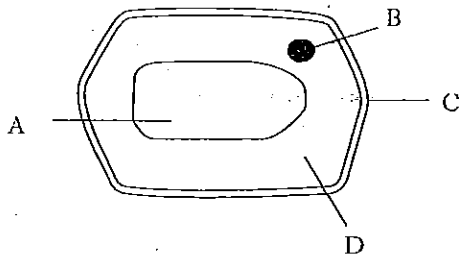# Cell Structure

Questions 1 and 2 refer to the plant cell diagram below.


1. Which of the plant cell components shown above is made from a structural carbohydrate?

2. Which labelled part controls cell activities?

3. Which line in the table below correctly matches the plant cell structure to its function?

|	Plant cell structure	Function
A	Cytoplasm	Controls all the chemical activities
B	Cell wall	Keeps the cells turgid
C	Vacuole	Prevents the cell from bursting in a hypotonic solution
D	Cell membrane	Controls which molecules enter or leave the cell

4. Which of the following is not surrounded by a membrane?

A Nucleus

B Ribosome

C Chloroplast

D Mitochondrion

5. The bar chart below shows the number of cells of different lengths in a sample of onion epidermis.
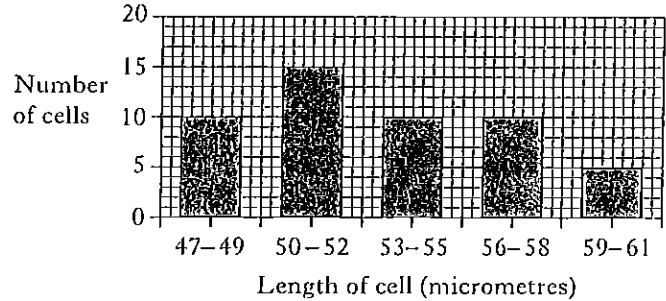
The percentage of cells with a length greater than 55 micrometres is

A 10%

B 15%

C 20%

D 30%.

6. Which structural feature is common to both plant and animal cells?

A Cell wall

B Chloroplast

C Nucleus

D Large central vacuole

7. The cell structures shown below have been magnified ten thousand times.
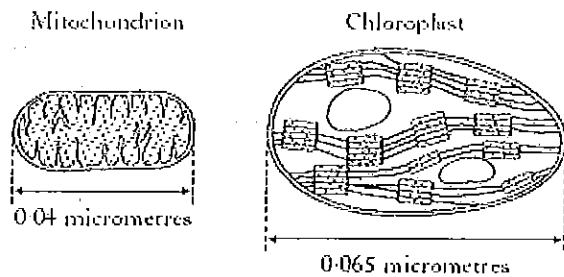
Expressed as a simple whole number ratio, the length of the mitochondrion compared to that of the chloroplast is
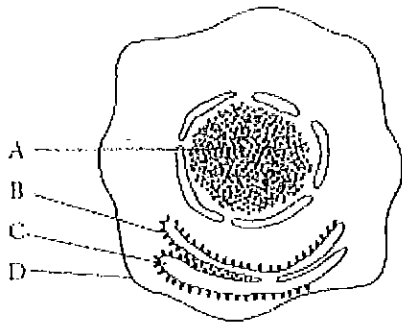
A 8 : 13

B 13 : 8

C 40 : 65

D 65 : 40.

3

8. The diagram below shows a cell.
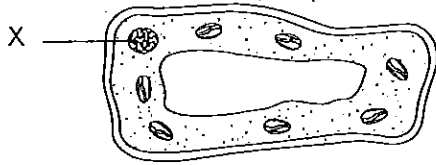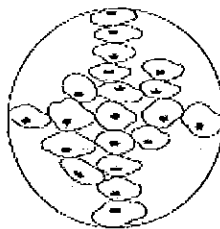

The function of structure X is to

A   control cell activities

B   keep the cell turgid

C   control entry and exit of material

D   release energy from glucose.

9. The diagram below shows parts of an animal cell.

Where does synthesis of mRNA take place?

10. The diagram below shows the arrangement of molecules in part of a cell membrane.

What types of molecule are represented by X and Y?

	X	Y
A	Phospholipid	Protein
B	Protein	Phospholipid
C	Protein	Carbohydrate
D	Carbohydrate	Protein

11. The diagram below shows a group of cells as seen under a microscope. The field of view was 2 mm in diameter.
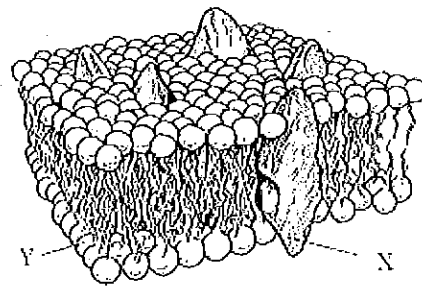

Calculate the average length and width of the cells.

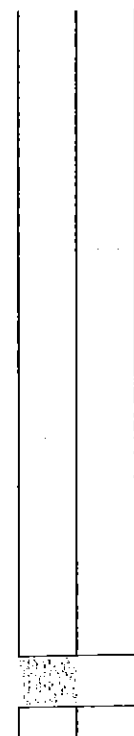*Space for calculation*

Average length _____ mm

Average width _____ mm

12. (a) The diagram below shows two cells P and Q.

Cell P   Cell Q

A   B   C
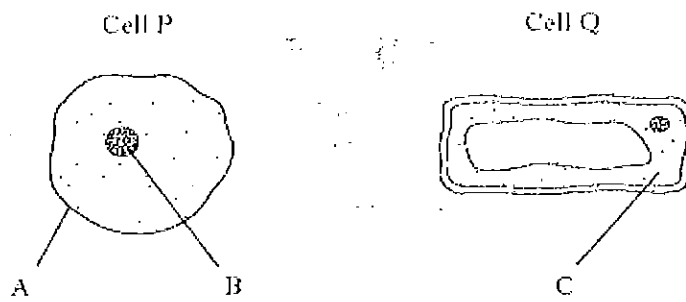
(i) Complete the table below to give the name and function of the parts labelled A, B and C.

Letter	Part	Function
A	cell membrane	
B	nucleus	
C		site of cell activities

2

(ii) Which cell is a plant cell? Give a reason for your choice.

Cell_____

Reason_____ 1

13. The diagram shows a human liver cell and a magnified section of its plasma membrane.

magnified section of
plasma membrane
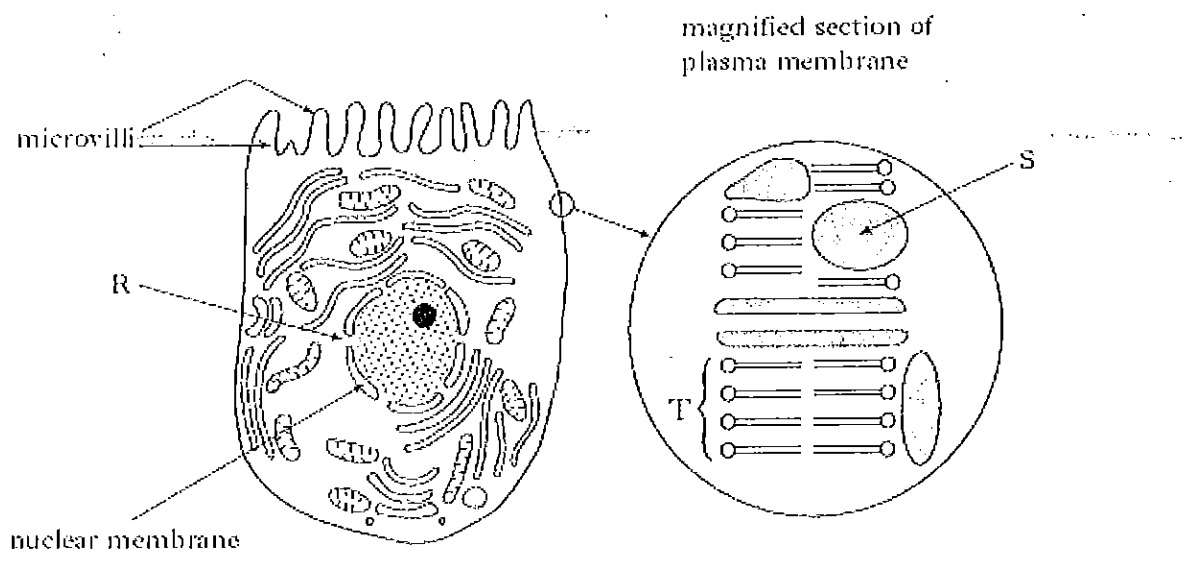
(a) (i) Identify molecules S and T.

S _____   1

T _____   1

(ii) A pore in the nuclear membrane is shown by label R.

Describe the importance of these pores in protein synthesis.

_____

_____   1

(iii) What evidence in the diagram suggests that this cell produces large quantities of ATP?

_____   1

14. The diagram below shows *Paramecium*, a unicellular organism found in fresh water.
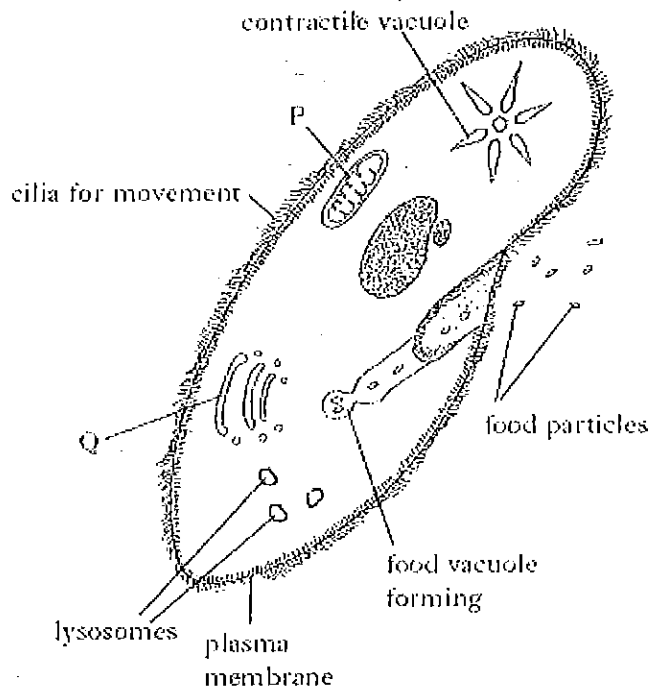
(*a*) Identify organelles P and Q.

P _____

Q _____   2

(*b*) (i) Name two chemical components of the plasma membrane.

1 _____

2 _____   1

(ii) Give a property of the plasma membrane which is related to its role in osmosis.

_____   1

15. (a) *Euglena* is a single celled organism.

The diagram below shows some of the structures within *Euglena*.
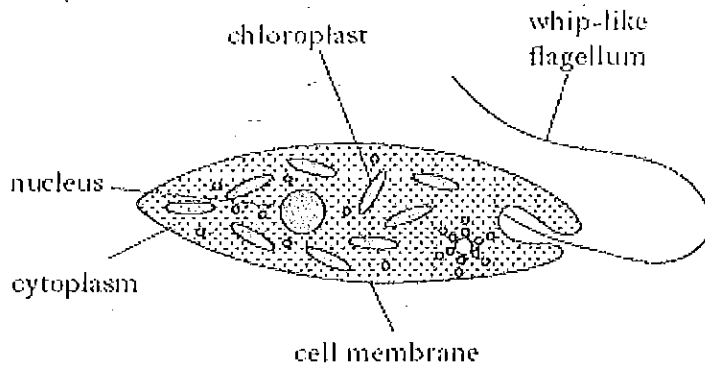
(i) *Euglena* has structures found in most cells.

Complete the table below to show the names of these structures and their functions.

Structure	Function
	controls the entry and exit of materials
Cytoplasm	
Nucleus	

2

(ii) Name the structure that identifies *Euglena* as a plant cell.

_____

1

(b) Most plant cells have a cell wall.

Name the structural carbohydrate in the cell wall.

_____

1

Uses of Microbes

1. Once yoghurt has been produced it is stored in a fridge.

   This is because

   A   bacterial growth is slowed down

   B   it makes the yoghurt more creamy

   C   it causes lactose to change to lactic acid

   D   the taste of the yoghurt is improved.

2. Fermentation of sugar cane produces alcohol. What is produced when this alcohol is mixed with petrol?

   A   Biogas

   B   Gasohol

   C   Methane

   D   Carbon dioxide

3. An investigation was carried out to measure the rate of carbon dioxide production in bread dough.

   Carbon dioxide production was measured by recording the change in volume of a sample of bread dough over a 50 minute period.
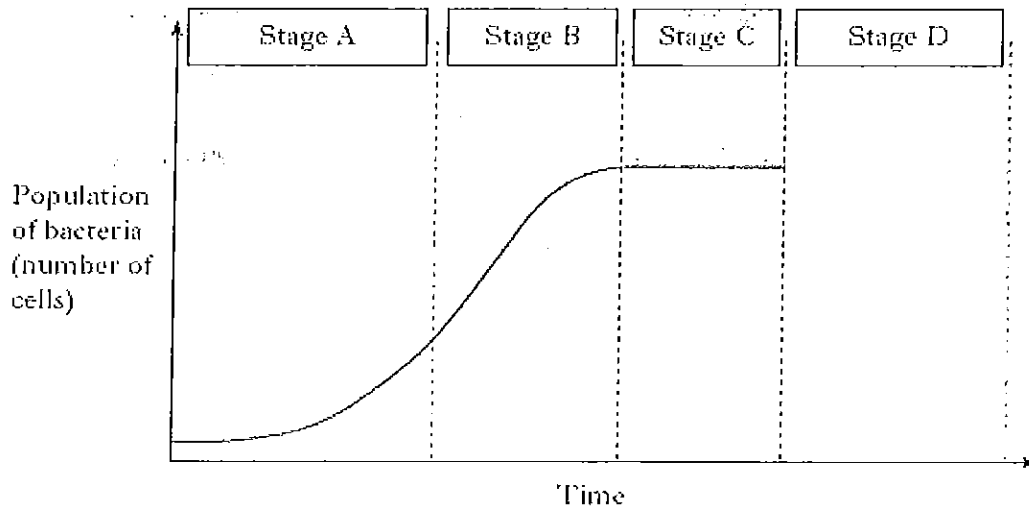
   The results are shown in the table below.

Time (minutes)	0	10	20	30	40	50
Volume of dough (cm³)	10	14	18	21	23	25

   The conclusion for this investigation was

   A $0.3\,cm^3$ of carbon dioxide was produced per minute

   B $0.5\,cm^3$ of carbon dioxide was produced per minute

   C $15\,cm^3$ of carbon dioxide was produced per minute

   D $25\,cm^3$ of carbon dioxide was produced per minute.

4. Yeast cells are used in the brewing industry.

   (i)   Name the type of respiration involved.

   _____

   (ii) Explain why yeast cells are used in the brewing industry.

   _____

   1

   1

5. (ii) <u>Underline</u> one option in each set of brackets to make the following sentence correct.

   Gasohol is produced when cells act on sugar to produce $\left\{ \begin{array}{l} \text{alcohol} \\ \text{methane} \end{array} \right\}$

   which is then mixed with $\left\{ \begin{array}{l} \text{ethanol} \\ \text{petrol} \end{array} \right\}$.

   1

6. Answer either A or B.

   Labelled diagrams may be included where appropriate.

   A. Describe the function of yeast in bread making and the anaerobic pathway of respiration involved in this process.

   5

7. The graph shows the changes in the population of bacteria in a fermenter.

(a) (i) Describe the changes in population of the bacteria during Stage B.

_____

_____

(ii) Give a reason for the changes in population shown during Stage B on the graph.

_____

_____

(iii) Complete Stage D on the graph to show the effect of an increasing death rate on the population of bacteria.

8. One type of cell is used in the production of yoghurt.

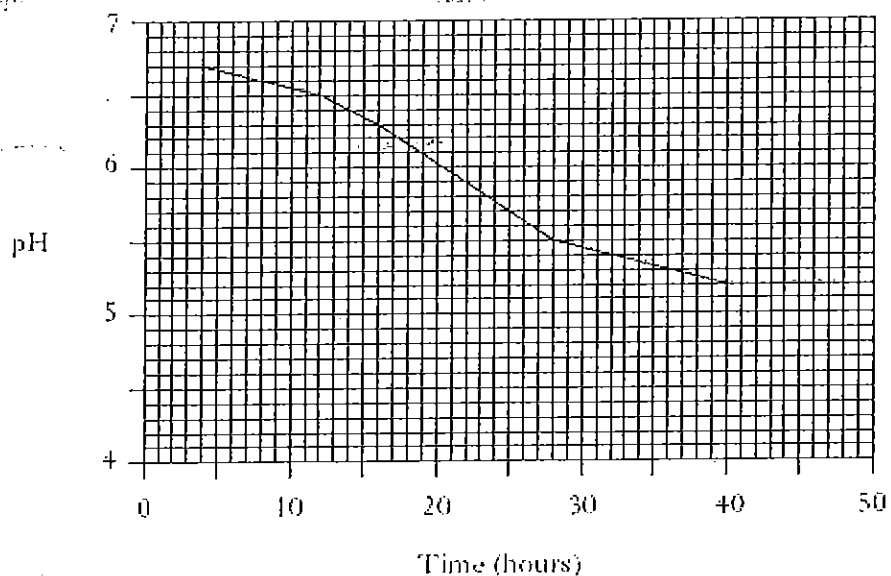(A) Name the type of cell used in the production of yoghurt.

_____

(B) Name the milk sugar used by these cells.

_____

10
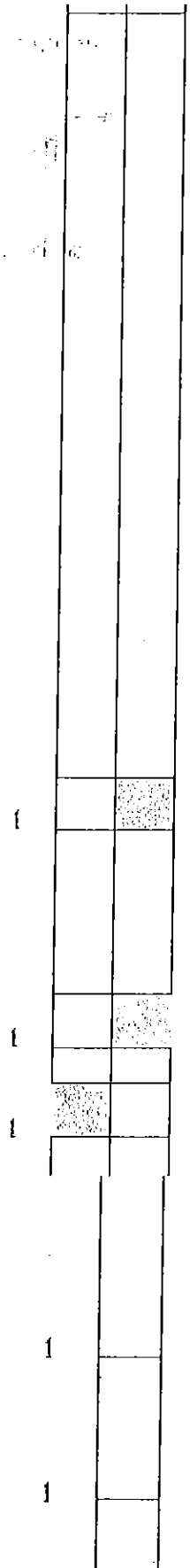
9. As milk sours there is a change in pH. The following graph shows the pH changes in a sample of milk over 50 hours at a temperature of 20°C.

Time (hours)

(a) Calculate the average decrease in pH per hour.

Space for calculation

_____ pH units

(b) Milk is considered to be too sour for human consumption when the pH is less than 6·4.

For how many hours would this sample have remained fit to drink?

_____ hours

(c) The souring of milk is a fermentation process.

Name the substrate, product and the type of micro-organism involved.

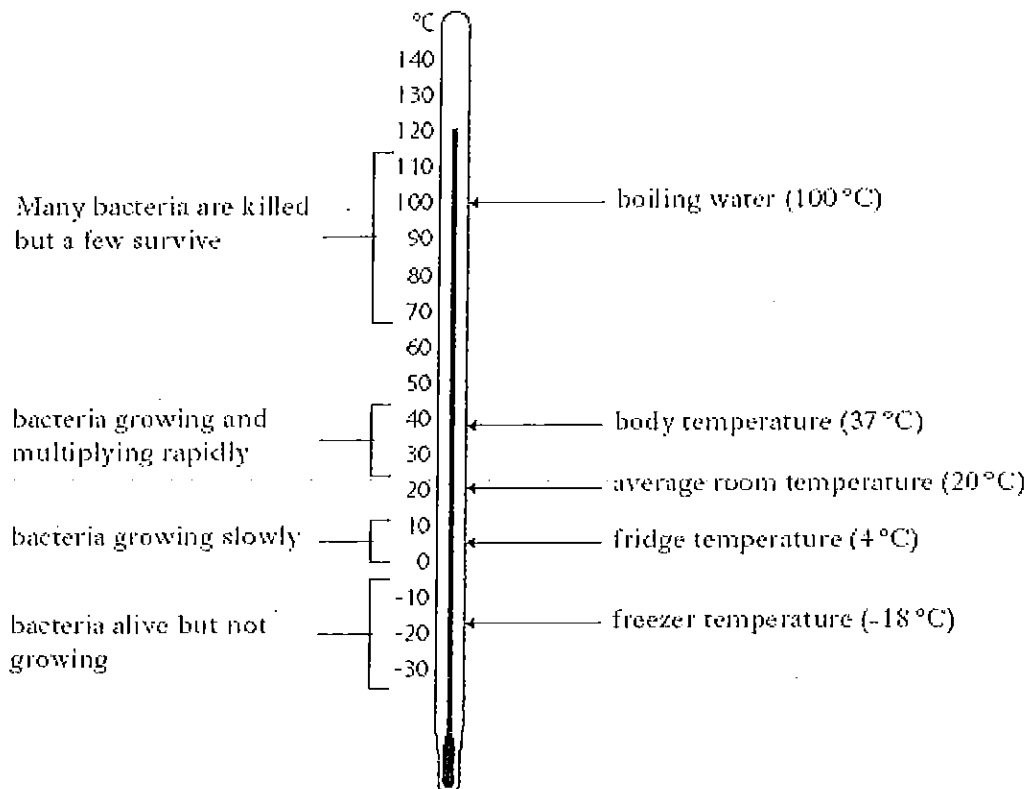Substrate _____

Product _____

Type of micro-organism _____

10. (a) The table below shows the number of bacteria grown in a fermenter over a 24 hour period.

Time (hours)	Number of bacteria (billions/mm³)
0	20
4	25
8	80
12	200
16	225
20	225
24	225

Describe the growth of the bacteria over the 24 hour period.

_____

_____

2

(b) The following diagram shows different temperatures and their effect on bacterial growth.

°C

140
130
120
110
100 ← boiling water (100 °C)
90
80
70
60
50
40 ← body temperature (37 °C)
30
20 ← average room temperature (20 °C)
10
0 ← fridge temperature (4 °C)
-10
-20 ← freezer temperature (-18 °C)
-30

Many bacteria are killed but a few survive

bacteria growing and multiplying rapidly

bacteria growing slowly

bacteria alive but not growing

12

10. (b) (continued)

(i) What would be a suitable temperature to provide optimum conditions for bacterial growth in a fermenter?

_____ °C

1

(ii) Why should a fermenter be heated to 120°C before it is set up?

_____

1

(iii) Explain why food should only be kept for a few days in a fridge.

_____

_____

1

(c) Micro-organisms can be grown on waste from food processing factories. They can then be harvested and used as animal feed.

Which important food component is present in increased quantities as a result of this upgrading of the waste?

_____

1

11. The diagram shows an industrial fermenter. It is fitted with a number of taps which allow substances to be added or removed.

motor

B

C — fermenter

D

A

cold water jacket

E
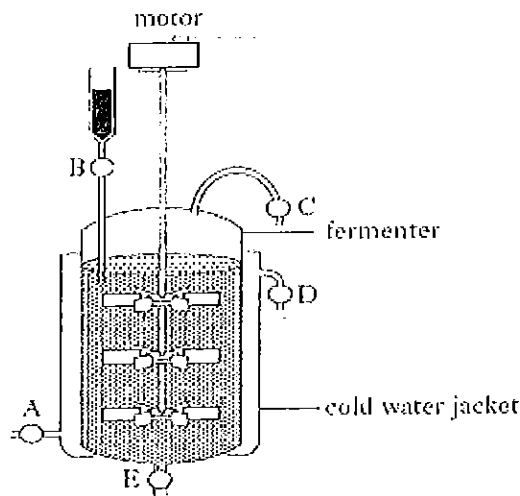
(a) Which of the taps, A, B, C, D or E, would open to

(i) add nutrients to the mixture? _____

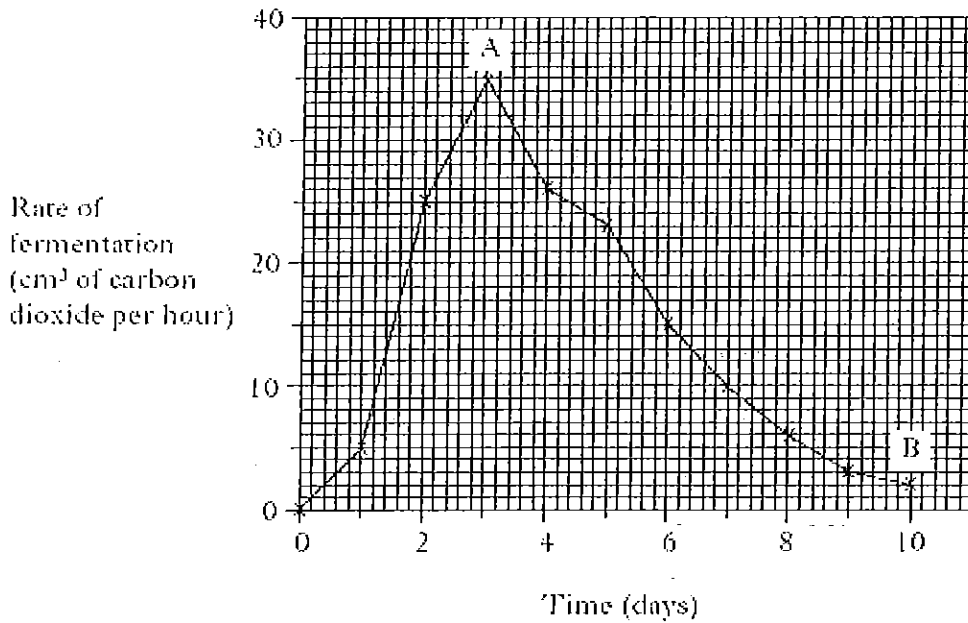(ii) remove waste gases? _____

(iii) drain off the products? _____

2

(b) The fermenter should be kept at 35°C. Explain why the water jacket around the fermenter should be cold.

_____

_____

1

13

11. (continued)

(d) Barley malt extract, water and yeast were placed in the fermenter and left for several days.
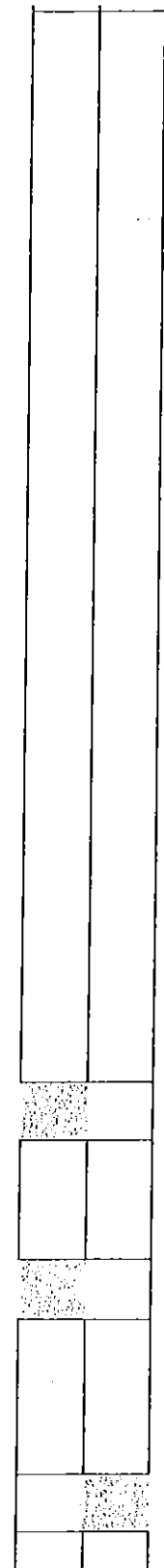
The rate of fermentation was measured and the results are shown in the graph below.

Time (days)

(i) Describe the changes in the rate of fermentation over the ten days.
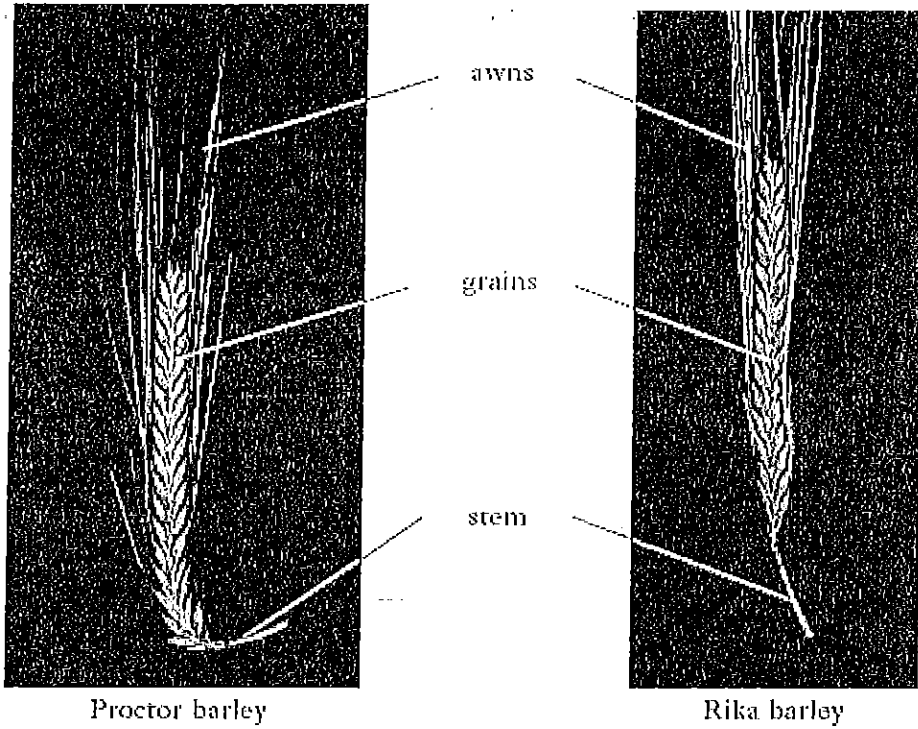
_____

_____

(ii) Suggest a reason for the change in the rate of fermentation between points A and B.

_____

(iii) Why must the barley be malted before it can be used by the yeast?

_____

_____

12. (a) Barley is a plant grown for use in the brewing industry. The photographs below show two varieties of barley that have been produced by selective breeding.

Proctor barley   Rika barley

Describe one difference between these two varieties of barley.

_____

_____

(b) (i) Explain why barley must be malted before use in the brewing process.

_____

_____

(ii) Describe how brewers ensure that the yeast carries out fermentation on the sugars extracted from the malted barley.

_____
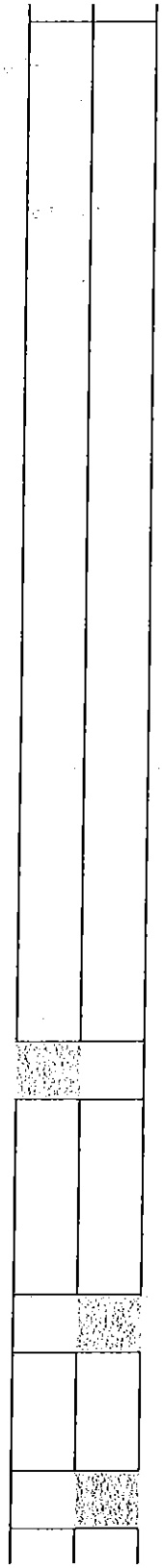
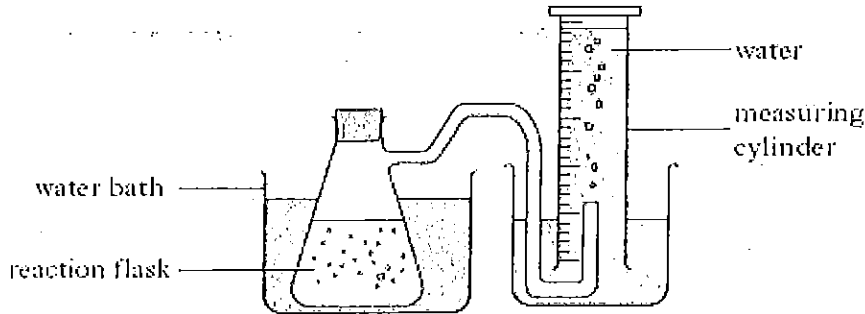**13.** An investigation was carried out into the effect of temperature on the rate of respiration by yeast.

Details of the apparatus, method used and results are given below.

Apparatus

water

measuring cylinder

water bath

reaction flask

Method

1   Water baths were set up over a range of temperatures.
2   100 cm³ of glucose solution and 50 cm³ of yeast suspension were allowed to reach the same temperature as the water bath.
3   The glucose solution and the yeast suspension were mixed in the reaction flask.
4   After 1 hour, the volume of gas in the measuring cylinder was measured.

Results

Temperature (°C)	10	20	30	40	50
Volume of gas produced in 1 hour (cm³)	9	18	36	48	5

(a) Ethanol was formed in the reaction flask.

What cell process produced this?

_____

(b) Describe the relationship between the temperature and the volume of gas produced in one hour.

_____

_____

1

2

16

13. (continued)

(c) Predict the volume of gas which would be collected in one hour if the investigation was repeated at 60°C. Give an explanation for your answer.
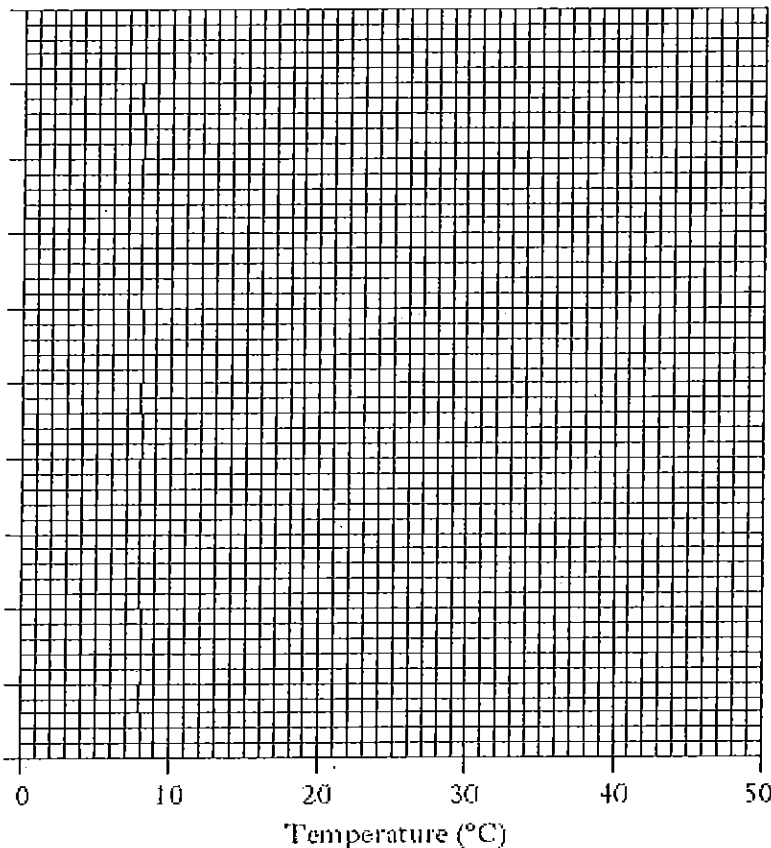
Prediction _____ cm³

1

Explanation _____

_____

1

(d) Describe the control flasks that would be set up to show that the gas was produced due to activity of the yeast and to no other factor.

_____

_____

2

(e) Use the results to complete a line graph to show the volumes of gas produced in one hour over the range of temperatures.

(An additional grid, if needed, will be found on page 27.)

Temperature (°C)

2

14. (*a*) In a sewage works, micro-organisms cause the decay of the sewage. What is the benefit to the micro-organisms in carrying out this process?

_____

1

(*b*) What type of respiration must be carried out by the micro-organisms to ensure complete breakdown of the sewage?
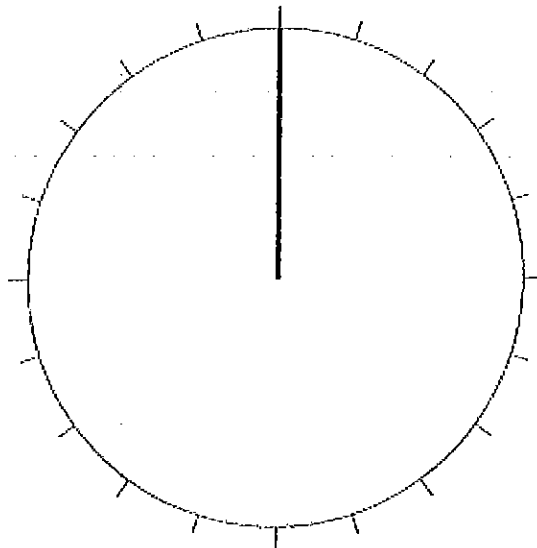
_____

1

(*c*) Sewage contains a wide range of materials. What ensures that all these materials are broken down?

_____

1

(*d*) The table shows the methods of disposal of the sludge obtained from sewage treatment.

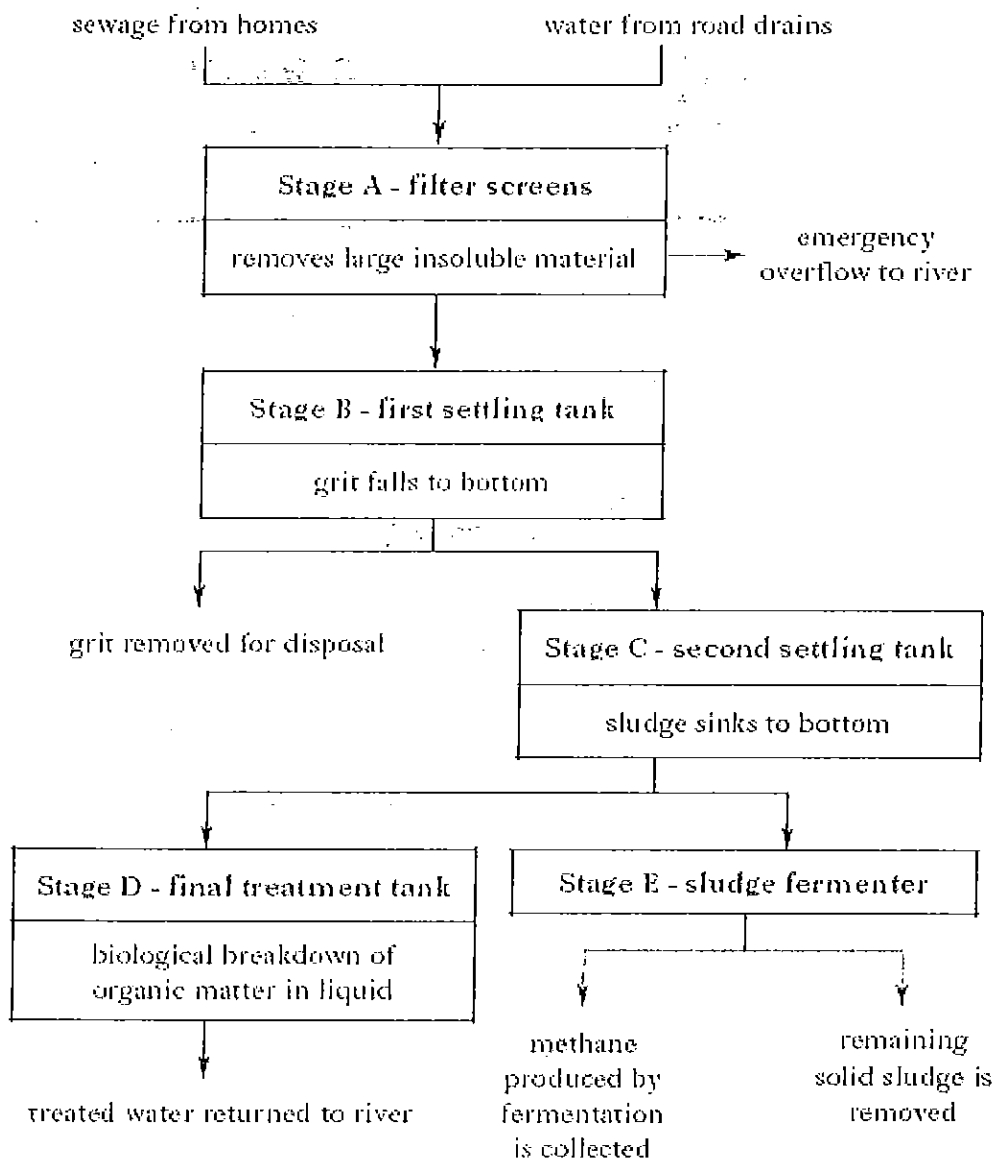| Method of disposal of sludge	Percentage
Spread on farmland	50
Landfill	10
Dumped at sea	15
Incinerated	20
Other disposal	5

Use the information from the table to complete the pie chart below.

(An additional chart, if needed, will be found on page 27.)

2

18

15. The flow chart shows what happens in a typical sewage treatment works.

sewage from homes   water from road drains

Stage A - filter screens
removes large insoluble material	→ emergency overflow to river

Stage B - first settling tank
grit falls to bottom

grit removed for disposal

Stage C - second settling tank
sludge sinks to bottom

Stage D - final treatment tank
biological breakdown of organic matter in liquid

treated water returned to river

Stage E - sludge fermenter

methane produced by fermentation is collected

remaining solid sludge is removed

(a) What material, which passes through the screens in Stage A, does not reach the tank in Stage C?

_____

(b) Name the gas needed for the final treatment in Stage D and explain why the gas is needed for this process.

Gas _____

Explanation _____

_____

19

15. (continued)

(c) When liquid from Stage D was sampled, it was found to contain over 80 different species of micro-organisms. Explain why this was seen as a good result.

_____

_____

(d) Under what environmental conditions could untreated sewage enter the river, even if the sewage treatment plant was working correctly?

_____

20

Transport Across the Cell Membrane

1. Four cylinders of potato tissue were weighed and each was placed into a salt solution of different concentration.

   The cylinders were reweighed after one hour. The results are shown in the following table.

Salt solution	Mass of potato cylinder (g)	
	Initial mass	Final mass
A	10·0	12·6
B	10·0	11·2
C	10·0	9·4
D	10·0	7·0

   In which salt solution would most potato cells be plasmolysed?

2. Which line in the table below identifies correctly the importance of diffusion to an animal cell?

 | | Raw material gained | Waste product removed |
   |---|---|---|
   | A | oxygen | glucose |
   | B | carbon dioxide | oxygen |
   | C | oxygen | carbon dioxide |
   | D | glucose | oxygen |

3. Which of the following molecules can both diffuse through a cell membrane?

   A Amino acids and starch

   B Amino acids and water

   C Starch and protein

   D Protein and water

4. Red blood cells burst when they are placed in water because

   A the cell contents are hypotonic to the water

   B the cell contents are isotonic to the water

   C the water is hypotonic to the cell contents

   D the water is hypertonic to the cell contents.

5. The diagram below shows an air sac with part of its capillary network.
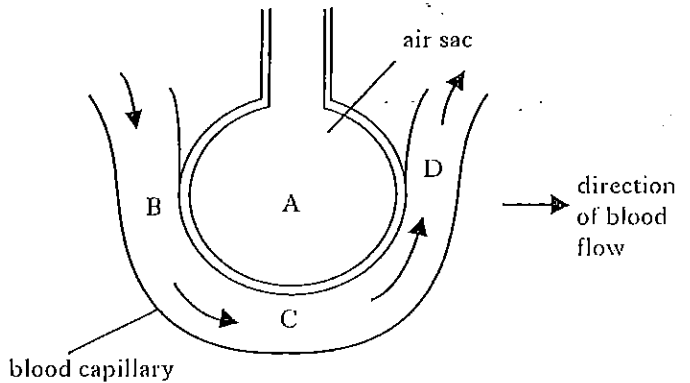
   At which position would blood with the highest concentration of oxygen be found?

6. Four thin sections of onion tissue were immersed in 5% sugar solution.

   The sections were left for 15 minutes then viewed under a microscope.

   The table below shows the percentage of cells plasmolysed in each section.

Section	Cells plasmolysed (%)
1	44
2	44
3	54
4	58

   The average percentage of cells plasmolysed is
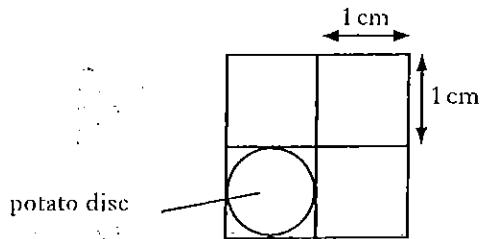
   A 44

   B 50

   C 54

   D 200.

7. A plant cell, which was placed in a liquid, gained water by osmosis.

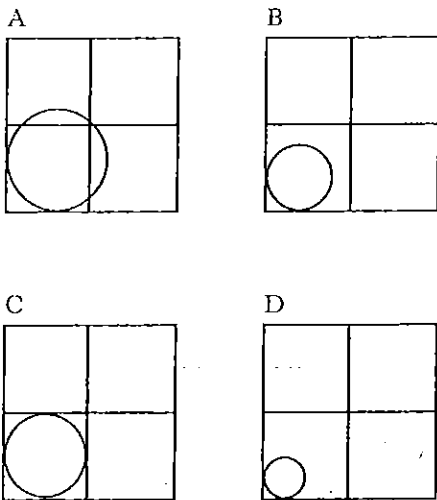   When compared to the liquid, the cell contents are described as being

   A plasmolysed

   B hypertonic

   C hypotonic

   D flaccid.

8. The diagram below shows the initial diameter of a potato disc.

The potato disc was placed in a hypotonic solution for one hour.

Which of the following diagrams shows correctly the change in the diameter of the potato disc?

A

B

C

D

9. Which line in the table below shows what happens to cells when placed in a hypertonic solution?

	Animal Cell	Plant Cell
A	swells and bursts	becomes turgid
B	becomes turgid	swells and bursts
C	shrinks	becomes plasmolysed
D	becomes plasmolysed	becomes plasmolysed

10. Red blood cells have a solute concentration of around 0·9%.

Which of the following statements correctly describes the fate of these cells when immersed in a 1% salt solution?

A   The cells will burst.

B   The cells will shrink.

C   The cells will expand but not burst.

D   The cells will remain unaffected.

11. The diagram below shows a model cell that was set up to investigate diffusion through a selectively permeable membrane.

Iodine is a small, soluble molecule.
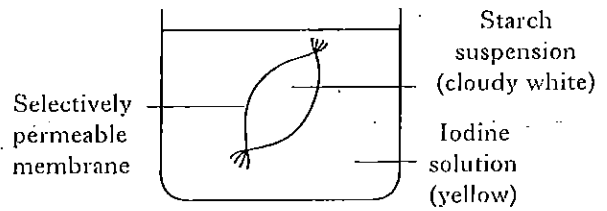
Predict the colour changes which would be observed after one hour.

	Colour change after one hour	
	Starch suspension	Iodine solution
A	remained cloudy white	yellow to blue/black
B	cloudy white to blue/black	remained yellow
C	remained cloudy white	remained yellow
D	cloudy white to blue/black	yellow to blue/black

12. The diagram below shows a plant cell which has been placed in a salt solution.
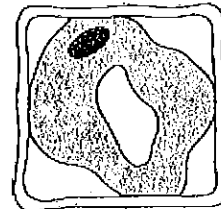
Which line in the table describes correctly the salt solution and the state of the plant cell?

	Salt solution	State of cell
A	hypertonic	plasmolysed
B	hypertonic	turgid
C	hypotonic	flaccid
D	hypotonic	plasmolysed

13. After an animal cell is immersed in a hypotonic solution it will

A   burst

B   become turgid

C   shrink

D   become flaccid.

22

14. The experiment below was set up to demonstrate osmosis.

Visking tubing is selectively permeable.
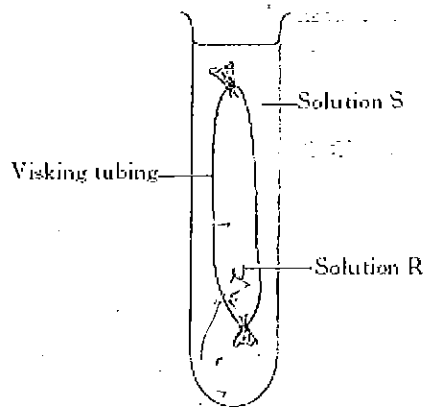

The following results were obtained.

Initial mass of Visking tubing
+ contents   = 10·0 g

Mass of Visking tubing + contents
after experiment   = 8·2 g

The results shown above could be obtained when

A   R is a 5% salt solution and S is a 10% salt solution

B   R is a 10% salt solution and S is a 5% salt solution

C   R is a 10% salt solution and S is water

D   R is a 5% salt solution and S is water.

15.   3. The diagram below refers to the plasma membrane of an animal cell.
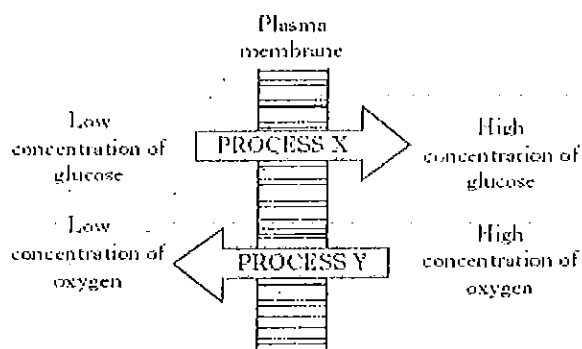
Identify the two processes X and Y.

	X	Y
A	active transport	diffusion
B	diffusion	active transport
C	respiration	diffusion
D	active transport	respiration

16. Thin sections of beetroot and rhubarb tissue were immersed in the same sucrose solution for the same time. This resulted in the plasmolysis of 0% of the beetroot cells and 20% of the rhubarb cells.

Which of the following statements can be deduced from these results?

A   The sucrose solution was hypertonic to the beetroot cells.

B   The sucrose solution was hypotonic to the rhubarb cells.

C   The contents of the beetroot cells were hypotonic to the contents of the rhubarb cells.

D   The contents of the rhubarb cells were hypotonic to the contents of the beetroot cells.

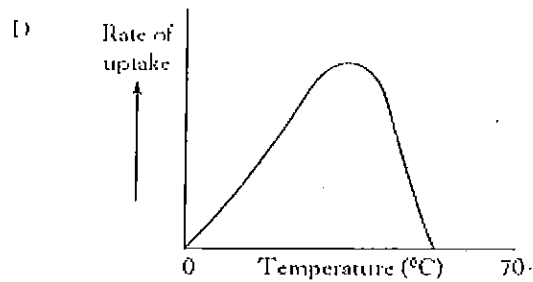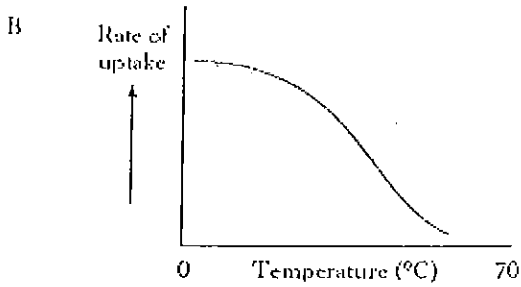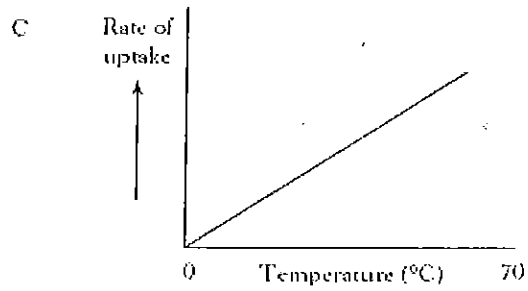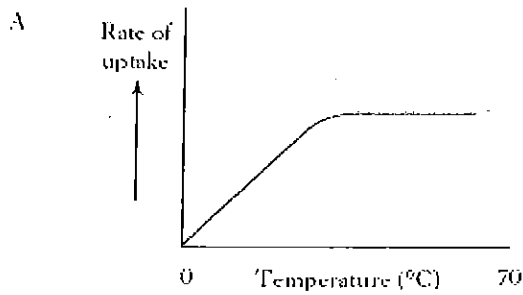17. The diagram below represents an osmosis experiment, using a model cell.
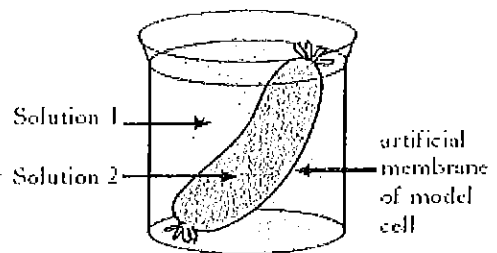
Which line of the table below shows a correct result for the solutions used in the experiment?

	Solution 1	Solution 2	Change of volume in model cell
A	water	5% sucrose	decrease
B	10% sucrose	water	increase
C	10% sucrose	5% sucrose	increase
D	10% sucrose	15% sucrose	increase

18. The cells of seaweed which actively absorb iodide ions from sea water would be expected to have large numbers of

A   chloroplasts

B   mitochondria

C   ribosomes

D   vacuoles.

19. Which graph best illustrates the effect of increasing temperature on the rate of active uptake of ions by roots?

A

Rate of uptake

0   Temperature (°C)   70

C

Rate of uptake

0   Temperature (°C)   70

B

Rate of uptake

0   Temperature (°C)   70
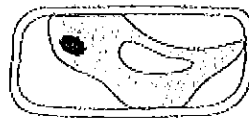
D

Rate of uptake

0   Temperature (°C)   70

20. A flower petal was examined under the microscope and then placed in a concentrated salt solution for 30 minutes. It was then re-examined under the microscope.

The diagrams show a cell from the petal before and after being in the solution.
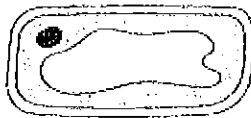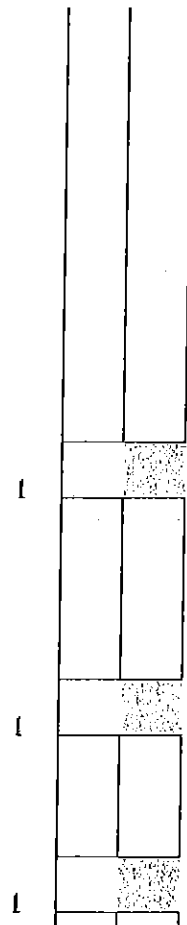

before   after

(a) (i) The movement of water caused the change in the appearance of the cell. What name is given to this movement of water?
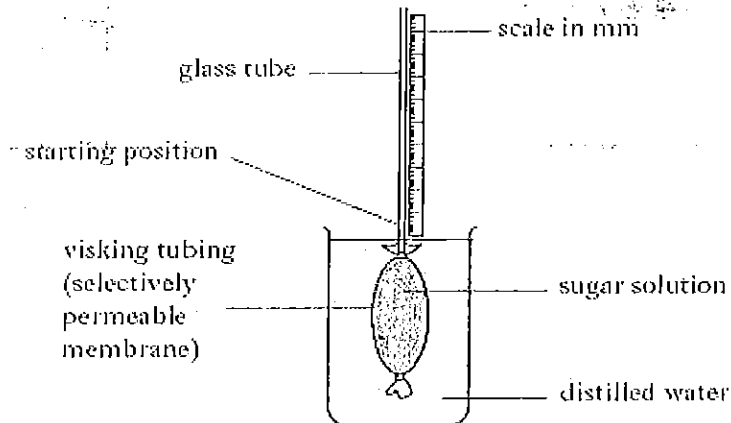
_____

(ii) In terms of water concentration, explain why this movement of water took place.

_____

_____

(b) Name one substance, other than water, which must be able to pass into a cell for its survival.

_____

24

21. An investigation was carried out into the movement of water through a selectively permeable membrane.

The apparatus used is shown in the diagram below.

The method used in the investigation is outlined below.

- A visking tubing bag containing 50 cm³ of 0·5% sugar solution was attached to the glass tube.

- The bag was lowered into the beaker of water.

- The starting position of the sugar solution was recorded on the scale.

- After one hour, the distance moved by the solution was recorded.

- The procedure was repeated with the same apparatus, using different concentrations of sugar solution.

The results are shown in the following table.

| Concentration of sugar solution (%)	Distance moved by sugar solution in 1 hour (mm)
0·5	3
1·0	6
2·0	12
3·0	18
3·5	21

(a) Identify one variable, not already mentioned, that should be kept constant when carrying out the investigation.

_____ 1

21.   (continued)

(b) Use the results to plot a line graph on the grid below of distance moved by the
sugar solution in one hour against the concentration of the sugar solution.

(An additional grid can be found, if required, on *Page twenty-eight*.)

Distance moved
by sugar solution
in 1 hour (mm)

25
20
15
10
5
0

2
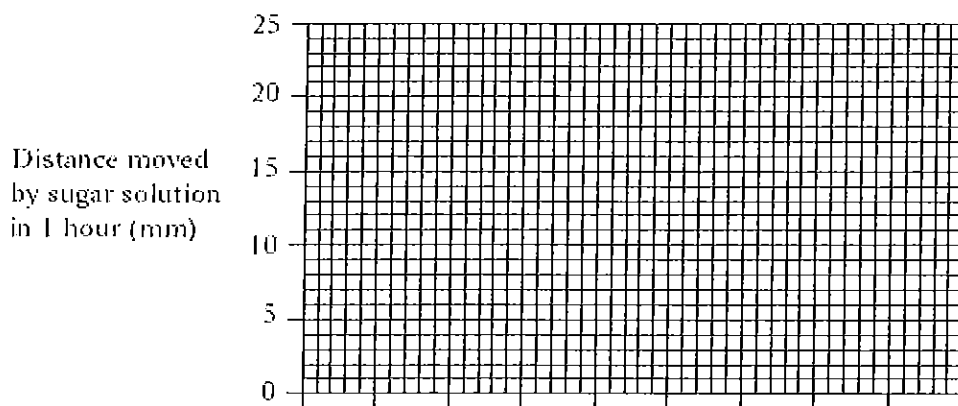
(c) From the results, predict the distance moved by a 4% sugar solution in one
hour and justify your prediction.

Prediction _____ mm

Justification _____

_____

1

22.   (a) The following sentences give information about the plasma membrane of
beetroot cells.

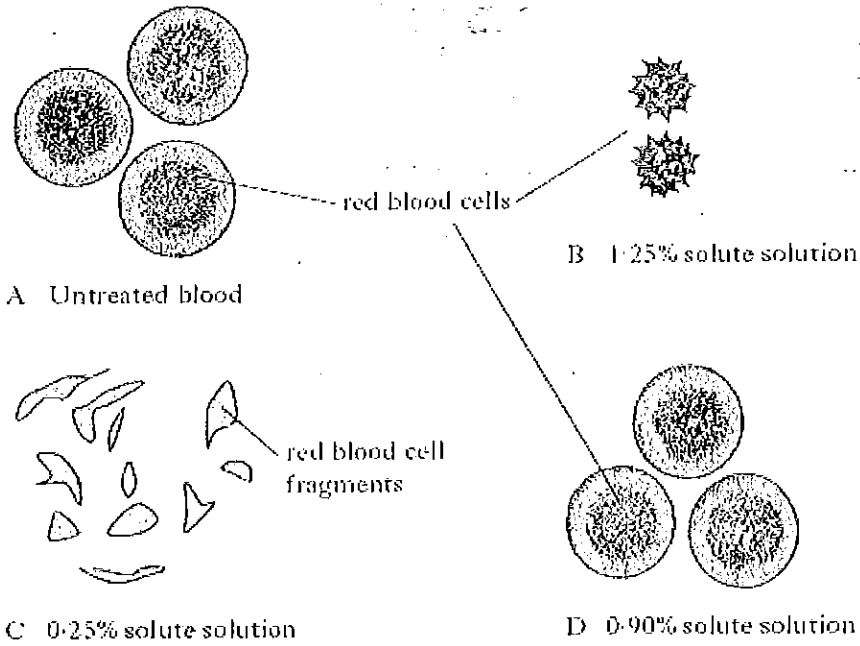Underline one alternative in each pair to make the sentences correct.

The plasma membrane contains $\begin{Bmatrix} \text{cellulose} \\ \text{protein} \end{Bmatrix}$ and $\begin{Bmatrix} \text{phospholipids} \\ \text{carbohydrate} \end{Bmatrix}$

and has a $\begin{Bmatrix} \text{fibrous} \\ \text{porous} \end{Bmatrix}$ nature. As a result, the membrane is

$\begin{Bmatrix} \text{fully} \\ \text{selectively} \end{Bmatrix}$ permeable.

2

23. The diagrams below represent red blood cells in different solutions as they would appear under a microscope.

A   Untreated blood

B   1·25% solute solution

C   0·25% solute solution

red blood cell fragments

D   0·90% solute solution

red blood cells

(a) Use the information in the diagrams to predict the percentage solute concentration of human blood. Explain your answer.

Solute concentration _____ %

Explanation _____

_____

_____

1

(b) What has happened to the cells in diagram B? Explain the change in terms of water concentrations.

Description _____

Explanation _____

_____

2

24. (a) The process of diffusion is important to organisms.

From the list below, select a substance which is involved in diffusion and answer the questions which follow.
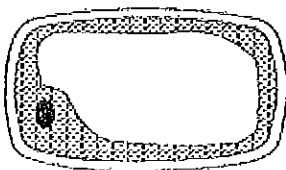
List

oxygen   glucose   carbon dioxide

Substance selected _____

(i) Explain why its diffusion is important.

_____

_____

(ii) Where does its diffusion take place?

_____

_____

2

(b) Cells from the same plant tissue were placed in three different liquids, left for 20 minutes and then examined using a microscope.
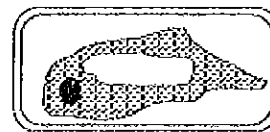
The following diagrams represent cells from each liquid.

Cell A   Cell B   Cell C

Which cell is most likely to have been placed in pure water?

Give a reason for your answer.

Cell _____

Reason _____

_____

_____

1

28

25. (*a*) The diagram below shows the appearance of a cell from an onion.

Pieces of onion were placed in three different solutions:

a 10% salt solution; a 2% salt solution and pure water.

The following diagrams show the appearance of the cells after 10 minutes.

solution X   solution Y   solution Z

cells swell   cells are unchanged   cell contents shrink
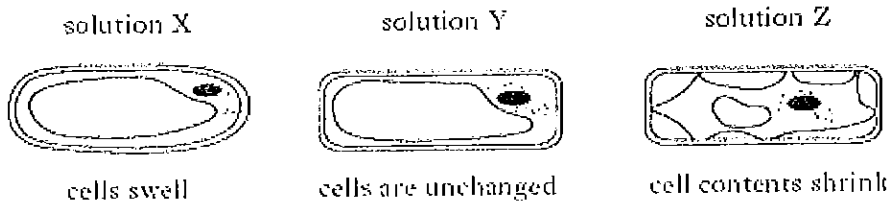
(i) Use the letters from the diagrams to identify the solutions.

One has been identified already.
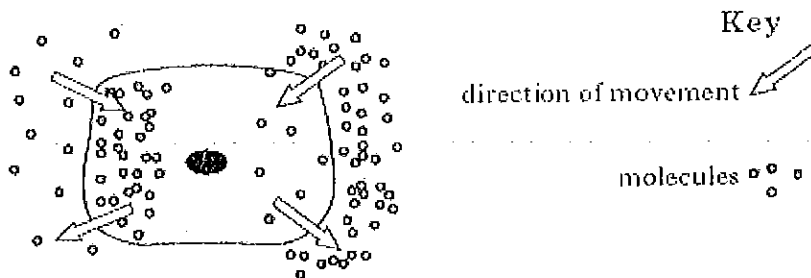
10% salt solution _____

2% salt solution ____Y____

pure water _____   1

(ii) Name the process by which water diffuses through a selectively permeable membrane.

_____   1

(*b*) The diagram below represents differences in the concentration of molecules inside and outside an animal cell, together with the direction of movement of the molecules.

Key

direction of movement

molecules

Circle the arrow on the diagram that would represent the diffusion of oxygen during respiration.   1

26. An investigation was carried out into the effect of water concentration on the rate of osmosis.

Details of the apparatus, method used and results are given below.

Apparatus

glass tube

0 10 20 30 40 50 60 70
scale in mm

thistle funnel

sugar solution

selectively permeable membrane
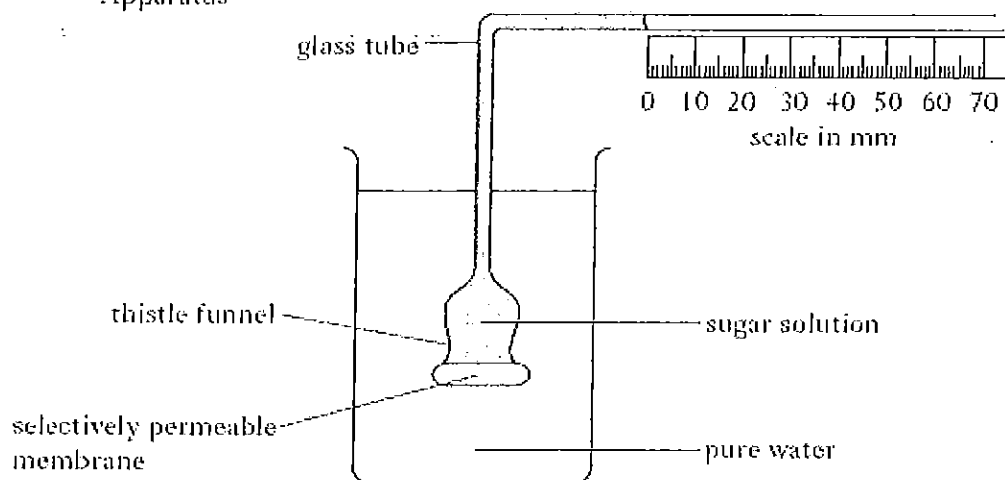
pure water

Method

1   A thistle funnel containing 50 cm³ of 0·5% sugar solution was covered with selectively permeable membrane.
2   The funnel was placed in a beaker of pure water.
3   The scale was positioned with the sugar solution at zero on the scale.
4   The position of the sugar solution was recorded after 30 minutes.
5   The procedure was repeated using 1·0%, 2·0% and 3·0% sugar solutions.

Results

Concentration of sugar solution (%)	Distance moved by sugar solution in 30 minutes (mm)
0·5	4·5
1·0	9·0
2·0	18·0
3·0	27·0

26. (continued)

   (a) Identify two variables not already mentioned that should be kept
        constant when setting up the investigation.

        1 _____

        2 _____

   (b) Explain the movement of the sugar solution in terms of water
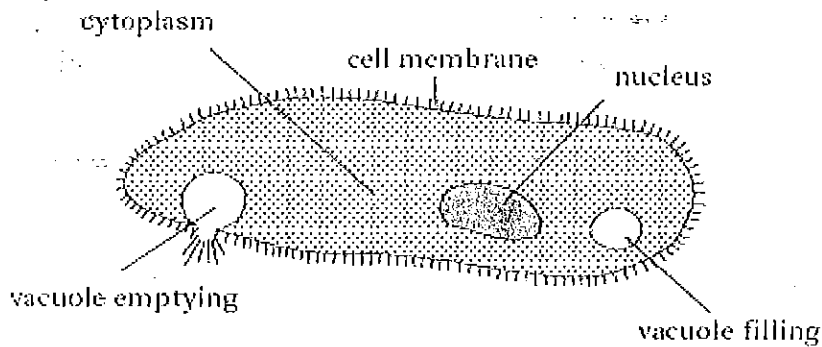   concentrations.

        _____

        _____

   (c) From the results, predict the distance moved by a 3·5% sugar solution in
        30 minutes and justify your prediction.

        Prediction _____ mm

        Justification _____

        _____

27. The diagram below shows *Paramecium*, a single-celled organism which lives in water.

cytoplasm

cell membrane

nucleus

vacuole emptying

vacuole filling

(a) The water concentration outside the cell is higher than the water concentration of the cytoplasm. This causes water to enter the cell constantly.

 (i) What is the name for this movement of water?

_____

 1

 (ii) From the information given, state whether *Paramecium* is likely to live in fresh water or salt water.

_____

 1

(b) *Paramecium* must get rid of excess water. Pure water is collected in the vacuoles by removing it from the cytoplasm. The vacuoles are emptied to the surrounding water as soon as they are full.

 (i) What would happen to the *Paramecium* cell if the vacuoles stopped working properly?

_____

 1

 (ii) The vacuoles are not filled by the diffusion of water.

 What evidence is there to support this statement?

_____

_____

 1

28. (a) (i) Oxygen diffuses into muscle cells for respiration. Name one other raw material needed for respiration that enters by diffusion.

_____   1

(ii) Name a waste product of respiration that diffuses out of muscle cells.

_____   1

(b) Osmosis occurs in plant cells.

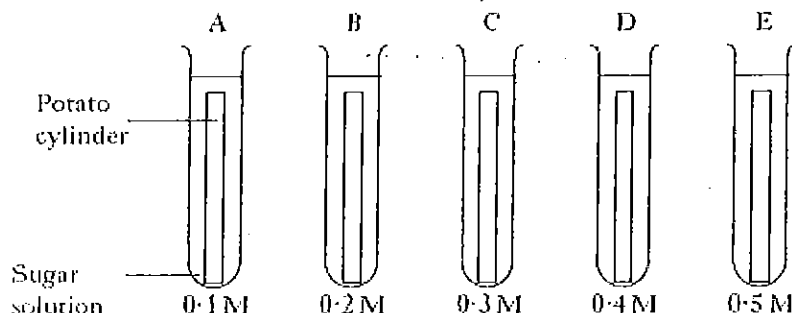(i) Name the substance that enters or leaves cells by osmosis.

_____   1

(ii) What term describes the condition of plant cells after being placed in distilled water?

_____   1

29.

A student cut five similar cylinders from the same potato, dried them with a paper towel and weighed them.

Each cylinder was placed in a different concentration of sugar solution as shown in the diagram below:

After three hours, the student removed the cylinders from the solutions, dried and weighed them as before.

The results are shown in the table below.

Test tube	Concentration of sugar solution (M)	Initial mass of potato cylinder (g)	Final mass of potato cylinder (g)	Change in mass of potato cylinder (g)	Percentage change in mass of potato
A	0·1	2·0	2·2	+0·2	+10
B	0·2	2·0	2·1	+0·1	+5
C	0·3	2·0	1·8	−0·2	−10
D	0·4	2·0	1·7	−0·3	
E	0·5	2·0	1·5	−0·5	−25

(a) Complete the table by calculating the percentage change in mass of the potato cylinder in 0·4 M sugar solution.

Space for calculation

1

(b) (i) Name the variable altered in this investigation.

_____

1

(ii) Suggest one way in which the reliability of the results could be improved.

_____

1

34

29. **(b)** **(continued)**

(iii) Would the results be valid if the cylinders were not dried before being weighed? Tick (✓) the correct box.

Valid ☐   Not valid ☐

Explain your answer.

Explanation _____

_____

_____ **1**

(c) (i) State the letter of one test tube containing a potato cylinder in a hypertonic solution.

Letter _____ **1**

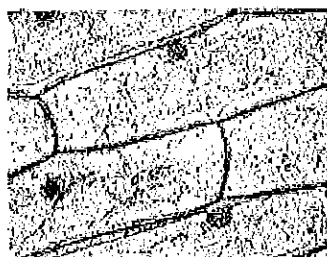(ii) Predict the appearance of the potato cylinder in test tube E after three hours.

_____ **1**

30. The diagrams below show animal and plant cells in isotonic solutions.
These diagrams are not to scale.

Animal cells   Plant cells

Describe the osmotic effect of transferring

(a) the animal cells into a hypotonic solution (water)

(b) the plant cells into a hypertonic solution (strong salt). **5**

31. (a) Samples of carrot tissue were immersed in a hypotonic solution at two different temperatures for 5 hours. The mass of the tissue samples was measured every hour and the percentage change in mass calculated.

The results are shown on the graph.
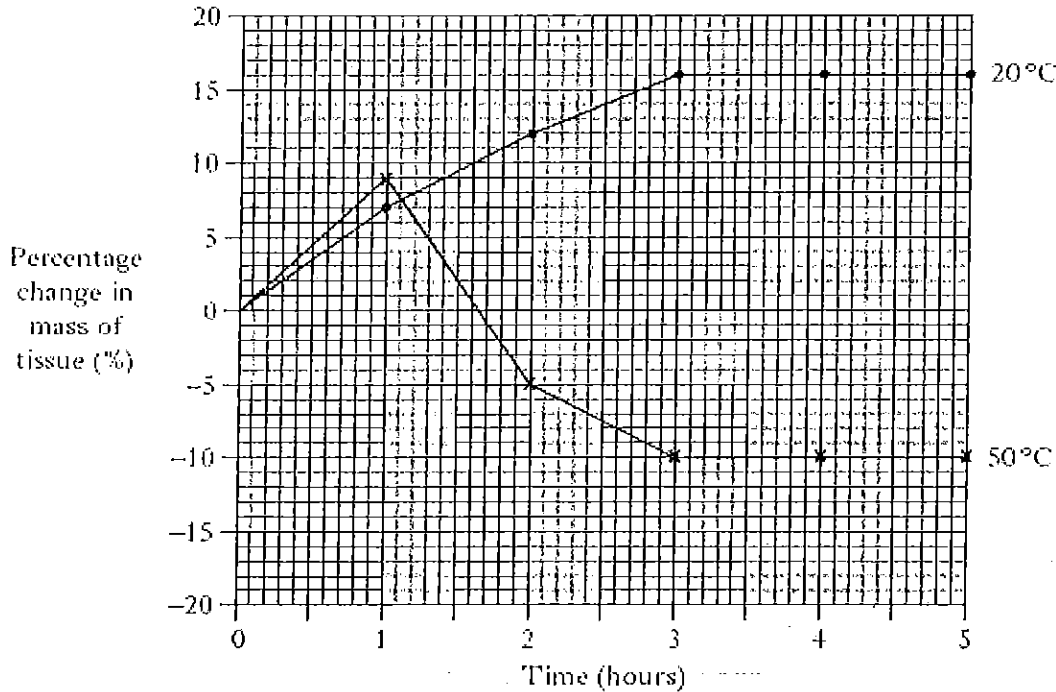
(i) Explain the results obtained at 20 °C from 0 to 3 hours and from 3 hours to 5 hours.

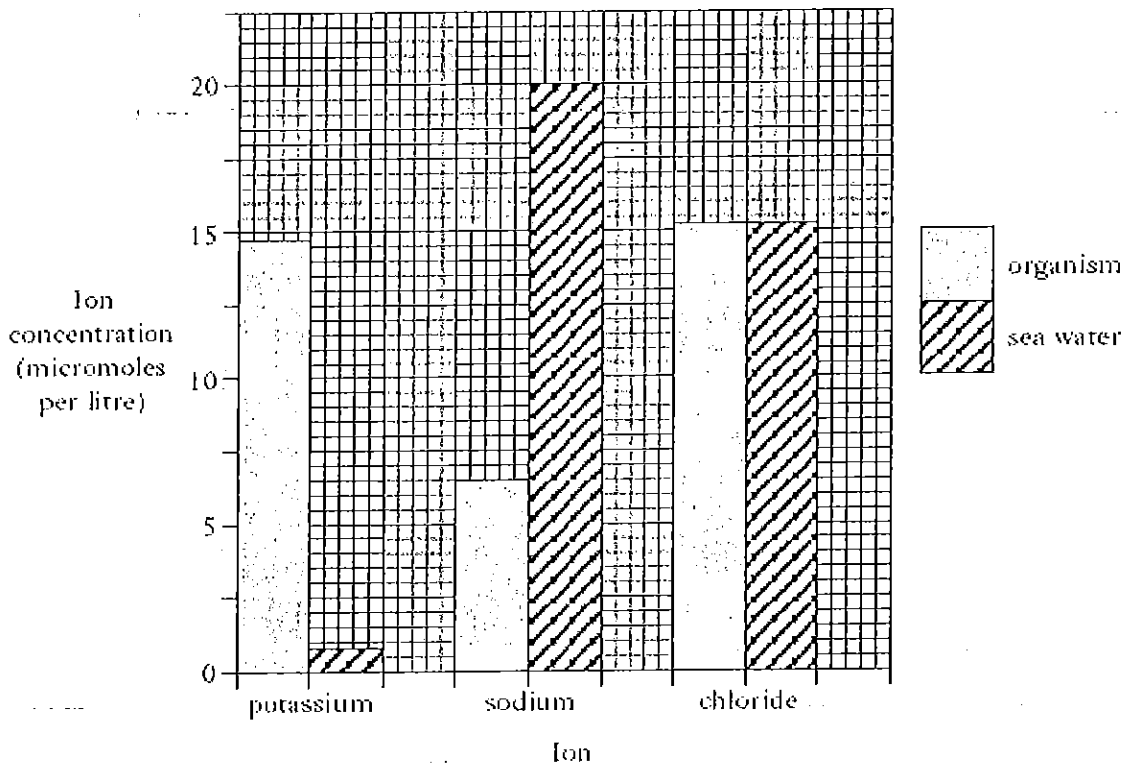0 to 3 hours _____

_____ 1

3 to 5 hours _____

_____ 1

(ii) Explain the change in mass of the carrot tissue between 1 and 3 hours at 50 °C.

_____

_____

_____ 2

36

31. (continued)

(*b*) The chart shows the concentration of ions within a unicellular organism and in the sea water surrounding it.

(i) From the information given, identify the ion which appears to move between the organism and the sea water by diffusion.

Justify your choice.
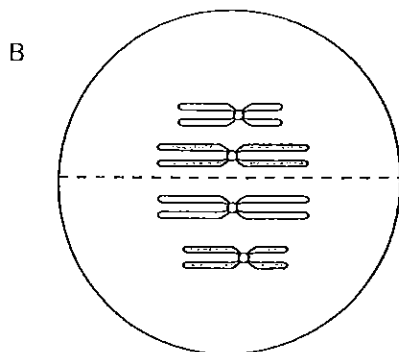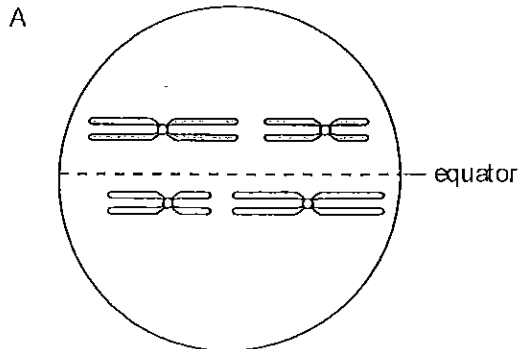
Ion _____

Justification _____

_____ 1

(ii) When oxygen was bubbled through a tank of sea water containing these organisms, the potassium ion concentration within the organisms increased.
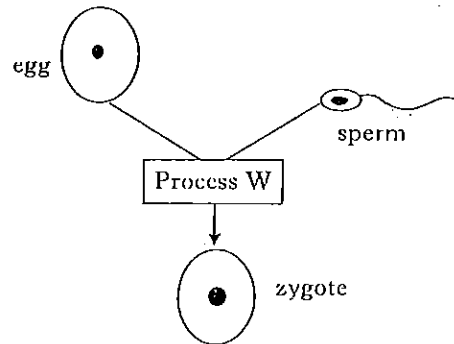
Explain this effect.

_____

_____

_____ 2

Producing New Cells

1. Which of the following diagrams best represents the arrangement of chromosomes in a cell undergoing meiosis?

A

— equator

B

C

D
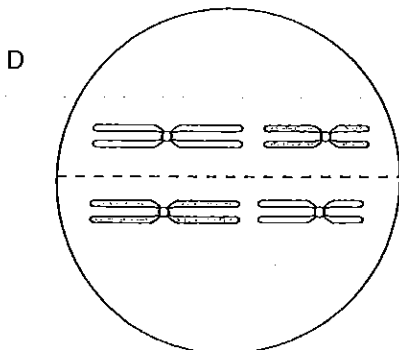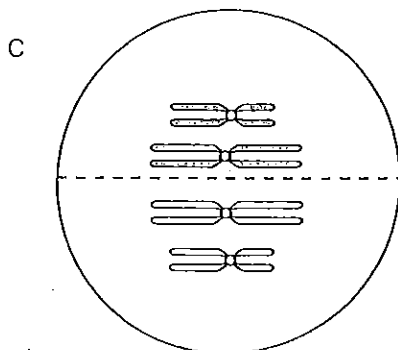
2. The diagram below shows a stage in the process of reproduction.

egg

sperm

Process W

zygote

Process W is

A meiosis

B fertilisation

C gamete production

D random assortment.

3. The diagram below shows the chromosome complement of cells during the development of abnormal human sperm.
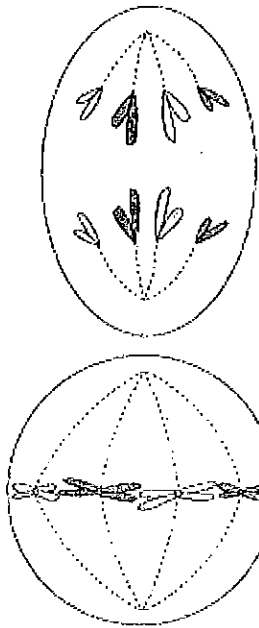

44 + XY

23 + X   21 + Y

23 + X   23 + X   21 + Y   21 + Y
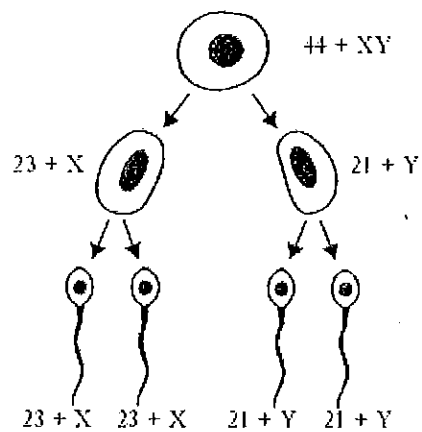
A sperm with chromosome complement 23 + X fertilises a normal haploid egg. What is the chromosome number and sex of the resulting zygote?

	Chromosome number	Sex of zygote
A	24	female
B	46	female
C	46	male
D	47	female

38

4. (a) The diagrams below show two stages of mitosis in cells.

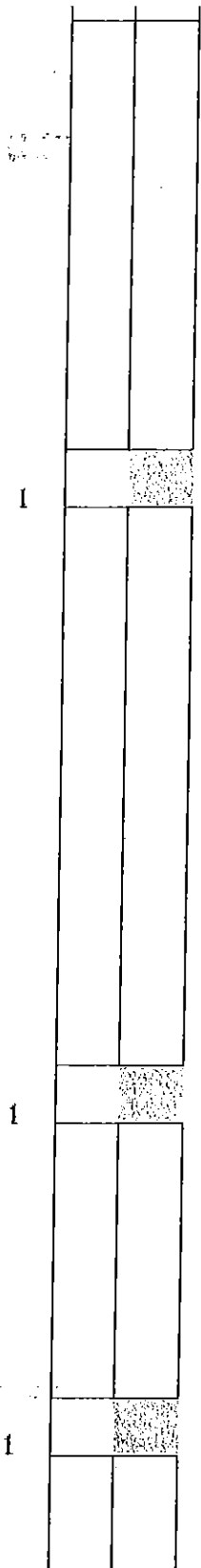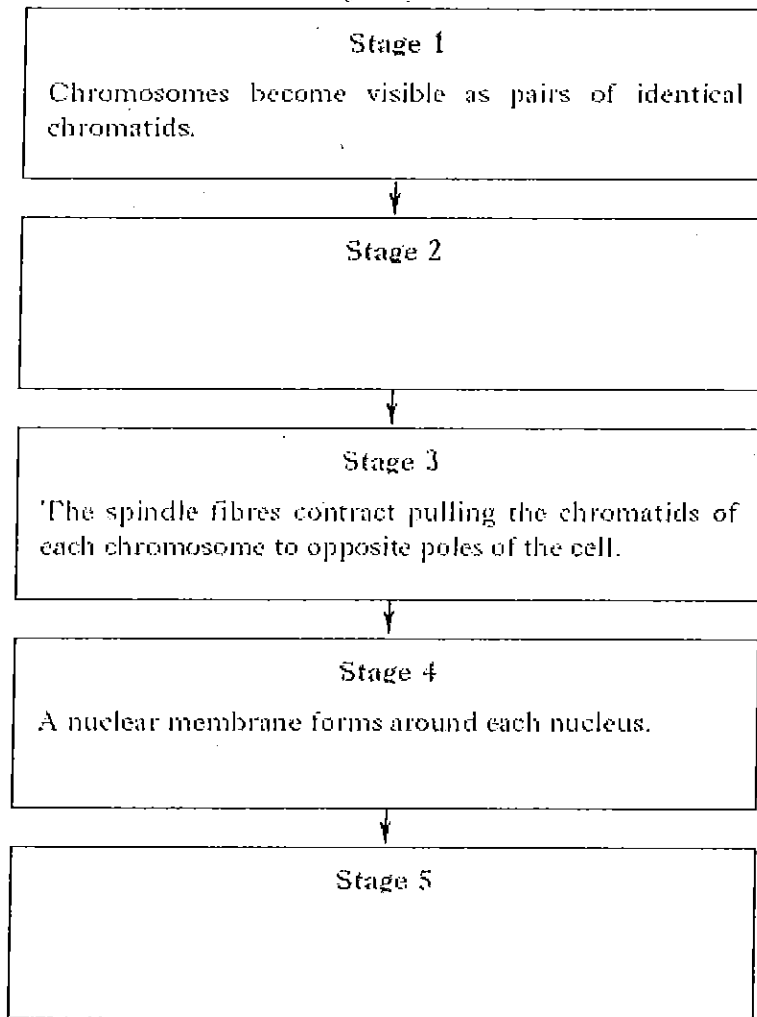Draw one straight line from each diagram to its correct description.

| chromosomes shorten and thicken |

| chromosomes line up at the centre of the cell |

| chromatids are pulled to opposite ends of the cell |

| nuclear membrane reforms |

2

(b) How does mitosis ensure that the daughter cells will be able to function properly?

1

5. (a) The diagram below contains some of the stages of cell division by mitosis.

Describe Stages 2 and 5 in the spaces provided.

Stage 1

Chromosomes become visible as pairs of identical chromatids.

↓

Stage 2

↓

Stage 3

The spindle fibres contract pulling the chromatids of each chromosome to opposite poles of the cell.

↓

Stage 4

A nuclear membrane forms around each nucleus.

↓

Stage 5

(b) Mitosis ensures that all daughter cells in a multicellular organism have the same number and type of chromosomes.

Explain why this is necessary.

_____

_____

1

1

1

6. (a) Stages of mitosis are shown in their correct order in the diagrams below.

Stage A   Stage B   Stage C
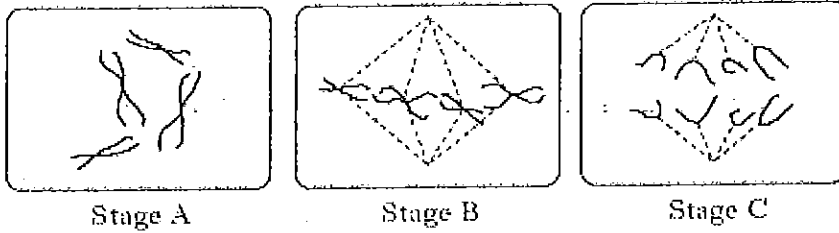
(i) Label the spindle on one of the diagrams.

(ii) Stage C would be followed by stage D. Describe what would happen in stage D.

_____

_____

(b) Typical timings of the stages of mitosis are shown in the table below.

Stage	A	B	C	D
Time (minutes)	88	33	25	54

What percentage of the total time for mitosis is taken by stage C?
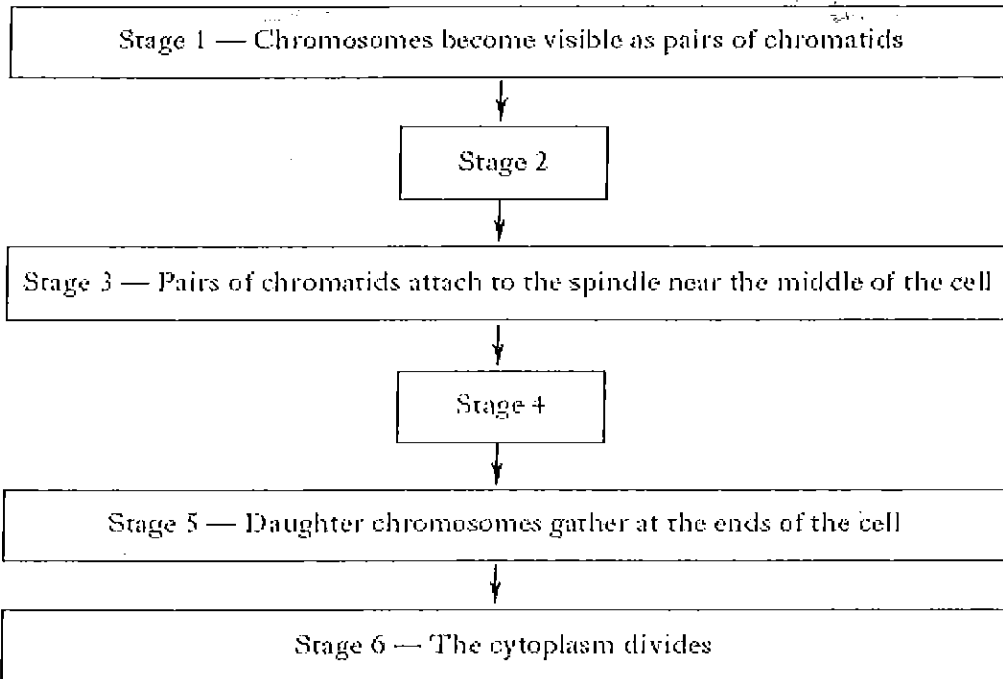
Space for calculation

_____ %

(c) Scientists can grow liver tissue in the laboratory. This is done by making a few liver cells divide by mitosis to form a large mass of cells.

Why is it important that the daughter cells contain the same number of chromosomes as the original mother cells?

_____

_____

7a. The following is a description of the stages of mitosis.

Stage 1 — Chromosomes become visible as pairs of chromatids

↓

Stage 2

↓

Stage 3 — Pairs of chromatids attach to the spindle near the middle of the cell

↓

Stage 4

↓

Stage 5 — Daughter chromosomes gather at the ends of the cell

↓

Stage 6 — The cytoplasm divides

Describe stages 2 and 4 in the spaces below.

Stage 2 _____

_____

Stage 4 _____

_____   2

(b) Daughter cells produced by mitosis each have the same chromosome complement as the original cell. Why is this important?

_____

_____   1

42
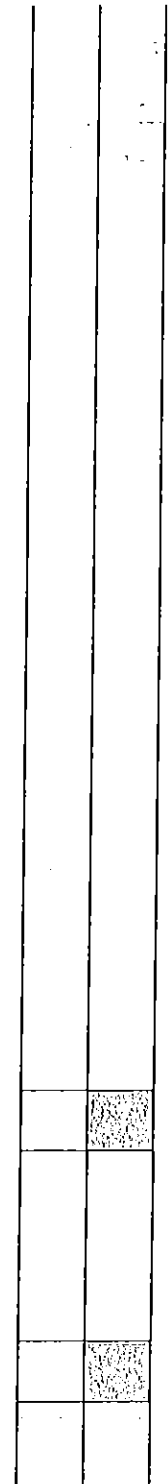
DNA and the Production of Protein

1. In humans, which of the following gametes are not normally formed?

   A An egg with an X chromosome

   B An egg with a Y chromosome

   C A sperm with an X chromosome

   D A sperm with a Y chromosome

2. All proteins are composed of

   A genes

   B DNA

   C amino acids

   D bases.

3. The chromosome complement of a human individual who inherits an X-chromosome from their father is

   A 44 including XX

   B 44 including XY

   C 46 including XX

   D 46 including XY

4. DNA determines the structure and function of a type of molecule in the cell. The molecule is

   A protein

   B fat

   C amino acid

   D carbohydrate.

5. Which of the following proteins has a fibrous structure?

   A Pepsin

   B Amylase

   C Insulin

   D Collagen

6. The diagram shows DNA during replication. Base H represents thymine and base M represents guanine. Which letters represent the base cytosine?
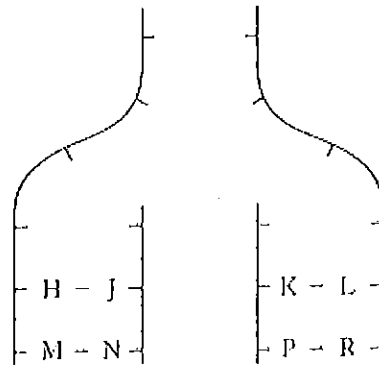
   A J and K

   B J and L

   C N and P

   D N and R

7. A section of a DNA molecule contains 300 bases. Of these bases, 90 are adenine. How many cytosine bases would this section of DNA contain?

   A 60

   B 90

   C 120

   D 180

8. A fragment of DNA was found to have 120 guanine bases and 60 adenine bases. What is the total number of sugar molecules in this fragment?

   A 60

   B 90

   C 180

   D 360

9. A DNA molecule consists of 4000 nucleotides, of which 20% contain the base adenine.

How many of the nucleotides in this DNA molecule will contain guanine?

A   800

B   1000

C   1200

D   1600

10.

by peptide bonds to form more complex molecules?

A   Bases

B   Nucleic acids

C   Nucleotides

D   Amino acids

11. A fragment of DNA was found to consist of 72 nucleotide base pairs. What is the total number of deoxyribose sugars in this fragment?

A   24

B   36

C   72

D   144

12. A single strand of a DNA molecule has 6000 nucleotides of which 24% are adenine and 18% are cytosine.

(i) Calculate the combined percentage of thymine and guanine bases on the same DNA strand.

Space for calculation

_____ %   1

(ii) How many guanine bases would be present on the complementary strand of this DNA molecule?

Space for calculation

bases   1

Marks

13. (*a*) The diagram below shows a yeast cell.
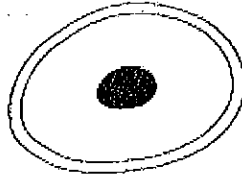
(i) Name the structure shown in the yeast cell which contains the genetic information.

_____

1

(ii) A molecule consisting of chains of bases is contained in chromosomes.
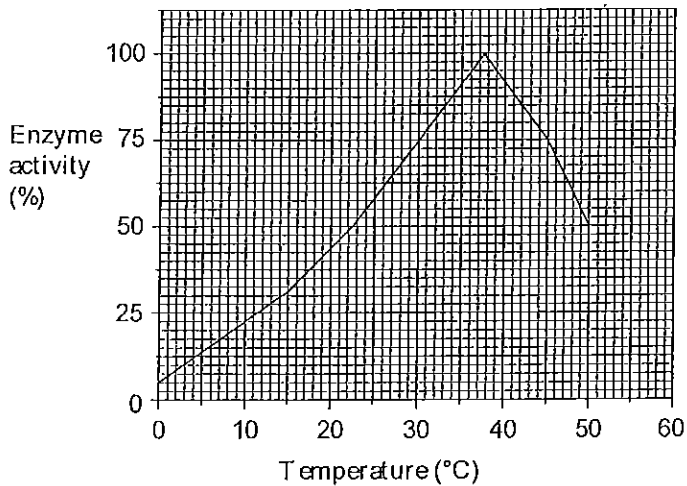
(A) Name this molecule.

_____

1

(B) Explain how this molecule controls cell activities.

_____

_____

_____

2

45

Proteins and Enzymes

1. The graph below shows the effect of temperature on the activity of the enzyme pepsin.

Between which two temperatures is there the greatest increase in enzyme activity?

A 0 – 10 °C

B 10 – 20 °C

C 20 – 30 °C

D 30 – 40 °C

2. One of the properties of enzymes in the initiation of chemical reactions is that an enzyme

A does not alter the energy input required

B raises the energy input required

C lowers the energy input required

D raises then lowers the energy input required.

3. Which term refers to the process by which complex molecules are formed from simple molecules?

A Digestion

B Synthesis

C Degradation

D Respiration

4. In an investigation into the synthesis of starch from glucose-1-phosphate (G-1-P) by the enzyme phosphorylase, a tile was set up as shown below. Starch-free potato extract was used as the source of phosphorylase.

Iodine solution was added to the columns at the time intervals shown.

Which of the following tiles shows the expected result of this investigation?


5. Which of the following correctly describes amylase?

A It breaks down starch into amino acids.

B It builds up glucose-1-phosphate into starch.

C It breaks down proteins into peptides.

D It breaks down starch into maltose.

46

6. (a) Four groups of students investigated the catalase concentration of different tissues.

Each group set up a test-tube containing $5\,cm^3$ of hydrogen peroxide and a cube of potato. The oxygen was collected over a 3 minute period and the volume was measured as shown in the diagram below.
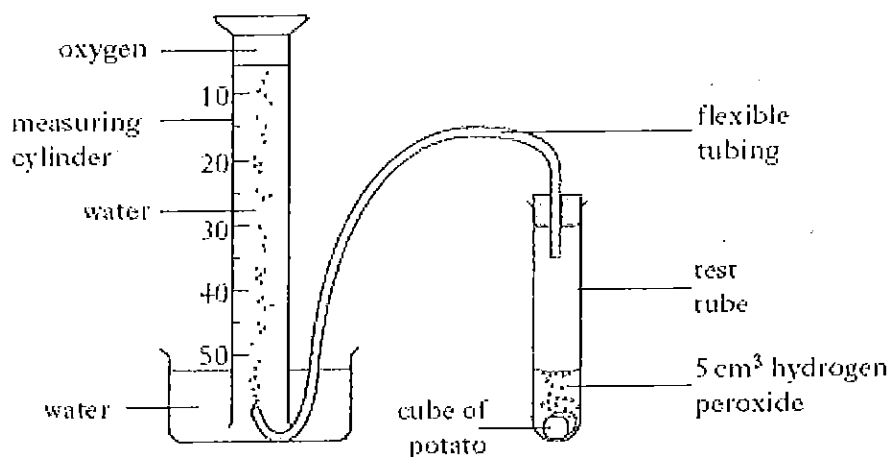
This procedure was repeated by each group using cubes of liver, apple and carrot. The results from the four groups are given in the table below.

| Tissue | Volume of oxygen collected in 3 minutes (cm³) | | | | |
	Group 1	Group 2	Group 3	Group 4	Average
Potato	5·5	5·0	5·5	6·0	
Liver	39·5	37·0	42·5	35·5	38·5
Apple	1·0	1·5	1·0	0·5	1·0
Carrot	3·5	3·0	3·5	2·0	3·0

(i) Complete the table to show the average volume of oxygen collected for potato tissue.

Space for calculation

1

(ii) The volume of hydrogen peroxide and time taken to collect the oxygen were kept constant in this investigation.

State two other variables that must be kept constant.
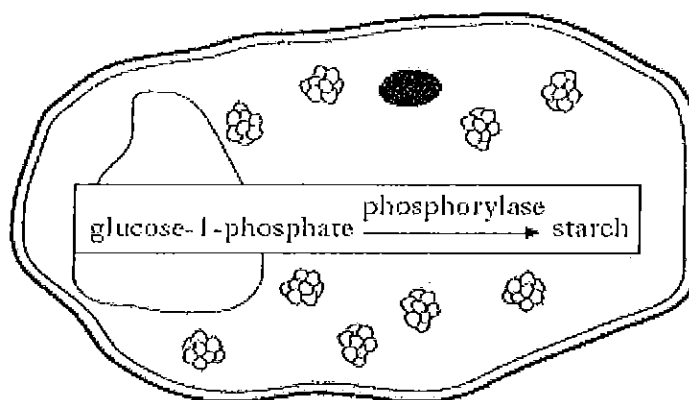
1 _____ 1

2 _____ 1

6. (a) (continued)

(iii) What was done in this investigation to make the results reliable?

_____

_____

1

(iv) What conclusion can be drawn from these results?

_____

_____

1

(b) The diagram below shows the action of the enzyme phosphorylase in a potato cell.

glucose-1-phosphate $\xrightarrow{\text{phosphorylase}}$ starch

(i) Underline the option in the bracket to make the sentence correct.

The action of the enzyme phosphorylase catalyses the $\left\{\begin{array}{l}\text{synthesis} \\ \text{degradation}\end{array}\right\}$ of starch.

1

(ii) State the effect of phosphorylase on the rate of this reaction.

_____

1

(iii) Explain why lipase could not produce starch in this reaction.

_____

_____

1

48

7. Describe the properties of enzymes and the function of the enzyme phosphorylase in a synthesis reaction. 5

8. (a) The diagram below shows three stages X, Y and Z that occur when an enzyme converts its substrate into a product.
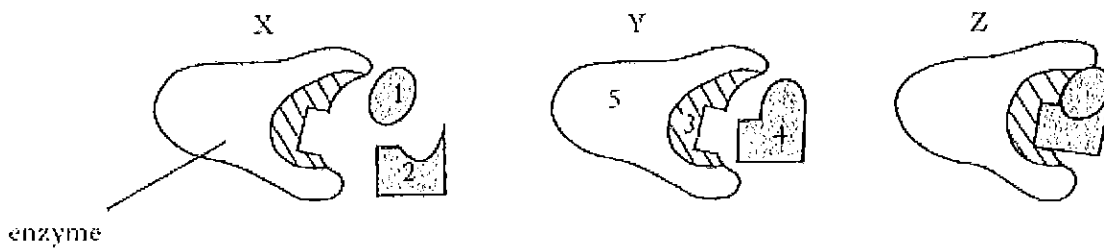
enzyme

(i) This enzyme promotes the breakdown of a complex molecule into simpler molecules.

Put the stages into the correct order to show this degradation reaction.

_____ ⟶ _____ ⟶ _____ 1

(ii) Which number in the diagram shows the active site?

_____ 1

(b) Complete the following sentence by underlining the correct word from the choice in brackets.

Enzymes are made of $\left\{\begin{array}{l} \text{carbohydrate} \\ \text{fat} \\ \text{protein} \end{array}\right\}$. 1

(c) Describe what happens to an enzyme when it is denatured.

_____

_____ 1

9. Liver contains the enzyme catalase which carries out the following reaction.

hydrogen peroxide ⟶ water + oxygen
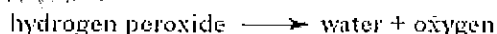
The investigation shown below was carried out to demonstrate the effect of pH on catalase activity in liver.

Hydrogen peroxide of different pH values was added to 1 g of roughly chopped raw liver.
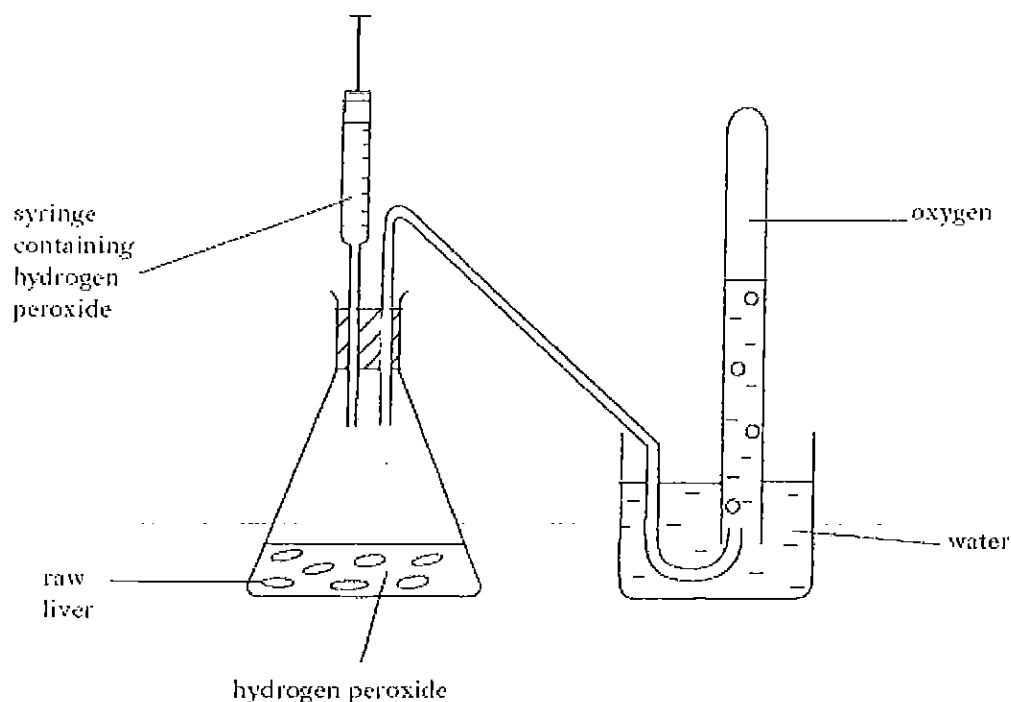
The time taken to collect 1 cm³ of oxygen was recorded and the results are shown in the table below.

pH of hydrogen peroxide solution	Time to collect 1 cm³ of oxygen (seconds)			Average time to collect 1 cm³ of oxygen (seconds)
	Trial 1	Trial 2	Trial 3	
7	76	77	81	78
8	56	58	57	57
9	50	45	40	45
10	53	50	53	52
11	59	69	70	66

(a) From the table, state the optimum pH for catalase in liver.

_____

1

50

9. (continued)

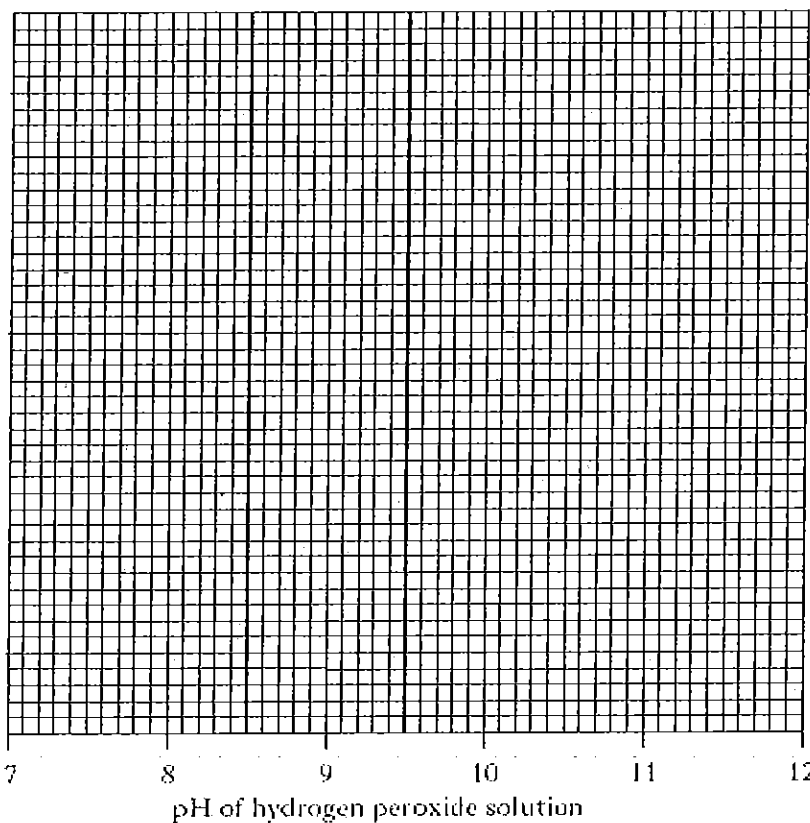(b) Name the variable altered in this investigation.

_____

1

(c) Explain why the experiment was repeated at each pH value and averages calculated.

_____

1

(d) Construct a line graph of the average time taken to collect 1 cm³ of oxygen against pH of hydrogen peroxide solution.

(Additional graph paper, if required, will be found on *Page thirty-two*)

pH of hydrogen peroxide solution

2

(e) Predict the average time to collect 1 cm³ of oxygen at pH 12.

_____seconds

1

51

10. The following apparatus was used to investigate the effectiveness of washing powders.

Identical pieces of stained cloth were washed using different washing powders.

The cloths were dried and the degree of stain removal was measured by recording light reflected from the cloth with a light meter. The meter was set to read 100% when the cloth was perfectly clean. Any stain left on the cloth reduced the intensity of light recorded.

Light-proof box

Light source

Sample of cloth

Light sensor

Light meter

96·0%
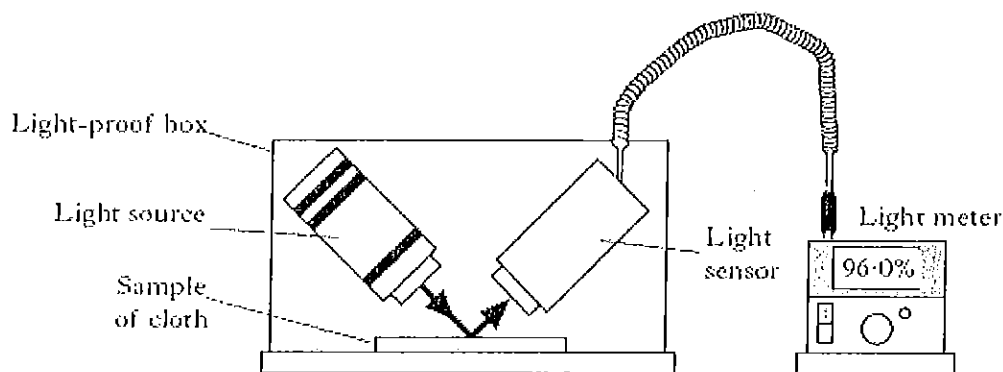
(a) (i) Various precautions were taken to ensure that the experimental procedure was valid.

Identify the point(s) which contributed to this.

Tick (✓) the correct box(es).

The procedure used gave appropriate information about the effectiveness of washing powders. ☐

All significant variables were controlled and were identical except the one being investigated. ☐

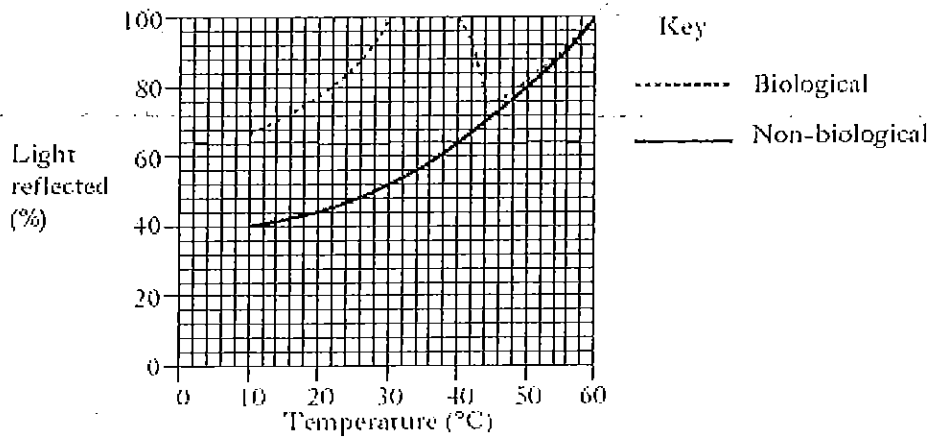Several results were collected and used to calculate an average. ☐

1

(ii) Explain why it was necessary to carry out the investigation in a light-proof box.

_____

_____

1

52

10. **(continued)**

(b) The results obtained using two different washing powders at various temperatures are shown below.

Key

.... Biological

———— Non-biological

(i) At which temperature was there the greatest difference between the effectiveness of the two washing powders?

_____ °C

1

(ii) Each one degree Celcius reduction in the washing temperature saves 2p in the cost of electricity used to heat the water for each wash.

Calculate the annual saving in the electricity costs to achieve 100% stain removal with biological washing powder compared to a non-biological one, for a household which does one wash per week.

Space for calculation

annual saving = £_____

1

(iii) What type of biological substance gives biological washing powders their properties?

_____

1

(iv) Explain why the effectiveness of the biological washing powder decreases between 40°C and 45°C.

_____

1

53

11. The apparatus shown below was used to study the effect of different temperatures on the activity of the enzyme catalase.
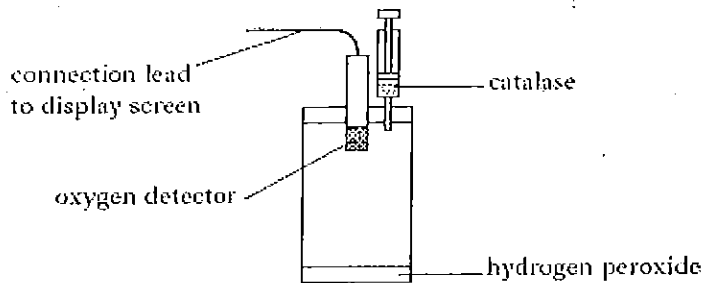

The catalase was added and reacted with the hydrogen peroxide to release oxygen. The increase in oxygen compared to the starting value was recorded as a percentage.

This was carried out at five different temperatures and the results are shown below.

Temperature (°C)	Increase in oxygen (%)
4	0·55
21	0·80
34	1·45
40	1·05
50	0·05

(a) Use the results to draw a line graph.

(An additional grid, if needed, will be found on *Page twenty-three*.)

54
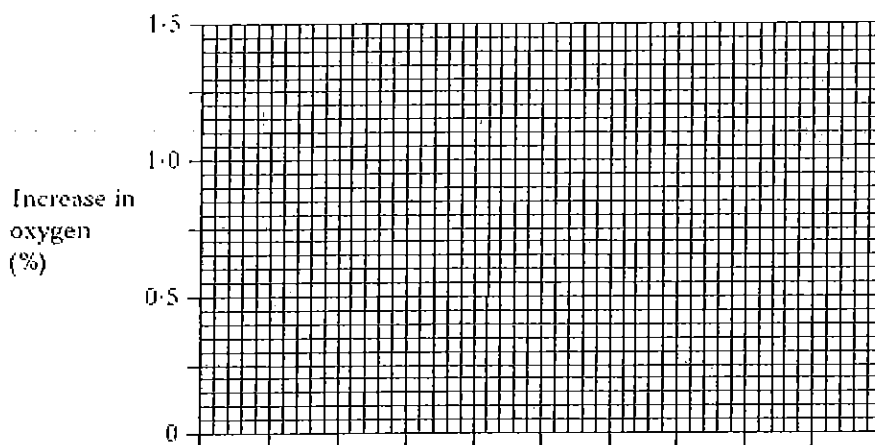
11. (continued)

(b) At which temperature was the catalase most active?

_____ °C

(c) Why was it important that the catalase and the hydrogen peroxide were both at the required temperature before the catalase was added?

_____

_____

(d) Explain why there was no oxygen released when the experiments were repeated with different enzymes.

_____

_____

(e) Calculate the simple whole number ratio of percentage increase in oxygen at 34 °C, 40 °C and 50 °C.

Space for calculation

_____ : _____ : _____
34 °C   40 °C   50 °C

55

12. (*a*) Biological washing powders contain enzymes. Explain how these enzymes work to remove stains.

_____

_____

_____ **2**

(*b*) In an investigation, identical pieces of cloth with identical stains were placed in solutions of biological or non-biological washing powders. They were left for one hour and the cloths were then examined. This was repeated at different temperatures and the results are shown in the table below.

Type of washing powder	Appearance of cloth after soaking for 1 hour		
	40 °C	60 °C	90 °C
Biological washing powder	clean	clean	clean
Non-biological washing powder	stained	clean	clean

(i) Name two variables, not already mentioned, which would need to be kept the same to ensure the investigation was valid.

1 _____

2 _____ **1**

(ii) What steps should be taken to reduce the effect of any unusual results.

_____ **1**

(iii) Describe one advantage of using biological washing powders.

_____ **1**

(*c*) Biological washing powders contain different enzymes.

Explain why this is necessary.

_____

_____ **1**

56

Genetic Engineering

1. The diagram below shows stages in the production of a desired product by genetic engineering.
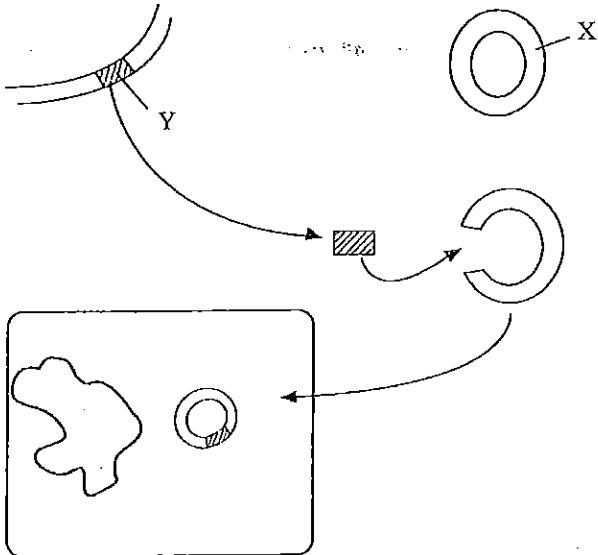
Which line in the table identifies correctly the structures labelled above?

	X	Y
A	bacterium	gene
B	plasmid	chromosome
C	bacterium	chromosome
D	plasmid	gene

2. Which line in the table below identifies correctly one advantage and one disadvantage of genetic engineering to make desired products?

	Advantage	Disadvantage
A	increased rate of production	cost of development
B	cost of development	possible release of genetically engineered bacteria into the environment
C	increased range of products	increased rate of production
D	increased rate of production	increased range of products

3. Which stage in the production of human insulin by genetic engineering is represented in the diagram below?
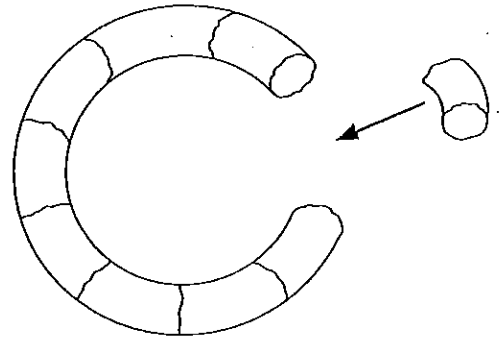
A Human gene is inserted into a plasmid.

B Human gene is inserted into a bacterium.

C Plasmid is inserted into a human chromosome.

D Bacterial gene is inserted into a human chromosome.

4. Human insulin can be produced by the bacterium *E. coli* using the following steps.

1 Culture large quantities of *E. coli* in vats of nutrients.

2 Insert human insulin gene into *E. coli* plasmid DNA.

3 Cut insulin gene from human chromosome using enzymes.

4 Extract insulin from culture vats.

The correct order for these steps is

A 3, 2, 1, 4

B 3, 1, 2, 4

C 1, 4, 3, 2

D 1, 2, 3, 4.

5. The diagram below shows stages involved in the genetic engineering of bacteria to produce human insulin.
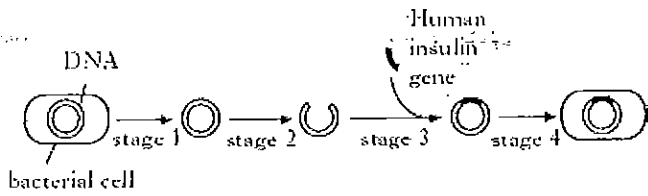
Which line in the table below shows the stages of this process in which endonuclease and ligase are involved?

|	Stage involving endonuclease	Stage involving ligase
A	2	4
B	2	3
C	3	2
D	4	3

6. The following steps are involved in the process of genetic engineering.

1 Insertion of a plasmid into a bacterial host cell.

2 Use of an enzyme to cut out the desired gene from a chromosome.

3 Insertion of the desired gene into the bacterial plasmid.

4 Use of an enzyme to open a bacterial plasmid.

What is the correct sequence of these steps?

A 4 1 2 3
B 2 4 3 1
C 4 3 1 2
D 2 3 4 1

7. The flow chart below represents the programming of *E. coli* bacteria to produce human insulin.
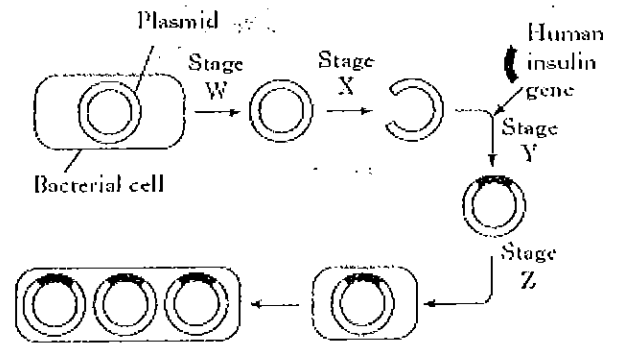
Which line in the table below identifies correctly the stages at which an endonuclease and a ligase are used?

	Endonuclease	Ligase
A	Stage X	Stage W
B	Stage Y	Stage Z
C	Stage X	Stage Y
D	Stage Y	Stage X

8. Answer either A or B.

Labelled diagrams may be included where appropriate.

A. Genetic engineering uses bacteria to produce human insulin. Describe the stages involved in this process.

5

9. Read the following passage and answer the questions based on it.

Genetic modification (GM) of crops began with the discovery that the soil bacterium. *Agrobacterium* could be used to transfer useful genes from unrelated species into plants. The Bt gene is one of the most commonly inserted. It produces a pesticide toxin that is harmless to humans but is capable of killing insect pests. Many new crop types have been produced. Most of these are modified to be pest, disease or weedkiller resistant, and include wheat, maize, oilseed rape, potatoes, peanuts, tomatoes, peas, sweet peppers, lettuce and onions.

Supporters argue that drought resistant or salt resistant varieties can flourish in poor conditions. Insect-repelling crops protect the environment by minimising pesticide use. Golden rice with extra vitamin A or protein-enhanced potatoes can improve nutrition.

Critics fear that GM foods could have unforeseen effects. Toxic proteins might be produced or antibiotic-resistance genes may be transferred to human gut bacteria. Modified crops could become weedkiller resistant "superweeds". Modified crops could also accidentally breed with wild plants or other crops. This could be serious if, for example, the crops which had been modified to produce medicines bred with food crops.

Investigations have shown that accidental gene transfer does occur. One study showed that modified pollen from GM plants was carried by the wind for tens of kilometres. Another study proved that genes have spread from the USA to Mexico.

(*a*) What role does the bacterium *Agrobacterium* play in the genetic modification of crops?

_____

_____   1

(*b*) Crops can be genetically modified to make them resistant to pests, diseases and weedkillers. Give another example of genetic modification that has been applied to potatoes.

_____   1
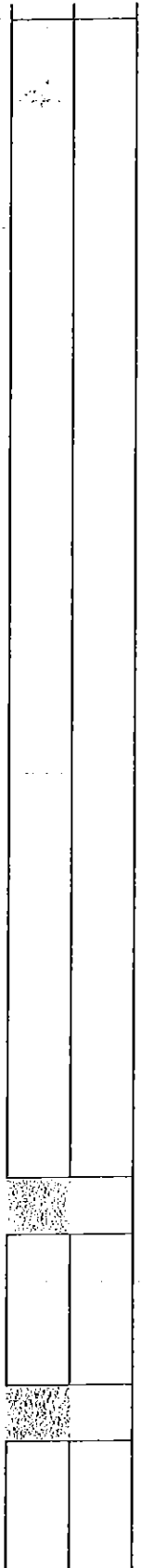
10. The diagram below summarises a form of genetic engineering.
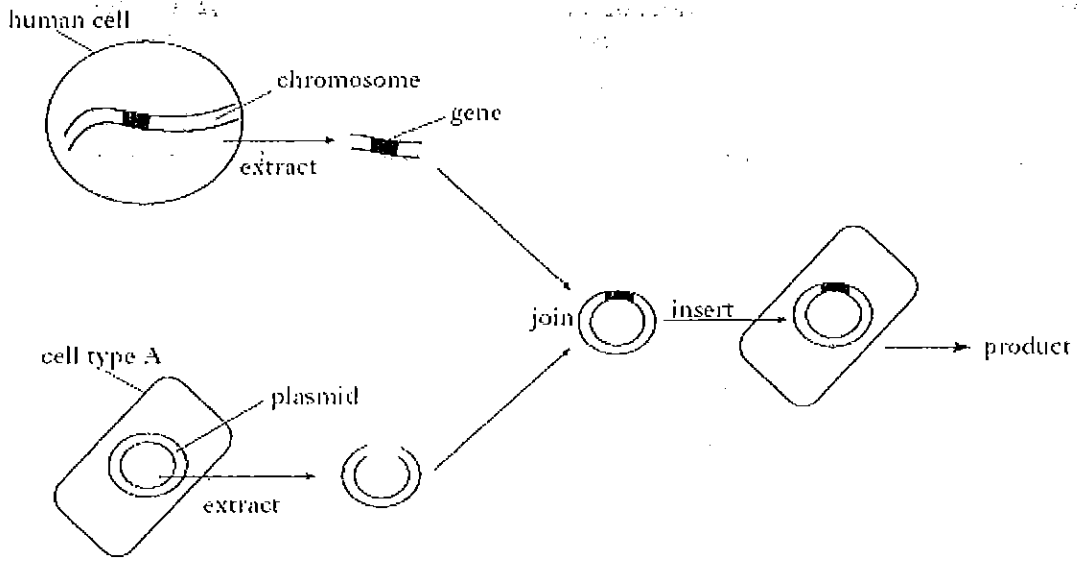
Identify cell type A and name a product of genetic engineering.
Describe the advantages and disadvantages of this process.

5

11 (a). Explain why a plant, which is modified to be weedkiller resistant could be:
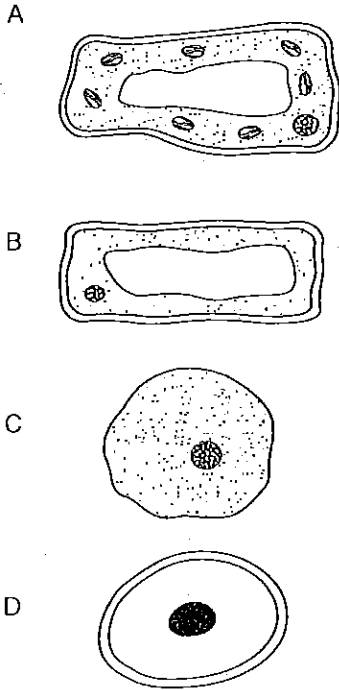
(i) useful to farmers.

_____

_____ 1

(ii) a problem for farmers.

_____

_____ 1

(b) Give one example of a potential threat to health by the use of GM crops.

_____

_____ 1

Photosynthesis

1. The diagrams below show four cells.
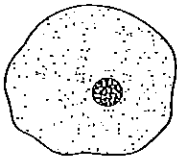   Which cell is a leaf mesophyll cell?

A

B

C

D

2. The graph shows the effect of varying the light intensity, temperature and carbon dioxide concentration on the rate of photosynthesis.

0.1% CO_2, $25°C$

0.1% CO_2, $15°C$

0.01% CO_2, $25°C$

Light intensity (kilolux)

The rate of photosynthesis is being limited by

A temperature at S and light intensity at T

B light intensity at S and temperature at T

C carbon dioxide at S and temperature at T

D light intensity at S and carbon dioxide at T.

3. An experiment was carried out to investigate the growth of pea plants kept in a high light intensity following germination.

The graph shows the average shoot length of the pea plants.

Average shoot length (mm)

Time (days)

During which 5 day period is there the greatest increase in average shoot length?

A Day 10 – 15

B Day 15 – 20

C Day 20 – 25

D Day 25 – 30

4. The role of chlorophyll in photosynthesis is to trap

A light energy for ATP production

B chemical energy for ATP production

C light energy for ADP production

D chemical energy for ADP production.

5. The raw materials for photosynthesis are

A carbon dioxide and water

B oxygen and water

C carbon dioxide and glucose

D oxygen and glucose.

Photosynthesis

1. The diagrams below show four cells.
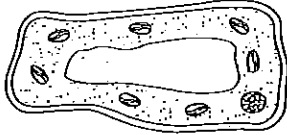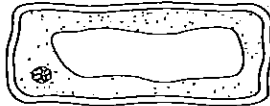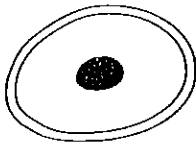
   Which cell is a leaf mesophyll cell?
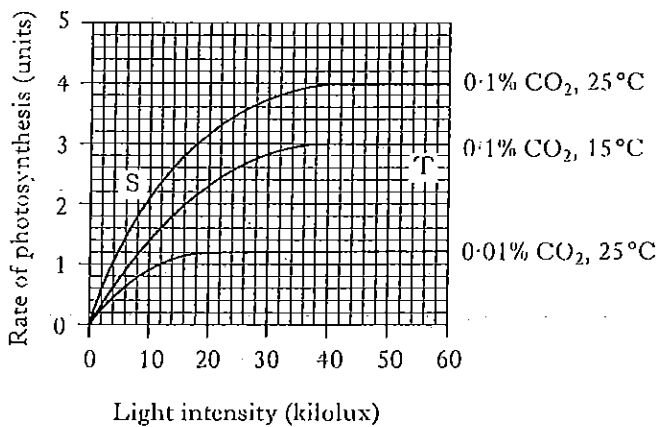
   A

   B

   C

   D

2. The graph shows the effect of varying the light intensity, temperature and carbon dioxide concentration on the rate of photosynthesis.
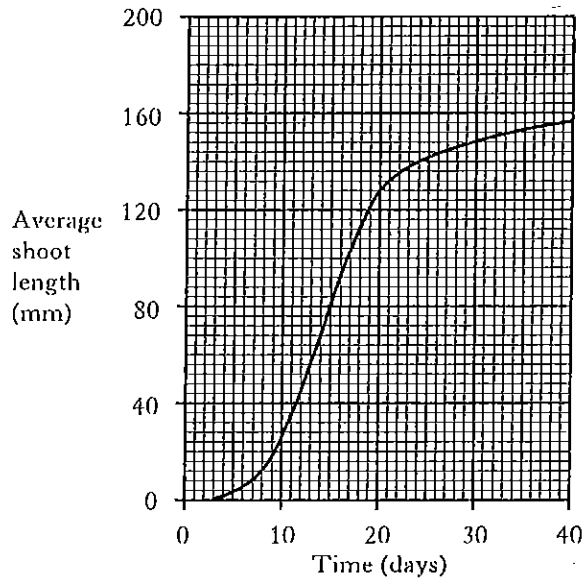

   The rate of photosynthesis is being limited by

   A   temperature at S and light intensity at T

   B   light intensity at S and temperature at T

   C   carbon dioxide at S and temperature at T

   D   light intensity at S and carbon dioxide at T.

3. An experiment was carried out to investigate the growth of pea plants kept in a high light intensity following germination.

   The graph shows the average shoot length of the pea plants.

   During which 5 day period is there the greatest increase in average shoot length?

   A   Day 10 – 15

   B   Day 15 – 20

   C   Day 20 – 25

   D   Day 25 – 30

4. The role of chlorophyll in photosynthesis is to trap

   A   light energy for ATP production

   B   chemical energy for ATP production

   C   light energy for ADP production

   D   chemical energy for ADP production.

5. The raw materials for photosynthesis are

   A   carbon dioxide and water

   B   oxygen and water

   C   carbon dioxide and glucose
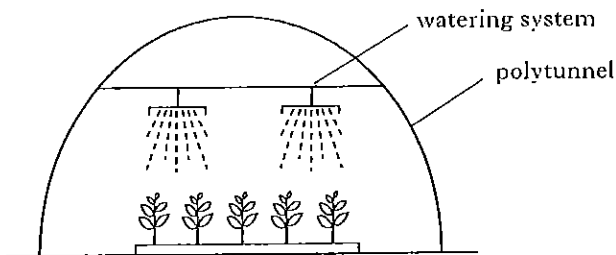
   D   oxygen and glucose.

6. The graph below shows the rate of photosynthesis, as light intensity increases, at two different temperatures.
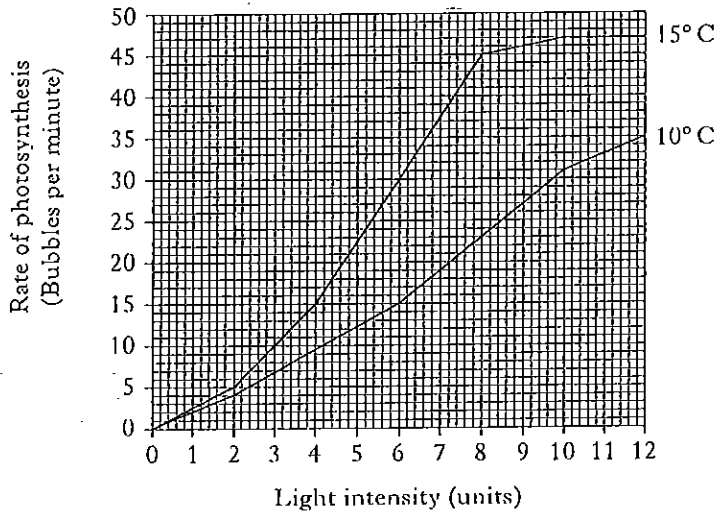
At a light intensity of 6 units, what is the simplest whole number ratio of the rate of photosynthesis at 10°C compared to 15°C?
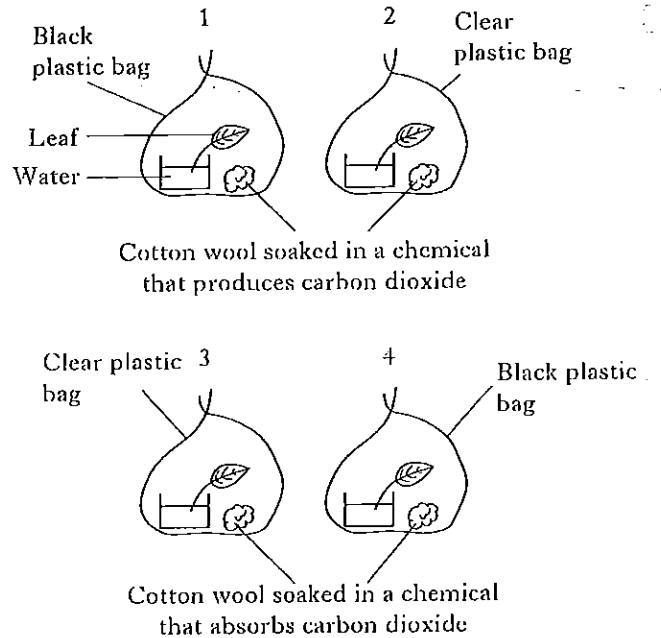
A 15 : 30

B 10 : 15

C 3 : 6

D 1 : 2

7. A crop of tomatoes was grown in a polytunnel.

Which of the following changes would not produce an earlier crop of tomatoes?

A Increasing the heating during the day.

B Increasing the CO_2 concentration at night.

C Increasing the light intensity at night.

D Increasing the CO_2 concentration during the day.

8. The diagrams below show four experiments used to investigate the conditions needed for photosynthesis.

Cotton wool soaked in a chemical that produces carbon dioxide

Cotton wool soaked in a chemical that absorbs carbon dioxide

After two days, the four leaves were tested for the presence of starch.

The results from which two experiments should be compared to show that carbon dioxide is needed for photosynthesis?

A 1 and 2

B 2 and 4

C 2 and 3

D 3 and 4

62

9. The graph below shows the effect of light intensity on the rate of photosynthesis at different temperatures.
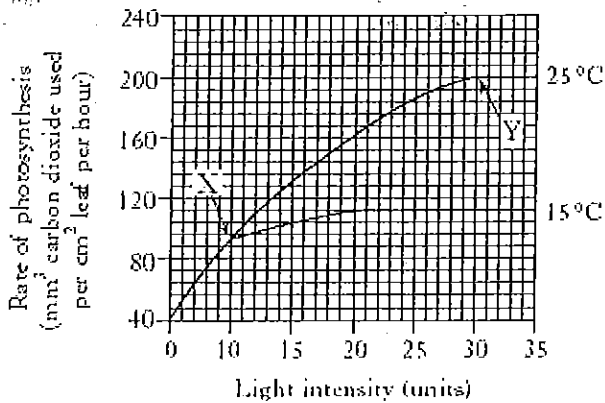
Which of the following conclusions can be made from the above data?

A Only at light intensities greater than 20 units does temperature affect the rate of photosynthesis.

B At point Y, the rate of photosynthesis is limited by the light intensity.

C Temperature has little effect on the rate of photosynthesis at low light intensities.

D At point X, temperature limits the rate of photosynthesis.

10. The graph below shows the rate of photosynthesis at two different levels of carbon dioxide concentration at 20 °C.
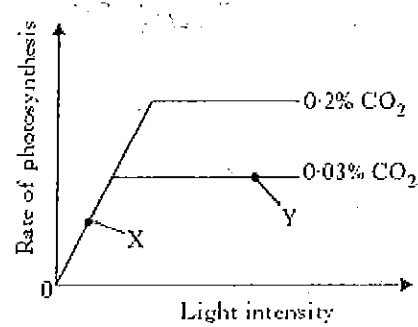

From the evidence given, identify the factors most likely to be limiting the rate of photosynthesis at points X and Y on the graph.

	Point X	*Point* Y
A	Light intensity	CO_2 concentration
B	Temperature	Light intensity
C	CO_2 concentration	Temperature
D	Light intensity	Temperature

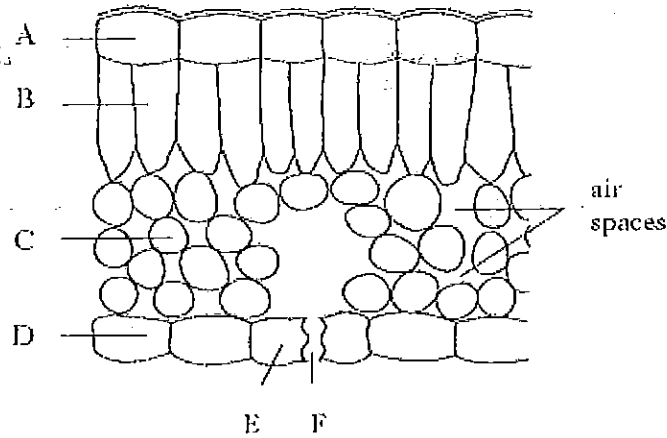11. (a) Carbon dioxide is used during photosynthesis to produce sugar.

(i) Complete the diagram below to show the fates of carbon dioxide after photosynthesis has taken place.
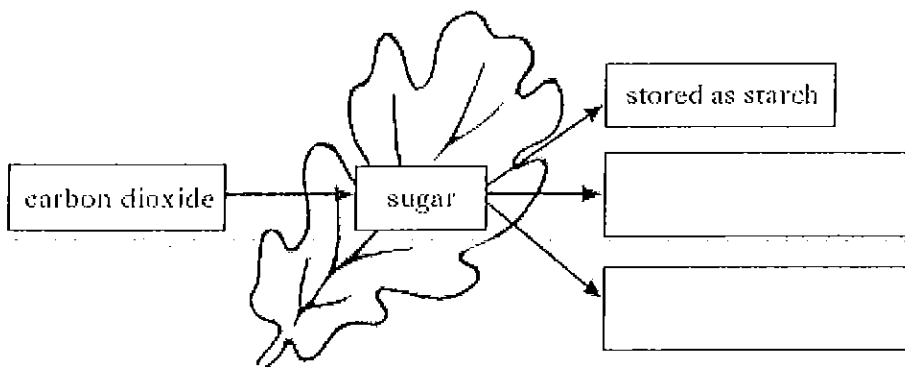
(ii) Explain why soot deposits on leaves reduce the rate of photosynthesis.

_____

_____

12. (a) The diagram below represents part of a cross section through a leaf.

Identify one example of each of the cells described below by using letters from the diagram to complete the boxes.

Each letter may be used once, more than once or not at all.

Transparent cells ☐

Cells which carry out photosynthesis ☐

Mesophyll cells ☐

Guard cells ☐

2

(b) The rate of photosynthesis can be affected by several factors.

<u>Underline</u> the correct word in each bracket in the following sentence to explain the term *limiting factor*.

The limiting factor is the factor which is preventing the rate of

photosynthesis from $\left\{ \begin{array}{c} \text{increasing} \\ \text{decreasing} \end{array} \right\}$ unless the supply of that factor

$\left\{ \begin{array}{c} \text{increases} \\ \text{decreases} \end{array} \right\}$.
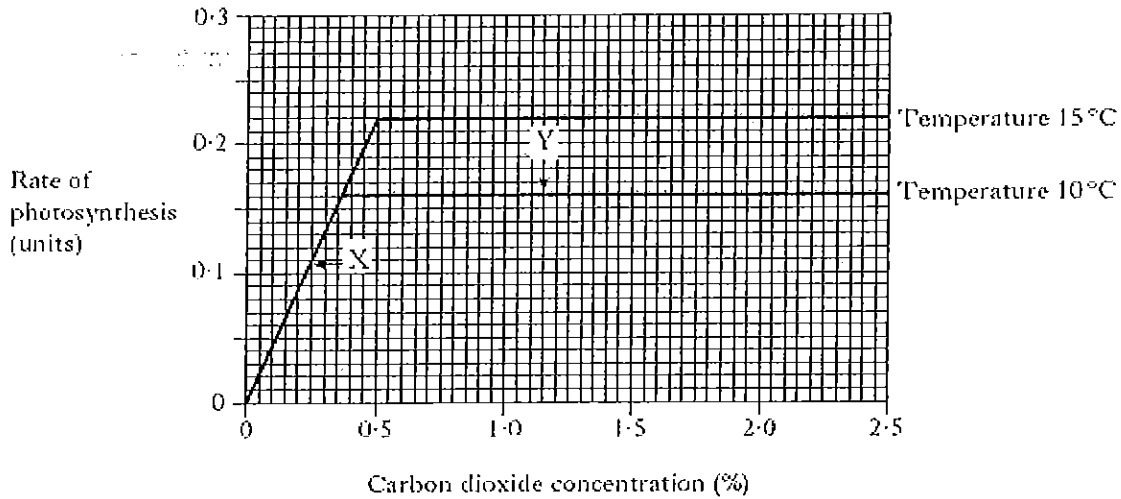
1

12. (continued)

(c) The following graph shows the effect of increasing carbon dioxide concentration on the rate of photosynthesis at two different temperatures. All other factors were kept constant.

Carbon dioxide concentration (%)

From the evidence in the graph, what are the limiting factors at points X and Y?

X _____

Y _____

1

(d) Some carbon compounds found in plants are shown in the list below.

List   carbon dioxide
            cellulose
            glucose
            starch

Complete the following table with the correct carbon compound for each of the functions.

Carbon compound	Function
	raw material for photosynthesis
	respiratory substrate
	storage carbohydrate

2

13. (*a*) The diagram represents phloem tissue from the stem of a plant.

Structure A

Sieve tube
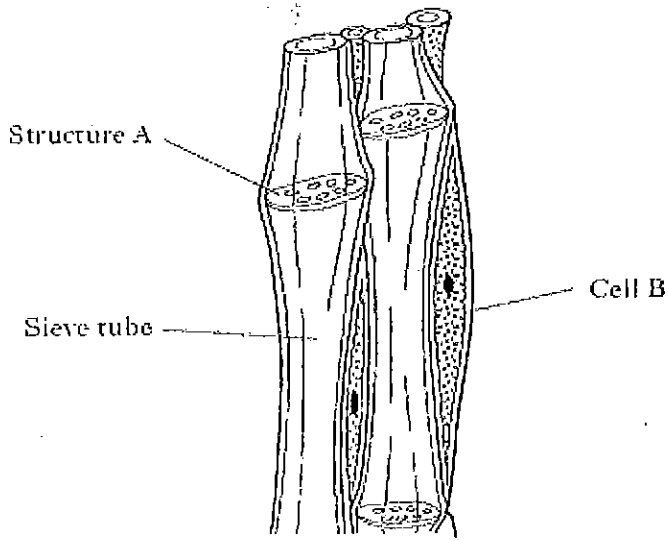
Cell B

(i) Name Structure A and Cell B.

Structure A _____

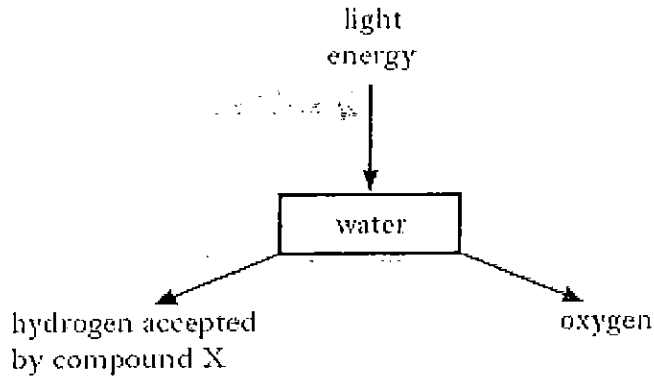Cell B _____   2

(ii) State the function of phloem.

_____   1

(*b*)   (i) Name the leaf tissue where stomata are found.

_____   1

(ii) Name the cells which control the opening and closing of stomata.

_____   1

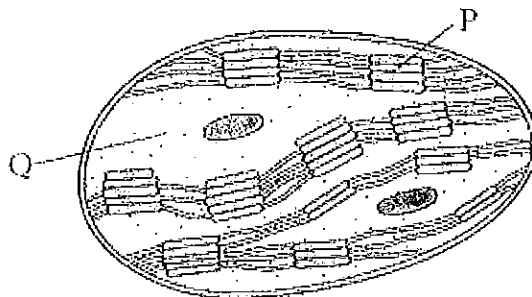14. The diagram below shows part of the light dependent stage of photosynthesis.

light
energy

↓

| water |

hydrogen accepted   oxygen
by compound X

(i) Name this part of the light dependent stage.

_____

1

(ii) Name compound X.

_____

1

15. The diagram shows a chloroplast from a palisade mesophyll cell.

(a) Name regions P and Q.

P _____

Q _____

1

(b) (i) Mark an X on the diagram to show the location of chlorophyll molecules.

1

(c) (i) Name one product of the light dependent stage of photosynthesis which is required for the carbon fixation stage (Calvin cycle).

_____

1

67

Marks

16. (a) An experiment was set up to measure the effect of light intensity on the rate of photosynthesis in the water plant, *Elodea*.

The light intensity was varied using a dimmer switch on the bulb.

The rate of photosynthesis was measured by counting the number of bubbles released per minute.
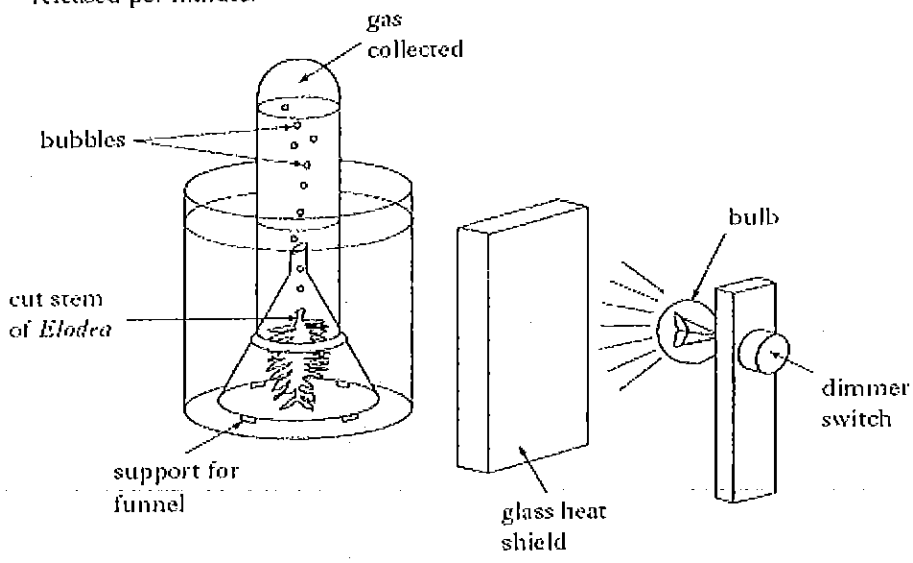
(i) Name the gas collected.

_____

1

(ii) The results of the experiment are shown in the table below.

Light intensity (units)	Rate of photosynthesis (number of bubbles per minute)
1	2
3	10
5	23
8	45
10	45
12	45

16. **(a) (ii) (continued)**

(A) On the grid below, plot a line graph to show rate of photosynthesis against light intensity.

(Additional graph paper, if required, will be found on page 32.)

Rate of photosynthesis (number of bubbles per minute)
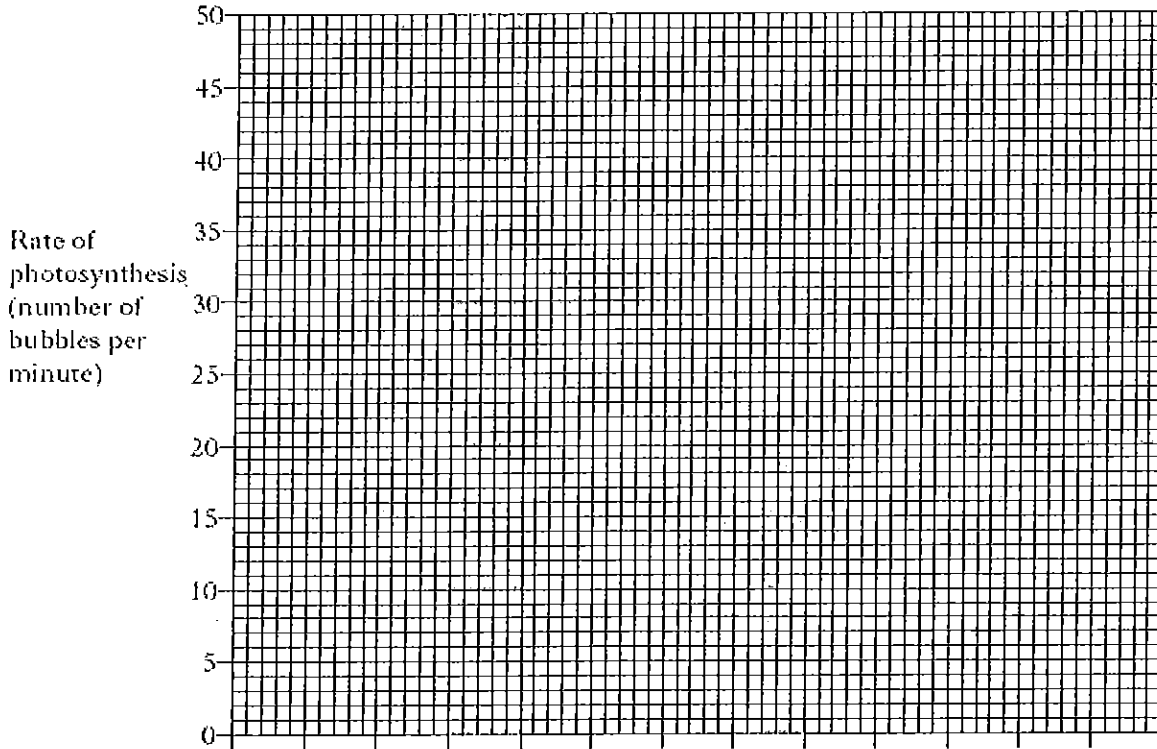
2

(B) Using the data in the table, explain the results obtained at light intensities greater than 8 units.

_____

_____ 1

(b) There are two reactions in photosynthesis. The first reaction is photolysis.

(i) Name the two substances produced by photolysis that are required for the second reaction.

Substance 1 _____

Substance 2 _____ 2

(ii) Name the second reaction.

_____ 1

Marks

16. (continued)

(c) Plant cells convert glucose into other carbohydrates.

Complete the table below by naming two of these carbohydrates.

Role of carbohydrate in plant cells	*Name of carbohydrate*
Storage as an insoluble material	
Forms cell walls	

2

(d) The graph below shows the effect of increasing the concentration of carbon dioxide on the rate of photosynthesis by a plant at different temperatures.

Light intensity was kept constant.
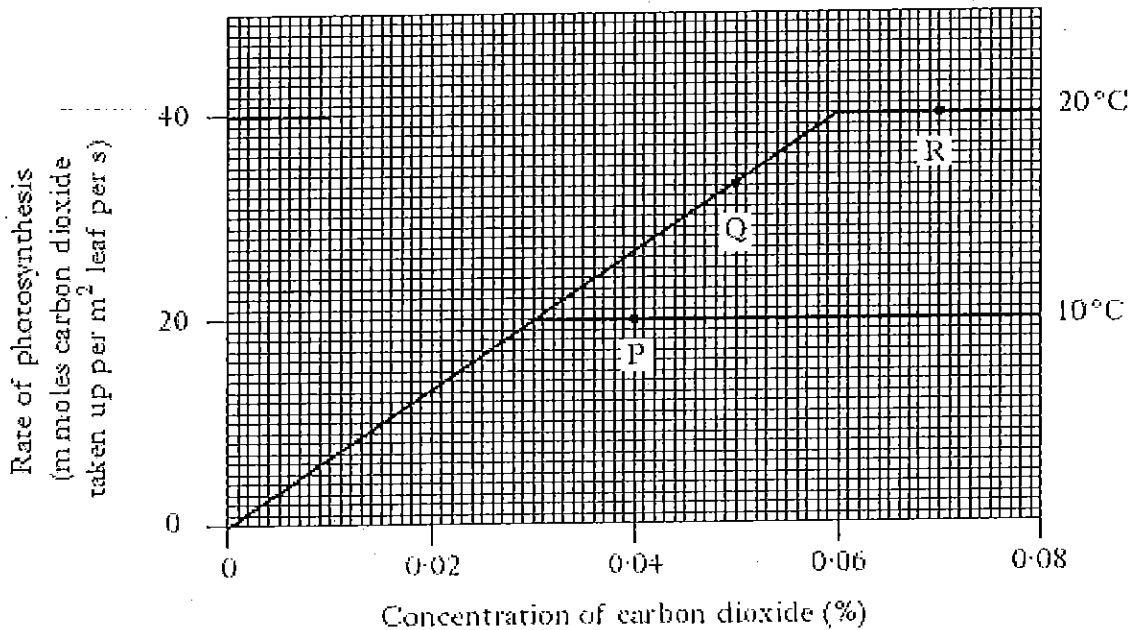
Using the information in the graph, identify the factor which is limiting the rate of photosynthesis at each of the points P, Q and R.
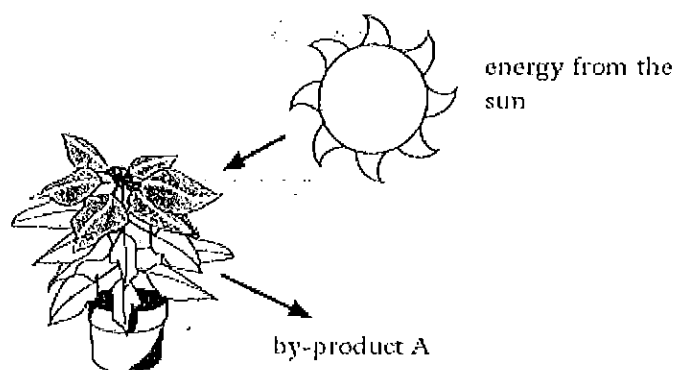
P _____

Q _____

R _____

2

70

17. Photosynthesis is the process by which green plants make glucose using energy from the sun.

energy from the
sun

by-product A

(*a*) Name the by-product A released during photosynthesis.

_____

1

(*b*) Hydrogen and a high energy molecule are produced during photolysis.

(i) Name the high energy molecule.

_____

1

(ii) Describe the use of hydrogen in carbon fixation.

_____

1

(*c*) (i) Explain why an increase in temperature can lead to an increase in the rate of photosynthesis.

_____

_____

2

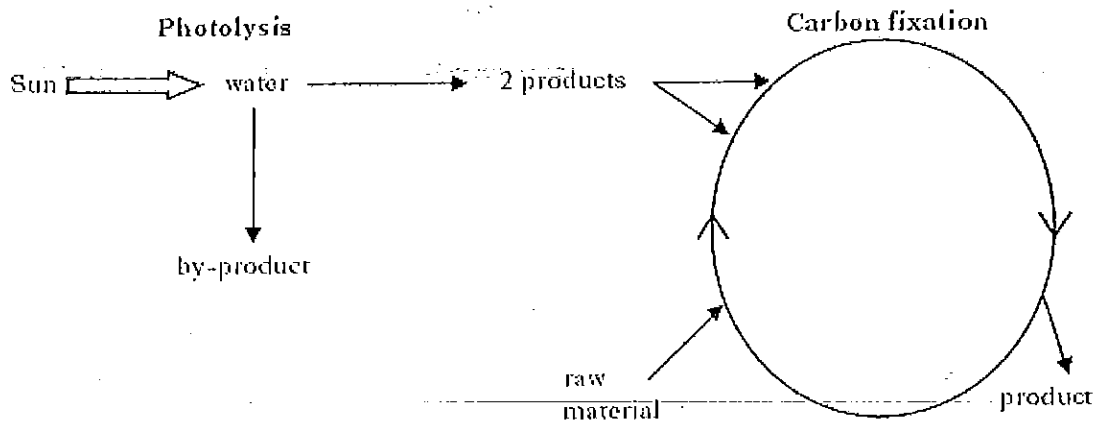(ii) Other than temperature, state two limiting factors of photosynthesis.

1. _____

2. _____

1

18. Answer either A or B.

A. The diagrams below show the two stages of photosynthesis.

Photolysis

Sun ⟹ water ⟶ 2 products ⟶ **Carbon fixation**

by-product

raw material ⟶ product

Describe what happens during the two stages

(*a*) photolysis
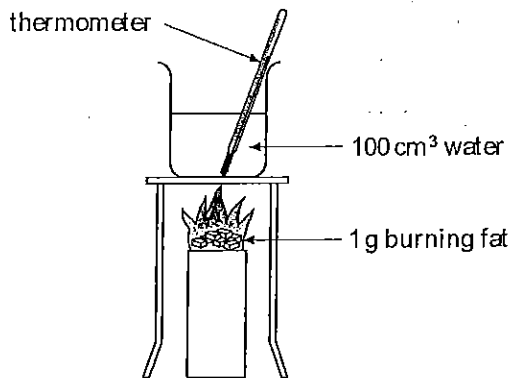
and

(*b*) carbon fixation.

5

Respiration

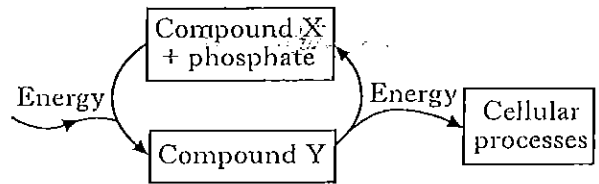1. The diagram shows the apparatus used to investigate the energy content of fat.

thermometer
— 100 cm³ water
— 1 g burning fat

Which of the experiments shown below allows a valid comparison to be made between the energy content of fat and protein?

A

— 200 cm³ water
— 1 g burning protein

B

— 100 cm³ water
— 2 g burning protein

C

— 200 cm³ water
— 2 g burning protein

D

— 100 cm³ water
— 1 g burning protein
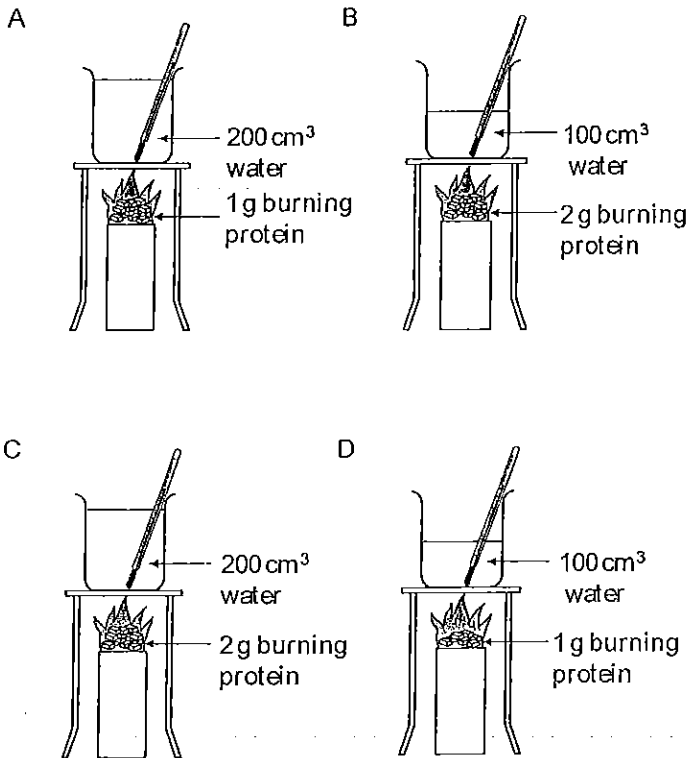
2. Which of the following increases in the muscles of an athlete and causes muscle fatigue during a race?

A Lactic acid

B Glucose

C Oxygen

D ATP

3. The diagram below shows energy transfer within a cell.

Energy — Compound X + phosphate — Compound Y — Energy — Cellular processes

Which line of the table below identifies correctly compounds X and Y?

|	X	Y
A	glucose	ATP
B	glucose	ADP
C	ADP	ATP
D	ATP	glucose

4. The energy yield per glucose molecule during aerobic respiration is

A 2 molecules of ATP

B 18 molecules of ATP

C 36 molecules of ATP

D 38 molecules of ATP.

5. The following are statements about respiration.

1 ATP is produced

2 Lactic acid is produced

3 Carbon dioxide is produced

4 Ethanol is produced

Which of the statements are true of anaerobic respiration in human muscle tissue?

A 2 only

B 2 and 3 only

C 1 and 2 only

D 1, 3 and 4 only

6. The graph below shows the relationship between the concentration of carbon dioxide and oxyhaemoglobin in the blood.

Concentration of oxyhaemoglobin in blood (%)

Concentration of CO_2 in blood (%)
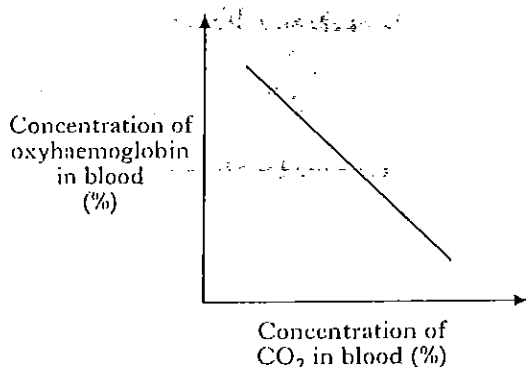
Which of the following describes this relationship?

A As the carbon dioxide concentration decreases, the concentration of oxyhaemoglobin decreases.

B As the carbon dioxide concentration increases, the concentration of oxyhaemoglobin decreases.

C As the carbon dioxide concentration increases, the concentration of oxyhaemoglobin increases.

D As the carbon dioxide concentration increases, it has no effect upon the concentration of oxyhaemoglobin.

7. The diagram below shows energy transfer within a cell.
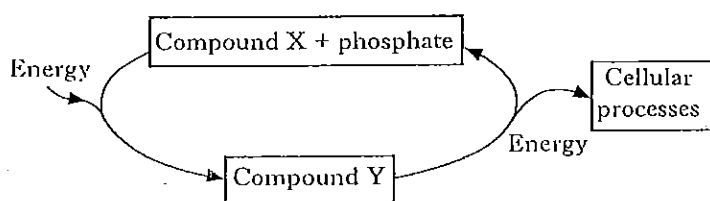
Which line in the table identifies correctly compounds X and Y?

	X	Y
A	glucose	CO_2
B	CO_2	ADP
C	ADP	ATP
D	ATP	glucose

8. The diagram below shows the apparatus used to investigate the energy contents of different foods.

1 g of each food was burned under a beaker containing 100 cm³ of water. The rise in water temperature was measured using a thermometer.

thermometer

100 cm³ water

1 g burning food
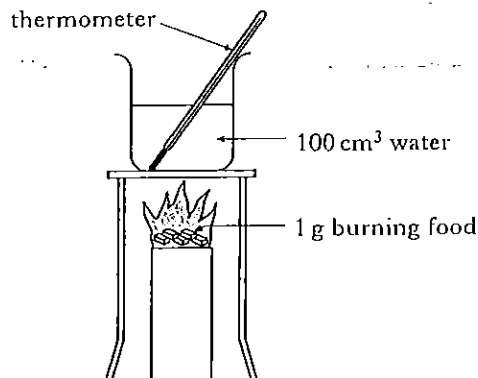
When different foods were burned, the following results were obtained.

Food	Temperature rise (°C)
potato	15
margarine	40
egg	20

The following equation can be used to calculate the energy value of food.

Energy value = 0·42 × temperature rise (°C)
(kJ per gram)
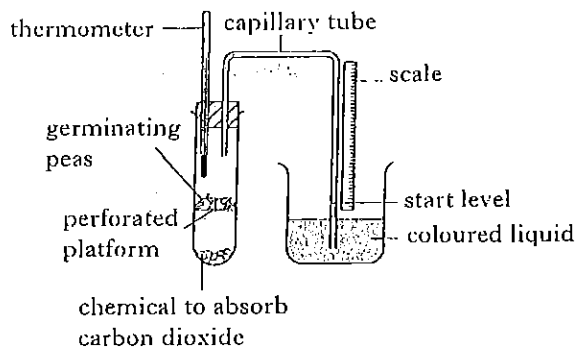
Using this equation, the energy value of egg is

A 0·42

B 8·4

C 84

D 840.

9. Which of the following stages in respiration would result in the production of 38 molecules of ATP?

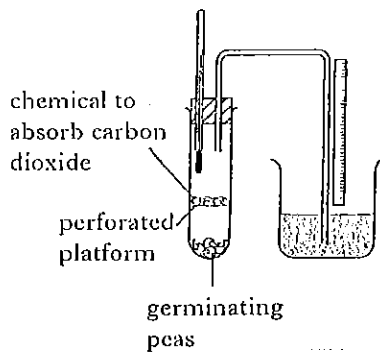A Glucose to pyruvic acid

B Pyruvic acid to lactic acid

C Pyruvic acid to carbon dioxide and water

D Glucose to carbon dioxide and water

74

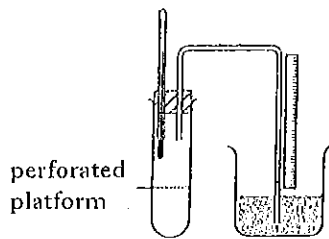**10.** The apparatus below was used to investigate respiration in germinating peas.

thermometer — capillary tube

germinating peas

perforated platform

scale

start level

coloured liquid

chemical to absorb carbon dioxide

A suitable control for this investigation would be

A

chemical to absorb carbon dioxide

perforated platform

germinating peas

B

perforated platform

C

perforated platform

chemical to absorb carbon dioxide

D

germinating peas

perforated platform
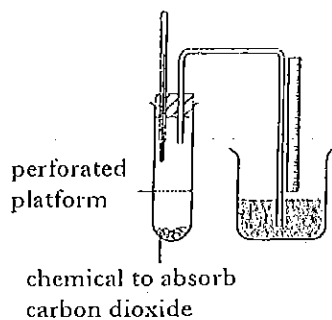
11. The following experiment was set up.

X
air in

Y
air out

Sodium hydroxide

Flask P Lime water

Flask Q Insect
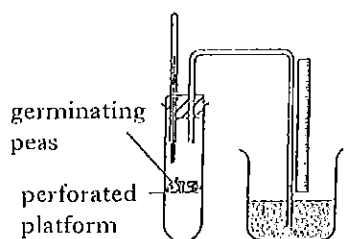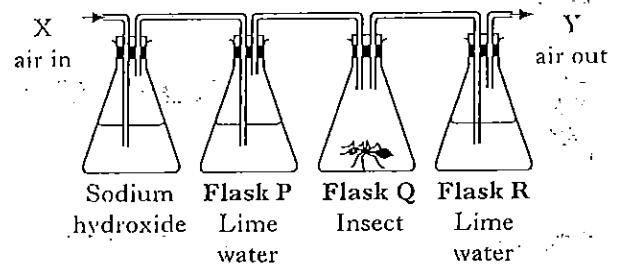
Flask R Lime water

Sodium hydroxide solution absorbs carbon dioxide from air.

Lime water turns from clear to cloudy in the presence of carbon dioxide.

Air is drawn through the apparatus from X to Y, passing through each flask in turn.

Predict what would happen to the results if two insects were used in flask Q. The lime water in

A Flask P turns cloudy more slowly

B Flask P turns cloudy more quickly

C Flask R turns cloudy more slowly

D Flask R turns cloudy more quickly.

12. Which substance enters animal cells by diffusion and is used to produce ATP?

A Carbon dioxide

B Starch

C Water

D Glucose

13. The energy values of different food groups are shown in the table.

Food group	Energy value (kJ per gram)
Carbohydrate	19
Fat	38
Protein	19

What is the simple whole number ratio of the energy value in fat to protein to carbohydrate?

A 1 : 2 : 1

B 2 : 1 : 1

C 19 : 38 : 19

D 38 : 19 : 19

14. The following statements relate to respiration and the mitochondrion.

1 Glycolysis takes place in the mitochondrion.

2 The mitochondrion has two membranes.

3 The rate of respiration is affected by temperature.

Which of the above statements are correct?

A 1 and 2

B 1 and 3

C 2 and 3

D All of them

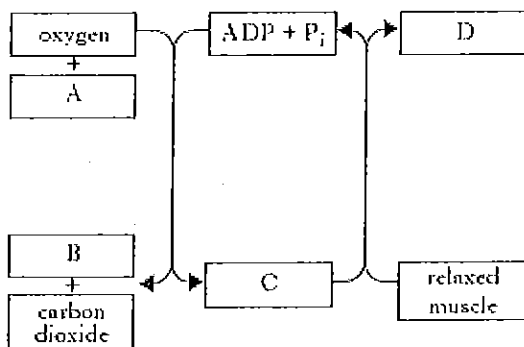**15.** The diagram below shows energy transfer within a cell.
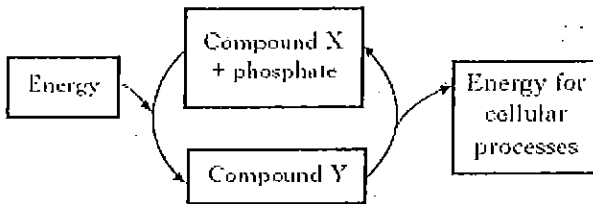
Which line in the table below identifies correctly compounds X and Y?

	X	Y
A	glucose	ATP
B	glucose	ADP
C	ADP	ATP
D	ATP	glucose

16. The diagram below represents a summary of respiration in a mammalian muscle cell.
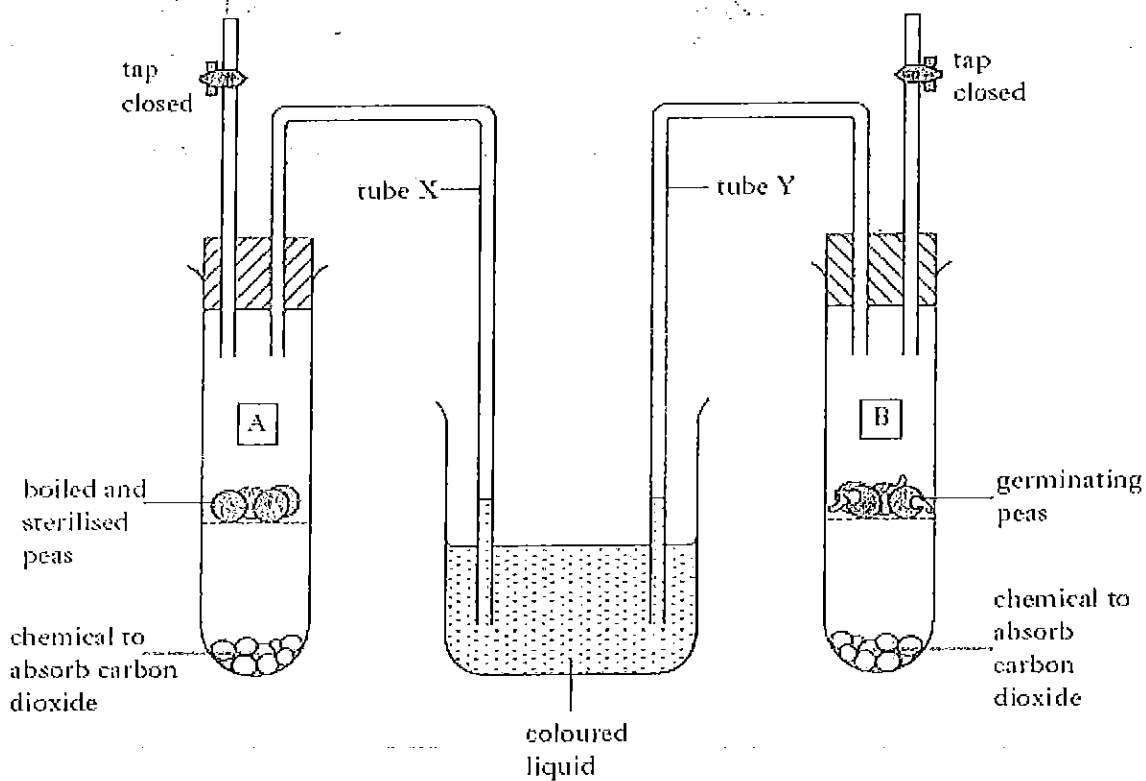

Which box represents ATP?

17. Which line in the table below correctly shows the two chemical reactions which occur in the grana of a chloroplast following the absorption of light energy by chlorophyll?

	Chemical reaction 1	Chemical reaction 2
A	ATP → ADP + Pi	water → hydrogen + oxygen
B	ADP + Pi → ATP	water → hydrogen + oxygen
C	ATP → ADP + Pi	hydrogen + oxygen → water
D	ADP + Pi → ATP	hydrogen + oxygen → water

18. Which line in the table below correctly shows the number of molecules of ATP used and produced when one molecule of glucose undergoes glycolysis?

	Number of molecules of ATP	
	Used	Produced
A	0	2
B	2	0
C	2	4
D	4	2

76

19.

(a) The experiment shown below was set up to demonstrate aerobic respiration in peas that are germinating (starting to grow).

tap closed

tube X

tube Y

tap closed

A

B

boiled and sterilised peas

germinating peas

chemical to absorb carbon dioxide

chemical to absorb carbon dioxide

coloured liquid

After two days, the level of liquid had risen in tube Y but had not risen in tube X.

(i) Explain the purpose of A as a control in this experiment.

_____

_____ 1

(ii) Predict the effect on the level of the liquid in tube Y if a greater mass of peas is used.

_____ 1

19. (continued)

(b) The following list contains some features of aerobic and anaerobic respiration in germinating peas.

List

W   Does not use oxygen
X   Produces carbon dioxide
Y   Yields 38 molecules of ATP per glucose molecule
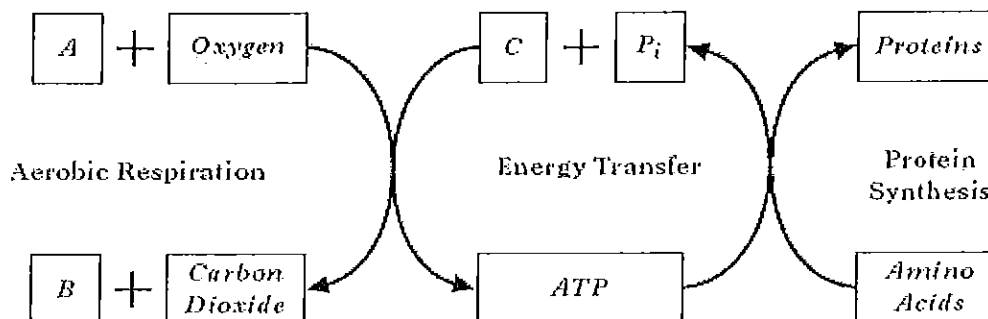Z   Produces ethanol

Complete the table below by writing the letters from the list in the correct columns.

Each letter may be used once or more than once.

Aerobic respiration in germinating peas	Anaerobic respiration in germinating peas

2

20. (a) The diagram below shows the link between aerobic respiration and protein synthesis.

(i) Name substances A, B and C.

A _____

B _____

C _____   2

(ii) Some energy released in respiration can be used for protein synthesis. State one other cellular activity that uses energy.
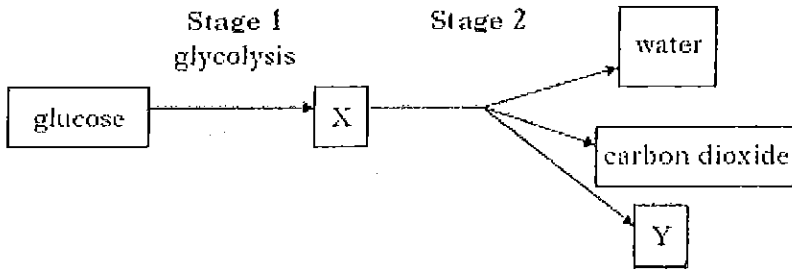
_____   1

21. Yeast may carry out two different types of respiration.

(a) Name the type of respiration in yeast which has the highest energy yield.

_____

(b) The diagram below shows one type of respiration in yeast cells.

Stage 1 glycolysis   Stage 2

glucose → X → water, carbon dioxide, Y

(i) Name substances X and Y.

X _____

Y _____

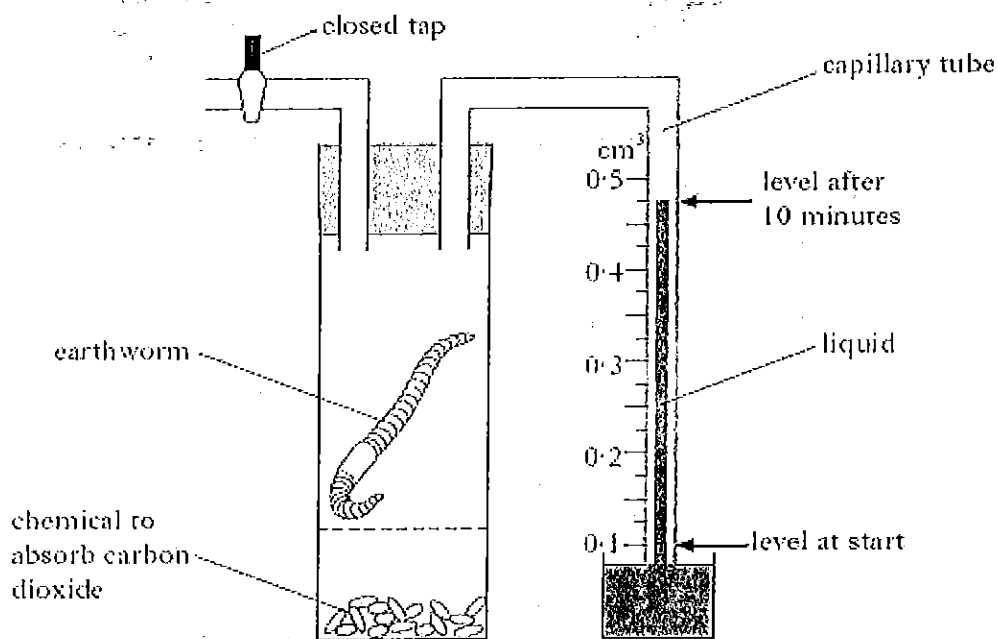(ii) What other substance must be present for stage 2 to occur?

_____

22. The diagram shows apparatus set up to investigate the rate of respiration in an earthworm. After 10 minutes at 20 °C the level of liquid in the capillary tube had changed as shown.

(a) (i) What volume of oxygen is used by the earthworm during the 10 minute period?

_____ cm³   1

(ii) Describe a suitable control for this experiment.

_____

_____   1

(b) In a second experiment, a worm of 5 grams used 0·5 cm³ of oxygen in 10 minutes.

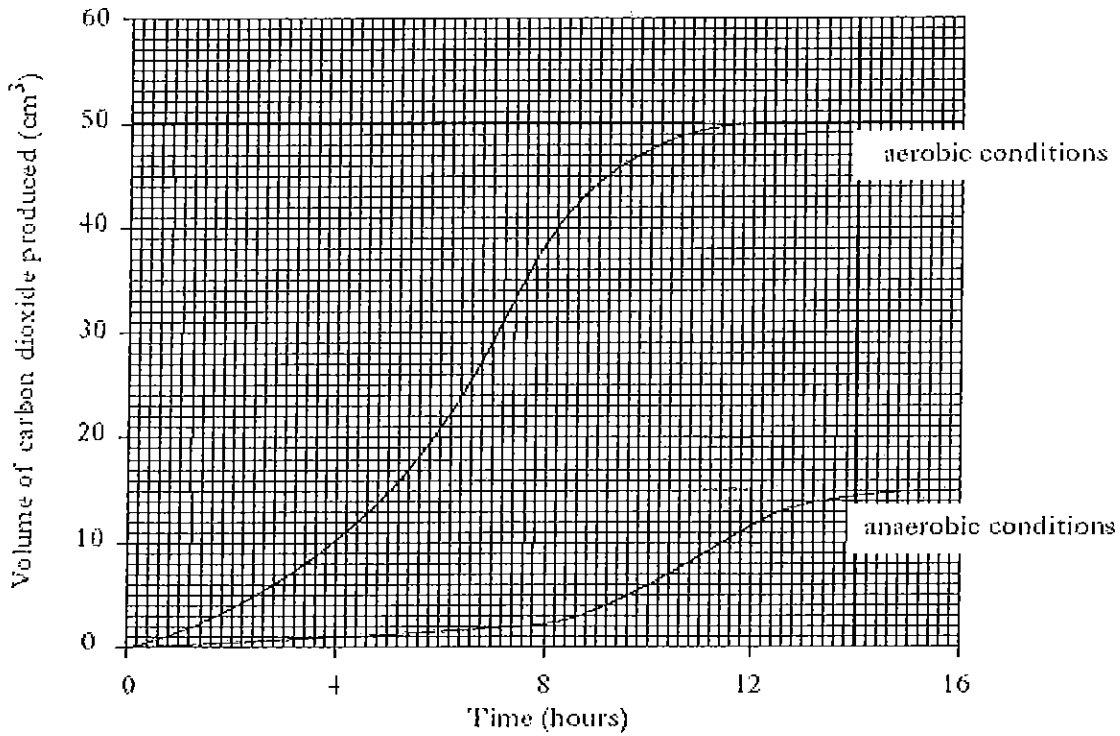Calculate its rate of respiration in cm³ per minute per gram of worm.

Space for calculation

_____ cm³ per minute per gram of worm   1

80

22. **(continued)**

(b) Yeast cells were grown in both aerobic and anaerobic conditions and the volume of carbon dioxide produced was measured.

The results are shown in the graph below.

(i) At which time is there the greatest difference between the volumes of carbon dioxide produced in aerobic and anaerobic conditions?

Tick (✓) the correct box.

☐ 8 hours   ☐ 10 hours   ☐ 12 hours   ☐ 14 hours   ☐ 16 hours   1
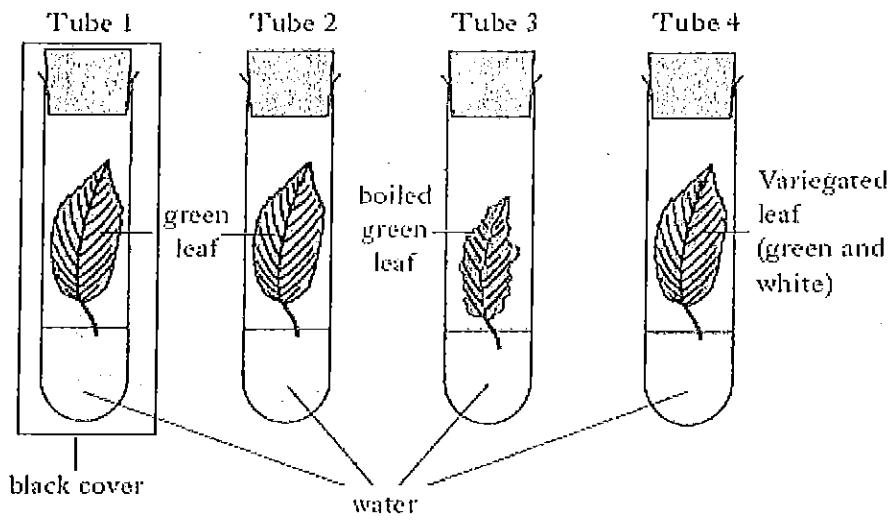
(ii) Calculate the average rate of carbon dioxide production per hour over the first 6 hours in aerobic conditions.

Space for calculation

_____ cm³ per hour   1

81

23. Leaves were placed in tubes as shown below.

The tubes were left in bright light.

For each of the tubes, tick (✓) the appropriate box in the table to indicate which processes will take place in the leaves.

Process Tube	Only photosynthesis	Only respiration	Both	Neither
1				
2				
3				
4				