1. Galactosaemia is an inherited disorder that produces an inability to metabolise galactose. Babies with galactosaemia vomit soon after they have started to breast feed because of the production of metabolic toxins. If it is not treated it can result in mental retardation. The babies obtain the galactose because it is a sub-unit of lactose which is present in milk.

(a) (i) State the general formula for a disaccharide.

.....

(1)

(ii) Name the chemical process by which lactose is broken down into its constituent sub-units.

.....

(1)

(iii) State *one* chemical difference between lactose and maltose.

.....

(1)

(b) Suggest a simple treatment for a baby who has galactosaemia and give a reason for your answer.

.....

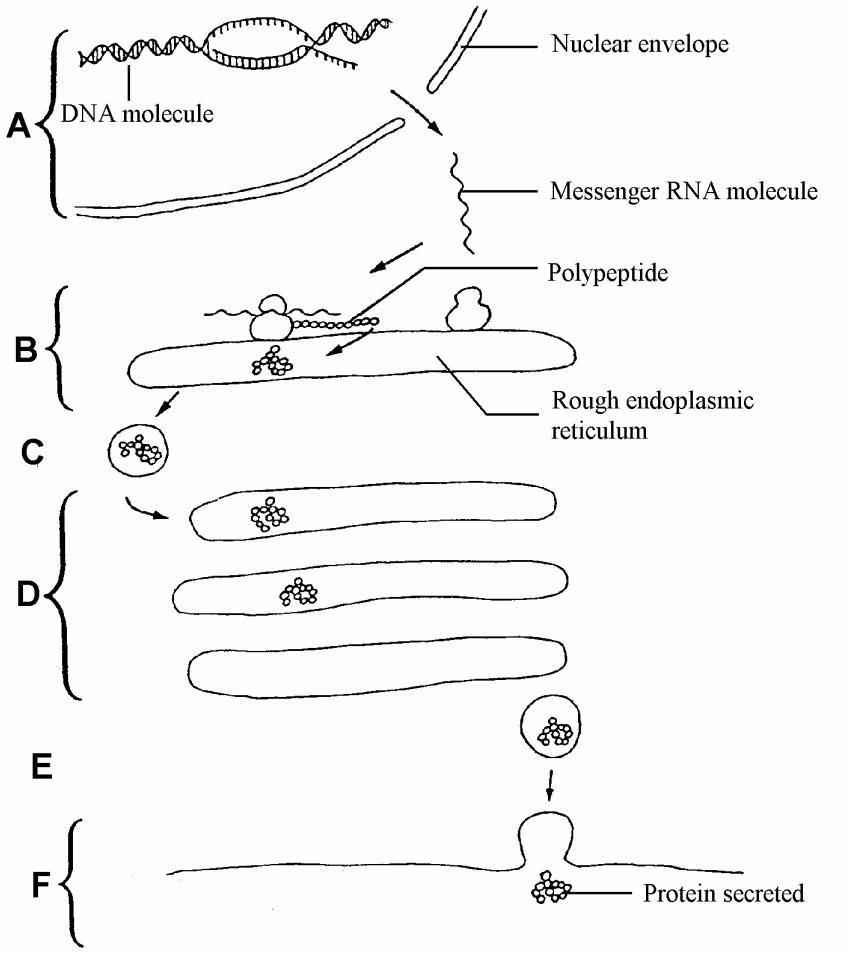
.....

.....

(2)

(Total 5 marks)

2. The diagram below shows some of the stages in protein synthesis and secretion in a mammalian cell.



(a) (i) Name the processes taking place during stages A and B.

A .....

B .....

(2)

(ii) Name the process by which protein is secreted in stage F.

(1)

(b) Describe the part played by transfer RNA in the formation of the polypeptide chain during stage B.

.....

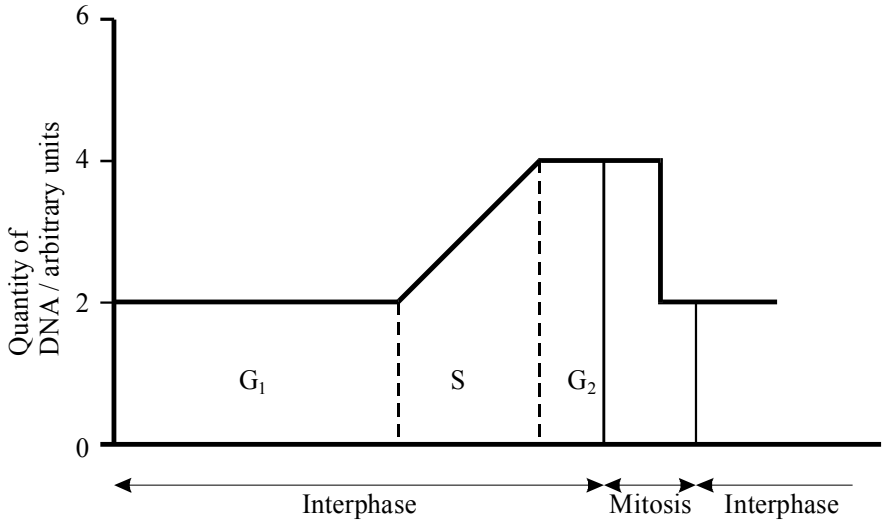
.....

.....

.....

(3)
(Total 6 marks)

3. The graph below shows how the quantity of DNA, measured in arbitrary units, varies with time during the different phases of the cell cycle in an animal cell.



(a) Interphase is made up of two growth phases, G_1 and G_2, separated by an intermediate phase, S.

(i) Explain what is happening within the cell during phase S.

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.....

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.....

(2)

(ii) State *one* process other than cell growth which occurs during phase G_2.

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(1)

(b) Account for the changes in the quantity of DNA in the cell during mitosis.

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(2)
(Total 5 marks)

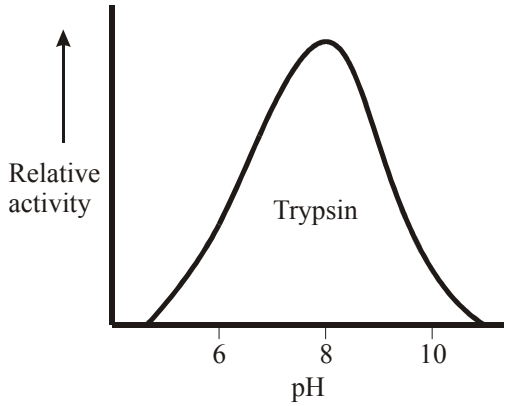
4. The table below refers to some features of prokaryotic and eukaryotic cells.

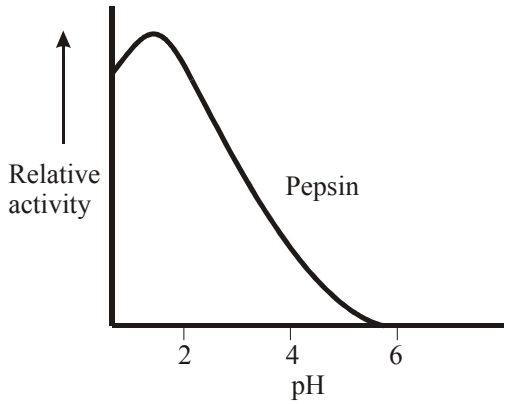
If the feature is present, place a tick (√) in the appropriate box and if the feature is absent, place a cross (***X***) in the appropriate box.

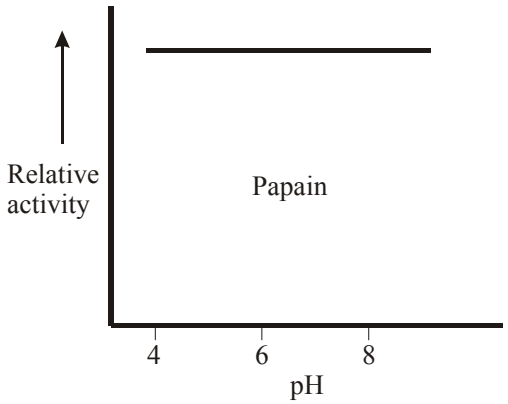
Feature	Prokaryotic cell	Eukaryotic cell
Nuclear envelope		
Cell surface membrane		
Ribosomes		
Microtubules		
Mitochondria		

(Total 5 marks)

5. The graphs below show the relationship between pH and the relative activity of three different protein digesting enzymes: trypsin, pepsin and papain.







(a) Explain why changes in pH usually affect the activity of the enzymes.

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(3)

(b) Comment on the effect of changes in pH on the activity of trypsin, pepsin and papain.

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(4)

(c) Which of these three enzymes would be most suitable to use as a meat tenderiser? Give an explanation for your answer.

.....

.....

.....

.....

(2)

(d) Rennin, an enzyme extracted from the stomach of calves, is used in the manufacture of cheese. Maxiren®, an enzyme similar to rennin, is produced by gene technology.

State *two* advantages of using Maxiren®, instead of rennin in cheese manufacture.

1 .....

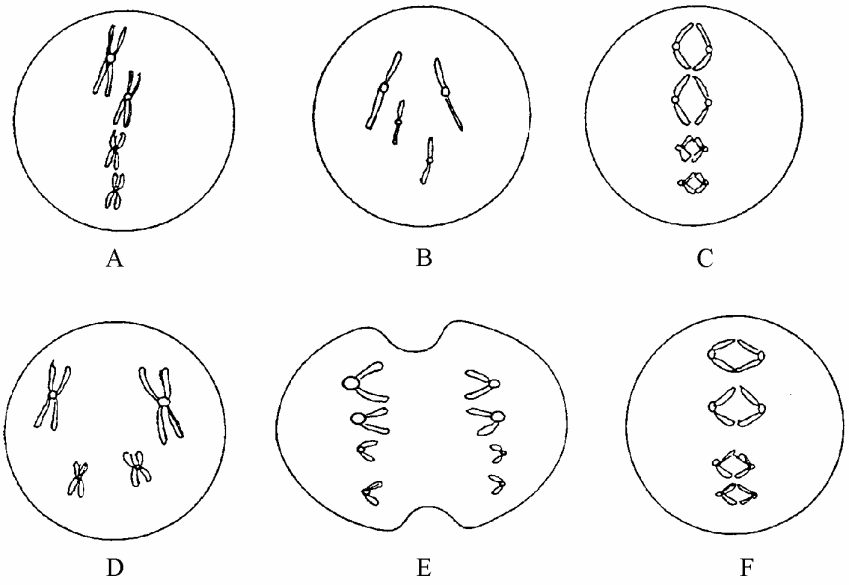
.....

2 .....

.....

(2)
(Total 11 marks)

6. (a) The diagrams below represent the chromosomes during stages in the process of mitosis.



Write the letters in the order that represents the sequence in which these stages occur.

.....

(1)

(b) State *two* ways in which meiosis differs from mitosis.

1 .....

.....

2 .....

.....

(2)

(c) Explain the significance of mitosis in living organisms.

.....

.....

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.....

.....

(3)

(Total 6 marks)

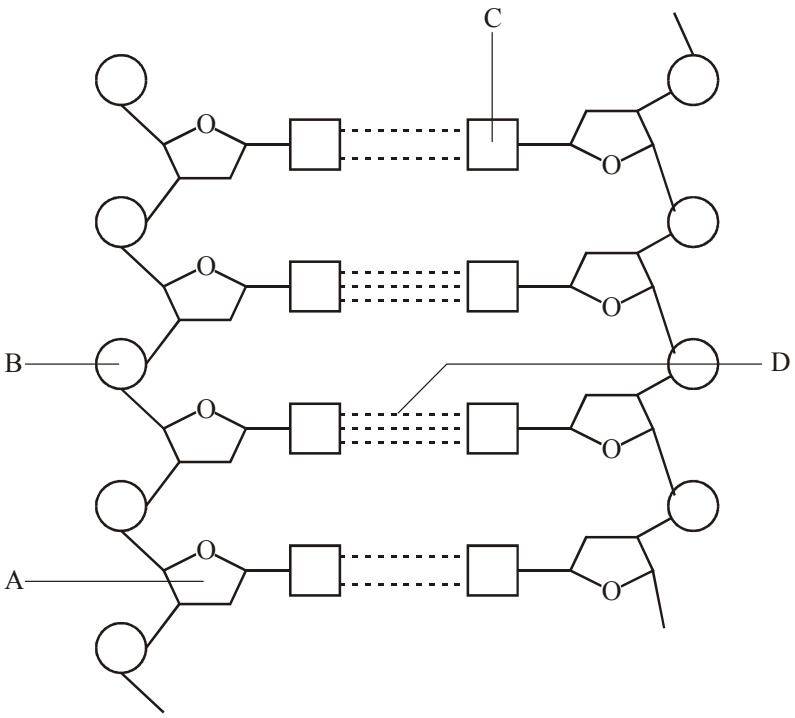
7. The table below refers to three organic compounds found in cell organelles.

If the compound is found in the organelle, place a tick (√) in the appropriate box and if the compound is not found in the organelle, place a cross (***x***) in the appropriate box.

Organelle	Phospholipid	DNA	RNA
Ribosome			
Chloroplast			
Smooth endoplasmic reticulum			
Mitochondrion			

(Total 4 marks)

8. The diagram below shows the structure of part of a molecule of deoxyribonucleic acid (DNA)



(a) Name the parts labelled A, B, C and D.

A .....

B .....

C .....

D .....

(4)

(b) (i) On the diagram, draw a ring around *one* nucleotide.

(1)

(ii) What type of chemical reaction is involved in the formation of a molecule of DNA from nucleotides?

.....

(1)

(Total 6 marks)

9. The diagram below shows part of a messenger RNA (mRNA) molecule.

(a) (i) How many codons are shown in this section of mRNA?

.....

(1)

(ii) What is specified by a sequence of codons in an mRNA molecule?

.....

(1)

(b) A tRNA molecule carries a complementary base sequence for a particular codon.

(i) Write the complementary sequence for the first codon in the mRNA sequence given above.

.....

(1)

(ii) Describe the role of tRNA molecules in the process of protein synthesis.

.....

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.....

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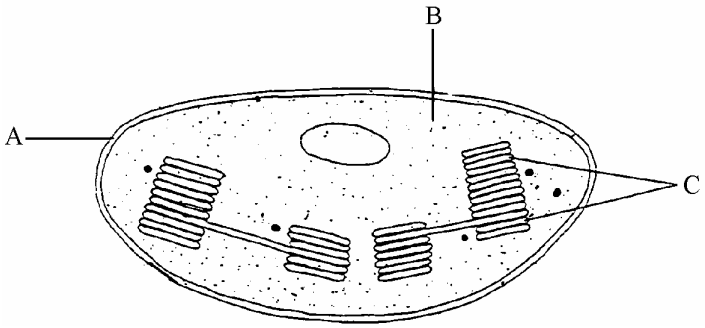
(3)
(Total 6 marks)

10. Give an account of the structure and functions of polysaccharides in living organisms.

(Total 10 marks)

11. The diagram below shows the structure of a chloroplast, as seen using the electron microscope.



(a) Name the parts labelled A, B and C.

A .....

B .....

C .....

(3)

(b) The actual length of this chloroplast is 2.5 μm. Calculate the magnification of this diagram. Show your working.

Answer .....

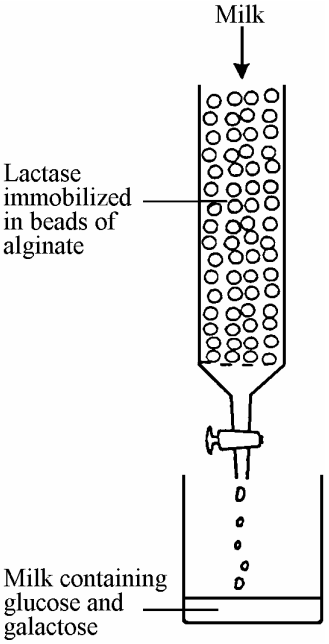
(2)
(Total 5 marks)

12. Some people become ill if they drink milk or milk products as they do not secrete the enzyme lactase in their intestine. This is known as lactose intolerance.

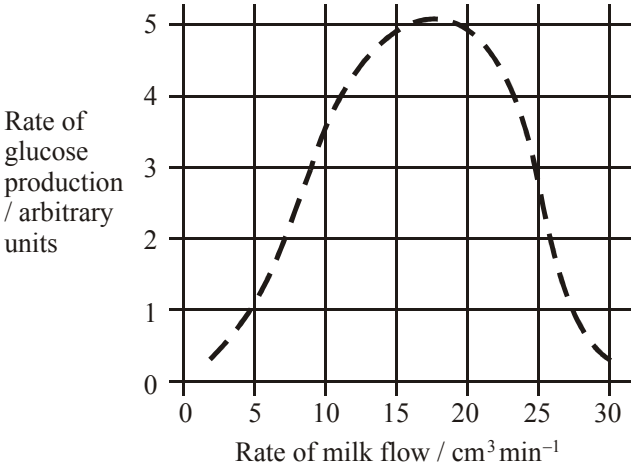
Lactose, present in milk, is converted to glucose and galactose by the action of the enzyme lactase.
In an investigation, milk was passed at different rates over lactase immobilised in beads of

sodium alginate. The rate of glucose production was measured at each flow rate.

The apparatus used is shown in the diagram below.



The results are shown in the graph below.



(a) (i) Describe the effect of the rate of flow of milk on the rate of glucose production.

.....

.....

.....

(2)

(ii) Suggest *two* reasons why variations in the rate of flow of milk should produce this effect.

1 .....

.....

2 .....

.....

(2)

(b) (i) Explain what is meant by *enzyme immobilisation.*

.....

.....

.....

(2)

(ii) Suggest *two* advantages of using immobilised enzymes in commercial processes.

1 .....

.....

2 .....

.....

(2)

(c) (i) Suggest why it may be advantageous to treat milk with lactase during the manufacture of dairy products.

.....

.....

.....

(2)

(ii) Suggest why most people with lactose intolerance only develop the illness after infancy.

.....

.....

.....

(1)

(Total 11 marks)

13. An experiment was carried out to determine the effect of temperature on the activity of an enzyme digesting the protein gelatin.

Gelatin was incubated with the enzyme at a range of temperatures from 5 °C to 60 °C. The rate of amino acid production was measured over a three-hour period.

The results are shown in the table below, expressed as rate of amino acid production in mg dm^{-3} h^{-1}

Temperature / ºC	Rate of production of amino acid / mg dm^{-3} h^{-1}
5	14
10	19
15	24
20	31
25	40
30	51
35	68
40	93
45	98
50	89
60	33

(a) (i) Plot the data on graph paper.

(4)

(ii) Comment on the effect of temperature on the activity of the enzyme as shown in the graph.

.....

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(3)

(b) The experiment was continued at 45 °C for a further 7 hours. At the end of this time, an additional 292 mg dm^{-3} of amino acid had accumulated.

(i) Calculate the mean rate of reaction during the 10 hours at 45 °C.

.....

(1)

(ii) Give *two* possible reasons for the difference between the rate at the end of 10 hours and the rate after 3 hours incubation.

1 .....

.....

2 .....

.....

(2)

(c) Protein-digesting enzymes can be used as an ingredient in biological washing powders.

Suggest how the results of this experiment could be used to design a suitable washing programme using a biological washing powder.

.....

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.....

(2)
(Total 12 marks)

14. An experiment was carried out to determine the effect of temperature on the activity of an enzyme digesting the protein gelatin.

Gelatin was incubated with enzyme at a range of temperatures from 5 °C to 60 °C. The rate of amino acid production was measured over a three-hour period.

The results are shown in the table below, expressed as rate of amino acid production in mg dm^{-3} h^{-1}

Temperature / ºC	Rate of production of amino acid / mg dm^{-3} h^{-1}
5	14
10	19
15	24
20	31
25	40
30	51
35	68
40	93
45	98
50	89
60	33

(a) (i) Plot the data on graph paper.

(4)

(ii) Comment on the effect of temperature on the activity of the enzyme as shown in the graph.

.....

.....

.....

.....

.....

(3)

(b) The experiment was continued at 45 °C for a further 7 hours. At the end of this time, an additional 292 mg dm^{-3} of amino acid had accumulated.

(i) Calculate the mean rate of reaction during the 10 hours at 45 °C.

.....

(1)

(ii) Give *two* possible reasons for the difference between the rate at the end of 10 hours and the rate after 3 hours incubation.

1 .....

.....

2 .....

.....

(2)

(c) Protein-digesting enzymes can be used as an ingredient in biological washing powders.

(i) Suggest how the results of this experiment could be used to design a suitable washing programme using a biological washing powder.

.....

.....

.....

.....

(2)

(ii) Suggest possible advantages of using biological washing powders rather than non-biological detergents.

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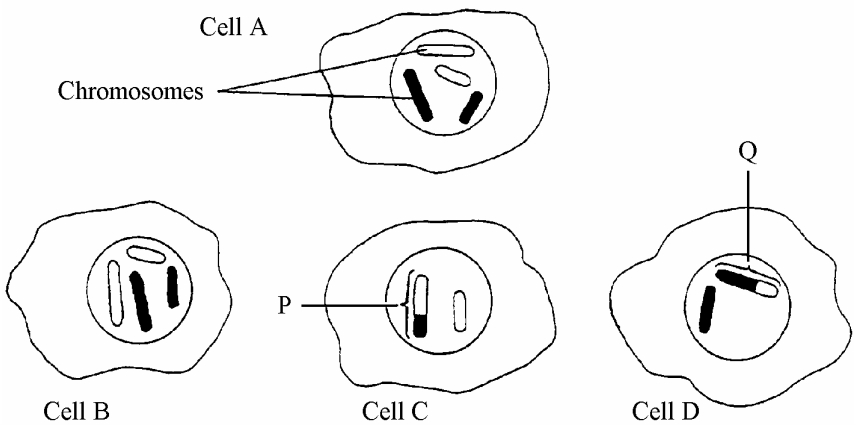
(2)

(Total 14 marks)

15. (a) Cell A in the diagram below has two pairs of chromosomes.

Cell B, C and D have each arisen from A by cell division.



(i) For each of the cells labelled B and C, identify the type of cell division which has occurred to produce the cell. In each case give a reason for your answer.

Cell B

Type of division .....

Reason .....

Cell C

Type of division .....

Reason .....

(2)

(ii) Explain the reasons for the difference between the parts labelled P and Q in cells C and D.

.....

.....

.....

.....

.....

(3)

(b) State *one* way in which oogenesis differs from spermatogenesis.

.....

(1)

(c) State *two* ways in which embryo development in flowering plants differs from embryo development in humans.

1 .....

.....

2 .....

.....

(2)

(Total 8 marks)

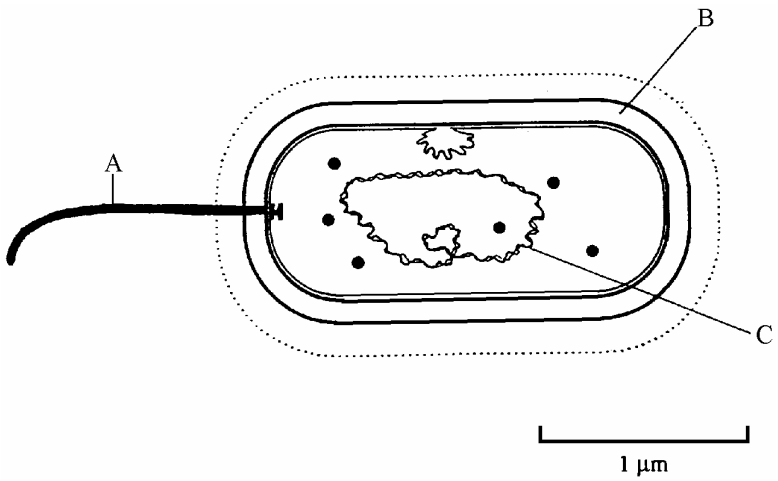
16. The table below refers to components of the cell surface membrane (plasma membrane) and to their roles in transporting substances across the membrane.

Complete the table by inserting an appropriate word or words in the empty boxes.

Component	Subunits	Chemical bond between subunits	Role in transport
Phospholipid	Fatty acids, glycerol and phosphate		
Carbohydrate side chain			Receptor
Protein		Peptide	

(Total 6 marks)

17. The diagram below shows the structure of a bacterial cell as seen using an electron microscope.



(a) Name the parts labelled A, B and C

A .....

B .....

C .....

(3)

(Total 3 marks)

18. Read through the following passage on the cell cycle and mitosis, then write on the dotted lines the most appropriate word or words to complete the passage.

In the cell cycle, replication of DNA takes place during .....

At the beginning of prophase the chromosomes become visible and can be seen to consist

of two .....joined at the ..... .

The ..... and nuclear membrane disappear and a spindle

develops in the cell.

The chromosomes become attached to the spindle at the equator during

..... . At anaphase one copy of each chromosome is pulled

towards each ..... of the spindle. The final phase, called

telophase, involves the formation of two new nuclei. In plant cells the two daughter

cells are separated by the formation of a ..... .

(Total 7 marks)

19. The monosaccharides glucose and fructose are *reducing sugars*. Sucrose is a disaccharide which is not a reducing sugar.

The Benedict's test is used to detect reducing sugars. When reducing sugars are boiled with Benedict's solution a red precipitate is produced. This precipitate can be filtered from the solution, dried and weighed. If excess Benedict's solution is used, the mass of precipitate produced is proportional to the concentration of reducing sugar in the solution. The enzyme sucrase is a hydrolase and does not reach with Benedict's solution.

(a) In an experiment, sucrase was added to a solution of sucrose and incubated for five minutes. The Benedict's test was then carried out on the resulting solution and a red precipitate was produced.

Suggest an explanation for this result.

.....

.....

.....

(2)

(b) A further experiment was carried out to investigate the effect of silver nitrate on the activity of sucrase. The procedure described above was repeated, but different concentrations of silver nitrate were added to the sucrase. The solutions were kept at the same pH for the same time. The mass of precipitate produced by the Benedict's test at each concentration was measured. The results are shown in the table below.

Concentration of silver nitrate / mol dm^{-3}	Mass of precipitate / mg
0 (control)	50
10^{-6}	37
10^{-5}	27
10^{-4}	10

(i) Calculate the percentage decrease in the mass of precipitate produced in the solution containing 10^{-5} mol dm^{-3} silver nitrate compared with the control test. Show your working.

Answer .....

(2)

(ii) Suggest an explanation for the effect of the silver nitrate solution on the activity of the enzyme sucrase.

.....

.....

.....

(2)

(c) (i) Explain why it is important to maintain constant pH when investigating enzyme activity.

.....

.....

.....

(2)

(ii) State *three* precautions, other than maintaining constant pH, which should be taken to produce reliable results in the above investigation.

1 .....

.....

2 .....

.....

3.....

(3)

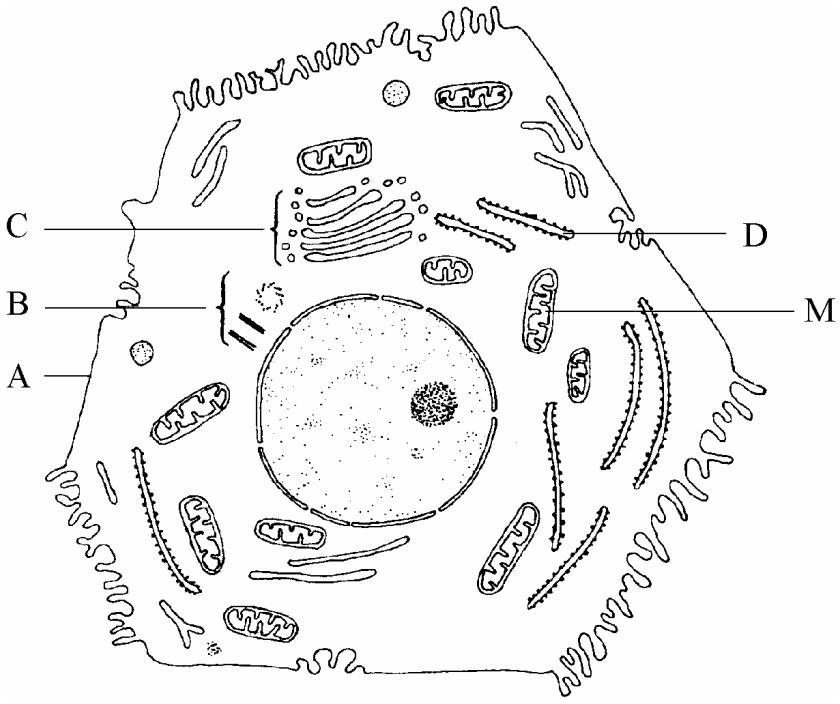
(Total 11 mark)

20. Read through the following passage about enzymes and their industrial uses, then write on the dotted lines the most appropriate word or words to complete the account.

As much as 75% of the world's adult population maybe unable to tolerate and digest the sugar in milk, and so this sugar is removed during the manufacture of some milk products. This is done using the enzyme ..... ; which hydrolyses the milk sugar into ..... and ..... . Unlike the sugar in milk, these are both ..... sugars. They are both ..... than milk sugar, so milk products treated in this way are particularly useful in the manufacture of confectionery.

(Total 5 marks)

21. The diagram below shows the structure of a liver cell as seen using an electron microscope.



(a) Name the parts labelled in A, B, C and D.

A .....

B .....

C .....

D .....

(4)

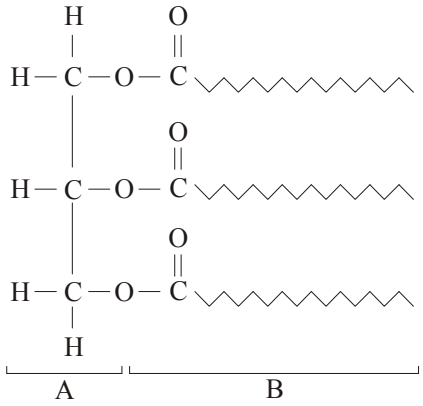
(b) The magnification of this diagram is × 12 000. Calculate the actual length of the mitochondrion labelled M, giving your answer in μm. Show your working.

Answer .....

(2)

(Total 6 marks)

22. The diagram below shows the structure of a lipid molecule.



(a) (i) Name the parts labelled A and B.

A .....

B .....

(2)

(ii) Name this type of lipid.

.....

(1)

(iii) Name the chemical reaction used to form the bonds between A and B.

.....

(1)

(b) (i) State *one* function of this type of lipid in living organisms.

.....

(1)

(ii) State *one* feature of the molecules of this type of lipid which makes them suitable for the function you have given.

.....

(1)

(Total 6 marks)

23. The statements in the table below refer to three polysaccharide molecules. If the statement is correct, place a tick (√) in the appropriate box and if the statement is incorrect, place a cross (***x***) in the appropriate box.

Statement	Starch	Glycogen	Cellulose
Polymer of α – glucose			
Glycosidic bonds present			
Unbranched chains only			
Energy store in animal cells			

(Total 4 marks)

24. Give an account of the factors affecting enzyme activity.

(Total 10 marks)

25. Write an essay on the following topic:

The structure and functions of cell surface membranes.

(15)

26. Read the following passage about the palisade cells of a leaf and write on the dotted lines the most appropriate word or words to complete the passage.

The palisade cell is typical of plant cells in that it has three structures,

..... , ... and

....., none of which is present in animal cells. In common

with animal cells, plant cells (such as palisade cells) have membrane-bound organelles

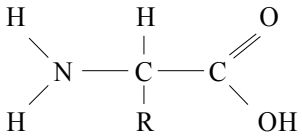
which are not present in..... cells. In a leaf, palisade cells are

grouped together as a layer just below the epidermis forming a

....., the function of which is to carry out photosynthesis.

(Total 5 marks)

27. Polypeptides are synthesised from amino acids. The diagram below shows the molecular structure of an amino acid.



(a) (i) In the space below, draw a molecular diagram to show how this amino acid reacts with another amino acid to produce a dipeptide.

(3)

(ii) Name the type of reaction involved.

.....

(1)

(b) State *two* functions of the R groups in a polypeptide chain.

1 .....

.....

2 .....

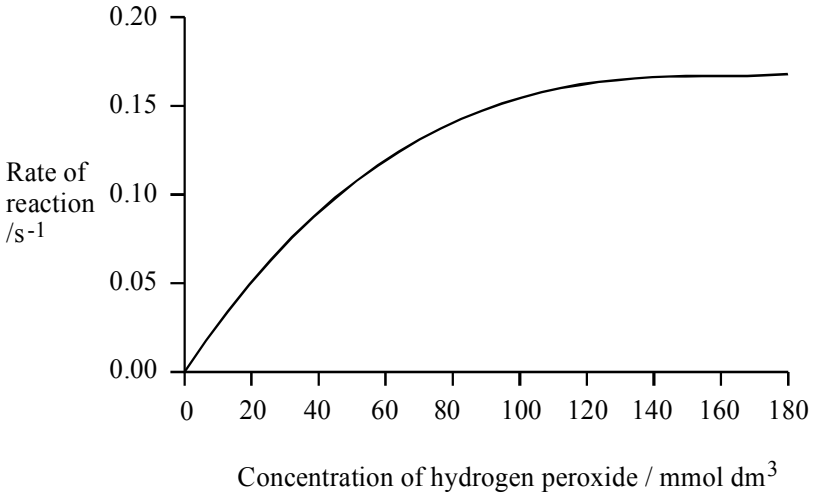
.....

(2)
(Total 6 marks)

28. Catalase is an enzyme which breaks down hydrogen peroxide into oxygen and water. The activity of catalase can be measured by soaking small discs of filter paper in a solution containing the enzyme. The discs are immediately submerged in a dilute solution of hydrogen peroxide. The filter paper discs sink at first but float to the surface as oxygen bubbles are produced. The reciprocal of the time taken for the discs to rise to the surface indicates the rate of reaction.

An experiment was carried out to investigate the effect of substrate concentration on the activity of catalase. A filter paper disc was soaked in a solution containing catalase, and then submerged in a buffer solution containing hydrogen peroxide. The time taken for the disc to rise to the surface was recorded. This experiment was repeated using a range of concentrations of hydrogen peroxide.

The results are shown in the graph below.



(a) State why a buffer solution was used in this experiment.

.....

(1)

(b) (i) Describe the relationship between the rate of reaction and the concentration of hydrogen peroxide as shown by the graph.

.....

.....

.....

.....

.....

(3)

(ii) Explain this relationship between substrate concentration and the rate of reaction.

.....

.....

.....

.....

.....

(3)

(c) Describe how a solution containing 160 mmol of hydrogen peroxide per dm^3 would be diluted to prepare a solution containing 80 mmol of hydrogen peroxide per dm^3.

.....

.....

.....

(2)

(d) Describe how this experiment could be modified to investigate the effect of temperature on the activity of catalase.

.....

.....

.....

.....

.....

.....

.....

(4)
(Total 13 marks)

29. Read through the following passage on the use of enzymes in the extraction of juice from fruit, then write on the dotted lines the most appropriate word or words to complete the account.

Enzymes made by microorganisms may be used in commercial processes. In order to speed up the extraction of juice from fruit, enzymes called..... are used. The fruit is first.....and then the enzymes are added to break down the.....present in the .....These enzymes help to make the extracted juice .....

(Total 5 marks)

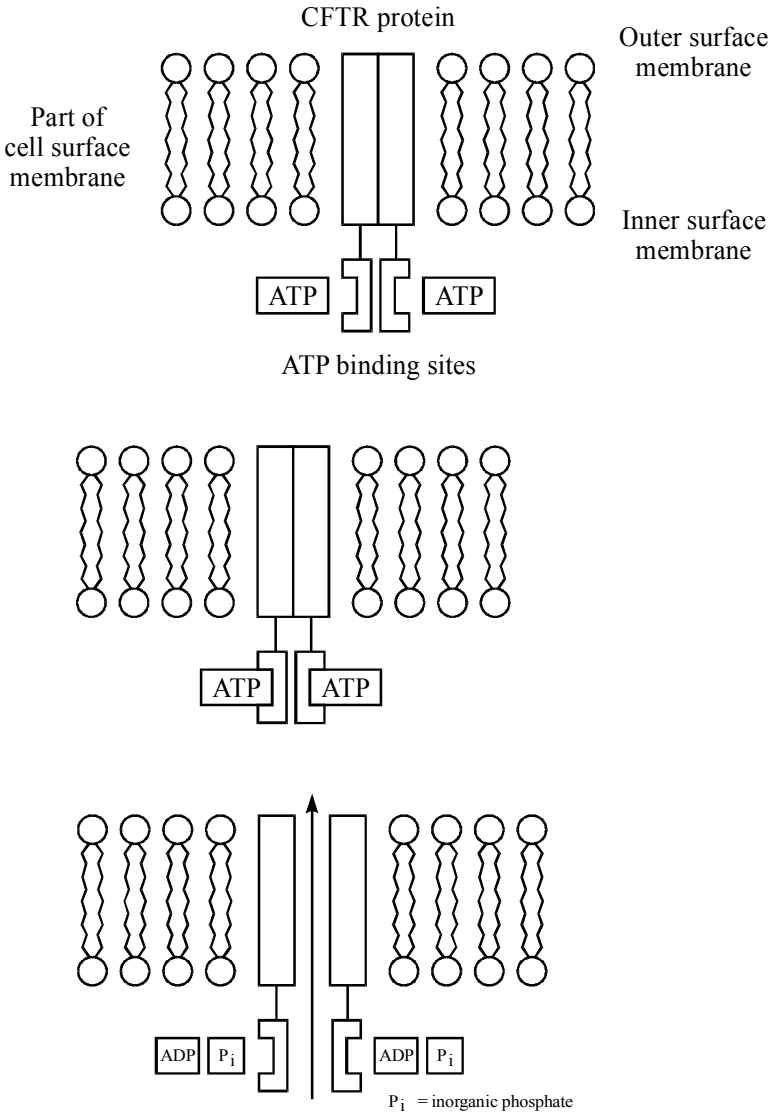
30. Write an essay on the following topic.

The factors affecting enzyme activity *(Bio, HBio)*

(Total 15 marks)

31. Cystic fibrosis is a genetic disorder caused by a mutation in the gene which codes for a protein known as the CFTR protein. This protein is involved in the transport of chloride ions through the cell surface membrane.

The diagram below shows how the normal CFTR protein is believed to function in the cell surface membrane.



(a) (i) Describe the sequence of events that takes place when ATP is present.

(3)

(ii) What is the function of ATP in this sequence of events

(1)

(b) One symptom of cystic fibrosis is the production of very sticky, thick mucus which cannot easily be moved. This occurs particularly in the lungs, pancreas and testes.

Suggest an explanation for each of the following.

(i) Many people affected by cystic fibrosis suffer from repeated lung infections.

(1)

(ii) Reduced ability to digest starch in the small intestine is common among people affected by cystic fibrosis

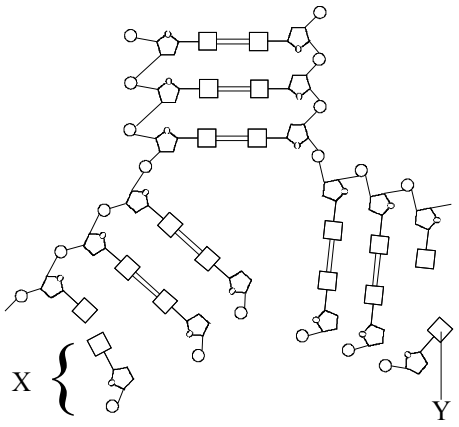
(1)

(iii) 95% of males affected by cystic fibrosis are infertile

(1)

(Total 7 marks)

32. The diagram below shows the process of DNA replication.



(a) Name the parts labelled X and Y.

X ……

Y ……

(2)

(b) Name *one* enzyme involved in DNA replication and state the type of reaction it catalyses.

Enzyme ……

Reaction ……

(2)

(c) Suggest why DNA replication is described as *semi-conservative*.

……

……

(1)

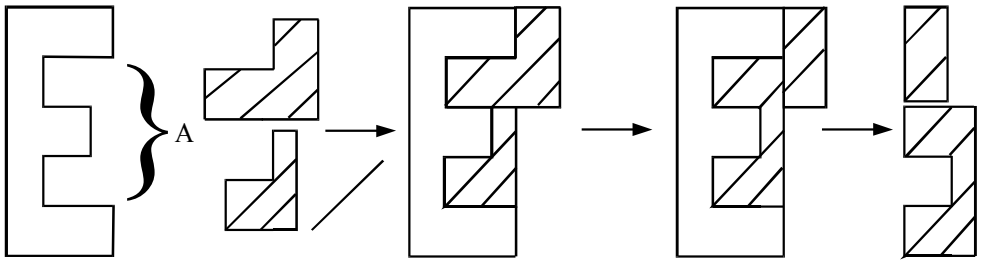
(d) Name the stage of the cell cycle during which DNA replication occurs.

……

(1)

(Total 6 marks)

33. The diagrams below illustrate one model of enzyme action.



(a) Name the part of the enzyme labelled A.

……

(1)

(b) Explain how this model can account for enzyme specificity.

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(2)

(c) With reference to this model, explain the effect of a competitive inhibitor on an enzyme-catalysed reaction.

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……

(2)

(Total 5 marks)

34. The table below refers to *two* organic molecules.

If the statement is correct for the molecule, place a tick (√) in the appropriate box. If it is incorrect, place a cross (***X***) in the appropriate box.

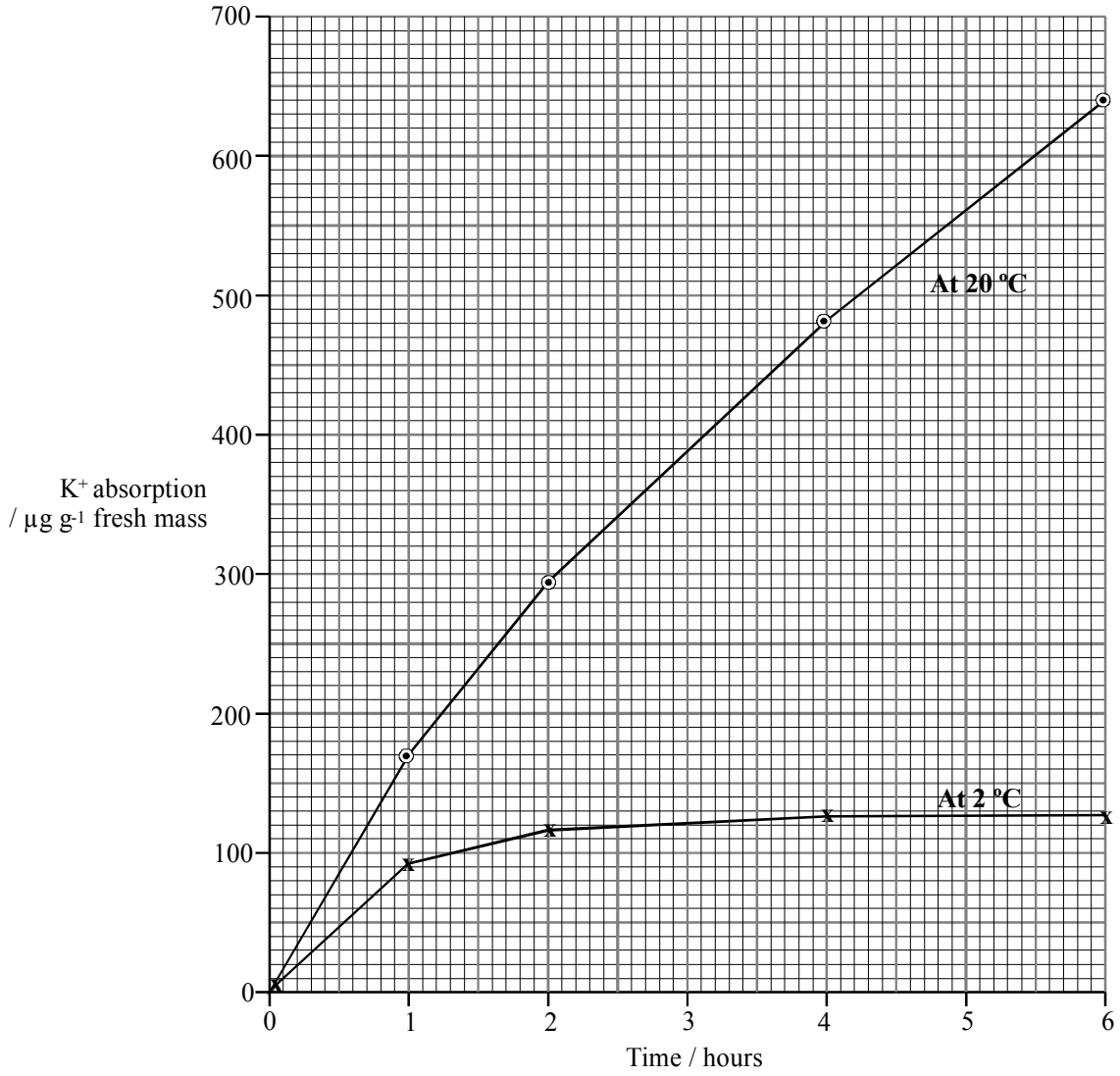
Statement	Triglyceride	Glycogen
Contains only carbon hydrogen and oxygen		
Glycosidic bonds present		
Soluble in water		
Provides storage of energy		
Occurs in flowering plants and animals		

(Total 5 marks)

35. An experiment was carried out with cells of carrot tissue to determine the effect of temperature on the absorption of potassium ions.

Slices of carrot tissue were immersed in a potassium chloride solution of known concentration. The changes in concentration of potassium ions in the solution were determined at intervals for 6 hours. From these measurements, the mass of potassium ions taken in by the carrot cells was found. The experiment was carried out at 2°C and 20°C. The solutions were aerated continuously.

The results are shown in the graph below. Absorption of potassium ions is given as micrograms of potassium per gram of fresh mass of carrot tissue (μg g^{-1}).



(a) During the first hour, some of the potassium ions enter the cells by diffusion. State *two* conditions which are necessary for a substance to enter a cell by diffusion.

1 ……

……

2 ……

……

(2)

(b) (i) Calculate the mean rate of absorption of potassium ions at 20°C, between 2 and 6 hours. Show your working.

Answer .....

(3)

(ii) Compare the rates of absorption of potassium ions at 2°C and 20°C during this experiment.

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(3)

(iii) Suggest an explanation for the differences in the rates of absorption of potassium ions at the two temperatures.

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(3)
(Total 11 marks)

36. Give an account of the process of mitosis.

(Total 10 marks)

37. Human Biology

Haemoglobin in mammals is made up of four polypeptide chains, two identical α chains and two identical β chains. The sequence of amino acids in these chains has been determined for a number of different mammals.

Table 1 below shows a sequence of fifteen amino acids in an β chain from four different primates: a chimpanzee, a human, a gorilla and an orang-utan.

Table 1

Primate	Amino acid sequence
Chimpanzee	K A A W G K V G A H A G E Y G
Gorilla	K A A W G K V G A H A G D Y G
Human	K A A W G K V G A H A G E Y G
Orang-utan	K T A W G K V G A H A G D Y G

Key: A = alanine D = asparagine E = glutamic acid G = glucine H = histidine
K = lysine T = threonine V = valine W = tryptophan Y = tryrosine

(a) (i) What differences are there between the amino acid sequence for the orang-utan and the chimpanzee?

….

….

(1)

(ii) Name *one* other pair of primates in the table in which there is a difference in the amino acid sequence.

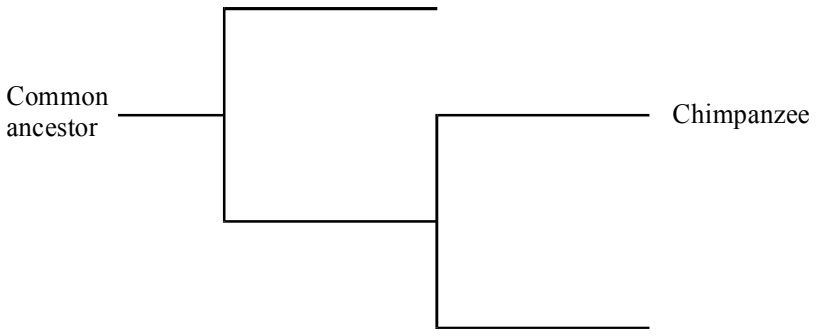
….

….

(1)

(b) Comparisons of amino acid sequences have been used to determine evolutionary (phylogenetic) relationship in the primates.

(i) Using evidence given in Table 1, complete the evolutionary tree diagram below to show the possible evolutionary relationship between chimpanzees, gorillas, humans and orang-utans.



(3)

(ii) Give two ways in which the data in Table 1 support your suggested evolutionary relationship.

1 ……

…..……

2 ……

…..……

(2)

(c) When human blood serum is injected into a rabbit, the rabbit produces antibodies against human serum proteins. When blood serum from humans and other mammals is mixed with rabbit serum containing these antibodies, precipitation occurs.

Table 2 below shows the percentage precipitation when this rabbit serum was mixed with serum from a human, a gibbon, a spider monkey and a hedgehog.

Table 2

Mammal	Percentage precipitation
Human	100
Gibbon	79
Spider monkey	58
Hedgehog	17

What do these data suggest about the phylogenetic relationship of the four mammals in Table 2?

…..……..

…..……..

…..……..

(2)

(d) (i) Describe how fossils can be used to provide evidence for human evolution.

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(3)

(ii) Give *one* disadvantage of the use of fossils in providing evidence for human evolution.

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(1)

(Total 13 marks)

38. Write an essay on the following.

Lipids in living organisms

(20)

39. Write an essay on the following.

Lipids in humans

(Total 20 marks)

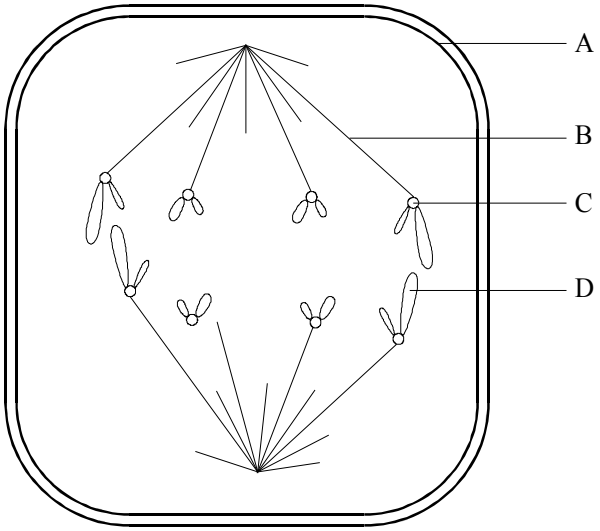
40. The table below refers to features of prokaryotic and eukaryotic cells.

If the feature is present place a tick (√) in the appropriate box and if the feature is absent, place a cross (***X***) in the appropriate box.

Feature	Prokaryotic cell	Eukaryotic
Endoplasmic reticulum		
Mesosome		
Ribosomes		
Golgi apparatus		

(Total 4 marks)

41. The diagram below shows a plant cell which is undergoing mitosis.



(a) name the parts labelled A, B, C, and D.

A ……

B ……

C ……

D ……

(4)

(b) Name the stage of mitosis shown in this diagram.

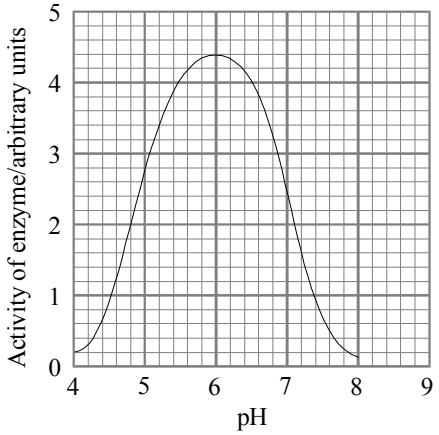
……

(1)

(Total 5 marks)

42. Glucose oxidase is an enzyme which catalyses the oxidation of glucose from gluconic acid and hydrogen peroxide.

An experiment was carried out to investigate the effect of pH on the activity of glucose oxidase. The activity of this enzyme was determined at a range of pH values. The results are shown in the graph below.



(a) (i) State how the different pH values could be obtained in this experiment.

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……

(1)

(ii) Describe the effect of changes in pH on the activity of this enzyme.

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……

……

(2)

(iii) Explain why changes in pH affect the activity of enzymes.

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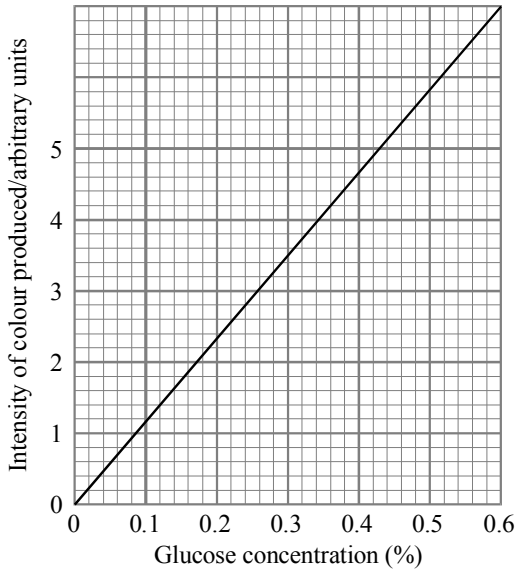
……

(3)

(b) Glucose oxidase with another enzyme, peroxidase, can be used to measure the concentration of glucose in solutions.

The solution to be tested is first incubated with glucose oxidase, and then with peroxidase, plus an indicator which changes colour when it is oxidised. Peroxidase breaks down the hydrogen peroxide formed by glucose oxidase, and simultaneously changes the colour of the indicator.

The intensity of the colour produced is directly proportional to the concentration of glucose in the solution, as shown in the graph below.



(i) From the graph, determine the concentration of glucose corresponding to a colour intensity of 6.5 arbitrary units.

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(1)

(ii) Describe how this method could be used to compare the concentration of glucose in two samples of fruit juice.

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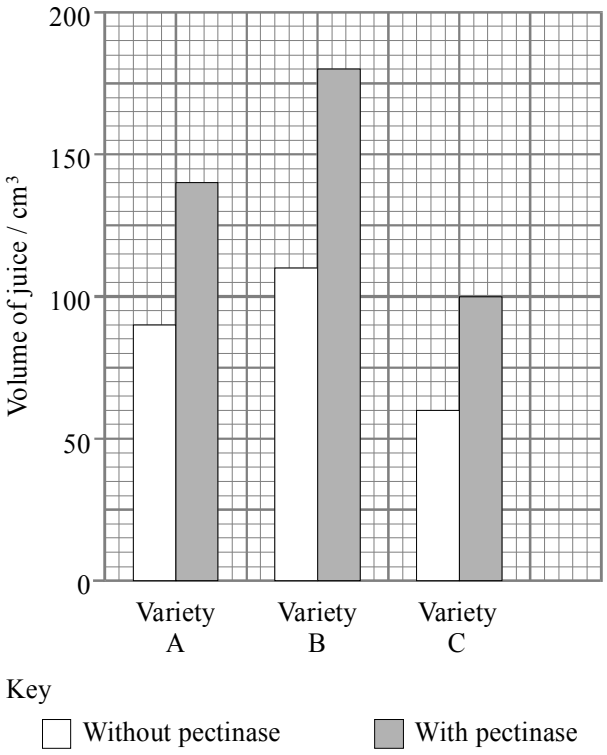
(4)

(Total 11 marks)

43. Give an account of the biological significance of polysaccharides.

(Total 10 marks)

44. A comparison was made between the volume of juice which could be extracted from the same mass of three varieties of apples, with and without pectinase. In this comparison, the same mass of pectinase was added to apples from each variety. The results are shown in the graph below.



(a) (i) Calculate the percentage difference in volume of the juice extracted without pectinase from variety A compared to the volume extracted from variety C. Show your working.

Answer ……

(3)

(ii) Explain the effect of the use of the pectinase on the volume of juice extracted from the apples.

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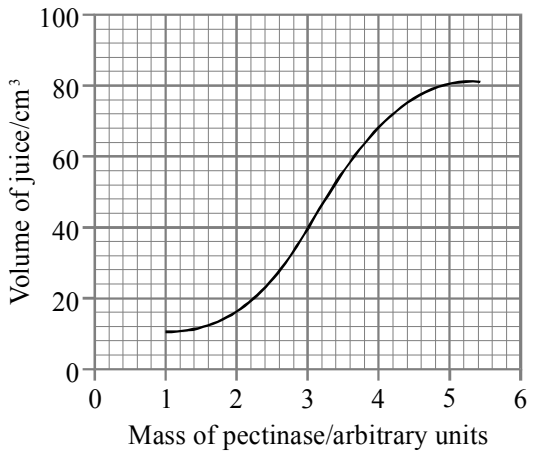
(2)

(b) The effect of increasing the mass of the pectinase used on the volume of juice extracted was then investigated.

The results are shown in the graph below.



Using the information available from both graphs, suggest how a manufacturer of apple juice could make use of these results.

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(3)

(c) Suggest *two* factors, other than apple variety and use of pectinase, which could affect the extraction of juice from apples.

1 ……

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2 ……

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(2)

(Total 10 marks)

45. Write an essay on the following topic.

The roles of RNA in protein synthesis (*Bio, Hbio*)

(Total 15 marks)

46. Write an essay on the following.

The movement of molecules and ions through membranes

(Total 20 marks)

47. The table below gives descriptions of organelles found in eukaryotic cells. Complete the table by writing the name of each organelle in the spaces provided.

Description	Name of organelle
Usually rod–shaped, 1 μm wide and up to 7 μm long; have a double membrane; the inner membrane is folded to form cristae	
Rounded organelle approximately 25 nm in diameter; consist of RNA and protein	
Disc–shaped structure, about 1 μm wide and up to 5 μm long; contains a system of thylakoids	
Hollow cylindrical structure, consist of nine triplets of microtubules	
Contains the genetic material of a cell; surrounded by a double membrane	

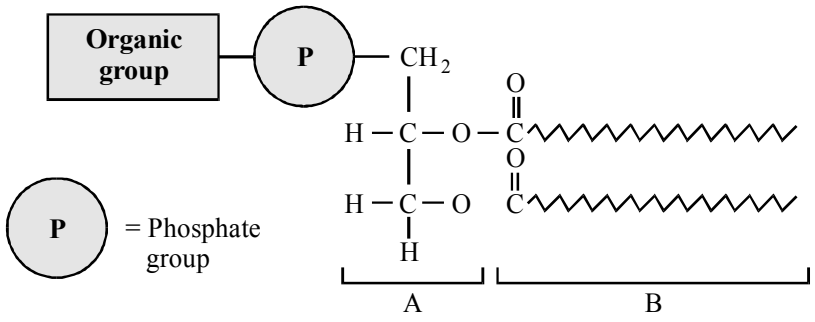
(Total 5 marks)

48. Read through the following passage about enzymes, then write on the dotted lines the most appropriate word or words to complete the passage.

Enzymes are globular proteins which act as biological catalysts. An individual enzyme will usually catalyse a single type of chemical reaction between particular substrates. This property of enzymes, which is referred to as ..... is due to the presence in the enzyme molecule of a region called the ..... which temporarily binds to the substrate. If the shape of the enzyme molecule is altered, as occurs when it is denatured by ....., the catalytic activity is lost. Binding with ..... instead of the substrate can also slow down the rate of reaction. Enzymes which catalyse similar reactions are grouped under common names. For example, enzymes which catalyse the transfer of electrons between different substrates are known as .....

(Total 5 marks)

49. The diagram below shows the general structure of a phospholipid.



(a) (i) Name the parts labelled A and B.

A .....

B .....

(2)

(ii) Name the type of reaction by which the bonds between parts A and B may be broken.

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(1)

(b) Phospholipids are major components of cell membranes. Explain how the properties of phospholipids are important in membrane formation.

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(3)
(Total 6 marks)

50. An experiment was carried out to determine what happens to amino acids after they are absorbed by animal cells. The cells were incubated for 5 minutes in a medium containing radioactively labelled amino acids. The radioactive amino acids were then washed off and the cells were incubated in a medium containing only non–radioactive amino acids.

Samples of the cells were taken at 5, 10 and 45 minutes after the start of the experiment and the sites of radioactivity in the cells were determined.

The results are given in the table below. The figures show radioactivity in certain cell organelles expressed as a percentage of the total radioactivity within the cells.

Organelle	Percentage of total radioactivity		
	At 5 minutes	At 10 minutes	At 15 minutes
Rough endoplasmic reticulum	80	10	5
Golgi apparatus	10	80	30
Secretory vesicles	0	5	60

(a) (i) Name *one* type of molecule synthesised from amino acids in cells.

.....

(1)

(ii) Explain why the radioactivity is associated mainly with the rough endoplasmic reticulum after the first 5 minutes of the experiment.

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(2)

(iii) Explain the changes in the pattern of radioactivity in the cell during the remaining 40 minutes of the experiment.

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(3)

(iv) Suggest why the totals in the tables are less than 100%.

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(2)

(b) If the experiment is continued for a further period of time, most of the radioactivity will be found outside the cell.

Name and describe the process which brings about this result.

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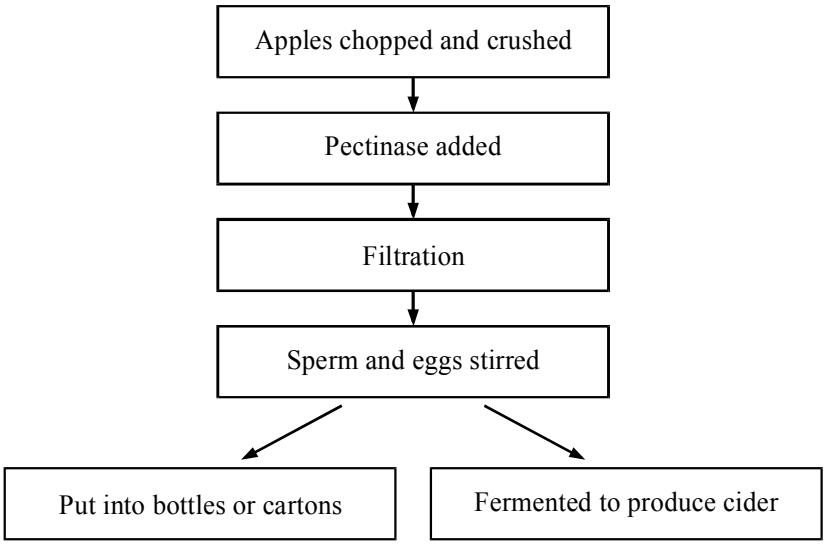
.....

(3)
(Total 11 marks)

51. Give an account of the structure and replication of deoxyribonucleic acid (DNA).

(Total 10 marks)

52. The diagram below shows some stages in the production of fresh apple juice.



(a) Explain why the apples are chopped and crushed.

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(2)

(b) Explain the effect of adding pectinase to the chopped and crushed apples.

.....

.....

.....

(2)

(c) Suggest why pectinase may also be added after filtration.

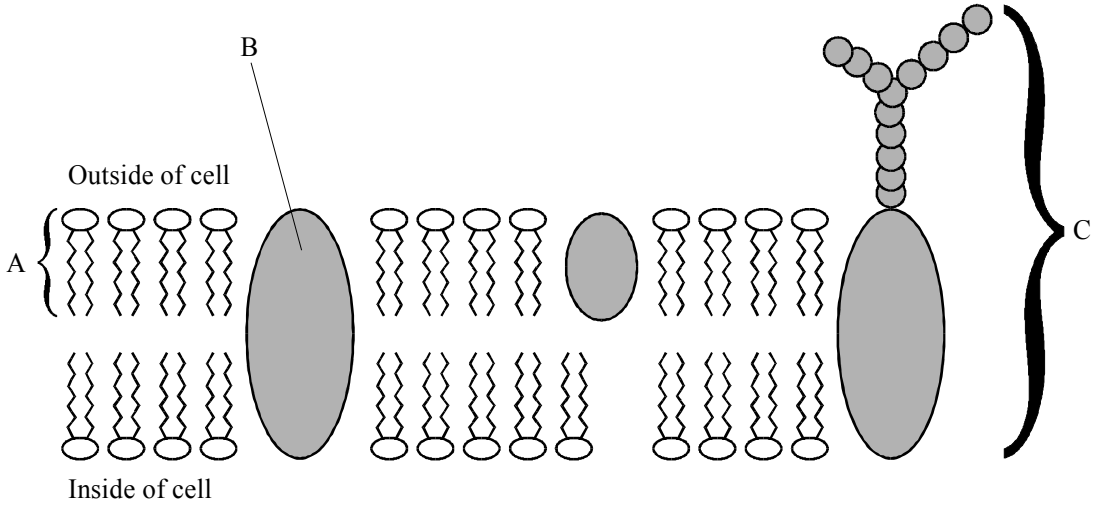
.....

.....

(2)

(Total 6 marks)

53. The diagram below represents the structure of part of the cell surface membrane.



(a) Name the molecules labelled A, B and C.

A ……

B ……

C ……

(3)

(b) Describe *one* function of part C.

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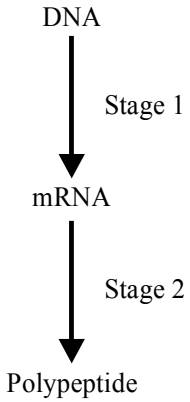
(2)
(Total 5 marks)

54. Read through the following account of compounds used for energy storage in cells, then write on the dotted lines the most appropriate word or words to complete the account.

Water is the universal …….. in living organisms. Molecules which dissolve easily in water can produce osmotic effects. A high concentration of small, soluble molecules within a cell can cause water to .....…….. the cell. This effect is reduced if the molecules used for storage in a cell are …….. . Therefore energy storage compounds are usually either polysaccharides or …….. . Examples of storage polysaccharides include starch and …….. Starch is found mainly in …….. cells.

(Total 6 marks)

55. The diagram below outlines protein synthesis in a cell.



(a) Name stages 1 and 2.

Stage 1 …..……..

Stage 2 ..……..

(2)

(b) Where does stage 2 take place within a cell?

…….

(1)

(c) Describe the role of tRNA in stage 2.

……

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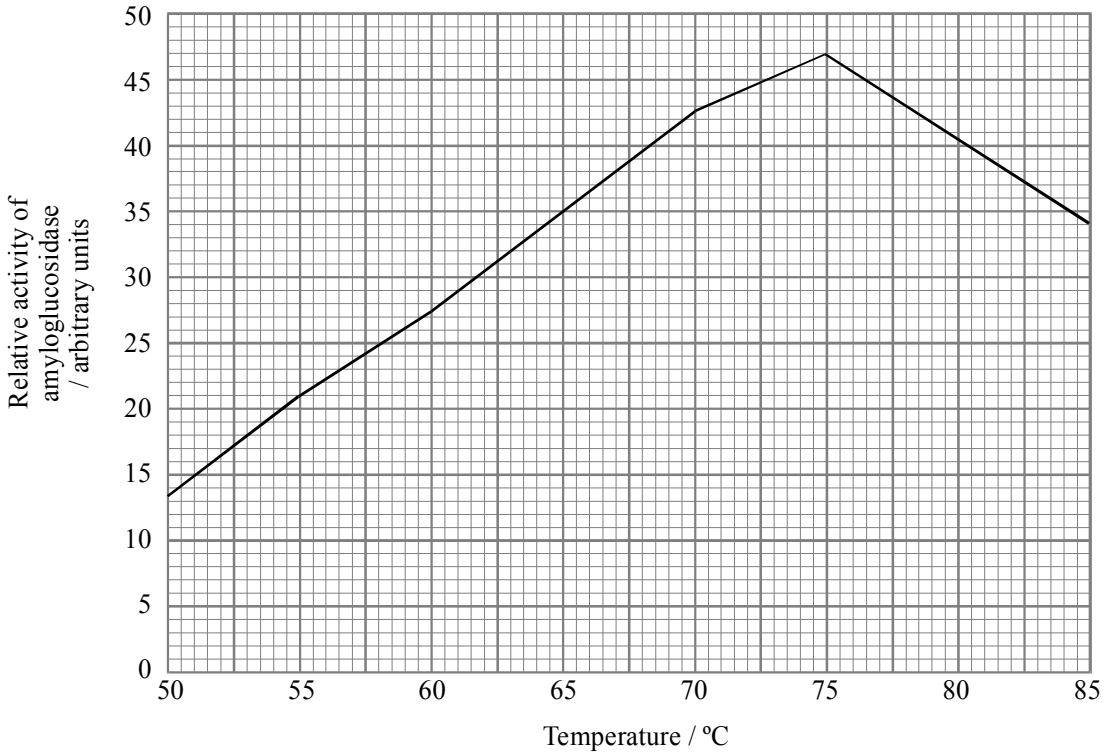
(3)
(Total 6 marks)

56. Amyloglucosidase is an enzyme which breaks down starch to glucose, by removing glucose units stepwise from starch molecules.

The effect of temperature on the activity of a commercial preparation of amyloglucosidase is shown in the graph below.



(a) (i) Calculate the percentage increase in activity of the enzyme as the temperature increases from 65 °C to 75 °C.

Answer …….

(3)

(ii) Explain why temperature affects enzyme activity as shown in the graph.

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(4)

(iii) This enzyme has a relatively high optimum temperature. Suggest why this may be an advantage when using the enzyme in industrial processes.

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……

(2)

(b) Suggest what effect the addition of heavy metal ions, such as mercury or silver, would have on the activity of amyloglucosidase, giving a reason for your answer.

……

……

……

……

(2marks)
(Total 11 marks)

57. The enzymes pectinase and cellulase can be used during the commercial extraction of juice from fruit.

An investigation was carried out into how the addition of these enzymes to apple pulp affects the volume of juice extracted.

Apple pulp was prepared from fresh apples and divided into 12 samples, all of equal mass. Before the juice was extracted, batches of 3 samples were treated in one of the following ways.

Batch	
A	No enzymes added
B	Pectinase only added
C	Cellulase only added
D	Pectinase and cellulase added

The samples were left for the same length of time and then the juice was extracted in the same way from each sample.

The results of this investigation are shown in the table below.

Treatment	Volume of juice extracted / cm^3			
	Sample 1	Sample 2	Sample 3	Mean
A No enzyme	31	33	25	29.7
B Pectinase only	36	37	38	37.0
C Cellulase only	45	42	41	42.7
D Pectinase + Cellulase	44	39	45	M **……**

(a) (i) Calculate the mean volume of juice extracted when both pectinase and cellulase were added to the pulp. Write your answer in space M in the table.

(1)

(ii) Give *two* pieces of evidence, from these results, which show that cellulase has a greater effect than pectinase on the volume of juice extracted.

1 ……...

..…….

2 ……

..……

(2)

(b) Suggest how pectinase and cellulase may act to increase the volume of juice extracted from apple pulp.

……

……

……

……

……

……

(3)

(c) Suggest *two* factors, other than the addition of enzymes, that might affect the volume of juice extracted from the apples.

1 ……

……

2 ……

……

(2)

(d) Pectinase is also used to clarify fruit juices. Suggest advantages of using immobilised rather than free pectinase for this purpose.

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(3)
(Total 11 marks)

58. The diagram below shows part of the nutritional information label given on a carton of lactose-reduced milk.

NUTRITION INFORMATION
Typical values per 100 ml

	Lactose-reduced milk	Normal whole milk
Energy content	284 kJ	284 kJ
Sugars	4.8 g	4.7 g
of which lactose	0.24 g	4.7 g
of which glucose	2.4 g	NIL

(a) (i) Name the sugar, other than glucose, which is present in lactose-reduced milk but not in normal whole milk.

..……

(1)

(ii) For the lactose-reduced milk, calculate the percentage of the total sugar content which is lactose. Show your working.

Answer …….....

(2)

(b) Explain why lactose-reduced milk is produced.

..……

..……

..……

..……

(2)
(Total 5 marks)

59. Write an essay on the following topic.

The roles of carbohydrates in living organisms (Bio)

(15 marks)

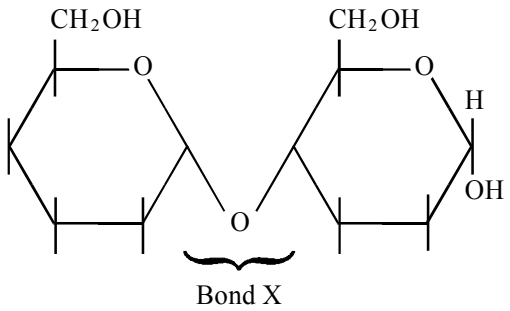
60. The table below refers to structures that may be found in liver cells and leaf palisade cells.

If the structures are present in the cell, place a tick (✓) in the appropriate box and if they are not present place a cross (**X**) in the appropriate box.

Structures	**Liver cell**	**Leaf palisade cell**
Mitochondria		
Starch grains		
Microtubules		
Golgi apparatus		
Glycogen granules		

(Total 5 marks)

61. The diagram below shows a carbohydrate molecule formed from two glucose molecules.



(a) Name the molecule shown in the diagram.

……

(1)

(b) What type of carbohydrate is this?

……

(1)

(c) Name the type of bond labelled X on the diagram, that links the two glucose molecules.

……

(1)

(d) Many glucose molecules can be linked together to form cellulose.

(i) State **one** function of cellulose in living organisms.

……

……

(1)

(ii) Explain how the structure of cellulose is related to its functions.

……

……

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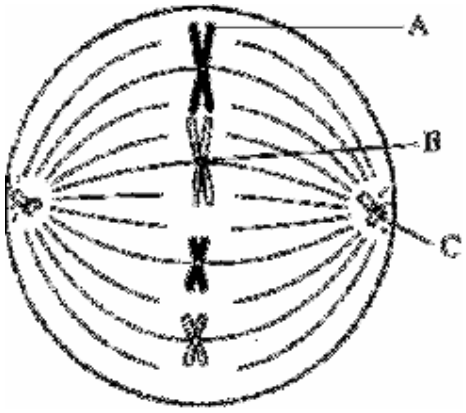
(2)
(Total 6 marks)

62. The diagram below shows an animal cell, in which 2n is 4, undergoing nuclear division.



(a) Name the structures labelled A, B and C on the diagram.

A ……

B ……

C ……

(3)

(b) (i) Name the type of nuclear division which is taking place.

……..……

(1)

(ii) Give **one** reason for your answer.

……..……

……..……

(1)

(c) Explain the biological significance of this type of nuclear division.

……

……

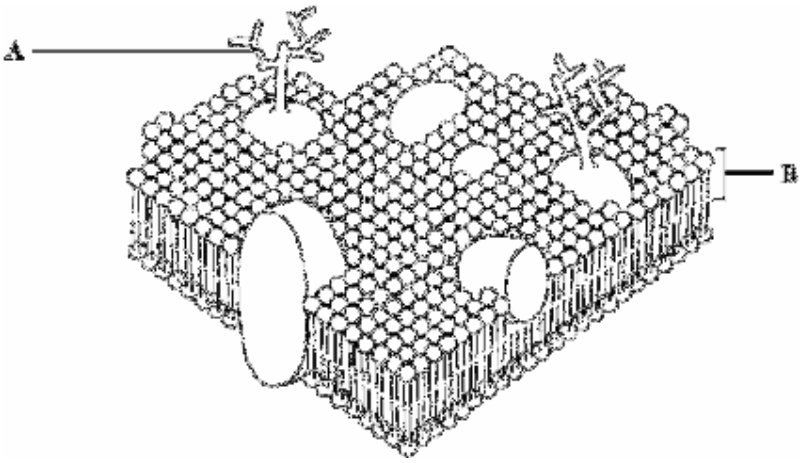
……

……

(2)

(Total 7 marks)

63. (a) The diagram below shows part of a cell surface membrane.



Name the molecules labelled A and B.

A ……

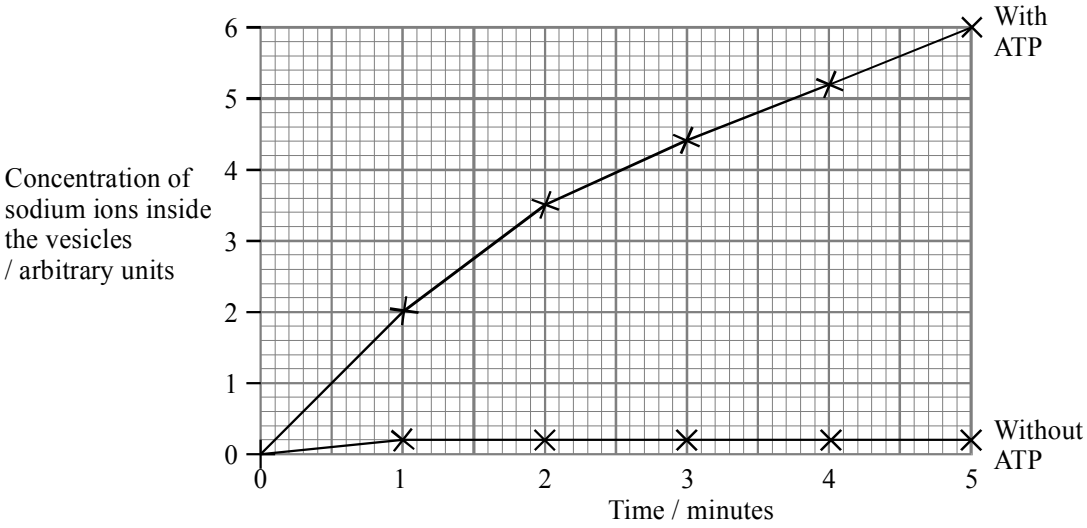
B ……

(2)

(b) Cell surface membranes can be broken into small pieces. These small pieces curl in on themselves to form membrane-bound spheres. These spheres are filled with liquid and are known as vesicles.

An experiment was carried out into the movement of sodium ions across the membranes of these vesicles. The vesicles were immersed in a solution of sodium chloride. The concentration of sodium ions in the vesicles was measured over a period of five minutes. The procedure was then repeated with ATP added to the sodium chloride solution.

During the experiment the temperature was kept constant at 23 °C. The results are shown in the graph below.



(i) Compare the uptake of sodium ions by the vesicles with and without ATP.

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(3)

(ii) What do these results suggest about the mechanisms of transport of sodium ions across these membranes? Explain your answer.

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(4)

(c) State why the temperature was kept constant during this experiment.

……

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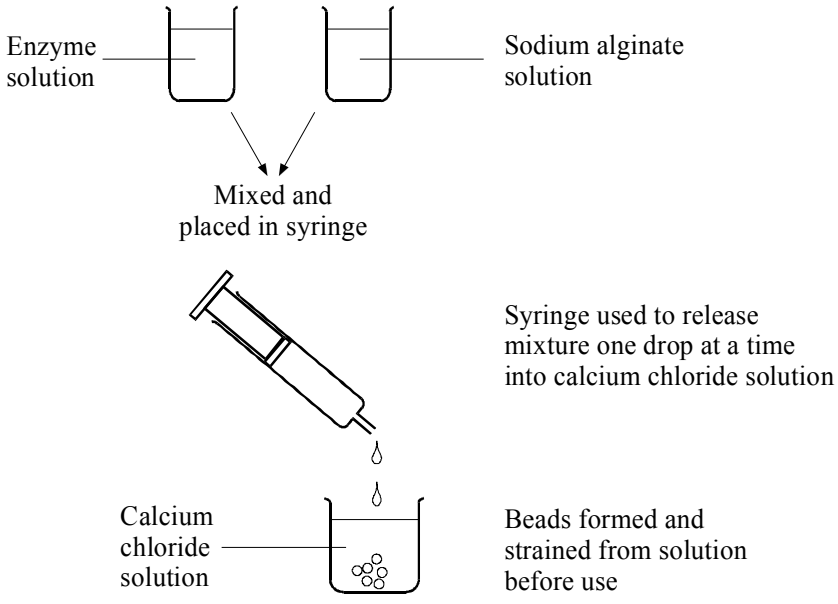
(1)
(Total 10 marks)

64. The diagram below shows one process used to prepare an immobilised enzyme.



(a) Suggest how beads of different sizes can be produced by this method.

…….

…….

…….

…….

(2)

(b) Suggest how reducing the size of the beads would affect the rate of a reaction catalysed by an immobilised enzyme. Explain your answer.

…….

…….

…….

…….

…….

…….

(3)

(c) The enzyme lactase (β-galactosidase) catalyses the hydrolysis of lactose to glucose and galactose.

Lactase was immobilised as described above and the beads were placed in a column. Lactose solution was poured through the column and the solution dripping from the column was tested with a glucose-testing strip. Glucose causes the test strip to turn blue. The time taken to obtain a standard blue colour was recorded.

The experiment was repeated with different concentrations of lactose. The results are shown in the table below.

Lactose concentration 1 mol dm^{-3}	**Time for standard blue colour / s**
0.01	340
0.05	65
0.10	35
0.15	25
0.20	25

(i) Describe and explain the effect of increasing the concentration of lactose on the rate of reaction.

……

……

……

……

……

……

(3)

(ii) During these experiments the temperature was kept constant and the same beads were used throughout.

State **one other** factor which should be controlled and explain why this is necessary.

……

……

……

……

(2)

(d) (i) State **one** industrial use of lactase.

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……

(1)

(ii) Suggest **two** advantages of the use of immobilised enzymes in industrial processes.

1 ……

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2 ……

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(2)

(Total 13 marks)

65. Give an account of protein synthesis, from the time that the mRNA leaves the nucleus.

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(Total 10 marks)

66. Read through the following passage on the cell surface membrane, then write on the dotted lines the most appropriate word or words to complete the passage.

All cells are surrounded by a cell surface membrane. This is made up of

..... arranged as a bilayer. Embedded in this bilayer are

....., some of which act as carriers. Some molecules in the cell

surface membrane have glycoside side chains made up of .....

sub-units. These side chains act as ..... and enable the cell to

form vesicles around extracellular substances, part of the process known

as ..... .

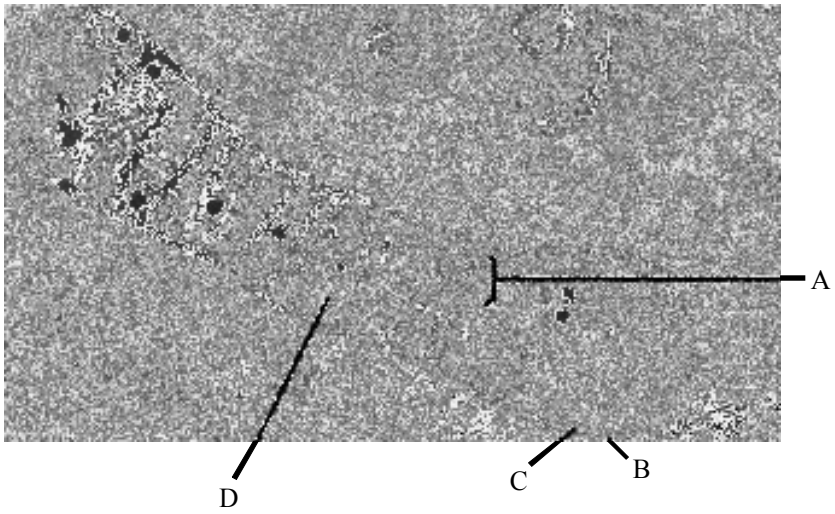
(Total 5 marks)

67. The table below refers to two processes in aerobic respiration: glycolysis and the Krebs cycle. If the statement is correct for the process place a tick (✓) in the appropriate box. If it is incorrect, place a cross (✗) in the appropriate box.

Statement	Glycolysis	Krebs cycle
Compounds with six carbon atoms are involved		
Pyruvate (pyruvic acid) is produced		
Carbon dioxide is produced		
ATP is hydrolysed		
Reduced coenzyme ($NADH + H^+$) is produced		

(Total 5 marks)

68. The photograph below shows a section through a mitochondrion as seen using an electron microscope.



Prof. R. Bellairs/Wellcome Photo Library

(a) Name the parts labelled A, B and C.

A .....

B .....

C .....

(3)

(b) Name a metabolic pathway that takes place in the part labelled D.

.....

(1)

(c) The actual length of the mitochondrion is 6 μm. Calculate the magnification of the photograph. Show your working.

Answer .....

(2)
(Total 6 marks)

69. Distinguish between each of the following pairs of terms, illustrating your answer with suitable examples.

(a) Monohybrid inheritance and dihybrid inheritance.

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(3)

(b) Continuous variation and discontinuous variation.

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(3)
(Total 6 marks)

70. Diagram 1 below shows the sequence of bases in a length of mRNA from the food poisoning bacterium *Salmonella*, and the amino acid sequence for which it codes. This amino acid sequence is part of a longer polypeptide chain.

Diagram 2 shows the effects of two mutations on this length of mRNA, and the resulting amino acid sequence.

Diagram 1

Base sequence

GUU	ACA	GCG	GUA	CGC	GUC	ACC	CCU	GAG

valine - threonine - alanine - leucine - arginine - valine - threonine - proline - glutamic acid

Amino acid sequence

Diagram 2

Base sequence

GUU	AAG	CGG	UAC	GCG	UCA	CCC	CCU	GAG

↑ Mutation I ↑ Mutation II

valine - lysine - arginine - tyrosine - X - serine - proline - proline - glutamic acid

Amino acid sequence

(a) Name the types of point mutations shown in Diagram 2.

Mutation I .....

Mutation II .....

(2)

(b) Name the amino acid labelled X.

Amino acid X .....

(1)

(c) Mutation I by itself would have caused a greater effect on the amino acid sequence of the polypeptide than the effect of both mutations occurring together. Explain why this is so.

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(2)

(d) These mutations were caused by the chemical proflavin. What is the general name given to chemicals which have such effects?

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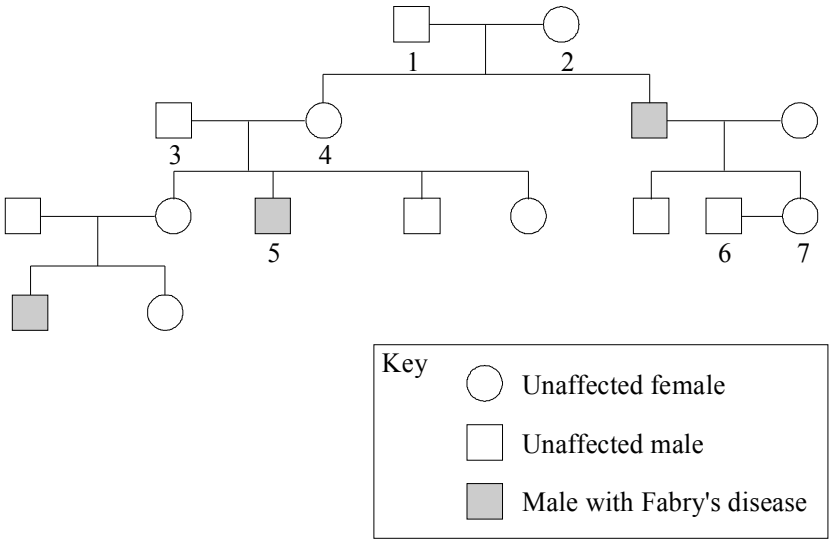
(1)

(Total 6 marks)

71. Fabry's disease is a sex-linked recessive genetic disorder that causes mental retardation.

A study was carried out into the inheritance of this disorder in a family, and the results are shown in the pedigree below.



(a) Using the symbol **A** for the dominant allele and **a** for the recessive allele, state the genotype of person 2.

.....

(1)

(b) Using the evidence from the pedigree, explain why Fabry's disease is described as a sex-linked recessive genetic disorder.

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(3)

(c) Explain why person 3 is unaffected but why one of his children (person 5) has Fabry's disease.

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(3)

(d) What are the chances of the children of persons 6 and 7 having Fabry's disease? Give reasons for your answer.

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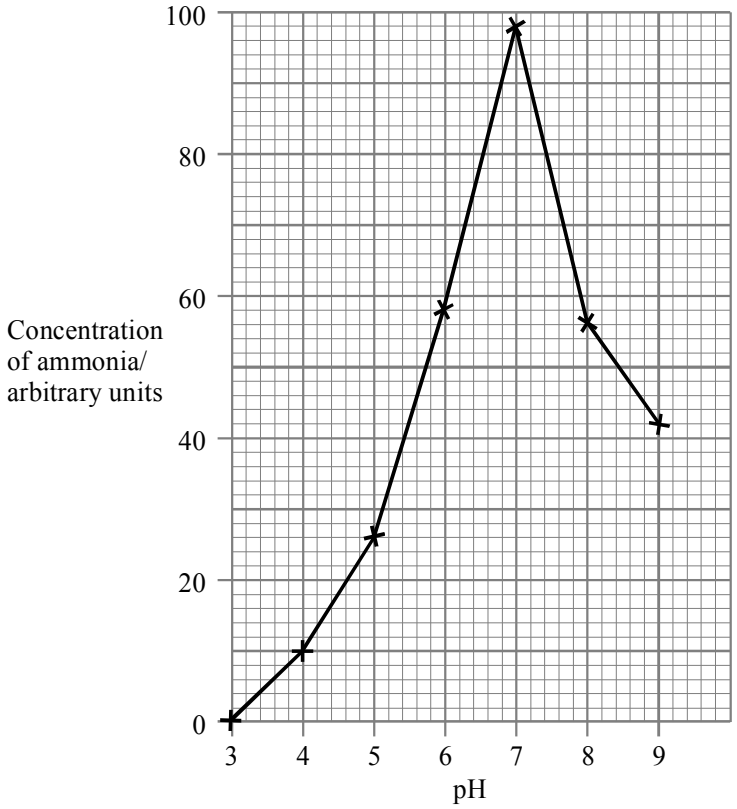
(4)
(Total 11 marks)

72. Urease is an enzyme which catalyses the breakdown of urea to ammonia and carbon dioxide.

An experiment was carried out into the effect of pH on the activity of urease. 10 cm^3 of pH 3 buffer solution was mixed with 1 cm^3 of urease solution. This mixture was then added to 10 cm^3 of urea solution and the concentration of ammonia in the mixture was measured after 60 minutes. This procedure was repeated using buffer solutions of pH 4, 5, 6, 7, 8 and 9.

The results are shown in the graph below.



(a) What do these results suggest is the optimum pH for urease activity?

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(1)

(b) Suggest how the experiment could be modified to determine the optimum pH more accurately.

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(1)

(c) Explain why no ammonia was produced at pH 3.

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(3)

(d) Explain why less ammonia is produced at pH 9 than at pH 8.

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(2)

(e) Describe how this experiment could be modified to determine the effect of substrate concentration on the activity of urease.

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(4)
(Total 11 marks)

73. Give an account of the process of meiosis

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(extra 2 pages of lines required)

(Total 10 marks)

74. Lactase is an enzyme which catalyses the hydrolysis of the disaccharide lactose to the monosaccharides glucose and galactose. The enzyme can be immobilised in beads of gel such as calcium alginate.

Glucose test strips turn blue when dipped into a solution containing glucose. The intensity of the blue colour is proportional to the concentration of glucose in the solution.

Describe an experiment which you could carry out to determine the effect of pH on the activity of immobilised lactase.

Your answer should give details under the following headings.

(a) (i) An account of the method you would use, including full experimental details and any precautions you would take

(9)

(ii) Record of results and their presentation in a suitable form

(4)

(b) Describe *two* limitations of your method.

(2)

(Total 15 marks)

75. Describe, with full practical details, the method you would use to obtain and stain a squash preparation of a root tip to study the stages of mitosis.

(Total 7 marks)

76. Read through the following passage on the structure of prokaryotic cells, then write on the dotted lines the most appropriate word or words to complete the account.

Bacteria, such as *Escherichia coli,* are prokaryotic organisms. One of the main

differences between prokaryotic cells and eukaryotic cells is that in a prokaryotic cell,

the bacterial chromosome is not surrounded by a ..... .

Prokaryotic cells store carbon compounds in the form of .....

and ..... and they may also contain one or more small circular

DNA molecules, known as ..... . *E. coli* cells are motile due

to the presence of a..... .

(Total 5 marks)

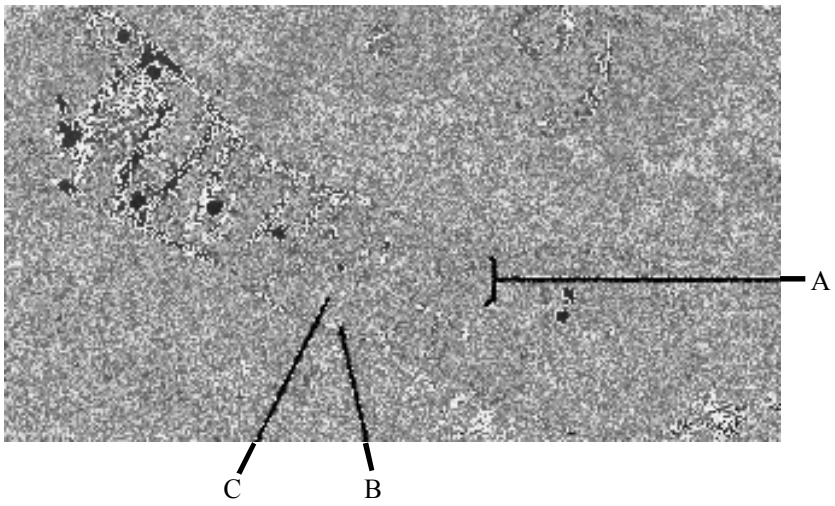
77. The table below refers to some disaccharides, their constituent monomers and their roles in living organisms.

Complete the table by writing in the appropriate word or words in the empty boxes.

Disaccharide	Constituent monomers	**One** role in living organisms
Lactose		Carbohydrate source in mammalian milk
	Glucose + glucose	
		Form in which sugars are transported in plants

(Total 5 marks)

78. The photograph below shows a section through a mitochondrion as seen using an electron microscope.



Prof. R. Bellairs/Wellcome Photo Library

(a) Name the parts labelled A, B and C.

A .....

B .....

C .....

(3)

(b) Describe the role of mitochondria.

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(2)
(Total 5 marks)

79. (a) Explain what is meant by the **primary structure** of a protein molecule.

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(2)

(b) Explain the role of hydrogen bonding in maintaining the structure of a globular protein such as insulin.

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(3)

(c) Describe how the structure of a fibrous protein, such as collagen, differs from the structure of a globular protein.

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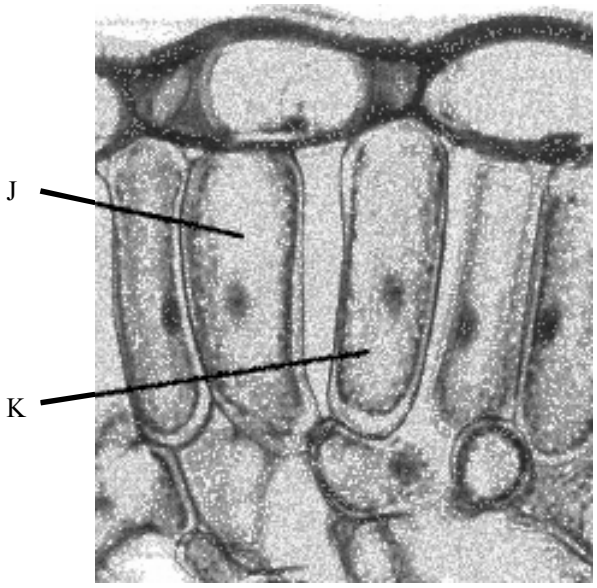
(3)
(Total 8 marks)

80. The photomicrograph below shows some cells viewed using a light microscope.



(a) Name the tissue in which the cells labelled J and K are found, giving **one** reason for your identification.

Tissue.....

Reason for identification.....

.....

(2)

(b) Give the function of this tissue.

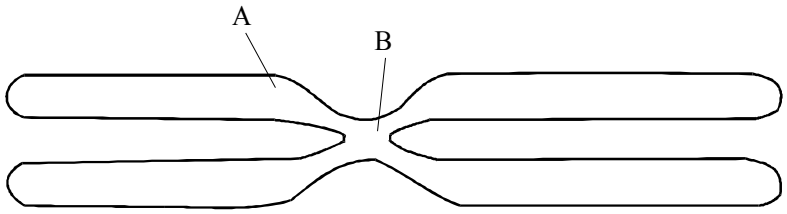
.....

(1)

(c) In the space below make an accurate drawing, enlarged × 1.5, of the cells labelled J and K. Do not label your drawing.

(5)
(Total 8 marks)

81. The diagram below shows the structure of a chromosome as it might appear at the end of prophase of mitosis.



(a) Name the parts labelled A and B.

A .....

B .....

(2)

(b) During metaphase of mitosis, the chromosomes become attached to the equator of the spindle. Name the stage of mitosis that follows metaphase and describe the events that occur in this stage.

Stage .....

Events occurring .....

.....

.....

.....

(3)

(c) Explain the significance of the stage you have named and described in (b).

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(1)

(d) Mitosis forms part of the cell cycle. Name **one** other stage of the cell cycle and state what occurs in the stage that you have named.

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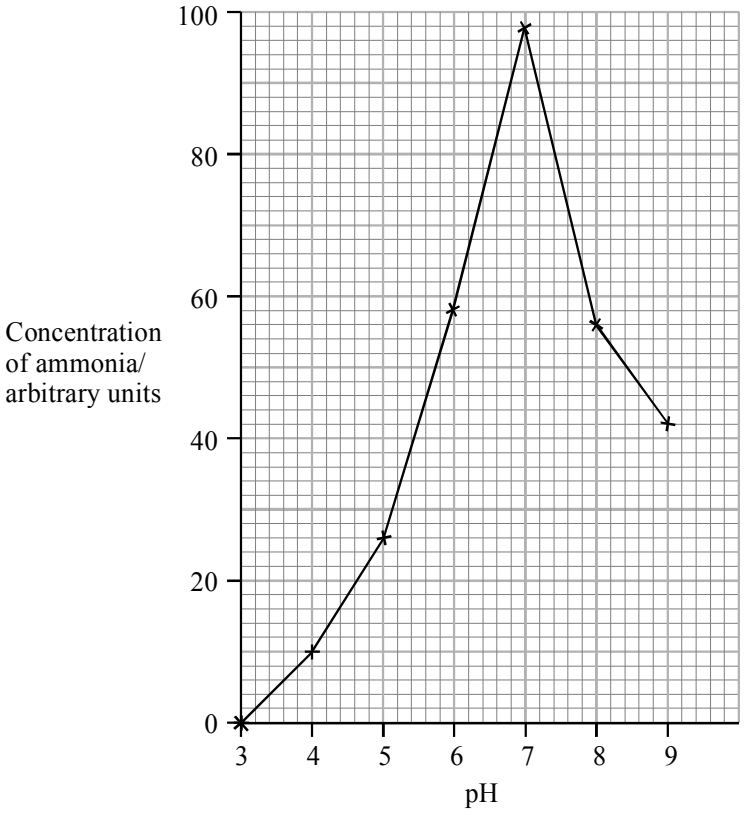
(2)
(Total 8 marks)

82. Urease is an enzyme which catalyses the breakdown of urea to ammonia and carbon dioxide.

An experiment was carried out into the effect of pH on the activity of urease. 10 cm^3 of pH 3 buffer solution was mixed with 1 cm^3 of urease solution. This mixture was then added to 10 cm^3 of urea solution and the concentration of ammonia in the mixture was measured after 60 minutes. This procedure was repeated using buffer solutions of pH 4, 5, 6, 7, 8 and 9.

The results are shown in the graph below.



(a) What do these results suggest is the optimum pH for urease activity?

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(1)

(b) Suggest how the experiment could be modified to determine the optimum pH more accurately.

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(1)

(c) Explain why no ammonia was produced at pH 3.

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(3)

(d) Explain why less ammonia is produced at pH 9 than at pH 8.

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(2)

(e) Describe how this experiment could be modified to determine the effect of enzyme concentration on the activity of urease.

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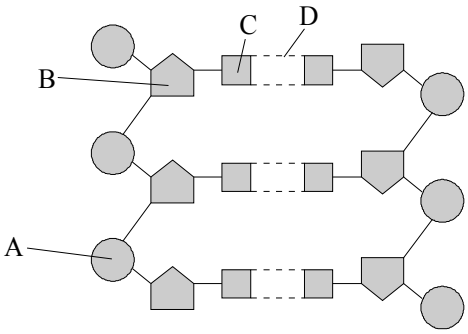
(4)
(Total 11 marks)

83. The diagram below shows part of a molecule of deoxyribonucleic acid (DNA).



(a) Name A, B, C and D.

A .....

B .....

C .....

D .....

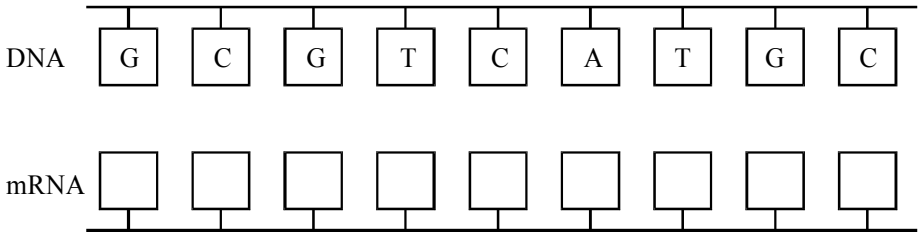
(4)

(b) Analysis of a molecule of DNA showed that cytosine accounted for 42 per cent of the content of the nitrogenous bases. Calculate the percentage of bases in the molecule which would be thymine. Show your working.

Answer.....

(3)

(c) During the process of **transcription,** one of the DNA strands is used as a template for the formation of a complementary strand of messenger RNA (mRNA)**.** The diagram below shows the sequence of bases in part of a strand of DNA.



(i) Write the letters of the complementary bases in the boxes of the mRNA strand.

(2)

(ii) How many amino acids are coded for by this part of the strand of mRNA?

.....

(1)

(Total 10 marks)

84. Give an account of the ways in which molecules and ions move into and out of cells.

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(Allow 2 lined pages)

(Total 10 marks)

85. The table below refers to three organelles commonly found in eukaryotic cells. Complete the table by writing the name of the organelle, its description or **one** function as appropriate in the five boxes provided.

Name of organelle	Description	**One** function
Golgi apparatus		
	Cylindrical organelles, made up of microtubules.	Involved in spindle organisation during cell division in animal cells.
	Rod-shaped structures with a double membrane, the inner one folded to form cristae.	

(Total 5 marks)

86. Read through the following account of the structure and roles of triglycerides, then write on the dotted lines the most appropriate word or words to complete the account

Triglycerides are lipids whose molecules are composed of two types of sub-unit, fatty acids

and ..... held together by .....

bonds. These bonds are produced when the sub-units are linked together during

..... reactions. Triglycerides have a number of roles in living

organisms, for example ..... and ..... .

(Total 5 marks)

87. A solution thought to contain either a reducing sugar or a non-reducing sugar was tested with Benedict's reagent.

(a) Describe how the presence of a reducing sugar is detected using Benedict's reagent.

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(2)

(b) If the test was negative for reducing sugars, describe what steps you would need to carry out before you could show that a non-reducing sugar was present.

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(3)

(c) Describe how Benedict's reagent could be used to compare the concentrations of reducing sugar present in two solutions.

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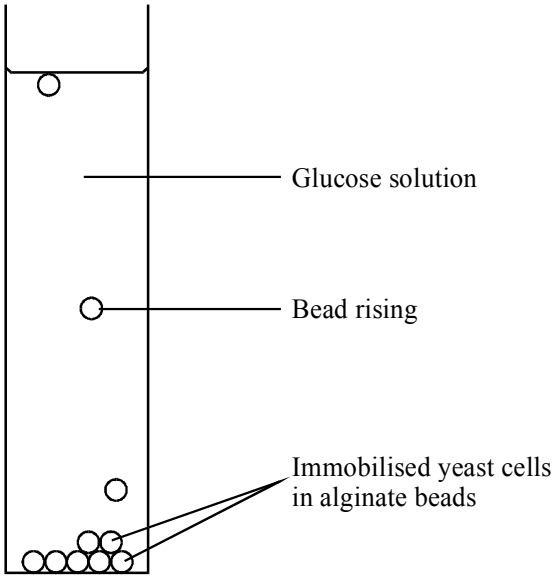
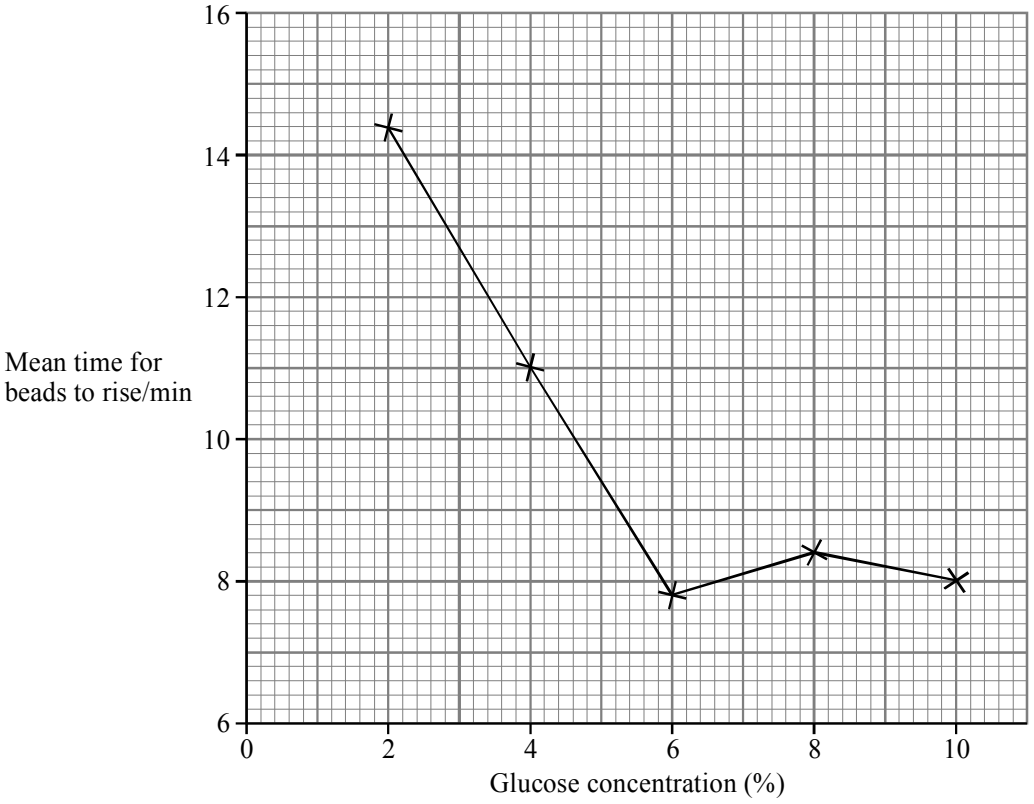
(3)
(Total 8 marks)

88. An investigation was carried out to investigate the effect of glucose concentration on the rate of respiration of immobilised yeast cells (*Saccharomyces* sp.).

A suspension of yeast cells was mixed with a 3% solution of sodium alginate. This mixture was then dripped through a syringe into a solution of calcium chloride to produce small beads. Once the beads had set, they were rinsed in distilled water and ten of them were added to a tube containing 20 cm^3 of a 2% solution of glucose. The beads sank to the bottom of the tube and then the time taken for each bead to rise to the surface was recorded.



The mean time for the beads to rise was calculated. The experiment was repeated using 4%, 6%, 8% and 10% glucose solutions. The results are shown on the graph.



(a) Suggest **two** other factors that should be controlled in this investigation.

1. .....

2. .....

(2)

(b) Suggest why the beads containing the yeast rose to the surface.

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(2)

(c) Describe and explain the effect of changing glucose concentration on the time it takes for the beads to rise.

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(3)

(d) The experiment was repeated using a 4% solution of maltose. The mean time taken for the beads to rise was 19.8 minutes. Suggest reasons for the difference between this result and that for 4% glucose.

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(3)

(e) Immobilised enzymes are often used in industrial processes.

Suggest **two** commercial advantages for the use of immobilised enzymes.

1. .....

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2. .....

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(2)

(Total 12 marks)

89. Give an account of the effects of pH and inhibitors on the activity of enzymes.

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(Allow three lined pages)

(Total 10 marks)

90. The process of protein synthesis and the subsequent secretion of products by a cell can be investigated by following the movement of a radioactive substance.

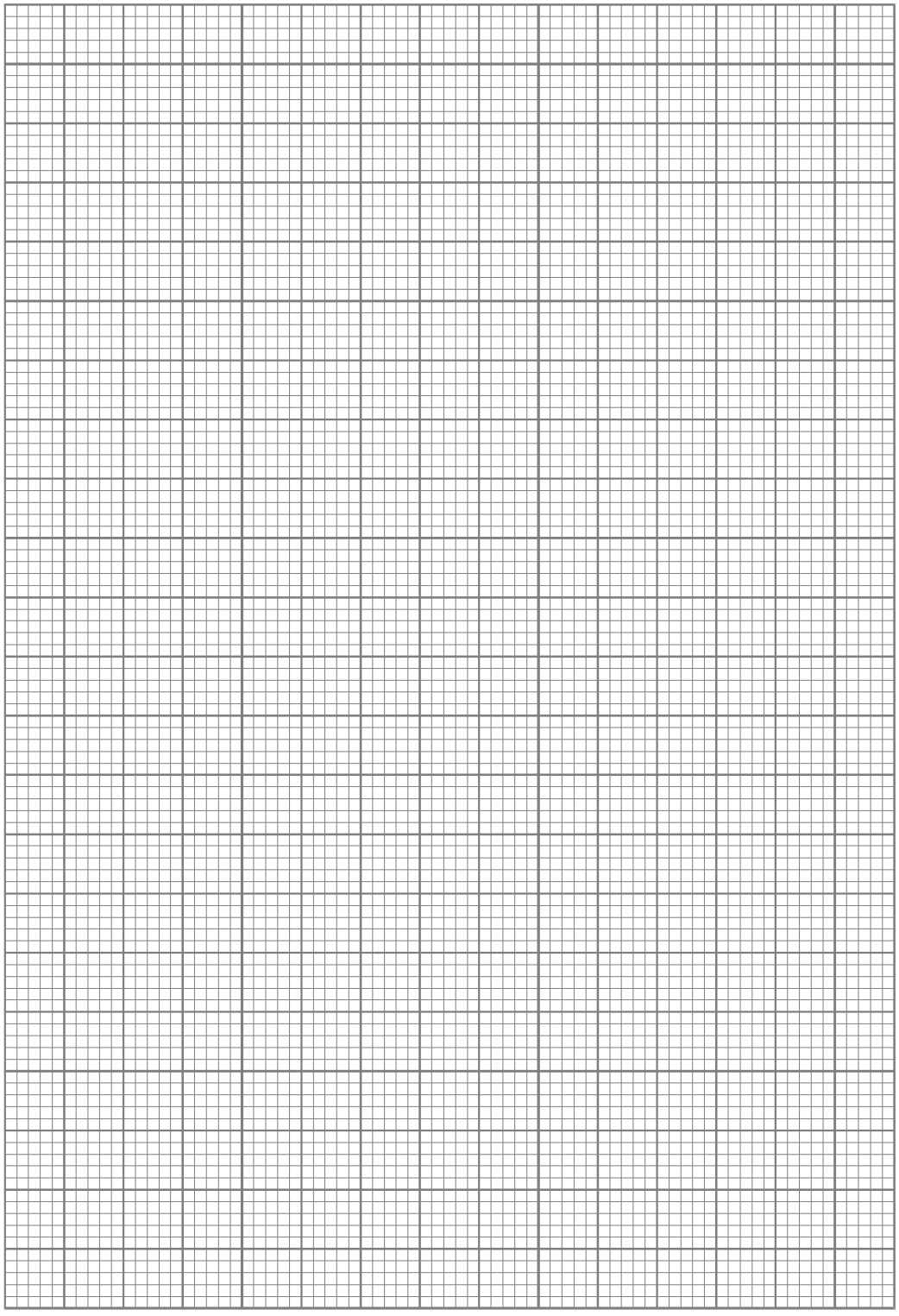
In one such experiment, small pieces of pancreas tissue were incubated in a medium containing the amino acid leucine. This amino acid contained radioactive carbon, ^{14}C.

The pieces of tissue were then transferred to a medium in which the radioactive leucine had been replaced with a large excess of normal (non-radioactive) leucine. They were incubated for 120 minutes and the route taken by the radioactive amino acids was followed.

The table below shows the changes in the radioactivity in the rough endoplasmic reticulum and the secretory vesicles, expressed as a percentage.

Incubation time /min	Radioactivity (%)	
	Rough endoplasmic reticulum	Secretory vesicles
3	85	3
10	42	3
20	37	3
40	22	10
60	18	35
120	18	58

(a) Plot these data in a suitable graphical form on the graph paper.



(5)

(b) Name one enzyme that is secreted by the pancreas.

.....

(1)

(c) Compare the distribution of radioactivity in the rough endoplasmic reticulum with that in the secretory vesicles during the experiment.

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(3)

(d) Describe the process by which the radioactive amino acids are used to make proteins.

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(3)

(e) After an incubation time of 20 minutes, most of the radioactivity was found in the Golgi apparatus. Radioactivity associated with the Golgi apparatus then steadily decreased. Suggest an explanation for these observations.

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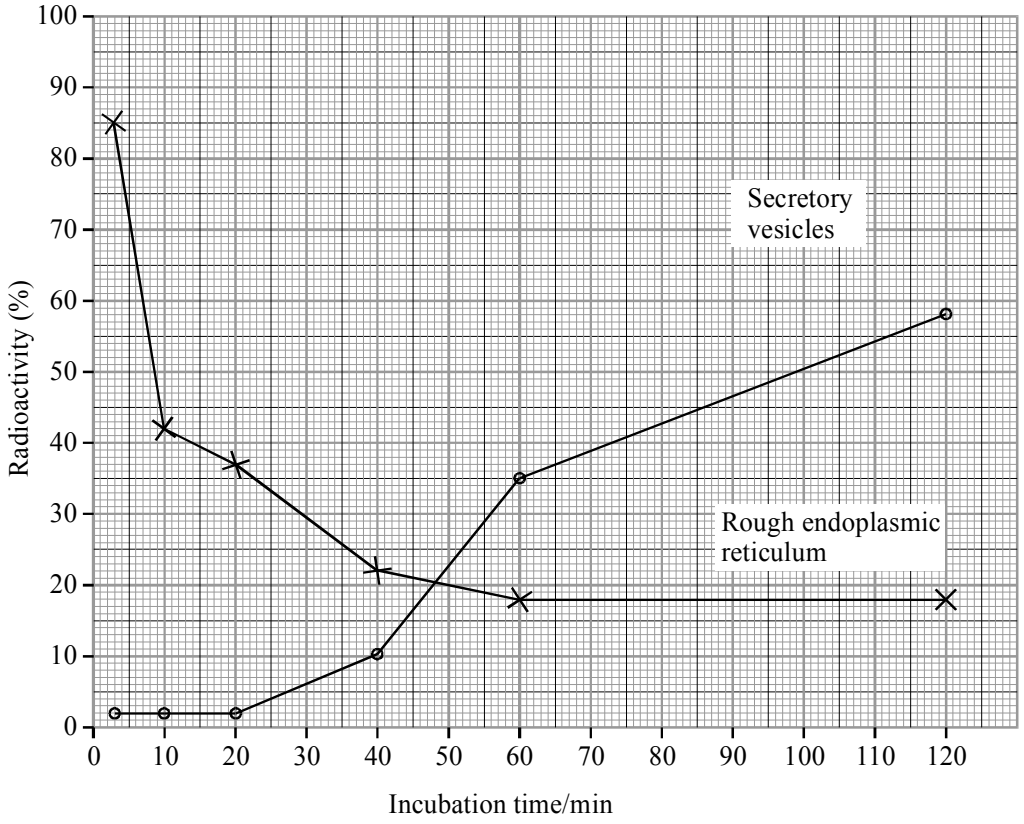
(3)
(Total 15 marks)

91. The process of protein synthesis and the subsequent secretion of products by a cell can be investigated by following the movement of a radioactive substance.

In one such experiment, small pieces of pancreas tissue were incubated in a medium containing the amino acid leucine. This amino acid contained radioactive carbon, ^{14}C. The pieces of tissue were then transferred to a medium in which the radioactive leucine had been replaced with a large excess of normal (non-radioactive) leucine. They were incubated for 120 minutes and the route taken by the radioactive amino acids was followed.

The graph below shows the changes in the radioactivity in the rough endoplasmic reticulum and the secretory vesicles, expressed as a percentage.



(a) Name **one** enzyme that is secreted by the pancreas

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(1)

(b) Compare the distribution of radioactivity in the rough endoplasmic reticulum with that in the secretory vesicles during the experiment.

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(3)

(c) Describe the process by which the radioactive amino acids are used to make proteins.

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(3)

(d) After an incubation time of 20 minutes, most of the radioactivity was found in the Golgi apparatus. Radioactivity associated with the Golgi apparatus then steadily decreased. Suggest an explanation for these observations.

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(3)

(e) Describe the process by which enzymes are secreted by the pancreatic cells.

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(2)

(f) Some of the enzymes synthesised by the pancreatic cells appear in lysosomes, rather than in the secretory vesicles.

Describe the functions of lysosomes.

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(2)

(Total 14 marks)

92. The table below refers to four membrane transport processes: diffusion, facilitated diffusion, osmosis and active transport. If the statement is correct, place a tick (✓) in the appropriate box and if the statement is incorrect, place a cross (**X**) in the appropriate box.

Process	Takes place against a concentration gradient	Requires energy in the form of ATP
Diffusion		
Facilitated diffusion		
Osmosis		
Active transport		

(Total 4 marks)

93. Read through the following account of the structure of deoxyribonucleic acid (DNA), then write on the dotted lines the most appropriate word or words to complete the account.

DNA is a molecule consisting of a long chain of nucleotides, which are joined together

by..... reactions. Each nucleotide in DNA consists of a

nitrogenous base, a phosphate group and ..... .The

nitrogenous base may be adenine, guanine, cytosine or ..... .

A molecule of DNA is made up of two polynucleotide chains coiled into a

..... . The two chains are held together by

..... bonds between the nitrogenous bases

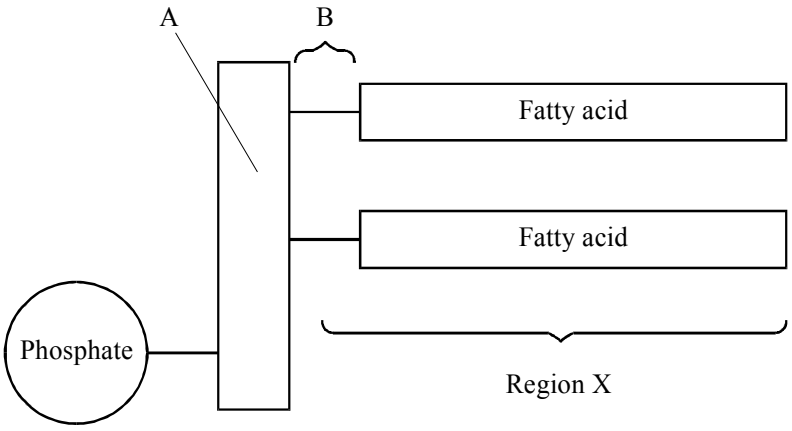
(Total 5 marks)

94. The table below refers to three organelles commonly found in eukaryotic cells. Complete the table by writing the name of the organelle, its description or one function, as appropriate, in each of the five boxes provided.

Name of organelle	Description	**One** function
Golgi apparatus		
	Cylindrical organelles made up of microtubules	Involved in spindle Organisation during cell division in animal cells
	Rod-shaped structures with a double membrane, the inner one folded to form cristae	

(Total 5 marks)

95. The diagram below shows the structure of a molecule found in the cell surface membrane.



(a) Name the type of molecule shown in the diagram.

.....

(1)

(b) Name A and B as labelled on the diagram.

A .....

B .....

(2)

(c) Region X is said to be **hydrophobic**. What is meant by the term hydrophobic?

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.....

(1)

(d) Explain why the cell surface membrane is described as a fluid-mosaic.

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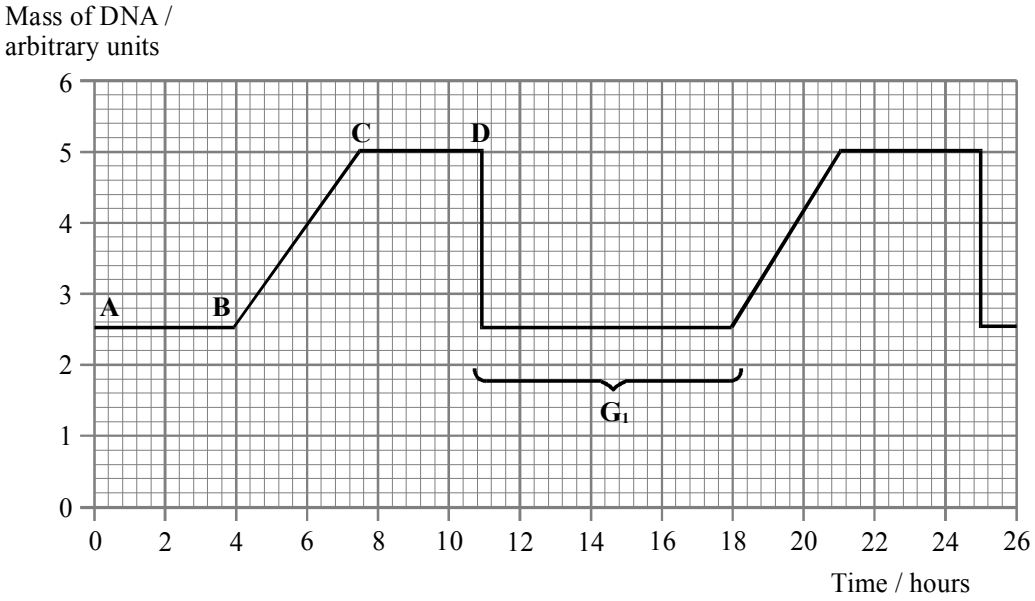
(2)
(Total 6 marks)

96. (a) The table below describes some of the key events that occur during mitosis Complete the table by writing the name of the stage of mitosis next to its description.

Key events	Stage
Chromatids separate and move to opposite poles of the dividing cell.	
Chromosomes shorten and thicken. The nuclear envelope breaks down and the spindle forms.	
The spindle fibres break down, the nuclear membrane re-forms and the chromosomes elongate.	
Chromosomes line up on the equator of the cell, attached to spindle fibres by their centromeres.	

(4)

(b) The graph below illustrates the change in DNA content during the cell cycle



(i) Calculate the percentage of the cell cycle time spent in G_1.

Answer.....

(3)

(ii) At which point, A, B, C or D, does chromosome replication (the S phase) begin? Explain your answer.

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(2)

(Total 9 marks)

97. A solution thought to contain either a reducing sugar or a non-reducing sugar was tested with Benedict's reagent.

(a) Describe how the presence of a reducing sugar is detected using Benedict's reagent.

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(2)

(b) If the test was negative for reducing sugars, describe what steps you would need to carry out before you could show that a non-reducing sugar was present.

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(3)

(c) Describe how Benedict's reagent could be used to compare the concentrations of reducing sugar present in two solutions.

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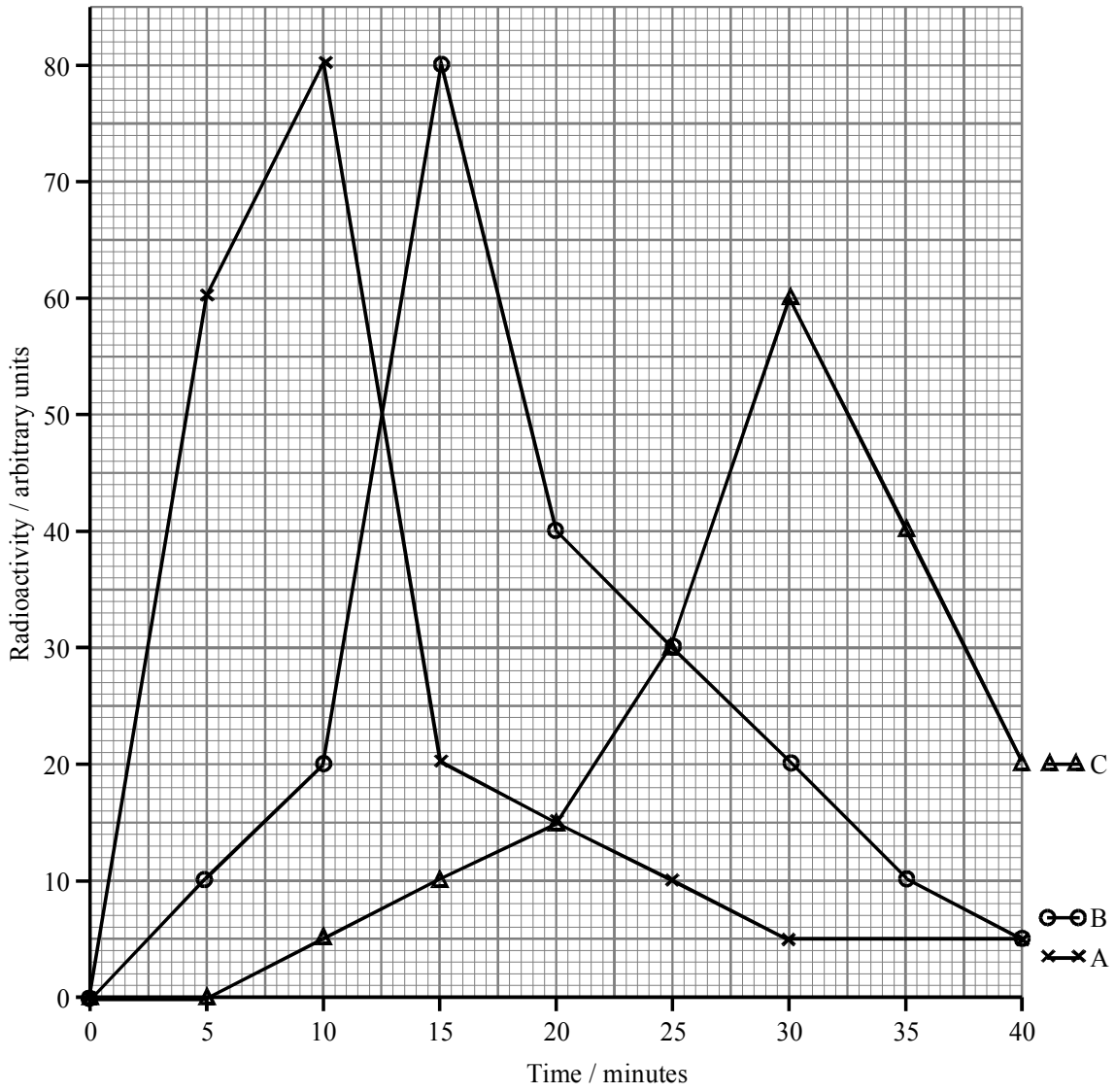
(3)
(Total 8 marks)

98. (a) In the space below, draw a diagram to show the molecular structure of an amino acid. Do not label your diagram.

(2)

(b) An experiment was carried out to determine what happens to amino acids after they are absorbed by animal cells. The cells were incubated for 5 minutes in a medium containing radioactively labelled amino acids. The radioactive amino acids were then washed off and the cells were incubated in a medium containing only non-radioactive amino acids. Samples of the cells were removed from the medium every five minutes for 40 minutes. For each sample, the levels of radioactivity in three different organelles, A, B and C, were determined.

The results of the experiment are shown in the graph below.



(i) Identify the organelles A, B and C by choosing from the list below. Write answers in the spaces provided in the table

Golgi apparatus

Mitochondria

Ribosomes

Rough endoplasmic reticulum

Organelle A	
Organelle B	
Organelle C	

(3)

(ii) Calculate the rate of increase in radioactivity in organelle C between 5 and 20 minutes. Show your working.

Answer.....

(3)

(c) Suggest what will happen to the radioactivity after 40 minutes, and explain your suggestion.

.....

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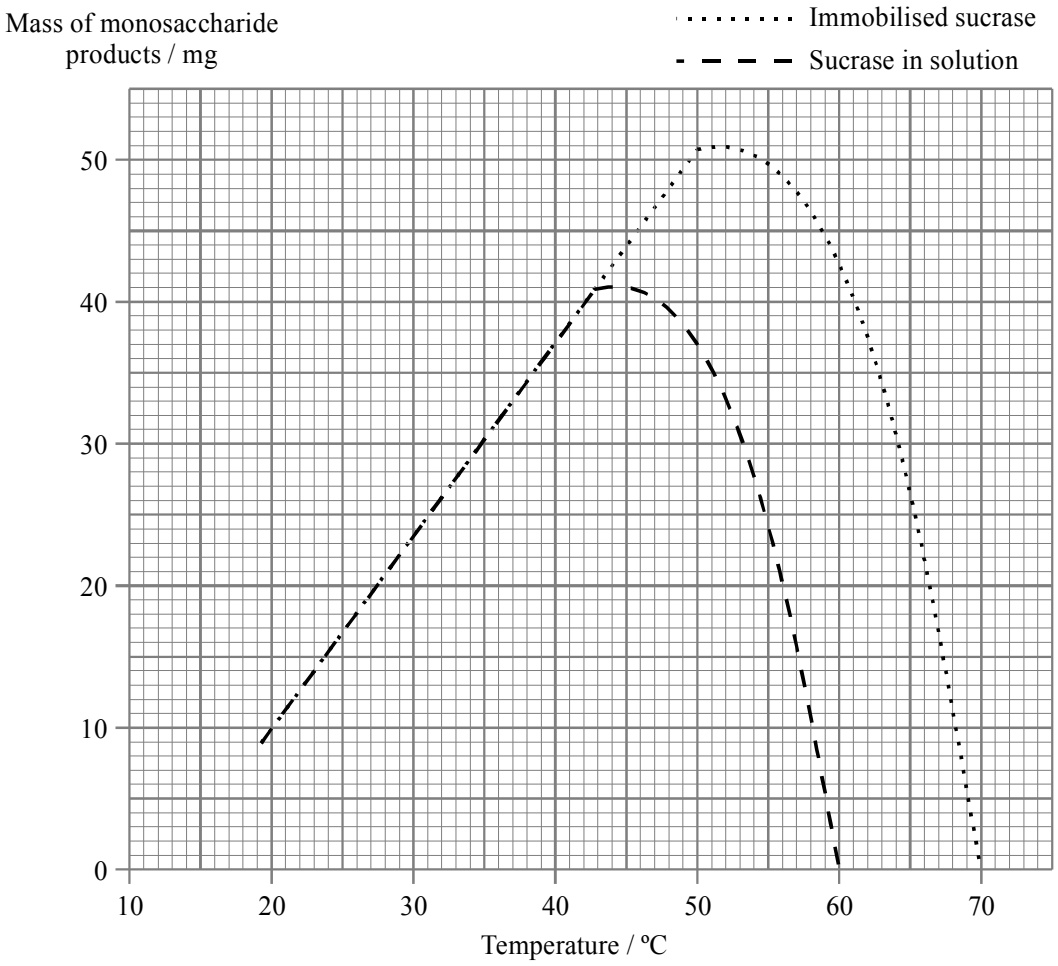
.....

.....

(3)
(Total 11 marks)

99. Sucrase is an enzyme that catalyses the hydrolysis of sucrose. An investigation was carried out to compare the activity of sucrase in solution with immobilised sucrase, over a range of temperatures. The enzyme in solution was incubated with a solution of sucrose for 5 minutes at different temperatures. The mass of monosaccharide produced at each temperature was determined. This was repeated using immobilised sucrase. The results of the investigation are shown in the graph.



(a) Name the **two** monosaccharides produced from the hydrolysis of sucrose.

1.....

2.....

(2)

(b) What evidence from the graph suggests that the concentrations of sucrase in solution and immobilised sucrase were equivalent?

.....

.....

.....

.....

.....

.....

(1)

(c) Compare the effect of temperature on the activity of sucrase in solution with that on immobilised sucrase.

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(3)

(d) Suggest why temperatures above 45°C have different effects on immobilised sucrase and sucrase in solution.

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(2)

(e) Describe how this investigation could be adapted to compare the activity of sucrase in solution with that of immobilised sucrase over a range of pH values.

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(4)

(Total 12 marks)

100. Give an account of the structures of the proteins insulin and collagen.

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(Allow three lined pages)

(Total 10 marks)

101. The diagram below shows the structure of a liver cell as seen using an electron microscope.

(a) Name the parts labelled A, B, C and D.

A ……..……..……..

B …….

C …….

D …….

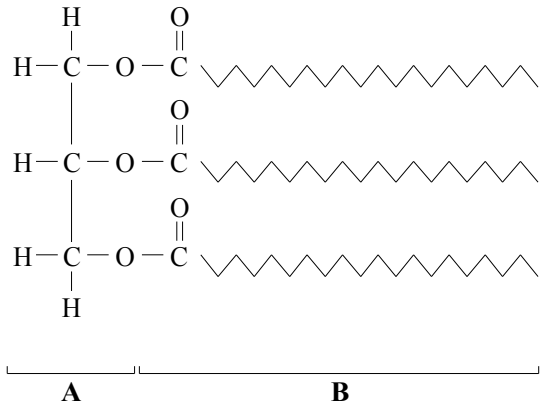
(4)

(b) The magnification of the diagram is × 12 000. Calculate the actual length of the mitochondrion labelled M, giving your answer in μm. Show your working.

Length ……..……..…

(2)
(Total 6 marks)

102. The diagram below shows the structure of a lipid molecule.



(a) Name the parts labelled A and B.

A ……..……..……..

B …….

(2)

(b) Name this type of lipid

…….…..

(1)

(c) Name the chemical reaction used to form the bonds between A and B.

……..…..

(1)

(d) State ONE function of this type of lipid in living organisms.

……..…..

(1)

(e) State ONE feature of the molecules of this type of lipid that makes them suitable for the function you have given.

……..…..

(1)

(Total 6 marks)

103. The statements in the table below refer to three polysaccharide molecules.

If the statement is correct place a tick (✓) in the appropriate box and if the statement is incorrect place a cross (**X**) in the appropriate box.

Statement	Starch	Glycogen	Cellulose
Polymer of α–glucose			
Glycosidic bonds present			
Unbranched chains only			
Energy store in animal cells			

(Total 4 marks)

104. Explain what is meant by the following terms.

(a) Osmosis

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……

(3)

(b) Facilitated diffusion

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……

……

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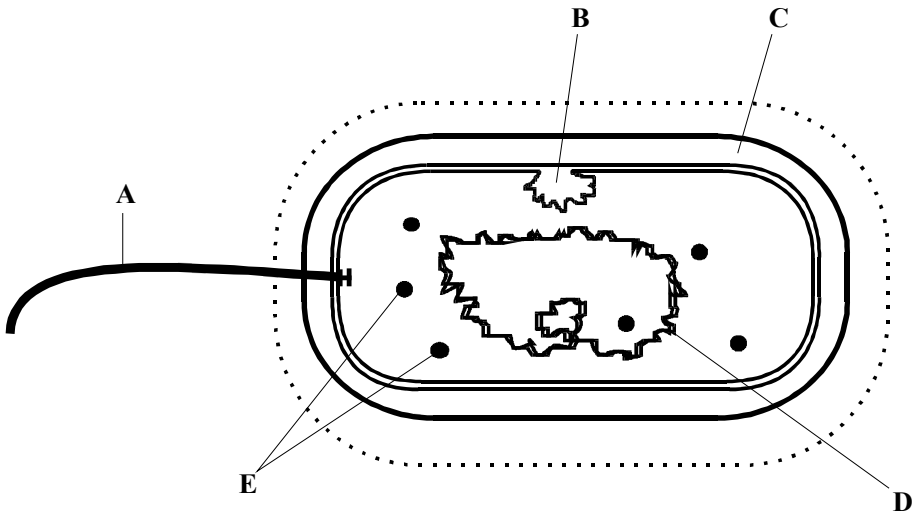
(3)
(Total 6 marks)

105. The diagram below shows the structure of a bacterial cell as seen using an electron microscope.



(a) Name the parts labelled A, C and D.

A ……..……..

B ……..……..

C ……..……..……..

(3)

(b) Describe the roles of the parts labelled B, C and E.

B ……..……..

……..

C ……..……..

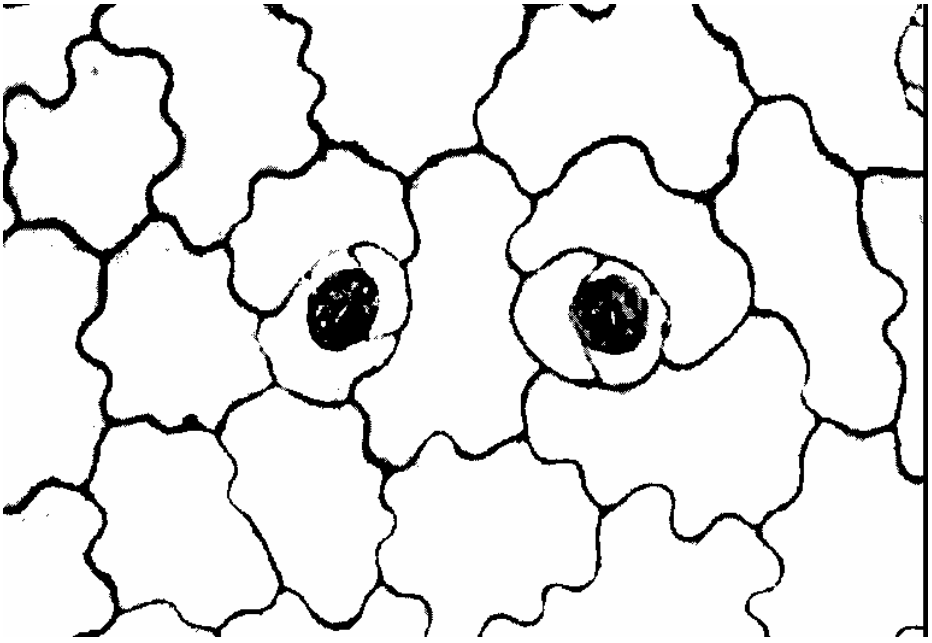
……..

E ……..……

……..

(3)
(Total 6 marks)

106. The photomicrograph below shows some cells.



(a) Name the tissue shown in the photomicrograph and describe its function.

……..

……..

……..

……..

……..

(3)

(b) In the space below make an accurate drawing, enlarged × 1.5, of the stomata and surrounding cells. Do not label your drawing.

(5)
(Total 8 marks)

107. An experiment was carried out to determine what happens to amino acids after they are absorbed by animal cells. The cells were incubated for 5 minutes in a medium containing radioactively labelled amino acids. The radioactive amino acids were then washed off and the cells were incubated in a medium containing only non-radioactive amino acids.

Samples of the cells were taken at 5, 10 and 45 minutes after the start of the experiment and the sites of radioactivity in the cells were determined.

The results are given in the table below. The figures show radioactivity in certain cell organelles expressed as a percentage of the total radioactivity within the cells.

Organelle	Percentage of total radioactivity		
	At 5 minutes	At 10 minutes	At 45 minutes
Rough endoplasmic reticulum	80	10	5
Golgi apparatus	10	80	30
Secretory vesicles	0	5	60

(a) Name ONE type of molecule synthesised from amino acids in cells.

……..

(1)

(b) Explain why the radioactivity is associated mainly with the rough endoplasmic reticulum after the first 5 minutes of the experiment.

……..

……..

……..

……..

(2)

(c) Explain the changes in the pattern of radioactivity in the cell during the remaining 40 minutes of the experiment.

……..

……..

……..

……..

……..

(3)

(d) Suggest why the figures in the tables total less than 100%.

……..

……..

……..

……..

(2)

(e) If the experiment is continued for a further period of time, most of the radioactivity will be found outside the cell.

Name and describe the process which brings about this result.

……..

……..

……..

……..

……..

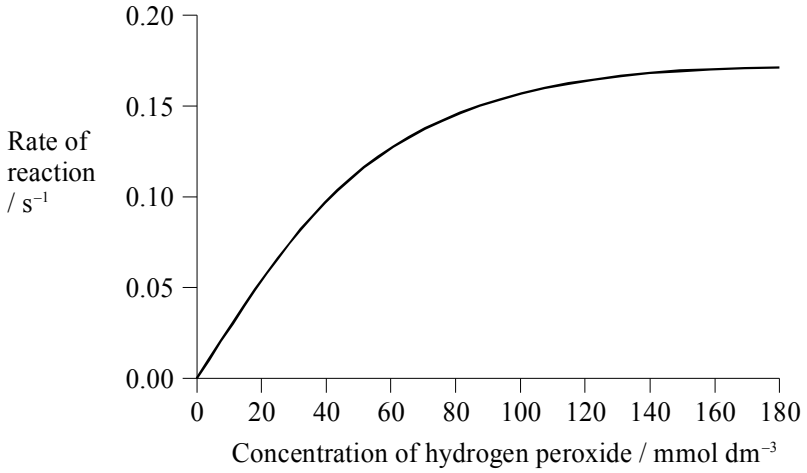
(3)

(Total 11 marks)

108. Catalase is an enzyme that breaks down hydrogen peroxide into oxygen and water. The activity of catalase can be measured by soaking small discs of filter paper in a solution containing the enzyme. The discs are immediately submerged in a dilute solution of hydrogen peroxide. The filter paper discs sink at first, but float to the surface as oxygen bubbles are produced. The reciprocal of the time taken for the discs to rise to the surface indicates the rate of reaction.

An experiment was carried out to investigate the effect of substrate concentration on the activity of catalase. A filter paper disc was soaked in a solution containing catalase, and then submerged in a buffer solution containing hydrogen peroxide. The time taken for the disc to rise to the surface was recorded. This experiment was repeated using a range of concentrations of hydrogen peroxide.

The results are shown in the graph below.



(a) State why a buffer solution was used in this experiment.

……..

……..

(1)

(b) Describe the relationship between the rate of reaction and the concentration of hydrogen peroxide as shown by the graph.

……..

……..

……..

……..

……..

……..

(3)

(c) Explain this relationship between substrate concentration and the rate of reaction.

……..

……..

……..

……..

……..

(3)

(d) Describe how a solution containing 160 mmol of hydrogen peroxide per dm^3 would be diluted to prepare a solution containing 80 mmol of hydrogen peroxide per dm^3.

……..

……..

……..

……..

(2)

(e) Describe how this experiment could be modified to investigate the effect of temperature on the activity of catalase.

……..

……..

……..

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……..

(4)

(Total 13 marks)

109. Give an account of the process of mitosis.

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(Allow three lined pages)

(10)

110. The table below refers to features of prokaryotic and eukaryotic cells. If the feature is usually present, place a tick (✓) in the appropriate box and if the feature is absent, place a cross (**X**) in the appropriate box.

Feature	Prokaryotic cell	Eukaryotic cell
Cell surface membrane		
Plasmids		
Ribosomes		
Mitochondria		

(Total 4 marks)

111. Read through the following passage about protein structure, then write on the dotted lines the most appropriate word or words to complete the passage.

Proteins are composed of long chains of monomers called ....., which are linked together by ..... bonds. These bonds are formed by ..... reactions between adjacent monomers. The primary structure of a protein is the specific sequence of monomers in a polypeptide chain and determines the secondary and tertiary protein structure. The secondary structure of a protein may be a coil, known as an ..... which is held in shape by ..... bonds between different monomers in the chain.

(Total 5 marks)

112. (a) Explain what is meant by the term **diffusion.**

.....

.....

.....

.....

(2)

(b) State **two** factors which influence the rate of diffusion across a cell surface membrane.

1 .....

2 .....

(2)

(c) Give **one** way in which **active transport** differs from **diffusion.**

.....

.....

(1)

(Total 5 marks)

113. Describe the role of messenger RNA (mRNA) in the following processes.

(a) Transcription

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.....

.....

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(3)

(b) Translation

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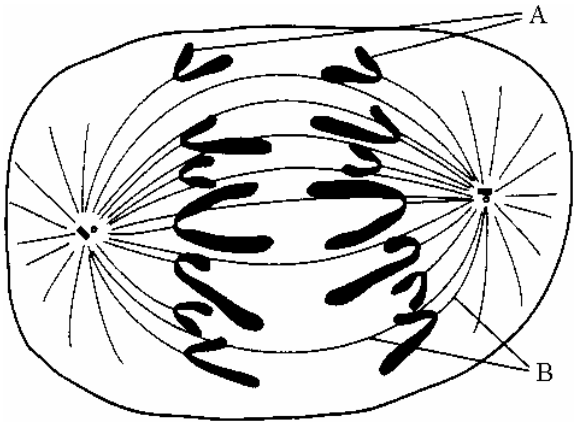
(3)
(Total 6 marks)

114. The drawing below shows an animal cell, magnified × 1000, undergoing mitosis.



(a) Give **two** features that help to identify this as an animal cell.

1 .....

2 .....

(2)

(b) Name the parts labelled A and B.

A .....

B .....

(2)

(c) Name the stage of mitosis shown in the drawing.

.....

(1)

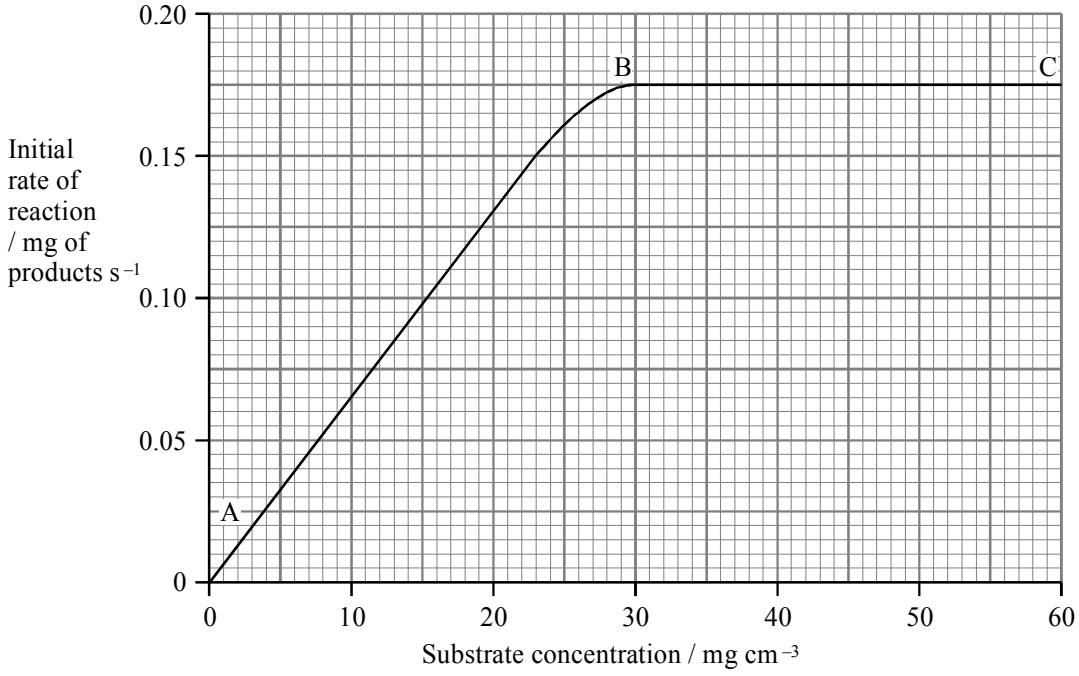
(d) Calculate the actual maximum diameter of this cell. Show your working.

Answer .....

(2)

(Total 7 marks)

115. The graph below shows the results of an investigation into the effect of substrate concentration on the initial rate of an enzyme-controlled reaction.



(a) Suggest **two** conditions, apart from temperature, that should be kept constant in this investigation.

1 .....

2 .....

(2)

(b) Explain why changes in the substrate concentration cause an increase in the rate of reaction between points **A** and **B** on the graph.

.....

.....

.....

.....

(2)

(c) Suggest why the curve levels off between points **B** and **C.**

.....

.....

.....

.....

(2)

(d) On the graph on page 6, sketch a curve to show how the results for the investigation would change if it were repeated at a lower temperature.

Explain any differences between the two curves.

.....

.....

.....

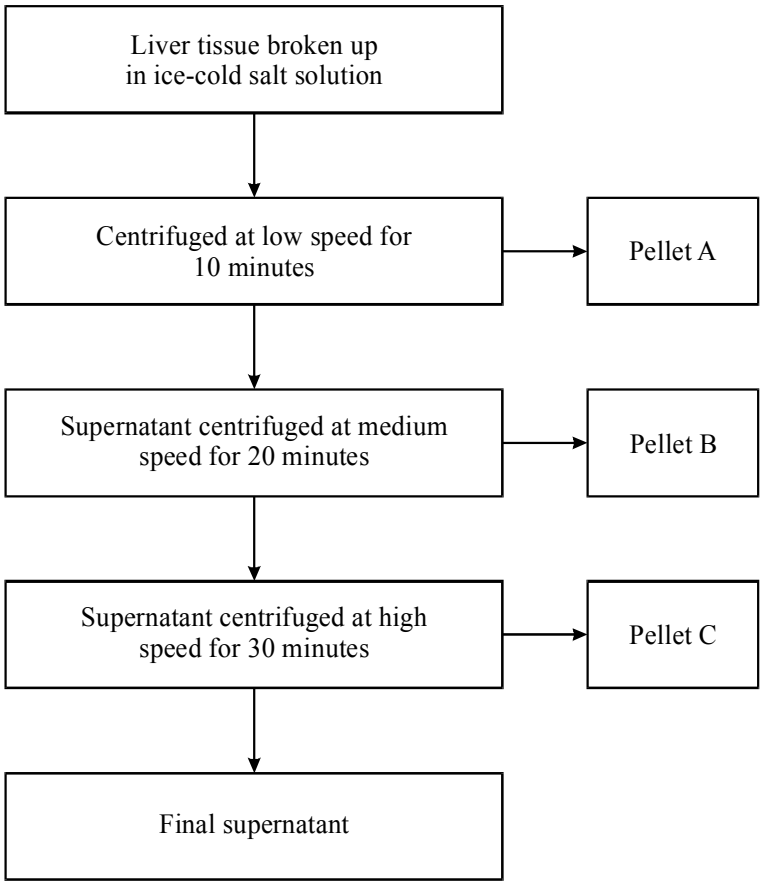
.....

(3)
(Total 9 marks)

116. A procedure was carried out to separate the major organelles within liver cells. This involved breaking up (homogenising) liver tissue in an ice-cold salt solution which had the same water potential as the cell cytoplasm.

Ultracentrifugation was then used to separate the organelles. Ultracentrifugation is a process that separates materials of different densities by spinning them in a tube at different speeds. The denser materials are forced to the bottom of the tube as a pellet, while less dense materials remain nearer to the top of the tube in liquid known as the supernatant.

The flow chart below summarises the steps involved in this procedure.



(a) Suggest why it was necessary for the salt solution to have the same water potential as the cell cytoplasm.

.....

.....

.....

.....

(2)

(b) This procedure separated mitochondria, nuclei and ribosomes into the three pellets, **A, B** and **C.** Complete the table below to show which one of these organelles would be found in which pellet.

Pellet	Organelle
A	
B	
C	

(2)

(c) Suggest **two** components of the cell, other than water, that might be present in the final supernatant.

1 .....

2 .....

(2)

(d) In the space below, draw and label a diagram to show the structure of a mitochondrion.

(4)

(e) Explain why large numbers of mitochondria are found in liver cells.

.....

.....

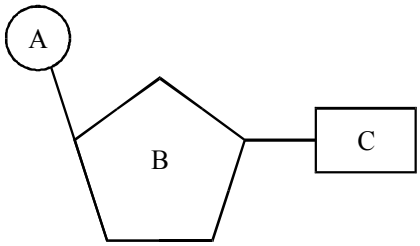
.....

.....

(2)

(Total 12 marks)

117. The diagram below shows the structure of a nucleotide.



(a) Identify the parts labelled A, B and C in the diagram.

A .....

B .....

C .....

(3)

(b) The sequence of bases from part of a gene is shown below.

A G C C G T C C C G T C

Write out the sequence of bases on messenger RNA (mRNA) that would be coded for by this part of the gene.

.....

(2)

(c) Describe what is meant by the **semi-conservative replication** of DNA.

.....

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.....

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.....

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.....

(4)

(d) A quantity of DNA was labelled with radioactive nitrogen. It was then allowed to replicate three times, using non-radioactive nucleotides to synthesise the new DNA strands. What proportion of the final mass of DNA would you expect to be radioactive? Explain your answer.

.....

.....

.....

.....

(2)

(e) In which stage of the cell cycle does replication of DNA take place?

.....

(1)
(Total 12 marks)

118. Give an account of the structure and functions of the cell surface membrane.

.....

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.....

(Allow three lined pages)

(Total 10 marks)

119. The table below refers to two disaccharides, sucrose and maltose. If the statement is correct, place a tick (✓) in the appropriate box and if the statement is incorrect, place a cross (✗) in the appropriate box.

Statement	Sucrose	Maltose
Contains glucose		
Is a reducing sugar		
Contains glycosidic bonds		
Is transported in the phloem of flowering plants		

(Total 4 marks)

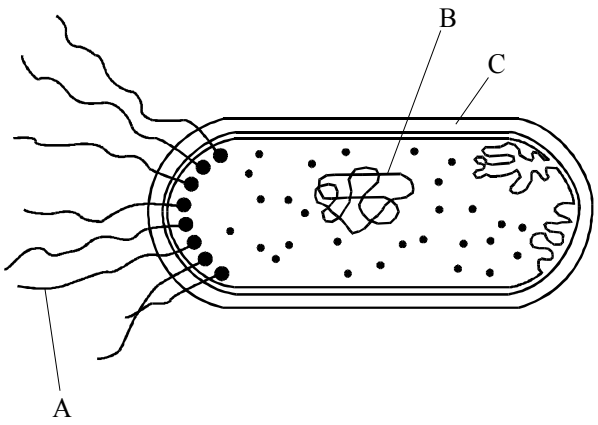
120. Read through the following account of the properties of water, then write on the dotted lines the most appropriate word or words to complete the account.

Water has the chemical formula …… . Water molecules are described as …….. because they have a slight positive charge at one end of the molecule and a slight negative charge at the other end. As a result, individual molecules form …….. bonds with each other.

Water is an important …….. in living organisms because most biochemical reactions take place in aqueous solution. Water also has a high ……., which means that its temperature remains relatively stable despite large changes in the temperature of the surrounding environment.

(Total 5 marks)

121. The diagram below shows the structure of a bacterium, a typical prokaryotic cell.



(a) Name A, B and C as labelled on the diagram.

A .....

B .....

C .....

(3)

(b) Complete the table below to show **three** differences between a prokaryotic cell and a eukaryotic cell.

	Prokaryotic cell	Eukaryotic cell
1		
2		
3		

(3)
(Total 6 marks)

122. Explain what is meant by the following terms.

(a) Semi-conservative replication of DNA

……..

……..

……..

……..

……..

……..

(3)

(b) Tertiary structure of a protein

……..

……..

……..

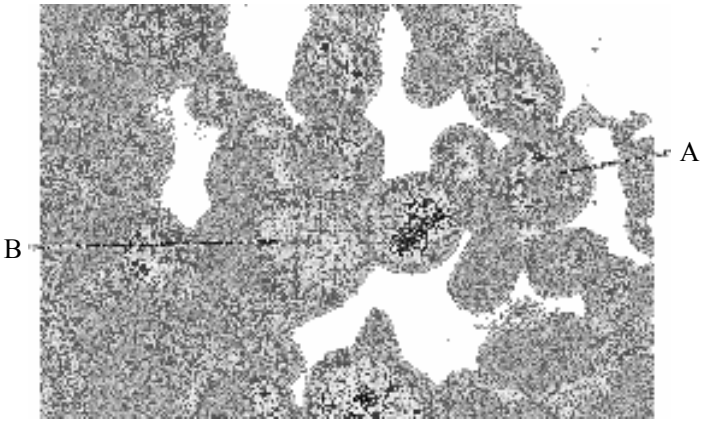
……..

……..

……..

(3)
(Total 6 marks)

123. The photograph below shows human cells as seen using a light microscope. It has been magnified 800 times.



(a) Calculate the actual diameter of the cell labelled A, expressing your answer in μm (micrometres). Show your working.

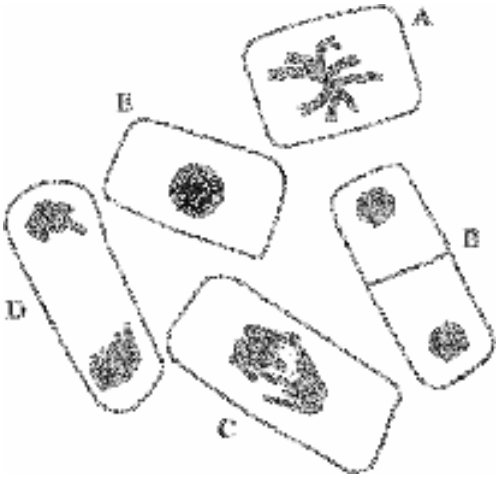
Answer …… μm

(3)

(b) In the space below, make an accurate drawing of the cells labelled A and B, enlarge 2 ×. Do not label your drawing.

(4)
(Total 7 marks)

124. The diagram below shows cells from a root tip, prepared by the root tip squash method.



(a) Describe how you would prepare a root tip squash so that mitosis can be studied.

……..

……..

……..

……..

……..

……..

……..

……..

(4)

(b) State which of the cells labelled A–E is in:

(i) metaphase .....

(ii) anaphase .....

(2)

(c) State **two** events that take place during interphase.

1. ……..

2. ……..

(2)

(Total 8 marks)

125. (a) (i) Explain what is meant by the term **facilitated diffusion**.

.....

.....

.....

.....

(2)

(ii) State **two** ways in which active transport differs from facilitated diffusion.

1 .....

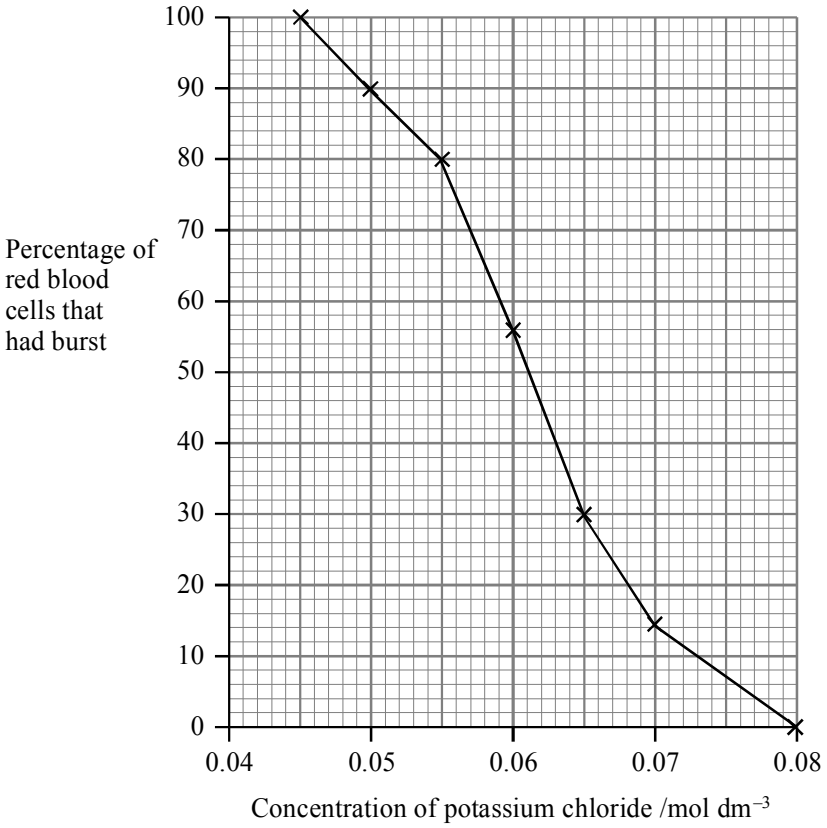
.....

2 .....

.....

(2)

(b) In an investigation into the effects of osmosis on red blood cells, seven samples of red blood cells were placed in potassium chloride solutions of different concentrations. After two hours, each sample was examined to find the percentage of cells that had swollen and burst (lysed). The results are shown in the graph below.



(i) Calculate the difference between the percentage of red blood cells that burst in 0.05 mol dm^{-1} and 0.07 mol dm^{-1} potassium chloride solutions.
Show your working.

Answer .....

(2)

(ii) With reference to water potential, explain why most of the cells burst when placed in 0.05 mol dm^{-3} potassium chloride solution.

……

……

……

……

……

……

(3)

(iii) Suggest what would happen if red blood cells were placed in a 0 1 mol dm^{-3} solution of potassium chloride.

……

……

(1)

(c) Explain why plant cells do not burst when placed in distilled water.

……

……

……

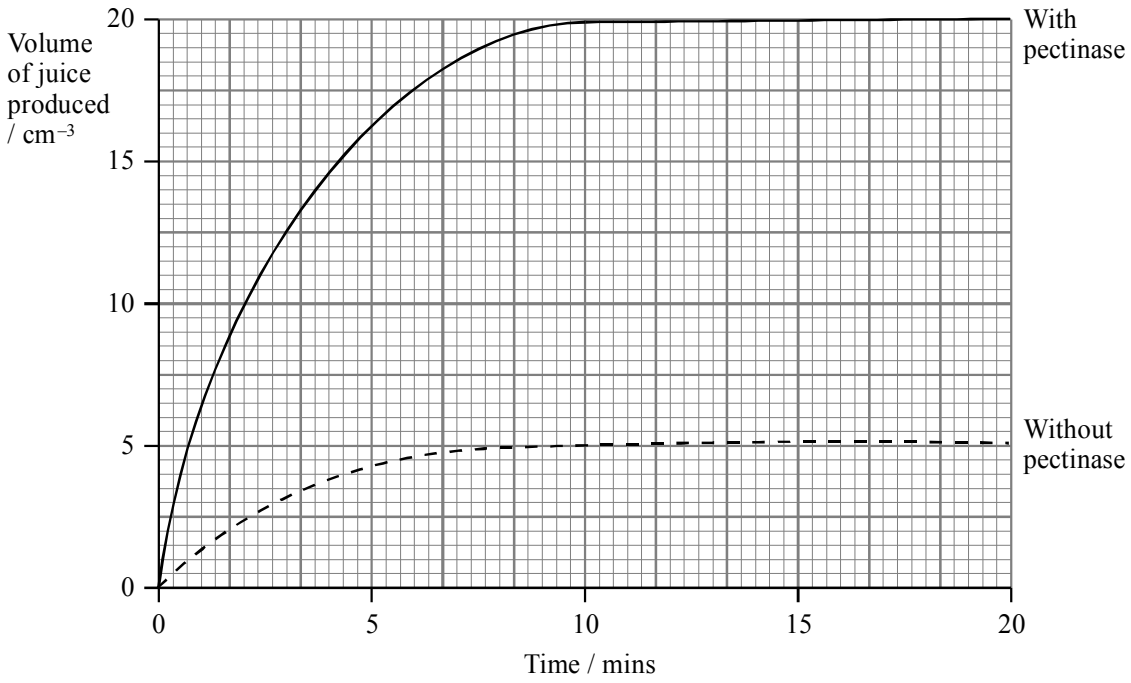
……

(2)
(Total 12 marks)'

126. An experiment was performed to determine the effect of pectinase on the yield of apple juice. An apple was cut into small pieces and blended in a food processor to produce apple pulp. The pulp was then left to stand for 15 minutes.

One 50 g sample of pulp was mixed with 5 cm^3 of pectinase solution and a second 50 g sample of pulp was mixed with 5 cm^3 of water. Each sample was then placed in a separate filter funnel and the Juice was collected in a measuring cylinder. The volume of Juice produced was recorded every minute for 20 minutes.

The results of this experiment are shown in the graph below.



(a) (i) With reference to the graph, describe how pectinase affects the production of apple juice.

.....

.....

.....

.....

(2)

(ii) Explain why pectinase has this effect on the production of apple juice.

.....

.....

.....

.....

(2)

(b) Apples contain chemicals which act as active site-directed inhibitors of pectinase, However, these chemicals lose their effectiveness when exposed to air.

(i) Explain what is meant by the term **active site-directed inhibition**.

.....

.....

.....

.....

(2)

(ii) In a second experiment the apple pulp was left to stand for 30 minutes before mixing it with pectinase. Suggest what effect this would have had on the volume of juice produced. Explain your answer.

.....

.....

.....

.....

(2)

(c) Describe how you would carry out an experiment to investigate the effect of temperature on the production of apple juice using pectinase.

……

……

……

……

……

……

……

……

(4)
(Total 12 marks)

127. Give an account of the structure and functions of lipids, including triglycerides and phospholipids.

(Allow 3 lined pages)

(Total 10 marks)

128. The table below refers to the structure of different types of nucleic acids. If the feature is present,

place a (✓) in the appropriate box and if the feature is absent place a cross (✗) in the appropriate box.

Feature	DNA	mRNA
Cytosine present		
Uracil present		
Pentose sugar present		
Is single stranded		

(Total 4 marks)

129. Read through the following passage about protein structure, then write on the dotted lines the most appropriate word or words to complete the passage.

The tertiary structure of a protein depends on its primary and secondary structure.

The primary structure is the …….. of amino acids, which are joined together by …….. bonds to form a chain. This type of bond is formed when a …….. reaction takes place between two amino acids.

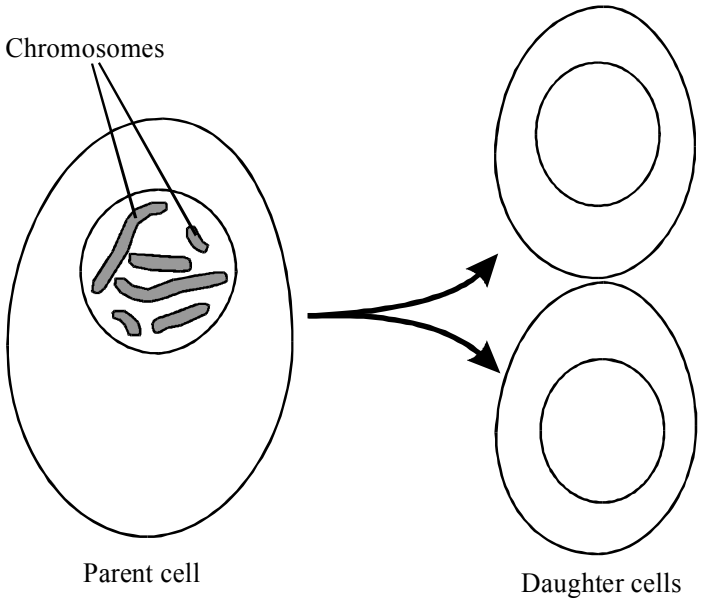
The chain of amino acids may be folded into an alpha helix, held in shape by …….. bonds.

A number of different types of bonds hold the tertiary and quaternary structure in shape. For example, the two peptide chains in insulin are held together by …….. bonds which form between the …….. of certain amino acids.

(Total 6 marks)

130. Yeast cells grown in culture will divide asexually to form a clone of yeast cells.

The diagram below shows this process occurring.



(a) Explain what is meant by the term **clone**.

……

……

……

……

(2)

(b) On the diagram of **one** of the daughter cells, draw in the chromosomes that would be found in the nucleus.

(c) Suggest **two** advantages of asexual reproduction to an organism.

1 .....…

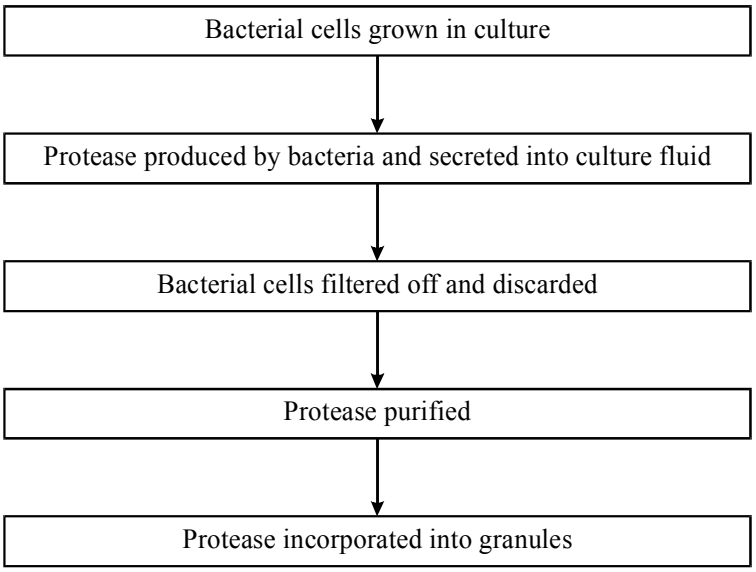
.....

2 .....…

.....

(2)
(Total 5 marks)

131. The diagram below represents some of the stages involved in the commercial production of the enzyme protease for use in the manufacture of a biological detergent.



(a) Explain why proteases are incorporated into biological detergents.

……

……

……

……

……

……

(3)

(b) The bacteria used in this process normally live in hot water springs where the temperature stays above 45 °C.

Suggest **two** reasons why it is an advantage to use the enzymes from these bacteria in the detergents.

1 ……

……

2 ……

……

(2)

(c) When the granules containing the protease come into contact with water they swell and release their contents.

Suggest why the enzymes are incorporated into granules during the manufacture of biological detergents.

……

……

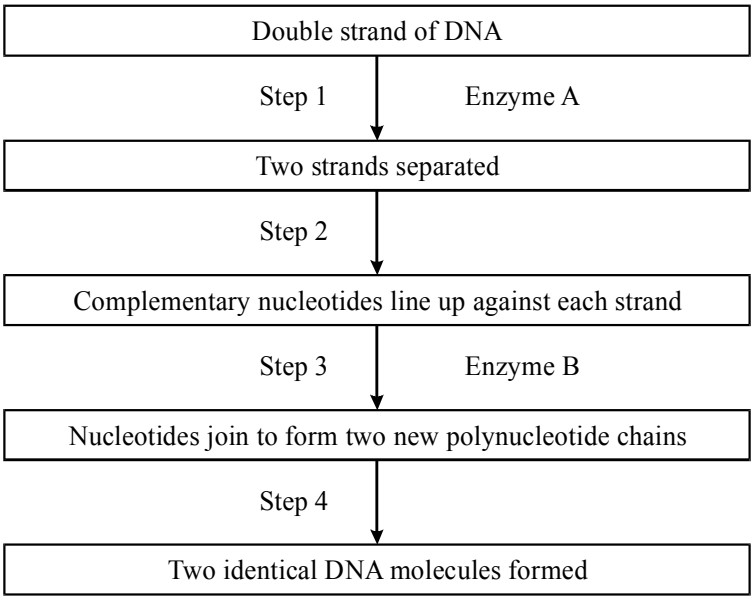
……

……

(2)

(Total 7 marks)

132. The diagram below summarises the steps involved in the semi-conservative replication of DNA.



(a) Describe how Enzyme A separates the two DNA strands in Step 1.

……

……

(1)

(b) In Step 3 the individual nueleotides are joined up to form a polynucleotide chain by Enzyme B.

Name the type of reaction that Enzyme B catalyses.

……

(1)

(c) Give the phase of the cell cycle during which DNA replication occurs.

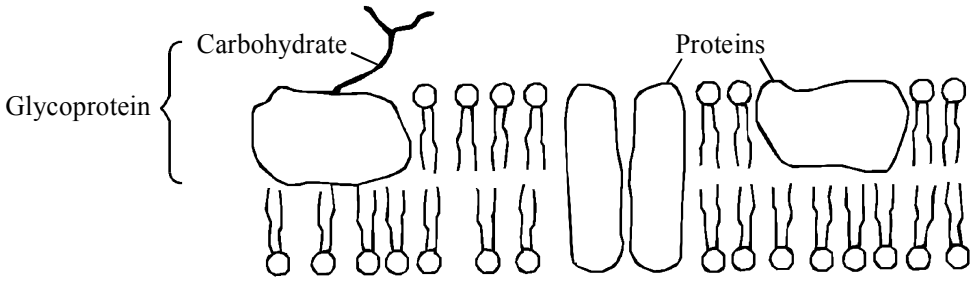
……

(1)

(d) Draw and label a diagram to show the appearance of a chromosome as it appears in metaphase of mitosis.

(3)
(Total 6 marks)

133. The diagram below shows the structure of the cell surface membrane.



(a) The cell surface membrane is composed of a phospholipid bilayer. Explain why tile phospholipids in the bilayer are arranged with the fatty acid tails pointing inwards and the phosphate heads outwards.

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……

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……

(3)

(b) The diagram has been magnified three million (3×10^6) times. Calculate the width of the cell surface membrane in tin (micrometres). Show your working.

Answer …… μm

(3)

(c) State **one** function of each of the following components of the cell surface membrane.

Carbohydrate ……..

Protein ……

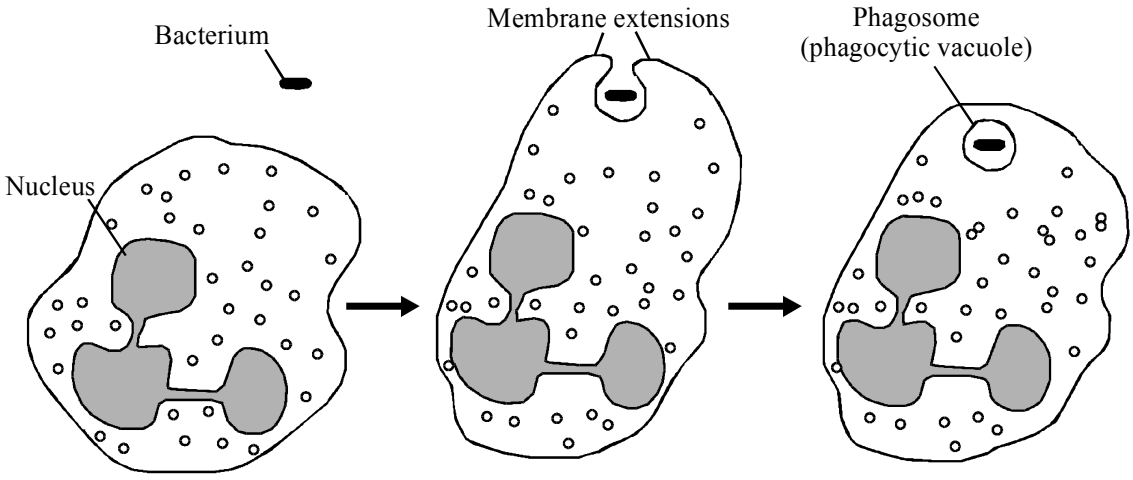
(2)

(Total 8 marks)

134. Some bacteria were grown in a culture with radioactive amino acids. They used the labelled amino acids to synthesise proteins which were incorporated into their cells.

The bacteria were then washed thoroughly and mixed with some white blood cells. The amount of radioactivity taken up by the white blood cells was measured at intervals of two hours for 24 hours.

The white blood cells were phagocytic and engulfed (took up) the bacteria by a process called phagocytosis. Phagocytosis is a form of endocytosis. This process is illustrated in the diagram below.



White blood cell

Lysosomes then fuse with the phagosome and release their contents into it.

The table below shows the level of radioactivity found inside and outside the white blood cells during the 24 hour period.

Time after mixing cells together/hours	Radioactivity inside white blood cells/arbitrary units	Radioactivity outside white blood cells/arbitrary units
0	0	80
2	16	64
4	48	32
6	61	19
8	70	10
10	72	8
12	72	8
14	71	9
16	43	37
18	21	59
20	10	70
22	8	72
24	5	75

(a) (i) Describe the structure of a lysosome.

……

……

……

……

(2)

(ii) Describe the roles of lysosomes.

……

……

……

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(2)

(b) Describe the changes in the level of radioactivity found inside the white blood cells during the period of 24 hours.

……

……

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……

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……

(3)

(c) Suggest what is happening to the bacteria inside the phagosomes between 10 and 14 hours.

……

……

(d) Explain why the amount of radioactivity increases outside the white blood cells after 14 hours.

……

……

……

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(2)

(e) Suggest why the white blood cells did not take up all the radioactivity.

……

……

(1)

(Total 11 marks)

135. The rate of an enzyme-catalysed reaction can be altered by the presence of an inhibitor.

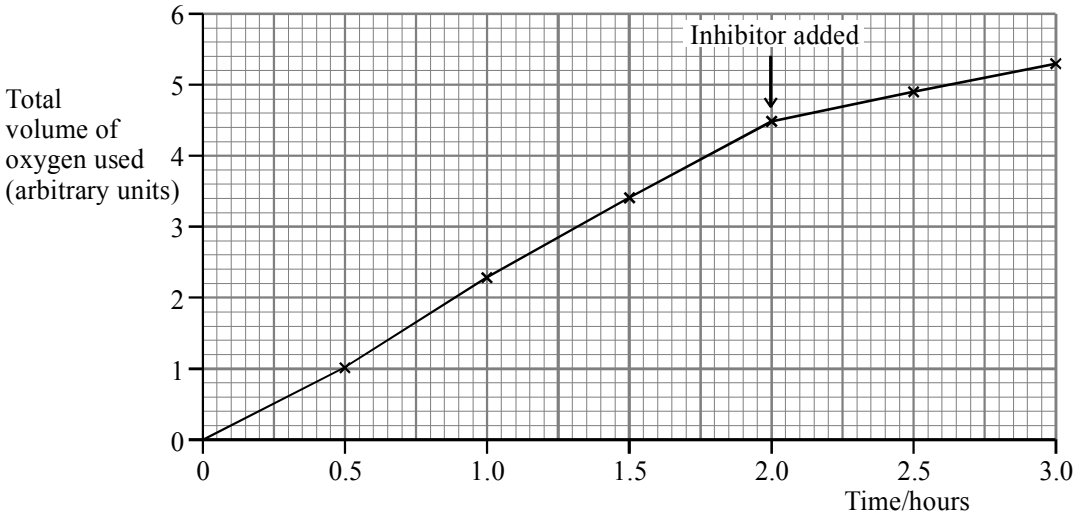
An investigation was carried out into the effect of an inhibitor on enzyme activity in barley root tips. Enzyme activity was measured by finding the rate at which oxygen was used by the root tips.

Several groups of students carried out experiments in which the volume of oxygen used by root tips of barley seedlings was measured over a period of 2 hours.

Each group of students used 50 root tips from seedlings of the same age. These were placed in the same volume of a pH 6.5 buffer solution and kept at 30 °C.

After 2 hours, the same volume of a 1% solution of an inhibitor was added to each set of root tips. The students continued to record the volume of oxygen used for a further hour.

The results are shown in the graph below.



(a) Compare the enzyme activity during the first two hours of the experiment with the activity after the inhibitor was added.

……

……

……

……

(2)

(b) The inhibitor used in this experiment was a non-active site-directed inhibitor.

Explain what is meant by **non-active site-directed inhibition**.

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(3)

(c) Suggest what effect increasing the concentration of the inhibitor might have on the rate at which oxygen was used by the root tips. Give an explanation for your answer.

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(2)

(d) Suggest why readings were taken for 2 hours before the inhibitor was added

……

……

(1)

(e) Suggest why the root tips were kept at a temperature of 30 °C throughout this investigation.

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(2)

(f) Explain why a buffer solution was used in this experiment.

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(2)

(g) Suggest **one** reason why the results from the different groups of students might vary.

……

……

(1)
(Total 13 marks)

136. Give an account of the structure and function of the polysaccharides cellulose, starch and glycogen.

(Allow three lined pages)

(Total 10 marks)

137. Read through the following passage about enzymes, then write on the dotted lines the most appropriate word or words to complete the passage.

Enzymes can be described as biological ..... as they reduce

the ..... needed for a metabolic reaction to occur.

The ..... combines with the enzyme at a specific region of

the molecule called the ..... . The shape of this region can

be altered by a change in pH or ..... which will

..... the rate of the metabolic reaction.

(Total 6 marks)

138. (a) State **two structural** differences between the molecules of the polysaccharides cellulose and glycogen.

	Cellulose	Glycogen
1		
2		

(2)

(b) State **two structural** differences between the molecules of the proteins collagen and insulin.

	Collagen	Insulin
1		
2		

(2)
(Total 4 marks)

139. (a) A student was given two carbohydrate solutions, labelled A and B, and was told to perform two tests on each solution.

Test 1: Add Benedict's solution and heat.

Test 2: Add hydrochloric acid and boil.
Neutralise with alkali.
Add Benedict's solution and heat.

The table below shows the colour of each solution after testing.

Solution	Colour after Test 1	Colour after Test 2
A	Red	
B	Blue	Red

(i) Complete the table to show what colour solution A would be following Test 2.

(1)

(ii) Explain why these results indicate that solution B contained a non-reducing sugar.

.....

.....

.....

.....

(2)

(b) Describe how you would use biuret reagent to compare the concentration of proteins in two solutions.

.....

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.....

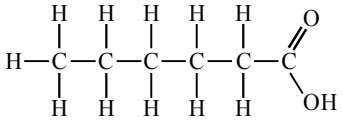
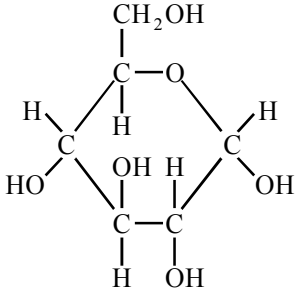
.....

.....

(3)
(Total 6 marks)

140. The table below refers to the formula and structure of some biological molecules.

Complete the table by writing in the name, the formula or the structure of the molecule where appropriate in the empty boxes.

Name	Formula	Structure
Water	H_2O	
	$NH_2RCHCOOH$	
Fatty acid		
		

(Total 6 marks)

141. Immobilised enzymes have a wide range of commercial applications.

(a) Explain what is meant by the term **enzyme immobilisation.**

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(2)

(b) Explain **two** advantages of using immobilised enzymes in industrial processes.

1. .....

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2. .....

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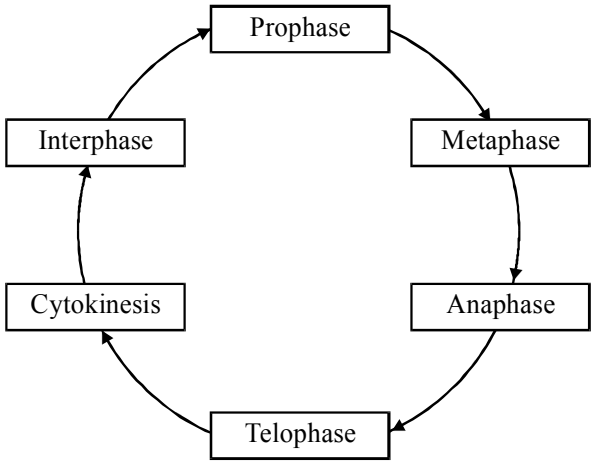
(4)
(Total 6 marks)

142. The diagram below shows the sequence of stages in the cell cycle.



(a) During the cell cycle, the DNA content of the cell changes. Identify the stage when the DNA content increases and the stage when the DNA content decreases. In each case give an explanation for your answer.

DNA increases .....

Explanation .....

.....

DNA decreases .....

Explanation.....

.....

(4)

(b) Proteins are synthesised during interphase of the cell cycle. Protein synthesis involves transcription and translation of the genetic code.

(i) Explain what is meant by the term **transcription**.

.....

.....

.....

.....

(2)

(ii) The letters below show the sequence of bases in part of a gene which codes for an enzyme.

ATGGAAAAAGC

Use the information in the table below to work out the sequence of amino acids which is coded for by this part of the gene. The names of the amino acids are shortened to their first three letters. You do not need to write down the full names of the amino acids.

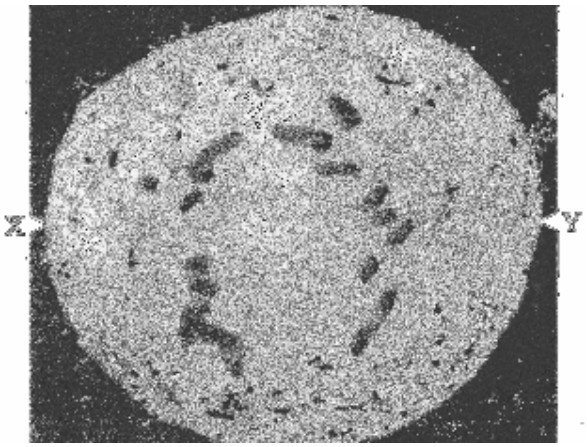
		Second base					
		A	**G**	**T**	**C**		
First base	**A**	AAA, AAG: Phe AAT, AAC: Leu	AGA, AGG, AGT, AGC: Ser	ATA, ATG: Tyr ATT, ATC: STOP	ACA, ACG: Sys ACT: STOP ACC: Trp	**A** **G** **T** **C**	**Third base**
	G	GAA, GAG, GAT, GAC: Leu	GGA, GGG, GGT, GGC: Pro	GTA, GTG: His GTT, GTC: Gln	GCA, GCG, GCT, GCC: Arg	**A** **G** **T** **C**	

Sequence of amino acids .....

(2)

(Total 8 marks)

143. The photograph shows a cell in mitosis as viewed using a transmission electron microscope.



Dr D. Spector, Peter Arnold Inc./ Science Photo Library

(a) The actual diameter of the cell between points X and Y is 50 μm. Calculate the magnification of this photograph. Show your working.

Answer .....

(3)

(b) In the space below make an accurate drawing of the cell. Label the chromosomes, spindle fibres and centrioles.

(5)

(c) State the stage of mitosis that this cell is in.

.....

(1)

(d) State **one** function of each of the following.

Spindle fibres

.....

.....

Centrioles

.....

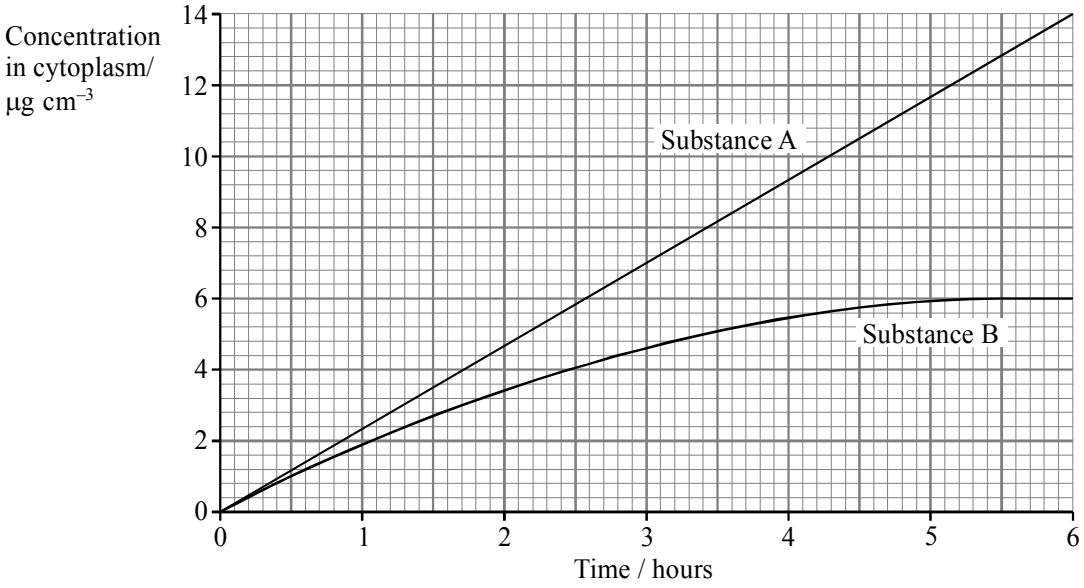
.....

(2)
(Total 11 marks)

144. An experiment was carried out to compare the uptake of two substances, A and B, by *Amoeba*. *Amoeba* is a single-celled aquatic organism.

Cells of *Amoeba* were placed in a solution containing equal concentrations of both substances and kept at 15 °C. The concentration of each substance in the cytoplasm of the cells was measured every 30 minutes over a period of 6 hours.

The results of this experiment are shown in the graph below.



(a) Compare the uptake of substance A by the cells with the uptake of substance B during the period of 6 hours.

.....

.....

.....

.....

.....

.....

(3)

(b) Substance B enters the cells by diffusion. Describe and explain how the results of this experiment support this statement.

.....

.....

.....

.....

.....

.....

(3)

(c) Explain why an increase in temperature to 25 °C would increase the rate of diffusion of substance B into the cells.

.....

.....

.....

.....

(2)

(d) Substance A is taken into *Amoeba* by active transport. Describe the process of active transport.

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(5)
(Total 13 marks)

145. The information in the table below refers to some carbohydrates and their roles in living organisms.

Complete the table by writing the name of the carbohydrate, or **one** role, in each of the empty boxes.

Carbohydrate	**One** role in living organisms
	Form in which carbohydrate is transported in mammals
Sucrose	
	Form in which carbohydrate is stored in mammals
Cellulose	

(Total 4 marks)

146. Distinguish between each of the following pairs of terms.

(a) Tissues and organs

.....

.....

.....

.....

(2)

(b) Magnification and resolution

.....

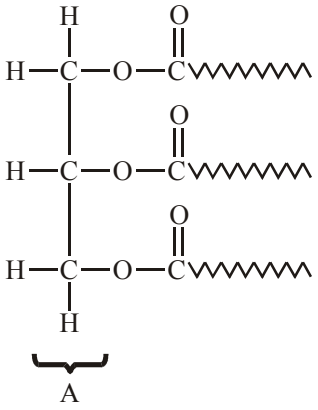
.....

.....

.....

(2)
(Total 4 marks)

147. The diagram below shows the structure of a triglyceride molecule.



(a) (i) Name the part of the molecule labelled A.

.....

(1)

(ii) Name the type of bond formed between part A and a fatty acid.

.....

(1)

(b) Stearic acid and oleic acid are both examples of fatty acids. Each has a hydrocarbon chain containing 17 carbon atoms. Stearic acid is a saturated fatty acid but oleic acid is an unsaturated fatty acid.

Give **two** ways in which the structure of a stearic acid molecule differs from the structure of an oleic acid molecule.

1 .....

.....

2 .....

.....

(2)

(c) Describe **two** functions of lipids in animals.

1 .....

.....

.....

.....

2 .....

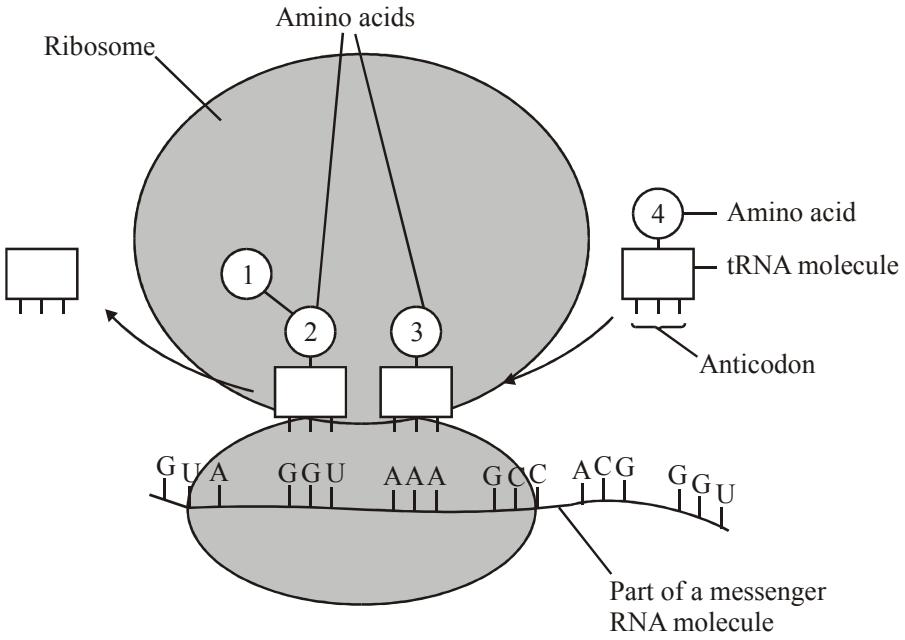
.....

.....

.....

(4)
(Total 8 marks)

148. The diagram below shows a stage in the process of translation during protein synthesis. This process is occurring on a ribosome.



(a) Describe the structure of a ribosome.

.....

.....

.....

.....

(2)

(b) The table below shows the anticodons of some tRNA molecules and the specific amino acids that each one carries.

tRNA anticodon	Amino acid
GGU	Proline
CCA	Glycine
AAA	Phenylalanine
CGA	Alanine
ACC	Tryptophan
UUU	Lysine

Using the information in the table, identify amino acids 2 and 3 shown in the diagram on the previous page.

Amino acid 2 .....

Amino acid 3 .....

(2)

(c) During translation, amino acids are linked by a peptide bond.

(i) Draw a diagram to show two amino acids linked by a peptide bond.

(3)

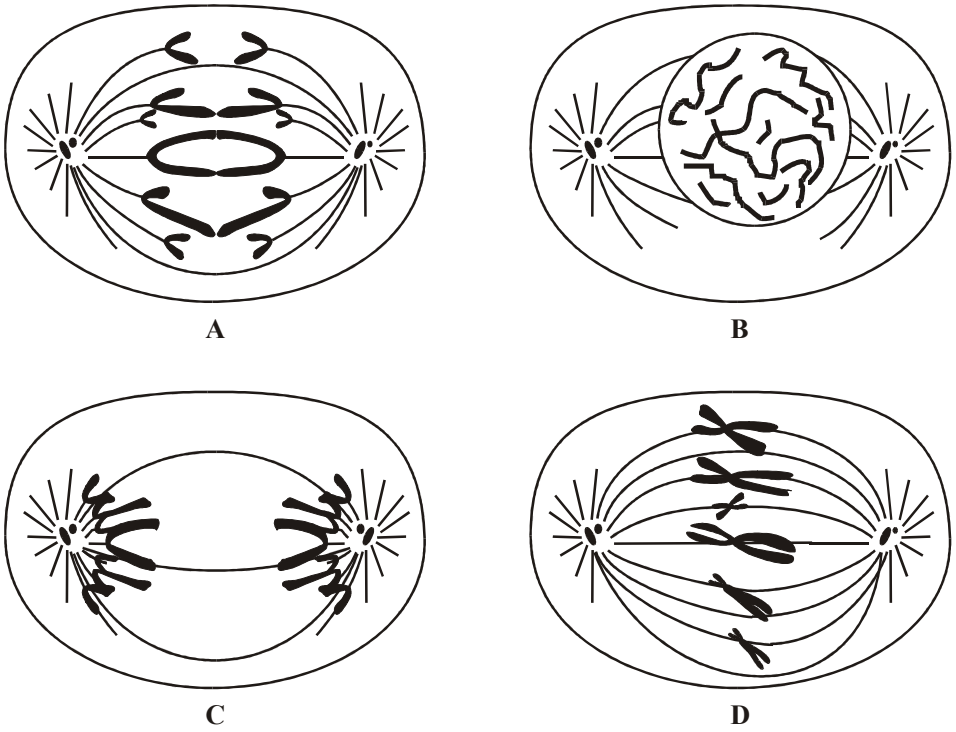
(ii) Name the type of reaction that occurs during the formation of a peptide bond.

.....

(1)

(Total 8 marks)

149. The diagrams below show four stages of mitosis.



(a) (i) Write the letters of the stages in the sequence in which they occur during mitosis.

....

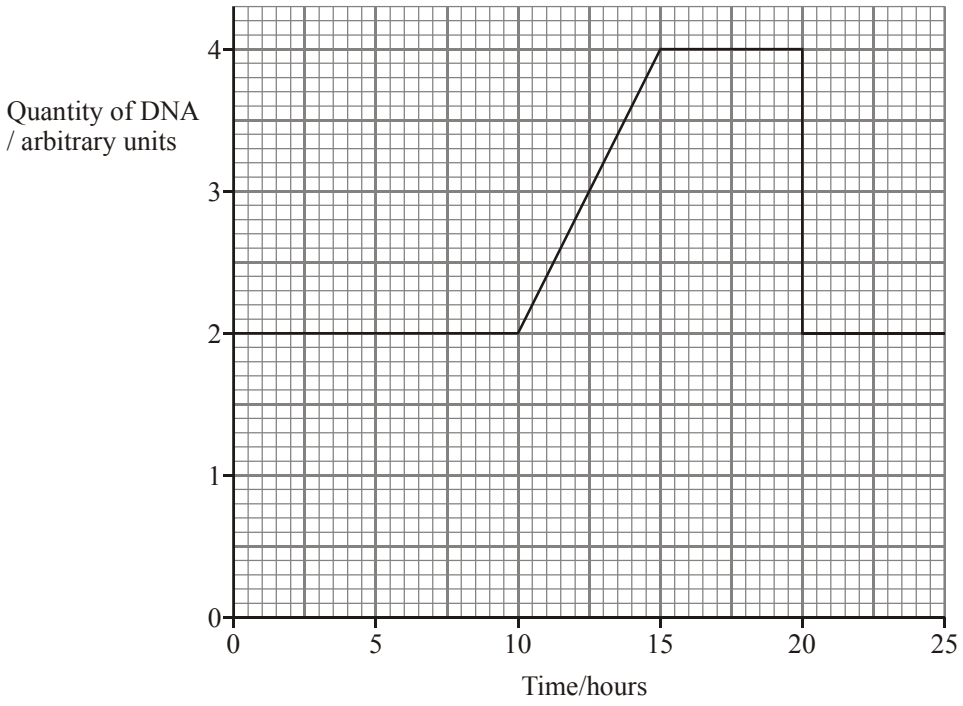
(1)

(ii) Name stage D.

.....

(1)

(b) The graph below shows how the quantity of DNA varies with time in a cell cycle.



(i) Explain the changes in the quantity of DNA that take place:

between 10 to 15 hours

.....

.....

at 20 hours

.....

.....

(2)

(ii) What is happening- in the cell between 15 and 20 hours?

.....

.....

(1)

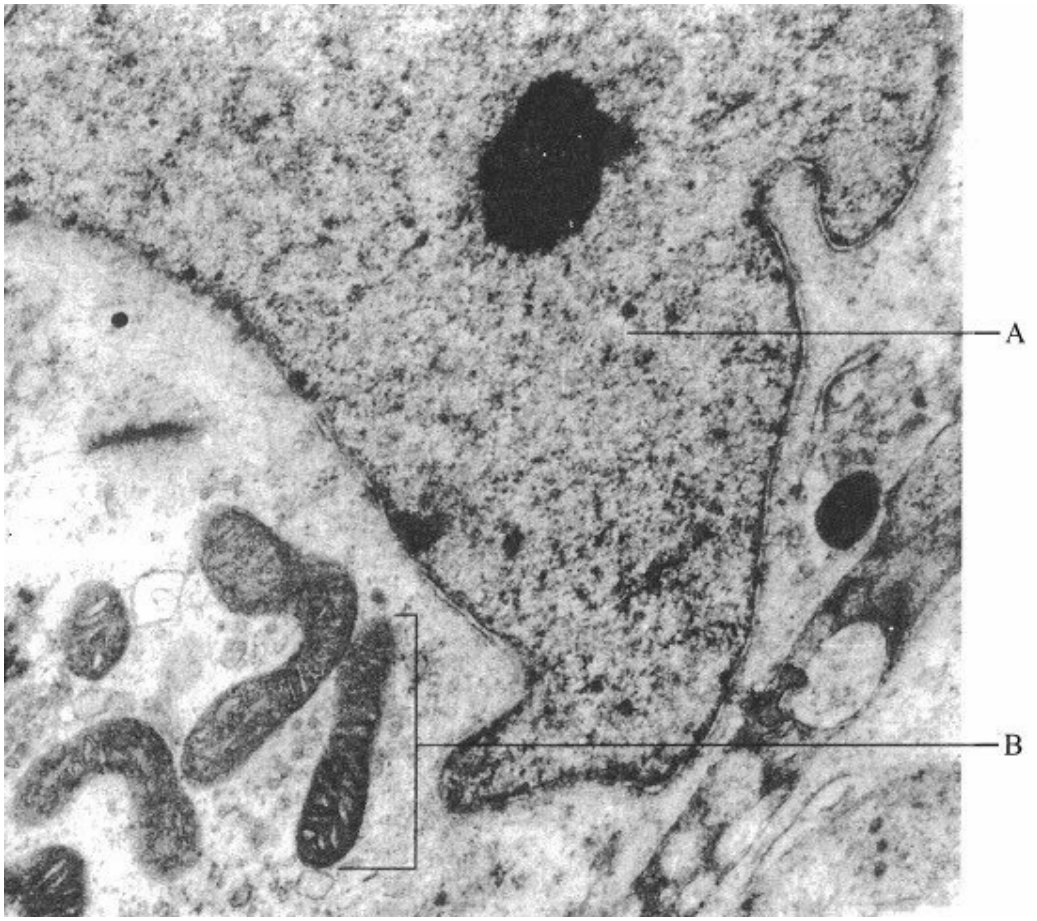
(iii) What is the **minimum** length of time that interphase would occupy in this cell cycle?

.....

(1)

(Total 6 marks)

150. The photograph below-shows part of an animal cell, as seen using an electron microscope. The magnification is ×5000.



(a) Name the structures labelled A and B.

A.....

B.....

(2)

(b) Calculate the actual length of the structure labelled B in μm. Show your working.

Actual length of B ..... μm

(3)

(c) Describe how proteins synthesised on the rough endoplasmic reticulum are processed and transported out of the cell.

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(5)

(Total 10 marks)

151. (a) A student prepared solutions of glucose, maltose and sucrose of varying concentrations. A sample of each one was heated with Benedict's reagent. The results are shown in Table 1.

Table 1

	Concentration of solution/mol dm^{-3}		
Solution	0.0001	0.001	0.01
Glucose	Blue solution	Green precipitate	Orange precipitate
Maltose	Blue solution	Green precipitate	Orange precipitate
Sucrose	Blue solution	Blue solution	Blue solution

A fresh sample of each solution was boiled with dilute acid, neutralised, then heated with Benedict's reagent. The results are shown in Table 2.

Table 2

	Concentration of solution /mol dm^{-3}		
Solution	0.0001	0.001	0.01
Glucose	Blue solution	Green precipitate	Orange precipitate
Maltose	Green precipitate	Green precipitate	Orange precipitate
Sucrose	Green precipitate	Green precipitate	Orange precipitate

(i) Use the information in Table I and Table 2 to explain the results for sucrose.

.....

.....

.....

.....

(2)

(ii) Explain the difference shown in Table 2 between the results obtained for glucose and those obtained for maltose.

.....

.....

.....

.....

(2)

(b) Describe how you would test two solutions of the same protein to find out which contains the higher concentration of the protein.

.....

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(4)
(Total 8 marks)

152. (a) With reference to enzyme activity, explain the meaning of the following terms:

Catalyst .....

.....

.....

.....

.....

Activation energy …….....

.....

.....

.....

.....

(4)

(b) An investigation was carried out to study the effect of copper sulphate concentrations on the breakdown of cellulose by the enzyme cellulase.

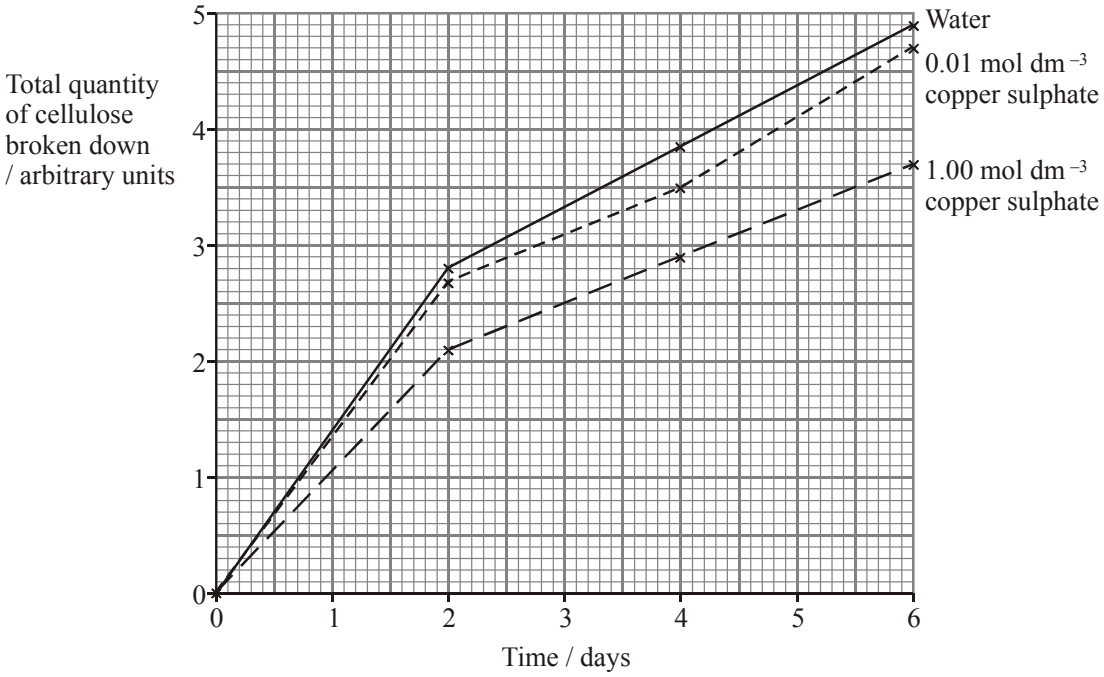
Two concentrations of copper sulphate were used.

0.01 mol dm^{-3}

1.00 mol dm^{-3}

Water was used as a control.

The results are shown in the graph below.



(i) Name the type of reaction that is catalysed by cellulase.

.....

(1)

(ii) Name the bond that is broken by cellulase.

.....

(1)

(iii) Using the information shown in the graph, describe the effect of copper sulphate on the rate of breakdown of cellulose.

.....

.....

.....

.....

.....

.....

(3)

(iv) Copper ions bind to cellulase and cause disulphide bonds to break.

Explain the effect of copper ions on the activity of the cellulase.

.....

.....

.....

.....

.....

.....

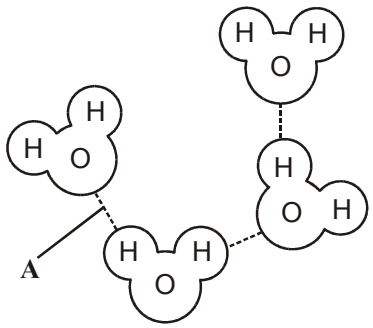
(3)
(Total 12 marks)

153. The following table refers to organelles found in eukaryotic cells. Complete the table by writing the name of the organelle, **two** features of its structure or **one** function of the organelle in each of the four empty boxes as appropriate.

Name of organelle	**Two** features of structure	**One** function
	1. Stack of curved cisternae 2. Surrounded by many vesicles	Modification of proteins
Rough endoplasmic reticulum	1. 2.	
Chloroplast	1. 2.	Site of photosynthesis

(Total 6 marks)

154. The diagram below shows four molecules of water.



(a) Name the type of bond labelled **A** on the diagram.

……

(1)

(b) Explain why water molecules are described as **dipolar**.

……

……

……

……

(2)

(c) One of the properties of water is that it has a high specific heat capacity. Explain why this property is important for organisms that live in water.

……

……

(2)

(Total 5 marks)

155. (a) The table below describes three carbohydrates.

Complete the table by writing the name of each carbohydrate next to its description.

Description of carbohydrate	Name of carbohydrate
A pentose found in transfer RNA	
A disaccharide consisting of glucose and galactose	
The carbohydrate transported in the phloem of plants	

(3)

(b) Describe the structure of cellulose.

……

……

……

……

……

……

(3)
(Total 6 marks)

156. The micrograph below shows a section through a typical mesophytic leaf, as seen using a light microscope.

(a) In the space below draw a **plan** to show the tissues of this leaf. The scale of your drawing should be ×1. You should **not** draw individual cells.

(3)

(b) (i) Name **two** tissues that would be found in a typical mesophytic leaf.

1. .....

2. .....

(2)

(ii) Explain why a leaf is described as an organ.

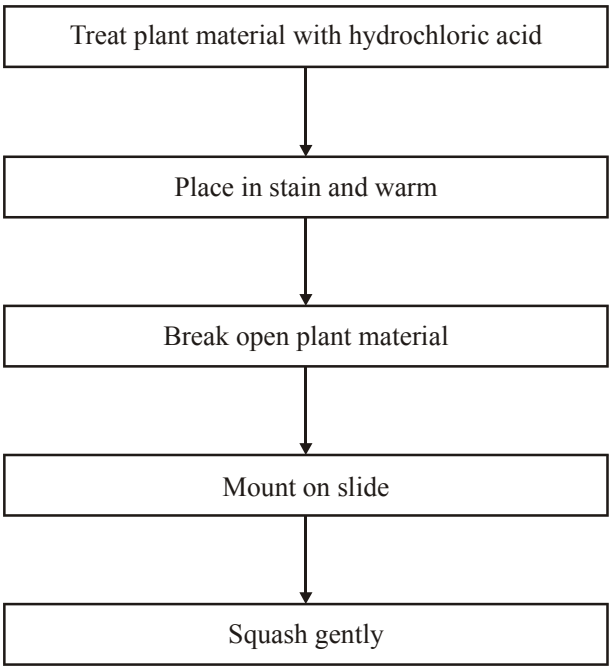
……..

……..

(1)

(Total 6 marks)

157. The flow diagram below shows a method for preparing and staining cells in order to study stages of mitosis.



(a) Name a suitable part of a plant to use, giving a reason for your choice.

……

……

……

(2)

(b) (i) Explain why staining is necessary in this preparation.

……

……

(1)

(ii) Name a suitable stain for this technique.

.....

(1)

(c) Explain why it is necessary to squash the preparation.

……

……

(1)

(Total 5 marks)

158. Protein synthesis involves transcription and translation.

(a) (i) Where does transcription take place in a eukaryotic cell?

……

(1)

(ii) Name the type of chemical reaction that occurs when a strand of messenger RNA is formed from individual nucleotides.

……

(1)

(b) The diagram below shows part of a messenger RNA (mRNA) molecule.

(i) What is the maximum number of amino acids coded for by this strand of mRNA?

.....

(1)

(ii) Complete the diagram below to show the sequence of bases on the strand of DNA that coded for this mRNA.

(2)

(c) A strand of mRNA was found to have **53** codons but the protein produced from it contained only **51** amino acids. Suggest **two** reasons for this difference.

……

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……

……

(2)

(d) Describe the process of translation.

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……

……

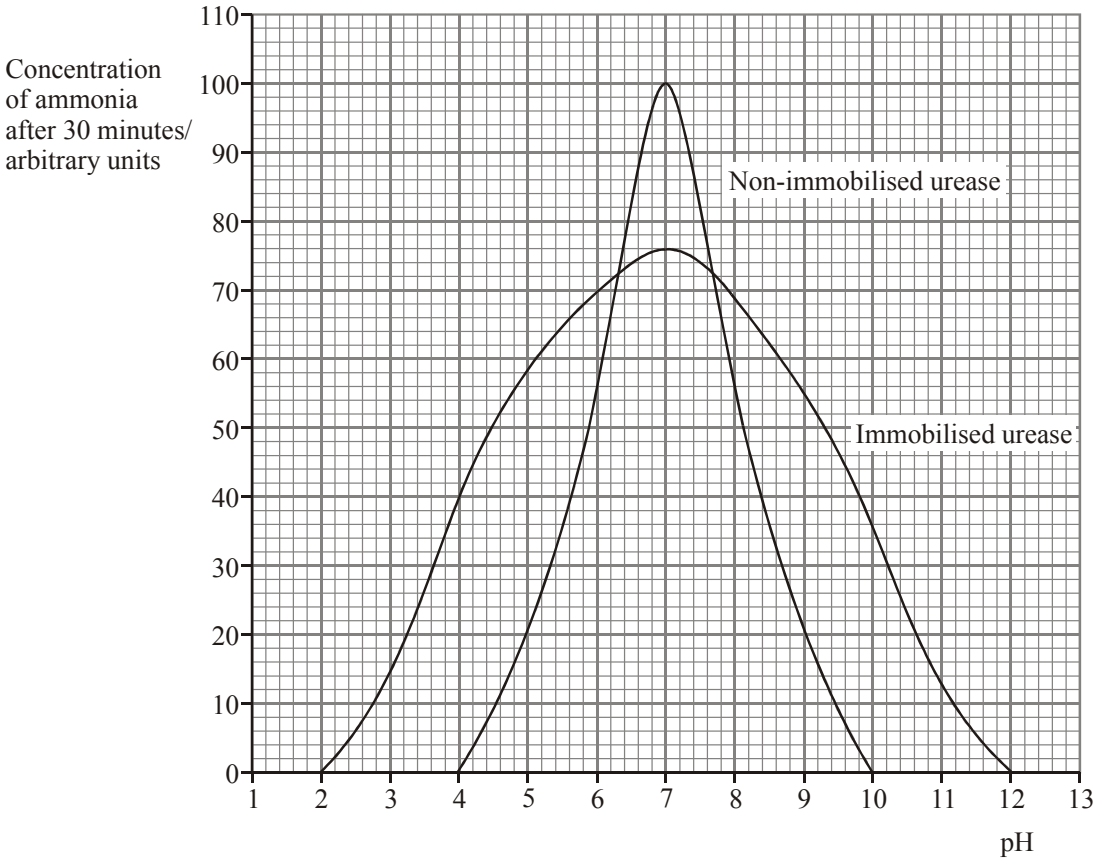
……

(5)
(Total 12 marks)

159. Urease is an enzyme which catalyses the breakdown of urea to ammonia and carbon dioxide.

An experiment was carried out into the effect of pH on the activity of immobilised and non-immobilised urease. 10 cm^3 of pH 9 buffer solution was mixed with 10 cm^3 of urea solution. This was mixed with urease and the concentration of ammonia in the mixture was measured after 30 minutes.

The procedure was repeated at different pH values for both immobilised and non-immobilised urease, at the same concentrations of enzyme. The results are shown in the graph below.



(a) Describe how the immobilised urease could be prepared for this experiment.

……

……

……

……

(2)

(b) The rate of ammonia production for immobilised urease at pH 7 was 2.6 arbitrary units per minute.

(i) Calculate the rate of ammonia production for non-immobilised urease at pH 7. Show your working.

Answer = ...

(2)

(ii) Compare the effect of pH on the activity of immobilised and non-immobilised urease.

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(3)

(iii) Suggest why immobilisation has this effect on the activity of urease.

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(2)

(Total 9 marks)

160. (a) DNA is replicated by a process called semi-conservative replication. Explain what is meant by the term **semi-conservative replication**.

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(4)

(b) When bacteria grow and reproduce they need a nitrogen source. The nitrogen becomes part of their DNA.

Bacteria were placed in a culture medium containing a heavy form of nitrogen. The bacteria were grown and allowed to reproduce for several generations until all the nitrogen in their DNA was heavy nitrogen.

The bacteria were removed, washed thoroughly and then divided into five batches labelled A, B, C, D and E. They were then placed in fresh culture medium and allowed to grow for different periods of time.

Batch A was placed into fresh culture medium containing heavy nitrogen, and left for four generations. The other four batches were placed into fresh culture medium containing light nitrogen and left for different periods of time.

The treatments are shown in the table below.

Batch	First treatment	Second treatment
A	All grown in heavy nitrogen	Grown in heavy nitrogen for four generations
B		Grown in light nitrogen for one generation
C		Grown in light nitrogen for two generations
D		Grown in light nitrogen for three generations
E		Grown in light nitrogen for four generations

The DNA from the five batches of bacteria was then removed, placed on separating solutions and centrifuged (spun). The mass of DNA added to each separating solution was the same.

DNA containing different proportions of heavy and light nitrogen can be seen as separate bands after centrifugation. The heavier molecules are lower down in the separating solution than the lighter molecules. The wide bands contain more molecules than the narrow bands.

Figure 1 shows an example of the results of centrifuging a mixture of heavy and light DNA.

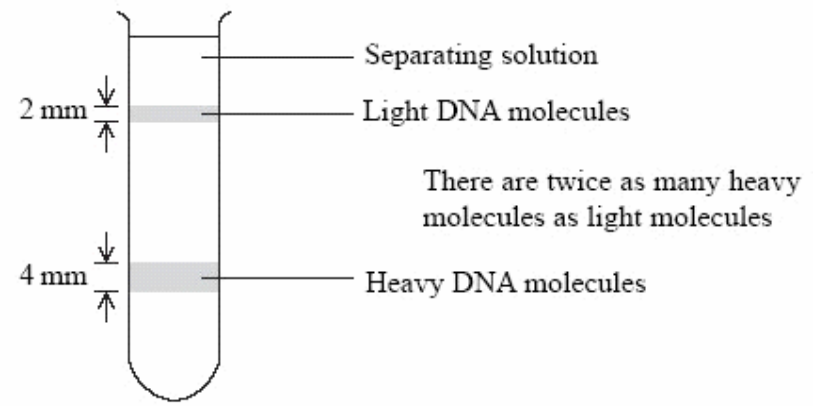

Figure 1

Figure 2 shows the results for the batches A, B, C and D.

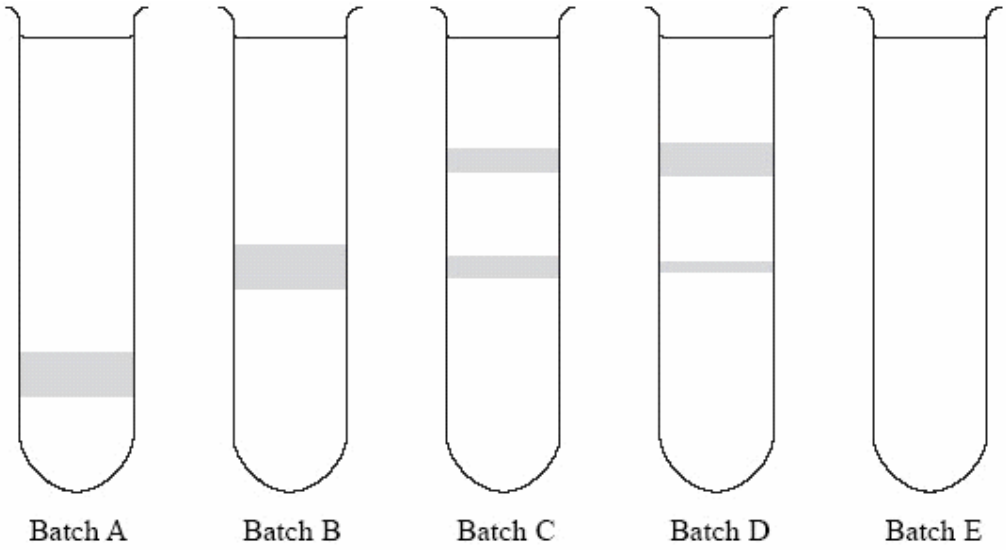

Figure 2

(i) Explain why the DNA from batch B is higher up in the separating solution than the DNA from batch A.

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(2)

(ii) Explain the results for batch C.

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(3)

(iii) On **Figure 2**, draw in the bands you would expect to see for the DNA separated from the bacteria grown in batch E.

(2)

(Total 11 marks)

161. The table below refers to some important biological molecules, the smaller molecules from which they are made and the bonds joining these smaller molecules together. Complete the table by writing the most appropriate word or words in the empty boxes.

Name of biological molecule	Smaller molecules from which it is made	Name of bond joining the smaller molecules
Triglyceride		
	β Glucose	
Polypeptide	Amino acids	

(Total 5 marks)

162. Read through the following account of mitosis in an animal cell, then write on the dotted lines the most appropriate word or words to complete the account.

During prophase, the ..... breaks down and the

..... migrate to opposite poles of the cell.

During ....., the chromosomes are visible as pairs of

chromatids, lined up along the equator of the cell. Spindle fibres extend from the poles

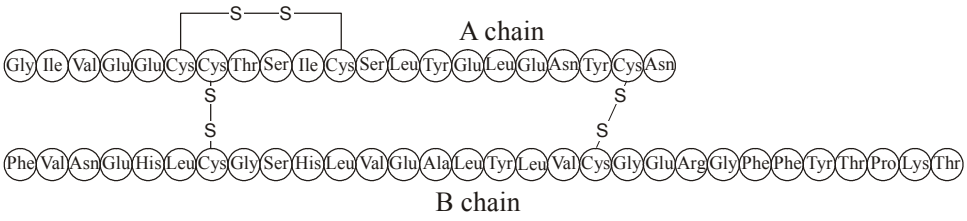
of the cell and attach to the ..... .

In ....., the spindle fibres contract, pulling the chromatids

apart.

(Total 5 marks)

163. The diagram below shows the structure of a human insulin molecule. Each circle represents one amino acid.



Insulin is a protein that has a tertiary structure and a quaternary structure.

(a) (i) Name **two** types of bond that help to maintain the tertiary structure.

1. .....

2. .....

(2)

(ii) What evidence is there in the diagram that insulin has a quaternary structure?

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(1)

(b) (i) All human insulin molecules have the same primary structure. Explain what is meant by **primary structure**.

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(1)

(ii) When insulin molecules are formed they fold into a specific shape. Explain why all human insulin molecules fold into the same shape.

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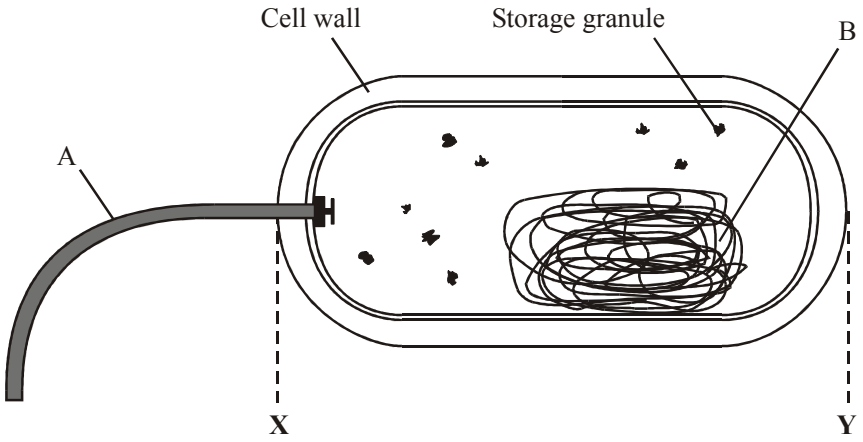
(2)

(Total 6 marks)

164. The diagram below shows the structure of a bacterial cell as seen using an electron microscope.



(a) (i) Name the parts labelled A and B.

A .....

B .....

(2)

(ii) Name the carbohydrate present in the storage granules.

.....

(1)

(iii) Describe how the cell wall in this bacterial cell differs from that in a plant cell.

.....

.....

(1)

(b) The diagram has been magnified 6000 times. Calculate the actual length of the bacterial cell between X and Y. Show your working, and give your answer in micrometres.

Answer ..... µm

(3)

(Total 7 marks)

165. Eukaryotic cells contain organelles, many of which are bound by a membrane. Some organelles have a double membrane, often called an envelope.

(a) (i) Describe **two** structural differences between the double membrane surrounding a mitochondrion and the double membrane surrounding a nucleus.

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(2)

(ii) Name **one** other organelle that has a double membrane.

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(1)

(b) Centrioles are an example of organelles that are **not** membrane-bound. Describe the structure and function of centrioles.

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(3)

(Total 6 marks)

166. Beetroots are root vegetables. They appear red because their cells contain a water soluble red pigment in their vacuoles, which cannot pass through membranes.

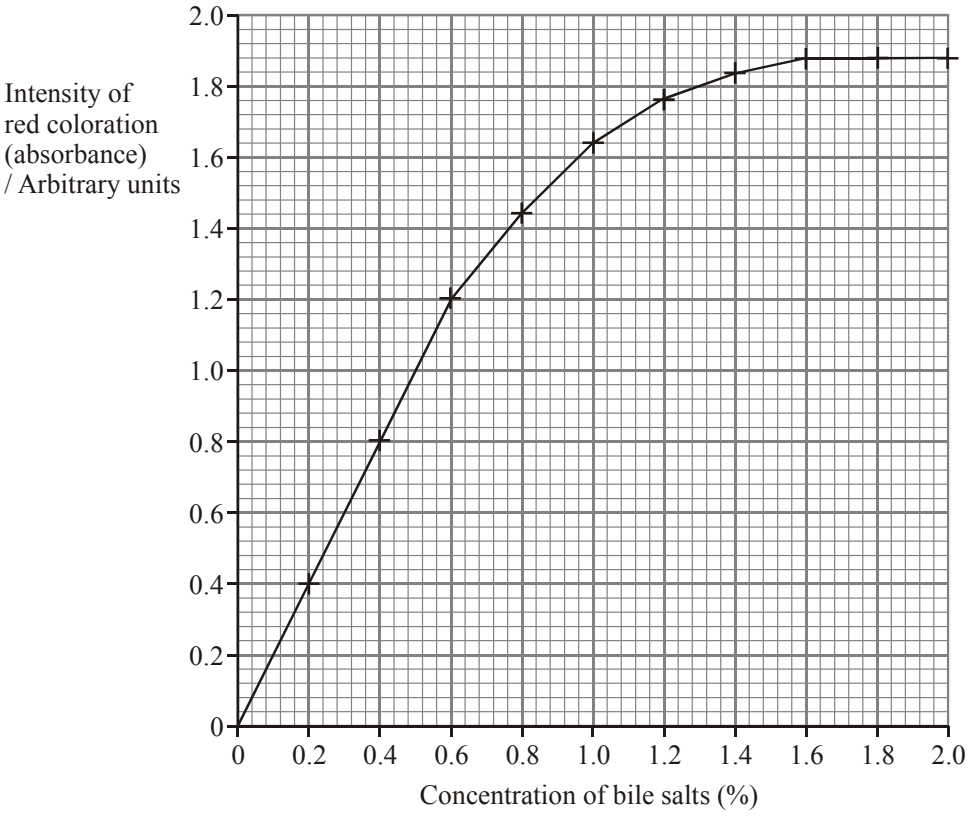
An experiment was carried out to investigate the effect of bile salts on the permeability of beetroot membranes. Bile salts disrupt the structure of the membranes. Several beetroot discs were cut of equal dimensions. Each disc was rinsed in distilled water and dried using absorbent tissue.

Five beetroot discs were then placed in a tube containing 25 cm^3 of 2% bile salt solution and left for 30 minutes at 20 °C. The procedure was repeated for different concentrations of bile salts and one set of discs was left in distilled water.

After 30 minutes, each set of beetroot discs was removed from the solutions and from the water. Each bile salt solution had become red and the discs were slightly pink. There was no change in the colour of the discs in the water and the water remained colourless.

Each bile salt solution was stirred and a sample removed and placed in a colorimeter. The intensity of red coloration (absorbance) was determined by the colorimeter.

The results of the investigation are shown in the graph below.



(a) Explain why the cell membrane is described as having a fluid mosaic structure.

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.....

(2)

(b) Suggest why it was necessary to rinse the beetroot discs before they were added to the bile salt solution.

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(1)

(c) Describe the effect of increasing bile salt concentration on the intensity of the red colour (absorbance) of the solution.

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(3)

(d) Suggest an explanation for these results.

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(4)

(e) The experiment was repeated using a second beetroot. Suggest why the readings obtained might be slightly different from those for the first beetroot.

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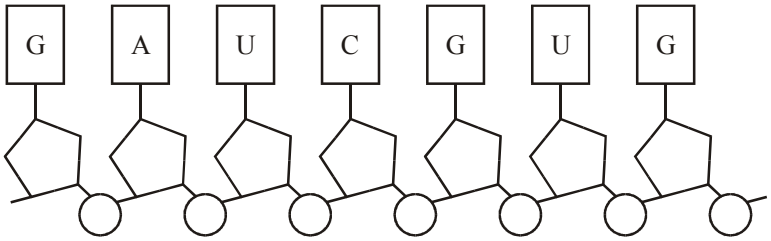
(1)

(Total 11 marks)

167. The diagram below shows part of a molecule of messenger RNA.



(a) On the diagram, draw a ring around a mononucleotide and label it with the letter **M**.

(1)

(b) Messenger RNA is formed during protein synthesis by a process called transcription. Describe the events which occur during transcription.

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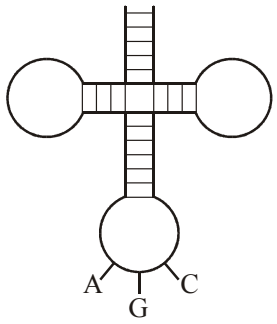
(5)

(c) During translation, transfer RNA molecules line up against the messenger RNA molecule. The diagram below shows the structure of one transfer RNA molecule.



(i) State precisely where in the cell translation takes place.

.....

(1)

(ii) On the diagram of the messenger RNA molecule above, draw a ring around the codon that this transfer RNA molecule would bind to. Label it with the letter **C**.

(1)

(Total 8 marks)

168. The enzyme pectinase can be used to extract juice from fruit such as apples.

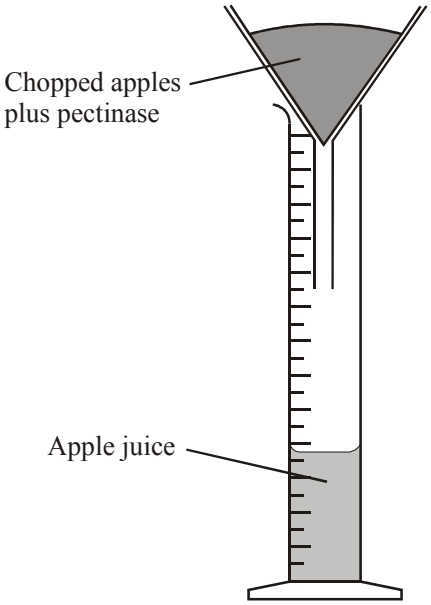
(a) Give **one** other use of pectinase in food modification.

.....

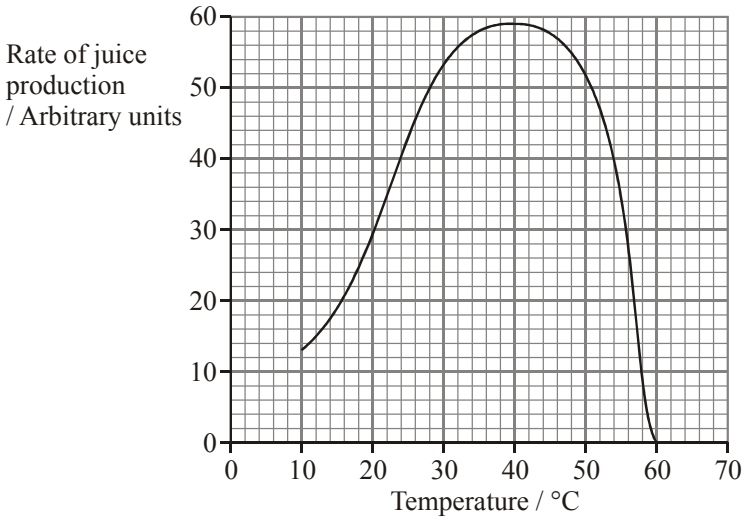
.....

(1)

(b) An experiment was carried out to investigate the effect of temperature on the rate at which pectinase extracted fruit juice from apples. An apple was chopped up and 2 cm^3 of pectinase solution was added to a 50 g sample of this chopped apple. This mixture was incubated at 20 °C for 10 minutes. The volume of apple juice produced was measured by filtering into a measuring cylinder. The experiment was repeated at different temperatures.



The results are shown in the graph below.



(i) State **two** variables, other than the mass of apple and volume of enzyme solution, that should be kept constant during the experiment.

1. .....

2. .....

(2)

(ii) Describe and explain the shape of the graph between 20 °C and 40 °C.

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(2)

(iii) Describe and explain the shape of the graph between 40 °C and 60 °C.

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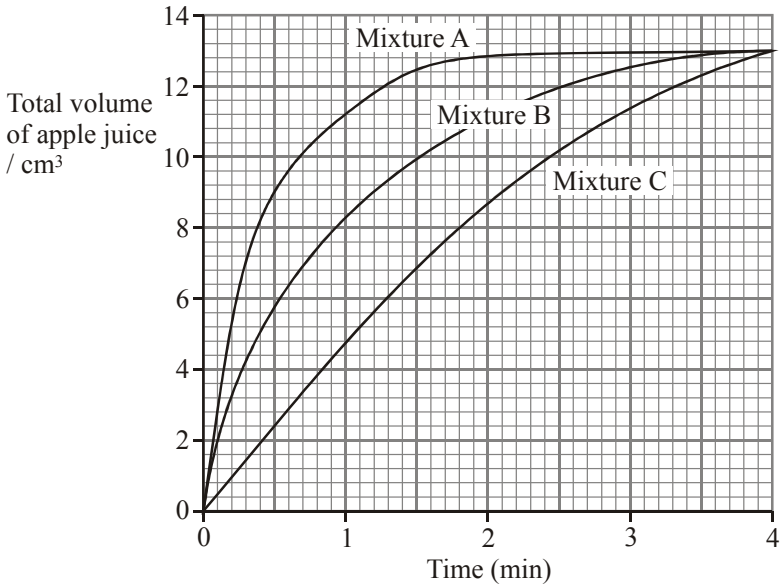
(3)

(c) In another experiment a student investigated the effect of an inhibitor on the activity of pectinase. The student made apple pulp by placing several apples together in a blender. She used this apple pulp as the substrate. She then made mixtures of the apple pulp with an inhibitor as shown in the following table.

Mixture	Volume of apple pulp / cm^3	Volume of water / cm^3	Volume of inhibitor solution / cm^3	Concentration of inhibitor solution (%)
A	20	20	0	—
B	20	0	20	10
C	20	0	20	20
D	20	0	20	5

She added 2 cm3 of the pectinase solution to each mixture and then measured the total volume of apple juice obtained every 30 seconds for several minutes. The results for mixtures A, B and C are shown on the graph below.



(i) Draw and label on the graph above the expected results for mixture **D**.

(2)

(ii) The student concluded that this is an example of active site-directed inhibition because the rate of reaction depends on the relative concentrations of inhibitor and substrate. Explain how the results support her conclusion.

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(2)
(Total 12 marks)

169. (a) The table below refers to the composition of the disaccharides sucrose, maltose and lactose. Place a tick (✓) in the appropriate box or boxes to indicate clearly the monosaccharide or monosaccharides that make up each disaccharide.

Disaccharide	Monosaccharides		
	Galactose	Glucose	Fructose
Sucrose			
Maltose			
Lactose			

(3)

(b) Name the bond that joins two monosaccharides in a disaccharide.

.....

(1)

(Total 4 marks)

170. Read through the following passage about protein structure, then write on the dotted lines the most appropriate word or words to complete the passage.

All amino acids contain the elements carbon, hydrogen, oxygen and

..... The primary structure of a protein is formed when amino

acids are joined together by ..... bonds. Chains of amino acids

may then form a secondary structure such as a spiral shape called the

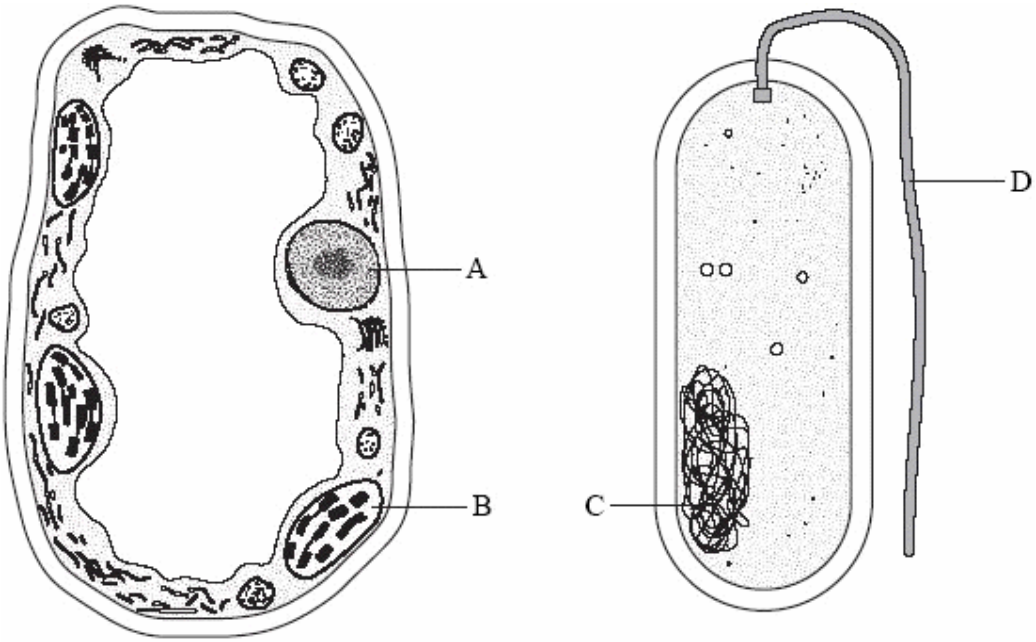
....., which is maintained by .....

bonding. The tertiary structure of a protein is maintained by bonding between the

..... of amino acids.

(Total 5 marks)

171. The diagrams below show the structures of a leaf palisade cell and a bacterial cell, as seen using an electron microscope.



Leaf palisade cell
(Magnification × 100000)

Bacterial cell
(Magnification × 18000)

(a) Name the parts labelled A, B and C.

A .....

B .....

C .....

(3)

(b) Give **one** difference between the cell wall of a leaf palisade cell and the cell wall of a bacterial cell.

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(1)

(c) Describe the function of part D.

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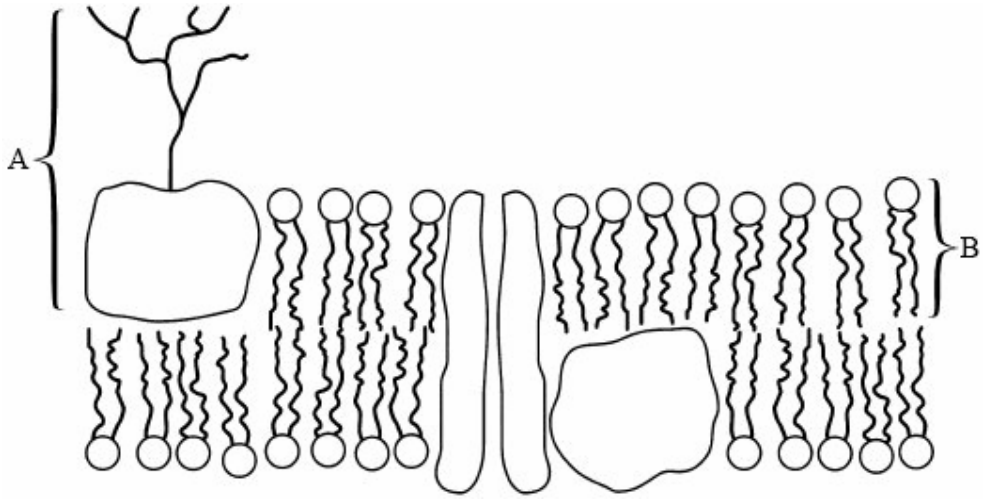
(2)

(Total 6 marks)

172. The diagram below shows the structure of the cell surface membrane.



(a) (i) Name the molecules A and B.

A .....

B .....

(2)

(ii) Give **one** function of the molecule labelled A.

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(1)

(iii) Explain why the molecules labelled B form a bilayer.

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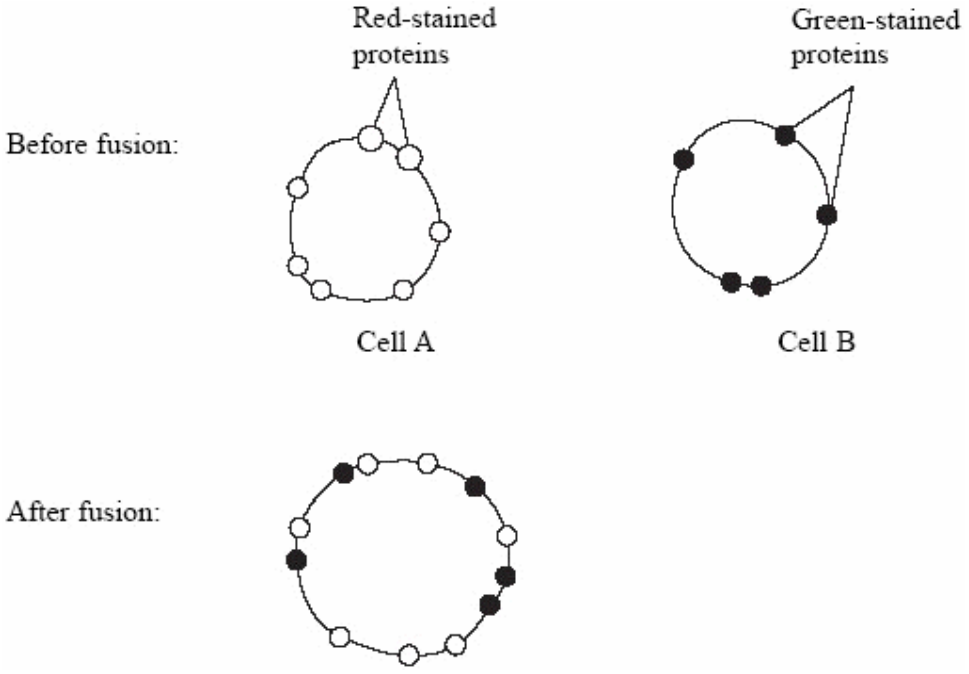
(3)

(b) The proteins in the cell surface membranes of two cells (A and B) were stained using different coloured dyes. One cell's membrane proteins were stained with a green dye and the other cell's membrane proteins with a red dye. The cells were then fused (merged together) to form one cell.

The diagram below shows the distribution of the proteins in the cells before and after fusion.



Use your knowledge of the properties of cell surface membranes to explain these results.

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(2)
(Total 8 marks)

173. An investigation was performed to determine the length of time that a cell in an onion root tip spends in each stage of mitosis.

A growing root from an onion was selected and a root tip squash was made. This was examined under a light microscope and the percentage of cells in each stage of mitosis was determined.

The results are shown in the table below.

Stage of mitosis	Percentage of cells in this stage
Prophase	2.43
Metaphase	1.40
Anaphase	0.70
Telophase	2.78

(a) Describe how you would prepare a root tip squash so that mitosis could be studied.

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(4)

(b) The percentage of cells in a stage of mitosis is proportional to the duration of that stage.

Use this information to compare the duration of each stage of mitosis in these root tip cells.

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(3)

(c) The duration of each stage of mitosis can be calculated using the equation below.

$$\text{Duration of a stage} = \frac{\text{Percentage of cells in that stage} \times \text{cell cycle time}}{100}$$

The cell cycle time for these cells is 1200 minutes.
Describe how you would use this data to determine the total duration of mitosis.

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(2)
(Total 9 marks)

174. (a) The medium power lens on a light microscope gave a magnification of × 100 and a resolution (resolving power) of 1.5 ∝m. Explain the meaning of these terms.

Magnification

.....

.....

Resolution

.....

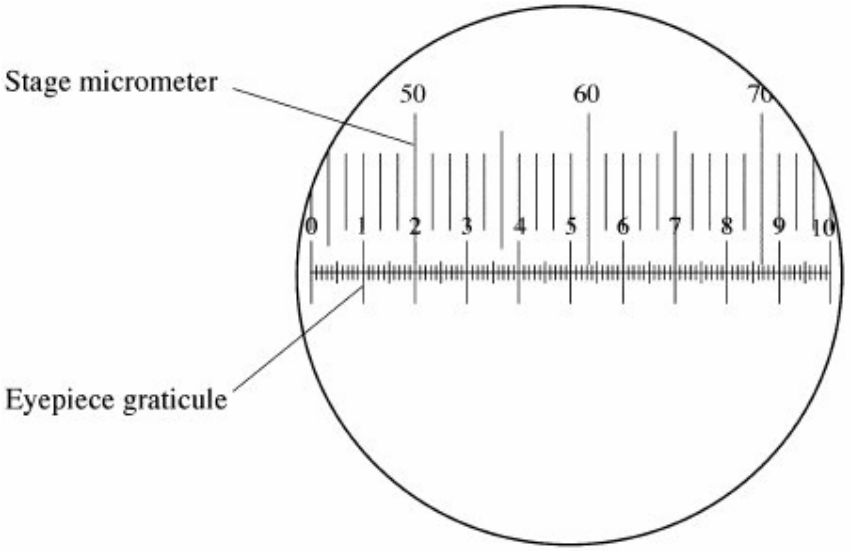
.....

(2)

(b) A student used a light microscope to view some cells. She calibrated an eyepiece graticule scale in order to measure the size of one of the cells.

To do this she placed a glass disc with a scale etched on it (an eyepiece graticule scale) into the eyepiece of her microscope. She placed another scale (a stage micrometer) on the stage of her microscope.

On looking through the microscope she could see both scales. The diagram below shows what she saw when the medium power objective lens was used.

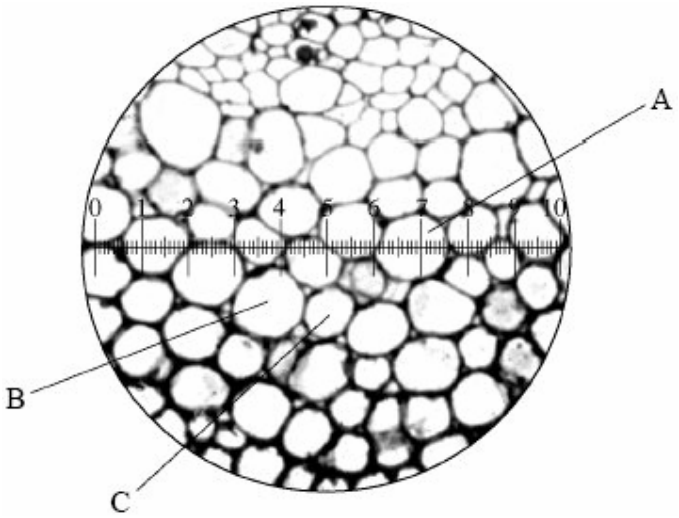


Each small division of the stage micrometer is 100 μm. Calculate the size of one small division of the eyepiece scale, expressing your answer in μm (micrometres).
Show your working.

Answer .....μm

(2)

(c) Another student used the medium power objective lens to view some plant cells through a different microscope. He used an eyepiece graticule to measure the width of a cell. The photograph below shows the cells that he saw.



(i) He had calculated that one small division on his eyepiece graticule measured 20 μm.

Use this information to calculate the width of cell A.

.....

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(1)

(ii) In the space below make a drawing, enlarged ×2, of the cells labelled B and C. Do **not** label your drawing.

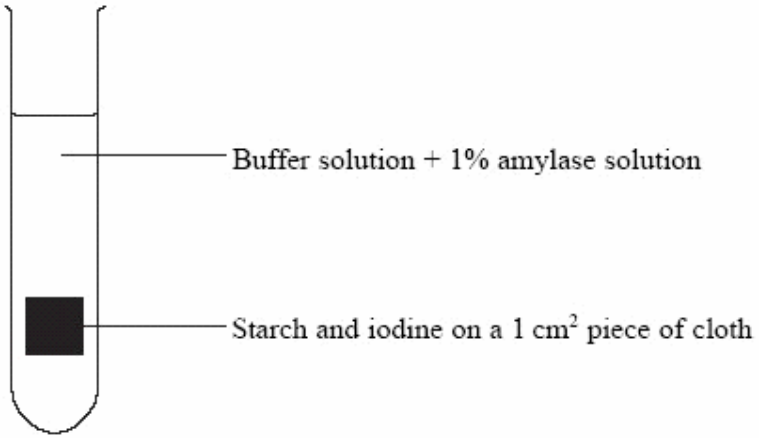
(3)
(Total 8 marks)

175. (a) Amylase is an enzyme which catalyses the hydrolysis of starch into maltose.

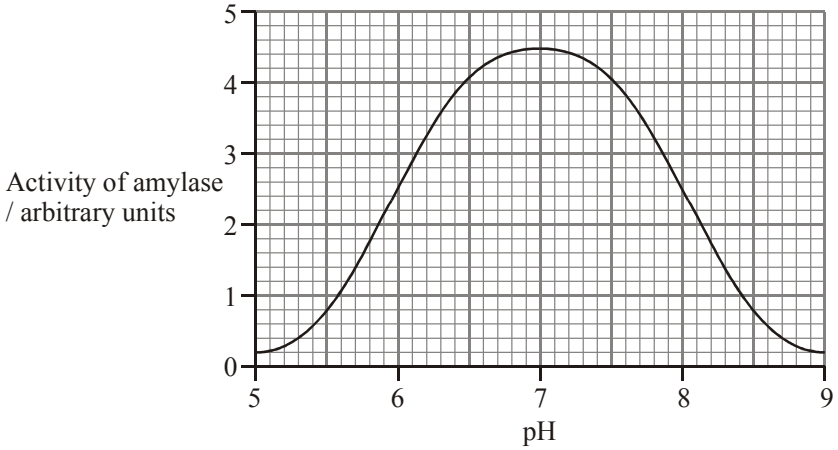
An experiment was carried out to investigate the effect of pH on the activity of amylase.

A piece of white cloth was sprayed with 'spray-on' starch and cut up into small squares each measuring 1 cm^2. Each square was covered with iodine solution so that the cloth was stained a blue-black colour.

One of the squares was placed in a test tube containing 5 cm^3 of a buffer solution and 5 cm^3 of a 1% amylase solution. The apparatus is shown in the diagram below.



The activity of the amylase was measured by timing how long it took for the enzyme to remove all of the starch on the cloth, and was measured at a range of pH values.
The results are shown in the graph below.



(i) Describe how each of the following factors was controlled in each test tube.

pH

.....

.....

Volume of substrate

.....

.....

(2)

(ii) Another test tube was set up as a control. Describe what should have been added to this tube.

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(2)

(b) Explain why changes in pH affect enzyme activity.

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(3)

(c) Describe the structure of starch.

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(5)
(Total 12 marks)

176. (a) Draw and label a diagram to show the structure of the Golgi apparatus as seen using an electron microscope.

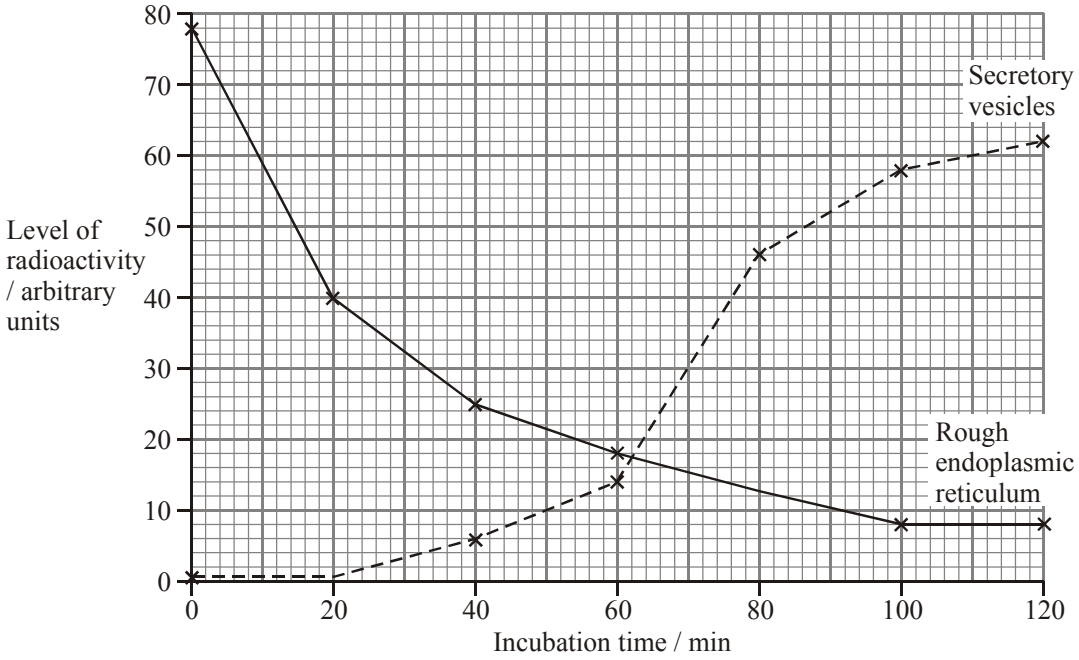
(3)

(b) The process of protein synthesis in cells and the secretion of proteins from the cells was investigated using radioactively labelled amino acids.

The cells were incubated with radioactive amino acids for 30 minutes. The cells were then removed and washed thoroughly to remove any radioactive amino acids on the cell surfaces.

The washed cells were then incubated with non-radioactive amino acids for 120 minutes. Every 20 minutes a sample of cells was removed and the level of radioactivity in the rough endoplasmic reticulum and in the secretory vesicles was determined.

The graph below shows the levels of radioactivity in the rough endoplasmic reticulum and the secretory vesicles.



(i) Describe and explain the changes in the level of radioactivity in the rough endoplasmic reticulum during the first 40 minutes of the incubation period.

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(2)

(ii) Explain the shape of the curve for the secretory vesicles between 0 and 40 minutes.

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(3)
(Total 8 marks)