1)

Nucleic acids, DNA and RNA, are very important molecules in living organisms. Messenger RNA (mRNA) and transfer RNA (tRNA) are involved in the synthesis of proteins.

For each of the statements (a) to (f), put a cross ☒ in the box that corresponds to the correct statement.

(a) DNA and RNA are polynucleotides composed of mononucleotides joined by

- ☒ **A** catabolic reactions
- ☒ **B** condensation reactions
- ☒ **C** hydrolysis reactions
- ☒ **D** redox reactions

(1)

(b) The mononucleotides of RNA consist of a phosphate joined to the sugar

- ☒ **A** deoxyribose
- ☒ **B** dextrose
- ☒ **C** ribose
- ☒ **D** ribulose

(1)

(c) The mononucleotides in mRNA are joined together by

- ☒ **A** disulphide bridges
- ☒ **B** glycosidic bonds
- ☒ **C** hydrogen bonds
- ☒ **D** phosphodiester bonds

(1)

(d) The bases in RNA are

- ☐ **A** adenine, cytosine, guanine and thymine
- ☐ **B** adenine, cytosine, guanine and uracil
- ☐ **C** adenine, guanine, thymine and uracil
- ☐ **D** cytosine, guanine, thymine and uracil

(1)

(e) DNA is a double stranded molecule twisted into

- ☐ **A** a beta-pleated sheet
- ☐ **B** a double helix
- ☐ **C** a triple helix
- ☐ **D** an alpha helix

(1)

(f) The two DNA strands are held together by

- ☐ **A** disulphide bridges
- ☐ **B** glycosidic links
- ☐ **C** hydrogen bonds
- ☐ **D** phosphodiester bonds

(1)

(g) Describe the role of each of the following in protein synthesis.

(4)

mRNA .....

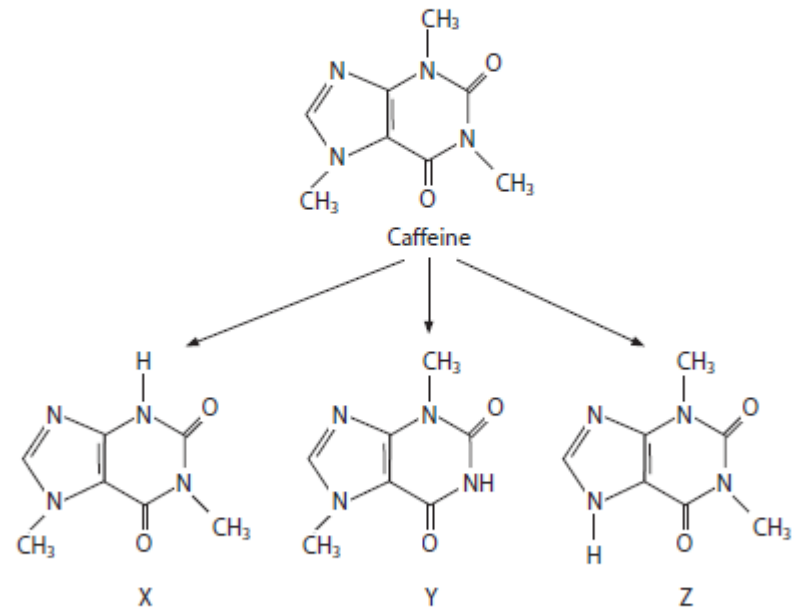
tRNA .....

2)

Caffeine is a drug frequently consumed in a number of drinks such as coffee, cola, hot chocolate and tea.

Caffeine is broken down in the liver by a group of enzymes called cytochrome P450 oxidase.

(a) The diagram below shows the structure of caffeine and its three breakdown products, X, Y and Z.



(i) Using the information in the diagram, give **two** reasons why caffeine is **not** an amino acid.

(2)

(ii) Using the information in the diagram, state **two** differences between the breakdown products.

(2)

(iii) Using the information in the diagram and your own knowledge of enzyme action, suggest why cytochrome P450 oxidase consists of more than one type of enzyme.

(3)

(b) A student decided to investigate the concentration of caffeine in four drinks: coffee, cola, hot chocolate and tea.

The student's results are shown in the table below.

Drink	Volume of drink	Caffeine content / mg
coffee	200 cm^3	135
cola	1 can	80
hot chocolate	200 cm^3	10
tea	1 cup	50

The student made two conclusions from these results.

Conclusion 1 "Different drinks have different concentrations of caffeine."

Conclusion 2 "Coffee has the highest concentration of caffeine."

Comment on the validity of these conclusions. Give reasons for your answer.

(3)

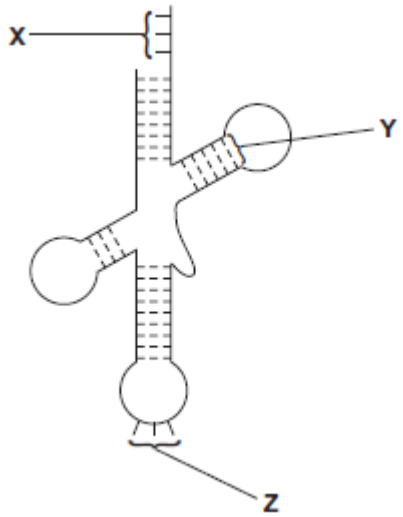
3)

Messenger RNA (mRNA) and transfer RNA (tRNA) are important nucleic acids involved in the process of protein synthesis.

(a) Describe how a molecule of mRNA is made during transcription.

(4)

(b) The diagram below represents a tRNA molecule.



For each of the statements below, put a cross (☒) in the box that corresponds to the correct statement.

(i) Part **X** binds to

☐ **A** an amino acid for transcription

☐ **B** an amino acid for translation

☐ **C** mRNA for transcription

☐ **D** mRNA for translation

(1)

(ii) Part **Y** is a

- ☒ **A** glycosidic bond
- ☒ **B** hydrogen bond
- ☒ **C** peptide bond
- ☒ **D** phosphodiester bond

(1)

(iii) Part **Z** binds to

- ☒ **A** an amino acid during transcription
- ☒ **B** an amino acid during translation
- ☒ **C** mRNA during transcription
- ☒ **D** mRNA during translation

(1)

(c) Using the information shown in the diagram, describe **two** ways in which the structure of a tRNA molecule differs from the structure of a mRNA molecule.

(2)

4)

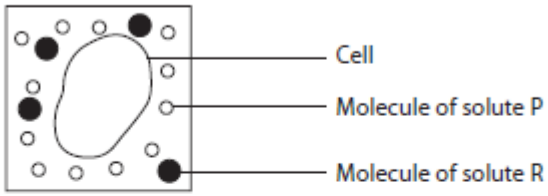
Molecules are transported across the cell membrane in a number of different ways.

(a) Describe the structure of a cell membrane.

(3)

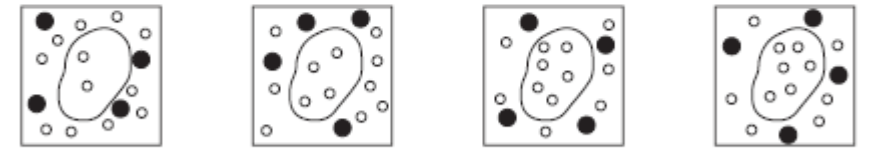
(b) Cells were placed in a solution containing two different solutes, solute P and solute R.

The diagram below represents the concentration of the two solutes outside one of the cells, when this cell was placed in the solution.



The cells were left in the solution for 50 minutes.

The diagrams below represent the concentrations of the two solutes, inside and outside the cell after 10, 20, 30 and 40 minutes in the solution.



After 10 minutes | After 20 minutes | After 30 minutes | After 40 minutes

(i) Using the information in the diagrams, describe the changes that have taken place in the concentrations of solute P and solute R, in the 40 minute period.

Suggest an explanation for these changes.

(5)

(ii) Complete the diagram below, to show the concentration of solute P and solute R inside and outside the cell, after 50 minutes.

(1)

5)

Enzymes act as biological catalysts.

Amylase is an enzyme present in saliva that catalyses the hydrolysis of starch into maltose.

*(a) Describe the structure of starch. (5)

(b) Explain the meaning of the following terms.

(i) Catalyst (2)

(ii) Hydrolysis

(2)

(c) Bread contains a high proportion of starch. If bread is chewed for a long period of time it begins to taste sweet.

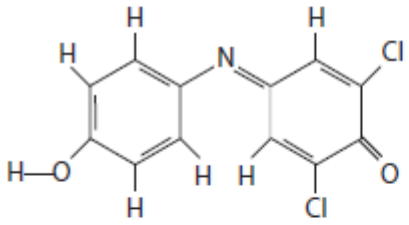
Suggest why bread tastes sweet after chewing for a long period of time.

(1)

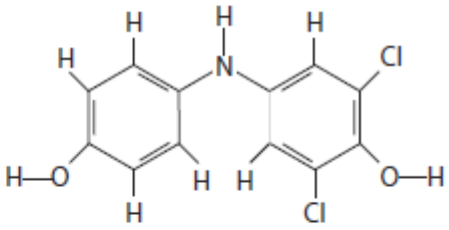
6)

The concentration of vitamin C in a solution can be determined using the chemical DCPIP.
DCPIP is blue when it is in its oxidised form and colourless when it is in its reduced form.

(a) The diagrams below show the structure of DCPIP in its oxidised form and in its reduced form.



Oxidised DCPIP



Reduced DCPIP

(i) Using the diagram, describe **two** differences between the structure of oxidised DCPIP and reduced DCPIP.

(2)

(ii) Suggest why these differences occur when DCPIP is used to determine the concentration of vitamin C.

(1)

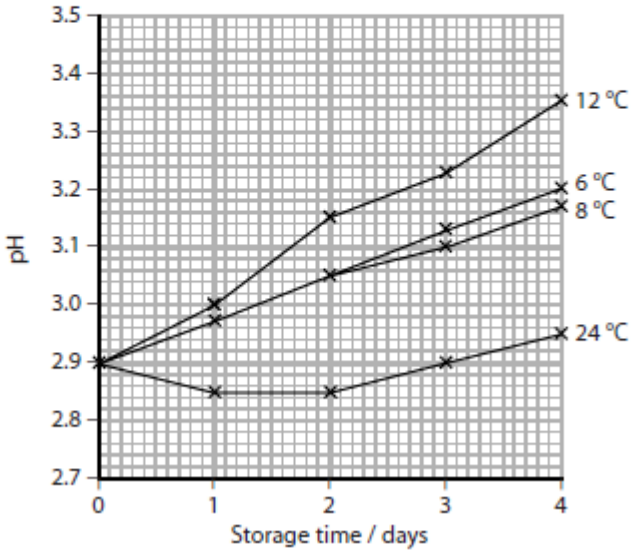
(b) Mangaba fruit is produced by a tropical plant native to Brazil.
As this fruit is a good source of protein and vitamins, it is important to study changes that take place in the fruit after picking.

The photograph below shows mangaba fruit.

Magnification × 0.2

A study was carried out to measure the changes in pH of mangaba fruit at different storage temperatures. Mangaba fruits were picked and stored at four different temperatures for four days. Each day the pH of the fruits was measured.

The graph below shows the results of this study.



(i) Using the information in the graph, describe the effects of storage temperature on the pH of mangaba fruits during this four-day storage period.

(3)

*(ii) Describe an experiment that could be carried out to compare the changes in the vitamin C content of the mangaba fruit stored at 6 °C and 8 °C.

(5)

7)

The structure and properties of the cell membrane control which molecules can move into or out of the cell.

(a) The phospholipid bilayer plays an important role in this control of movement of molecules.

Explain why the phospholipid molecules form a bilayer.

(3)

(b) The table below describes four methods by which molecules or ions can move through the cell membrane.

Description of method	Method by which molecules or ions can move through the cell membrane			
	A	B	C	D
The direction of movement is from a higher concentration to a lower concentration of the molecule	✓	×	✓	✓
ATP required	×	✓	×	×
Membrane proteins involved	✓ or ×	✓	✓	×
A molecule or ion transported by this method	water	sodium ions	glucose	oxygen

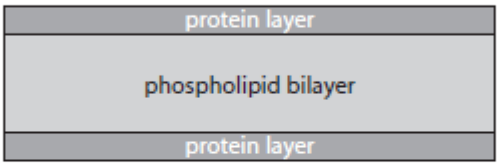
Identify the method of movement by placing a cross ☒ in the correct box in the table below.

(3)

Method of movement	A	B	C	D
Active transport	☐	☐	☐	☐
Facilitated diffusion	☐	☐	☐	☐
Osmosis	☐	☐	☐	☐

(c) The fluid mosaic model explains our current knowledge of the structure and properties of cell membranes. This model was developed from the Davson-Danielli model.

The diagram below shows the Davson-Danielli model of membrane structure.



(i) Use the information in the diagram to compare the Davson-Danielli model with the fluid mosaic model.

(2)

(ii) Explain why the Davson-Danielli model does not support our current knowledge of how molecules can move through the cell membrane.

(2)