Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

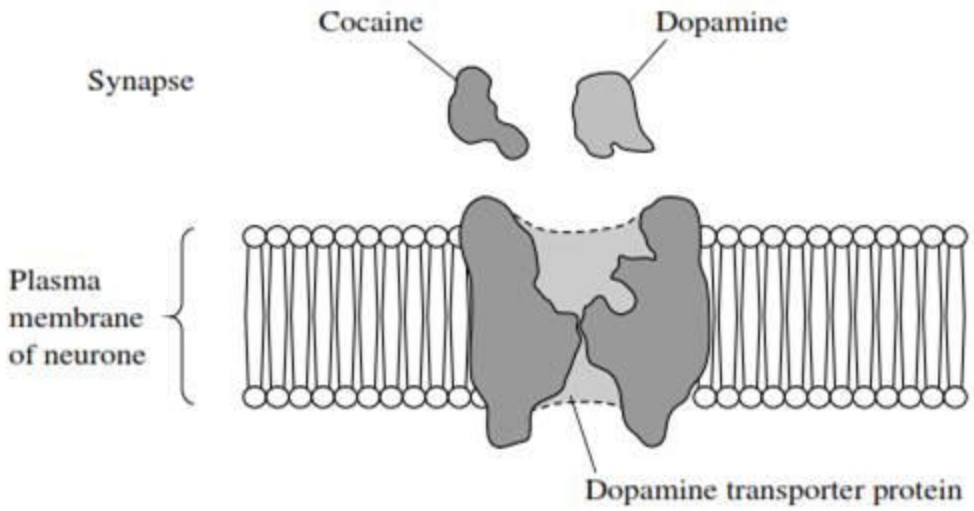
Q1.

Cocaine is a highly addictive and illegal drug.

The release of the neurotransmitter dopamine in specific synapses in the brain leads to feelings of pleasure. Dopamine is removed from synapses by dopamine transporter proteins in the plasma membrane of neurones. Cocaine binds to the dopamine transporter protein.

Figure 1 shows a dopamine transporter protein and molecules of cocaine and dopamine.

Figure 1



(a) Using all of the information, suggest how cocaine leads to feelings of pleasure.

_____

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(Extra space) _____

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(3)

(b) (i) Scientists isolated a mutated gene for the dopamine transporter protein.

Name **one** method that the scientists could have used to produce many copies of the mutated gene in the laboratory.

_____

(1)

(ii) Copies of the gene were then inserted into early embryos of mice. When these mice were born, samples of their DNA were tested using DNA probes to make sure that the mutated gene was present in the mice.

What is a DNA probe?

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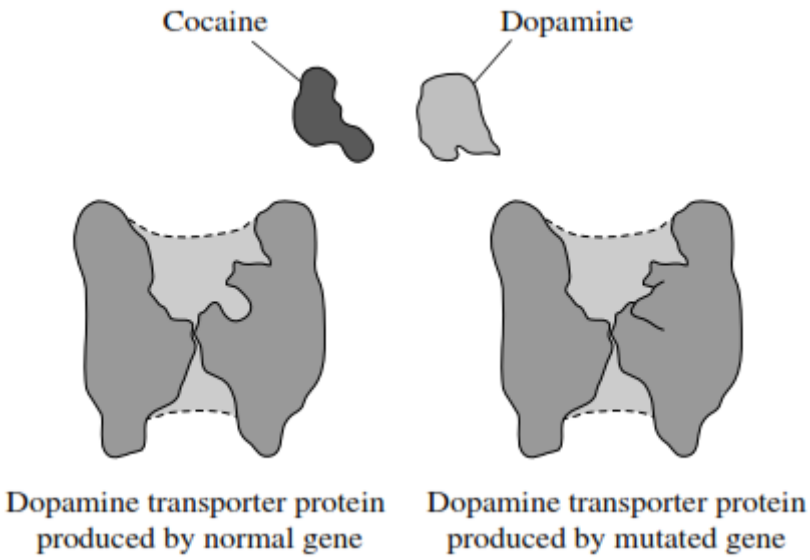
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(2)

(c) **Figure 2** shows dopamine transporter proteins produced from the normal gene and from the mutated gene.

Figure 2



Explain how the mutation leads to the production of a protein that transports dopamine but is **not** affected by cocaine.

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(3)
(Total 9 marks)

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Q2.

Some autism spectrum disorders (ASDs) are associated with a mutation affecting the neuroligin-3 gene. This gene codes for a protein called NL3, that is found in synapses.

Scientists investigated the effects of a mutation affecting NL3 in mice. They obtained brains from mice with the mutation and from mice without the mutation. For each type of mouse they:

- obtained a solution containing all of the proteins from synapses in one part of the brain
- separated these proteins using gel electrophoresis
- identified and measured the amount of three proteins from the solution using three different labelled antibodies.

The three proteins are parts of a postsynaptic membrane receptor.

The diagram below shows the scientists' results. Each band shows the presence of a protein. The size of a band shows the amount of the protein present.



(a) The mutation affecting NL3 in these mice was a substitution in the neuroligin-3 gene.

What is a substitution mutation?

_____

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_____

(1)

(b) Suggest how gel electrophoresis separated the proteins obtained from the synapses.

_____

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(2)

(c) Each type of labelled antibody binds specifically to one of the proteins.

Explain why.

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(3)

(d) What do these data show about the effects of the mutation on the proteins?

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(2)

(e) These proteins are part of a receptor found in synapses in the part of the brain called the hippocampus. A high ratio of NR2B to NR2A protein in this receptor has been associated with good memory.

Using all of the information, suggest how the mutation affecting the NL3 protein may affect a mouse.

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(2)

(Total 10 marks)

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