Name of the Student:_____
Max. Marks : 26 Marks **Time : 26 Minutes**

Q1.

(a) Exercise causes an increase in heart rate.

Describe the role of receptors and of the nervous system in this process.

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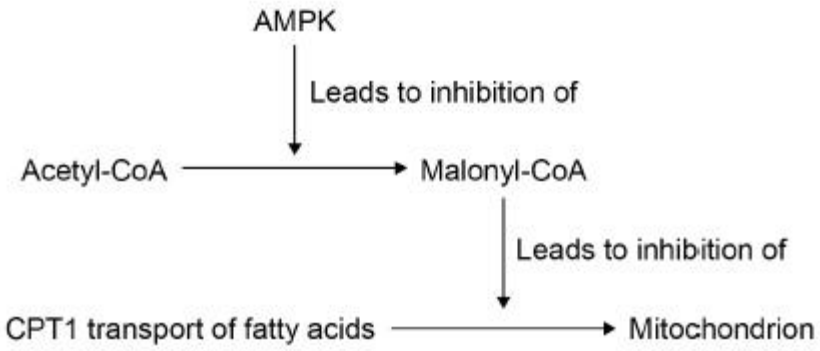
(4)

(b) AMP-activated protein kinase (AMPK) is an enzyme that regulates a number of cellular processes. Exercise leads to activation of AMPK.

The diagram shows one effect of activation of AMPK during exercise.



CPT1 is a channel protein that transports fatty acids into mitochondria.

Using the diagram above, explain the benefit of activation of AMPK during exercise.

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(3)

(Total 7 marks)

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Q2.

A student isolated chloroplasts from spinach leaves into a solution to form a chloroplast suspension. He used the chloroplast suspension and DCPIP solution to investigate the light-dependent reaction of photosynthesis. DCPIP solution is blue when oxidised and colourless when reduced.

The student set up three test tubes as follows:

- **Tube 1** – 1 cm^3 of solution without chloroplasts and 9 cm^3 of DCPIP solution in light.
- **Tube 2** – 1 cm^3 of chloroplast suspension and 9 cm^3 of DCPIP solution in darkness.
- **Tube 3** – 1 cm^3 of chloroplast suspension and 9 cm^3 of DCPIP solution in light.

The student recorded the colour of the DCPIP in each of the tubes at the start and after the tubes had been left at 20 °C for 30 minutes.

His results are shown in the table.

Tube	**Colour of DCPIP in tube**	
	At start	**After 30 minutes**
1	blue	blue
2	blue	blue
3	blue	colourless

(a) The solution that the student used to produce the chloroplast suspension had the same water potential as the chloroplasts.

Explain why it was important that these water potentials were the same.

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(2)

(b) Explain why the student set up **Tube 1**.

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(2)

(c) Explain the results in **Tube 3**.

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(2)

(d) The student evaluated the effectiveness of different chemicals as weed-killers by assessing their ability to prevent the decolourisation of DCPIP in chloroplast suspensions.

He added different concentrations of each chemical to illuminated chloroplast suspensions containing DCPIP. He then determined the IC_{50} for each chemical. The IC_{50} is the concentration of chemical which inhibits the decolourisation of DCPIP by 50%.

Explain the advantage of the student using the IC_{50} in this investigation.

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(1)

(e) Explain how chemicals which inhibit the decolourisation of DCPIP could slow the growth of weeds.

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(2)

(Total 9 marks)

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Q3.

Arbuscular mycorrhiza fungi (AMF) are fungi which grow on, and into, the roots of plants. AMF can increase the uptake of inorganic ions such as phosphate.

(a) Suggest **one** way in which an increase in the uptake of phosphate could increase plant growth.

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_____

(1)

(b) Suggest **one** way in which AMF may benefit from their association with plants.

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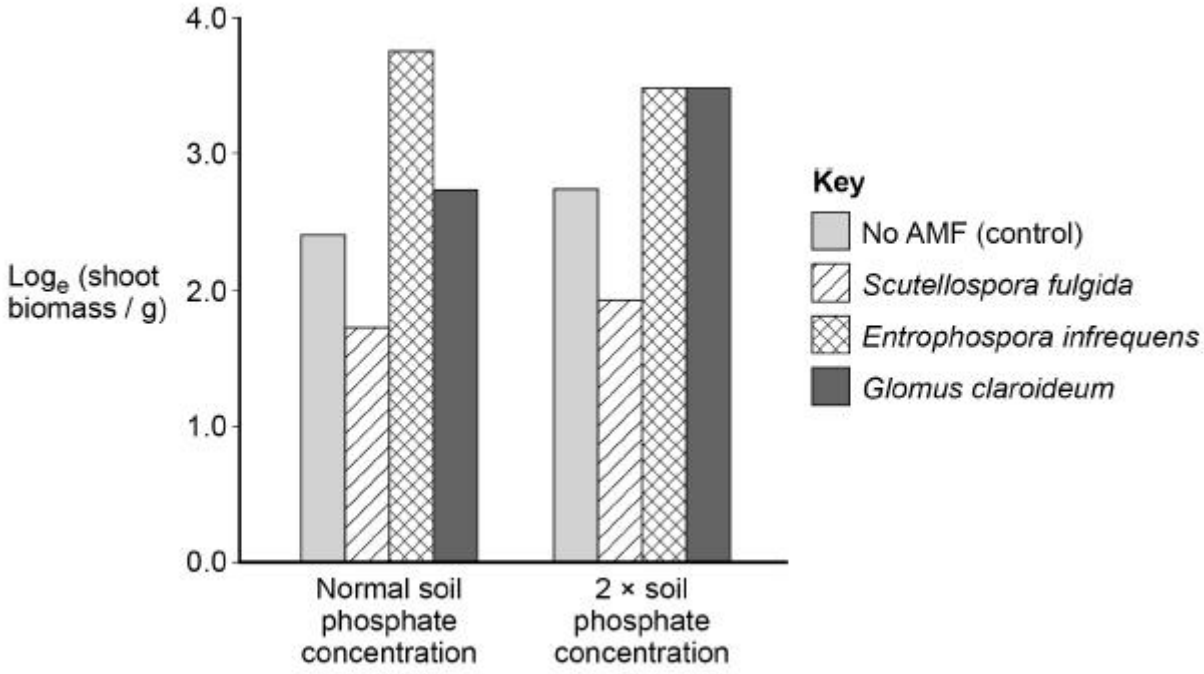
(1)

(c) Scientists investigated the effects of different AMF species on the productivity of the plant community of a prairie grassland ecosystem when growing in/on soil containing different phosphate concentrations.

The scientists set up identical plots of prairie grassland soil containing seeds of the plant species found in the ecosystem. The scientists added different AMF species and different concentrations of phosphate to particular plots. Control plots without AMF species were also set up. After 20 weeks the scientists determined the shoot biomass for each plot.

The results the scientists obtained are shown in the graph.



Explain why an increase in shoot biomass can be taken as a measurement of **net** primary productivity.

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(2)

(d) Using the data from the graph in part (c), evaluate the effect on plant productivity of adding AMF species and adding phosphate to the soil.

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(4)

(e) Using the e^x button on your calculator, determine the rate of shoot biomass production in grams per day for the control plot in soil with normal phosphate concentration.

Answer = _____ g day^{-1}

(2)

(Total 10 marks)

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