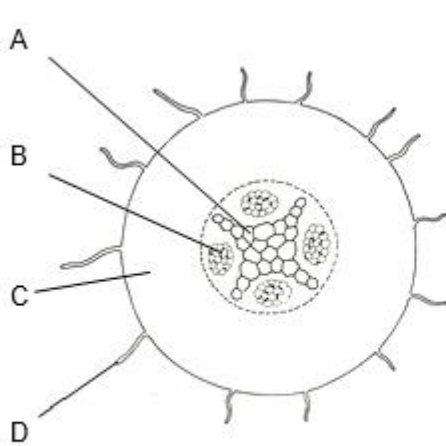


Figure 1

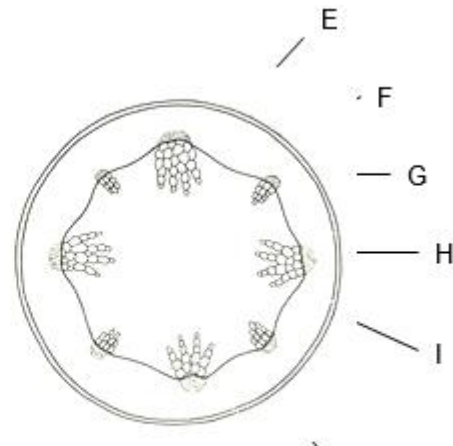


Figure 2

Plant Structure – Answers

1. A-terminal bud, B-leaf, C-lateral bud, D-stem, E-lateral root, F-root (tap root),
2. The stem (b) carries water to the leaves, (h) conducts food to the roots and (k) spaces out the leaves. If the stem is green it may also (a) produce carbohydrates and (c) absorb sunlight. If it is not covered by bark, the stem will probably (i) evaporate water. The leaf (a) produces carbohydrates, (c) absorbs sunlight and (i) evaporates water. The root (e) absorbs mineral salts, (g) anchors the plant in the soil and (n) absorbs water. The terminal bud (d) continues growth in height, (j) produces new leaves and may (l) produce flowers. The lateral bud (f) makes branches, (j) produces new leaves and may (l) produce flowers.
3. (a) A - upper epidermis, B - chloroplast, C - air space (intercellular space), D - guard cell, E - lower epidermis.
 (b) The palisade cells are elongated and have many chloroplasts; the spongy mesophyll cells are rounded and have fewer chloroplasts.
 (c) The air space C permits the diffusion of oxygen, carbon dioxide and water vapour to or from the cells inside the leaf.

(d) (i) and (ii) The elongated palisade cells allow the sunlight to penetrate without being absorbed by cell walls. The abundant chloroplasts in the palisade cells absorb and use the energy from sunlight. The chloroplasts are more abundant in the upper layers where most sunlight is received, the stoma allows entry of carbon dioxide for photosynthesis; the air space allows the gas to reach the photosynthesising cells.

(e) Most leaves are broad and offer a large absorbing surface to the sunlight, which they need for photosynthesis. They are also mostly thin, a feature which reduces the distance over which carbon dioxide has to diffuse in order to reach photosynthesising cells in the leaf. The branching network of veins in a leaf delivers water to the cells which need it for photosynthesis.

4. When stomata are open the leaf will be (b) giving off water vapour. If the stomata are open, it is likely to be daylight and therefore the leaf will be photosynthesising and thus (c) absorbing carbon dioxide and (e) giving off oxygen.
5. (a) There are twelve stomata in the drawing.
(c) None of them is likely to be open at night.
(b) Seven of them are open.
(d) The magnification is x200
6. (a) Diffusion is responsible for the movement of carbon dioxide into a leaf.
(b) Oxygen will diffuse into a leaf when the concentration of oxygen inside the leaf is lower than its concentration in the air outside. This might occur in low light intensities when the rate of respiration exceeds the rate of photosynthesis.
7. (a) Figure 1 represents a transverse section through a root. The presence of root hairs and the central position of the vascular tissue (xylem and phloem) are the features which identify this structure as a root.
Figure 2 represents a transverse section through a stem. The diagnostic features are the distinct epidermis, the central pith and the distribution of vascular bundles round the periphery.
(b) A-xylem (or vessels), B-phloem, C-cortex, D-root hair, E-epidermis, F-cortex, G-phloem, H-xylem (or vessels), I-cambium, J- pith.

Transport in Plants Questions

1. All of the following statements are true but which one is the most precise? Water is conducted through plant stems in
(a) the xylem, (b) vascular bundles, (c) vessels, (d) veins.
2. Which of the following statements is the most accurate?
(a) Food can travel up the stem in the phloem.
(b) Food can travel down the stem in the phloem.
(c) Food can travel up or down the stem in the phloem.
(d) Food can travel up or down the stem in the xylem.
3. Roots have no chlorophyll and grow in darkness. So how do roots obtain their food?

4. Which of the following conditions is least likely to increase the rate of transpiration in a plant?
 - (a) a rise in temperature
 - (b) an increase in humidity
 - (c) increased air movement
 - (d) increased sunlight

5. Which of the following statements are true of transpiration
 - (a) it draws water up the stem
 - (b) it draws dissolved salts up the stem
 - (c) it draws food up the stem
 - (d) it has a cooling effect on the leaves
 - (e) it speeds up photosynthesis?

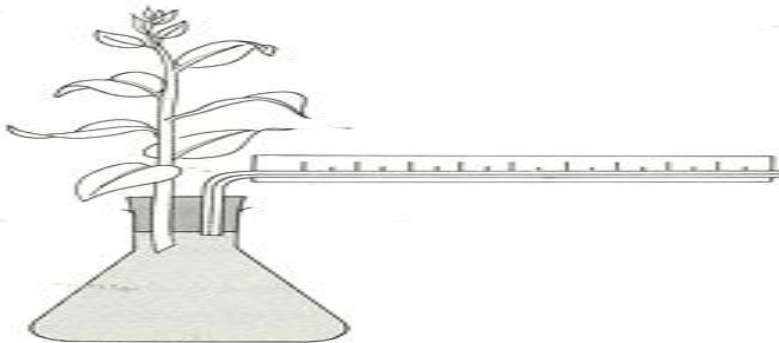
6. Osmosis and transpiration both play a part in the movement of water through a plant. Which of these two processes makes the greater contribution to the movement of water up the trunk of a tree?

7. Which of the following statements are true? A potometer is an apparatus which can be used to:
 - (a) measure the rate of water uptake in a shoot
 - (b) measure the rate of transpiration in a shoot
 - (c) measure the rate of photosynthesis in a shoot
 - (d) compare rates of transpiration in different conditions

8. Most of the water taken up by a plant passes through it and is evaporated to the atmosphere. What use is made of the tiny fraction of this water which is retained by the plant?

9. A student set up a potometer in the laboratory and measured the rate of movement of water in the capillary. An average of four readings gave a rate of 50mm per minute. The apparatus was then taken outside, where there was a light breeze. Four more readings were taken without delay. The average of these readings was 130 mm per minute. The student concluded that exposure of the shoot to rapid air movement had increased the rate of transpiration. Criticise the design of the experiment and the student's conclusions.

10. The drawing on the right represents a design for a potometer. Criticise the design and practicability of the apparatus.



11. A pot plant was watered and the pot enclosed in a plastic bag tied securely round the base of the stem. The plant was weighed at 9 a.m. and 4 p.m. During this time it lost 32g in weight.
- (a) From these results, what was the plant's rate of transpiration?
 - (b) Why might this calculated rate be slightly inaccurate (i) in daylight, (ii) in darkness?
 - (c) What was the point of (i) watering the plant, (ii) enclosing the pot in a plastic bag?

Transport in Plants - Answers

1. The most precise statement is (c).
2. The most accurate statement is (c). Statements (a) and (b) are correct but incomplete. Statement (d) is wrong.
3. Food made in the leaves is transported to the roots in the phloem of the vascular bundles
4. (b) An increase in humidity is likely to slow down the rate of transpiration.
5. Transpiration (a) draws water and (b) dissolved salts up the stem, and also (d) has a cooling effect on the leaves.
6. In a mature tree (in full leaf) transpiration makes by far the greater contribution to water movement through the trunk.
7. Statements (a), (b) and (d) are correct.
8. The water retained by a plant is used for photosynthesis and other chemical reactions. It is also used for maintaining cell turgor.
9. By taking the second set of readings 'without delay', the student did not allow time for a new rate to become established. The student should either have waited for 5 minutes or, better, kept taking readings until four of them were nearly the same.
When the apparatus was taken outside, several variables were changed, e.g. light intensity, temperature, humidity and air movement. There is no way of knowing which of these was contributing to the increased transpiration rate. It would have been better to vary just one condition while remaining in the laboratory, e.g. moving the apparatus from shade to sunlight.
10. The large volume of water in the conical flask, connected to a narrow capillary will behave like a giant thermometer. Small changes in temperature will produce large movements in the water column.
There is no way of re-setting the water column.
The cork will have to be removed and the apparatus set up again each time a new reading is wanted.
11. (a) The plant lost 32g in 7 hours, so its rate of transpiration was 4.6g per hour.

(b) (i) In daylight, the weight loss due to transpiration will be reduced by a gain in weight resulting from photosynthesis.

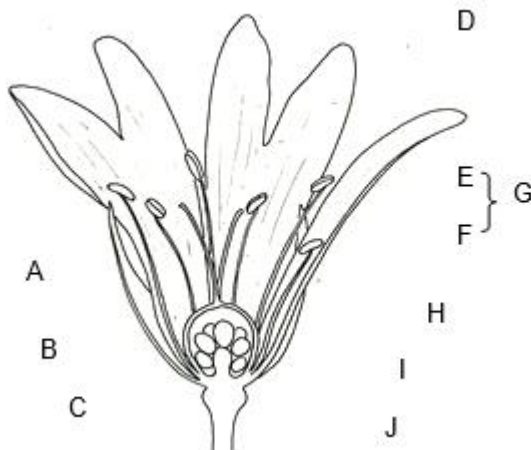
(ii) In darkness some of the decrease in weight will be due to the loss of water and carbon dioxide produced by respiration.

(c) (i) If the plant had been short of water, this might have restricted the rate of transpiration.

(ii) The plastic bag prevented evaporation taking place from the pot or the soil. Had this evaporation not been prevented, the weight loss could not have been attributed solely to transpiration.

Reproduction in flowering plants - Questions

1. Which is the most accurate statement? The principal role of a flower in the life cycle of a plant is:
 - (a) attracting insects
 - (b) producing seeds
 - (c) producing pollen
 - (d) producing nectar
2. Name the parts A-J shown on this drawing of a half-flower of a Stitchwort.



3. What is (a) the male gamete, and (b) the female gamete in a flowering plant?
4. Complete the following paragraph selecting words from the list below. Pollination is the transfer of from the to the in a flower. In cross-pollination, the from a flower on one is transferred to the of another of the same species.
anthers, ovule, stigma, plant, flower, pollen, ovary, petal, style, receptacle, stamens
5. Complete the following sentences:

In a flowering plant fertilisation occurs when theof the fuses with theof the After fertilisation , the becomes the and the becomes the

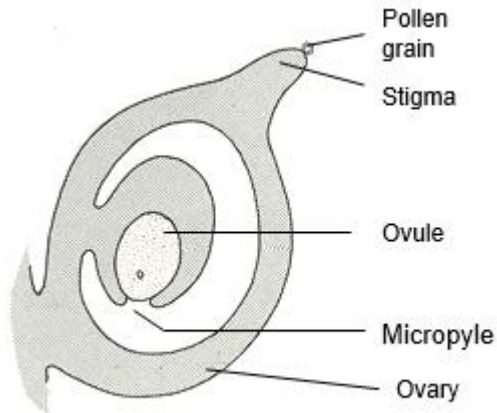
6. Which of the following statements is correct? In flowering plants:
 - (a) pollination can take place without fertilisation
 - (b) fertilisation can take place without pollination
 - (c) pollination and fertilisation are the same
 - (d) pollination and fertilisation must occur at the same time

7. Some species of plant are strongly adapted to pollination by certain insects. Which of the following characteristics would you regard as adaptations to pollination by bees:

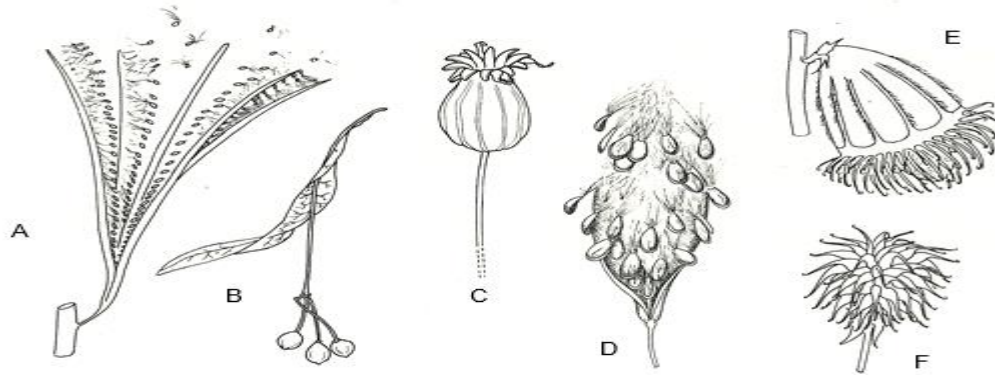
(a) white or coloured petals	(f) small green petals
(b) light, smooth pollen grains	(g) production of nectar
(c) spiky or sticky pollen grains	(h) production of pollen
(d) anthers and stigma inside the flower	(i) production of scent?
(e) anthers and stigma protruding from the flower	

8. A bee visits several flowers in succession on a single willow herb plant. In doing so, the bee transfers pollen from the younger flowers, near the top of the inflorescence (group of flowers) to the older flowers near the base of the inflorescence. Is this an example of self-pollination or cross-pollination?

9. Complete the drawing to show what has to happen before fertilization can occur



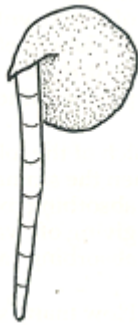
10. The drawings show seeds or fruits of different plants.



(a) From the appearance of the structures, make a guess at how each one is dispersed giving reasons for your answers.

(b) What are the advantages to a plant of an effective method of seed dispersal?

11. The root of the pea seedling is marked with equally spaced lines as shown here. Draw what you would expect to see in two days' time if the root



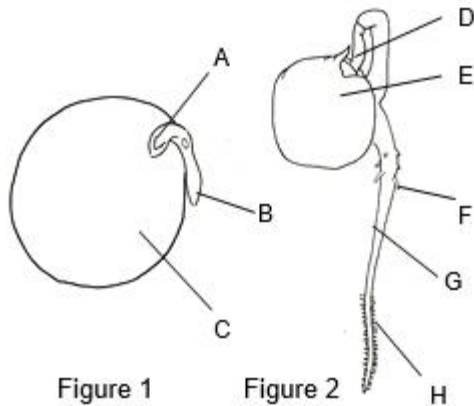
- (a) grew only from the tip
- (c) grew only at the top
- (b) grew uniformly along its length
- (d) did not grow.

12. (a) What conditions do most seeds need in order to begin germination?

(b) What other condition do the seedlings need to continue growth to mature plants?

13. How would you design, in principle, an experiment to test the hypothesis that a certain

14. variety of lettuce seed needed daylight in order to germinate? Figure 1 represents a pea seed split open to show its structure. Name the parts A-C and state the function of each. Figure 2 represents a pea seedling-5 days after germination. Name the parts D-H.



15. The early stages of germination take place in the soil where there is little or no light for photosynthesis. How does the seedling obtain materials for its growth and energy during needs during this time?

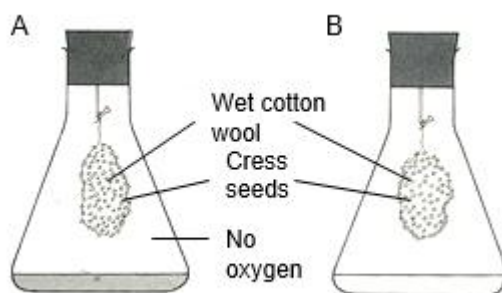
16. You are asked to set up an experiment to investigate the effect of temperature on the rate of germination. You place ten soaked peas in each of three flower pots containing moist sand. One pot is placed in a refrigerator at 4°C, one is placed in a cupboard at room temperature (about 18°C) and the third is placed in an incubator at 25°C. You leave them for a week, checking each day that the sand is kept moist.

(a) How would you judge the results?

(b) Why was the pot, at room temperature, kept in a cupboard rather than on the laboratory bench?

17. Starch is one of the most common storage product in seeds. What happens to the starch before it can be used by the germinating seed?

18. The diagram represent an experiment to test the hypothesis that seeds need oxygen in order to germinate.



(a) What is the liquid in A and what does it do?

(b) What is the liquid in B and what does it do?

(c) Which of the two flasks represents the control and what is its purpose?

(d) What results would you expect

- (i) if oxygen is necessary for germination
(ii) if oxygen is not necessary for germination?
19. What differences would you expect to see between pea seedlings grown for 10 days in total darkness and pea seedlings grown in the light for the same period of time?

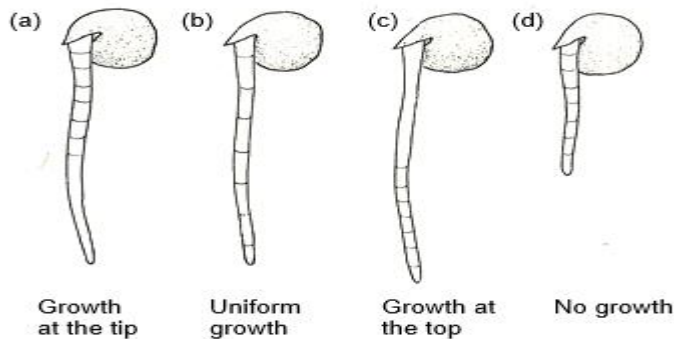
Reproduction in flowering plants - Answers

1. The most accurate statement is (b). A flower's principal role is seed production. Statements (a), (c) and (d) are true of many plants but these are functions which may help bring about seed production.
2. A-stigma, B-style, C-sepal, D-petal, E-anther, F-filament, G-stamen, H-ovary, I-ovule, J-receptacle.
3. (a) The male gamete in a flowering plant is the pollen grain (strictly, the gamete is the male nucleus in the pollen grain).
(b) The female gamete is the egg cell in the ovule.
4. Pollination is the transfer of pollen from the anthers (or stamens) to the stigma in a flower. In cross-pollination, the pollen from a flower on one plant is transferred to the stigma of another plant of the same species.
5. In a flowering plant, fertilisation occurs when the nucleus of the pollen grain fuses with the nucleus of the egg cell. After fertilisation, the ovule becomes the seed and the ovary becomes the fruit.
6. Statement (a) is correct, though normally fertilisation will follow pollination if the pollen and stigma are compatible.
7. Characteristics which are regarded as adaptations to pollination by bees are: (a) white or coloured petals, (c) spiky or sticky pollen grains, (d) anthers and stigma inside the flower, (g) production of nectar, (i) production of scent. Some of these features could equally well be adaptations to pollination by butterflies.
8. Transfer of pollen between flowers on the same plant is self-pollination; so is transfer of pollen within the same flower.
9. The drawing should show a pollen tube growing from the pollen grain to reach the micropyle of the ovule.



10. A (willow herb) and D (Asclepias) have seeds dispersed by the wind. The fine fluffy hairs act as parachutes. E (Agrimone) and F (herb bennet) are dispersed by animals.. The fruits have hooks which catch in the animal's fur. B (lime) and C (campion) are also wind dispersed. The lime has a bract which functions as a wing, slowing down the fruit's rate of fall. The campion is an example of the censer mechanism in which seeds are shaken out of the fruit capsule when the wind sways the long stalk.

11. Answers



12. (a) Most seeds need water, oxygen and a certain minimum temperature (warmth) to start germinating.

(b) To grow to maturity the seedlings will also need mineral salts from the soil and sunlight for photosynthesis.

13. You would need as large a sample of seeds as was convenient for counting, say 30. The seeds would be provided with water and a suitable temperature. The seeds, in a suitable container, would be placed in a light-proof box or cupboard for a period long enough to allow germination. The box or cupboard would not be opened during this period. The same number of seeds, from the same batch (same packet), would be given identical conditions of moisture and temperature but placed in daylight for the same period of time. At the end of this period the numbers of seeds which germinated in each case would be counted and compared.

14 Figure 1: A-plumule, will form the plant's shoot;

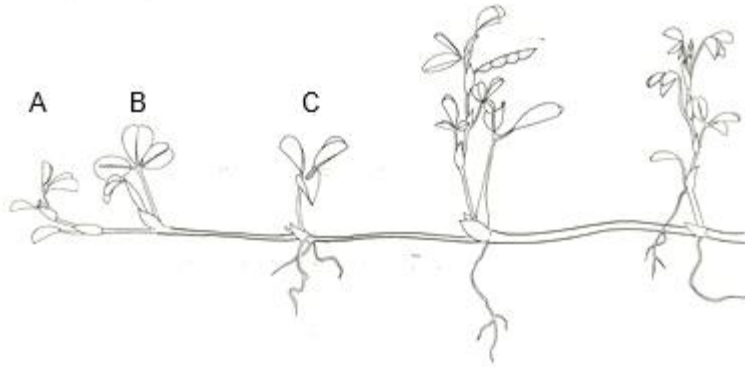
B-radicle, will form the plant's first root; C- cotyledon, stores food, mainly starch and protein.

Figure 2: D-plumule, E-testa, F-lateral root, G-radicle (root), H-root hairs.

15. In the early stages of germination, the seedling derives the materials for its growth and energy from food stored in the cotyledons (for dicotyledonous plants).
16. (a) To compare the extent of germination at each temperature you would need to measure the height of the shoots and the lengths of the roots of the seedlings from each pot. The measurements for each temperature would then be averaged and compared. You could also count the number of leaves and lateral roots, if any.
 (b) Because the seeds in the refrigerator and incubator would be in darkness, it was necessary to keep the ones at room temperature in darkness as well; otherwise, any difference in germination might be attributed to a difference in light rather than to a difference in temperature.
17. Starch is insoluble and has to be converted, by enzymes, to soluble sugars before it can be transported and used in the seedling.
18. (a) The liquid in flask A is a mixture of pyrogalllic acid and sodium hydroxide in water (a solution of sodium pyrogallate). This solution absorbs oxygen (and carbon dioxide) from the air in the flask.
 (b) The liquid in B is sodium hydroxide solution. It absorbs carbon dioxide from the air in the flask. (Some experiments may use water rather than sodium hydroxide solution, but this is less satisfactory.)
 (c) Flask B represents the control. It shows that, if oxygen is present, cress seeds can germinate even in these artificial conditions and also in the absence of carbon dioxide (if sodium hydroxide is used).
 (d) (i) If oxygen is necessary for germination the cress seeds should germinate in B but not in A.
 (ii) If oxygen is unnecessary, the cress seeds should germinate in both flasks.
19. The seedlings grown in darkness will have long, thin, white stems (long internodes) and small, unopened leaves. The seedlings grown in the light will have shorter, thicker greenish stems (short internodes). The leaves will have opened up and will be green, and larger than those of the seedlings in darkness.

Asexual reproduction and cloning in plants - Questions

- In natural vegetative propagation, which of the following structures are most likely to give rise to new individuals: (a) stems, (b) roots, (c) buds, (d) leaves, (e) flowers?
- The drawing shows a plant which reproduces vegetatively.
 - What will need to happen before shoots A - C become independent plants?
 - How might a gardener assist this process?
 - What name is given to the horizontal stem in this kind of propagation?
 - Name a commercially grown fruit whose plants are propagated in this way



3. Before stem cuttings are planted, the cut end of the stem is often dipped in a hormone powder. What is the point of this?
4. The following are thought to be some of the advantages of either vegetative reproduction or sexual reproduction: produces greater variety in the offspring, good at colonising new areas, reduces competition from other species, maintains desirable qualities in the offspring, good at colonising favourable areas. Make a table with these qualities under the headings of 'Sexual reproduction' and 'Vegetative reproduction'.
5. If a gardener wanted to propagate a useful variety of apple tree in a way which maintained all its desirable qualities, which of the following techniques would be used:
 - (a) planting stem cuttings in potting compost
 - (b) grafting stem cuttings onto a rootstock
 - (c) grafting buds on to a root stock
 - (d) growing the seeds produced from the useful variety
 - (e) cross-pollinating the variety with another good variety and growing the seeds resulting from the cross?
6. What name is given to the population of genetically identical offspring which result from a process of asexual (vegetative) reproduction?
7. Which structures of a flowering plant give rise to (a) potatoes, (b) the fleshy scales of an onion?
8. In the process of tissue culture in plants, what is needed to induce the formation of a complete plant, in addition to a growth medium with nutrients?

Asexual reproduction and cloning in plants - Answers

1. The plant structures most likely to give rise to new individuals are (c) buds and (a) stems (because stems carry buds).
2. (a) The shoots A-C would need to develop a root system and produce enough leaves to maintain the shoots' food supply by photosynthesis. To become fully independent of the parent plant the stem connecting the daughter plants to the parent must die and disappear.

(b) Gardeners may assist this process by pegging down the potential daughter plants at the nodes, to encourage root growth. The connecting stems can later be cut.

(c) The horizontal stem is called a runner.

(d) The most familiar fruit propagated by runners is the strawberry.

3. The hormone powder contains a plant growth substance which promotes the formation of roots. It may also contain a fungicide which reduces the chance of fungus attack on the cut stem.

4. Answer

Sexual reproduction	Vegetative reproduction
Greater variety in the offspring	Reduces competition from other species
Good at colonising new areas	Maintains desirable qualities
	Good at colonising favourable areas

5. To propagate a useful variety of apple tree the gardener would graft either stem cuttings (b) or buds (c) on to a rootstock. Stem cuttings (a) from apple trees do not usually produce roots but, for other species, this is a method of propagation which maintains the genetic characteristics of the parent. The seeds from cultivated varieties do not breed true.

6. The population of genetically identical offspring from asexual reproduction is called a 'clone'.

7. (a) A potato is a tuber formed at the end of an underground stem (b) Onion scales are modified leaves containing a food store.

8. The appropriate plant growth substances ('hormones') would need to be added.

HUMAN PHYSIOLOGY

Food and diet - questions

1. State three main ways in which the body uses food.
2. Write down the words missing from the following paragraph: Fats and carbohydrate both provide the body with, but fats can provide as much as carbohydrates. Excess fats can be stored in the body but carbohydrates must be changed into or before they can be stored. The main types of carbohydrates are, and Examples of foods rich in starch are and foods rich in fat are and
3. In what form is most. carbohydrate taken in the normal diet?
4. Write down the words omitted from the following paragraph: Proteins are made up of about 20 different One example of a plant product rich in protein is An

animal product rich in protein is When a protein is digested, it is broken down into its constituent and these are later built up in the body to make new Excess proteins which are not used for making new cells or tissues are converted to which can be stored or used to provide

5. Which of the following are not rich in carbohydrate: bread, fish, potatoes, beans, meat, lettuce, sugar, biscuits?
6. (a) Carbohydrates contain the elements , and
(b) Proteins contain these elements but also and
7. (a) Name the mineral elements needed by (i) bones, (ii) red blood cells, (iii) the thyroid gland
(b) Which of these elements is (i) present in milk, (b) lacking in milk?
8. State one benefit of including vegetable fibre (roughage) in the diet..
9. (a) Which vitamin helps to maintain resistance to infectious diseases?
(b) Name two foods which are a good source of this vitamin.
10. (a) Which vitamin is necessary for the proper development of the skeleton?
(b) Name two foods which are a good source of this vitamin.
11. A balanced diet must contain enough energy to meet the body's needs. What else must it contain?
12. Could you survive on a diet which contained no carbohydrate?
13. Western diets are often unhealthy because they contain too much andand not enough
14. How does refrigeration help to stop food from going bad?
15. Give one method of pasteurisation of milk.
16. (a) Name two food additives needed to keep food wholesome, and say what they do.
(b) Name two food additives (or types of additive) which are not necessary for keeping food wholesome.
17. (a) Heating a food sample with Benedict's solution is a test for
(b) A test for starch is to add solution to the food.
(c) In the biuret test for protein and solutions are added to the sample. A colour indicates the presence of protein.

Food and diet - answers

1. The body uses food (i) for energy, (ii) for growth (making new cells), (iii) repairing or replacing tissues.
2. Fats and carbohydrates both provide the body with energy but fats can provide twice as much as carbohydrates. Excess fats can be stored in the body but carbohydrates must be changed into glycogen or fat before they can be stored. The main types of carbohydrates are starch, sugar and cellulose. Examples of food rich in starch are (e.g.) potatoes and bread. Foods rich in fats are (e.g.) butter, cheese or fatty meat.
3. Most carbohydrate is taken in as starch.
4. Proteins are made up of about 20 different amino acids. One example of a plant product rich in protein is beans (or wheat or maize). An animal product rich in protein is meat (or eggs or cheese or fish). When a protein is digested, it is broken down into its constituent amino acids and these are later built up in the body to make new cytoplasm (or cells or tissues). Excess proteins which are not used for making new cells or tissues are converted to glycogen which can be stored or used to provide energy.
5. Fish, meat and lettuce contain little or no carbohydrate.
6. (a) Carbohydrates contain the elements carbon , hydrogen and oxygen.
(b) Proteins contain these elements but also nitrogen and sulphur.
7. (a) (i) Bones need calcium, (ii) red blood cells need iron, (iii) the thyroid gland needs iodine. (b) (i) Milk contains calcium, (ii) milk is deficient in iron.
8. Vegetable fibre retains water (keeping the faeces soft and bulky), prevents constipation, reduces the chance of disease of the large intestine (any one).
9. (a) Vitamin A (retinol) helps maintain resistance to infectious disease.
(b) Liver, cheese, butter, margarine, milk, eggs, green vegetables, carrots (any two) are a good source.
10. (a) Vitamin D (calciferol) is necessary for the healthy development of the skeleton. (b) Butter, milk, cheese, egg-yolk, liver, oily fish (any two) are a good source.
11. In addition to sufficient energy, a balanced diet must contain proteins, carbohydrates and fats in the right proportion, and water, vitamins, mineral salts and fibre.
12. It should be possible to survive without carbohydrate as energy can be obtained from fats and proteins.
13. Western diets are often unhealthy because they contain too much sugar and fat, and not enough fibre.
14. The low temperature of refrigeration slows down bacterial reproduction and enzyme reactions.

15. Pasteurisation may involve heating milk to 72°C for 15 seconds, or 60°C for 30 minutes.
16. (a) Preservatives such as sodium nitrite (cured meat) or sulphur dioxide (fruit juice) may be needed to stop bacteria growing in food.
 (b) Artificial colouring and flavouring are not necessary, nor are additives which simply cause the food to retain more water.
17. (a) Heating a food sample with Benedict's solution is a test for sugar. (Strictly, it is a test for a reducing sugar.)
 (b) A test for starch is to add iodine solution to the food.
 (c) In the biuret test for protein, sodium hydroxide and copper sulphate solutions are added to the sample. A mauve colour indicates the presence of protein.

Digestion - Questions

- Which one of the following structures is not part of the alimentary canal?
 (a) duodenum (c) liver
 (b) mouth (d) stomach:
- Name two digestive glands.
- What name is given to the muscular contraction which moves food along the alimentary canal?
- What do digestive enzymes do to food?
- What are the final digestion products of (a) protein, (b) fat, (c) starch?
- How does chewing food help to speed up digestion?
- Name the enzyme present in saliva and say what type of food it acts on.
- Are the contents of the stomach (a) acid, (b) alkaline, (c) neutral?
- What class of food is partially digested in the stomach?
- What is the name of the enzyme in gastric juice?
- What types of enzymes are produced by the pancreas?
- Into which part of the alimentary canal does the pancreas secrete pancreatic juice?
- What is the function of bile in digestion?

14. State three ways in which the absorbing surface of the small intestine is increased.

15. Into what body fluids do (a) glucose, (b) fatty acids, glycerol (c) amino acids pass?

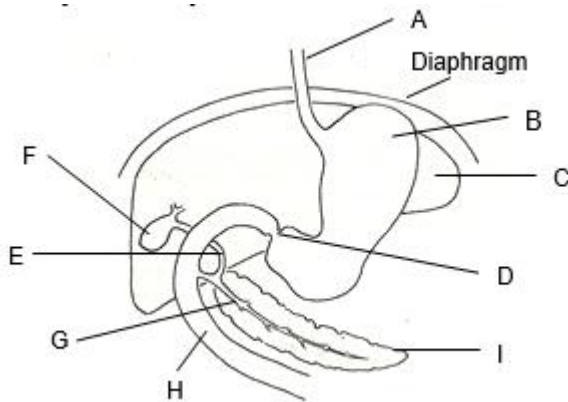
16. Fill in the missing words..

The blood from the intestine goes first to the before entering the general circulation. If the glucose concentration in the blood is above a certain level, it is changed to and stored. Glucose which passes into the general circulation is taken up by the body cells and used to provide

If there are excess amino acids in the blood from the intestine, the liver converts them to which is stored, and which is excreted by the kidneys..

17. What does the liver do to (a) hormones, (b) alcohol, (c) vitamin A?

18. Name the structures labelled A to I.



Digestion - answers

1. (c) The liver is not part of the alimentary canal.
2. Salivary gland, gastric gland, pancreas (any two).
3. Peristalsis.
4. Digestive enzymes dissolve food, make food soluble, break large insoluble food molecules into smaller, soluble molecules.
5. (a) Proteins are digested to amino acids, (b) fats are digested to fatty acids and glycerol, (c) starch is digested to glucose.
6. Chewing reduces food to portions small enough to be swallowed and increases the surface area of the food for digestive enzymes to act on.

7. The enzyme in saliva is salivary amylase and it acts on starch.
8. (a) The stomach contents are acid.
9. Proteins are partially digested in the stomach.
10. The enzyme in gastric juice is pepsin.
11. The pancreas produces enzymes which act on proteins (proteases), starch (amylase) and fat (lipase).
12. The pancreas releases pancreatic juice into the duodenum.
13. Bile emulsifies fats (breaks fats into small droplets).
14. The absorbing surface of the small intestine is increased by (a) being very long, (b) having internal folds, (c) having villi, (d) micro-villi on the epithelial cells.
15. (a) Glucose and (c) amino acids enter the blood stream, (b) fatty acids and glycerol may enter the blood or the lymph.
16. The blood from the intestine goes first to the liver before entering the general circulation. If the glucose concentration in the blood is above a certain level, it is changed to glycogen and stored. Glucose which passes into the general circulation is taken up by the body cells and used to provide energy. If there are excess amino acids in the blood from the intestine, the liver converts them to glycogen which is stored, and urea which is excreted by the kidneys.
17. The liver (a) converts hormones to inactive compounds, (b) oxidises alcohol to carbon dioxide and water, (c) stores vitamin A.
18. (A) gullet (oesophagus), (B) stomach, (C) liver, (D) pyloric sphincter, (E) bile duct, (F) gall bladder, (G) pancreatic duct, (H) duodenum, (I) pancreas.

The blood circulatory system questions

1. How do white cells differ from red cells
 - (a) in their structure,
 - (b) their function?
2. Where are blood cells made in the body?
3. Name two proteins carried in the plasma.
4. What else is carried in the plasma?

5. Put the following events in their correct order starting with the first one listed: atria fill with blood, semi-lunar valves close, tricuspid and bicuspid valves close, ventricles contract, semi-lunar valves open, atria contract, ventricles relax, tricuspid and bicuspid valves open
6. Fill in the missing words.
Oxygenated blood from the lungs returns to the ...(A)... atrium of the heart in the ...(B)... vein. From here it enters the ...(C)... ventricle and leaves the heart in the ...(D)... to go to the body. From the body.....(E)...blood returns via the ...(F)...to the ...(G)... atrium, and then leaves the heart in the ...(H)..... artery to go to the ...(I)....
7. Which one of the following is not a characteristic of capillary blood vessels?
 - (a) Repeatedly branched.
 - (b) Small diameter.
 - (c) Permeable to salts (ions)
 - (d) Thick walled.
8. Arteries carry blood the heart. Veins carry bloodthe heart.
9. In which parts of the circulatory system are there valves?
10. What is the connection between tissue fluid, plasma and lymph?
11. How is lymph propelled through the lymphatics?
12. What is the function of lymph nodes?
13. Complete the table.

Substance	Transported by the blood	
	<i>From</i>	<i>To</i>
Oxygen	(A)	whole body
(B)	whole body	lungs
(C)	liver	kidneys
(D)	intestine	(E)
Heat	(F)	(G)

14. After a period of vigorous activity you would expect blood leaving a muscle to have
 - (a) less carbon dioxide, less oxygen and less glucose
 - (b) more carbon dioxide, more oxygen and less glucose
 - (c) more carbon dioxide, more oxygen and more glucose
 - (d) more carbon dioxide, less oxygen and less glucose.
15. Blood from the alimentary canal returns to the heart by way of

- (a) hepatic vein and vena cava
- (b) hepatic artery, hepatic vein and vena cava
- (c) hepatic portal vein and vena cava
- (d) hepatic portal vein, hepatic vein and vena cava.

16. Describe briefly how platelets, fibrin and red cells interact to form a blood clot.
17. Briefly describe the principal lines of defence against bacteria entering the blood system.
18. The substances produced by lymphocytes to combat bacterial cells are called
- (a) antigens,
 - (b) antibodies,
 - (c) antidotes,
 - (d) antitoxins.
19. You may acquire natural, active immunity to a disease if
- (a) you are injected with an antibody to the disease
 - (b) you recover from an attack of the disease
 - (c) you are inoculated, against the disease
 - (d) you are born with antibodies to the disease?
20. In each case, give an example of a disease to which immunity can be acquired by injecting
- (a) an inactivated bacterial toxin
 - (b) a killed bacterium
 - (c) an antibody.
21. A person: whose blood group is AB can receive a blood transfusion from
- (a) group O only
 - (b) group AB only
 - (c) groups A and B
 - (d) any group.
22. Apart from any inherited tendency towards coronary heart disease, what are thought to be the four main risk factors?

The blood circulatory system - Answers

1. (a) White cells have nuclei, red cells do not have nuclei. Some white cells can change their shape, red cells cannot.
(b) White cells ingest bacteria or make antibodies. Red cells carry oxygen.
2. Blood cells are made in the red bone marrow, e.g. in the ribs, sternum or vertebrae.
3. Fibrinogen, albumin and globulin (any two) are plasma proteins.
4. In addition to proteins, plasma contains salts (ions), glucose, lipids and amino acids, hormones, carbon dioxide and urea.

5. (1) Atria fill with blood, (2) ventricles relax, (3) semi-lunar valves close, (4) atria contract, (5) tricuspid and bicuspid valves open, (6) ventricles contract, (7) bicuspid and tricuspid valves close, (8) semi-lunar valves open.
Note: The order of semi-lunar valves and bicuspid and tricuspid valves may be reversed as their action is virtually simultaneous.
6. The missing words are: (A) left, (B) pulmonary, (C) left, (D) aorta, (E) deoxygenated, (F) vena cava, (G) right, (H) pulmonary, (I) lungs.
7. (d) Capillaries are thin-walled, not thick-walled.
8. Arteries carry blood from the heart. Veins carry blood to the heart.
9. There are valves in the heart (between each atrium and ventricle, in the aorta and pulmonary artery), in some of the large veins and in some of the lymphatics.
10. Tissue fluid is plasma (minus its proteins) which has leaked out of the capillaries. Lymph is tissue fluid which has entered the lymphatics.
11. Some of the larger lymphatics are able to contract, otherwise the lymph is propelled by body muscles which contract and 'squash' the lymphatics.
12. Lymph nodes contain white blood cells which ingest bacteria and prevent them from reaching the circulation.
13. Oxygen is transported from the lungs (A) to the whole body. Carbon dioxide (B) is transported from the whole body to the lungs. Urea (C) is transported from the liver to the kidneys. Digested food (D) is transported from the intestine to the whole body (E) (via the liver).
Heat is transported from active muscles (F) to the whole body (G).
14. (d) Blood leaving a muscle will have more carbon dioxide, less oxygen and less glucose as a result of respiration.
15. (d) Blood from the alimentary canal returns to the heart by way of the hepatic portal vein, hepatic vein and vena cava.
16. Platelets release a substance which, indirectly, causes fibrinogen to be converted to fibrin. The fibrin forms a network which traps red cells to form a clot.

17. A blood clot forms a barrier to entry by bacteria. White cells ingest and kill bacteria. Antibodies from lymphocytes inactivate bacteria or make them easier to ingest. White cells in lymph nodes trap bacteria.
18. (b) The anti-bacterial substances produced by lymphocytes are called antibodies.
19. (b) If your immunity is acquired, natural and active, it must result from having recovered from a disease.
20. (a) Diphtheria and tetanus vaccines are prepared from the inactivated toxins (toxoids).
(b) Whooping cough vaccine is prepared from the dead bacteria.
(c) Temporary immunity to tetanus, rabies and chicken pox can be produced by injecting antibodies to these diseases.
21. (d) Group AB persons have neither anti-A nor anti-B antibodies in their plasma, so red cells from any donor will not be clumped.
22. The four main risk factors for coronary heart disease are thought to be (i) smoking, (ii) high blood pressure (possibly accentuated by stress), (iii) high blood cholesterol (possibly aggravated by a fatty diet), (iv) lack of exercise.

Breathing - Questions

1. Energy is obtained from food by a process called(A).....
(b) The intake of oxygen and output of carbon dioxide at a respiratory surface is called(B).....(c) The process of renewing air in the lungs is called(C)..... (d) Which of the processes A-C are included in the term 'breathing'?
2. Name, in the correct order, the structures that incoming air would pass through between the nasal cavity and the alveolus.
3. What is the function of the rings of cartilage in the respiratory passages?
4. Using the words 'cilia' and 'mucus', describe, very briefly, how the body gets rid of dust which enters the lungs.
5. Which of the following is correct: When we inhale
(a) our intercostal muscles contract and our ribs move down
(b) our diaphragm muscles contract and the ribs move up
(c) our diaphragm muscles contract and the ribs move down
(d) our intercostal muscles contract and the diaphragm muscles relax.
6. In what two ways will the composition of blood coming from the pulmonary artery differ from that going to the pulmonary vein?
7. The percentage of oxygen absorbed from the air in the lungs is always about the same, so how can the oxygen supply to the blood be increased during vigorous activity?

8. Inhaled air contains about 21 % oxygen. What is the approximate percentage concentration of oxygen in exhaled air?
9. Which of the terms (i) vital capacity, (ii) tidal volume, (iii) residual air, could reasonably apply to each of the volumes given below? (a) 500 cm³, (b) 5000 cm³, (c) 1000 cm³.
10. State four characteristics of an efficient respiratory surface.
11. What process causes oxygen to pass from the alveoli into the lung capillaries?
12. Which of the following diseases are unlikely to be caused by smoking: (a) lung cancer, (b) tuberculosis, (c) bronchitis, (d) colds, (e) heart attacks?

Breathing - answers

1. (a) Energy is obtained from food by a process called respiration (A).
(b) The intake of oxygen and output of carbon dioxide at a respiratory surface is called gaseous exchange (B).
(c) The process of renewing air in the lungs is called ventilation (C).
(d) The processes B and C are included in the term 'breathing'.
2. From the nasal cavity the air would pass through the (pharynx, glottis), larynx, trachea, bronchi and bronchioles to reach the alveolus.
3. The cartilage rings hold the air passages open.
4. The lining of the air passages produces mucus which traps dust particles. Cilia in the lining flick to and fro to carry the mucus up and out of the passages.
5. (b) When we inhale our diaphragm muscles contract and the ribs move up.
6. Blood in the pulmonary artery will contain less oxygen and more carbon dioxide than blood in the pulmonary vein.
7. Breathing becomes deeper and more rapid, thus exposing the capillaries to a greater volume of air in a given time.
8. Exhaled air contains approximately 16% oxygen.
9. (i) vital capacity: 5000 cm³, (ii) tidal Volume: 500 cm³, (iii) residual air: 1000 cm³.
10. Four characteristics of an efficient respiratory surface are: thin epithelium, large surface area, abundant capillaries, ventilation mechanism.
11. Diffusion is the process by which oxygen passes from the alveoli to the lung capillaries.

12. (b) Tuberculosis and (d) colds are unlikely to be caused by smoking (but it doesn't help).

Excretion and the kidneys - Questions

1. Name four substances that have to be excreted from the body.
2. Name three organs which have an excretory function.
3. Supply the missing words in the following paragraph:

Blood is taken to the kidney in the (A).... artery, which divides up into many arterioles. The arterioles enter the (B) of the kidney and supply thousands of glomeruli. In each glomerulus, (C) forces plasma minus its (D) out of the capillaries, and it collects in the (E) This liquid passes down the (F) where (G) ,(H) and (I) are reabsorbed into the blood. The remaining liquid, called (J) passes down the (K) and collects in the (L) before being expelled from the body.

4. In hot weather the urine becomes
 - (a) more concentrated and lighter in colour;
 - (b) more concentrated and darker in colour
 - (c) less concentrated and lighter in colour
 - (d) less concentrated and darker in colour.
5. Which of the following substances would you not normally expect to find in a sample of urine? (a) uric acid, (b) ammonia, (c) glucose, (d) sodium chloride, (e) urea.
6. Blood in the renal vein differs from that in the renal artery by having
 - (a) less oxygen, more carbon dioxide and less urea
 - (b) more oxygen, 'more carbon dioxide and less urea
 - (c) less oxygen, less carbon dioxide and less urea
 - (d) less oxygen, more carbon dioxide and more urea,
7. In what ways is water lost from the body?
8. If the concentration of solutes in the blood rises above a certain level, then
 - (a) more water is reabsorbed in the kidney tubules
 - (b) less water is reabsorbed in the kidney tubules
 - (c) more salt is reabsorbed in the kidney tubules
 - (d) less glucose is reabsorbed in the kidney tubules,
9. In a dialysis machine, which one of the following combination of substances is allowed to escape from the patient's blood into the bathing solution?
 - (a) Salts, water and glucose.
 - (b) Salts, urea and glucose.
 - (c) Water, urea and uric acid.
 - (d) Water, uric acid and glucose.

10. State two procedures which are used to reduce the chances of a kidney graft being rejected.
11. Make a table to show three organs which have a homeostatic function and in each case indicate two of the substances whose concentration they control.

Excretion and the kidneys - answers

1. Carbon dioxide, urea, uric acid, spent hormones, excess water and salts (any four) have to be excreted from the body.
2. The kidneys, lungs and liver have an excretory function.
3. The missing words are (A) renal, (B) cortex, (C) blood pressure, (D) proteins, (E) Bowman's capsule (or renal capsule), (F) renal tubule, (G) glucose, (H) salts, (I) water, (J) urine, (K) ureter, (L) bladder.
4. (b) In hot weather, urine becomes more concentrated and darker in colour.
5. (c) You would not normally expect to find glucose in a urine sample.
6. (a) Blood in the renal vein will have less oxygen and more carbon dioxide (as a result of the kidney's respiration) and less urea, than blood in the renal artery.
7. Water is lost from the body by evaporation (lungs and skin), urination and defaecation (faeces always contain water).
8. (a) If the concentration of solutes in the blood rises, more water is reabsorbed in the kidney tubules. (This helps to reduce the concentration of the blood.)
9. (c) Water, urea and uric acid can pass through the dialysis tubing into the bathing solution. (You could argue that, if the patient's blood contained excessive salts or glucose, these too would escape.)
10. Drugs are used to suppress the patient's immune response to foreign tissue. The donor is as closely related as possible to the patient (or the tissue types are very similar).

11. Answer

Organ	Substances regulated
Lungs	oxygen, carbon dioxide
Liver	glucose, amino acids
Kidneys	urea, uric acid, water, salts

The skin, and temperature control - Questions

1. From the list below, select the most appropriate words or phrases to complete the following sentences.
 - (a) Our skin protects us against(A)and(B).....
 - (b) Our skin helps to control (C) and(D)

touch and pressure, ultraviolet light, bacteria, evaporation of water, heat from the sun, body temperature.
2. Name the two main layers of the skin.
3. What are the main functions of (a) the basal (Malpighian) layer, (b) the cornified layer of the skin?
4. Make a list of the structures you would expect to find in the dermis.
5. What are likely to be (a) the coldest, (b) the warmest parts of the body?
6. What, approximately, is the normal range of body temperature?
7. List the ways in which the body might lose heat.
8. What (a) internal, (b) external events contribute to gain of heat in the body?
9. (a) What is 'vaso-constriction'?
(b) What are the effects of vaso-constriction in the skin?
10. Why should shivering contribute to heat gain in the body?
11. (a) What is meant by 'vaso-dilation'?
(b) What are the effects of vaso-dilation in the skin?
12. Sweating, by itself, will not cool the body. What has to happen to sweat if it is to have a cooling effect?
13. What do you understand by the term hypothermia?
14. Name two ways in which the chances of hypothermia can be reduced during outdoor activities.

The skin, and temperature control - answers

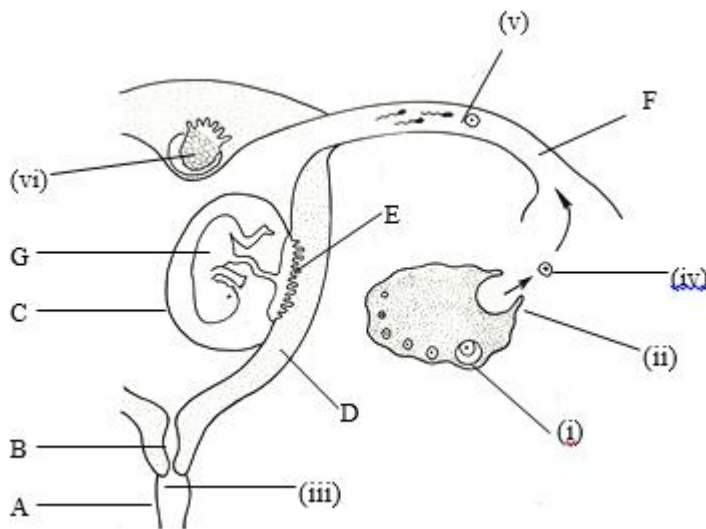
1. (a) Our skin protects us against bacteria (A) and ultraviolet light (B).
(b) Our skin helps to control body temperature (C) and evaporation of water (D).
2. The two main layers of the skin are the epidermis and dermis.

3. (a) The basal (Malpighian) layer produces new skin cells and the pigment, melanin, which protects against ultraviolet light.
(b) The cornified layer reduces evaporation from the skin and resists entry of bacteria.
4. In the dermis you would expect to find sensory nerve endings, nerve fibres, capillaries, arterioles and venules, sweat glands and ducts, sebaceous glands and hair follicles.
5. The extremities of the body (hands and fingers, feet and toes, ears and nose) are likely to be the coldest parts. The internal organs (particularly the brain and active muscles) are likely to be the warmest parts.
6. The approximate range of normal body temperature is 36-38 °C.
7. The body loses heat by conduction, convection, radiation and evaporation (from skin and lungs).
8. (a) Respiration in the tissues, particularly in the brain and active muscles, is the main internal source of body heat.
(b) Direct sunlight, a hot environment and hot food and drink are external sources of body heat.
9. (a) Vaso-constriction is the reduction in diameter of small arterioles and capillaries. (b) Vaso-constriction in the skin makes the skin look paler and reduces heat loss.
10. Respiration in the spasmodically contracting muscles produces heat.
11. (a) Vaso-dilation is an increase in diameter of small arterioles and capillaries.
(b) Vaso-dilation makes the skin go more pink and increases heat loss.
12. For sweat to have a cooling effect, it must evaporate. In doing this it takes heat from the body.
13. Hypothermia is a lowering of the 'core' temperature of the body to below 35°C.
14. Eating well before going out and wearing warm, wind-proof clothing can reduce the chances of hypothermia.

Human Reproduction - Questions

1. Fertilisation occurs when the(A)..... of the sperm cell fuses with the.....(B) of the..... (C)
2. State the differences between the male gametes and the female gametes with regard to (a) their size; (b) their structure, (c) their relative numbers.

3. Before fertilisation can occur, the sperms have to travel from the testes to meet an ovum in the female organs. Using the list below, name the organs, in the correct order, through which the sperms will have to pass. uterus, sperm duct, oviduct, urethra, cervix, vagina
4. (a) Explain what is meant by ovulation.
(b) How often does it occur in humans?
5. Explain why the chance of fertilisation in humans is restricted to only a few days each month.
6. The diagram below represents the events leading up to fertilisation (v), implantation (vi) and development. In each case name the structures involved and, at the numbers, state briefly what is happening or what has happened previously.



7. Blood from the fetus circulates through the placenta.
(a) What substances pass (i) from the maternal to the fetal blood, (ii) from the fetal to the maternal blood?
(b) By what means is the fetal blood circulated through the placenta?
8. What is the function of the umbilical cord?
9. What are the possible effects on the fetus if, during pregnancy, the mother (a) smokes, (b) catches rubella?
10. Describe the events which lead to the formation of (a) identical twins, (b) fraternal twins.
At an ante-natal clinic what can (a) blood tests, (b) urine tests reveal?
11. Place the following events in the correct order for natural childbirth.

amniotic fluid expelled, placenta expelled from uterus, baby's feet emerge from vagina, abdominal contractions begin, baby's head emerges from vagina, amnion breaks, cervix dilates, contractions of the uterus begin .

12. (a) What are the advantages of human milk over cows' milk for feeding babies?
(b) Apart from the composition of the milk, what are the other advantages of breast-feeding?
13. Name (a) the male sex hormone and (b) the female sex hormone which help bring about the changes at puberty .
14. After ovulation (a) what structure replaces the Graafian follicle, (b) what hormone does it produce?

Human reproduction - answers

1. Fertilisation occurs when the nucleus (A) of a sperm cell fuses with the nucleus (B) of the ovum (C).
2. (a) The sperm (male gamete) is much smaller than the ovum (female gamete).
(b) The ovum is spherical and contains more cytoplasm than the sperm, which is elongated with a 'tail'.
(c) Sperms are produced in much greater numbers than the ova.
3. Before fertilisation can occur, the sperms must pass through the sperm duct, urethra, vagina, cervix, uterus and oviduct.
4. (a) Ovulation is the release of an ovum from a mature follicle in the ovary.
(b) Ovulation occurs approximately once every 28 days.
5. Sperms can fertilise an ovum for up to about three days after entering the female reproductive system, and the ovum survives for about one day.
6. (A) vagina, (B) cervix, (C) amnion, (D) uterus, (E) placenta, (F) oviduct, (G) fetus. (i) Ovum matures in ovary, (ii) ovum released from follicle, (iii) sperms deposited at top of vagina, (iv) ovum enters oviduct, (v) sperm fertilises ovum, (vi) embryo implants in lining of uterus.
7. (a) (i) oxygen and digested food (glucose, amino acids) pass from maternal to fetal blood, (ii) carbon dioxide and nitrogenous waste (urea) pass from fetal to maternal blood. (b) The fetus's own heart pumps blood through the fetal vessels in the placenta.
8. The umbilical cord contains blood vessels which convey blood between the fetus and the placenta.
9. (a) Smoking during pregnancy can lead to an underweight fetus.
(b) If a pregnant woman catches rubella in the first 4 months of pregnancy, the fetal ears, eyes and nervous system may be damaged.

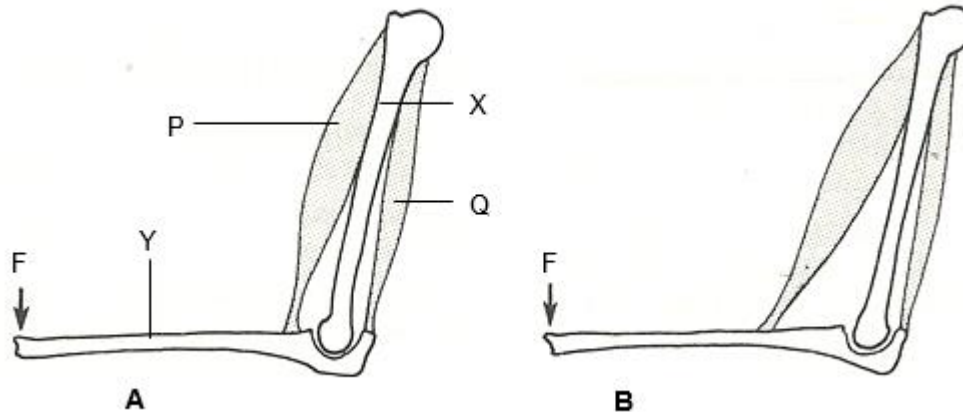
10. (a) Identical twins are derived from the products of a single zygote which divides into two at an early stage of development.
(b) Fraternal twins result from the simultaneous fertilisation of two ova.
11. (a) Blood tests can reveal the mother's Rhesus blood group and show whether she is anaemic.
(b) Urine tests can confirm the pregnancy and show if she is diabetic. Later in pregnancy, the presence of proteins in the urine implies restricted circulation in the placenta.
12. Contractions of the uterus begin, amnion breaks, amniotic fluid escapes, cervix dilates, abdominal contractions begin, baby's head emerges from vagina, baby's feet emerge from vagina, placenta expelled from uterus. Note: The amnion may break earlier or later, but prior to emergence.
13. (a) Human milk is the correct composition for human babies and it contains antibodies to some diseases.
(b) The milk is free from bacteria and at the right temperature. Breast-feeding helps to establish a psychological bond between mother and baby.
14. (a) testosterone, (b) oestrogen(s).
15. (a) After ovulation, the follicle is replaced by the corpus luteum.
(b) The corpus luteum produces the hormone progesterone.

The skeleton, muscles and movement - questions

1. Match the following biological names of bones to their everyday names, Biological names: humerus, femur, sternum, tibia, clavicle, scapula, pelvis. Everyday names: shoulder blade, shin bone, upper arm bone, hip girdle, collar bone, breast bone, thigh bone.
2. Which organs are protected by (a) the skull, (b) the rib cage, (c) the vertebrae?
3. What is the function, other than protection, of the ribs?
4. Give one example in each case of (a) a fixed joint, (b) a ball and socket joint, (c) a hinge joint.
5. Where does cartilage occur in a joint and what is its function?
6. Name one inorganic component of bone,
7. (a) Name three parts of the body where smooth (involuntary or unstriated) muscle may be found.
(b) In any one of your examples, say what the smooth muscle does.
8. How does skeletal (striated) muscle differ from smooth (unstriated) muscle in its function?

9. Why does each skeletal muscle need an antagonistic partner?
10. Which bone forms the non-moving muscle attachment in (a) the hip joint, (b) the shoulder joint, (c) the ankle joint?

11. Question



- (a) Assuming that the bone X remains stationary, what will happen (i) when muscle P contracts, (ii) when muscle Q contracts?
- (b) Assuming muscle P is equally strong in each case, which one of A and B will produce
- (i) the greater movement at F,
- (ii) the stronger force at F?

12. In a word, what process provides the energy for muscle contraction?

The skeleton, muscles and movement (continued)

13. (a) What are the immediate effects of exercise on the functions of (i) the heart, (ii) the lungs, (iii) the liver?
- (b) How do these changes help to meet the needs of exercise?
14. State four long-term benefits of exercise.
15. Which one of the following is most likely to contribute to good health when you are 45?
- (a) Active participation in sport when you were at school. .
- (b) Walking to work every day.
- (c) Playing golf every week-end.
- (d) Playing squash three times a week.

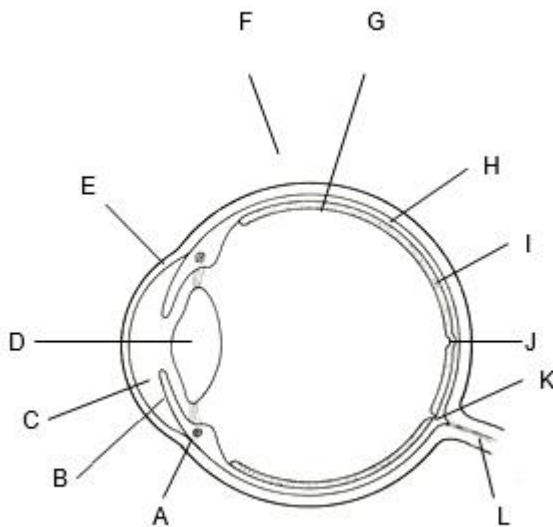
The skeleton, muscles and movement - answers

1. Humerus - upper arm bone, femur - thigh bone, sternum - breast bone, tibia - shin bone, clavicle - collar bone, scapula - shoulder blade, pelvis - hip girdle.
2. (a) The skull protects the brain, (b) the rib cage protects the heart, lungs, liver and spleen, (c) the vertebrae protect the spinal cord.
3. The ribs help to change the volume of the thorax during breathing movements.
4. (a) The bones of the skull, the junction of pelvic girdle and vertebral column are fixed joints.
(b) Shoulder and hip are examples of ball and socket joints.
(c) Knee and elbow are examples of hinge joints.
5. Cartilage may be found covering the surface of bones where they meet in a movable joint. Cartilage reduces friction between the bones and, to some extent, acts as a shock absorber.
6. Calcium phosphate is an inorganic component of bone.
7. (a) Smooth muscle is found in the wall of the alimentary canal, in arterioles and in the uterus.
(b) Contraction of smooth (circular) muscle of the alimentary canal produces peristalsis. In the arterioles it causes vaso-constriction. In the uterus it helps to expel the fetus.
8. Skeletal muscle produces voluntary movements.
9. Because muscles can only contract and relax, each skeletal muscle needs an antagonistic partner to extend it after contraction.
10. (a) The pelvic girdle provides the non-moving attachment for the leg muscles at the hip. (b) The scapula provides the non-moving attachment for the arm muscles at the shoulder. (c) The tibia provides the non-moving attachment for the muscles which move the foot at the ankle.
11. (a) When muscle P contracts it will raise bone Y (flex the joint), (ii) extend muscle Q.
(b) (i) Example A will give greater movement at F because the muscle attachment is closer to the joint. (ii) Example B will produce the greater force because the muscle attachment is further from the joint.
12. Respiration is the process which provides the energy for muscle contraction.
13. (a) Exercise increases the heart rate and the volume of blood expelled at each contraction (stroke volume); the rate and depth of breathing increase; the liver converts more glycogen to glucose.
(b) These changes supply the extra oxygen and glucose that the active muscles need for their increased respiration. The extra carbon dioxide from respiration is removed as fast as it accumulates.
14. The long-term benefits of exercise are: increase in size of the muscles used, reduction of heart rate and increase in stroke volume, more enzymes made in the muscles, stronger ligaments and tendons, more flexibility at the joints, possibly loss of excess body fat, possibly reduced chance of premature heart attack (any four).

15. (d) Playing squash three times a week is probably the best form of exercise to contribute to good health.
- (a) The benefits of exercise at school do not persist unless the exercise is continued after leaving school.
- (b) If the distance is long enough and the pace fast enough to raise the heart beat and breathing rate for 30 minutes or more, this form of daily exercise may be as good as (d).

The senses - Questions

- Complete the sentence below using the three most appropriate words from the list.
A(A) such as touch, is detected by a (B) and we may make a (C) response, change, organ, stimulus, movement, receptor, effector
- List four stimuli which can be detected by the skin.
- By what means do we become aware of a stimulus?
- Name the four taste sensations that we can distinguish
- Give the names of the parts of the eye labelled in the diagram.



- Which one of the following statements is incorrect?
When a bright light shines in the eye
 - impulses travel in the optic nerve
 - the radial fibres in the iris contract.
 - the retina responds
 - the pupil becomes smaller.
- What is the cause of the blind spot in the

field of vision?

- (a) There are no nerves in the blind spot.
 - (b) There are only cones in the blind spot.
 - (c) There are no sensory cells in the blind spot.
 - (d) The image is not formed on the blind spot.
8. (a) Which region of the retina gives the most accurate interpretation of the image?
(b) What type of light-sensitive cell is present in this region?
9. Which parts of the eye refract ('bend') the light in such a way as to form an image on the retina?
10. (a) What do you understand by the term 'accommodation'?
(b) What part does the lens play in this process?
11. Which is the correct statement?
To focus a distant object
- (a) the ciliary muscle contracts and the lens gets thicker
 - (b) the ciliary muscle relaxes and the lens gets thinner
 - (c) the ciliary muscle contracts and the lens gets thinner
 - (d) the ciliary muscle relaxes and the lens gets thicker.
12. What type of colour blindness is most common in men?
13. What kind of eye defect can give rise to short-sightedness?
14. What type of spectacle lens can help correct long-sightedness?

The senses - answers

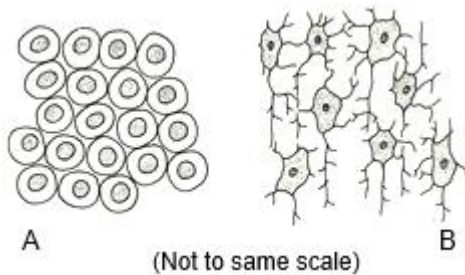
1. A stimulus (A) such as touch, is detected by a receptor (B) and we may make a response (C).
2. The skin can detect heat, cold, touch and pressure.
3. Nerve impulses travelling from a receptor to the brain make us aware of a stimulus.
4. We can distinguish sweet, sour, salt and bitter tastes.
5. A - ciliary muscle, B - iris, C - aqueous humour, D - lens, E - cornea, F - sclera, G - vitreous humour, H - choroid, I - retina, J - fovea, K - blind spot, L - optic nerve.
6. (b) 'The radial fibres in the iris contract' is incorrect
7. (c) There are no sensory cells in the blind spot.

8. (a) The fovea is the region of the retina which gives the most accurate interpretation of the image.
(b) The light-sensitive cells in the fovea are the cones.
9. The curved surface of the cornea, and the aqueous humour enclosed by it, refract the light. The lens also refracts the light.
10. (a) Accommodation is the way the eye can focus either near or distant objects to form a sharp image on the retina.
(b) The lens is made thinner so that light from a distant object is refracted less, or fatter so that light from a close object is refracted more.
11. (b) 'The ciliary muscle relaxes and the lens gets thinner' is the correct statement.
12. Red-green colour blindness is the most common form of colour blindness in men.
13. Long eyeballs, large eyeballs, too powerful a lens, or a combination of these defects can give rise to short-sightedness.
14. Converging (convex or meniscus) lenses can help correct long-sightedness.

Co-ordination Questions

1. Name the two systems which help to co-ordinate the body's actions.
 2. Name the two structures which make up the central nervous system.
 3. (a) The nerve fibres which carry impulses from the sense organs to the central nervous system are called A fibres.
(b) The nerve fibres which carry impulses from the central nervous system to the glands and muscles are called B fibres.
 4. Complete the passage below, selecting the appropriate words from the list below. A neurone (nerve cell) consists of a A containing a nucleus surrounded by B Branching filaments, called C, extend from the cell surface and make D, with other neurones. In E and F neurones, one of the filaments is very long and is called, G
- sensory, nerve fibre, cell body, impulses, dendrons, dendrites, motor, contact, axons, synapses, cytoplasm
5. Which one of the following is the most likely speed of conduction of a nerve impulse?
10 metres per second
50 metres per second
1000 metres per second.

6. Which one of the following best explains how we can tell which part of the body a sensory nerve impulse comes from?
- Impulses from each part of the body are different.
 - Each part of the body is connected to its own region of the brain.
 - Sensations of touch, heat, light etc. are carried by nerve fibres to the brain.
 - We learn from experience where the impulses come from.
7. A transverse section through the spinal cord is examined under the high power of the microscope. Part of it looks like diagram A and part looks like diagram B. Which is grey matter and which is white matter? Give reasons for your decision.



8. Give three examples of reflex actions.
9. Complete the passage below, selecting the most appropriate words from the list below.

In a spinal reflex aAis stimulated to produce a nerve impulse which travels in a B fibre to the C Here, the nerve fibre makes aD with a relay (association) Ewhich transmits the impulse to a F fibre. This fibre conducts the impulse to anG organ such as muscle.

effector, tendon, sensory, sense organ, motor, nerve, brain, spinal cord, active, synapse, neurone

10. In a reflex knee-jerk, what is (a) the receptor, (b) the effector?
11. Match the following structures and functions of the brain.
- | | |
|-------------------------|--|
| (a) Cerebellum. | (i) Memory and reasoning. |
| (b) Medulla. | (ii) Balance and muscular co-ordination. |
| (c) Cerebral hemisphere | (iii) Control of heart beat and breathing. |
| (d) Mid-brain. | (iv) Eye movements. |
12. In the table below, enter some general points of contrast between the nervous and endocrine systems.

	Nervous system	Endocrine system
Speed of conduction		

Route of conduction		
Area affected		
Duration of response		

13. Which one of the following statements about adrenaline is correct?
 (a) It increases heart rate and increases release of glucose from the liver.
 (b) It increases heart rate and reduces release of glucose from the liver.
 (c) It reduces heart rate and increases release of glucose from the liver.
 (d) It reduces heart rate and reduces release of glucose from the liver.
14. Name the two hormones produced by the pancreas and say (a) in what circumstances, (b) in what way, they adjust the glucose concentration in the blood.
15. Name the hormones produced by (a) the testes, (b) the ovaries.
16. (a) Name the condition and
 (b) describe the effects of the failure of the pancreas to produce sufficient-insulin.
 (c) How is this condition treated? .
17. The pituitary gland produces several hormones, including ADH, FSH, LH and TSH. Give the full name of each of these hormones and say briefly what each one does.

Co-ordination - Answers

- The nervous system and endocrine system help to co-ordinate the body's actions.
- The central nervous system consists of the brain and spinal cord.
- (a) The nerve fibres which carry impulses from the sense organs to the central nervous system are called sensory fibres (A).
 (b) The nerve fibres which carry impulses from the central nervous system to the glands and muscles are called motor (B) fibres.
- A neurone consists of a cell body (A) containing a nucleus surrounded by cytoplasm (B). Branching filaments, called dendrites (C), extend from the cell surface and make synapses (D) with other neurones. In sensory (E) and motor (F) neurones, one of the filaments is very long and is called a nerve fibre (G).
- Of the three speeds suggested, 50 metres per second is the most likely speed of conduction of a nerve impulse.
- (b) 'Each part of the body is connected to its own region of the brain', is the best explanation of our ability to identify the source of a nerve impulse.

7. Diagram A represents nerve fibres cut in cross-section and therefore comes from white matter. Diagram B shows multipolar neurones which constitute much of the grey matter.
8. Examples of reflex actions are change in size of the pupil of the eye in response to light intensity, blinking in response to foreign particles on the cornea, coughing or sneezing in response to irritation of the nasal passages and trachea or bronchi, knee jerk in response to a blow on the tendon of the leg extensor muscle, rapid removal of the hand from a hot or sharp object (any three).
9. In a spinal reflex, a sense organ (A) is stimulated to produce a nerve impulse which travels in a sensory fibre (B) to the spinal cord (C). Here, the fibre makes a synapse (D) with a relayneurone (E) which transmits the impulse to a motor (F) fibre. This fibre conducts the impulse to an effector (G) organ such as a muscle.
10. In a reflex knee jerk (a) the receptor is a stretch receptor in the leg extensor muscle, (b) the effector is the leg extensor muscle itself.
11. (a) Cerebellum - (ii) Balance and muscular co-ordination, (b) Medulla - (iii) Control of heart beat and breathing, (c) Cerebral hemisphere - (i) - Memory and reasoning, (d) Mid-brain - (iv) Eye movements.

12. Answer

	Nervous system	Endocrine system
Speed of conduction	faster	slower
Route of conduction	nerves	blood system
Area affected	very localised	rather general
Duration of response	short-lived	longer lasting

13. The correct statement is (a). Adrenaline increases the heart rate and the rate at which glucose is released from the liver.
14. The pancreas produces the hormones glucagon and insulin.
 - (a) Glucagon is produced in response to a fall in the concentration of glucose in the blood; it stimulates the liver to release glucose.
 - (b) Insulin is produced in response to a rise in the concentration of glucose in the blood; it stimulates the liver to convert glucose to glycogen.
15. (a) The testes produce testosterone.
(b) The ovaries produce oestrogen and progesterone.
16. (a) Diabetes (insulin-dependent diabetes) is the condition which results from insufficient insulin.
(b) The diabetic is unable to control effectively the glucose concentration of the blood. The glucose concentration therefore fluctuates from dangerously high to dangerously low.

(c) Insulin-dependent diabetes is treated by regular injections of insulin, plus some dietary control.

17. ADH-anti-diuretic hormone, causes the kidneys to reabsorb more water from the renal tubules, so reducing the production of urine. FSH-follicle-stimulating hormone, acts on the ovaries and promotes the maturation of the follicles. LH-luteinising hormone, acts on the follicles to cause ovulation. TSH-thyroid-stimulating hormone, stimulates the thyroid gland to produce thyroxine.

Personal health - Questions

1. Which of the following are not considered to be necessary components of a healthy diet? sugar, salt, protein, butter, vitamins, alcohol, green vegetables
2. For which one of the following is there not strong evidence for the beneficial effects of exercise? more efficient muscular contraction, improved stamina, prevention of heart attack, stronger muscles, avoidance of obesity, feeling of well-being
3. Which of the following diseases are not associated with smoking? emphysema, hay fever, diabetes, lung cancer, bronchitis, stomach ulcers, bladder cancer, arterial disease, tuberculosis, coronary thrombosis
4. (a) Match the following descriptions to the terms (i) 'drug tolerance', (ii) 'drug dependence' :
A - If the drug is not taken, there are physical withdrawal symptoms.
B - A steadily increasing dose of the drug is needed to achieve an acceptable effect.
(b) Which of these conditions is also known as 'addiction'?
5. Name two stimulant drugs and state the undesirable side-effects of each.
6. (a) What effect does alcohol have on reaction time?
(b) What other short-term effects does alcohol have?
(c) What long-term effects can result from an excessive alcohol intake?
7. If a woman thinks she is pregnant she should
(a) take no more than three standard alcoholic drinks per day
(b) take no more than one standard alcoholic drink per day
(c) take no more than five standard alcoholic drinks per week
(d) take no alcoholic drinks at all.
8. Put the following in order of their total alcohol content, starting with the strongest. double whisky, 2 pints of cider, 3 glasses of wine, a glass of sherry, pint of beer
9. Which of the following is considered to be a relatively safe level of alcohol intake for a) men,(b) women, (c) pregnant women, (d) people about to drive?
0, 10, 20, 30, 40, 50 units of alcohol (standard drinks) per week

10. Drugs which relieve pain are calledA..... Readily available (i.e. non-prescription) examples of these drugs are BandC Morphine and codeine, drugs which relieve severe pain, are called D These drugs are prescribed with care because their use can lead to E and F
11. List four possible after-effects of solvent abuse (glue-sniffing).
12. Classify the following under the headings 'Mental illness' and 'Mental handicap'. clinical depression, Down's syndrome, acute anxiety, claustrophobia, phenylketonuria
13. Which component of the diet is thought to be largely responsible for causing tooth decay?
14. What is the connection between this substance, mouth bacteria and tooth decay?
15. Which one of the following is likely to be most effective in reducing dental decay?
 - (a) Eating crisp food, e.g. apples, after meals.
 - (b) Cutting down on sweets, biscuits etc. between meals.
 - (c) Cleaning the teeth after meals and at night.
 - (d) Using an antiseptic mouth wash.
16. What is plaque?
17. From which part of the teeth is it particularly important to remove plaque]
18. What gum conditions may result from a failure to remove plaque?

Personal health - answers

1. Sugar, salt, butter and alcohol are not necessary components of a healthy diet.
2. At present, the evidence for the beneficial effects of exercise is controversial with respect to prevention of heart attack and avoidance of obesity. There is not much scientific evidence for the effect of exercise on the feeling of well-being apart from a large number of personal observations (i.e. what people say).
3. Hay fever and diabetes are not associated with smoking. The other diseases occur more frequently in smokers than in non-smokers.
4. (a) (i) Drug tolerance is described by B. Increasing doses are needed to produce the same effect as the initial doses.
(ii) Drug dependence is described by A. Physical withdrawal symptoms occur if the drug is not taken.
(b) Addiction is another term for (ii), drug dependence.
5. Amphetamine and cocaine are stimulant drugs. The side-effects of amphetamines are high blood pressure; unwarranted self-confidence and reduced accuracy. Cocaine can cause

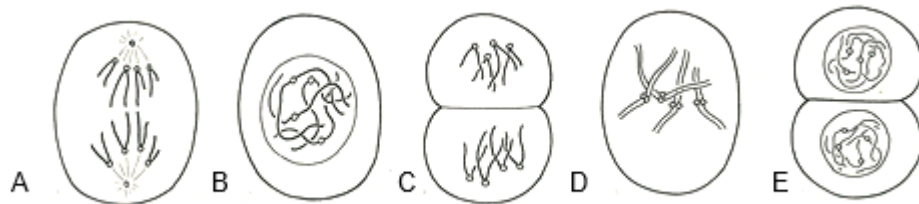
arterial constriction and mental disorders. The after-effects of both drugs can be severe depression.

6. (a) Alcohol increases a person's reaction time (responses are slower).(b) Alcohol causes vaso-dilation, increase in self-confidence, reduction of accuracy and, in some people, irresponsible behaviour. (c) Excessive intake of alcohol over a long period can damage the stomach, liver (cirrhosis of the liver), nervous system and brain. It may also induce dependence (alcoholism).
7. A woman who thinks she is pregnant should take no alcohol at all.
8. In order of decreasing quantity of alcohol, the drinks are ranged as follows: 2 pints of cider (4 units), 3 glasses of wine (3 units), a double whisky (2 units), a pint of beer(2 units), a glass of sherry (1 unit). (The beer and the whisky are equal third.)
9. Relatively 'safe' weekly levels of drinking are as follows: (a) men -30 units (maximum), (b) women -20 units, (c) pregnant women - 0 units (i.e. no safelevel), (d) there is no safe level for people who are going to drive.
10. Drugs which relieve pain are called analgesics (A). Readily available examples of these drugs are aspirin (B) and paracetamol (C). Morphine and codeine are called narcotic analgesics (narcotics) (D). They are prescribed with care because their use can lead to tolerance (E) and dependence (F).
11. Possible after-effects of solvent abuse are headache, nausea, vomiting, convulsions, runny nose, a rash round the mouth, irritability, lethargy, depression, liver and kidney damage (any four).
12. Clinical depression, acute anxiety and claustrophobia are examples of mental illness. Down's syndrome and phenylketonuria are examples of mental handicap. Personal health - answers (continued)
13. Refined sugar is the most likely cause of tooth decay.
14. Mouth bacteria use sugar for their metabolism and produce acids as a waste-product. The acids dissolve the enamel and dentine, so causing cavities in the teeth.
15. (b) Cutting down on sweets etc. is the most effective method of reducing dental decay.
16. Plaque is a film over the teeth and consists of saliva, mucus, bacteria and the substances they produce. It may also contain mineral salts of calcium and magnesium.
17. It is most important to remove plaque from between the teeth and from the region where the gum covers the teeth.
18. Gingivitis (gum inflammation) and periodontal disease (infection of the socket) may result from a failure to remove plaque.

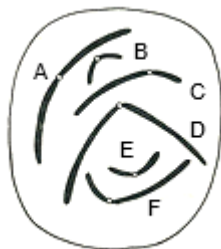
GENETICS AND HEREDITY

Cell division and chromosomes - questions

1. A cell in the basal layer of the skin contains 46 chromosomes and divides by mitosis to produce new skin cells. After ten successive divisions, how many chromosomes will the basal cell have?
2. The drawings below depict stages in the mitotic division of a cell



- (a) Write the letters in the order in which these stages occur.
 - (b) How many pairs of chromosomes are there in the cell?
 - (c) What is the diploid number of chromosomes in these cells?
3. Choose the most appropriate word to complete the sentence. When chromosomes replicate, they produce tissues, nuclei, chromatids, somatic cells
 4. In which three of the following cells is mitosis unlikely to occur?
a sperm cell, an epithelial cell of a villus, a hair cell, a cell in the red bone marrow, a red blood cell, a lymphocyte, a cell in the basal layer of the skin
 5. An animal has 36 chromosomes in each of its body cells. How many of these chromosomes came from its male parent?
 6. Which pairs of chromosomes in the cell shown here are homologous?



7. Fill in the missing words.
The A of a cell contains a fixed number of

chromosomes. Before mitosis, each chromosome
..... B to produce two C

8. The following drawings-show the sequence of events early in cell division.
(a) Is the division meiotic or mitotic?
(b) How do you know?



9. Give two examples in each case of organs or tissues in which you would expect
(a) meiosis, (b) mitosis to be taking place.
10. A fruit fly has four pairs of chromosomes in its cells. At meiosis, how many different combinations of maternal and paternal chromosomes are possible in the gametes?
11. From the list below, choose the most suitable words to complete the sentence.
Mutations are changes which occur in a Aor a B If a mutation occurs in a cell which is going to form a C, the mutation may affect the whole..... D which develops. Down's syndrome results from a E mutation In the F.....Sickle cell anaemia results from a G mutation which affects H of the blood system.
- cells, gene, gamete, chromosome, nucleus, ovum, organism
12. Exposure to A, B or C may increase the rate of mutation
Suggest words or phrases for A - C
13. What kinds of mutation in disease-causing bacteria might make them more dangerous?

Cell division and chromosomes - answers

1. After ten successive mitotic divisions, a basal cell will still have 46 chromosomes.
2. (a) The correct sequence is B, D, A, C, E.
(b) There are two pairs of chromosomes in the cell.
(c) The diploid number of chromosomes is four.
3. When chromosomes replicate, they produce chromatids.
4. Mitosis is unlikely to occur in a sperm cell (once sperm cells are formed they do not divide again), a hair cell (they are dead) and a red blood cell (they have no nuclei).

5. If an animal species has 36 chromosomes in its cells, 18 of these came from each parent.
6. The homologous chromosomes are A and D, B and E, C and F.
7. The nucleus (A) of a cell contains a fixed number of chromosomes. Before mitosis, each chromosome replicates (B) to produce two chromatids (C).
8. (a) The cell division is meiotic.
(b) In (ii) the homologous chromosomes have paired up and in (iii) they are separating to form daughter cells with half the diploid number of chromosomes.
9. (a) Meiosis is likely to be taking place in testes and ovaries.
(b) Mitosis may be occurring in the red bone marrow of the skeleton (to produce blood cells),
in the basal layer of the skin including hair follicles, in tissue where growth is occurring, e.g. ends of bone shafts, in the lining epithelium of the gut.
10. In gametes derived from a cell with four pairs of chromosomes there are $2^4 = 16$ possible combinations of maternal and paternal chromosomes.
11. Mutations are changes which occur in a chromosome (A) or a gene (B). If a mutation occurs in a cell which is going to form a gamete (C), the mutation may affect the whole organism (D) which develops. Down's syndrome results from a chromosome (E) mutation in the ovum (F). Sickle cell anaemia results from a gene (G) mutation which affects cells (H) of the blood system.
12. Exposure to ultraviolet light, X-rays, radioactive emissions, mutagenic chemicals may increase the rate of mutation.
13. Pathogenic bacteria will become more dangerous to us if mutations make them more virulent or resistant to drugs (antibiotics).

Heredity - Questions

NOTE: Alleles are alternative forms of a gene which occupies a particular position in a chromosome. Alleles affect the same characteristic (e.g. blood group) but not necessarily in the same way. IA, IB and i are alleles of a gene which controls the ABO blood groups.

1. A plant with red flowers is crossed with a white-flowered plant of the same species. All the seeds, when grown, produce plants with red flowers. Assuming that the flower colour is controlled by a single pair of alleles, which allele is dominant and which is recessive?
2. If a dominant allele for tall plants is represented by the letter D, what letter should represent the corresponding recessive allele?

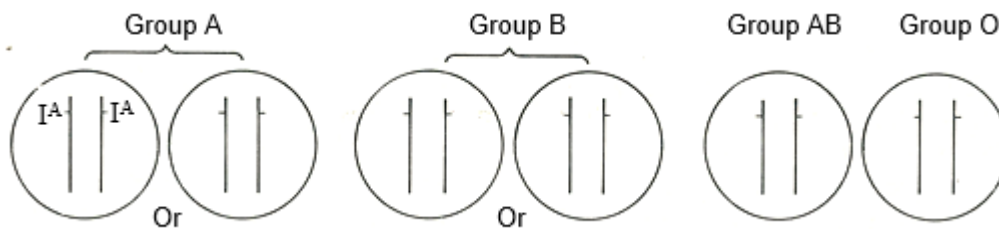
3. In cats, the allele (S) for short fur is dominant to the allele (s) for long fur.
- What is the genotype of a true-breeding, long-furred cat?
 - What is the phenotype of a cat with the genotype Ss?
 - In an Ss genotype, which allele is expressed in the phenotype?
 - Which of the following genotypes is (i) heterozygous (ii) homozygous dominant?
SS, Ss, ss
4. In rabbits, assume that the dominant allele (B) produces black fur. The allele (b) for white fur is recessive to B.
- What colour fur will each of the following rabbits have?

	Rabbit 1	Rabbit 2	Rabbit 3	Rabbit 4
genotype	BB	Bb	bB	bb

- Which of them will breed true?
- Which rabbits are homozygous for coat colour?
- If rabbits 1 and 4 were mated together and had 12 babies, how many of these would you expect to be black?
- If rabbits 2 and 3 are interbred and produce several litters, totalling 48 babies, how many white babies would be predicted by the laws of genetics?
- If rabbits 3 and 4 are mated together on several occasions and have 50 babies altogether, how many of their babies would you 'expect' to be black?

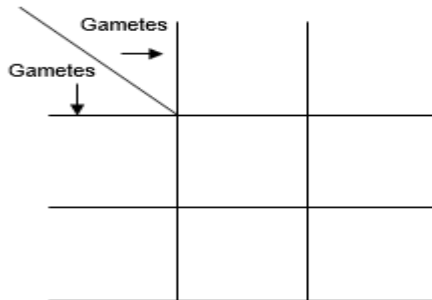
NOTE: In this context, 'expect' implies the perfect Mendelian ratio. In practice you would not expect to achieve this ratio with as few as 50 offspring.

5. The alleles controlling the ABO blood groups are given the letters I^A (group A), I^B (group B) and i (group O). On the drawings below, write in the alleles on the chromosomes for each of the blood groups. (The first one has been done for you)

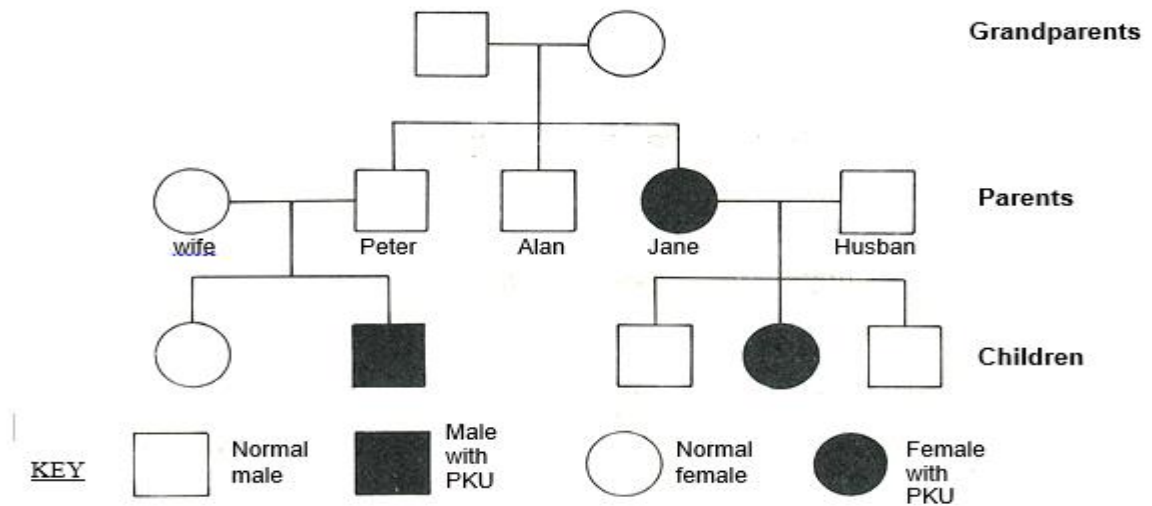


6. In shorthorn cattle, the coat colours red or white are controlled by a single pair of alleles. A calf which receives the allele for red coat from its mother and the allele for white coat from its father is called a 'roan'. It has an equal number of red and white hairs in its coat.
- Is this an example of codominance or of incomplete dominance?
 - Give a reason for your answer.
 - Give one example in each case of (i) codominance, (ii) incomplete dominance, in humans.

7. Give three examples of human disorders which are caused by the action of a single pair of alleles. In each case say whether the harmful allele is dominant or recessive to the non-harmful allele.
8. In humans, maleness or femaleness is determined by a pair of sex chromosomes called X and Y.
 - (a) What is the genotype for males?
 - (b) What is the genotype for females?
9. (a) In humans, is it the sperm or the ovum which determines the sex of the offspring?
 (b) Give a reason for your answer.
10. In fruit flies, the allele (n) for ebony (black) body is recessive to the allele (N) for normal (grey) body.
 - (a) Complete the Punnett square, for a cross between normal (grey-bodied) flies which are heterozygous for this allele (i.e. Nn genotypes).
 - (b) State the expected proportion of normal and ebony-bodied flies in a large sample of the offspring.
 - (c) State the proportion of the normal phenotypes which would be true breeding



11. When a particular gene is said to be 'sex-linked', on which chromosome is that gene usually present?
12. The genetic disorder phenylketonuria (PKU) is caused by a recessive allele (n). The family tree below shows the incidence of the disease over three generations.



- (a) your reasoning.
 (c) What is the genotype of Jane's husband?
 (d) Explain your reasoning.
 (e) What are the chances that Peter is the carrier of the PKU allele that resulted in his having an affected son?
 (f) If Jane had been normal, what are the possible genotypes of the grandparents?
 (g) Is it possible that the allele for PKU is sex-linked?
)What can you deduce about the genotypes of the grandparents?
 (b) Explain

13. One form of colour-blindness is a sex-linked inherited condition controlled by a recessive allele. Use the symbols X and Y for the sex chromosomes and N and n for the alleles for normal or defective colour vision to show the genotypes of

- (a) a normal male (d) a colour-blind female
 (b) a colour-blind male (e) a normal (carrier) female.
 (c) a normal (non-carrier) female

14. Use the genotypes you have written for your answer to question 13 to show the chances of (a) a son being colour blind, (b) a daughter being a carrier, resulting from a marriage between a normal man and a carrier woman.

Heredity – answers

- The allele for red-coloured flowers must be dominant if no white flowers appear in the first generation (assuming a very large sample).
- The recessive allele corresponding to D is d.
- (a) A true-breeding, long-furred cat has the genotype ss.
 (b) The Ss genotype will produce a short-furred phenotype.
 (c) In an Ss genotype, the dominant allele (S) will be expressed.
 (d) (i) Ss is heterozygous. (ii) SS is homozygous dominant.

4. (a) Rabbit 1 (BB) will be black; Rabbits 2 and 3 (Bb or bB) will be black; Rabbit 4 (bb) will be white.
 (b) Rabbits 1 (BB) and 4 (bb) will breed true.
 (c) Rabbits 1 (BB) and 4 (bb) are homozygous for coat colour.
 (d) All 12 babies should be black as rabbit 1 contributes dominant alleles to all the offspring.
 (e) If the heterozygous rabbits (Bb) are mated, you would expect a ratio approximating to 3 black to 1 white baby; e.g. 36 black and 12 white.
 (f) Rabbit 4 contributes only recessive alleles so approximately 50% of the babies should be black and 50% should be white; e.g. 25 of each.
5. Group A - IAIA or IAi,
 Group B - IBIB or IBi.
 Group AB - IAIB; Group O - ii.
6. (a) The roan calf exhibits codominance of the two alleles.
 (b) Each allele is fully expressed, i.e. neither allele is dominant.
 (c) (i) the ABO blood groups are examples of the codominance of the IA and the IB alleles.
 (ii) Sickle-cell anaemia is an example of incomplete dominance. The recessive allele is partially expressed in the heterozygote.
7. Haemophilia (recessive), albinism (recessive), phenylketonuria (recessive), red-green colour blindness (recessive), sickle-cell anaemia (partially recessive) (any three).
8. (a) The male genotype is XY. (b) The female genotype is XX.
9. (a) The sperm determines the sex of the offspring.
 (b) All the ova contain an X chromosome. Half the sperms carry an X chromosome and half carry a Y chromosome.

10. Answer

		Gametes	
		N	n
Gametes	N	NN	Nn
	n	Nn	nn

- (b) The expected ratio of phenotypes would be approximately three normal to one ebony.
 (c) On average, one-third of the normal phenotypes would be true-breeding (NN).
11. A sex-linked gene is usually carried on the X chromosome and is absent from

the Y chromosome.

12. (a) Both grandparents must be heterozygous (Nn).
 (b) If either grandparent was homozygous (NN) the N allele would be dominant in the offspring, the PKU allele would not be expressed and none of their children would be affected.
 (c) Jane's husband must be heterozygous (Nn).
 (d) If he were homozygous (NN) all his children would receive a dominant allele and none could exhibit PKU.
 (e) There is a 50% chance that Peter has inherited the recessive PKU allele from his parents. This would make him a carrier.
 (f) If Jane had been normal, the grandparents' genotypes could be (i) both Nn or (ii) one NN and one Nn. They could not both have been NN or Jane would also have been NN and could not have had an affected child.
 (g) If the allele for PKU was sex-linked, the grandparents could not have had an affected daughter.

13. (a) XN Y, (b) Xn Y, (c) XN XN, (d) Xn Xn (e) XN Xn.

14. See diagram below

- (a) The chances are 1:1 that a boy from this marriage will be colour-blind,
 (b) The chances of a carrier daughter are also 1:1.

	<i>Normal man</i>		<i>Carrier woman</i>	
Genotypes	XN Y		XX Nn	
Gametes	XN	Y	XN	Xn
Possible combinations	XX NN normal girl	XN Xn carrier girl	XN Y normal boy	Xn Y colour blind boy

Variation and selection Question

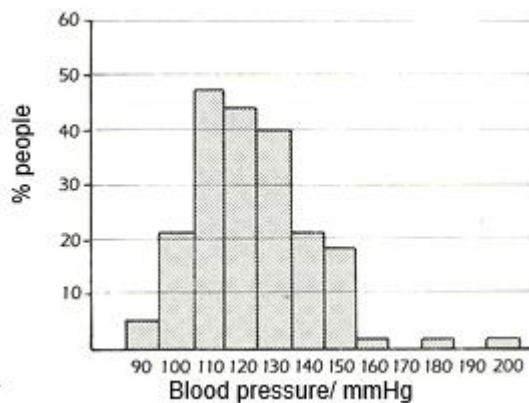
1. What are the two main causes of heritable variation?
2. Classify the following variations as either (i) caused entirely by genetic effects or (ii) caused by a combination of genetic and environmental effects.

obesity, eye colour, tallness, ability to sing, maleness, masculinity, blood group, natural hair colour; sickle-cell anaemia, agility
3. Alleles are genes which occupy corresponding positions on..... A chromosomes. They control the same B but not necessarily in the same way.
4. (a) What new combinations of characteristics might arise in the offspring when a tall plant with white flowers is crossed with a dwarf plant (of the same species) with red flowers?
 (b) What selective advantage might either of the new varieties have?

5. The genotypes of two guinea pigs, for two characteristics are represented as AABB and aabb. These guinea pigs are mated, and their offspring eventually mate with each other.
 - (a) What genotypes could emerge in the second generation?
 - (b) Which of these would be phenotypically different (i.e. be different in appearance) from the original pair?

6. Suppose that there are six pairs of alleles which control height and that each dominant allele adds 5cm to the stature. Suppose also that the average height of an adult (with equal numbers of recessive and dominant alleles) is 160cm
 - (a) What is (i) the tallest, (ii) the shortest person you would expect from this pattern?
 - (b) On this basis, what would be the minimum difference in height between any two people?
 - (c) Why is this minimum difference unlikely to be observed in reality?

7. The histogram shows the range and frequency of occurrence of particular blood pressures (systolic) in a group of women in the 30-39 age group
 - (a) On this evidence, could you say that blood pressure is a discontinuous variable?
 - (b) Justify your answer.



8. Give two examples in each case (a) continuous, (b) discontinuous populations
9. Which one of the following statements is least accurate
 - (a) Discontinuous variation results entirely from genetic differences.
 - (b) Continuous variation can result from genetic differences.
 - (c) Discontinuous variation cannot be altered by environmental effects.
 - (d) Continuous variation results from environmental effects.
10. When A and B put forward the theory of Natural Selection in 1858 they observed that there are C between the individuals of a species. They also observed that organisms produce more offspring than can possibly Dto maturity. If the E are inherited and give the individuals an advantage over the other members of the species, they will live F and so leave more offspring with the same beneficial G

12. A pair of mice has, on average, a litter of six babies. Assuming (i) that there are equal numbers of males and females in the litters, (ii) that the offspring breed freely amongst themselves, how many mice will there be after three generations?
13. (a) Give three examples of types of competition between members of an animal species in the same population.
(b) In each case suggest a variation that might help an individual to compete more effectively.
14. For a beneficial variation to have a selective advantage in the course of evolution, it must be A by the offspring.
15. Evolution is thought to come about as a result of A which produce new B These gradually replace the original population as a result ofC
16. Which of the following statements is most acceptable from an evolutionary point of view?
 - (a) Apes and humans have evolved from a common ancestor.
 - (b) Humans have evolved from apes.
 - (c) Certain apes have gradually evolved into humans.
 - (d) Apes and humans are related.
17. What characteristics might a breeder select for in (i) a cereal crop, (ii) a farm animal?

Variation and selection - answers

1. The two main causes of heritable variation are mutations and recombinations.
2. (i) Entirely genetic: eye colour, maleness, blood group, natural hair colour, sickle-cell anaemia.
(ii) Environmental and genetic: obesity, tallness, ability to sing, masculinity, agility.
3. Alleles are genes which occupy corresponding positions on homologous (A) chromosomes. They control the same characteristic (B) but not necessarily in the same way.
4. (a) New combinations would be tall plants with red flowers, or dwarf plants with white flowers.
(b) Tall, red-flowered plants might attract more insects for pollination.
5. (a) The possible genotypes in the F₂ are
AABB aabb AaBB AABb aaBb* AaBb AAbb* aaBB* Aabb*
7. (b) * phenotypes different from the original pair.
6. (a) In this model there are twelve alleles (six pairs) which could contribute to stature. An average person would be expected, therefore, to have six dominant and six recessive alleles.
(i) The shortest person will therefore, lack the dominant alleles and be 30cm (6 x 5) shorter than average, i.e. 130cm. (ii) The tallest person will have an additional six dominant alleles and therefore be 30 cm taller than average, i.e. 190cm.
(b) If stature were controlled solely by genes, the minimum difference between individuals would be 5cm.
(c) Since height is also influenced by nutrition and health, it is very unlikely that people would differ by exactly 5cm.
7. (a) and (b) The blood pressures seem to differ by distinct steps (discontinuous variation). But this is because the women have been arbitrarily placed in groups whose blood pressure differs by ten

units. If they had been put into groups differing by only one unit, the steps would have virtually disappeared. This variation is continuous.

8. (a) Continuous variation: for example, weight, height, intelligence, hair colour, skin colour, physique, blood pressure (any two).
 (b) Discontinuous variation: blood group, sex, eye colour (more or less), presence or absence of certain genetic diseases (e.g. albinism, haemophilia), free or attached ear lobes (any two).
9. The least accurate statement is (d). Continuous variation can be wholly genetic (e.g. hair colour) or result from a combination of genetic and environmental effects (e.g. skin colour).
10. Identical twins are derived from the same fertilized ovum (zygote) and will therefore have the same sets of chromosomes and genes.
11. When Darwin (A) and Wallace (B) put forward the theory of Natural Selection in 1858, they observed that there are variations/differences (C) between the individuals of a species. They also observed that organisms produce more offspring than can possibly survive/live (D) to maturity. If the variations/differences (E) are inherited and give the individuals an advantage over the other members of the species, they will live longer (F) and so leave more offspring with the beneficial variation/difference (G).

12. Answer

1st generation	{	2 parents	2
		6 babies	6
2nd generation	{	When mature, they form 3 pairs which each have 6 babies (3 x 6)	18
3rd generation	{	18 babies; when mature they form 9 <u>pairs</u> which each have 6 babies (9 x 6)	54
			80

14. For a beneficial variation to have a selective advantage in the course of evolution, it must be inherited (A) by the offspring.
15. Evolution is thought to come about as a result of mutations (A) which produce new varieties (B). These gradually replace the original population as a result of natural selection (C).
16. The most acceptable statement is (a). Statements (b) and (c) imply a direct line of evolution from existing apes to humans. Statement (d) is too vague to have much significance.
17. (i) In a cereal variety, a breeder might select for high yield; disease-, frost- or drought- resistance; early maturation; short straw (easier to harvest); reduced need for fertilisers; good quality of product (e.g. high in protein); processing qualities (e.g. good for making bread). (ii) In a farm animal a breeder might select for high yield (wool, milk, meat); good meat/fat ratio; disease resistance; fertility (more offspring).

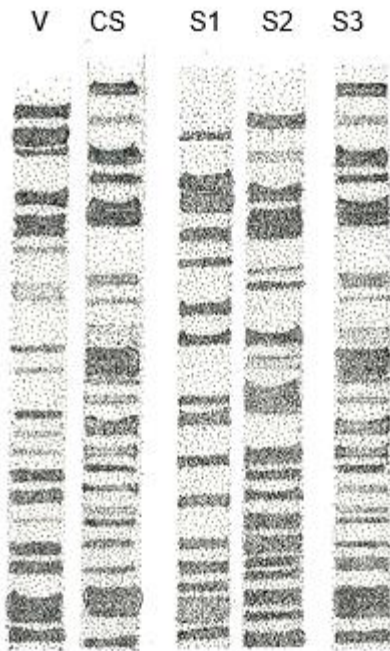
Applied genetics - Answers

1. A strain of barley (A) has a high yield of seeds but a long stem which is subject to 'lodging' (a flattening of areas of the crop). Another strain (B) has a short, sturdy stem but a lower yield. The genotype of variety A is HHss (high yield, long stem) and the genotype of B is hhSS (low yield, short stem)
 - (a) Show how a plant breeder would cross these varieties to produce a high yielding, short stemmed variety.
 - (b) Explain why this variety would not breed true.
2. Choose from the list of words below, to complete the following sentence. In genetic engineering, aAfrom one organism is introduced into the B of an unrelated organism. chromosome, nucleus, gene, protein, genome
3. What name is given to an enzyme which is used to cut a DNA molecule at specific sites?
4. What bacterial cell structures are used to carry the genes intended for genetic engineering?
5. Name three useful products that can be obtained by genetic engineering.
6. Outline the steps involved in using bacteria to produce human insulin.
7. Give three examples of genetic engineering that are intended to improve crop plants.
8. DNA can be split into fragments using restriction enzymes.
 - (a) Outline the technique used to separate these fragments.
 - (b) What property of the DNA fragments allows this separation?
9. The illustration shows the separation of DNA fragments produced from blood samples taken at the scene of a crime, plus those of three suspects.

Rule horizontal lines through the DNA bands from the crime scene, to cross the three suspects profiles.

- (a) Which suspect is most likely to be guilty?
- (b) Explain why you think so.

V Victim
 CS Sample taken from crime scene
 S1 Suspect 1
 S2 Suspect 2
 S3 Suspect 3

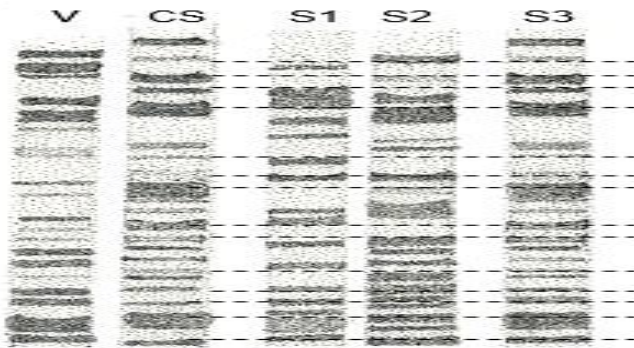


10. What is the special characteristic of (a) stem cells, (b) embryonic stem cells?
11. What are the possible sources of human embryonic stem cells?
12. What would be the advantage of using a patient's own stem cells e.g. blood stem cells, to treat his or her illness?

Applied genetics - answers

1. (a) The plant breeder would pollinate plant A with pollen from plant B (or vice versa). The gametes would be (A) HsHs, (B) hShS. When the gametes combined in the zygote, the seeds would all have the HhSs genotype. Since H and S are the dominant alleles, the plants would all be high-yielding, short-stemmed varieties (the F1 variety).
 (b) When the HhSs variety produces gametes, these could be HS, Hs, hS or hs which, when combined in the zygote, could produce four varieties of offspring; some of which might be short-stemmed / high yield; short-stemmed / low yield; long-stemmed / low yield, or long-stemmed / low yield.
2. In genetic engineering, a gene (A) from one organism is introduced into the genome (B) of an unrelated organism.
3. An enzyme which is used to cut DNA at specific sites is called a restriction enzyme.
4. The cell structures in bacteria which carry genes intended for genetic engineering are called plasmids.

5. Useful products of genetic engineering are chymosin, Alpha-anti-trypsin, hepatitis B vaccine, and insulin (any three)
6. The gene for insulin is 'cut' from the appropriate strand of DNA using restriction enzymes. Plasmids are extracted from bacterial cells and 'opened up' using the same restriction enzymes and the insulin gene is inserted in the gap. The recombinant plasmids are inserted into bacteria which then produce insulin.
7. Genetic engineering of crop plants can improve resistance to pests, retard ripening, improve uptake of ions from the soil, increase the vitamin content of the crop. In the future, genetic engineering might improve drought resistance and salt tolerance.
8. (a) DNA fragments, in solution, are placed at one end of a sheet of gel and an electric current is applied which separates the fragments.
(b) The size of the fragments determines how rapidly they move through the gel. Smaller fragments travel faster and further than larger fragments.
9. (a) Suspect S3 is the most likely to be guilty
(b) The greatest correspondence in the position of the bands at the crime scene is with those of suspect 3. (not all the relevant lines are drawn here)

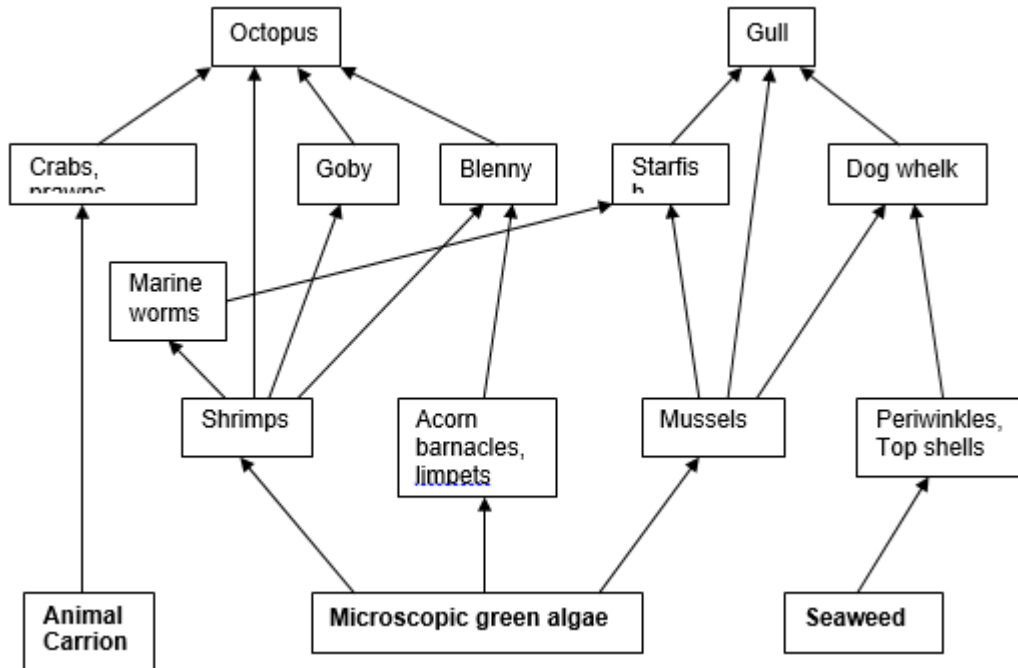


10. (a) Stem cells can continue to divide throughout their life.
(b) The special characteristic of embryonic stem cells is that they can develop into any kind of cell and in some animals (e.g. amphibia) into complete organism.
11. Embryonic stem cells can be derived from individual cells of an early embryo, from blood cells in the umbilical cord of mammals and from cultures of stem cells.
12. The advantage of using stem cells from the patient being treated is that they will not be rejected by the patient's immune system.

Interdependence of living organisms - questions

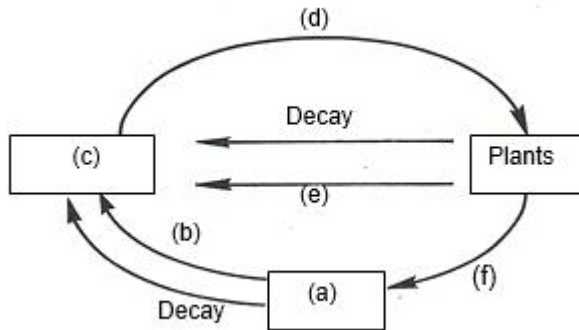
1. Classify the following animals as either carnivores or herbivores. cow, rabbit, dog, shark, sheep, deer, lion, eagle, giraffe, seal, grass snake, horse

- Classify the following as producers, primary consumers or secondary consumers. caterpillar, falcon, mouse, tree, phytoplankton, pike, cat, grass, locust, goat, otter, wheat
- The diagram represents a food web that might occur on a rocky seashore.

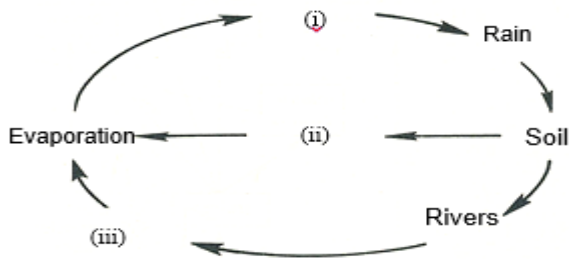


- Pick out a food chain that includes shrimps and ends with gulls.
 - Which are the producers?
 - Name a primary, secondary and tertiary consumer in the food web.
 - What might happen to the food web if all the mussels were killed by a pollutant?
- A meal consists of grilled trout, potatoes and mushrooms. Explain how each item is ultimately the product of photosynthesis.
 - On average, what percentage of the sun's energy, which reaches the surface of the Earth, is used for photosynthesis?
(a) 100% (b) 10% (c) 1% (d) 0.1 %
 - On average, what percentage of the food given to cattle is converted to flesh and bone?
(a) 100% (b) 10% (c) 1 % (d) 0.1 %
 - Choose the most appropriate words from the list below to complete the following paragraph.
In a food chain, passes from one to another. Theof the is always less than that of thebecause most of the food eaten by the is used to producerather than new growth.
biomass, sunlight, trophic level, photosynthesis, producers, energy, consumers, decomposers
 - Which two major groups of organisms make up the bulk of the decomposers?

9. The diagram represents part of a simplified carbon cycle. Write the name of the organisms, substances or processes represented by the letters (a)-(f).



10. What processes (a) remove and (b) add to the carbon dioxide in the air?
 11. What part do (a) nitrifying, (b) nitrogen-fixing and (c) denitrifying bacteria play in the nitrogen cycle?
 12. What processes remove nitrates from the soil
 13. The diagram represents a simplified water cycle.
 (a) Say what might be represented by (i) - (iii).
 (b) At which three points in the cycle are humans most likely to interfere?



14. (a) In what ways do farmers try to improve the quality of (i) their soil, (ii) their crop plants?
 (b) What other steps do farmers take to maximize the yield from their crops?

Interdependence of living organisms - answers

- Carnivores: dog, shark, lion, eagle, seal, grass snake.
 Herbivores: cow, rabbit, sheep, deer, giraffe, horse.
- Producers: tree, phytoplankton, grass, wheat. Primary consumers: caterpillar, mouse, locust, goat.
 Secondary consumers: falcon, pike, cat, otter.
- (a) Microscopic green algae, shrimps, marine worms, starfish, gull.

- (b) The producers are the microscopic green algae and seaweed.
- (c) Primary consumers: shrimps, acorn barnacles, limpets, mussels, periwinkles, top shells. Secondary consumers: crabs, prawns, marine worms, goby, blenny, starfish, dog whelk and sometimes octopus and gull. Tertiary consumers: octopus, gull and sometimes starfish.
- (d) If the mussels are killed the starfish will (i) decrease in numbers, (ii) eat more marine worms. The gull population may decline and gulls may eat more dog whelks. Each of these events will affect most of the other steps in the food web.
4. Trout eat aquatic insects, many of which eat microscopic algae (phytoplankton) which make their food by photosynthesis. Potatoes are stem tubers containing food which the potato plant made in its leaves (by photosynthesis). Mushrooms feed on decaying organic matter which comes from (i) dead plants which had made their food by photosynthesis or (ii) remains or faeces of animals which fed on plants, or on animals which ate plants which photosynthesised.
 5. (c) On average, only 1 % of the sun's energy is used in photosynthesis.
 6. (b) On average, 10% of food given to cattle is converted to flesh and bone.
 7. In a food chain, energy passes from one trophic level to another. The biomass of the consumers is always less than that of the producers because most of the food eaten by the consumers is used to produce energy rather than new growth.
 8. Bacteria and fungi are the principal decomposers.
 9. (a) animals, (b) respiration, (c) carbon dioxide, (d) photosynthesis, (e) respiration, (f) eaten by.
 10. (a) Carbon dioxide is removed from the air by the photosynthesis of green plants and by being absorbed by the sea.
(b) Respiration, decay and combustion of carbon- containing compounds add to the carbon dioxide in the air.
 11. (a) Nitrifying bacteria in the soil convert ammonia and other nitrogenous substances (e.g.urea) into nitrates.
(b) Nitrogen-fixing bacteria (in the soil or in root nodules) convert gaseous nitrogen into nitrogenous compounds.
(c) Denitrifying bacteria in the soil, decompose nitrogenous compounds to produce gaseous nitrogen.
 12. Nitrates are removed from the soil by plant roots, by being washed out in rainwater and by the activities of denitrifying bacteria.
 13. (a) (i) clouds, (ii) plants, (iii) sea.
(b) Humans are likely to interrupt the water cycle (1) between rivers and the sea (by irrigation and domestic and industrial use), (2) between soil and rivers (by drainage schemes, afforestation or deforestation), (3) between plants and clouds (by deforestation).
 14. (a) (i) Soil quality is improved by adding organic manure or compost and artificial fertilizers, by adding lime (to reduce acidity), by ploughing (to improve aeration and drainage), by draining (to reduce waterlogging).

- (ii) Farmers try to select crop plants which have a high yield and which are resistant to diseases.
- (b) Farmers irrigate their crops and try to eliminate weeds and pests.

The human impact on the environment - answer

1. List three human activities which could cause the loss of a species.
2. Distinguish between the terms 'pesticide', 'insecticide' and 'herbicide'.
3. (a) What is the special property of a 'persistent' insecticide?
(b) In what ways is 'persistence' (i) a useful property, (ii) a harmful property?
4. Put the following events in the most probable order.
 - (a) Predatory birds poisoned by insecticide.
 - (b) Trees sprayed with insecticide.
 - (c) Earthworms eat leaves which fall from trees.
 - (d) Predatory birds eat small birds.
 - (e) Beetles damage trees by spreading a virus.
 - (f) Insecticide absorbed by tree leaves.
 - (g) Small birds eat earthworms.
5. Put the following events in the most probable order.
 - (a) Dead algae decomposed by bacteria.
 - (b) Excess nitrate and phosphate.
 - (c) Fish die of suffocation.
 - (d) Bacteria use up oxygen.
 - (e) Aquatic algae die. discharged into river.
 - (f) Water depleted of oxygen
 - (g) Aquatic algae grow rapidly.
6. What are the principal sources of excessive nitrate and phosphate in rivers and lakes?
7. List the short-term and long-term effects of forest destruction (a) on hillsides, (b) in the tropics.
8. In what ways does over-grazing lead to soil erosion?
9. Which of the following are likely to help conserve soil and prevent erosion?
 - (a) Ploughing slopes.
 - (b) Planting trees on steep slopes.
 - (c) Using chemical fertilizers.
 - (d) Terracing hillsides.
 - (e) Using organic manure.
 - (f) Removing trees from hillsides
 - (g) Growing the same crops each year.
 - (h) Keeping as many animals as possible on grassland.
10. (a) What are the two main pollutants that contribute to acid rain?
(b) Where do these pollutants come from?

(c) What direct or indirect effect is 'acid rain' thought to have on (i) lakes, (ii) forests and (iii) buildings?

11. Which of the following are important 'greenhouse' gases?

oxygen, water vapour, carbon dioxide, nitrogen oxides, ozone, methane, nitrogen

12. Which part of the carbon cycle is responsible for the increasing concentration of carbon dioxide in the atmosphere.

The human impact on the environment (continued)

13. Explain briefly why 'greenhouse' gases lead to global warming.

14. By how much do we need to cut carbon dioxide emissions in order to halt global warming?

5%, 20%, 60%, 90%

15. In what way do chlorofluorocarbons (CFCs) cause global problems?

16. (a) What do you understand by the term 'monoculture'?

(b) What is one disadvantage of a monoculture?

17. Which of the following are not covered by the 1956 and 1968 Clean Air Acts?

(a) Sulphur dioxide emission from power stations.

(b) Smoke emission from factories.

(c) Particulate emission from vehicles.

(d) Emission of chlorofluorocarbons from aerosol sprays.

18. State two ways in which sulphur dioxide emissions from coal-fired generating stations could be reduced.

19. Which of the gases listed below can be reduced in vehicle exhausts by (a) a catalytic converter (b) a lean burn engine?

carbon dioxide, carbon monoxide, unburned petrol, nitrogen oxide, water vapour, oxygen

The human impact on the environment - answers

1. Human activities which threaten species with extinction are: (i) hunting of individual species, (ii) over-exploitation of stocks (e.g. over-fishing), (iii) destruction of habitats (deforestation, agriculture, urbanisation).
2. A pesticide is a compound which destroys or controls any organism which is considered to be harmful to our interests. An insecticide destroys or controls populations of insects, preferably only those thought to be harmful. A herbicide kills or controls plants which humans want to get rid of, e.g. weeds.
3. (a) A persistent insecticide is chemically stable, i.e. it takes a long time to break down.

- (b) (i) This property is useful because the substance will continue to kill insects long after it has been applied.
(ii) 'Persistence' is harmful because the insecticide lasts long enough to pass up a food chain and become concentrated in the bodies of secondary or tertiary consumers.
4. (e) Beetles damage trees by spreading a virus.
 - (b) Trees sprayed with insecticide.
 - (f) Insecticide absorbed by tree leaves.
 - (c) Earthworms eat leaves which fall from trees.
 - (g) Small birds eat earthworms.
 - (d) Predatory birds eat small birds.
 - (a) Predatory birds poisoned by insecticide.
 5. (b) Excess nitrate and phosphate discharged into river.
 - (g) Aquatic algae grow rapidly.
 - (e) Aquatic algae die.
 - (a) Dead algae decomposed by bacteria.
 - (d) Bacteria use up oxygen.
 - (f) Water depleted of oxygen.
 - (c) Fish die of suffocation.
 6. Excessive nitrates and phosphates come mainly from sewage effluents and intensive agriculture.
 7. (a) Deforestation on hillsides exposes the soil to erosion by rain and leads to silting of rivers and lakes. Floods may be caused by (i) the rapid run off from deforested slopes, (ii) the silting up of rivers and lakes by the eroded topsoil.
(b) Deforestation in the tropics also leads to erosion. If followed by agriculture, it causes impoverishment of the soil. There may also be local climatic changes and a global increase in atmospheric carbon dioxide. Biodiversity is reduced.
 8. Over-grazing leads to erosion because (i) the animals remove all the vegetation, so exposing the soil to heavy rain, (ii) their hooves compact the soil so that rain water runs off the surface carrying the soil with it.
 9. Soil conservation is helped by (b) planting trees on steep slopes, (d) terracing hillsides, (e) using organic manure. The other activities are likely to lead to soil erosion.
 10. (a) The main pollutants in acid rain are Sulphur dioxide and oxides of nitrogen. Ozone may also be a pollutant.
(b) Sulphur dioxide and oxides of nitrogen come mainly from burning coal in power stations. Oxides of nitrogen come from burning petrol and diesel in cars and lorries. Ozone results from reactions of these gases in the atmosphere.
(c) Acid rain (i) leads to acidification of lakes which kills all the living organisms;
(ii) directly or indirectly leads to the premature death of trees and the destruction of forests; (iii) the erosion of buildings and other structures containing limestone, marble, mortar etc.
 11. Important 'greenhouse' gases are water vapour, carbon dioxide, nitrogen oxides, methane

12. The burning of fossilized products (coal and oil) of some plants is the cause of increasing carbon dioxide in the atmosphere. (Burning wood and paper has a neutral effect because these are products of plants which have absorbed carbon dioxide during photosynthesis).
13. The greenhouse gases do not interfere with the short-wave radiation reaching the Earth from the sun but absorb the long wave radiation reflected from the Earth's surface. This reduces the escape of heat from the Earth.
14. We need to cut carbon dioxide emissions by about 60% to halt (but not reverse) global warming.
15. Chlorofluorocarbons react with and deplete the ozone in the ozone layer. This allows more ultra-violet light from the sun to reach the Earth, with harmful effects on living organisms (e.g. skin cancer in humans).
16. (a) 'Monoculture' is the term applied to the growing of the same agricultural crop year after year on the same land. It also implies that the crop consists exclusively of one species of plant grown in dense stands.
(b) Because the crop consists of one species of plants in close proximity, any pest or disease will spread easily and rapidly to the whole crop.
17. (a), (c) and (d) are not covered by the Clean Air Acts of 1956 and 1968.
18. Sulphur dioxide emissions can be reduced by fitting desulphurization plants or by changing to a cleaner form of coal with less sulphur in it.
19. (a) A catalytic converter reduces emissions of nitrogen oxides, carbon monoxide and unburnt petrol. (b) A lean-burn engine reduces the nitrogen oxide emissions.

Conservation - Questions

1. In what ways could human activity lead to the extinction of a species in an area?
2. How could humans be disadvantaged by the extinction of a plant species?
3. In what ways can we try to protect a species from extinction?
4. What do the initials CITES, WWF and IWC stand for?
5. Apart from conserving individual plants and animals, what else needs to be conserved.
6. What term is used to describe the range of organisms in a habitat?
7. In what ways can modern agriculture threaten the survival of species?
8. Name three sources of energy which do not depend on fossil fuel.
9. Which of the following can be (a) recycled, (b) obtained from renewable sources?
coal, paper, lead, wood, glass, vegetable oil, iron, polythene, methane

10. Name three sources of biofuel (fuel derived from biological sources).

Conservation - answers

1. Human activity could lead to extinction of a species by (a) over-hunting, e.g. elephants, rhinos, whales, (b) destruction of habitats, e.g. logging, farming, building, (c) introduction of alien species, e.g. cats, rats, cane toads, (d) pesticide use, e.g. honey bees, predatory insects.
2. The loss of a plant species might deprive humans of any beneficial substances (e.g. drugs) that the species contained. There would also be a loss of genes (e.g. for drought resistance) that could be incorporated into crop plants.
3. We can attempt to protect species from extinction by making it illegal to kill the threatened animals or uproot or destroy the protected plants. Habitats of the species can be conserved. Breeding the endangered species in captivity and releasing them later can save a species from extinction.
4. CITES Convention on International Trade in Endangered Species. WWF World Wide Fund for Nature IWC International Whaling Commission
5. As well as conserving individual plants and animals, it is essential to conserve their habitats.
6. The term 'biodiversity' implies the range of organisms in a habitat (or even globally).
7. Modern agriculture destroys the natural vegetation (e.g. woodland, hedgerows) on a site, which means a natural habitat is lost. A cultivated area has little biodiversity. The use of pesticides can destroy harmless or beneficial organisms as well as agricultural pests.
8. Sources of energy which do not rely on fossil fuel are water (hydroelectric generation), wind, tidal power, wave energy, biofuels, geothermal energy (using heat from the deeper layers of the Earth's surface). (any three)
9. (a) Paper, lead, glass, iron and polythene can all be recycled.
(b) Wood, vegetable oil and methane can be obtained from renewable sources.
10. Biofuel can be obtained from sugar (sugar-cane), maize, sunflower oil, palm oil, human and animal waste.

Ecosystems Questions

1. Choose terms from the list below which best describe the following:
 - (a) All the organisms of one species living in a defined area.
 - (b) All the organisms living in the same defined area.
 - (c) The place where an organism is usually found.
 - (d) A self-supporting group of organisms and their environment.

ecosystem, population, habitat, biosphere, community, environment, farmland

2. What resources are competed for by (a) animals, (b) plants?

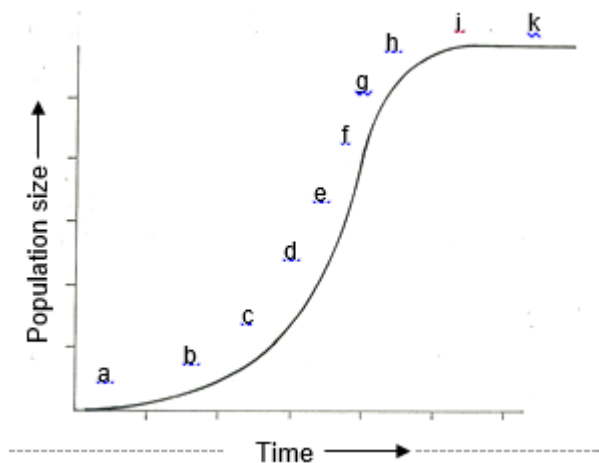
3. What is the distinction between interspecific competition and intraspecific competition?
4. Which of the following are (a) biotic factors or (b) abiotic factors in an ecosystem?
competition, temperature, rainfall, predation, sunlight, parasitism, oxygen concentration
5. What two abiotic factors might affect (a) an animal living at the bottom of the sea, (b) a plant growing on a mountainside?
6. What two biotic factors could affect an antelope living in the Serengeti?
7. Give two examples of artificial ecosystems.
8. Give three ways in which a polar bear is adapted to its environment.
9. Give three ways in which a plant might be adapted to a hot dry environment.

Ecosystems - answers

1. (a) All the organisms of one species living in a defined area. Population
(b) All the organisms living in the same defined area. Community
(c) The place where an organism is usually found. Habitat
(d) A self-supporting group of organisms and their environment. Ecosystem
2. (a) Animals compete for food, mates and shelter.
(b) Plants compete for light, water and minerals.
3. Interspecific competition takes place between organisms of the same species.
Intraspecific competition takes place between organisms of different species.
4. (a) Biotic factors: competition, predation, parasitism.
(b) Abiotic factors: temperature, rainfall, sunlight, oxygen concentration.
5. (a) The abiotic factors which might affect an animal living at the bottom of the sea might be; water pressure, light, salinity. (any two)
(b) The abiotic factors which might affect a plant growing on mountains might be; temperature, wind speed, drainage of water, light intensity. (any two)
6. The biotic factors that might affect an antelope living in the Serengeti could be:
predation by carnivores, availability of grass or leaves, internal or external parasites.
7. Artificial ecosystems could include; agricultural land, parkland, gardens, fish farms, orchards.(any two)
8. A polar bear is adapted to its environment by its high ratio of bulk to surface area, a thick water-repellent coat, a thick layer of fat beneath the skin, a heat exchange system for the feet. (any three)
9. A plant might be adapted to a hot dry environment by having a reduced leaf area, waxy cuticle to the leaves, few stomata, water-storing tissues. (any three)

Populations - Questions

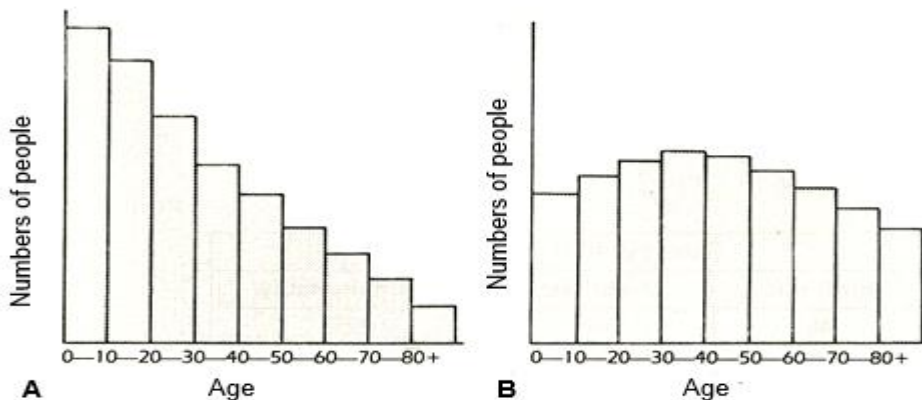
1. The graph represents a sigmoid growth curve For a population of micro-organisms.
 - (a) Select the sequence of letters on the curve Which best represents (i) the exponential Phase of growth, (ii) the stationary phase and (iii) The lag phase.
 - (b) What is taking place during the exponential? Phase?



3. What is meant by the expression 'infant mortality'?
4. What is meant by a 'fertility rate of 3'?
5. Each of the following events could result in population growth, but only if certain other conditions are fulfilled. In each case, suggest what these conditions are.
 - (a) Birth rate increases.
 - (b) Death rate decreases.
 - (c) More people live to reproductive age.
 - (d) Infant mortality decreases.
 - (e) Life expectancy increases.
6. The table shows birth rates, death rates and infant mortality for four African countries some years ago. Which country would you expect to show (a) the greatest, (b) the smallest population increase by now, assuming no wars or famines?

Country	Rates per 1000 population		
	Birth rate	Death rate	Infant mortality
Tanzania	46	16	125
Gabon	33	22	178
Ethiopia	50	25	162
Kenya	53	14	80

7. If 65 year-old women in Britain have a life expectancy of 13 years, what will be their average age at death?
8. State the changes in society which could contribute to a falling death rate.
9. State three conditions in a society which could contribute to a reduction in the birth rate.
10. How would an increase in the fertility rate affect the age structure of a population?
11. The bar charts show the numbers of people of different ages in two countries.
 - (a) Describe the age structure of the population in each case.
 - (b) Comment on the death rates in the two countries.
 - (c) Which of the two charts is characteristic of an industrialised country?



Populations - answers

1. (a) (i) The exponential phase is represented by the letters c - f
(ii) The stationary phase is represented by i - k
(iii) The lag phase is a - b
(b) During the exponential phase the population is doubling at each generation.
2. (a) In green plants the limiting factors are likely to be light, water, minerals, temperature, grazing, pests and diseases. (b) In birds the limiting factors could be food, nest sites, predation, temperature, diseases.

3. Infant mortality refers to the number of babies in a population who die at the age of 1 year or less. It is usually expressed as the number of deaths per 1000 live births.
4. A fertility rate of 3 means that women of child-bearing age will have, on average, three children.
5. A steady increase in population could result from: (a) an increased birth rate;- provided that (i) most of the extra babies survive to reproductive age, (ii) there is no corresponding increase in the death rate. (b) a decreased death rate;- provided that the decrease applies to people before they reach reproductive age. A decrease in the death rate of the over-50s will not produce a continuing increase in population. (c) more people living to reproductive age;- provided that the fertility rate (i.e. number of babies per woman) does not decrease. (d) a decrease in infant mortality; provided that the babies grow up and reach reproductive age. (e) an increase in life expectancy; provided that it applies to people of reproductive age and not just to the elderly. (NOTE: Most of the proviso's could apply to each case but they have not been repeated.)
6. (a) Kenya would be expected to show the greatest increase in population ($53 - 14 = 39$ per thousand or 3.9%) (b) Gabon would show the least increase (1.1%).
7. If 65 year-old women have a life expectancy of 13 years, their average age at death will be $65 + 13 = 78$ years.
8. The changes in society which could contribute to a falling death rate are:
 - (i) improvements in clean water, sewage disposal and sanitation,
 - (ii) better health care, including immunisation programmes,
 - (iii) improved standards of nutrition and housing,
 - (iv) better education, leading to the changes listed above,
 - (v) greater wealth, leading to the changes listed above.
9. Birth rate might be reduced by
 - (i) later marriages (hence smaller families),
 - (ii) family planning techniques, including contraception.
10. An increase in fertility would lead to a greater number of children and young people in the population. Populations - answers (continued)
11. (a) The age structure of population A shows a great preponderance of babies and young people. More than half the population is under 30 and there are relatively few elderly people. In population B the birth rate is declining (there were more babies born 50 years ago than there are today) and the bulk of the population is middle aged. There is a greater proportion of elderly people than in population A.
 - (b) The death rate in population A is much greater in the early years of life than it is in B.
 - (c) Chart B is characteristic of an industrialised country.

Micro-organisms and humans - Questions

1. List the main types of organism included under the heading of 'Micro-organisms' Bacteria
2. Which of the following are not found in bacteria? cytoplasm, cell wall, nuclear membrane, DNA, chromosome, glycogen, cellulose
3. Saprophytic bacteria release A into their surroundings and then absorb the B
4. Choose the most appropriate word from the list below to complete the following sentence. Aerobic bacteria differ from anaerobic bacteria because they need A for their respiration. air, oxygen, food, light
5. In what ways are bacteria affected by (a) boiling at 100 °C, (b) refrigerating at 4°C, (c) freezing at -20°C?
6. Give one example in each case of the usefulness of bacteria in (a) a natural environment, (b) an industrial process.
7. Give three examples of diseases caused by bacteria,
8. Complete the following paragraph.
Bacteria which cause diseases are called A The disease symptoms are usually the result ofB produced by the bacteria. Disease-causing bacteria feed parasitically on or in the body of their C
9. (a) What kind of food is most likely to contain Salmonella bacteria?
(b) What illness is caused by Salmonella typhimurium?
(c) What is the usual method of killing Salmonella bacteria in food?
10. When a particular strain of bacteria is called 'resistant', what is it resistant to?
11. Which one of the following is least likely to give rise to food poisoning?
(a) Cooking and eating a partially defrosted turkey.
(b) Eating a cooked chicken leg straight from the refrigerator:
(c) Preparing a fresh chicken for the oven and immediately making a lettuce and tomato salad. (d) Putting an uncooked chicken on the same plate as some cold ham.
12. Which of the following are not ways in which gonorrhoea and syphilis can be transmitted?
(a) Using a towel that has been used by an infected person.
(b) Touching an infected person.
(c) Kissing an infected person.
(d) Having sexual intercourse with an infected person.

13. How can a baby become infected with (a) gonorrhoea, (b) syphilis? Micro-organisms and humans (continued)

Viruses

14. Which one of the following is the most likely size of a virus?

1mm, 0.1 mm, 0.1 mm, 0.01 mm, 0.001 mm .

15. A virus consists of a central core of A or B surrounded by a coat made up of C units.

16. Which one of the following processes can be carried out by a virus? respiration, growth, excretion, reproduction

17. Name three diseases caused by viruses.

18. By what method may virus diseases be prevented?

19. (a) Which body cells are attacked by the HIV (AIDS) virus?
(b) What general effect does this have on the body?

20. State three ways by which the AIDS virus might be transmitted from an infected person to a healthy person.

Fungi

21. Most fungi are made up of A which form a B which spreads throughout the material on which the fungus feeds (the substrate). Many fungi are saprophytic. They secrete C into the substrate and then D the soluble products.

22. In what ways may saprophytic fungi be (a) useful, (b) harmful?

23. Name one fungus, in each case, which attacks (a) crops, (b) humans;

24. Choose the most appropriate word, from the list below, to complete the following sentence. Human fungus diseases are very A dangerous, infectious, contagious, catching

25. Which one of the following would be used to treat athlete's foot? A bactericide a fungicide., a pesticide, an insecticide.

Protozoa

26. State two ways in which protozoa differ from bacteria.

27. Which body cells are attacked by the malarial parasite?

28. By what means can malarial parasites be transmitted from an infected person to a healthy person?
29. (a) Anti-malarial drugs kill the parasites in the blood but they do not cure the disease. Why is this?
(b) Why was the use of DDT insecticide not successful in eradicating malaria?
- Biotechnology
30. Which group of fungi is most commonly used to convert sugar to alcohol?
31. (a) When sugar is fermented, alcohol is produced. What other substance is produced?
(b) What effect does this substance have in (i) baking, (ii) beer brewing?
32. Which one of the following is not a product of biotechnology?
flour, cheese, antibiotics, yoghurt
33. Name one biotechnological process which makes use of protozoa,
34. From what type of organisms are antibiotics obtained?

Micro-organisms and humans - answers

1 The term micro-organism includes viruses, bacteria, protozoa (protista), some fungi and some algae.

Bacteria

2 Bacteria do not have a nuclear membrane or cellulose.

3 Saprophytic bacteria release enzymes (A) into their surroundings and then absorb the soluble products/digested products/dissolved substances (B).

4 Aerobic bacteria differ from anaerobic bacteria because they need oxygen (A) for their respiration.
Note: Air is not an appropriate answer because most bacteria grow and reproduce in water.

5 (a) Boiling at 100°C kills most bacteria, (b) refrigeration slows down the rate of bacterial growth and reproduction, (c) freezing at -20°C stops the growth and reproduction of most bacteria.

6 (a) In a natural environment bacteria bring about decay. In this way they prevent accumulation of dead material and make available essential compounds such as nitrates.
(b) Bacteria are used in industrial processes to produce certain kinds of food (e.g. cheese, yoghurt), to make single-cell protein, to purify sewage and in the manufacture of certain chemicals (eg lactic acid).

7 Diseases caused by bacteria include tonsillitis, blood poisoning, scarlet fever, tuberculosis, typhoid, diphtheria, food poisoning, gonorrhoea, syphilis (any three).

8 Bacteria which cause diseases are called pathogenic/pathogens (A). The disease symptoms are usually the result of toxins (B) produced by the bacteria. Disease-causing bacteria feed parasitically on or in the body of their host (C).

9 (a) Salmonella bacteria are most likely to be present in poultry (chicken, duck, turkey), eggs, beef or pork, and unpasteurised milk.

(b) Salmonella typhimurium causes food poisoning.

(c) Cooking usually kills Salmonella bacteria in food.

10 Resistant bacteria are resistant to drugs, particularly antibiotics.

11 (b) A cooked chicken leg straight from the refrigerator is unlikely to contain Salmonella bacteria. Cooking should have killed the bacteria and refrigeration should have prevented the reproduction of any bacteria which survived the cooking.

12 (a), (b) and (c) are not recognised ways in which syphilis or gonorrhoea can be transmitted.

13 (a) During birth, a baby may be infected with gonorrhoea bacteria as it passes through the vagina of an infected women.

(b) Syphilis bacteria can pass through the placenta and infect the fetus before birth.

14 The most likely size for a virus is 0.001 mm

15. A virus consists of a central core of DNA (A) or RNA (B) surrounded by a coat made up of protein (C) units.

16. Viruses cannot respire, grow or excrete, but they can reproduce.

17. Virus diseases include colds, influenza, herpes, mumps, measles, chicken pox, rubella, hepatitis and AIDS (any three).

18. Virus infection may, in many cases, be prevented by immunisation.

19. (a) The HIV (AIDS) virus attacks the white cells (lymphocytes).

(b) The body thus loses its ability to fight disease organisms or cancerous cells (i.e. a loss of immunological response).

20. AIDS may be transmitted by sexual intercourse (heterosexual or homosexual) with an infected person, by using a syringe needle that has been used by an infected person, by receiving a blood transfusion (or blood products) from an infected person.

21. Most fungi are made up of hyphae (A) which form a mycelium (B) which spreads throughout the material on which the fungus feeds. Many fungi are saprophytic. They secrete enzymes (C) into the substrate and then absorb (D) the soluble products.

22. Saprophytic fungi are useful in bringing about decay of dead material. They are harmful when they grow on our food and make it unfit to eat, or when they invade timber in buildings.

23. (a) Crops are attacked by rust, mildew and blight fungi. (b) Humans are attacked by the athlete's foot fungus, Tinea.
24. Human fungus diseases are very contagious (A).
25. Athlete's foot is caused by a fungus, and so is treated with a fungicide.
26. Protozoa do not have a cell wall (unlike bacteria), but they do have a nuclear membrane.
27. The malarial parasite attacks red blood cells.
28. The malarial parasite is transmitted when a healthy person is bitten by a mosquito which has fed on an infected person.
29. (a) Anti-malarial drugs do not kill the parasites in the liver.
(b) Mosquitoes became resistant to the DDT insecticide.
30. The yeasts are most commonly used to convert sugar to alcohol.
31. (a) In addition to alcohol, fermentation of sugar produces carbon dioxide.
(b) (i) Bubbles of carbon dioxide cause the bread dough to rise and so give the bread a light texture.
(ii) Carbon dioxide dissolved in the beer makes it fizzy and gives it a sharp taste.
32. Flour is not a product of biotechnology.
33. Purification of sewage makes use of protozoa, at one stage of the process; the protozoa ingest bacteria and solid particles. Protozoa also help in the filtration process at the water works.
34. Antibiotics are obtained from fungi, or organisms closely related to fungi. Most of them live in the soil.