A Level Biology A

H420/01 Biological Processes

Question Set 13

13 (a) (i) The greater blue-ringed octopus, *Hapalochlaena lunulata*, is one of the most venomous of allanimals.

Its bite contains tetrodotoxin (TTX), a neurotoxin that can cause paralysis and death within minutes.

The following information has been discovered about the effects of TTX on nerve cells:

TTX binds to the external surface of the voltage-gated sodium ion channels in theaxon membrane.

Binding of TTX changes the tertiary structure of the channel.
This means the channel cannot open.

Using the information provided, explain how TTX affects the activity of neurones. **[4]**

The binding of TTX to voltage-gated Na^+ channels prevents Na^+ entering the axon. This prevents depolarisation of the axon membrane so it remains at resting potential. An action potential cannot be generated so the nerve impulse is not propagated along the axon.

13 (a) (ii) A common cause of death from TTX poisoning is suffocation (not getting enough oxygen)as a result of paralysis of the diaphragm.

Explain how paralysis of the diaphragm could lead to suffocation. **[2]**

If the diaphragm is paralysed, the thorax cannot increase in volume during inspiration. Thorax pressure cannot decrease below air pressure so air cannot be drawn into the lungs. This leads to suffocation.

13 (a) (iii) The greater blue-ringed octopus, *Hapalochlaena lunulata*, is one of the most venomous of allanimals.

Its bite contains tetrodotoxin (TTX), a neurotoxin that can cause paralysis and death withinminutes.

TTX is also known to reduce the speed of conduction in the Purkyne fibres of the heart. Suggest and explain what effect this would have on the heart rate. **[3]**

Heart rate would decrease. The transmission of impulses from the AVN to the apex of the ventricles would decrease, delaying ventricular systole.

13 (b) Molluscs such as *H. lunulata* have unmyelinated neurones. Saltatory conduction cannot occur in these neurones.

Suggest why transmission of action potentials along the axon is slower in molluscs than in mammals? **[1]**

There are no nodes of Ranvier so depolarisation must occur along the length of the whole axon in order to propagate the nerve impulse.

Total Marks for Question Set 13: 10