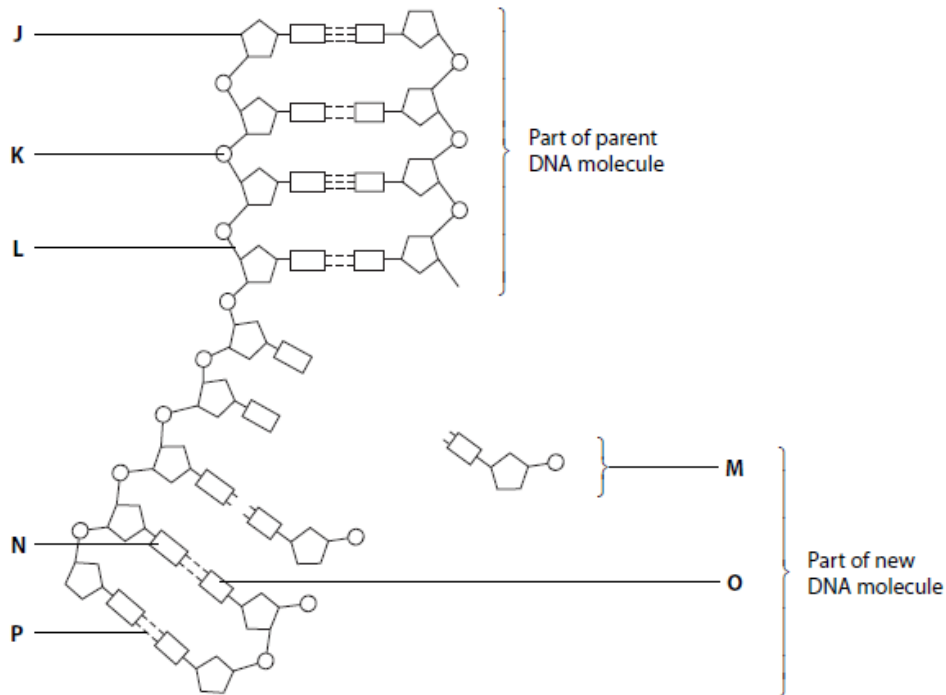


1)

1 DNA is a very important molecule in living organisms as it carries the genetic code that controls all characteristics. When a cell divides, the DNA molecule replicates so that each resulting daughter cell is genetically identical to the original parent cell.

The diagram below shows part of this process of DNA replication.



For each of the statements below, put a cross in the box that corresponds to the correct statement about DNA structure or DNA replication.

(a) The structure labelled J is

- A ribose
- B α glucose
- C β glucose
- D deoxyribose

(1)

(c) The bond labelled L is a

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

(1)

(b) The structure labelled K is a

- A phosphate group
- B phosphorus atom
- C sulphate group
- D potassium atom

(1)

(d) The structure labelled M is a

- A polynucleotide
- B mononucleotide
- C polypeptide
- D mononucleoside

(1)

(e) If the base labelled **N** on the parent DNA molecule is adenine, the base labelled **O** on the new DNA molecule is

- A** uracil
- B** guanine (1)
- C** thymine
- D** cytosine

(f) The bond labelled **P** is a

- A** peptide bond
- B** phosphodiester bond (1)
- C** hydrogen bond
- D** glycosidic bond

2)

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

(6)

Protein synthesis involves two stages. The first stage is and

takes place in the nucleus of the cell. During this stage, a molecule called

..... is made using the antisense DNA strand as a template.

The second stage, known as, takes place in the cytoplasm of

the cell on structures called During this stage,

..... molecules enable the amino acids attached to them to line

up in the correct order. The amino acids are joined together by the formation of

..... bonds.

3)

The questions below refer to some important biological molecules.

Place a cross (☒) in the most appropriate box that describes the structure or role of these biological molecules.

(a) Disaccharides can be split by

- A** hydrolysis of glycosidic bonds (1)
- B** condensation of glycosidic bonds
- C** hydrolysis of ester bonds
- D** condensation of ester bonds

(b) Amylose is an example of a

- A monosaccharide (1)
- B disaccharide
- C polysaccharide
- D trisaccharide

(c) The role of starch is to

- A be a source of energy to plants (1)
- B store energy in all living organisms
- C store energy in plants
- D store energy in animals

(d) Proteins are polymers of amino acids joined by peptide bonds formed between the

- A R groups
- B R group and the amino group (1)
- C R group and the carboxyl group
- D carboxyl group and the amino group

(e) The three-dimensional structure of a protein is held together by (1)

- A peptide, hydrogen and ionic bonds
- B hydrogen, ester and ionic bonds
- C disulphide bridges and ester bonds
- D disulphide bridges, hydrogen and ionic bonds

(f) DNA consists of mononucleotides joined together by bonds between (1)

- A two pentose sugars
- B one ribose sugar and one phosphate group
- C one deoxyribose sugar and one phosphate group
- D two phosphate groups

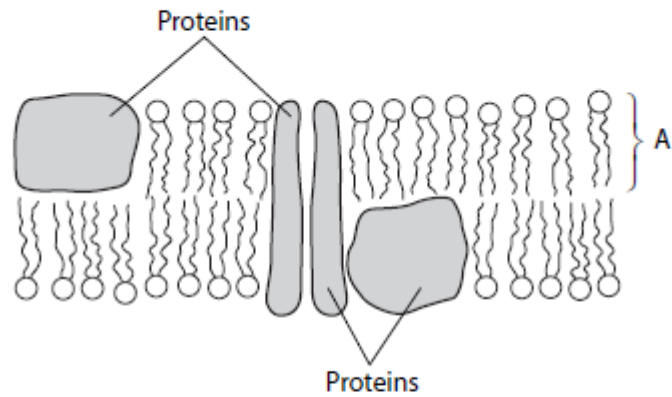
(g) Water is described as a dipolar molecule because it has a (1)

- A positively charged hydrogen end and a negatively charged oxygen end
- B positively charged hydrogen end and a positively charged oxygen end
- C negatively charged hydrogen end and a negatively charged oxygen end
- D negatively charged hydrogen end and a positively charged oxygen end

4)

The fluid mosaic model describes the structure and properties of cell membranes.

(a) The diagram below shows the structure of a cell membrane based on this model.



(i) Name the molecule labelled A and describe its structure.

(3)

Name

Structure

(ii) Explain how the properties of molecule A contribute to the structure of the cell membrane.

(3)

(b) Some proteins in the cell membrane are involved in active transport and facilitated diffusion. Describe the role of proteins in these cell transport mechanisms.

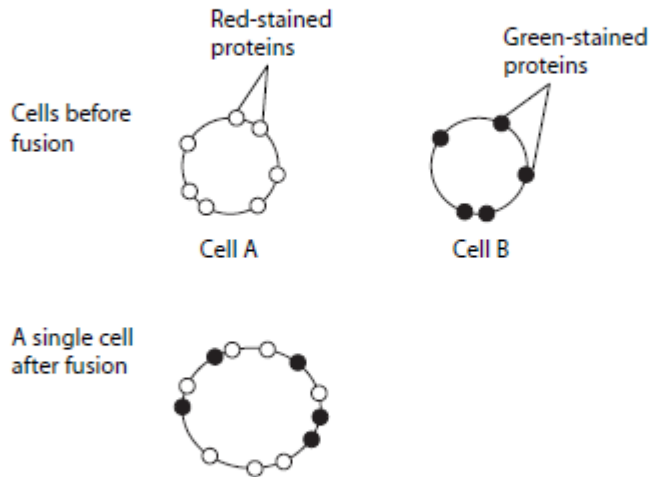
(3)

Active transport

Facilitated diffusion

(c) In an investigation into the properties of the cell membrane, the proteins in the membranes of two cells, A and B, were stained using different dyes. The proteins of one cell were stained green and the proteins of the other cell were stained red. The cells were then fused (merged together) to form a single cell.

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



(i) Describe the distribution of the proteins in this single cell after fusion. (2)

(ii) Describe how the results of this investigation can be explained by the fluid mosaic model. (2)

5)

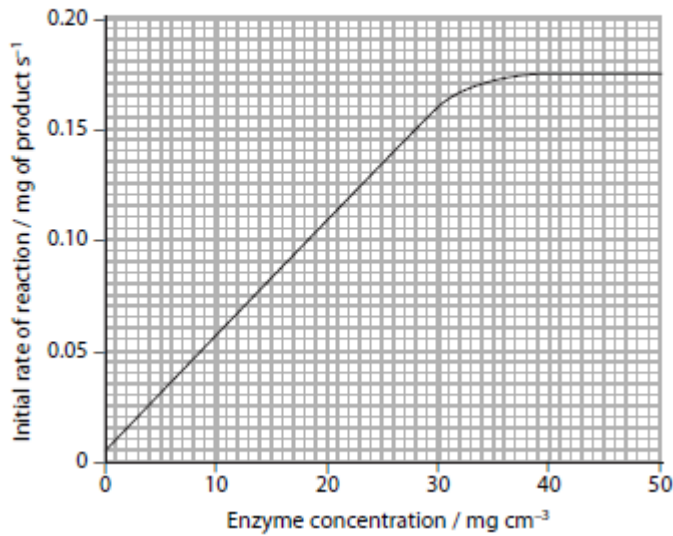
Enzymes are biological catalysts that change the activation energy of chemical reactions.

(a) Explain the meaning of the terms **biological catalyst** and **activation energy**. (4)

Biological catalyst

Activation energy

(b) The graph below shows the results of an investigation into the effect of enzyme concentration on the initial rate of this reaction.



Explain why it is necessary to measure the **initial rate** of reaction when investigating the effect of enzyme concentration on the rate of reaction.

(2)

(c) In this investigation, the substrate concentration was a factor that was kept constant. Suggest **two** other factors that should be kept constant. For each factor, state how it can be kept constant.

(4)

Factor 1

How the factor can be kept constant

Factor 2

How the factor can be kept constant

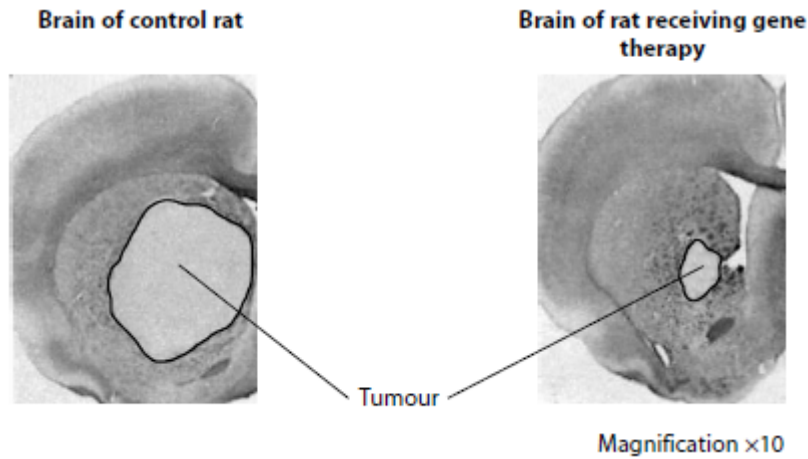
6)

Some types of cancer lead to the production of tumours (a group of rapidly-dividing cancer cells).

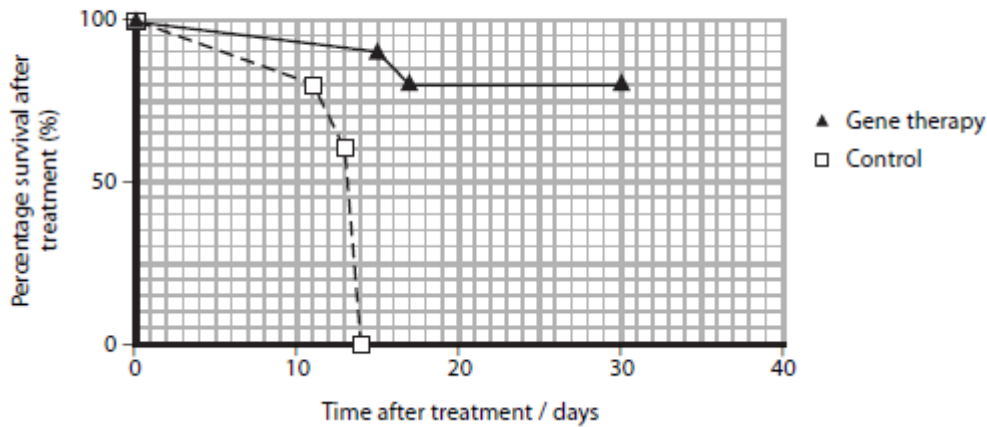
Gene therapy has the potential to cure a number of human diseases, including cancer. At present, research into gene therapy relies on animal models of diseases.

(a) In one investigation, brain tumours were induced in two groups of rats. One group of rats was given gene therapy and the other group of rats acted as a control.

The photographs below show the appearance of a tumour in the brain of a control rat and in a rat given gene therapy. Both photographs have the same magnification.



The graph below shows the percentage survival after treatment of the rats in the two groups.



Using the information shown in the photographs and in the graph, describe the effects of gene therapy on these rats.

(3)

- (b) Cancer can cause a lot of pain. Pain can be reduced by a chemical called endorphin that is made by cells in the brain and spinal cord. Endorphin reduces the activity of neurones that carry impulses from pain receptors.

Gene therapy has been used in rats to increase the tolerance to pain. Viruses, containing a gene coding for endorphin, were developed. These viruses were injected into the spinal cords of a group of rats. The level of tolerance to pain was tested in these rats and in the rats in a control group.

- (i) Describe the role of the viruses in this investigation.

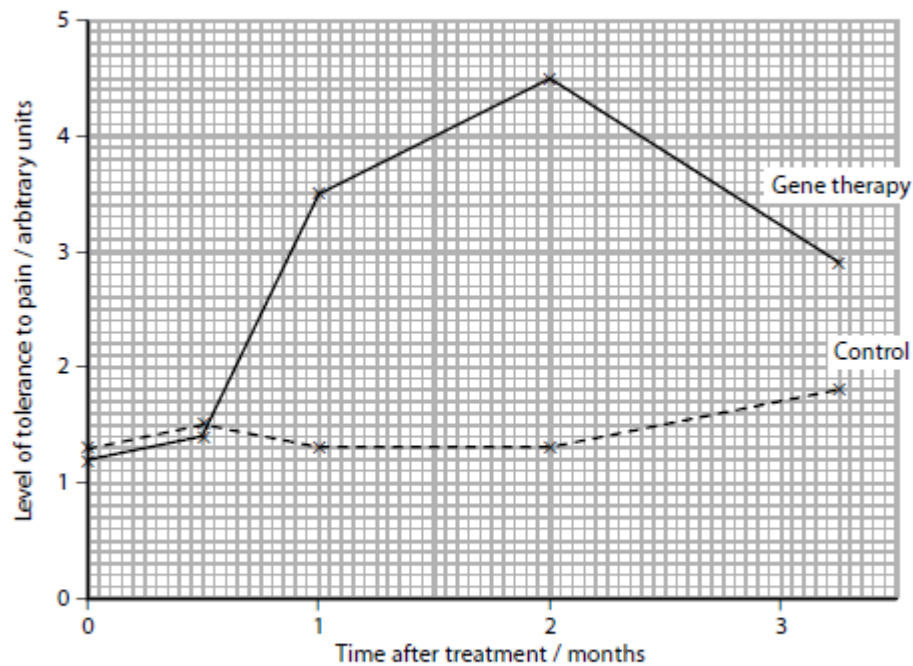
(2)

- (ii) Suggest why the injection was made into the spinal cord.

(1)

(iii) Suggest why a gene coding for an endorphin was used in this investigation. (1)

(iv) The results of this investigation are shown in the graph below.



Using the information in the graph, compare the levels of tolerance to pain in the rats given gene therapy with the control group.

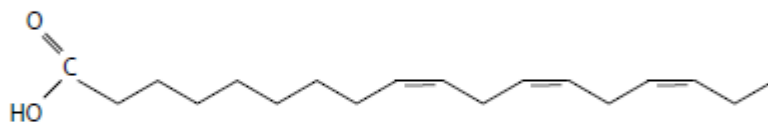
(3)

7)

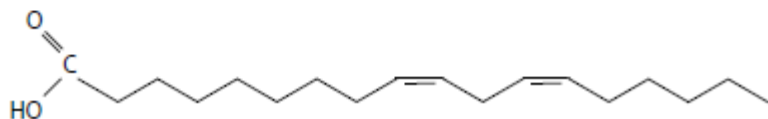
Some fatty acids are classed as essential fatty acids. These fatty acids need to be included in our diet, because the human metabolism cannot synthesise them. Omega 3 and omega 6 are two examples of essential fatty acids.

(a) The diagrams below represent the structures of the fatty acids omega 3 and omega 6.

Omega 3



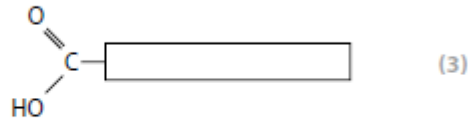
Omega 6



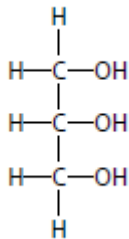
(i) Using the diagram of omega 3 above, describe its structure. (2)

(ii) Give **one** difference between the structure of omega 3 and the structure of omega 6. (1)

(iii) The diagram below shows a more simplified structure of omega 3.



A glycerol molecule is drawn below. Use these diagrams to show how **one** omega 3 molecule bonds to the glycerol molecule, by means of a condensation reaction, during the synthesis of a triglyceride.

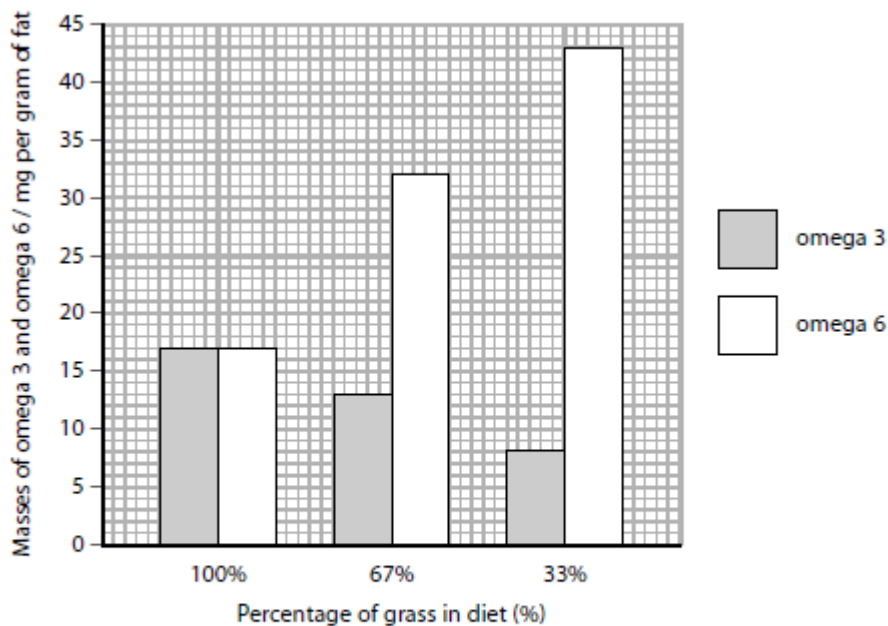


(b) Omega 3 and omega 6 are both present in animal fats.

The proportion of omega 3 and omega 6 in animal fat has been shown to depend on the diet of the animals.

In an investigation, the masses of omega 3 and omega 6, per gram of fat, were determined in the fat from cows fed on a diet containing 100%, 67% or 33% grass.

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



Describe what effect the percentage grass content of a cow's diet has on the proportion of omega 3 and omega 6 in its fat.

(3)