Q1. Scientists investigated the control of blood glucose concentration in mice. They kept a group of normal mice without food for 48 hours. After 48 hours, the blood glucose concentrations of the mice were the same as at the start of the experiment.

(a) Explain how the normal mice prevented their blood glucose concentration falling when they had **not** eaten for 48 hours.

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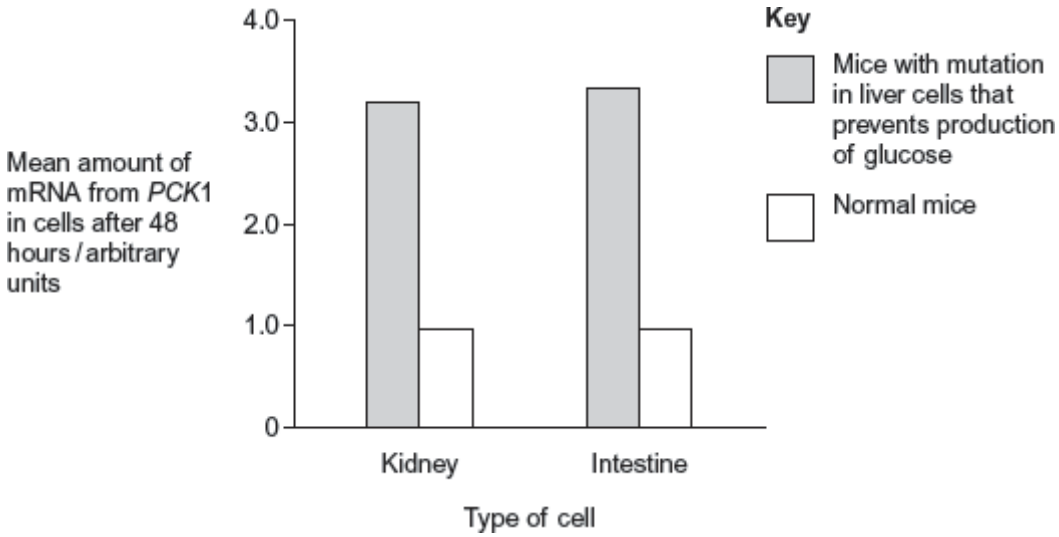
(3)

The scientists then investigated mice with a mutation that prevents their liver cells making glucose. They kept a group of these mice without food for 48 hours. After 48 hours, the mean blood glucose concentrations of the mutant mice and the normal mice were the same.

The scientists investigated how blood glucose concentration is controlled in these mutant mice. An enzyme required for synthesis of glucose is coded for by a gene called *PCK*1. The scientists measured the mean amount of mRNA produced from this gene in cells from the kidneys and intestines of normal mice and mutant mice. They did this with mice that had previously been without food for 48 hours.

The scientists' results are shown in the graph.



(b) Use information from the graph to suggest how blood glucose concentration is controlled in the mutant mice, compared with the normal mice.

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(c) The scientists performed statistical tests on the data shown in the graph, to see whether the differences in the amount of mRNA in cells from normal and mutant mice were significant. Both the probability values they obtained were $p<0.01$.

Explain what this means about the differences in the amounts of mRNA produced.

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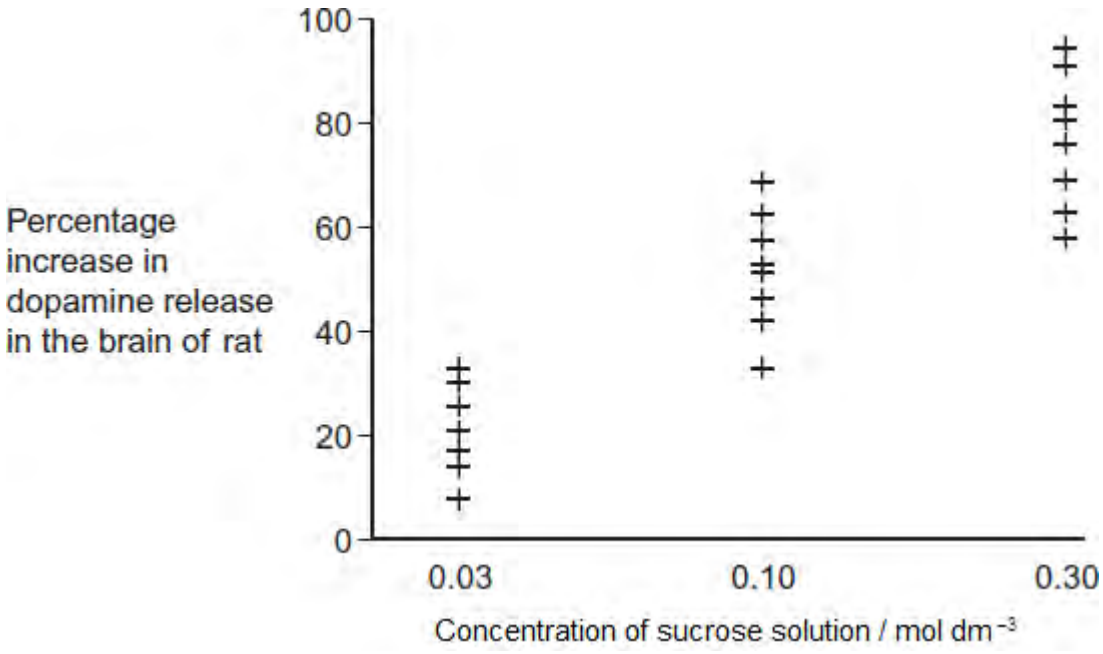
(2)
(Total 8 marks)

Q2. The release of a substance called dopamine in some areas of the brain increases the desire to eat.

Scientists measured increases in the release of dopamine in the brains of rats given different concentrations of sucrose solution to drink.

Sucrose stimulates taste receptors on the tongue.

The graph shows their results. Each point is the result for one rat.



(a) The scientists concluded that drinking a sucrose solution had a positive feedback effect on the rats' desire to eat.

How do these data support this conclusion?

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(Extra space).....

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(3)

(b) In this investigation, the higher the concentration of sucrose in a rat's mouth, the higher the frequency of nerve impulses from each taste receptor to the brain.

If rats are given very high concentrations of sucrose solution to drink, the refractory period makes it impossible for information about the differences in concentration to reach the brain. Explain why.

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(2)

(c) In humans, when the stomach starts to become full of food, receptors in the wall of the stomach are stimulated. This leads to negative feedback on the desire to eat. Suggest why this negative feedback is important.

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(3)

(Total 8 marks)

Q3. Different substances are involved in coordinating responses in animals.

(a) Synapses are unidirectional. Explain how acetylcholine contributes to a synapse being unidirectional.

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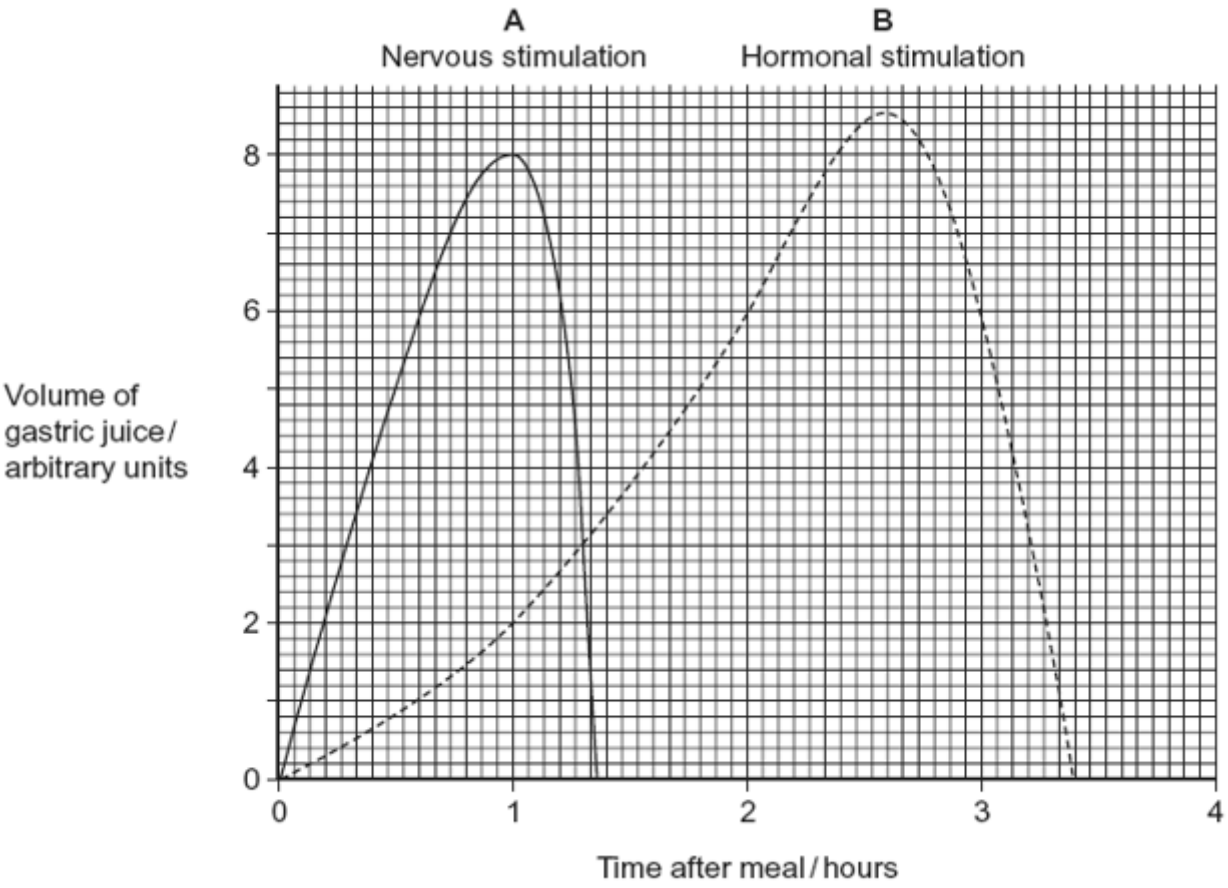
(2)

(b) Cells in the stomach wall release gastric juice after a meal. The graph shows how the volumes of gastric juice produced by nervous stimulation and by hormonal stimulation change after a meal.



(i) Describe the evidence from the graph that curve **A** represents the volume of gastric juice produced by nervous stimulation.

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(2)

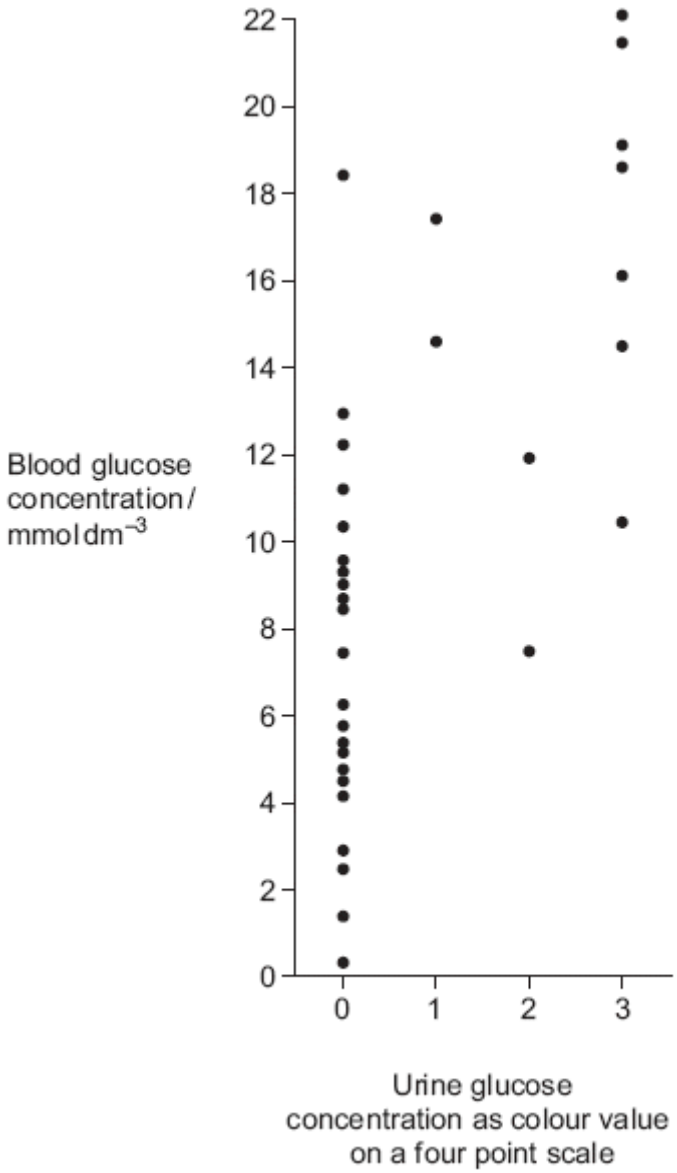
(ii) Complete the table to show the percentage of gastric juice produced by nervous stimulation at the times shown.

	Time after meal / hours		
	1	**2**	**3**

Percentage of gastric juice produced by nervous stimulation			

(1)
(Total 5 marks)

Q4. (a) Technicians in a hospital laboratory tested urine and blood samples from a girl with diabetes at intervals over a one-year period. Each time the technicians tested her urine, they also measured her blood glucose concentration. Their results are shown in the graph.



(i) The girl who took part in this investigation was being successfully treated with insulin. The graph shows that on some occasions, the concentration of glucose in her blood was very high. Suggest why.

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(2)

(ii) Use the graph to evaluate the use of the urine test as a measure of blood glucose concentration.

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(3)

(b) Diabetic people who do not control their blood glucose concentration may become unconscious and go into a coma. A doctor may inject a diabetic person who is in a coma with glucagon. Explain how the glucagon would affect the person's blood glucose concentration.

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(2)
(Total 7 marks)

Q5.(a) The control of water balance in the body involves negative feedback.

(i) Describe what is meant by *negative feedback*.

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(1)

(ii) Water is removed from the body via the kidneys. Give **two** other ways in which water is removed from the body.

1 .....

2 .....

(2)

(iii) Name the part of the brain which acts as the coordinator in the control of water balance.

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(1)

(b) **Figure 1** shows the cells lining the collecting duct in a human kidney. ADH molecules bind to the receptor proteins and this triggers the vesicles containing aquaporins to bind with the plasma membrane next to the lumen. **Figure 2** shows an aquaporin which is a large channel protein.

Figure 1

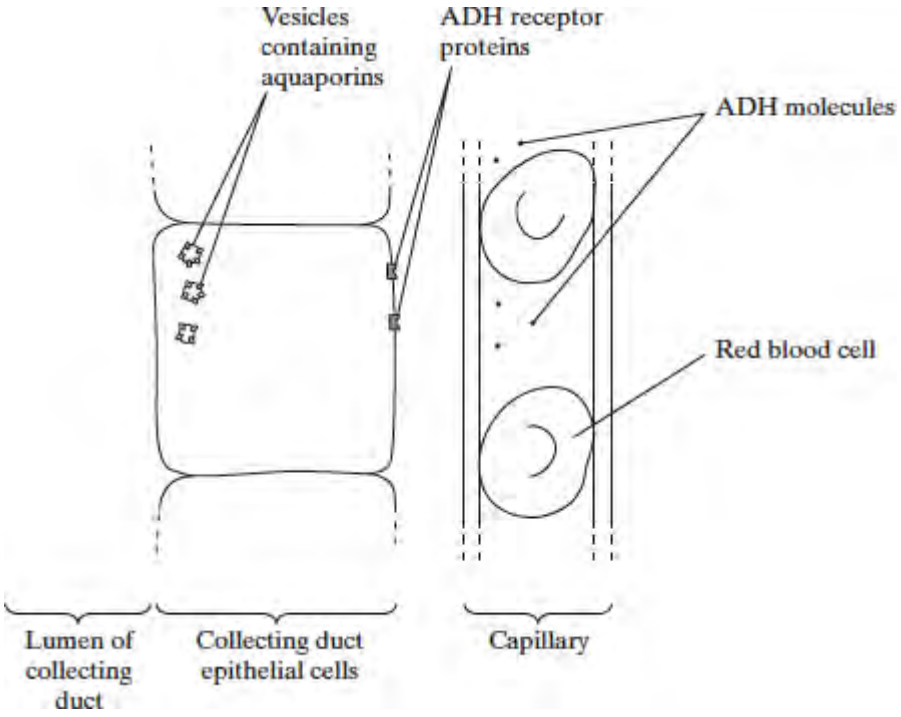
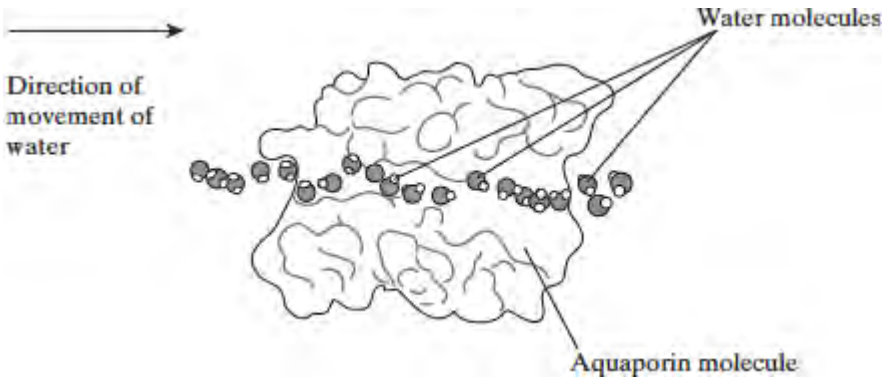


Figure 2



(i) From which gland is ADH released?

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(1)

(ii) Use the information given to explain how ADH increases the movement of water from the lumen of the collecting duct into the blood.

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(4)

(c) The gene for the ADH receptor proteins is found on the X chromosome. One allele of this gene causes a non-functioning receptor protein to be made. This allele is recessive and is one cause of the condition called diabetes insipidus.

(i) What would be the most obvious symptom of diabetes insipidus?

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(1)

(ii) Suggest why diabetes insipidus is more common in males.

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(2)

(iii) A recessive allele which has harmful effects is able to reach a higher frequency in a population than a harmful dominant allele. Explain how.

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(3)
(Total 15 marks)

Q6. (a) (i) What is meant by homeostasis?

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(1)

(ii) Giving **one** example, explain why homeostasis is important in mammals.

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(2)

(b) Cross-channel swimmers may suffer from muscle fatigue during which the contraction mechanism is disrupted. One factor thought to contribute to muscle fatigue is a decrease in the availability of calcium ions within muscle fibres. Explain how a decrease in the availability of calcium ions could disrupt the contraction mechanism in muscles.

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(3)
(Total 6 marks)