Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Q1.

(a) Describe how a Pacinian corpuscle produces a generator potential when stimulated.

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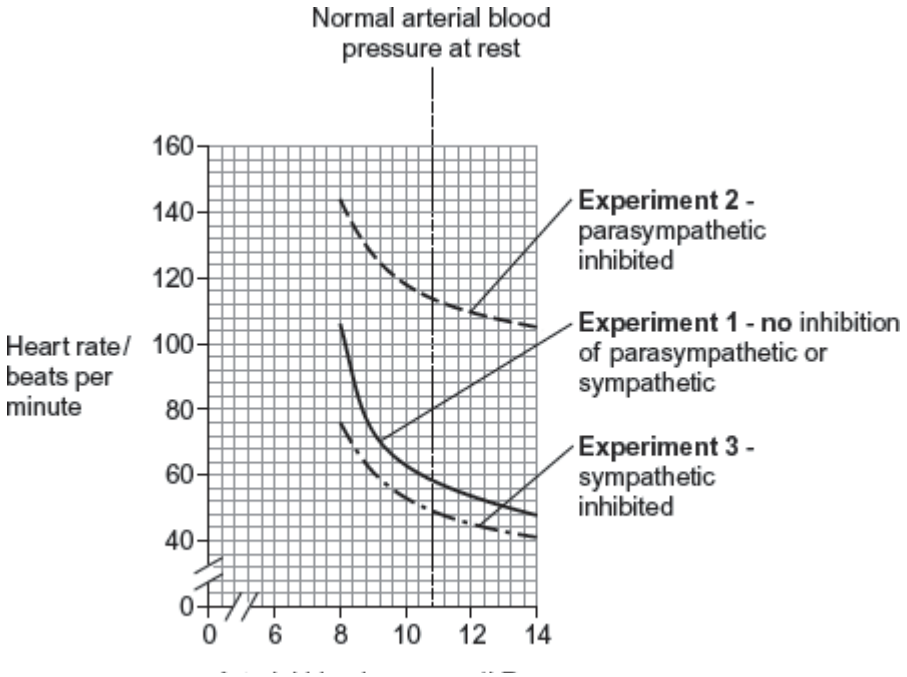
(3)

Doctors investigated the relationship between heart rate and arterial blood pressure. They recruited healthy volunteers. For each volunteer, they recorded their normal arterial blood pressure at rest. With each volunteer, they then carried out the following experiments.

Experiment 1	They recorded heart rate at different blood pressures.
Experiment 2	They repeated **experiment 1** after injecting a drug that inhibited the parasympathetic nervous system.
Experiment 3	They repeated **experiment 1** after injecting a drug that inhibited the sympathetic nervous system.

The graph shows the results for one volunteer.

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(b) Calculate the ratio of heart rate in **experiment 2** to heart rate in **experiment 3** at an arterial blood pressure of 10 kPa.
Show your working.

Answer = _____

(2)

(c) What do these data suggest about the control of heart rate by the parasympathetic and sympathetic nervous systems in response to changes in arterial blood pressure?

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(3)

(Total 8 marks)

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Q2.

Multiple sclerosis (MS) is a disease that involves damage to the myelin sheaths of neurones. Movement in MS sufferers may be jerky or slow.

(a) Damage to the myelin sheaths of neurones can lead to problems controlling the contraction of muscles.

Suggest **one** reason why.

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(2)

Scientists investigated the use of substances called cannabinoids to control muscle problems caused by MS.

(b) Cannabinoids are hydrophobic molecules. In the body, they easily pass into neurones. Explain why.

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(1)

(c) Cannabinoid receptors are found in the **pre-synaptic** membrane of neuromuscular junctions. When a cannabinoid binds to its receptor, it closes calcium ion channels.

Suggest how cannabinoids could prevent muscle contraction.

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(4)

(d) Cannabinoids include substances found in cannabis that can enter brain tissue. Scientists are developing artificial cannabinoids that can enter neuromuscular junctions but cannot enter brain tissue.

Suggest why these artificial cannabinoids would be better to use than cannabis when treating

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someone with MS.

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(2)

(Total 9 marks)

Q3.

Scientists investigated the control of blood glucose concentration in mice. They kept a group of normal mice without food for 48 hours. After 48 hours, the blood glucose concentrations of the mice were the same as at the start of the experiment.

(a) Explain how the normal mice prevented their blood glucose concentration falling when they had **not** eaten for 48 hours.

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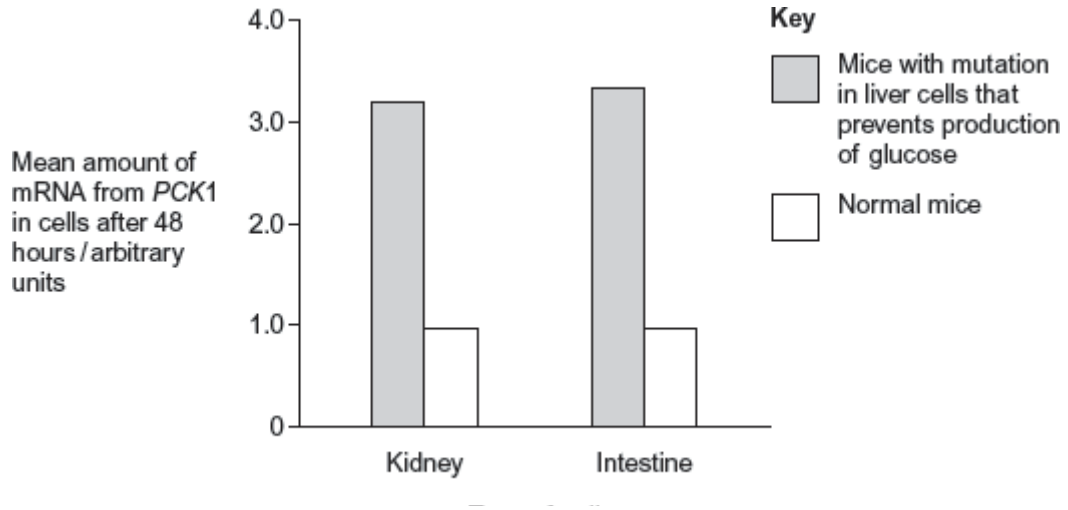
(3)

The scientists then investigated mice with a mutation that prevents their liver cells making glucose. They kept a group of these mice without food for 48 hours. After 48 hours, the mean blood glucose concentrations of the mutant mice and the normal mice were the same.

The scientists investigated how blood glucose concentration is controlled in these mutant mice. An enzyme required for synthesis of glucose is coded for by a gene called *PCK*1. The scientists measured the mean amount of mRNA produced from this gene in cells from the kidneys and intestines of normal mice and mutant mice. They did this with mice that had previously been without food for 48 hours.

The scientists' results are shown in the graph.

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(b) Use information from the graph to suggest how blood glucose concentration is controlled in the mutant mice, compared with the normal mice.

(3)

(c) The scientists performed statistical tests on the data shown in the graph, to see whether the differences in the amount of mRNA in cells from normal and mutant mice were significant. Both the probability values they obtained were $p<0.01$.

Explain what this means about the differences in the amounts of mRNA produced.

(2)

(Total 8 marks)

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