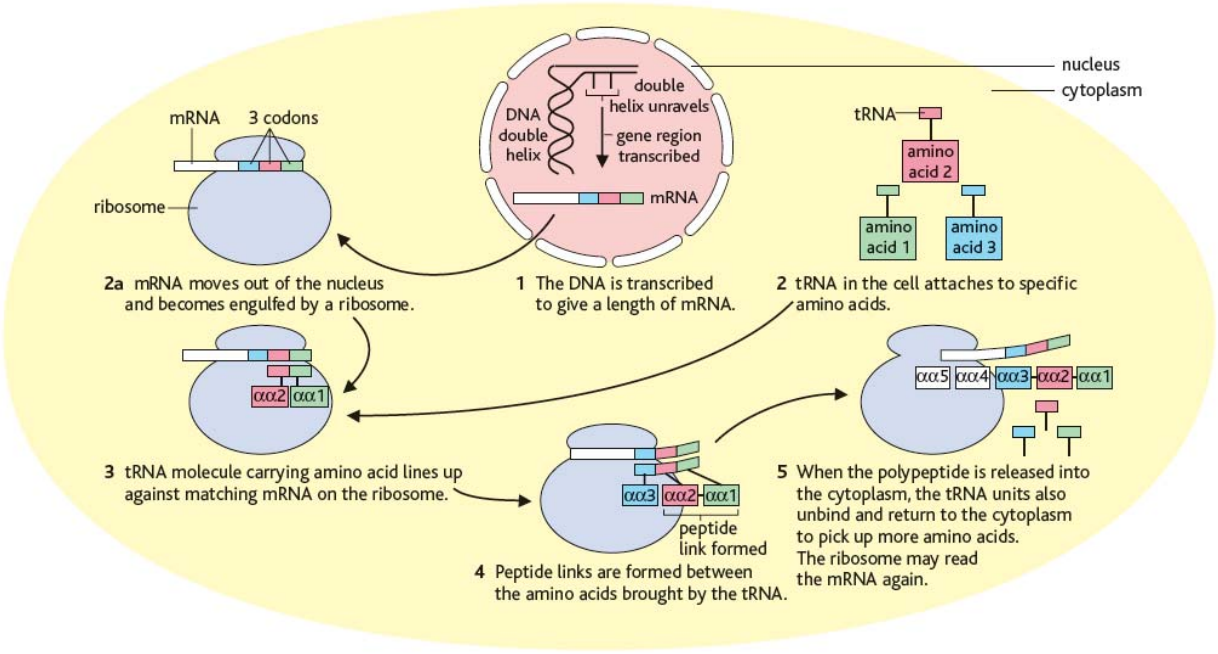
# Summary sheet 1: Protein synthesis

A gene is a sequence of DNA which codes for a protein. Proteins are synthesised in a two-step process – transcription and translation.

Transcription takes place in the nucleus and translation takes place at the ribosome. A complementary mRNA strand is made using the DNA as a template. The mRNA leaves the nucleus and attaches to the ribosome in the cytoplasm. A triplet of bases on the mRNA (a codon) code for specific amino acids. The amino acids are delivered to the ribosome by tRNA. Peptide bonds are formed between the amino acids to make the polypeptide.



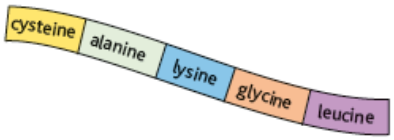

The DNA gene sequence is ACA CGG AAA CCT GAC.

The mRNA sequence is UGU GCC UUU GGA CUG.

This codes for the amino acid sequence is:

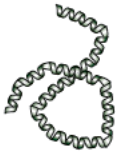
Cys-Ala-Lys-Gly-Leu

The protein folds into a specific structure.
For enzymes this means that the active site forms a specific shape that binds specific substrates.

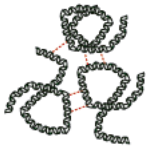



**Primary structure** – the linear sequence of amino acids in a peptide.

**Secondary structure** – the repeating pattern in the structure of the peptide chains, such as an α-helix or pleated sheets.



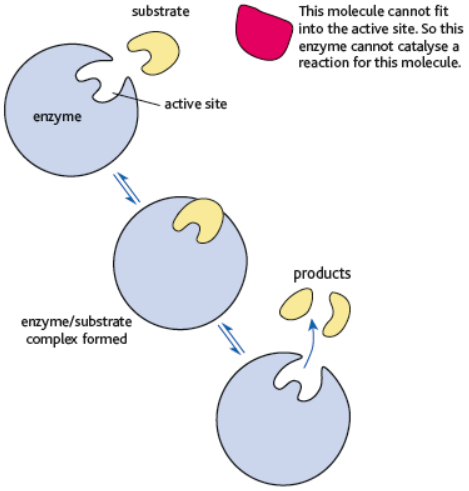
**Tertiary structure** – the three-dimensional folding of the secondary structure.



**Quaternary structure** – the three-dimensional arrangement of more than one tertiary polypeptide.

# Summary sheet 2: Enzymes activity

Enzymes are biological catalysts that speed up chemical reactions. Enzymes work by reducing the amount of activation energy needed for the reaction to occur.

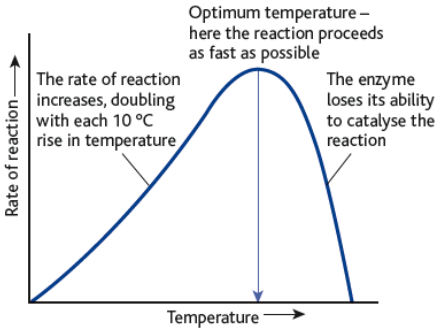



The active site of the enzyme is where the substrate binds. It has a specific shape which means enzymes can only bind to a specific substrate.

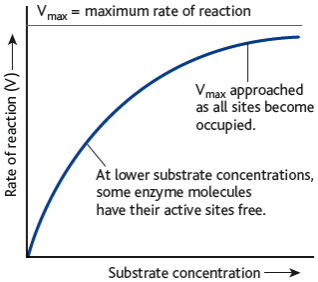
The substrate binds to the active site forming an enzyme-substrate complex. The reaction is catalysed and the products released.

Different factors can affect how quickly the enzymes work. These include temperature, pH, enzyme concentration and substrate concentration.

As temperature increases there is more chance of a collision between the enzyme and substrates, as they have more kinetic energy. This continues until the optimum temperature where the rate of reaction is highest. As the temperature continues to rise the enzyme denatures, as the active site changes shape, when bonds holding the protein together break.



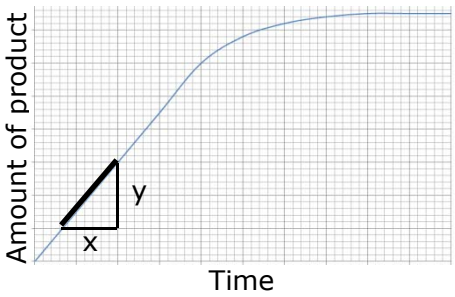

Enzymes also have an optimum pH, above and below the optimum pH the enzyme denatures.




As the substrate concentration increases there is more chance of a collision between the substrate and the enzyme. The rate of reaction increases until all the actives sites are occupied.

The rate of reaction increases as enzyme concentration increases until all the substrate is bound to an enzyme.

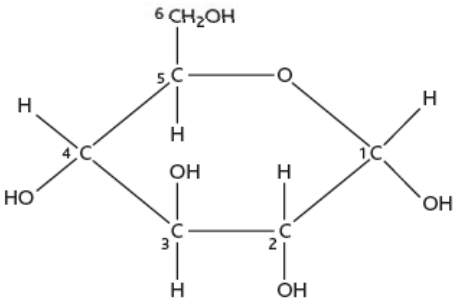
In practical situations you can sometimes measure the amount of product formed over time. The initial rate of the reaction for an enzyme can be calculated by measuring the gradient of the graph. If the line is curved a tangent to the curve can be used : gradient = y ÷ x.



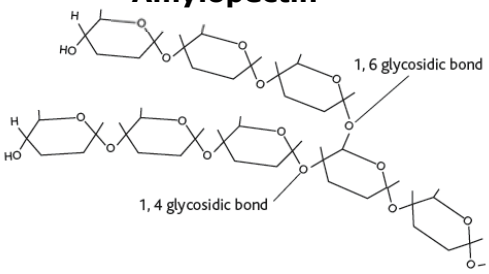
# Worksheet 1: Carbohydrates

The diagram shows the chemical structures of some monosaccharides, disaccharides and polysaccharides. Giving a reason, separate the molecules into these three groups.

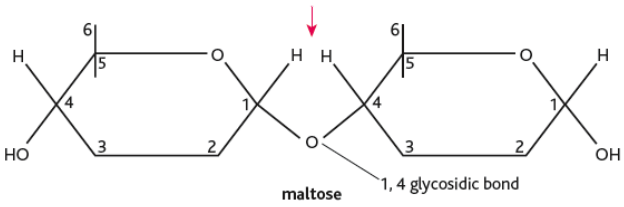
**Glucose**



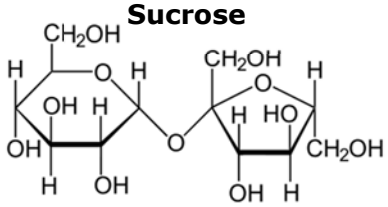
**Amylopectin**



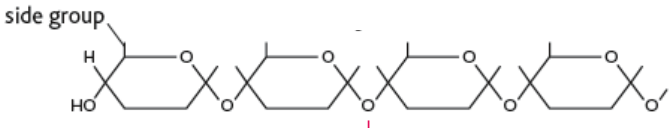

**Maltose**



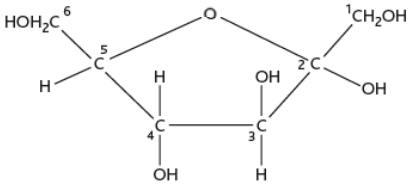

**Sucrose**



**Amylose**




**Fructose**



| Monosaccharides | Disaccharides | Polysaccharides |
|---|---|---|
| | | |

# Worksheet 2: Data analysis

**Processed data should be recorded to the same number of decimal places as the primary data**

This table shows the same data recorded to different numbers of decimal places.

| Data set 1 | Data set 2 |
|---|---|
| 2.4 | 2.37 |
| 3.6 | 3.55 |
| 4.1 | 4.05 |
| 2.8 | 2.76 |
| 3.5 | 3.51 |

**1** Compare the mean values for data set 1 and data set 2.

**2** Express data set 2 to 1 decimal place. What do you notice?

**3** Explain why it is incorrect to record 3.28 as the mean for data set 1.

**Being able to convert data, using standard form and different units, is an important skill**

**4** Convert the data in the table below.

| Data | | Value |
|---|---|---|
| 45 100 g | into standard form | |
| 45 100 g | into kilograms | |
| 34 ms | into seconds | |
| 780 μm | into millimetres | |
| $0.25 \times 10^{-9}$ s | into nanoseconds | |

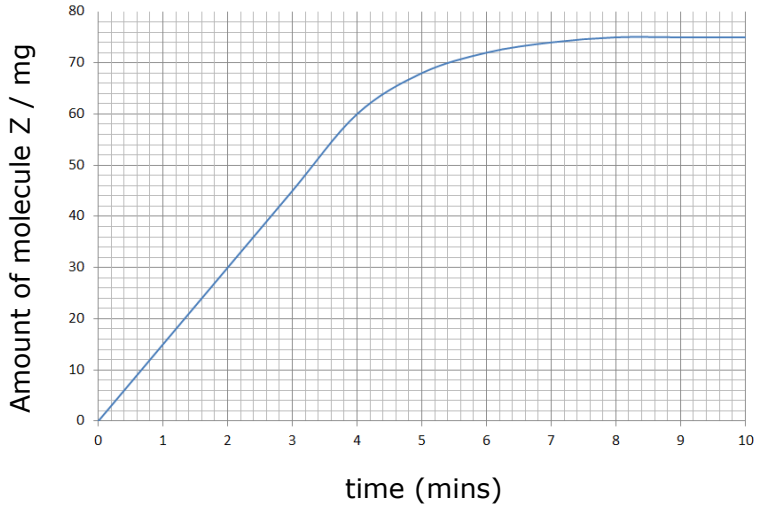
## Practice questions

**1** Enzyme A catalyses the breakdown of molecule X into Y and Z.

$$X \xrightarrow{\text{Enzyme A}} Y + Z$$

Molecule X and enzyme A were mixed together at 30°C at pH 6.8.

This graph shows the mass of molecule Z formed over a 10 minute time period.




**a** Calculate the initial rate of reaction of enzyme A.

**b** What is the rate of reaction of enzyme A after 8 minutes?

**c** Suggest a reason for the rate of reaction calculated in **b**.

**2** Enzyme B catalyses the breakdown of molecule X into Y and Z.

$$X \xrightarrow{\text{Enzyme B}} Y + Z$$

Molecule X and enzyme B were mixed together at different temperatures.

This table shows the initial rate of reaction of enzyme B at 15°C, 25°C, 30°C, 35°C, 40°C and 50°C.

| Temperature | Initial rate of reaction of enzyme B ($mmol.min^{-1}$) |
|---|---|
| 15 | 8 |
| 25 | 14 |
| 30 | 18 |
| 35 | 20 |
| 40 | 18 |
| 50 | 12 |

**a** The table has some missing information. Add the missing information to the table.

**b** Plot the data from the table on graph to show the initial rate of reaction of enzyme B at different temperatures.

You should consider:

- the variable which should be on the x-axis
- the labels for the axis
- the title of the graph.

**c** Compare different rates of reaction of enzyme B at 20°C, 37°C and 45°C.

**For questions which involve the use of data from a graph you must use scientific knowledge to explain the data you have extract from the graph.**

**3** Mutations in DNA can impact on the activity of enzymes.

This DNA sequence is from the region of the gene which codes for the active site of an enzyme.

GAA GAG AGT GGA CTC ACA GCT CGG

The table shows the amino acid coded for by some codons.

| **Amino acid/stop signal** | **DNA triplet codons** |
|---|---|
| Proline | GGT GGG GGA |
| Alanine | CGG CGA CGT CGC |
| Cysteine | ACA ACG |
| Serine | AGG AGA AGT AGC |
| Leucine | GAA GAG GAT GAC |
| Arginine | GCA GCG GCT GCC |
| Glutamine | CTT CTC |
| Gkycine | CCT CCG CCA CCC |
| Threonine | TGC TGA TGT TGG |
| Stop signal | ATT ATC ACT |

**a** State the amino acid sequence coded for by the sequence above.

**b** Using the information above explain the effect on the protein produced for the following mutations.

GAA GA**T** AGT GGA CTC ACA GCT CGG

GAA GAG AGT GGA CTC **C**CA GCT CGG

GAA GAG AGT GGA CTC ACA **A**CT CGG