1 **(a)** The control of blood glucose is a very important aspect of homeostasis.

(i) Explain what is meant by the term *homeostasis*.

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..... **[2]**

(ii) Describe how negative feedback is used to control blood glucose concentration.



In your answer, you should use appropriate technical terms, spelt correctly.

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..... **[6]**

(b) A 55 year old man visited the doctor and was newly diagnosed with diabetes.

- The doctor initially recommended to the man that he should change his diet to cut out excess carbohydrate, including sugars such as glucose and make a further appointment to check on his progress.
- At this second appointment, however, it was discovered that the dietary changes had not been effective, which was unexpected.
- It turned out that the man had a form of diabetes that required daily hormone injections to control his blood sugar concentration.

Using **only the information given above**, state how **this** man's form of diabetes is **similar** to:

(i) Type 1 diabetes

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..... **[1]**

(ii) Type 2 diabetes.

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..... **[1]**

[Total: 10]

2 Fatigue is a symptom of some medical conditions. One feature of fatigue is extreme tiredness, due to a lack of energy.

Medical conditions that have fatigue as a characteristic symptom include Type 2 diabetes, certain heart conditions, chronic fatigue syndrome (CFS) and emphysema.

(a) Explain how emphysema could result in fatigue.

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..... **[2]**

(b) In Type 2 diabetes, the target cells do not respond correctly to the insulin produced when there is an increase in blood glucose concentration.

Suggest why fatigue may occur in a person with Type 2 diabetes who is **not** taking medication.

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..... **[2]**

(c) Certain heart conditions result in a weak and irregular heart beat.

Suggest how a weak and irregular heart beat could result in fatigue.

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..... **[2]**

(d) Chronic fatigue syndrome (CFS) is a condition in which symptoms vary from individual to individual.

It is thought that a number of different malfunctioning processes can contribute to this condition in an individual.

CFS can affect every system in the body and is identified by symptoms that include fatigue, muscle weakness and aching muscles.

(i) It has been suggested that, in the cells of people with CFS, pyruvate may not be transferred into the mitochondria efficiently.

Outline the consequences of an inefficient transfer of pyruvate into mitochondria and link this to the symptoms of CFS stated above.

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..... **[3]**

(ii) Some people with CFS overproduce T lymphocytes and associated cytokines. Despite this, the specific immune response is poor in these people, resulting in an increased susceptibility to infection.

Suggest a reason for the poor specific immune response in people with CFS.

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..... **[1]**

[Total: 10]

3 **(a)** The pancreas is an unusual gland as it is both an endocrine and an exocrine gland.

Fig. 4.1, **on the insert**, shows a group of cells in the pancreas.

(i) State the name given to the group of cells labelled **X**.

..... **[1]**

(ii) Describe the different ways in which the pancreas acts as both an endocrine and an exocrine gland.



In your answer, you should use appropriate technical terms, spelt correctly.

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..... **[5]**

(b) One particular type of cell in the pancreas is responsible for secreting insulin. The various events involved in the secretion of insulin are listed below.

A	Glucose is phosphorylated and metabolised to produce ATP
B	Potassium channels open, allowing potassium ions to diffuse out of the cell
C	The change in voltage across the membrane causes calcium channels to open
D	Glucose enters the cell
E	The movement of ions results in a potential difference across the cell surface membrane of –70 mV
F	Calcium ions diffuse into the cell
G	The presence of extra ATP causes the potassium channels to close
H	The membrane potential changes to –30 mV
J	The calcium ions cause the vesicles to fuse with the membrane and release insulin

Complete the following list by placing the events in the correct order.

B **E** .... **J** ..... **[4]**

(c) **(i)** State **two** advantages of treating **Type 1** diabetes by using insulin that has been produced by genetically modified bacteria rather than insulin that has been extracted from pigs.

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..... **[2]**

(ii) A potential treatment for Type 1 diabetes is the use of stem cells.

State an advantage of this form of treatment compared to treatment using insulin.

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..... **[1]**

[Total: 13]

4 **(a)** Fig. 5.1 represents the sequence of events that takes place when adrenaline reaches a liver cell.

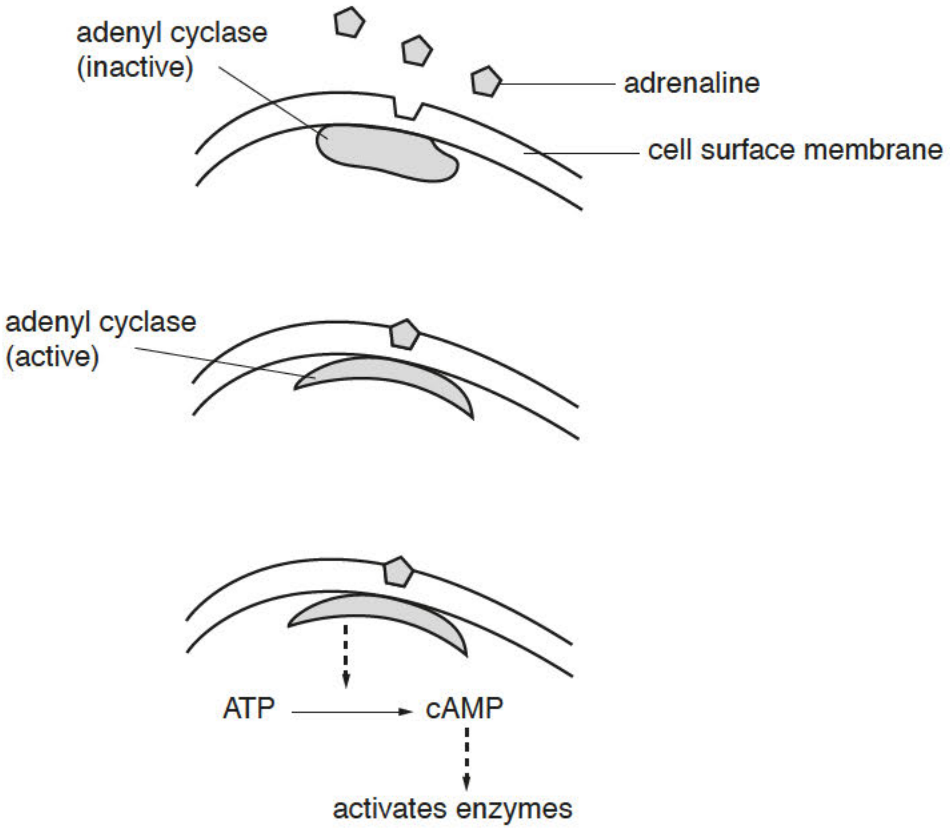


Fig. 5.1

(i) In terms of cell signalling, name the compound in Fig. 5.1 that is acting as:

the second messenger .....

the first messenger ..... **[2]**

(ii) Suggest what happens to polysaccharides in the liver cell as a result of the events shown in Fig. 5.1.

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..... **[1]**

(iii) Adrenaline affects a range of target tissues in the body.

Suggest how the adrenaline molecule can cause different effects in different target tissues.

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..... **[2]**

(b) Outline the **hormonal** and **nervous** mechanisms involved in the control of heart rate.

In your answer, you should use the appropriate technical terms, spelt correctly.

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..... **[5]**

[Total: 10]

5 As part of a study to control Type 2 diabetes by modification of the diet, an investigation was carried out into the effects of different food compounds on the blood glucose and blood insulin concentrations of patients with this type of diabetes.

The food compounds, their components and their effect on blood glucose and blood insulin concentrations are summarised in Table 4.1.

Table 4.1

food compound	component(s)	effect on blood glucose concentration	effect on blood insulin concentration
sucrose	glucose and fructose	moderate increase	moderate increase
lactose	glucose and galactose	moderate increase	moderate increase
starch	glucose	substantial increase	substantial increase
cellulose	glucose	no effect	no effect
protein	amino acid	no effect	moderate increase
fat	fatty acid and glycerol	no effect	moderate increase

(a) Suggest an explanation for the differences observed in **blood glucose concentration**:

(i) between starch and sucrose,

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..... **[2]**

(ii) between starch and cellulose.

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..... **[2]**

(b) With reference to the food compounds in Table 4.1, explain how a person with Type 2 diabetes could control the condition by modifying their diet.

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..... **[3]**

(c) Glycogen and glucagon are compounds that are involved in the control of blood glucose concentration.

Complete the table below to distinguish between these two compounds.

	glycogen	glucagon
type of compound		
role of compound		
site of production		

[3]

[Total: 10]