

Section A

Answer **all** the questions in this section.

- 1 Fig. 1.1 is an electron micrograph of a liver cell.

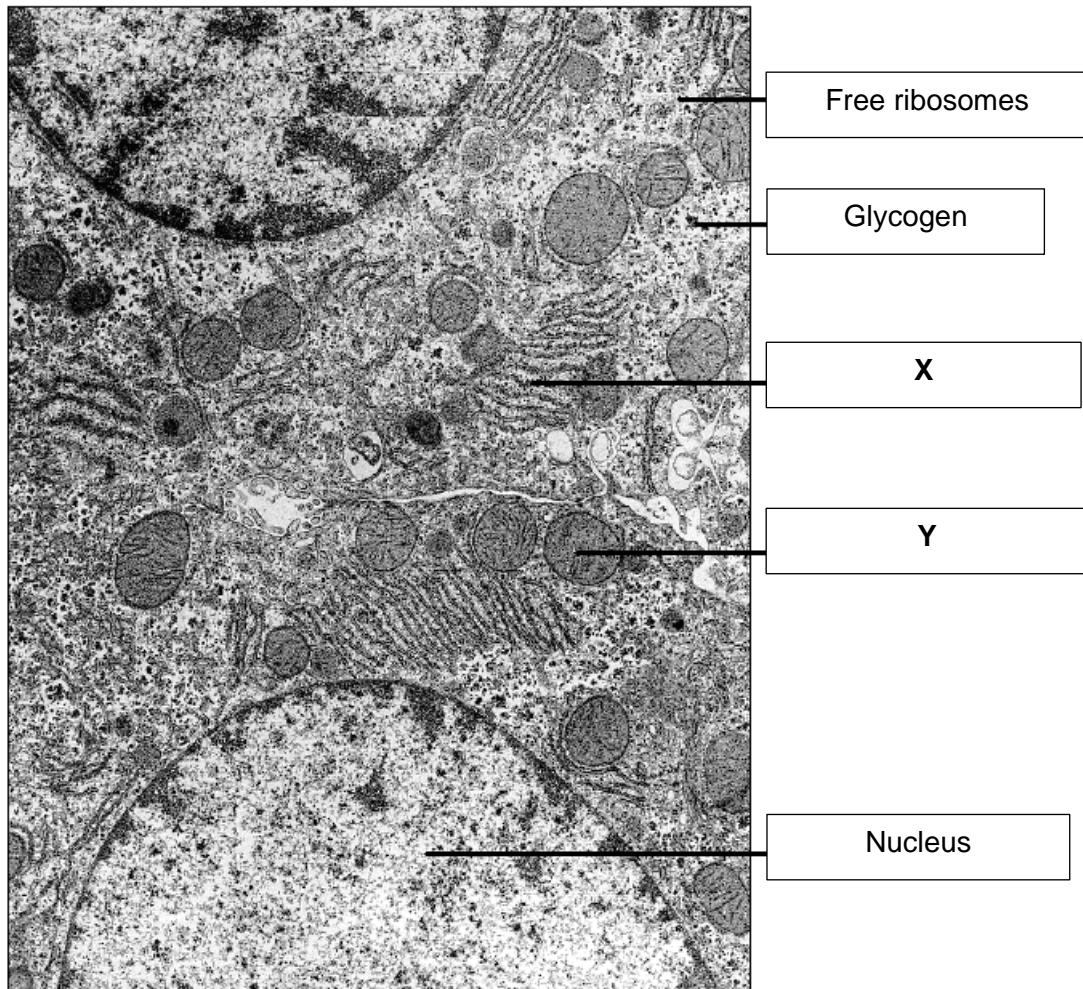


Fig. 1.1

- (a) Identify the structures labelled **X** and **Y**.

[2]

- (b) Explain for the high concentration of structure **Y** in the liver cell.

[2]

Growth hormones released from the anterior lobe of the pituitary binds to receptors on the surface of liver cells which stimulates the synthesis and release of Insulin-like Growth Factor 1 (IGF-1) from them. IGF-1 is a protein with 70 amino acids.

Many cells have receptors for IGF-1, especially cells in the bone marrow and in the cartilaginous growing regions of the long bones.

Binding of IGF-1 to cells with receptors for it stimulates them to move from G_1 of the cell cycle to S phase and on to mitosis.

- (c) (i)** Outline how mRNA of IGF-1 is used to synthesise IGF-1 and secreted out of the liver cell.

[3]

- (ii)** Explain one main event occurring during G_1 phase.

[1]

[Total: 8]

- 2 The light micrographs labelled A to F in Fig. 2.1 show different stages of the mitotic cell cycle in a living cell from the lung epithelium of a newt.

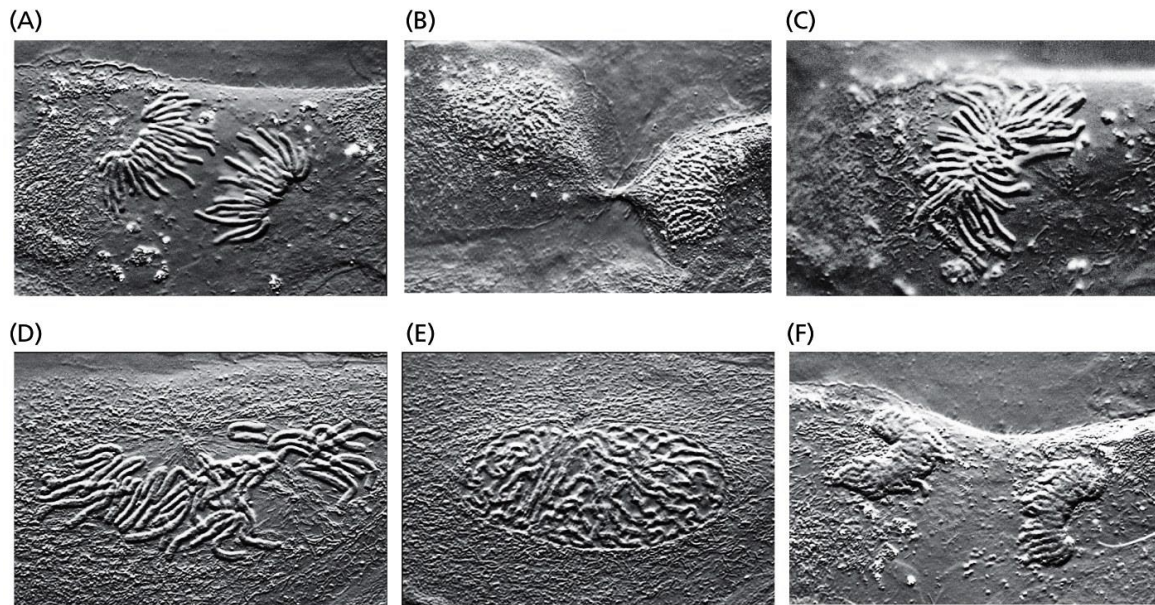


Figure 17-14 MBoc5: The Problems Book (© Garland Science 2008)

Fig. 2.1

- (a) (i) List the stages shown in **A** to **F** in the order of progression through the cell cycle.

_____ [1]

- (ii) With reference to the photomicrograph, identify and explain what is happening in the cell during Stage **A**.

_____ [2]

The NF1 gene contains 8454 base pairs and codes for a protein called neurofibromin. Neurofibromin regulates the action of the Ras protein, which promotes cell division. Mutant forms of NF1 produce a protein that cannot regulate Ras properly.

People with mutations in the NF1 gene develop neurofibromatosis type 1, a disease of the nervous system that affects 1 in 3500 people worldwide. Several different mutations result in neurofibromatosis. Some of these mutations involve the RNA transcript

- (b)** Discuss how a mutation may arise in the NF1 gene, and the effect this mutation could have on the control of cell division.

[3]

Edeine is an antibiotic that inhibits protein synthesis but has no effect on either DNA synthesis or RNA synthesis. When added to the cell extract of an immature red blood cell, edeine stops protein synthesis after a short lag, as shown in Fig. 4.2. By contrast, cycloheximide, which is also an inhibitor, stops protein synthesis immediately. Protein synthesis is measured via radioactivity in haemoglobin.

Analysis of the edeine-inhibited cell extract showed that no polyribosomes remained at the time protein synthesis had stopped. Instead, all the globin mRNA were found associated with small ribosomal subunit and initiator tRNA

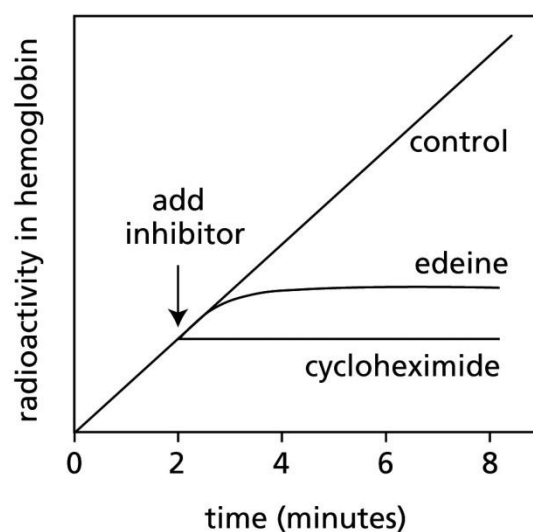


Fig. 3.2

- (c) (i)** Explain how protein synthesis is measured via radioactivity in haemoglobin.

[2]

- (ii)** Describe how edeine inhibits protein synthesis.

[2]

- (iii)** Explain why there is a lag between the addition of edeine and cessation of protein synthesis.

[2]

[Total: 12]

- 3 Fig. 3.1 and Fig. 3.2 show the structure of a part of glycogen and the structure of haemoglobin respectively.

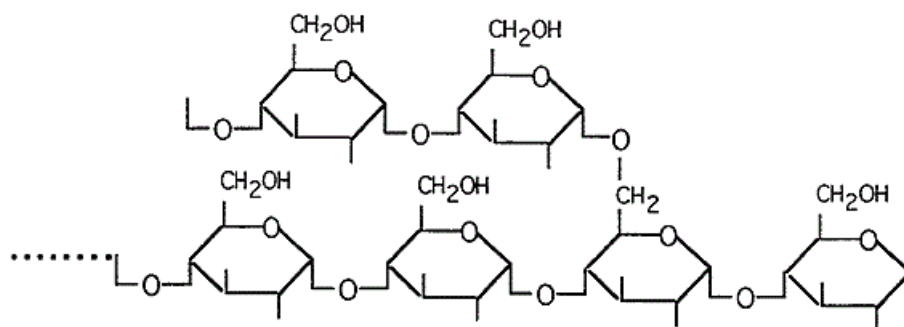


Fig. 3.1

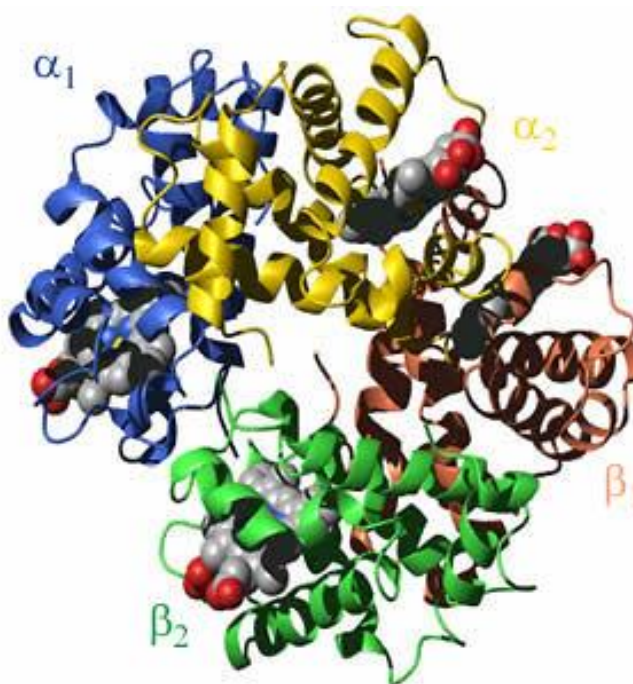


Fig.3.2

With reference to Fig. 3.1 and Fig. 3.2, and your own knowledge,

- (a) state one similarity and one difference in the structure of glycogen and haemoglobin.

Similarity: _____

Difference: _____ [2]

Fig. 3.3 shows some steps involved in glycolysis and the Krebs cycle. Some ATP is made directly. Hydrogen is also released and this can result in the production of more ATP.

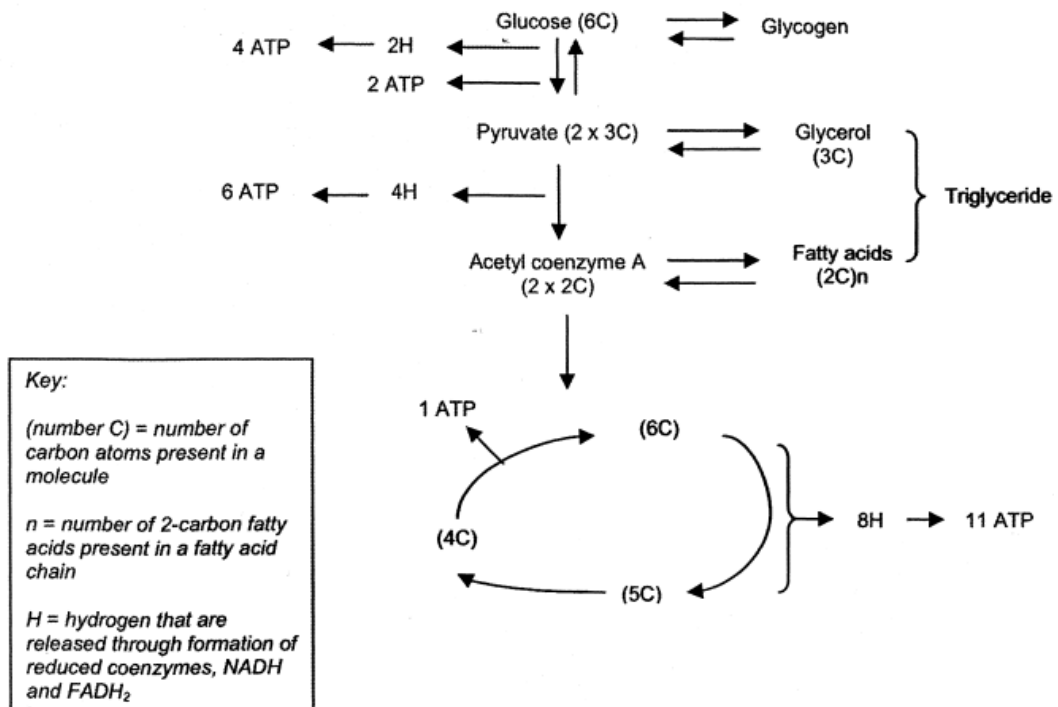


Fig.3.3

- (b) Describe how the hydrogen released during glycolysis and the Krebs cycle results in the production of ATP.

[4]

Similar to glycogen, triglycerides can be respired. The first step is to hydrolyse each triglyceride molecule. Each fatty acid formed is broken down into acetyl CoA molecules. The acetyl CoA molecules then enter the Krebs cycle.

- (c)** Using the information from Fig. 3.3, suggest why fatty acids can only be respired under aerobic conditions.

[2]

[Total: 8]

- 4 Plasmids are circular pieces of extra chromosomal DNA, found in many bacteria.

pUC19 is a plasmid that is frequently used for gene cloning. As shown in Fig. 5.2, the pUC19 plasmid has:

- an origin of replication (ori);
- a *lac Z* gene with its promoter. The *lac Z* gene codes for the α peptide fragment of the enzyme β -galactosidase;
- a short length of DNA called the 'Multiple Cloning Site' (MCS) which contains the recognition sites of 3 different restriction enzymes;
- a gene conferring resistance to the antibiotic ampicillin (amp^R).

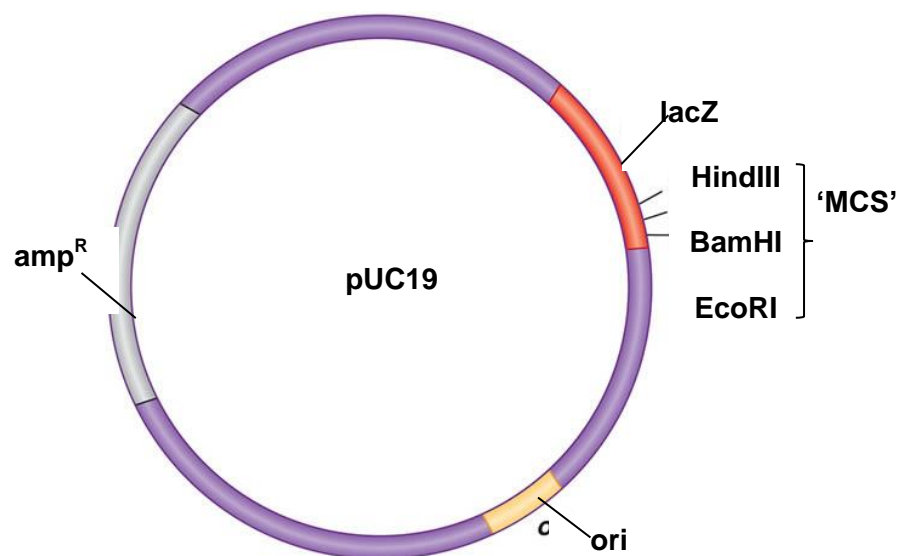


Fig. 4.1

- (a) Explain the purpose of the ori and amp^R gene on pUC19.

[4]

Recombinant plasmids were created by cloning the gene coding for human insulin chain B into the pUC19 plasmid.

Table 4.1 shows the composition of two different nutrient media.

medium	A	B
composition	nutrient agar+ampicillin	nutrient agar with lactose + Compound S + ampicillin

Table 4.1

Competent *Escherischa coli* (*E.coli*) were transformed with recombinant plasmids and grown on medium A.

Bacterial colonies growing on medium A were replica plated onto medium B. Fig 4.2 shows the growth of the resultant bacterial colonies on different media.

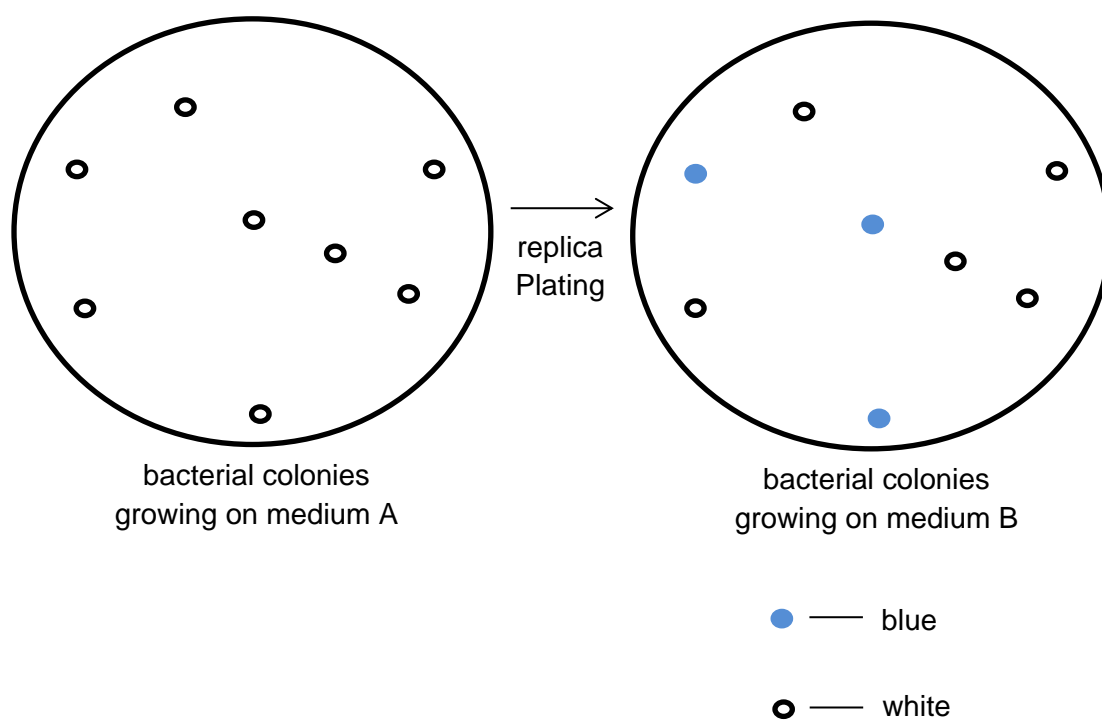


Fig. 4.2

- (b)** Describe how the human insulin chain B gene can be derived

[2]

- (c)** With reference to Table 4.1 and Fig. 4.3, identify the compound **S**.

[1]

- (d)** Explain why compound **S** was used in medium B.

[2]

[Total: 12]

Section B**Answer EITHER 5 OR 6.**

Write your answers on the separate answer paper provided.
Your answers should be illustrated by large, clearly labelled diagrams, where appropriate.
Your answers must be in continuous prose, where applicable.
Your answers must be set out in sections **(a)**, **(b)** etc., as indicated in the question.

Either

- 5** **(a)** Compare and contrast the process of replication and translation. [6]
 (b) Explain the steps involved in gel electrophoresis. [7]
 (c) Discuss the ethical and social implications of genetically modified crop plants. [7]

Or

- 6** **(a)** Compare and contrast between starch and cellulose [6]
 (b) Explain how the structure of the membrane affects the movement of substances into and out of a cell. [7]
 (c) Discuss how bacteria evolve through natural selection and its implication in antibiotic resistance. [7]