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Answer ALL questions in the spaces provided.

1. (a) The table below describes the structure of some carbohydrates.

Complete the table below by writing the name of the carbohydrate in the box next to its description.

Description	Name of carbohydrate
disaccharide consisting of α glucose only	
disaccharide consisting of glucose and fructose	
polysaccharide consisting of β glucose only	
polysaccharide consisting of amylose and amylopectin	

(4)

- (b) Give **two** structural features found in all the carbohydrates named above.

1

2

(2)

Q1

(Total 6 marks)



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

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. This makes water a good for salts and substances such as sugars.

Bonds that form between water molecules are called bonds.

Water is a good coolant because it has a high, which means that it takes a lot of heat to change it from a liquid to a gas. Water also has a high, which means that a lot of energy is needed to cause a small rise in its temperature.

(Total 5 marks)

Q2



3. The photograph below shows a cell in the metaphase stage of mitosis as seen using a light microscope.



Magnification $\times 400$

CNRI / Science Photo Library

- (a) Place a cross (☒) in the box next to the correct statement below.

Metaphase occurs after anaphase and before telophase

Metaphase occurs after prophase and before anaphase

Metaphase occurs after telophase and before prophase

Metaphase occurs after anaphase and before prophase

(1)

- (b) Draw and label a diagram to show the appearance of a chromosome in metaphase.

(3)



(c) Suggest how the cell shown in this photograph would differ when it is in anaphase.

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(2)

(Total 6 marks)

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Q3



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4. An analysis of the large organic molecules found in a prokaryotic cell was made. The dry mass of the cell is the mass of the cell not including water. The results of the analysis are shown in the table below.

Molecule	Percentage of total dry mass of the cell (%)	Number of molecules per cell	Number of different types of molecule
Protein	55.0	2360000	1050
Lipid	9.1	22000000	4
Glycogen	2.5	4360	1
DNA	3.1	2	1
RNA	20.5	262480	463

- (a) The molecular mass of a substance is the mass of one molecule of that substance. Using information in the table, state which of the molecules has the largest molecular mass. Give an explanation for your answer.

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(2)



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(b) Glycogen and protein molecules are both polymers. Explain why there is only one type of glycogen molecule but there are many types of protein molecule.

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(2)

(c) Explain why many different RNA molecules are found in a cell.

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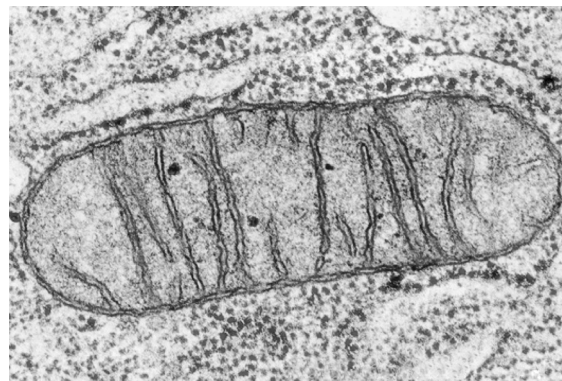
(2)

(Total 6 marks)

Q4



5. The photograph below shows a mitochondrion as seen using an electron microscope.



Magnification $\times 40\,000$

Prof. G. Gimenez Martin / Science Photo Library

(a) Describe the role of mitochondria in a cell.

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(2)

(b) In the space below, make an accurate drawing of this mitochondrion enlarged $\times 2$. On your drawing, label the **matrix** and a **crista**.

(4)

Q5

(Total 6 marks)

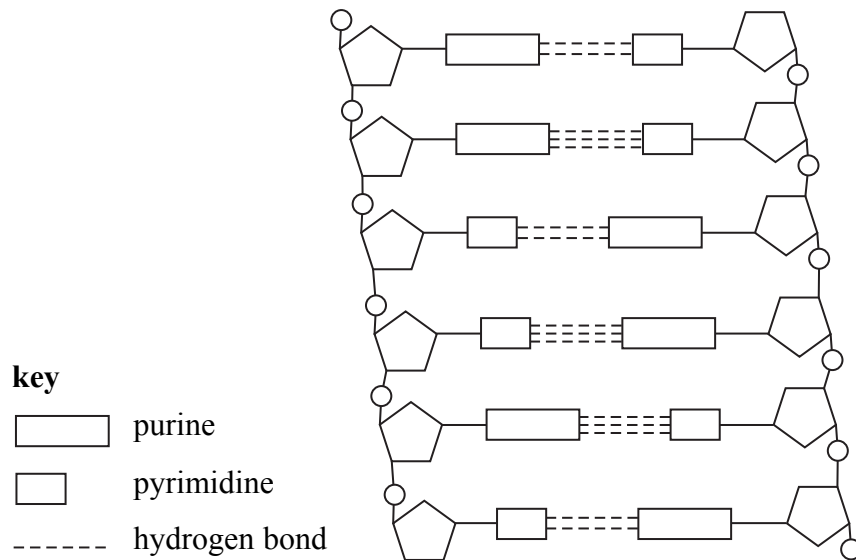


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N 3 3 8 8 7 A 0 9 2 0

6. The diagram below shows part of a DNA molecule.



(a) Draw a ring around **one** mononucleotide. **(1)**

(b) Name the two **purine** bases found in DNA.
 **(1)**

(c) (i) State where transcription takes place in eukaryotic cells.
 **(1)**

(ii) During transcription, part of a DNA molecule unwinds and the DNA strands separate.
 Describe the events that follow to produce a messenger RNA (mRNA) molecule.

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 **(3)**



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(d) Oligonucleotides are short chains of nucleotides. Some of these are man-made and have been used as drugs to treat a wide variety of diseases. They work by binding to mRNA or DNA and inhibiting protein synthesis. The drugs are described as antisense drugs when they bind to mRNA and triplex drugs when they bind to DNA.

(i) State which stage of protein synthesis will be inhibited by each of the following.

Antisense drugs

Triplex drugs

(1)

(ii) The table below shows the sequence of bases in part of a molecule of mRNA.

Complete the table to show the sequence of bases in the antisense drug that will bind to this part of the mRNA molecule.

Base sequence in mRNA	A	G	U	C	A	U
Base sequence in antisense drug						

(1)

Q6

(Total 8 marks)



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7. (a) Describe the structure of the cell surface (plasma) membrane.

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(5)

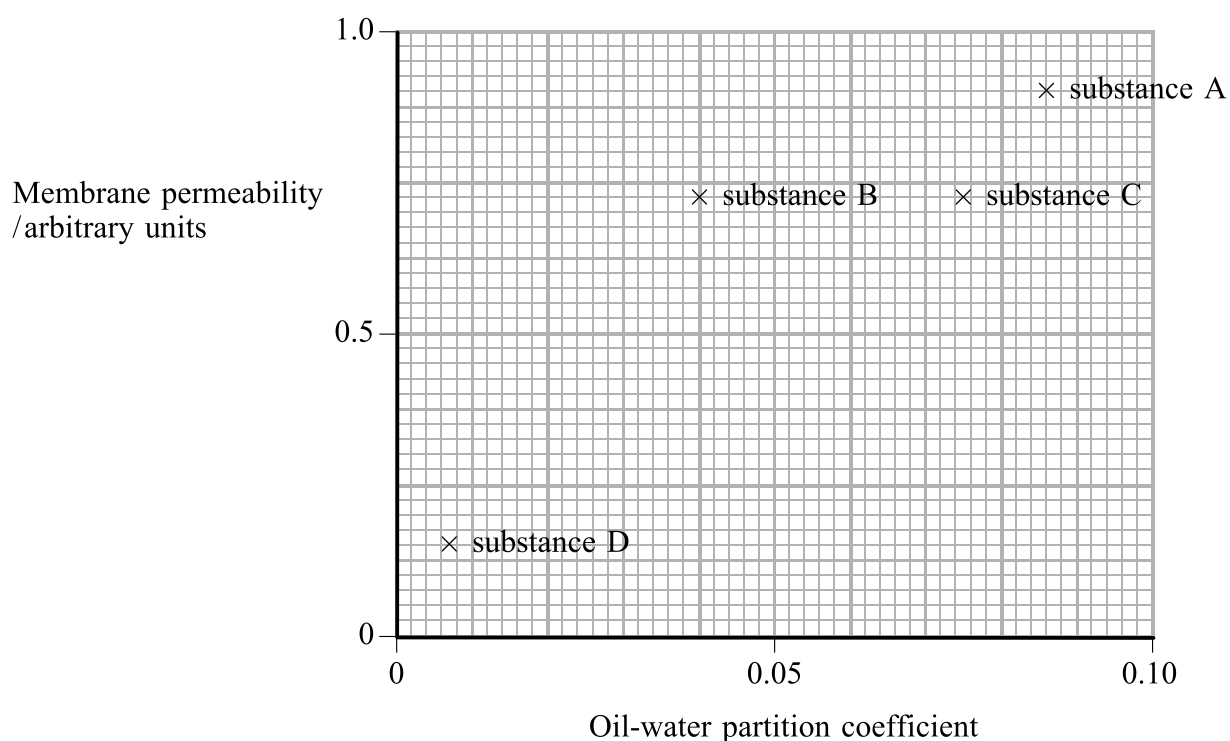


- (b) The ability of a substance to pass into a cell depends on its solubility in oil and water.

The oil-water partition coefficient is a measure of the solubility of a substance in oil compared to water. The equation below shows how it is calculated.

$$\text{Oil-water partition coefficient} = \frac{\text{Solubility in oil}}{\text{Solubility in water}}$$

The graph below shows the relationship between membrane permeability and the oil-water partition coefficient for four different substances A, B, C and D.



- (i) Compare the ability of substances A, B, C and D to cross a cell surface membrane.

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(3)



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(ii) Using the information shown in the graph and your knowledge of the cell surface membrane, suggest how substance A crosses a membrane.

Give an explanation for your answer.

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(3)

Q7

(Total 11 marks)

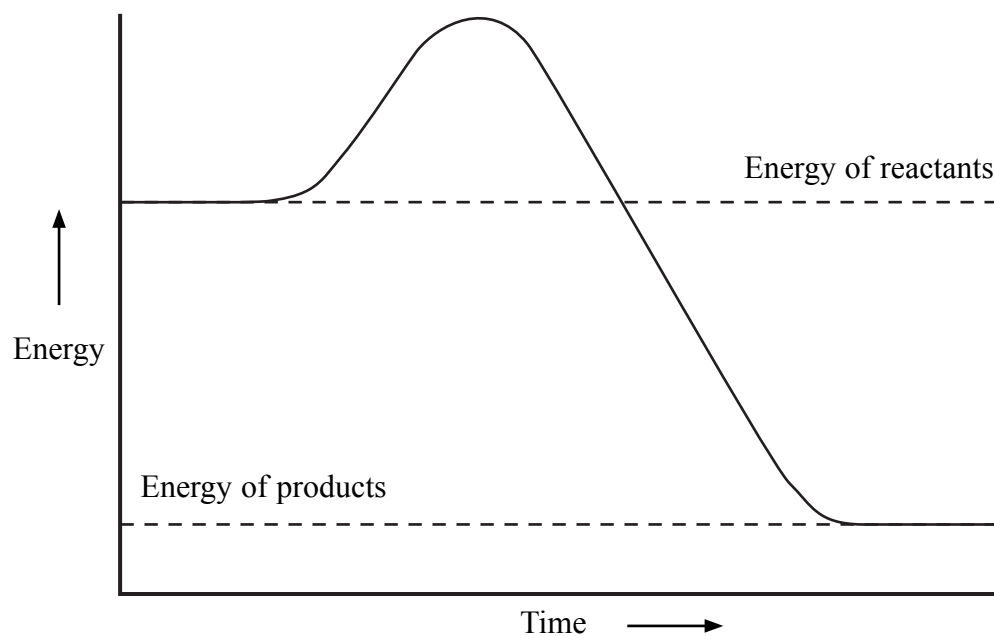
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8. (a) The graph below shows the change in energy that takes place during a chemical reaction.



(i) With reference to enzyme activity, explain the meaning of each of the following terms.

Activation energy

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Catalyst

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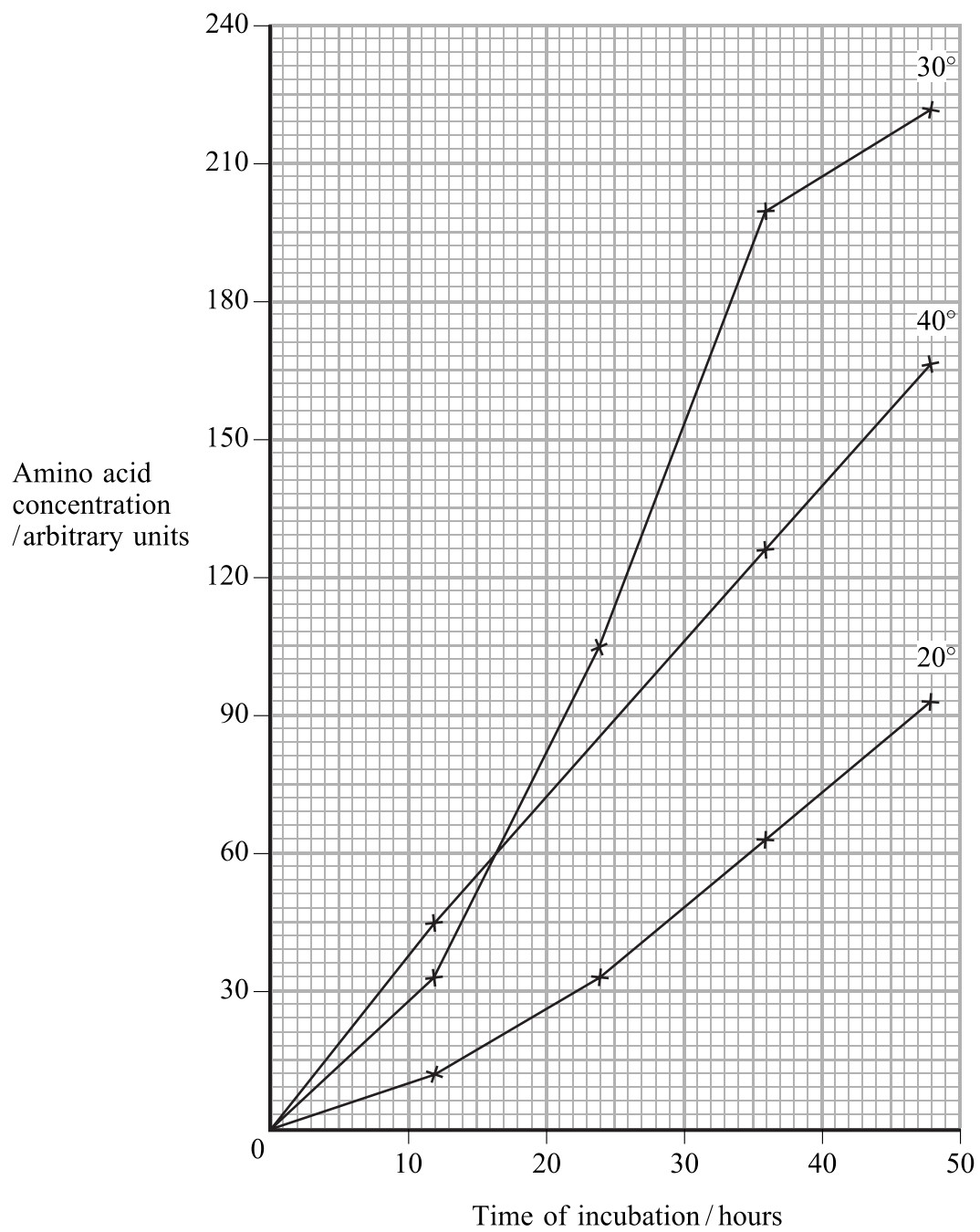
(4)

(ii) On the graph above, draw the energy changes that would take place if the same chemical reaction were catalysed by an enzyme.

(2)



(b) An experiment was carried out to determine the effect of temperature on the activity of a protein-digesting enzyme (a protease). Solutions of the protease were incubated with a protein called gelatine at three temperatures: 20 °C, 30 °C and 40 °C. The concentration of amino acids produced was measured over a 48-hour period. The results are shown in the graph below.



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(i) Name the type of reaction catalysed by this protease.

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(1)

(ii) Name the bond that is broken by this protease.

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(1)

(iii) Calculate the mean rate of production of amino acids at 40 °C during the first 36 hours of incubation. Show your working.

Answerarbitrary units hr⁻¹
(2)

(iv) The optimum temperature for this reaction is 30 °C. Explain the shape of the curve at this temperature.

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(2)

(Total 12 marks)

Q8

TOTAL FOR PAPER: 60 MARKS

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