1 Within the mammalian body, different systems of communication are used to coordinate and control activities.

(a) Complete the following passage by using the **most suitable** term in each case.

The pancreas and the adrenal glands are both examples of ..... glands. Adrenaline is a ..... that is secreted by the adrenal glands. These glands also secrete steroids such as corticosteroids from cells in the ..... region. The chemicals secreted by these glands are transported by the blood to their ..... cells and tissues. **[4]**

(b) Insulin is secreted from the beta cells of the pancreas in response to increased blood glucose concentration.

Fig. 2.1 is a diagram representing the sequence of events leading to the secretion of insulin from the beta cell.

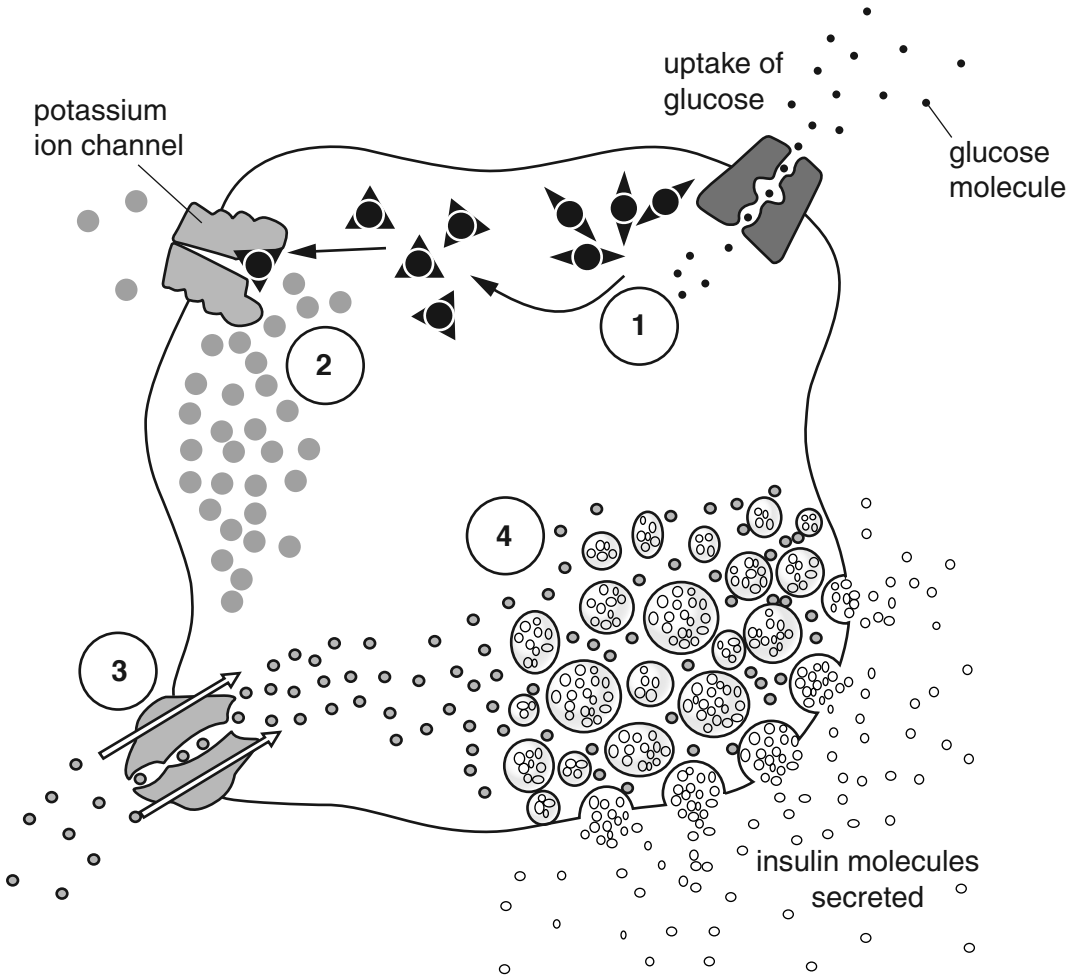

Fig. 2.1

(i) With reference to Fig. 2.1, describe the events occurring at the stages labelled **1** to **4**.

1 .....

.....

.....

2 .....

.....

.....

3 .....

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.....

4 .....

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..... **[4]**

(ii) After the initial release of insulin from the beta cell, insulin secretion continues even when there is no further glucose intake.

Suggest and explain why the cell continues to secrete insulin.

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.....

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

[Total : 10]

2 This question considers some similarities and differences in plant and animal biology.

(a) (i) Describe two **similarities** in the action of plant and animal hormones **in cell signalling**.

1 .....

.....

.....

2 .....

.....

....

[2]

(ii) Asexual reproduction and the ability to produce natural reproductive clones is common in plants but rare in animals.

Explain why plants are more able to form **natural** reproductive clones than animals.

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

(iii) Polyploidy is the possession of more than two sets of chromosomes in the nucleus. Polyploidy is common in plants.

Suggest an explanation for the significance of polyploidy in forming new species of plant such as bread wheat, *Triticum aestivum*.

.....

.....

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.....

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

(b) A student setting up an experiment to investigate the effect of light on cress plant seedlings accidentally shone the bright light onto one side of the face of another student. He noticed that the student immediately responded by raising her hand to shield her eye from the light.

The response of the cress seedlings to light shining from one direction was slower, but after 24 hours the cress seedlings had grown towards the light.

Describe the mechanisms that produced the responses to light in the cress seedlings **and** in the human.

cress seedlings .....

.....

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human .....

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[7]

[Total: 13]

3 **(a)** A doctor arranged for a 59-year-old patient to have a series of blood tests. One of these tests was to determine the patient's 'fasting blood glucose' concentration.

- The result of this test indicates whether or not the patient's blood glucose concentration is being regulated within the normal range.
- The validity of the result relies on the patient not having eaten for at least eight hours before the test.
- The patient confirmed to the doctor that he had not eaten since the previous evening.

(i) What condition was being tested for in this 59-year-old patient?

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

(ii) Why was it important that the patient had not eaten for at least eight hours before the test?

.....

.....

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

(iii) The result of the patient's fasting blood glucose test was 7.0 mmol dm^{-3}.

The upper limit for 'normal' blood glucose concentration is considered to be 5.9 mmol dm^{-3}.

Calculate the percentage by which this patient's blood glucose concentration is higher than the upper limit for normal concentration.

Show your working. **Give your answer to one decimal place.**

Answer = ... % **[2]**

(b) The patient was sent for a further blood test, known as the haemoglobin A1C (HbA1C) test.

- Glucose combines with haemoglobin in the bloodstream to form a 'glycosylated haemoglobin' molecule, HbA1C.

- The concentration of HbA1C is directly proportional to the mean concentration of glucose in the blood over an eight to twelve week period.

Suggest why a single HbA1C test cannot indicate accurately the mean blood glucose concentration for a period longer than twelve weeks.

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

(c) The result of the patient's fasting blood glucose test showed a blood glucose concentration higher than the normal range even though the patient had not eaten food for at least eight hours before providing a blood sample.

The result of the patient's HbA1C test indicated that his mean blood glucose concentration had been within the normal range for the previous eight to twelve weeks.

Suggest an explanation for the patient's high value for the **fasting blood glucose test**.

.....

.....

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

(d) Another patient shows severe symptoms of unregulated blood glucose concentration. Under certain circumstances this condition may need to be treated with glucagon injections.

(i) Under what circumstances might this patient need to be given a glucagon injection?

.....

.....

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

(ii) Describe how glucagon is involved in the regulation of blood glucose concentration in a person who is able to regulate their blood glucose concentration correctly.

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

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

[Total: 13]

4 The regulation of blood glucose concentration is important for homeostasis and involves hormonal control.

(a) **(i)** Name the endocrine tissue in the pancreas that is responsible for secretion of hormones.

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

(ii) Identify the **specific** cell type in pancreatic tissue that secretes the hormone insulin.

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

(b) The incomplete flowchart below outlines the way in which the secretion of insulin from a pancreatic cell is controlled.

Complete the flowchart by inserting the most appropriate word(s) in the spaces provided.

Insulin secretion is stimulated when the blood glucose concentration

.....

↓

Glucose enters the pancreatic cell through channel proteins. The glucose enters the..... pathway and ATP is produced.

↓

The increase in ATP causes ATP-controlled potassium ion channels to close and the cell membrane becomes .....

↓

This results in the opening of voltage-gated ..... ion channels and the concentration of this ion inside the cell increases.

↓

The increased concentration of these ions causes the secretion of insulin from the cell by the process of .....

[5]

(c) **(i)** Insulin is a polypeptide molecule.

State where in a pancreatic **cell** insulin molecules are synthesised.

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

(ii) Outline the events that occur after the synthesis of an insulin molecule until it is ready to be secreted from the pancreatic cell.

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

[Total: 11]