

Name of the Student: _____

Max. Marks : 17 Marks

Time : 17 Minutes

Q1.

In an investigation, the effects of caffeine on performance during exercise were measured. One group of athletes (**A**) was given a drink of decaffeinated coffee. Another group (**B**) was given a drink of decaffeinated coffee with caffeine added. One hour later the athletes started riding an exercise bike and continued until too exhausted to carry on. Three days later the same athletes repeated the experiment, with the drinks exchanged.

- (a) (i) The researchers added caffeine to decaffeinated coffee. Explain why they did not just use normal coffee.

(1)

- (ii) The performance of the athletes might have been influenced by how they expected the caffeine to affect them. How could the researchers avoid this possibility?

(1)

During the exercise the concentrations of glycerol and fatty acids in the blood plasma were measured. The results are shown in the table.

Drink	Mean time to exhaustion /minutes	Mean concentration of blood glycerol/ mmol dm^{-3}	Mean concentration of blood fatty acids/ mmol dm^{-3}
With caffeine	90.2	0.20	0.53
Without caffeine	75.5	0.09	0.31

- (b) (i) Describe the effect of caffeine on exercise performance.

(1)

- (ii) Suggest **one** explanation for the higher glycerol and fatty acid concentrations in the blood plasma of the athletes after they were given caffeine.

(2)

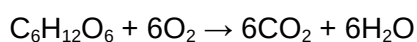
- (c) The researchers measured the volumes of carbon dioxide exhaled and oxygen inhaled during the exercise. From the results they calculated the respiratory quotient (RQ), using the formula

$$RQ = \frac{\text{volume of carbon dioxide exhaled per minute}}{\text{volume of oxygen inhaled per minute}}$$

When a person is respiring carbohydrate only, RQ = 1.0

When a person is respiring fatty acids only, RQ = 0.7

- (i) The basic equation for the respiration of glucose is



Explain why the RQ for glucose is 1.0.

(2)

- (ii) The researchers found that, when the athletes were given the drink containing caffeine, their mean RQ was 0.85. When given the drink without caffeine their mean RQ was 0.92.

The researchers concluded that when the athletes had caffeine they used glycogen more slowly than when they did not have caffeine, and that the store of glycogen in their muscles was used up less quickly during the exercise.

Explain the evidence from the information above and from the table which supports these conclusions.

(3)

(Total 10 marks)

Q2.

A hormone has been shown to switch on a gene in fish, leading to the increased production of an enzyme. Experiments were carried out to investigate the effects of heavy metal ions on the production of this enzyme, with and without the hormone. The table shows the results.

	Amount of enzyme produced / percentage of maximum	
Heavy metal ion present	Without hormone	With hormone
None	16	100
Cadmium	15	55
Zinc	17	94
Copper	16	100

Explain how the results suggest that cadmium affects the action of the hormone.

(Total 2 marks)

Q3.

The mesquite tree grows in dry areas which have soils with low concentrations of ions. Its roots grow down to 25 metres and contain nitrogen-fixing bacteria. It is considered a pest in areas where farm animals graze because it out-competes grass. In some areas, young mesquite trees are cut down and then ploughed into the ground. This is expensive but makes the soil slightly more fertile for a few years.

- (a) Using the information given, explain **one** way in which mesquite trees are adapted for survival.

(1)

- (b) Name the type of competition occurring between mesquite and grass.

(1)

- (c) Explain how ploughing the mesquite into the soil makes it more fertile.

(3)

(Total 5 marks)