

Q1.

A person with diabetes is in diabetes remission if their blood glucose concentration is below the diabetes threshold concentration for at least 3 months. This diabetes remission is achieved without taking medication.

Scientists investigated whether a weight-loss programme would result in type II diabetes remission.

The scientists:

- used a computer-generated list to select 380 volunteers from a large number of health centres
- selected volunteers aged 25 to 60 years, each with less than 5 years duration of type II diabetes
- divided the volunteers in the ratio 1 : 1 between experimental group **P** and control group **Q**
- placed group **P** on a weight-loss programme for the 2-year duration of this investigation
- recorded loss of mass and percentage of volunteers in each group in type II diabetes remission after 2 years.

- (a) Give **two** reasons why a weight-loss programme could be used to treat type II diabetes but **not** type I diabetes.

1 _____

2 _____

(2)

- (b) The design of this investigation helps to support the validity of any conclusions obtained.

Suggest and explain **three** features of this investigation that justify this statement.

1 _____

2 _____

3

(3)

(c) The table below shows some of the scientists’ results.

	Group P	Group Q
Percentage achieving diabetes remission	42.1	4.7
Percentage achieving weight loss ≥ 15 kg	15.8	2.1
Percentage with weight loss ≥ 15 kg achieving diabetes remission	70.0	75.0
Percentage with weight gain achieving diabetes remission	1.9	1.9

Use the information provided to calculate the difference in number of volunteers between the two groups who achieved diabetes remission.

Show your working.

Answer

(2)

- (d) Use all the information to evaluate whether a weight-loss programme is an effective treatment for type II diabetes.

(4)

(Total 11 marks)

Q2.

- (a) Describe and explain how **three** features of the cells in the proximal convoluted tubule allow the rapid reabsorption of glucose into the blood.

1 _____

2 _____

3 _____

(3)

- (b) Antidiuretic hormone (ADH) binds to **V** receptors found in cell-surface membranes in two parts of a nephron.

Name the **two** parts of a nephron where **V** receptors are found.

(1)

- (c) **V** receptors only bind with ADH.

Suggest and explain why.

(2)

- (d) A decrease in blood pressure stimulates the release of ADH.

Give the location of the receptors that detect a decrease in blood pressure and explain how the release of ADH will affect blood pressure.

Location _____

Explanation _____

(3)

(Total 9 marks)

Q3.

Scientists investigated the production of laboratory rats with the characteristics of type II diabetes. The scientists used the following method.

- They divided the rats into two groups, **A** and **B**, and fed them different diets for 2 weeks.
- They fed the rats in group **A** the normal diet containing 12% fat.
- They fed the rats in group **B** a high-fat diet containing 56% fat.
- After 2 weeks, they injected both groups of rats with 35 mg kg^{-1} of the drug streptozotocin (STZ) to induce diabetes.
- 1 week later, the scientists determined the mean body mass and mean blood glucose concentration for each group.

The table below shows the results.

A value of $\pm 2 \times \text{SD}$ from the mean includes over 95% of the data.

Group	Mean body mass / g ($\pm 2 \times \text{SD}$)	Mean blood glucose concentration / mg dm^{-3} ($\pm 2 \times \text{SD}$)
A	221.07 (± 3.28)	129.41 (± 8.34)
B	233.34 (± 5.73)	385.02 (± 7.75)

- (a) Calculate how many grams of STZ should be injected into a rat with a mass of 230.45 g. Show your working.

Give your answer in standard form.

Answer _____ g

(2)

- (b) Suggest and explain why STZ was injected per unit of body mass.

(1)

- (c) The scientists concluded that group **B** rats could be used for studying type II diabetes in humans.

Use all the information and your knowledge of type II diabetes to evaluate this conclusion.

(5)

- (d) The scientists repeated the investigation using much higher doses of STZ. This led to destruction of pancreatic cells. The scientists concluded that these rats would **not** be suitable for studying type II diabetes.

Give **two** reasons why the scientists made this conclusion.

1

2

(2)

(Total 10 marks)

Q4.

- (a) Name the part of the body which releases antidiuretic hormone (ADH) into the blood.

(1)

- (b) Alcohol decreases the release of ADH into the blood.

Suggest **two** signs or symptoms which may result from a decrease in ADH.

1

2

(2)

- (c) Describe the effect of ADH on the collecting ducts in kidneys.

(3)**(Total 6 marks)**