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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 - 3
TOTAL QUESTIONS	5
TOTAL MARKS	18

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Control of Blood Glucose - 3

1.

Resource A

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.

Figure 1 – glucometer and test strip



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

Glucose + oxygen gluconic acid + hydrogen peroxide

Hydrogen peroxide + dye with color A dye with color B + water

Urine from non-diabetics has no glucose. If a diabetic's blood glucose level exceeds $170 \text{ mg}/100 \text{ cm}^{-3}$, glucose will be detected in their urine.

Before the glucometer became accessible, diabetics could measure their blood glucose levels by using test strips to assess the amount of glucose in their urine. When testing urine, a color chart is used to compare the test strip color to a range of glucose concentrations indicated by the color produced.

Resource B

Diabetes comes in two varieties: type 1 and type 2.

Individuals with type 2 diabetes do create insulin, but their cells do not react to it. Individuals with type 1 diabetes do not make enough insulin.

A glucose tolerance test is one tool used by doctors to diagnose diabetes. Each test is administered following an overnight fast. They gauge an individual's blood glucose level.

After then, the individual consumes a solution that has 75 g of glucose in it. Two hours later, the patient's blood glucose level is measured by the doctors. The subject doesn't move during the test.

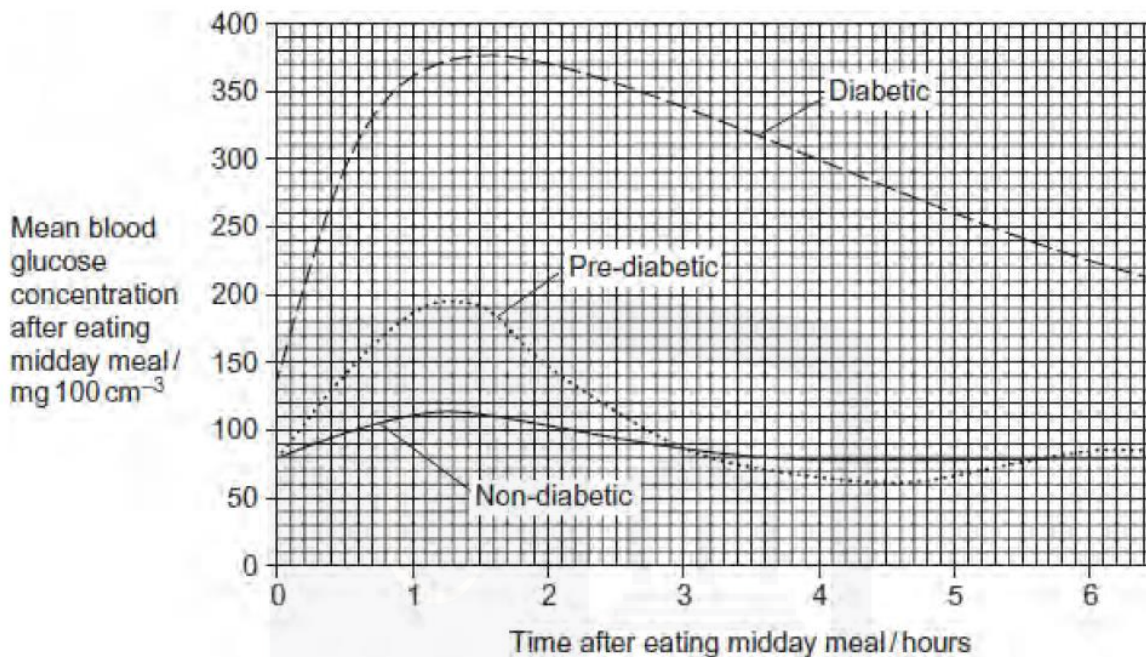
Three diagnoses that can be determined based on the test findings are displayed in Figure 1.

Figure 2 – 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

After each subject had a midday lunch, the mean blood glucose concentrations of the non-diabetic, pre-diabetic, and diabetic were observed by the researcher.

Figure 3 displays his findings.



Although she lacked a glucometer, a lab employee assumed she had type 2 diabetes. Rather, she utilized a color chart and a drop of her blood to estimate her blood glucose content, which came out to be 140 mg 100 cm⁻³.

Is it reasonable to assume that she had type 2 diabetes?

(a) Utilize this data, along with Resources A and B, to support your response.

(3)

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2.

(a) Adrenaline attaches itself to liver cell plasma membrane receptors. Describe the mechanism by which this raises the blood glucose levels. **(2)**

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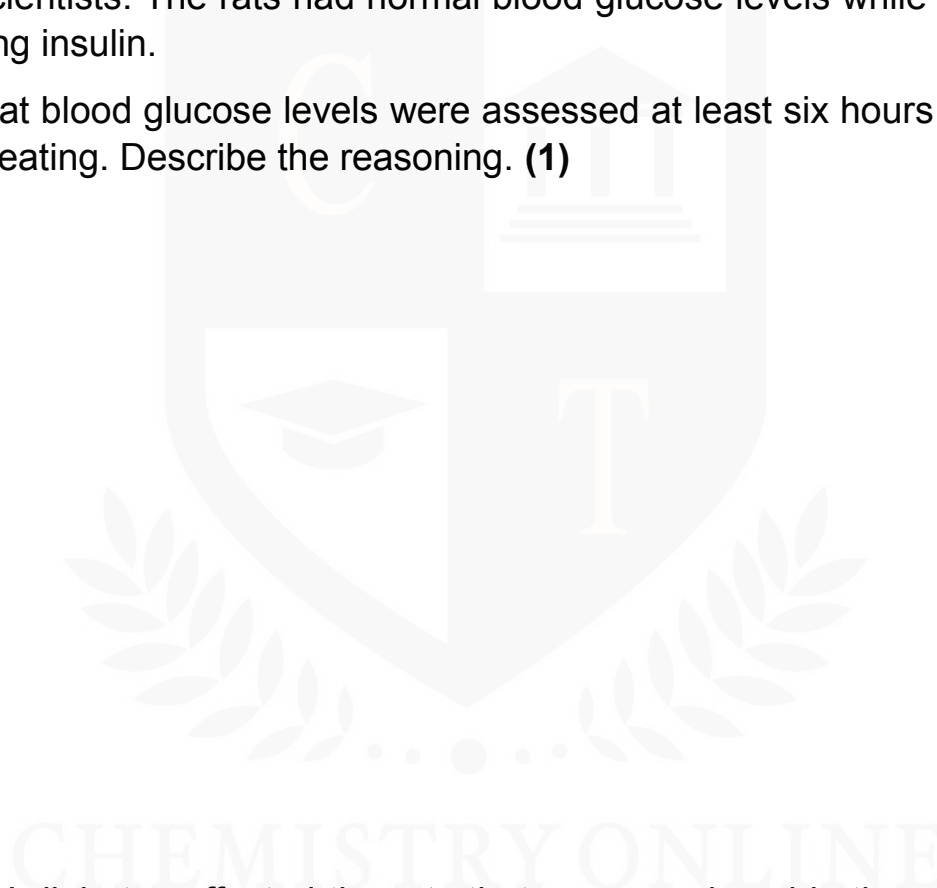
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3.

Researchers created a synthetic gene that codes for insulin. After encoding the gene into a virus, rats suffering from type I diabetes were administered the injection. The virus did not cause harm to the rats; nevertheless, it did introduce the gene into their cells.

The treated rats had no negative effects and continued to produce insulin for up to eight months. The rats' blood glucose levels were regularly monitored by the scientists. The rats had normal blood glucose levels while they were generating insulin.

(a) The rat blood glucose levels were assessed at least six hours after they stopped eating. Describe the reasoning. **(1)**



(b) Type I diabetes affected the rats that were employed in the study. Rats with type II diabetes may respond less well to this type of gene therapy. Describe your reasoning. **(1)**

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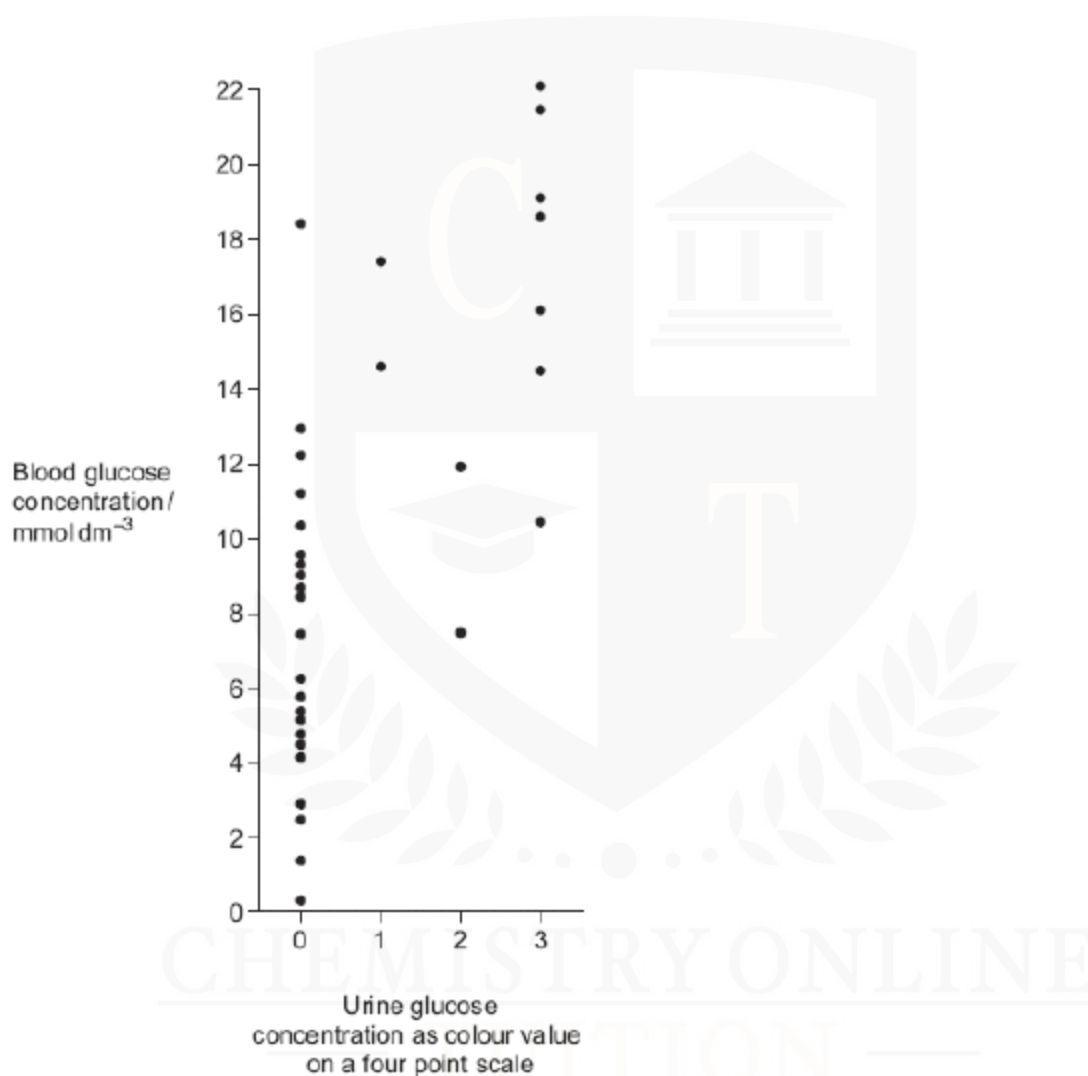
(c) Researchers have hypothesized that gene therapy may be a more effective treatment for diabetes in people than insulin injections. Consider this recommendation. **(4)**



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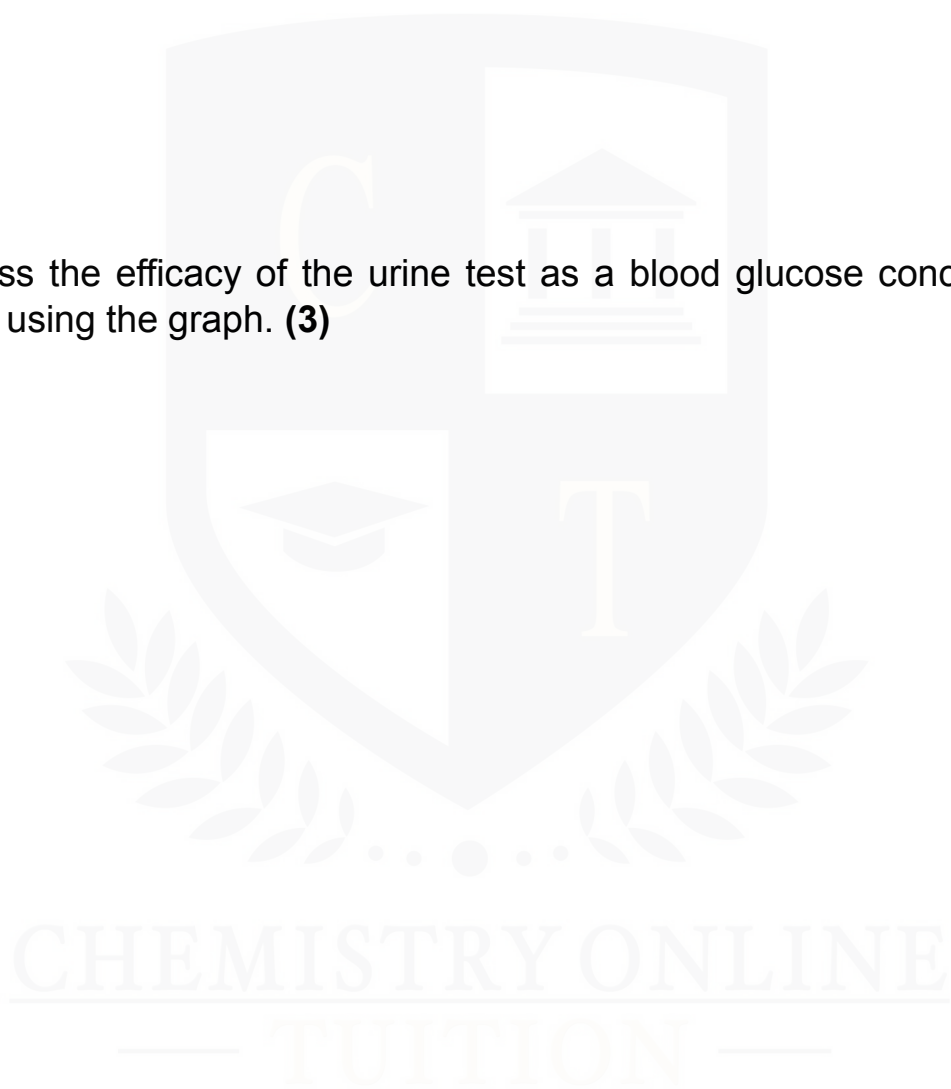
4.

Throughout the course of a year, laboratory technicians at a hospital examined urine and blood samples from a girl who had diabetes on a regular basis. Every time the technicians took a urine sample, they also took a blood glucose reading. The graph displays their findings.



(a) The girl involved in this study was receiving effective insulin treatment. The graph indicates that her blood glucose level was extremely high at several points. Explain why. (2)

(b) Assess the efficacy of the urine test as a blood glucose concentration indicator using the graph. **(3)**



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5.

(a) Individuals with diabetes who are unable to regulate their blood glucose levels run the risk of losing consciousness and entering a coma. A diabetic in a coma may receive glucagon injections from a medical professional. Describe the potential effects of glucagon on the patient's blood glucose levels. **(2)**



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