Candidate 3 evidence

MARKS

SECTION 2 — 75 marks

Attempt ALL questions

1. (a) The list gives four types of cells.

Bacteria Fungus Animal Plant

(i) Cell membranes are found in all of these cell types.

Describe the function of the cell membrane. 1

The cell membrane controls what enters and leaves the cell.

(ii) Name **one** other structure that is also present in all of these cells. 1

Cytoplasm

(b) The table gives information on the numbers of mitochondria in different types of mammalian cells.

Cell type	Number of mitochondria per cell			
	Cell 1	Cell 2	Cell 3	Average
Muscle	1352	1203	1450	1335
Skin epithelium	250	330	275	285
Lymphocyte	953	1112	860	975

(i) Complete the table by calculating the average number of mitochondria per cell in skin epithelium. 1

Space for calculation

250 + 330 + 275 = 855 855 ÷ 3 = 285

(ii) Compared to skin epithelium cells, muscle and lymphocyte cells have higher numbers of mitochondria.

Suggest why these cells need more mitochondria. 1

The more energy a cell requires/uses, the more mitochondria there will be present

MARKS

2. Ions move in and out of cells by passive and active processes.

The table shows the concentration of three ions outside and inside a human cell.

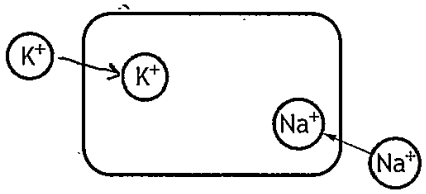
Ions	Outside cell (mM)	Inside cell (mM)
Sodium (Na^+)	145	12
Potassium (K^+)	4	139
Chloride (Cl^-)	116	4

(a) Name the process by which sodium ions move into this cell. 1

osmosis, diffusion

(b) (i) Potassium ions (K^+) move by active transport. 1

Using the information in the table, complete the diagram, by drawing an arrow, to show the direction in which the potassium ions move.



(ii) Name the type of molecule, found in a cell membrane, which is involved in moving ions by active transport. 1

Selectively permiable

(c) Calculate how many times greater the concentration of chloride ions is outside the cell compared to inside the cell. 1

Space for calculation

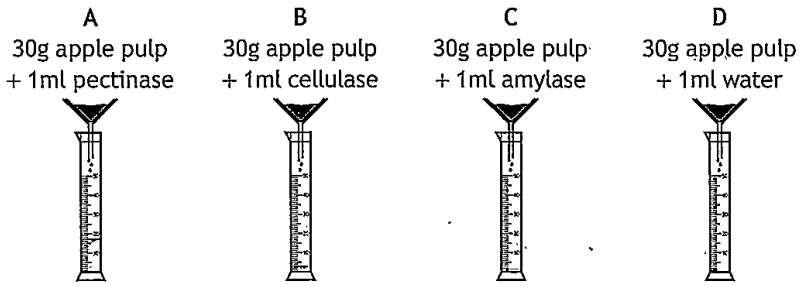
$\frac{116}{4} = 29$

29 times greater

MARKS

3. Enzymes are used to help extract juice from fruit pulp.

The diagrams show a student's investigation into the effectiveness of different enzymes on the volume of juice produced.



After 30 minutes, the volume of apple juice collected was measured and the procedure was then repeated.

The average for each cylinder was calculated and the results are shown in the table.

Cylinder	Liquid added to apple pulp	Average volume of apple juice collected (ml)
A	pectinase	17·6
B	cellulase	3·2
C	amylase	1·8
D	water	1·6

(a) Name the enzyme which was the least effective at extracting juice from the apple pulp. 1

Amylase

(b) Enzymes can be involved in two types of reaction. The extraction of juice from apple pulp is an example of a degradation reaction.

Name the other type of reaction. 1

Synthesis

MARKS

3. (continued)

(c) Cellulase is an enzyme that speeds up the breakdown of a component of the plant cell wall.

Name this component. 1

Cellulose

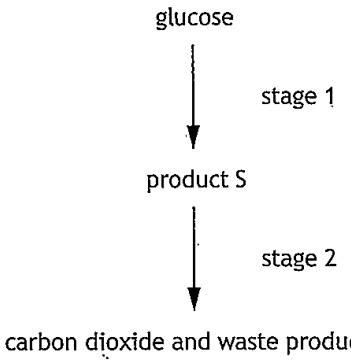
(d) All of the enzymes broke down at least some part of the apple pulp to produce apple juice.

What name is given to the substance that an enzyme breaks down? 1

~~Molecule protein~~ substrate

MARKS

4. The diagram represents the process of aerobic respiration in yeast cells.



(a) (i) Name product S and waste product T. 2

S Pyruvate

T ethanol

(ii) Name the substance that must be present for yeast to respire aerobically. 1

lactic acid

(iii) Identify which of the two stages releases the larger quantity of ATP. 1

Stage 2

4. (continued) MARKS

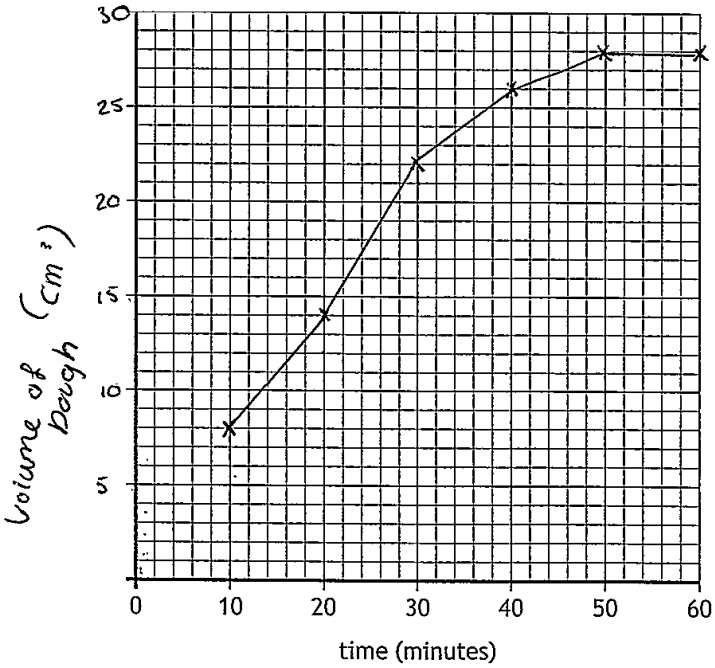
(b) An investigation was carried out into the respiration of yeast. A dough was made containing live yeast and left in optimum conditions. As the yeast respired, the carbon dioxide produced caused the dough to rise. The volume of the dough was measured every 10 minutes for 60 minutes.

The results are shown in the table.

Time (minutes)	Volume of dough (cm^3)
10	8
20	14
30	22
40	26
50	28
60	28

(i) On the grid, complete the vertical axis and plot a line graph to show the effect of time on the volume of dough. 2

(An additional grid, if required, can be found on *page 31*)



4. (b) (continued) MARKS

(ii) Predict the volume of dough at 50 minutes if the experiment was carried out at a lower temperature. 1

Give a reason for your answer. 1

Prediction ~~40 40~~ 26 cm^3

Reason Since it is now decreased in temperature from its optimum conditions, it won't do as well. It will only go so far since it is not in the right environment.

MARKS

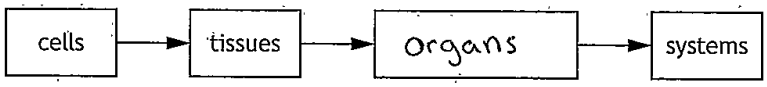
5. New cells are produced by mitosis throughout life.

(a) Name the cells, found in the early stages of an embryo's development, which have the potential to develop into specialised cells. 1

Stem Cells

(b) As cells become specialised they are organised according to their function.

Complete the flowchart to show the levels of organisation found within a multicellular organism. 1



(c) State a reason, other than growth, why cells continue to be produced throughout life. 1

To replace old or damaged or dead cells

(d) Lymphocytes and phagocytes are specialised white blood cells.

Describe the different ways in which these two types of cell destroy pathogens. 2

Phagocytes do not look for specific bacteria/fungi/viruses, they will engulf and digest any bacteria/fungi/viruses. Lymphocytes are looking for particular bacterium within the body and wont engulf and digest.

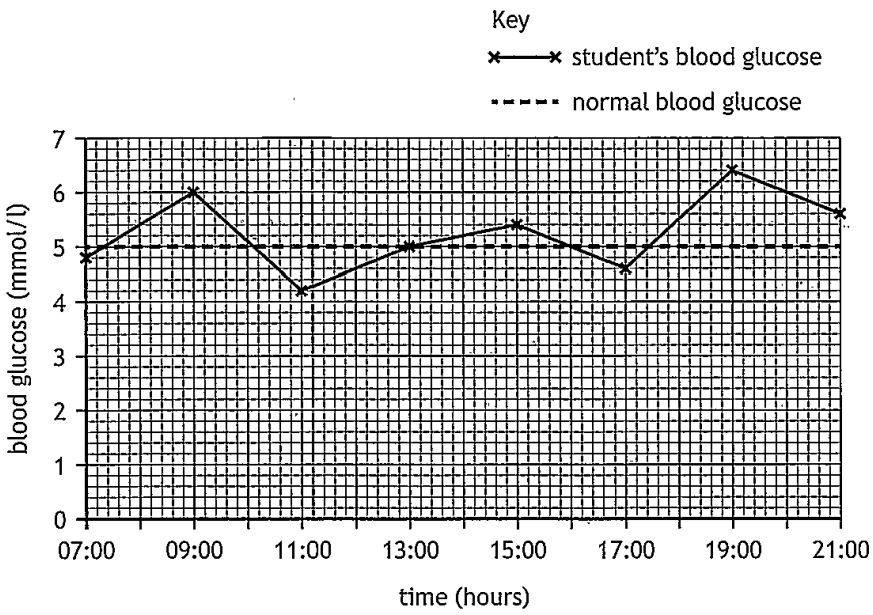
(e) Name the system in the human body which destroys pathogens. 1

pathogenosis

MARKS

6. As part of a study into the health of a group of students, blood glucose readings were taken over a period of time.

The graph shows the readings for one of the students.



(a) Identify the time when this student's blood glucose reached its maximum value. 1

19:00 hours

(b) Calculate the percentage decrease in blood glucose between 09:00 and 11:00 hours. 1

Space for calculation

$\frac{1.8}{2} \times 100$

90 %

MARKS

6. (continued)

(c) By 13:00 hours the blood glucose level had returned to normal from its lowest point.

Describe how blood glucose is returned from low to normal levels in the human body. 4

~~The decrease is detected in the pancreas. The pancreas then sends out less insulin and more glycogen. The liver then stores the~~

The decrease in glucose concentration in the blood is detected by cells in the pancreas. This then causes pancreas to produce more glycerol and less insulin. The liver then produces glucose and the blood glucose ~~regulation~~ concentration is returned to normal levels.

MARKS

7. An experiment was carried out to investigate stem height in pea plants.
The parental phenotypes were tall and dwarf as shown in the diagrams.

tall dwarf

stem height

(a) The parent plants were both homozygous. When they were crossed the F_1 generation were all tall. These plants were then crossed with each other to produce the F_2 generation.

(i) Explain what is meant by the term homozygous. 1

They have the same genes, DNA

(ii) The dwarf characteristic is recessive.
Using the information given, explain how this is known. 1

Since the F1 was crossed to produce F2, this means the f2 genes were there from past plants

MARKS

7. (continued)

(b) (i) The expected ratio in the F_2 generation was 3 tall to 1 dwarf.

Calculate the expected number of tall plants if there were 144 plants produced in this generation. 1

Space for calculation

144 ÷ 4 = 36

144 − 36 = 108

108 tall plants

(ii) The results obtained in the F_2 generation differed from the expected results.

The actual results were 90 tall and 36 dwarf plants.

Calculate the simplest whole number ratio for these results. 1

Space for calculation

6 ÷ 90 : 36

15 : 6

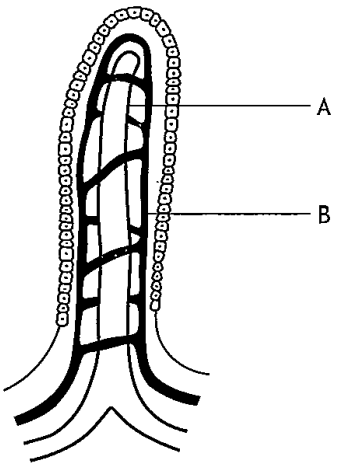
÷3 5 : 2 ÷3

5 : 2

tall : dwarf

MARKS

8. Nutrients from food are absorbed into villi found in the small intestine.
The diagram represents a single villus.



(a) Name one type of molecule absorbed by each of the labelled structures. **2**

A Glycerol

B amino ~~fatty~~ acids

(b) Explain why having a large number of villi improves the efficiency of absorption in the small intestine. **1**

If there is more villi, the more absorbtion will take place, if there was a small amount, they wouldn't absorb as much as they could.

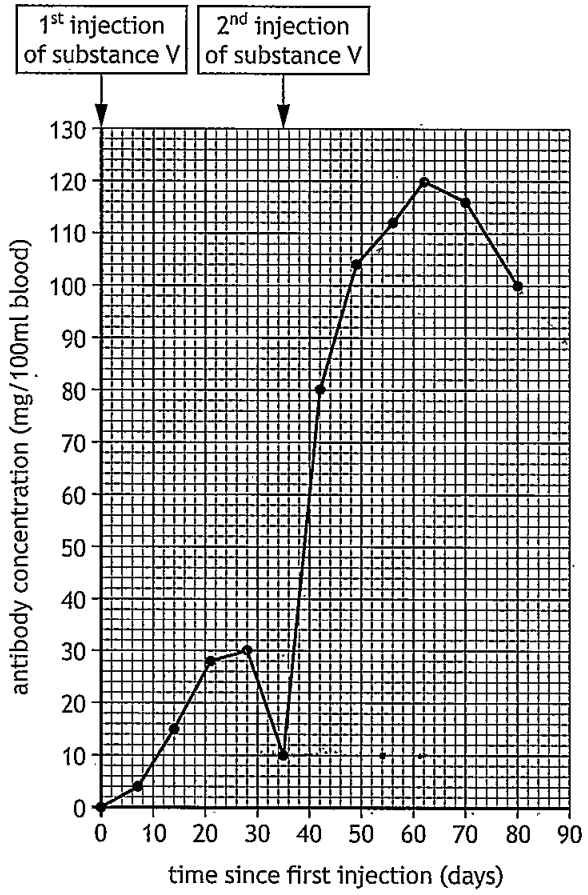
(c) Identify the structural feature of a single villus, that is also found in an alveolus, which increases the efficiency of absorption. **1**

large Surface Area.

MARKS

9. In a study, volunteers were injected with substance V on day 0 and again on day 35. Substance V causes antibodies to be produced.

The graph shows the antibody concentration in the blood of one of the volunteers in response to the two injections.



(a) Identify the maximum antibody concentration following the first injection, but before the second. 1

30 mg/100 ml

(b) Calculate the number of days after the second injection that it took for the antibody concentration to reach its maximum value. 1

Space for calculation

~~120-40 = 80~~ 24 + 8 = 32

= 32 days

32

~~80~~ days

MARKS

9. (continued)

(c) The second injection caused a higher concentration of antibody to be produced than the first.

Give **two** other differences in the antibody production in response to the two injections. 2

1 The second injection increased much faster than the first injection

2 The increasing rate ~~was~~ had longer periods of time between them in the second.

(d) If the trend continues as shown in the graph, predict the antibody concentration on day 90. 1

Space for calculation

80 mg/100 ml

MARKS

10. A study found that exercise can reduce the risk of developing some types of cancer.

Researchers examined the level of exercise of 1·4 million people over an 11 year period and recorded any diagnosis of cancer and when it occurred.

Participants were asked to keep their own record of the frequency and intensity of their exercise.

Those participants who exercised were found to have a reduced risk of developing some types of cancer. These results are shown in the table.

Type of cancer	Average risk reduction (%)
lung	26
kidney	23
stomach	22
myeloma	17
bladder	13

The study did not take into account factors such as diet and smoking, which may have affected the results. The fact that participants were asked to record their own exercise is another limitation of this study.

The doctor in charge of the research suggested that these results support the promotion of exercise as a means of reducing the risk of cancer.

However, it was suggested by a different researcher that further studies would need to be carried out before the results could be considered valid.

(a) Most research starts off with a question. For example, 'Is enzyme activity affected by pH?'

Suggest a question that could have led to the research described above. 1

Does Smoking decrease the amount of exercise taking place?

(b) Name the type of graph that should be used to present the results shown in the table. 1

Bar graph

MARKS

10. (continued)

(c) Suggest one reason why the participants recording their own exercise is described as a limitation. 1

People may forget ~~their~~ how much exercise they did, People may of been inaccurate with their results Some may have lied.

(d) Three factors that could affect the results are age, duration of exercise and type of exercise.

Choose one of these factors.

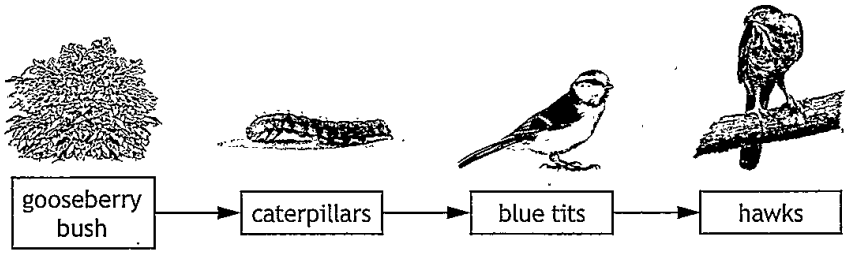
Describe how the study would be carried out to take the chosen factor into account and improve the validity of the results. 1

Factor Type of exercise

Description record all different types of exercise you will be carrying out before you ~~practise~~ proceed to do them.

MARKS

11. (a) The food chain represents the transfer of energy from organism to organism.



(i) Name the process carried out by the gooseberry bush that allows energy to enter the food chain. **1**

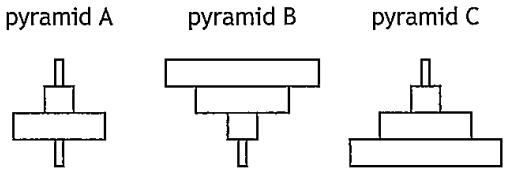
Transpiration

(ii) The blue tits are consumers.

Give another ecological term that describes the role of the blue tits in this food chain. **1**

Prey

(iii) A food chain can be shown as a pyramid of numbers.



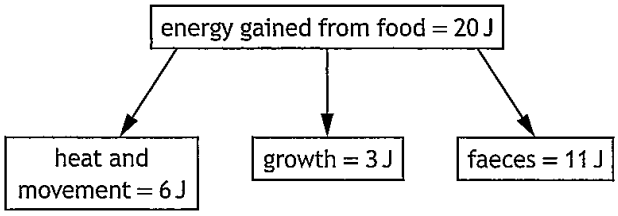
Identify which pyramid would be used to represent the food chain shown above. **1**

Pyramid C

MARKS

11. (continued)

(b) The diagram shows the fates of 20 joules (J) of energy gained by a caterpillar from food.



(i) Calculate the percentage of the caterpillar's energy intake that is used for growth. 1

Space for calculation

$\frac{3}{20} = 0.15 \times 100 = 15\%$

15 %

(ii) Tick one box to identify which of the fates allows energy to be passed onto the next level in the food chain shown. 1

☐ Heat and movement ☑ Growth ☐ Faeces

MARKS

12. Students carried out an investigation into the effect of soil moisture on the percentage ground cover of moss in their school lawn.

A quadrat was used to estimate the percentage ground cover of moss at several sites. Soil moisture was also measured at each of the sites.

The results of the investigation are shown in the table.

Sample site	Average soil moisture (%)	Ground cover of moss (%)
1	18	86
2	14	70
3	15	80
4	11	58
5	13	65
6	12	60
7	22	98
8	30	99
9	35	100

(a) Describe the relationship between average soil moisture and percentage ground cover of moss. 1

The higher the soil moisture, the larger the ground cover of moss

(b) Describe how the reliability of these results could be increased. 1

Go to other locations, not just school lawn. Take more samples for more accuracy.

MARKS

12. (continued)

(c) The students also used a soil thermometer to gather data on soil temperature at each of the sample sites.

(i) Describe what the students should have done each time they used the soil thermometer, to ensure valid results. 1

~~&~~ used the soil thermometer many times in the one area, used another thermometer to get accurate results.

(ii) Soil moisture and temperature are examples of abiotic factors.

Name **one** other abiotic factor that can affect plant growth. 1

~~Temperature~~ Temperature, light intensity

(d) (i) The students observed a species of lichen growing on some of the damper parts of the lawn.

Lichens are indicator species.

State what is meant by the term 'indicator species'. 1

Indicator Species ~~are~~ is the type of ~~type~~ species with an ecosystem.

(ii) Identify the sample site that would be least likely to contain this lichen. 1

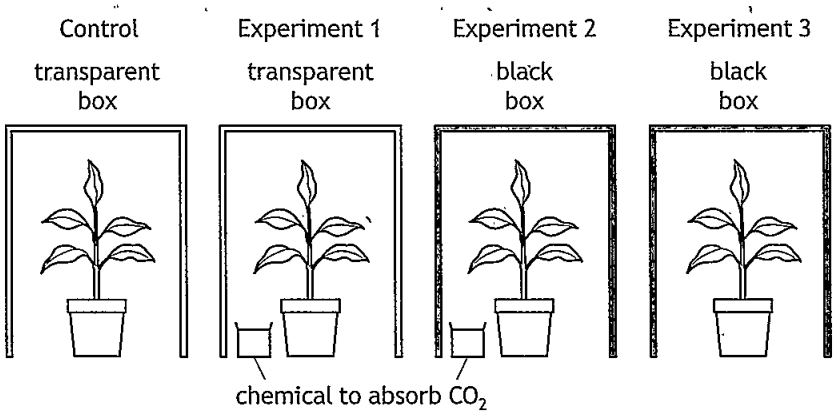
Sample site number 4

MARKS

13. An investigation was carried out into the conditions needed for photosynthesis.

Before starting the investigation, four plants were de-starched by placing them in the dark for 24 hours.

The plants were then placed in the conditions shown and then left for 48 hours.



The leaves of each plant were then tested for the presence of starch.

(a) (i) Tick the box(es) to show in which of the following starch would be present after 48 hours. 1

☑ Control ☒ Experiment 1

☒ Experiment 2 ☒ Experiment 3

(ii) Explain the purpose of the control. 1

Control is there to show that without any extra objects / substances added then it stays the same

(iii) Explain why experiment 2 is invalid. 1

Because both experiment one and 3 have everything experiment 2 has.

MARKS

13. (a) (continued)

(iv) State the factor that is being investigated in experiment 3. 1

Light intensity

(b) Name the product of carbon fixation that is converted to starch. 1

Sugar

MARKS

14. Antibiotic drugs are only effective in the treatment of bacterial infections. They either kill or prevent the growth of bacteria. Sometimes antibiotics are given but do not have any effect on the particular infection.

(a) The table gives information about the number of cases treated with antibiotics and the success rate for a range of infections.

Type of infection	Number of these cases treated with antibiotics (millions)	Number of these cases successfully treated with antibiotics (millions)	Success rate (%)
ear	23	16·1	70
common cold	18	0	0
chest	16	3·2	20
throat	15	7·2	48

(i) Complete the table by calculating the number of cases of throat infections successfully treated with antibiotics. 1

Space for calculation

15 x 48 = 720 ÷ 100 = 7·2

(ii) Antibiotics have no effect in the treatment of the common cold.

From the information given, suggest a reason why antibiotics have no effect on the pathogen that causes the common cold. 1

The common cold is a virus and is different everytime, the antibiotics have no effect on a virus

MARKS

14. (continued)

(b) The overuse of antibiotics has caused populations of antibiotic-resistant bacteria to evolve. The stages in their evolution are described in the table.

Stage	Description
A	Random mutations in bacteria make some of the bacteria antibiotic-resistant
B	The next generation of bacteria are antibiotic-resistant
C	The surviving bacteria reproduce and pass on the alleles for antibiotic resistance to their offspring
D	Bacterial populations show genetic variation
E	When antibiotics are used, the non-resistant bacteria are killed and the resistant bacteria survive

(i) Place letters from the table in the boxes, to show the order of the stages describing how populations of bacteria become resistant to antibiotics. 1

The first stage has been completed.

D ⟹ A ⟹ E ⟹ C ⟹ B

(ii) Name the process by which the bacteria, best adapted to their environment, survive and reproduce. 1

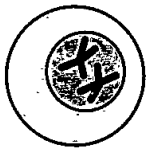
Natural Selection

(iii) Name an environmental factor that can increase the rate of mutation. 1

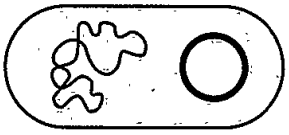
Natural pressures, ~~gamma rays~~ / environmental pressures

MARKS

15. Scientists use bacteria to act as host cells, to produce enzymes commercially by the process of genetic engineering.



source cell



bacterial cell

(a) Name the structure in the source cell from which the required gene is extracted during the first stage of this process. 1

plasmid

(b) Describe the stages of the process that would be used to produce genetically engineered bacteria, after the required gene has been extracted from the source cell. 4

required gene is extracted from cell, the bacteria cells plasmid is also Subtracted, the required gene from the source cell is then placed into the bacteria plasmid from where a section of the plasmid is removed for the required gene. this is then placed back into the bacteria produce fast. producing what the Scientist need e.g insulin