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BIOLOGY

ORGANISMS RESPOND TO CHANGES IN ENVIRONMENTS

Level & Board	AQA (A-LEVEL)
TOPIC:	CONTROLE OF BLOOD GLUCOSE
PAPER TYPE:	QUESTION PAPER - 2
TOTAL QUESTIONS	5
TOTAL MARKS	27

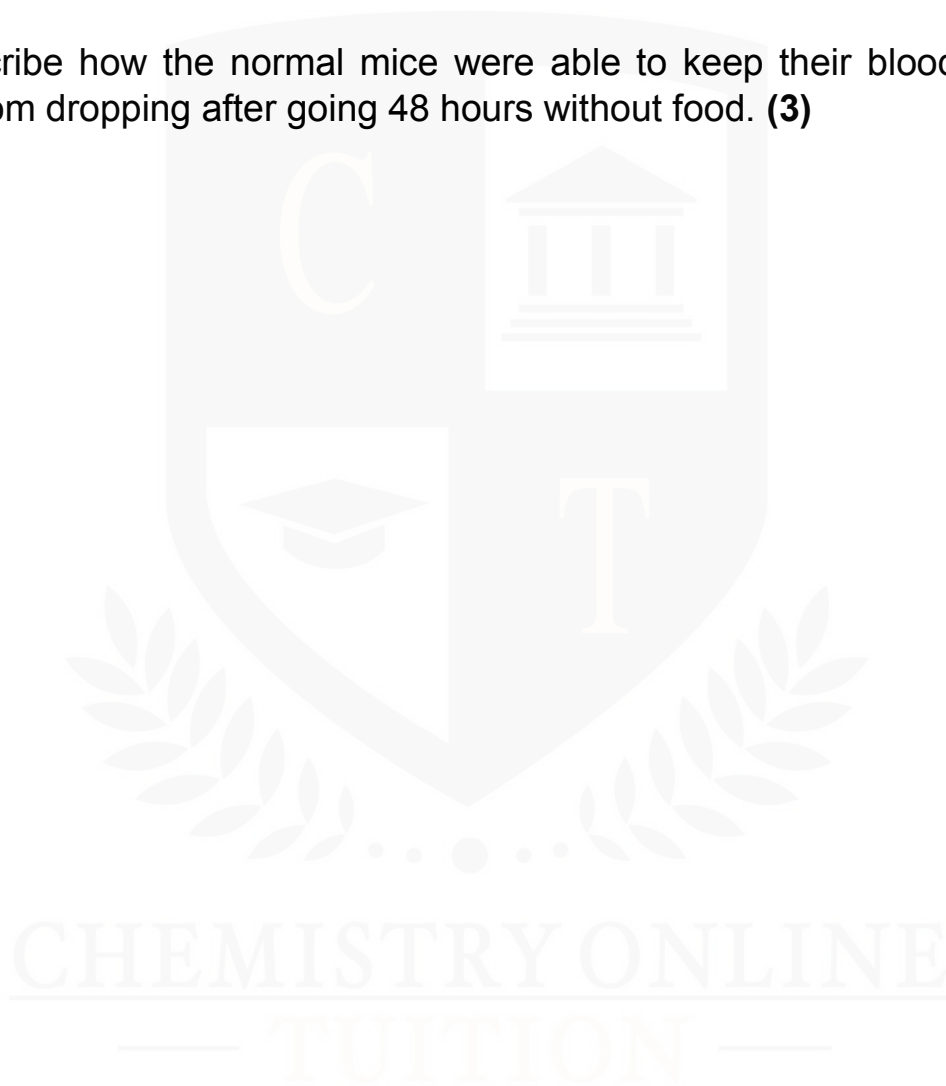
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Control of Blood Glucose - 2

1.

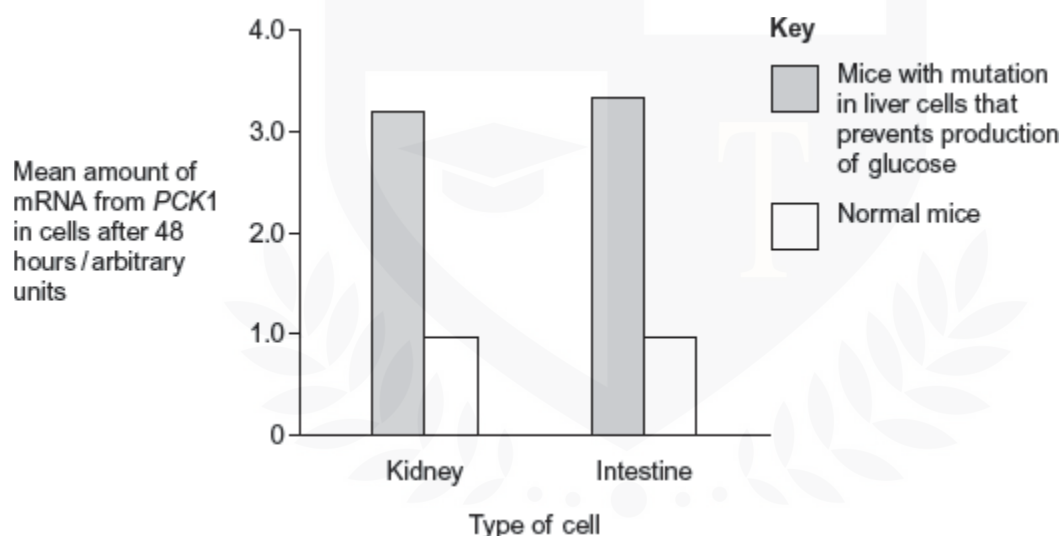
Researchers looked into how mice's blood glucose levels were controlled. A group of regular mice was deprived of food for 48 hours. The mice blood glucose levels at the beginning of the experiment and 48 hours later were identical.

(a) Describe how the normal mice were able to keep their blood glucose levels from dropping after going 48 hours without food. **(3)**

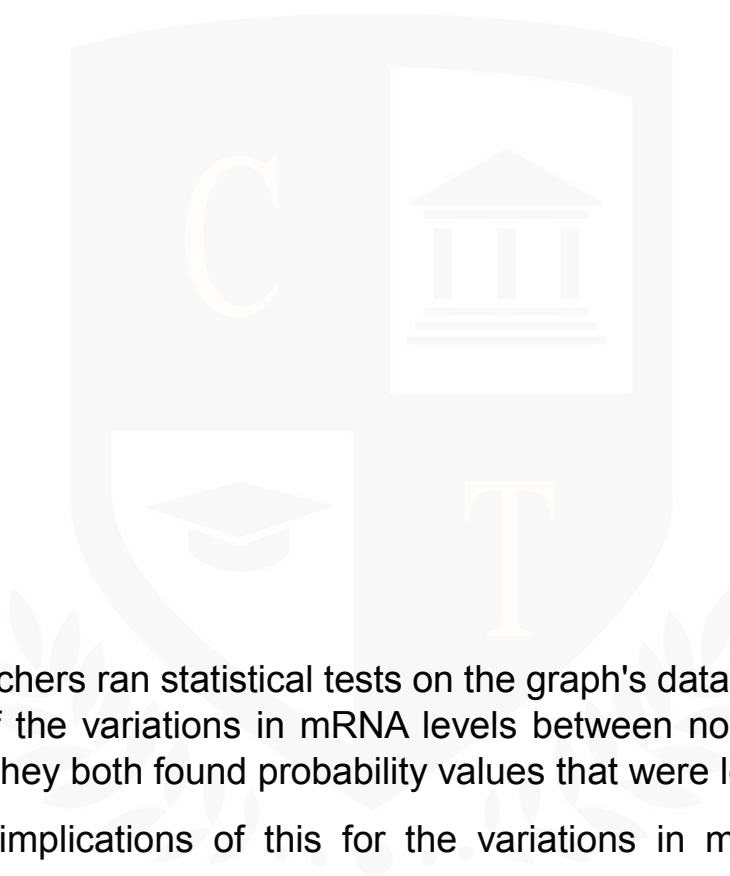


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Next, the scientists looked into mice that had a mutation that stopped their liver cells from producing glucose. For 48 hours, they deprived a group of these mice of food. The mean blood glucose levels of the mutant and normal mice were identical after 48 hours. The regulatory mechanisms for blood glucose concentration in these mutant mice were studied by the scientists. The gene *PCK1* codes for an enzyme needed for the production of glucose. The amount of mRNA that this gene produces on average in the kidney and intestine cells of both normal and mutant mice was examined by the scientists. They performed this on mice that had gone 48 hours without meals. The graph displays the scientists findings.



(b) Make recommendations on how the blood glucose concentration is managed in the mutant mice in relation to the normal mice using the data from the graph. **(3)**



(c) The researchers ran statistical tests on the graph's data to determine the significance of the variations in mRNA levels between normal and mutant mouse cells. They both found probability values that were less than 0.01.

Describe the implications of this for the variations in mRNA production amounts. **(2)**

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2.

Diabetes affects some mice. After a meal, blood glucose levels due to diabetes spike dramatically. Researchers looked on treating diabetes using an amylase inhibitor.

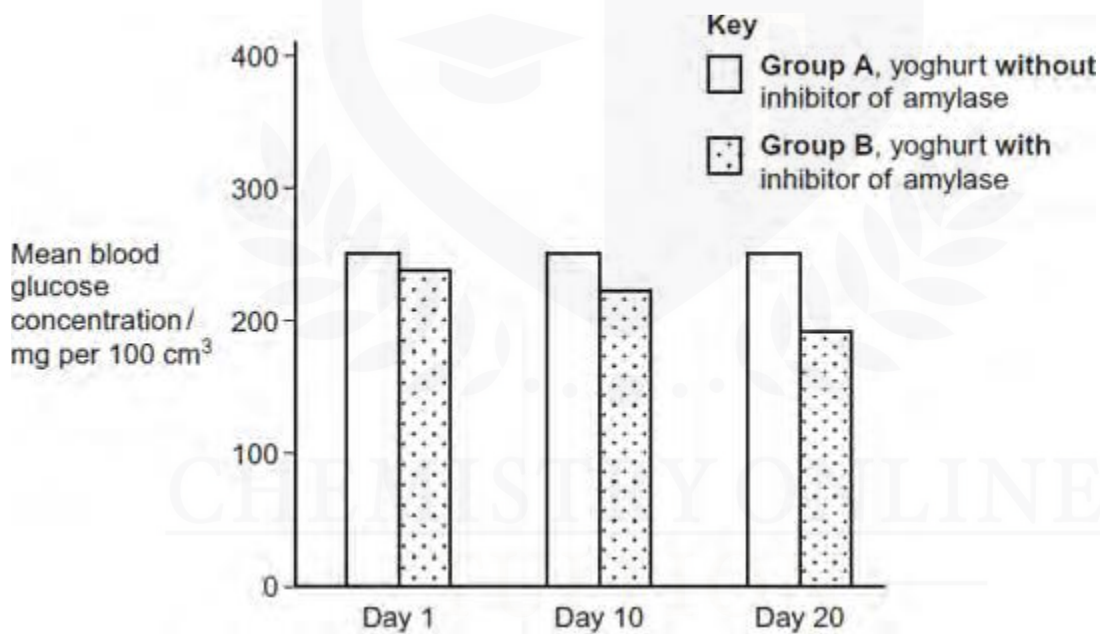
Thirty diabetic mice were used by the investigators, and they were split into two groups, A and B.

Every day, yoghurt without the amylase inhibitor was given to Group A, whereas yoghurt containing the inhibitor was given to Group B.

Every day, the mice had the same diet, with the exception of the yoghurt.

An hour following its meal, the researchers took each mouse's blood glucose level. Day 1, Day 10, and Day 20 of the study were spent doing this.

The scientists' findings are displayed in the following figure.

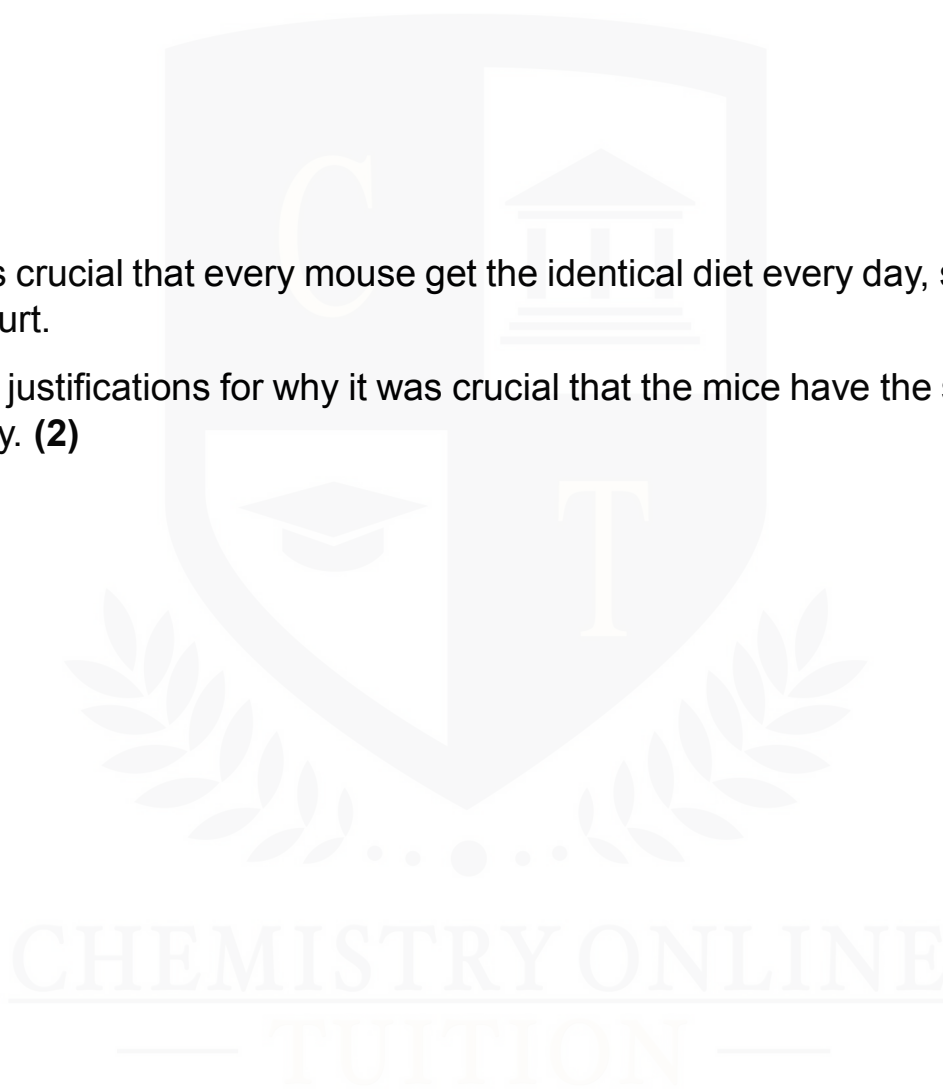


(a) In this study, Group A served as the control group.

Describe the group objectives. (2)

(b) It was crucial that every mouse get the identical diet every day, save from the yoghurt.

Give two justifications for why it was crucial that the mice have the same diet every day. **(2)**



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3.

(a) The researchers postulated that lowering the blood glucose concentration would result from including the amylase inhibitor into the meal.

Explain how the inclusion of the inhibitor can result in a decreased blood glucose levels using your understanding of digestion. **(2)**



(b) Provide an explanation for why these findings would not be consistent with treating mice's diabetes with an amylase inhibitor. **(2)**

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4.

(a) Glucose is converted to glycogen by insulin when it attaches to receptors on liver cells. As a result, the amount of glucose in liver cells is reduced.

Describe how the hepatic cells production of glycogen causes the blood glucose level to drop. **(2)**



Insulin-sensitive cells are seen in people with type II diabetes. Eighty percent or more of those with type II diabetes are obese or overweight. Some obese individuals have gastric bypass surgery (GBS) in an attempt to reduce their body weight.

Physicians looked at if GBS affects insulin sensitivity. Insulin sensitivity was assessed in the individuals both before and after GBS. Approximately 50% of the patients had diabetes mellitus. While the other half did not, they were nevertheless thought to be at a high risk of getting the illness.

The doctor findings are displayed in the table below. The greater the number, the higher the insulin sensitivity.

Patients	Mean sensitivity to insulin / arbitrary units (\pm SD)	
	Before gastric bypass surgery	1 month after gastric bypass surgery
Did not have diabetes	0.55 (\pm 0.32)	1.30 (\pm 0.88)
Had type II diabetes	0.40 (\pm 0.24)	1.10 (\pm 0.87)

(b) The physicians came to the conclusion that a large number of the patients who did not already have type II diabetes were at a high risk of getting it.

Give an explanation for their decision based on the information in the table.

(2)

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(c) The physicians also deduced that while GBS helped many patients with their diabetes, it did not significantly assist others.

Do the data lend credence to this conclusion? Provide justification for your response. (3)

5.

A glucometer is a tool for calculating blood glucose levels. A test strip is used, and it is inserted into the glucometer. A droplet of blood is applied to the test strip. The test strip contains certain ingredients that, when exposed to glucose, change color. The color created is deeper the higher the glucose concentration. The glucometer calculates the concentration of glucose by measuring the depth of color produced. Every blood test uses a fresh test strip.

Glucometer with test strip in Figure



The compounds on the test strip cause a color shift, which is illustrated by the following equations.

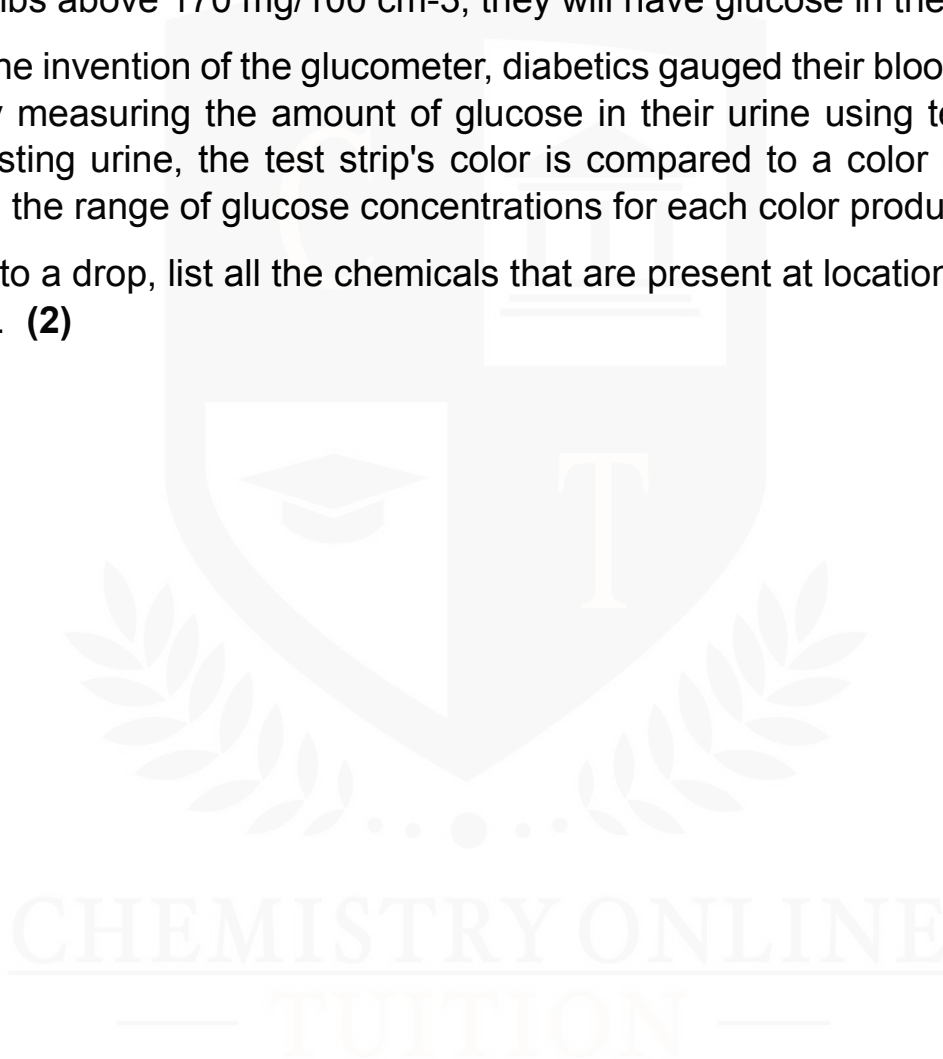
Hydrogen peroxide, glucose, and glutamic acid

hydrogen peroxide plus colored coloring A colour-B dye plus water

Urine does not contain glucose in non-diabetics. If a diabetic's blood glucose level climbs above 170 mg/100 cm⁻³, they will have glucose in their urine.

Prior to the invention of the glucometer, diabetics gauged their blood glucose levels by measuring the amount of glucose in their urine using test strips. When testing urine, the test strip's color is compared to a color chart that indicates the range of glucose concentrations for each color produced.

(a) Prior to a drop, list all the chemicals that are present at location X on the test strip. **(2)**



(b) Prior to the invention of the glucometer, diabetics gauged their blood glucose levels by measuring the amount of glucose in their urine using test strips.

Give two reasons why the blood glucose concentration would not be accurately measured using this method of testing urine. **(2)**



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