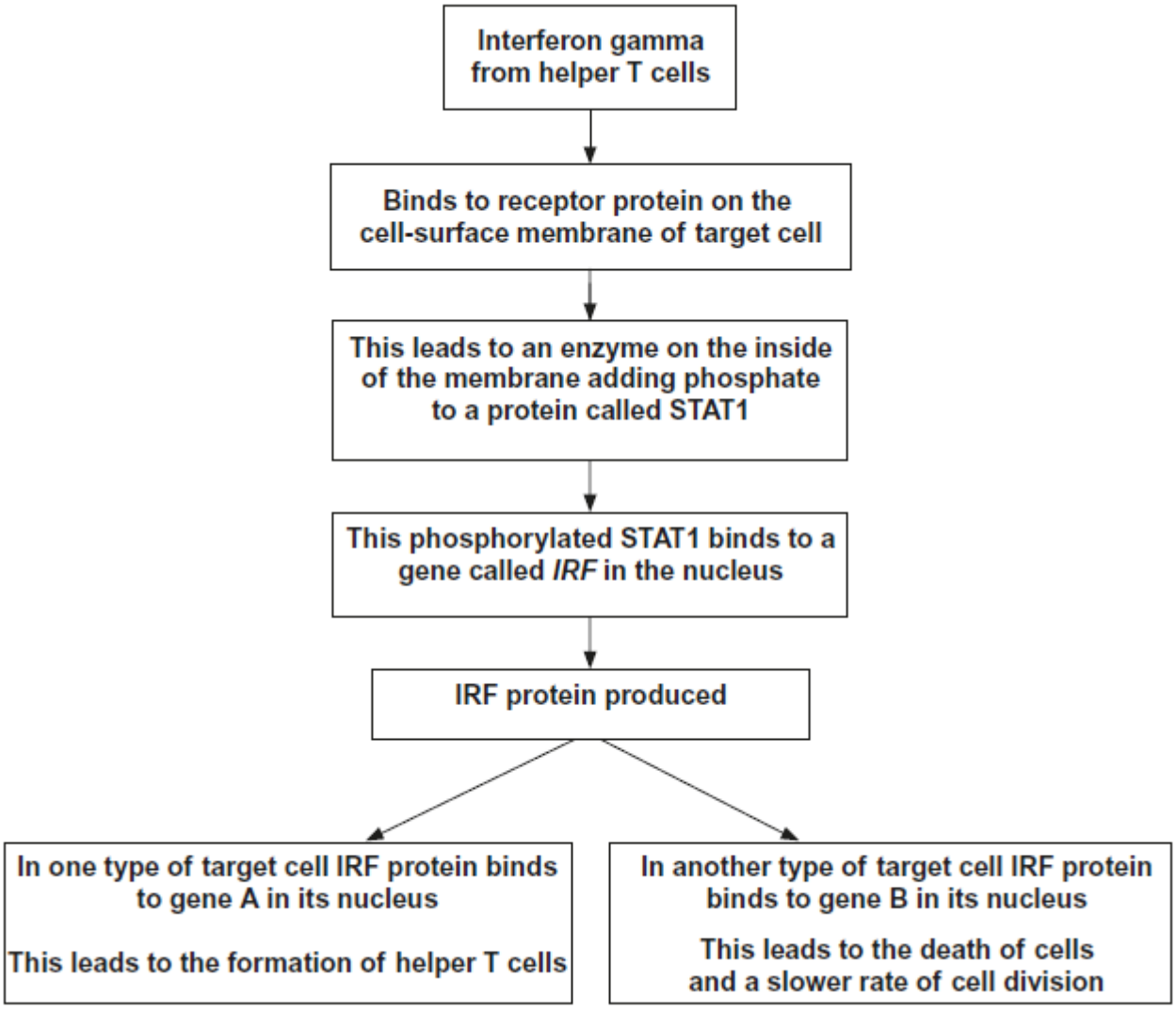
6.4 Organisms - Responses to their environment (A-Level Only) - Homeostasis 1 – Questions

Q1.

Interferon gamma is a substance secreted by some types of white blood cells, including helper T cells. It regulates the production of a number of proteins by target cells. Which protein is produced depends on the type of target cell.

The diagram shows how interferon gamma regulates three genes.



(a) Use information in the diagram to suggest how the binding of interferon gamma to its receptor protein leads to the production of phosphorylated STAT1.

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(2)

(b) Name the **two** transcription factors in the diagram.

1. _____

2. _____

(2)

(c) The regulation of the formation of helper T cells by interferon gamma is an example of positive feedback.

Explain why it is an example of positive feedback.

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(2)

(d) The *IRF* gene can be a tumour suppressor gene.

Use the information in the diagram to explain how the *IRF* gene acts as a tumour suppressor gene.

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(3)

(Total 9 marks)

Q2.

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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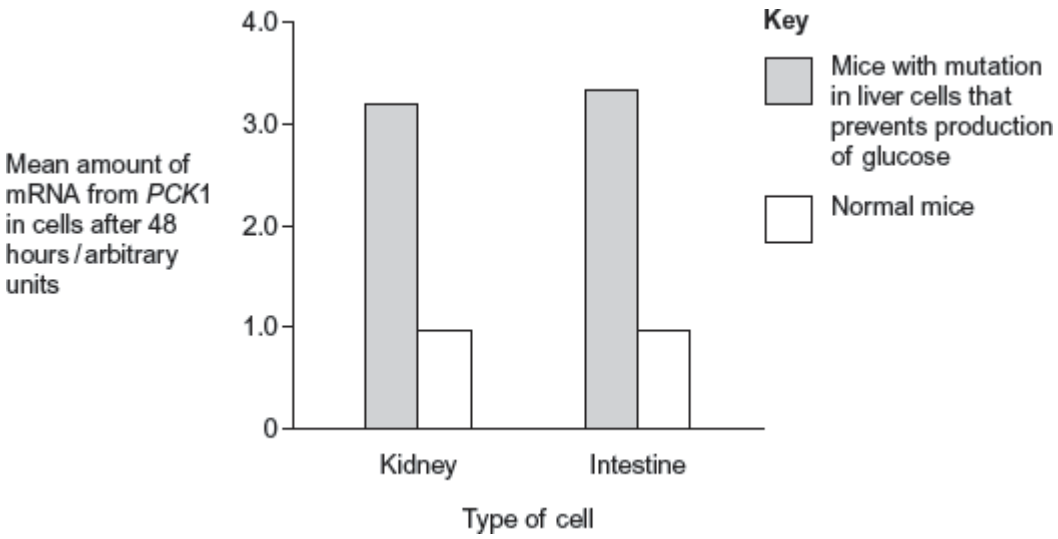
[Extra space] _____

(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.

[Extra space] _____

(3)

(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.

[Extra space]

(2)

(Total 8 marks)

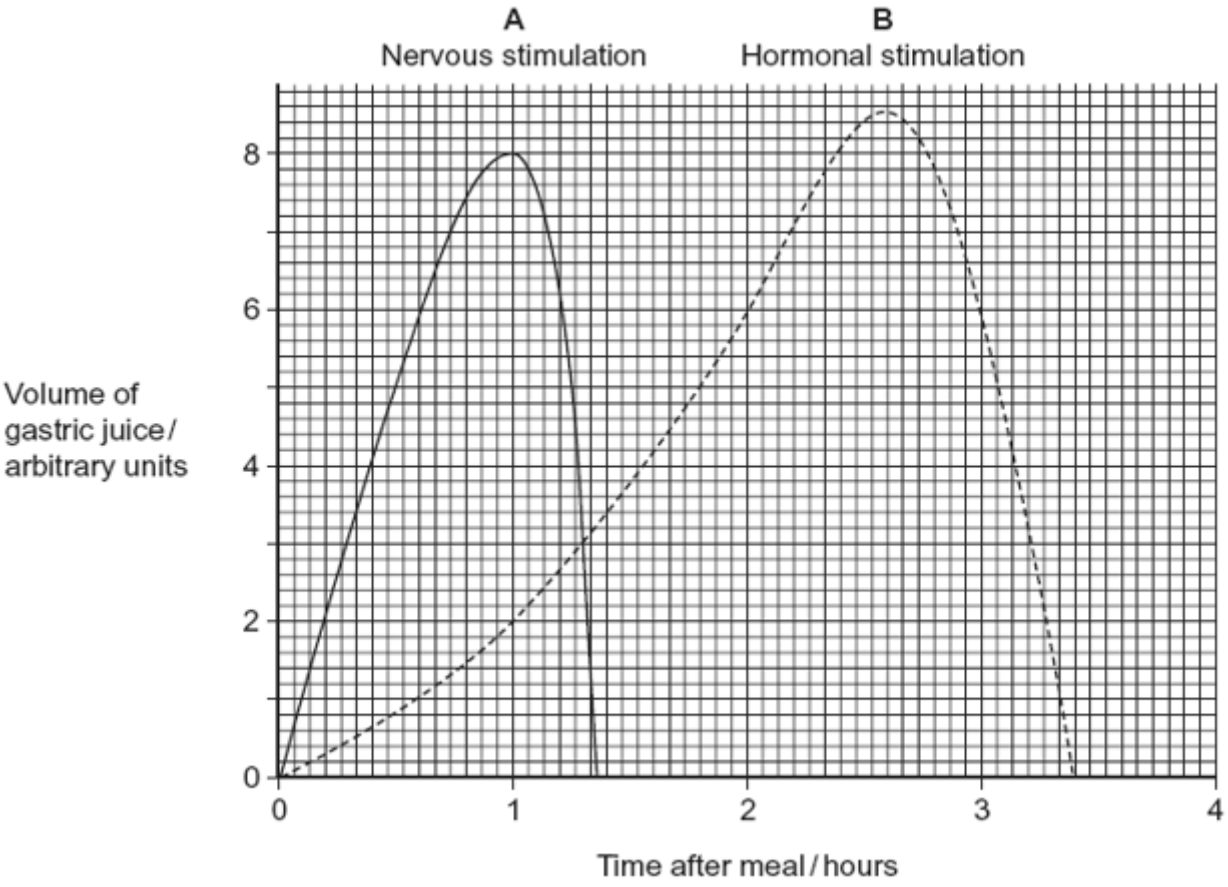
Q3.

Different substances are involved in coordinating responses in animals.

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

(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.

_____

_____

_____

_____

(2)

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

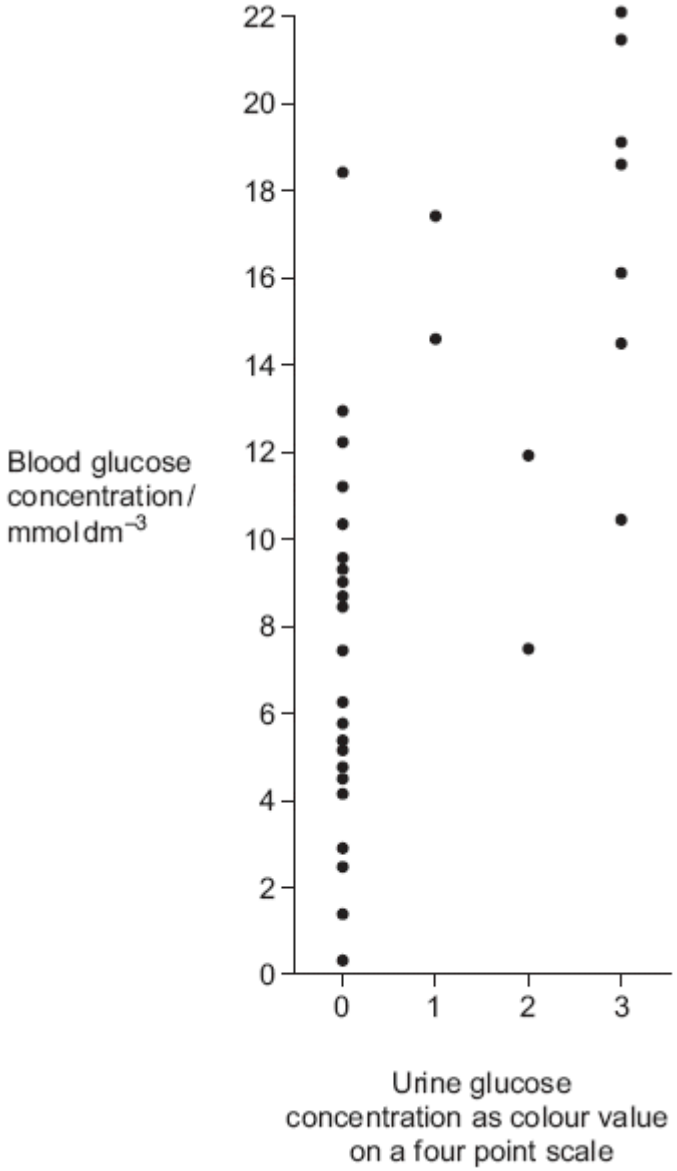
	Time after meal / hours		
	1	**2**	**3**
Percentage of gastric juice produced by nervous stimulation			

(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*.

_____

_____

_____

(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.

_____

(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

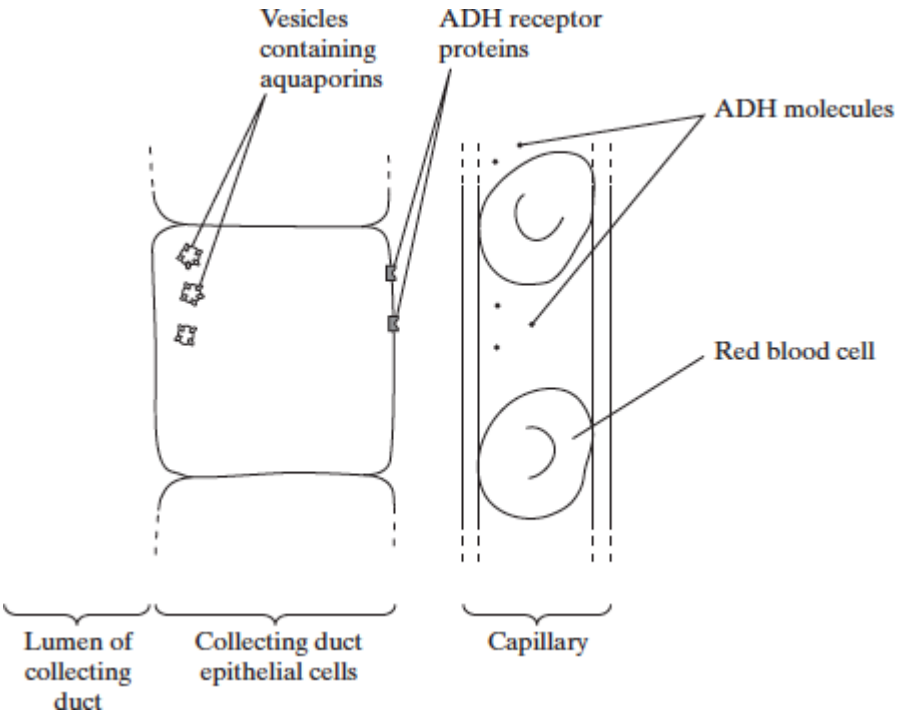
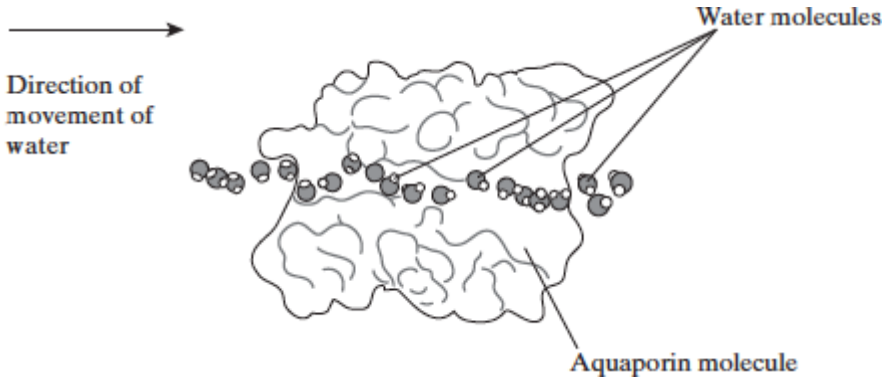


Figure 2



(i) From which gland is ADH released?

_____

(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?

(1)

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

(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.

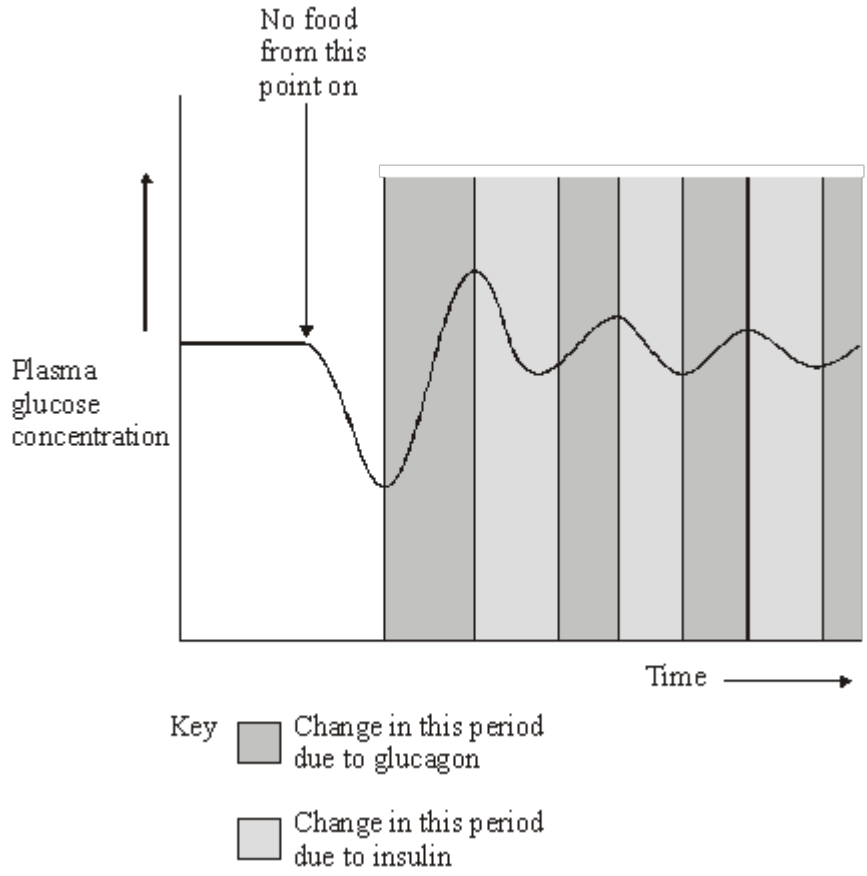
(3)

(Total 15 marks)

Q6.

Homeostatic mechanisms maintain a constant environment in the body.

(a) The graph shows changes in plasma glucose concentration that occurred in a person who went without food for some time.



Use evidence from the graph to explain the role of negative feedback in the control of plasma glucose concentration.

(5)

(b) How does maintaining a constant body temperature allow metabolic reactions in cells to proceed with maximum efficiency?

(5)

(Total 10 marks)

Q7.

Osmoreceptors are specialised cells that respond to changes in the water potential of the blood.

(a) Give the location of osmoreceptors in the body of a mammal.

(1)

(b) When a person is dehydrated, the cell volume of an osmoreceptor decreases. Explain why.

(2)

(c) Stimulation of osmoreceptors can lead to secretion of the hormone ADH. Describe and explain how the secretion of ADH affects urine produced by the kidneys.

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(Extra space) _____

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_____

(4)

The efficiency with which the kidneys filter the blood can be measured by the rate at which they remove a substance called creatinine from the blood. The rate at which they filter the blood is called the glomerular filtration rate (GFR).

In 24 hours, a person excreted 1660 mg of creatinine in his urine. The concentration of creatinine in the blood entering his kidneys was constant at 0.01 mg cm^{-3}.

(d) Calculate the GFR in cm^3 $minute^{-1}$.

Answer = _____

(1)

(e) Creatinine is a breakdown product of creatine found in muscle tissues. Apart from age and gender, give **two** factors that could affect the concentration of creatinine in the blood.

1. _____

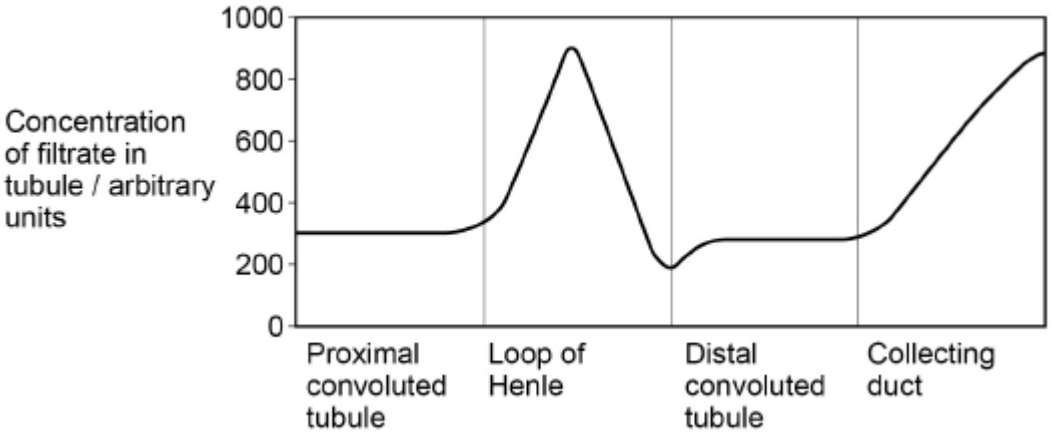
2. _____

(1)

(Total 9 marks)

Q8.

The graph below shows the concentration of the filtrate in different parts of one kidney tubule.



(a) More than 99% of biological molecules are reabsorbed from the filtrate in the proximal convoluted tubule.

Despite this, the concentration of fluid in this tubule remains constant.

Explain why.

(1)

(b) Explain the shape of the curve in the loop of Henle in the graph.

(3)

(c) What is the evidence in the graph that this person was secreting antidiuretic hormone (ADH)?

Explain your answer.

_____

_____

_____

_____

(2)

(Total 6 marks)

Q9.

(a) Give **two** ways in which people with type 1 diabetes control their blood glucose concentration.

1. _____

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2. _____

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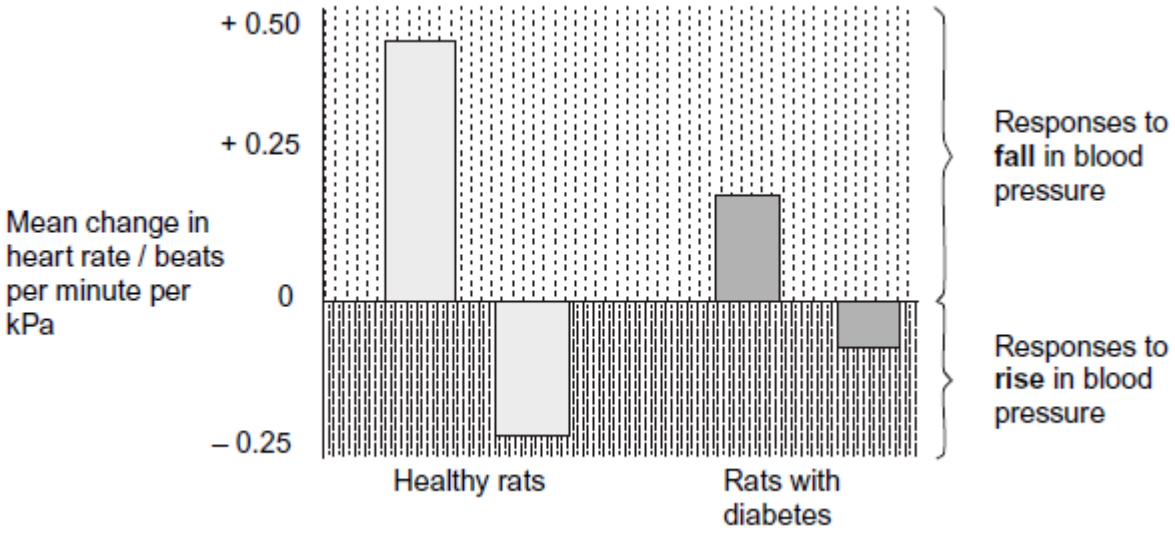
(2)

(b) Scientists investigated the effect of diabetes on the control of heart rate in response to changes in blood pressure in rats.

The scientists found the mean changes in heart rates of healthy rats and rats with diabetes in response to rises or falls in blood pressure.

The diagram shows their results in the form they were presented.



Diabetes can damage the nervous system. The response of the rats with diabetes is different from the response of the healthy rats. Use your knowledge of the control of heart rate by the nervous system to suggest an explanation for these results.

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_____

(4)

(Total 6 marks)

Q10.

(a) Each year, a few people with type I diabetes are given a pancreas transplant. Pancreas transplants are not used to treat people with type II diabetes.

Give **two** reasons why pancreas transplants are not used for the treatment of type II diabetes.

1. _____

_____

_____

2. _____

_____

_____

(2)

(b) The pancreas produces the hormone insulin.

Put a tick (✔) in the box next to the statement which describes **incorrectly** the action of insulin.

Activates enzymes involved in the conversion of glucose to glycogen.	☐
Controls the uptake of glucose by regulating the inclusion of channel proteins in the surface membranes of target cells.	☐
Attaches to receptors on the surfaces of target cells.	☐
Activates enzymes involved in the conversion of glycerol to glucose.	☐

(1)

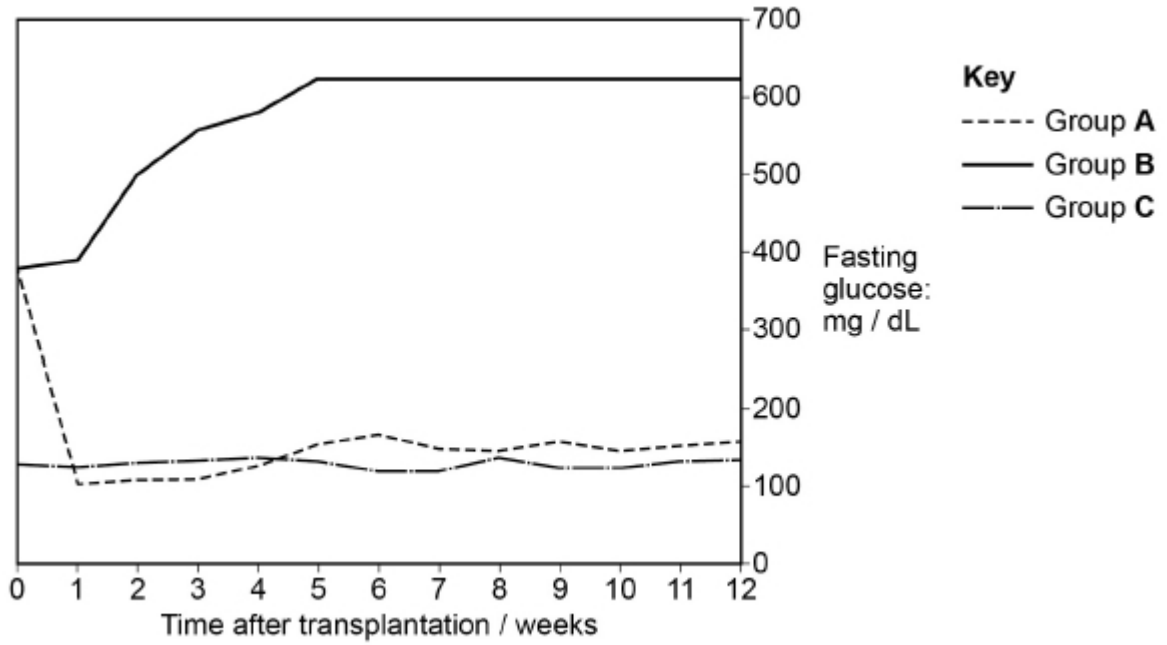
(c) Scientists investigated the use of induced pluripotent stem cells (iPS cells) to treat type I diabetes in mice. The scientists used four transcription factors to reprogramme skin cells to form iPS cells. The scientists then stimulated the *in vitro* differentiation of iPS cells into pancreatic cells.

The scientists set up three experimental groups:

- Group **A** – 30 mice with type I diabetes received pancreatic cell transplants derived from iPS cells.
- Group **B** – 30 mice with type I diabetes were left untreated.
- Group **C** – 30 mice without diabetes were left untreated.

The scientists measured the blood glucose concentration of all the mice on a weekly basis for 12 weeks.

The results the scientists obtained are shown in the graph.



Suggest how transcription factors can **reprogramme** cells to form iPS cells.

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(2)

(d) Using all the information provided, evaluate the use of iPS cells to treat type I diabetes in humans.

(4)

(Total 9 marks)

Q11.

(a) When insulin binds to receptors on liver cells, it leads to the formation of glycogen from glucose. This lowers the concentration of glucose in liver cells.

Explain how the formation of glycogen in liver cells leads to a lowering of blood glucose concentration.

(2)

People with type II diabetes have cells with low sensitivity to insulin. About 80% of people with type II diabetes are overweight or obese. Some people who are obese have gastric bypass surgery (GBS) to help them to lose weight.

Doctors investigated whether GBS affected sensitivity to insulin. They measured patients' sensitivity to insulin before and after GBS. About half of the patients had type II diabetes. The other half did not but were considered at high risk of developing the condition.

The table below shows the doctors' results. The higher the number, the greater the sensitivity to insulin.

Patients	**Mean sensitivity to insulin / arbitrary units (± SD)**	
	Before gastric bypass surgery	**1 month after gastric bypass surgery**

Did not have diabetes	0.55 (± 0.32)	1.30 (± 0.88)
Had type II diabetes	0.40 (± 0.24)	1.10 (± 0.87)

(b) The doctors concluded that many of the patients who did not have type II diabetes were at high risk of developing the condition.

Use the data in the table to suggest why they reached this conclusion.

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_____

_____

_____

(2)

(c) The doctors also concluded that GBS cured many patients' diabetes but that some were not helped very much.

Do these data support this conclusion? Give reasons for your answer.

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_____

(Extra space) _____

_____

_____

(3)

(Total 7 marks)

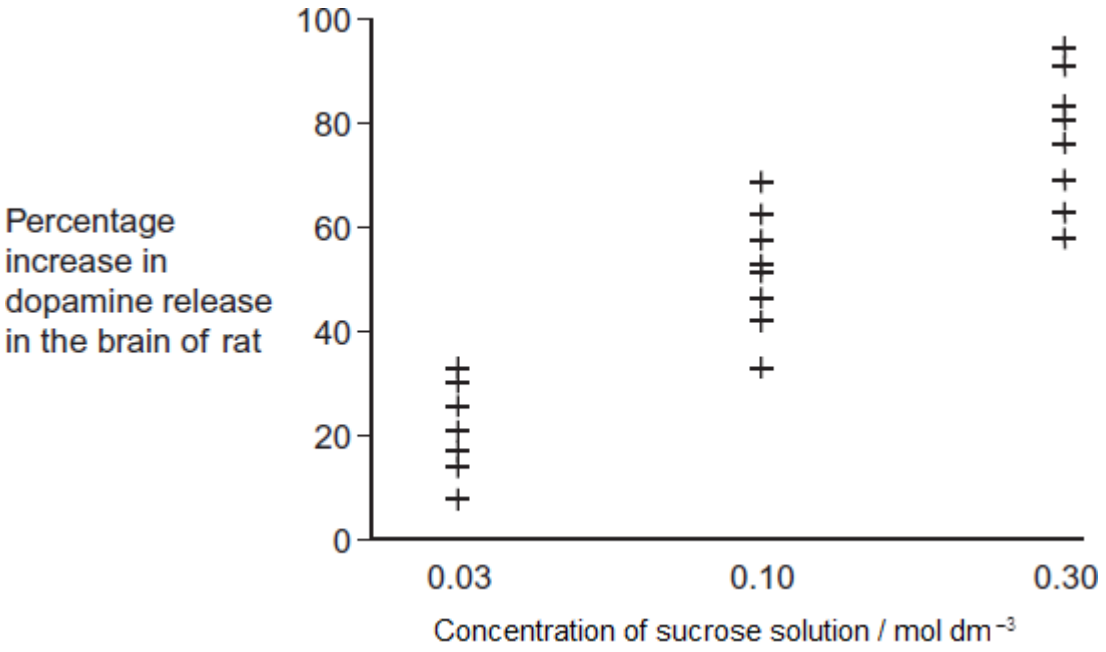
Q12.

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?

(Extra space)

(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.

(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.

(Extra space)

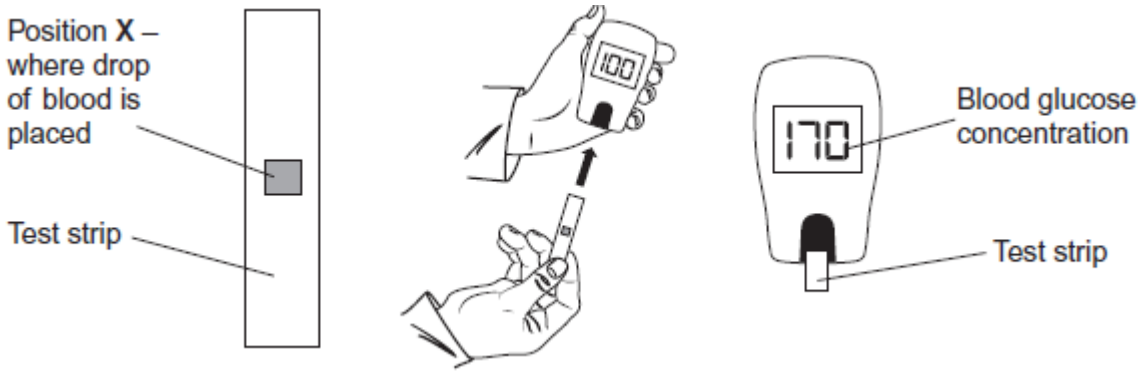
(3)

(Total 8 marks)

Q13.

A glucometer is a device used to measure blood glucose concentration. A person uses a test strip that goes into the glucometer. They put a drop of blood onto the test strip. There are substances on the test strip that produce a colour change with glucose. The higher the concentration of glucose, the deeper the colour produced. The glucometer measures the depth of colour produced and converts this into a glucose concentration. A new test strip is used for each blood test.

Figure – glucometer and test strip



The following equations show how the substances on the test strip produce a colour change.

$$\text{Glucose + oxygen} \xrightarrow{\text{Glucose oxidase}} \text{gluconic acid + hydrogen peroxide}$$

$$\text{Hydrogen peroxide + dye with colour A} \xrightarrow{\text{Peroxidase}} \text{dye with colour B + water}$$

Non-diabetics have no glucose in their urine. Diabetics have glucose in their urine if their blood glucose concentration rises above about 170 mg 100 cm^{-3}.
Before the glucometer was available, diabetics used test strips to measure the concentration of glucose in their urine as a means of measuring their blood glucose concentration. When testing urine, the colour of the test strip is compared against a colour chart which gives a glucose concentration range for the colour produced.

(a) Identify all the substances located at position **X** on the test strip before a drop of blood is added.

_____

_____

_____

_____

_____

(2)

(b) Before the glucometer was available, diabetics used test strips to measure the concentration of glucose in their urine as a means of measuring their blood glucose concentration.

Give **two** reasons why this method of testing urine would **not** give an accurate measurement of blood glucose concentration.

1. _____

_____

2. _____

_____

(2)
(Total 4 marks)

Q14.

There are two types of diabetes: type 1 and type 2.

- People with type 1 diabetes do not produce enough insulin.
- People with type 2 diabetes do produce insulin but have cells which do not respond to insulin.

Doctors use a glucose tolerance test to help diagnose people with diabetes. They start each test after a person has not eaten overnight. They measure a person's blood glucose concentration.
The person then drinks a solution containing 75 g of glucose. The doctors measure the person's blood glucose concentration 2 hours later. During the test, the person remains at rest.

Figure 1 shows three diagnoses that can be made from the results of the test.

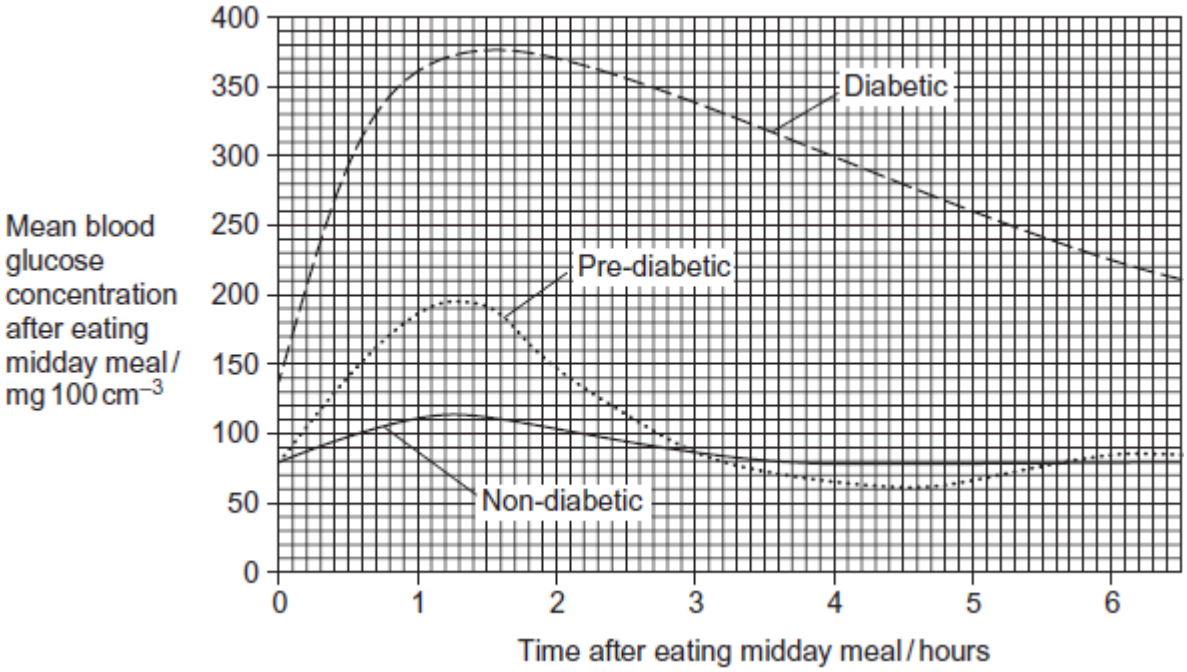
Figure 1 – glucose tolerance test results and diagnoses

Blood glucose concentration after 2 hours / mg 100 cm^{-3}	Diagnosis	Comments
≤ 110	Non-diabetic	Low risk for future diabetes
Between 140 and 200	Pre-diabetic	High risk for future diabetes. Some doctors recommend that the upper value should be lowered to 180 mg 100 cm^{-3}
≥ 200	Diabetic	Confirm by doing a second test

A researcher monitored the mean blood glucose concentration of a non-diabetic, a pre-diabetic and a diabetic after they had each eaten a midday meal.

His results are shown in **Figure 2**.

Figure 2



(a) People with type 1 diabetes are described as being insulin-dependent.
Suggest why they are described as insulin-dependent.

_____

_____

_____

(1)

(b) Some people with type 2 diabetes have cells which do **not** respond to insulin.
Explain how this leads to a reduced ability to regulate blood glucose concentration.

_____

(Extra space)

(3)

(c) During a glucose tolerance test the person remains at rest.
Why is it important that the person remains at rest?

(2)

(d) Use **Figure 2** to calculate how many times the maximum mean blood glucose concentration of the pre-diabetic is greater than the maximum of the non-diabetic person. Show your working.

Answer =

(2)

(e) Give **three** differences between the method used by the researcher to obtain the results in **Figure 2** and the method doctors use to carry out a glucose tolerance test.

1.

2.

3.

(3)

(f) Some doctors have recommended that the upper value used in the glucose tolerance test should be lowered to 180 mg 100 cm^{-3}.
Using information from **Figure 1** and **Figure 2**, suggest why.

(Extra space)

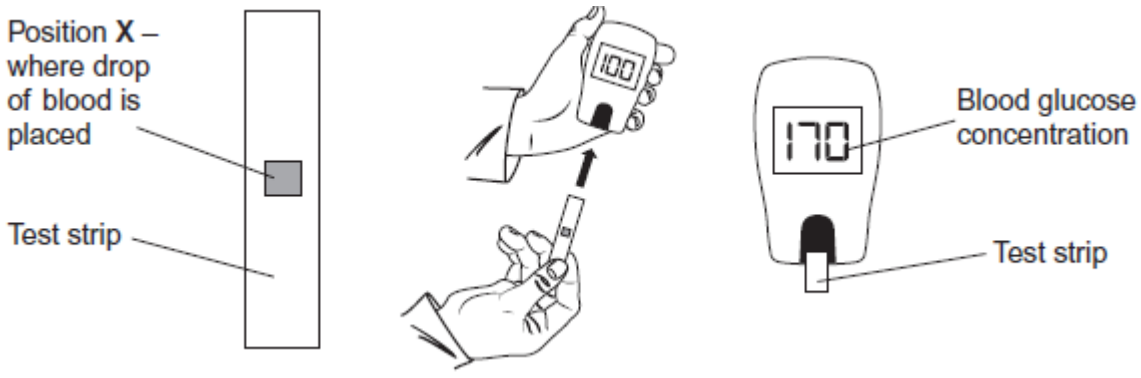
(3)
(Total 14 marks)

Q15.

Resource A

A glucometer is a device used to measure blood glucose concentration. A person uses a test strip that goes into the glucometer. They put a drop of blood onto the test strip. There are substances on the test strip that produce a colour change with glucose. The higher the concentration of glucose, the deeper the colour produced. The glucometer measures the depth of colour produced and converts this into a glucose concentration. A new test strip is used for each blood test.

Figure 1 – glucometer and test strip



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Resource B

There are two types of diabetes: type 1 and type 2.

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- People with type 2 diabetes do produce insulin but have cells which do not respond to insulin.

Doctors use a glucose tolerance test to help diagnose people with diabetes. They start each test after a person has not eaten overnight. They measure a person's blood glucose concentration.
The person then drinks a solution containing 75 g of glucose. The doctors measure the person's blood glucose concentration 2 hours later. During the test, the person remains at rest.

Figure 2 shows three diagnoses that can be made from the results of the test.

Figure 2 – glucose tolerance test results and diagnoses

Blood glucose concentration after 2 hours / mg 100 cm^{-3}	**Diagnosis**	**Comments**
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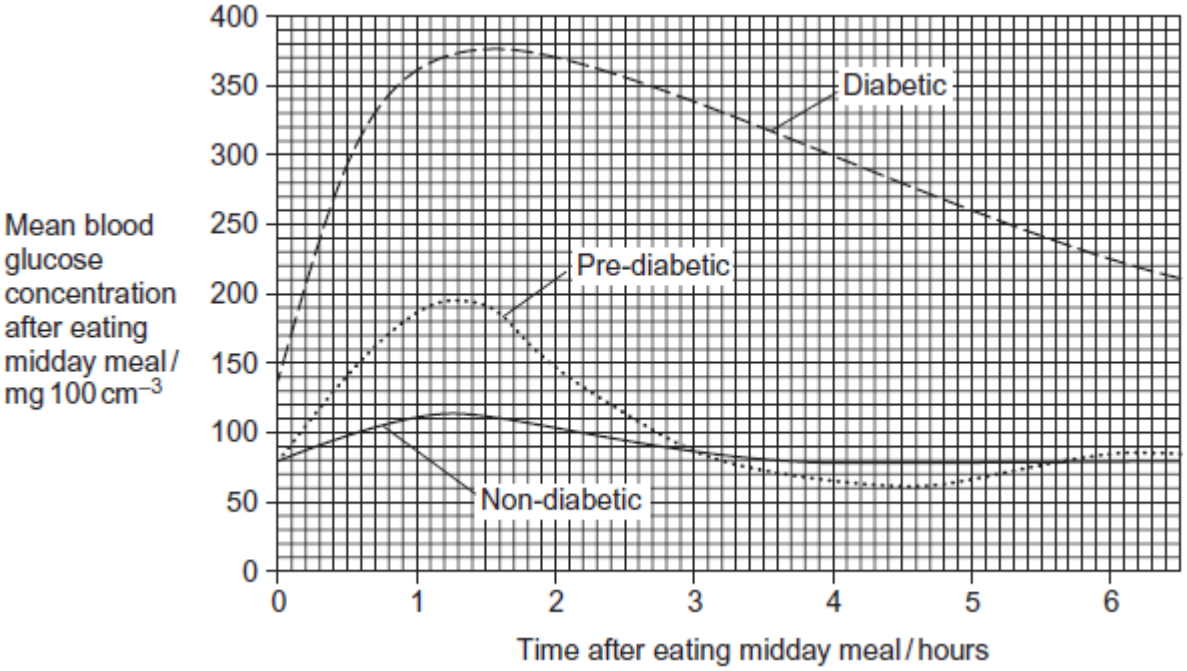
His results are shown in **Figure 3**.

Figure 3



A laboratory worker suspected she had type 2 diabetes but did not have a glucometer. Instead she added a drop of her blood to a test strip and used a colour chart to estimate her blood glucose concentration as 140 mg 100 cm^{-3}.

Is it valid to conclude that she did have type 2 diabetes?

Use this information, and **Resource A** and **Resource B**, to explain your answer.

(Extra space)

(Total 3 marks)

Q16.

(a) Adrenaline binds to receptors in the plasma membranes of liver cells. Explain how this causes the blood glucose concentration to increase.

(Extra space)

(2)

(b) Scientists made an artificial gene which codes for insulin. They put the gene into a virus which was then injected into rats with type I diabetes. The virus was harmless to the rats but carried the gene into the cells of the rats.

The treated rats produced insulin for up to 8 months and showed no side-effects. The scientists measured the blood glucose concentrations of the rats at regular intervals. While the rats were producing the insulin, their blood glucose concentrations were normal.

(i) The rats were not fed for at least 6 hours before their blood glucose concentration was measured. Explain why.

(1)

(ii) The rats used in the investigation had type I diabetes. This form of gene therapy may be less effective in treating rats that have type II diabetes. Explain why.

(1)

(iii) Research workers have suggested that treating diabetes in humans by this method of gene therapy would be better than injecting insulin. Evaluate this suggestion.

(Extra space)

(4)

(Total 8 marks)

Q17.

A glucose biosensor is an instrument used to measure glucose concentration. It contains an enzyme called glucose oxidase.

(a) A glucose biosensor detects only glucose. Use your knowledge of the way in which enzymes work to explain why.

(3)

(b) It is better to use a biosensor than the Benedict's test to measure the concentration of glucose in a sample of blood. Suggest **two** reasons why.

1.

2.

(2)

(c) (i) Diabetes mellitus is a disease that can lead to an increase in blood glucose concentration. Some diabetics need insulin injections. Insulin is a protein so it cannot be taken orally. Suggest why insulin cannot be taken orally.

_____

_____

(1)

(ii) A drug company produced a new type of insulin. Scientists from the company carried out a trial in which they gave this new type of insulin to rats. They reported that the results of this trial on rats were positive. A newspaper stated that diabetics would benefit from this new drug. Suggest **two** reasons why this statement should be viewed with caution.

1. _____

_____

2. _____

_____

(2)

(Total 8 marks)

Q18.

(a) Sucrose, maltose and lactose are disaccharides.

(i) Sucrase is an enzyme. It hydrolyses sucrose during digestion. Name the products of this reaction.

_____ and _____

(2)

(ii) Sucrase does **not** hydrolyse lactose. Use your knowledge of the way in which enzymes work to explain why.

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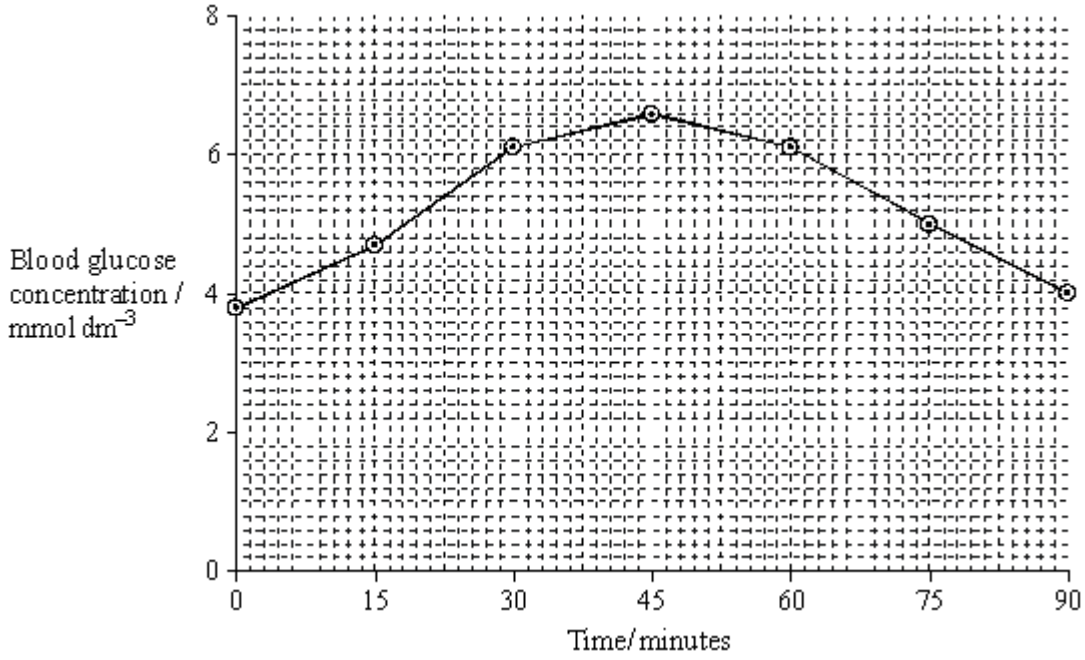
_____

_____

_____

(2)

(b) A woman was given a solution of sucrose to drink. Her blood glucose concentration was measured over the next 90 minutes. The results are shown on the graph.



(i) Describe how the woman's blood glucose concentration changed in the period shown in the graph.

_____

_____

_____

_____

(2)

(ii) Explain the results shown on the graph.

_____

_____

_____

_____

(2)

(Total 8 marks)

Q19.

In a mammal, urea is removed from the blood by the kidneys and concentrated in the filtrate.

(a) Describe how urea is removed from the blood.

_____

_____

_____

(2)

(b) Explain how urea is concentrated in the filtrate.

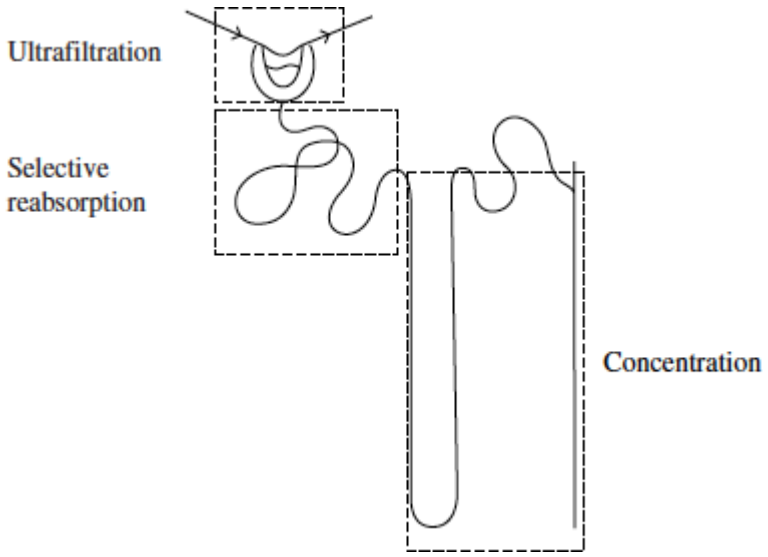
(Extra space) _____

(3)

(Total 5 marks)

Q20.

Three processes are involved in the formation of urine in a mammalian kidney. These are ultrafiltration, selective reabsorption and concentration. The diagram shows where these processes take place in a nephron.



(a) Describe how ultrafiltration produces glomerular filtrate.

(Extra space) _____

(5)

(b) Some people who have diabetes do not secrete insulin. Explain how a lack of insulin affects reabsorption of glucose in the kidneys of a person who does not secrete insulin.

(Extra space) _____

(4)

(c) Some desert mammals have long loops of Henle and secrete large amounts of antidiuretic hormone (ADH). Explain how these two features are adaptations to living in desert conditions.

(Extra space) _____

(6)

(Total 15 marks)

Q21.

(a) A diabetic person and a non-diabetic person each ate the same amount of glucose. One hour later, the glucose concentration in the blood of the diabetic person was higher than that of the non-diabetic person. Explain why.

(Extra space) _____

(3)

(b) (i) The urine of a non-diabetic person does **not** contain glucose. Explain why.

(2)

(ii) A high blood glucose concentration could cause glucose to be present in the urine of a diabetic person. Suggest how.

(2)

(c) A test for glucose in urine uses immobilised enzymes on a plastic test strip. One of these enzymes is glucose oxidase. Explain why the test strip detects glucose and no other substance.

(2)

(d) If the glomerular filtrate of a diabetic person contains a high concentration of glucose, he produces a larger volume of urine. Explain why.

(3)

(e) In some forms of kidney disease, proteins from the blood plasma are found in the urine. Which part of the nephron would have been damaged by the disease to cause proteins from blood plasma to be present in the urine? Explain your answer.

(Extra space) _____

(3)

(Total 15 marks)

Q22.

The kangaroo rat is a small desert mammal. It takes in very little water in its food and it rarely drinks. Its core body temperature is 38 °C.

The kangaroo rat takes in some water by feeding and drinking. Describe another method by which the kangaroo rat could obtain water.

_____

_____

_____

_____

(Total 2 marks)

Q23.

(a) The table shows the concentrations of dissolved substances in different regions of a nephron in a kidney in the presence and in the absence of antidiuretic hormone (ADH).

Region of nephron	Concentration of dissolved substances / arbitrary units	
	ADH present	ADH absent
First convoluted tubule	300	300
Bend of loop of Henle	1000	1000
Start of second convoluted tubule	150	150
Middle of second convoluted tubule	250	90
Start of collecting duct	300	50
End of collecting duct	1000	50

Describe and explain the effect of ADH on the volume and concentration of urine produced by the kidney. Give evidence from the table to support your answer.

_____

_____

_____

_____

_____

_____

(3)

(b) Glomerulosclerosis is a disease in which the glomeruli of the kidney are damaged. Explain why protein is not normally present in the urine of a healthy person but may be present in the urine of a person with glomerulosclerosis.

_____

_____

_____

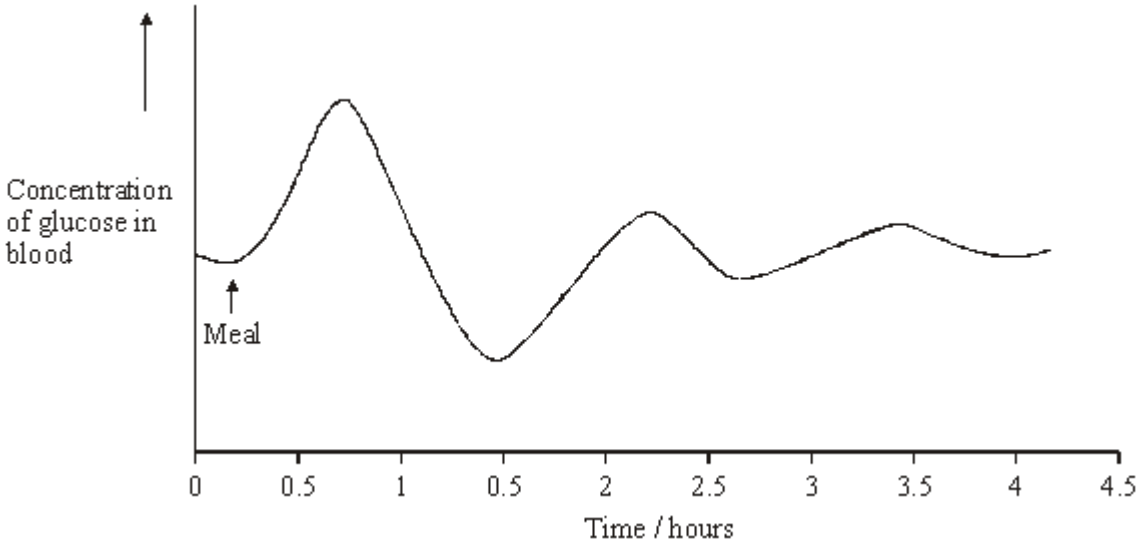
_____

(2)

(Total 5 marks)

Q24.

(a) The graph shows changes in the concentration of glucose in a person's blood following a meal.



Changes in the concentration of glucose are controlled by the hormones glucagon and insulin. Write the letters **X** and **Y** on the graph to show

X a time when glucagon secretion would be high;

Y a time when insulin secretion would be high.

(1)

(b) Many diabetics require regular injections of insulin. Describe how bacteria can be genetically modified to produce human insulin.

_____

_____

_____

_____

_____

_____

_____

_____

_____

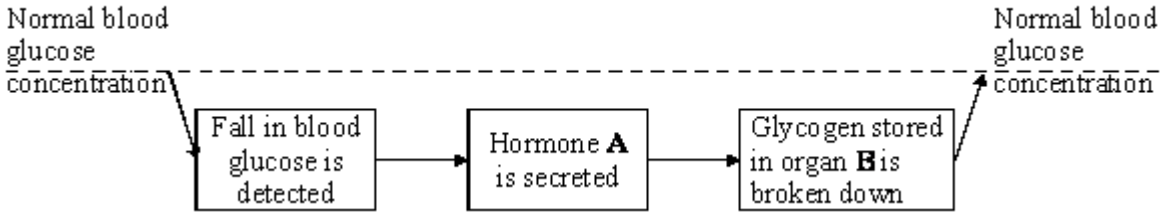
_____

(4)

(Total 5 marks)

Q25.

The diagram shows some of the events which maintain blood glucose concentration in a mammal.



(a) Name

(i) hormone **A**; _____

(ii) organ **B**.

_____

(2)

(b) Explain why the events shown in the diagram can be described as an example of negative feedback.

_____

_____

(1)

(Total 3 marks)

Q26.

Mammals and fish remove nitrogenous waste from their bodies in different forms.

(a) Name **two** polymers present in mammals and fish that contain nitrogen.

1. _____

2. _____

(2)

(b) In a mammal urea is removed from the blood by the kidneys and concentrated in the filtrate.

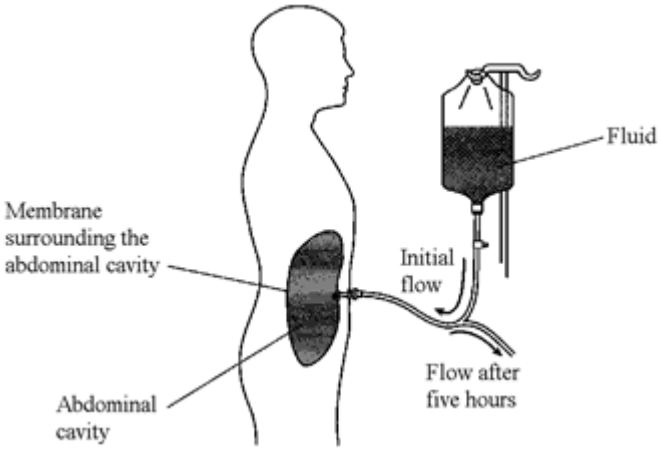
(i) Describe how urea is removed from the blood.

(2)

(ii) Explain how urea is concentrated in the filtrate.

(4)

(c) The diagram shows one way in which a person who has kidney disease can have the condition managed. In the process a fluid is put into the abdominal cavity. Exchange of materials takes place across the membrane that surrounds the abdominal cavity. This removes waste products from the blood. After five hours the fluid is drained out of the cavity and discarded. The cavity is then refilled with fresh fluid.



The table shows the concentration of solutes in the fresh fluid.

Solute	Concentration / mmol dm^{-3}
Sodium ions (Na^+)	132
Chloride ions (Cl^-)	96
Calcium ions (Ca^{2+})	1.25
Magnesium ions (Mg^{2+})	0.25
Glucose	76
Urea	0

(i) By what process does urea enter the fluid in the abdominal cavity from the blood?

_____

(1)

(ii) Explain why the fluid is changed every five hours.

_____

_____

(1)

(iii) Fluid of the composition shown in the table is used instead of distilled water. Explain why.

_____

_____

_____

_____

(2)

(Total 12 marks)

Q27.

Anti-diuretic hormone (ADH) is released into the blood in response to a shortage of water in the body. ADH enters the collecting duct cells in nephrons and causes the increased synthesis of one type of protein molecule. These protein molecules are inserted into the plasma membranes of the collecting duct cells where they act as channels. Only water molecules can pass through these channels, increasing the reabsorption of water from the kidney filtrate.

(a) Name the gland which releases ADH.

_____

(1)

(b) (i) Explain how the structure of protein molecules allows them to form channels

through which only water molecules can pass.

_____

_____

_____

_____

(2)

(ii) Explain how the cells of the collecting duct are able to absorb water from the filtrate through the protein channels in their plasma membranes.

_____

_____

_____

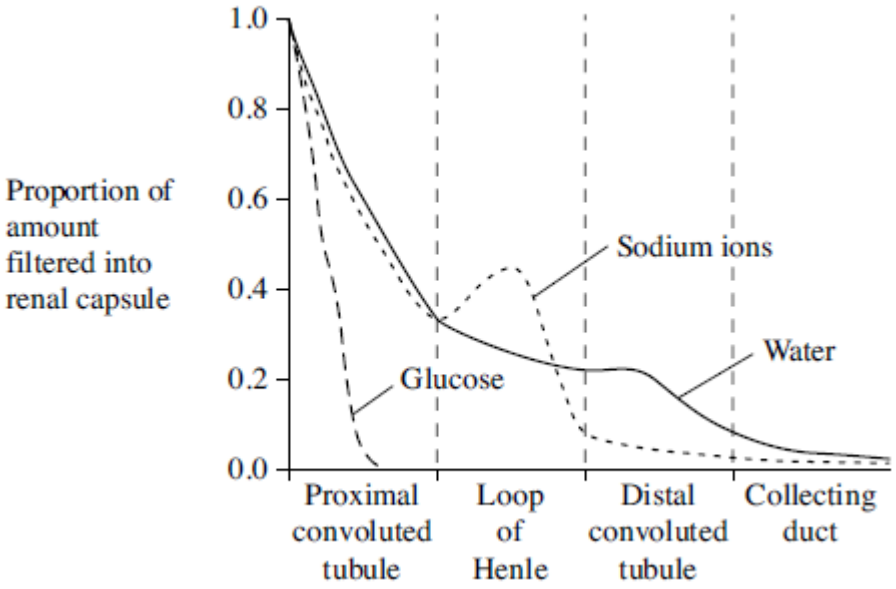
_____

(2)

(Total 5 marks)

Q28.

The graph shows changes in the amounts of water, glucose and sodium ions as fluid passes along a kidney tubule from the renal capsule to the collecting duct.



(a) Which hormone causes the decrease in the water content in the distal convoluted tubule?

_____

(1)

(b) Explain the change in the amount of glucose.

_____

(2)

(c) Explain the shape of the curve for sodium ions in the loop of Henle.

(Extra space)

(3)

(Total 6 marks)

Q29.

In the kidney, ultrafiltration and selective reabsorption are two of the processes involved in the formation of urine.

(a) (i) Where does ultrafiltration occur?

(1)

(ii) Give **one** component of the blood which is not normally present in the filtrate.

(1)

(b) The kidneys remove a substance called creatinine from the blood. The rate of creatinine removal is a measure of the rate of filtration of the blood.

In one hour, a person excreted 75 mg of creatinine in his urine. The concentration of creatinine in the blood entering his kidneys was constant at 0.01 mg cm^{-3}.

Calculate the rate at which the blood was filtered in cm^3 min^{-1}. Show your working.

Filtration rate = _____ $cm^3\ min^{-1}$

(2)

(c) Reabsorption of glucose takes place in the proximal tubule. Explain how the cells of the proximal tubule are adapted for this function.

_____

_____

_____

_____

(2)

(Total 6 marks)