



CHEMISTRY ONLINE
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BIOLOGY

ORGANISMS RESPOND TO CHANGES IN ENVIRONMENTS

Level & Board	AQA (A-LEVEL)
TOPIC:	NERVE IMPULSES
PAPER TYPE:	QUESTION PAPER - 1
TOTAL QUESTIONS	6
TOTAL MARKS	44

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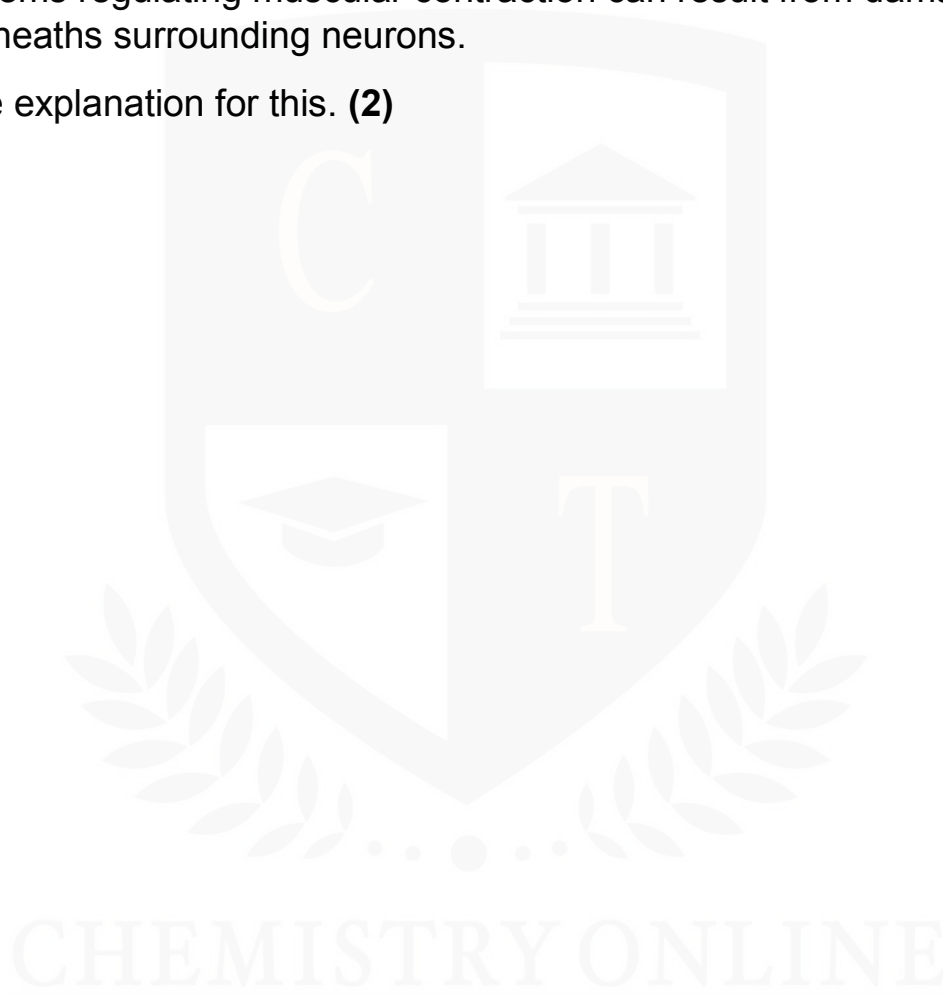
Nerve Impulses - 1

1.

Damage to the myelin sheaths of neurons is a symptom of multiple sclerosis. Patients may move slowly or jerkily.

(a) Problems regulating muscular contraction can result from damage to the myelin sheaths surrounding neurons.

Give one explanation for this. **(2)**

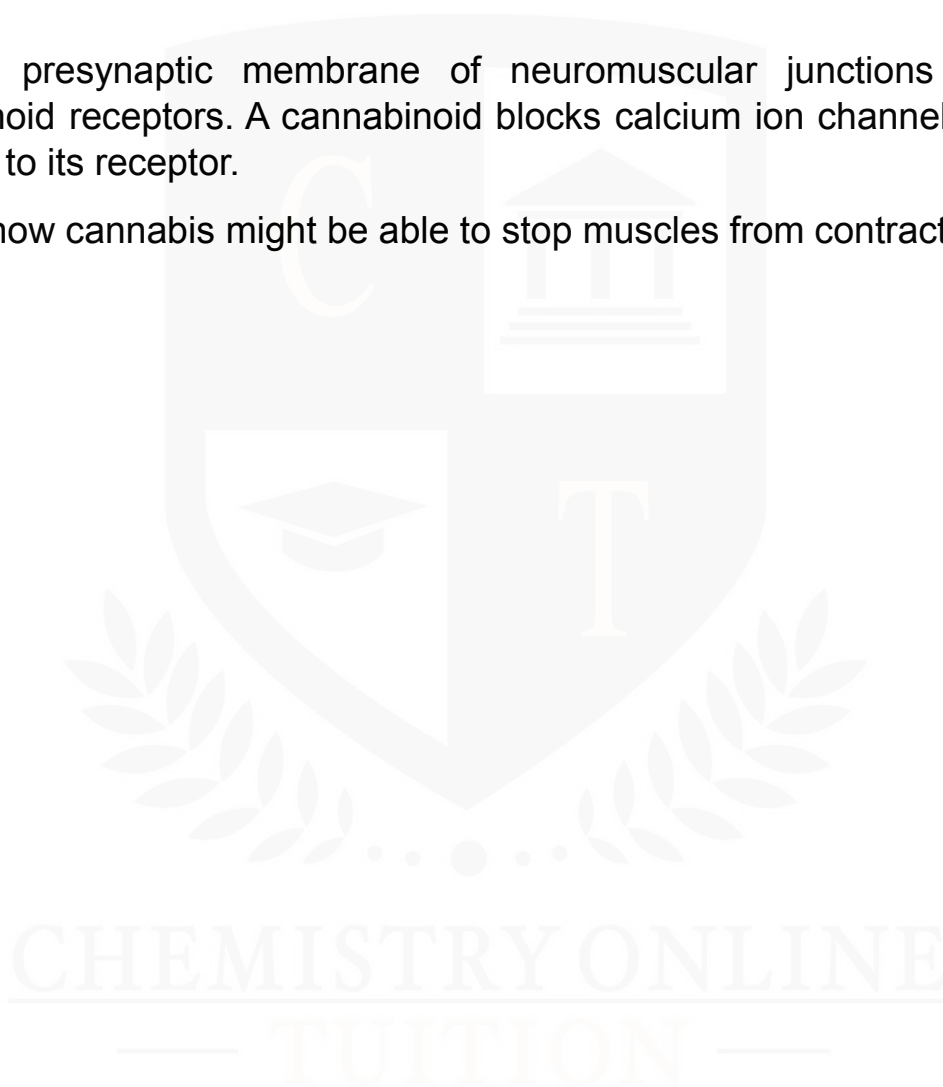


Researchers looked into the use of chemicals known as cannabinoids to treat muscle issues brought on by

(b) Cannabinoids are compounds that are hydrophobic. They readily transform into neurons inside the body. Describe your reasoning. **(1)**

(c) The presynaptic membrane of neuromuscular junctions contains cannabinoid receptors. A cannabinoid blocks calcium ion channels when it attaches to its receptor.

Explain how cannabis might be able to stop muscles from contracting. **(4)**



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(d) Chemicals in cannabis called cannabinoids have the ability to penetrate brain tissue. Researchers are creating synthetic cannabinoids that are able to penetrate neuromuscular connections but not brain tissue.

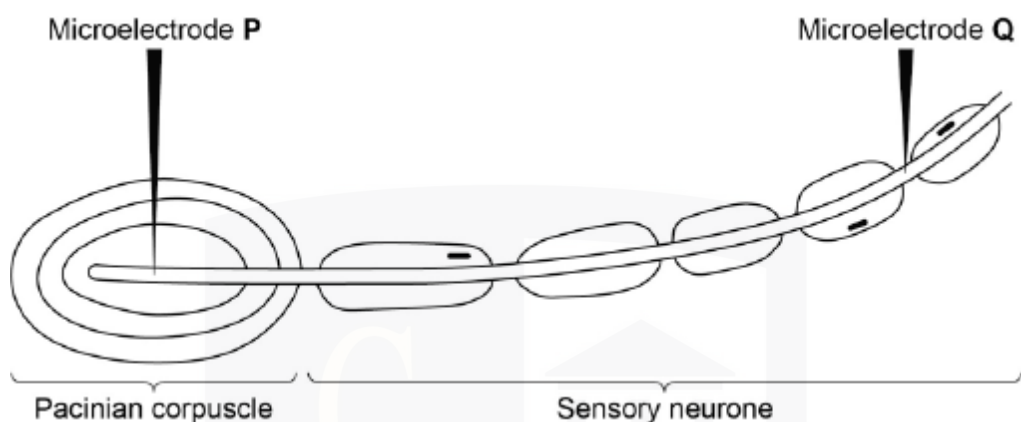
Explain why using these synthetic cannabinoids instead of cannabis would be more beneficial for treating someone with MS. **(2)**



2.

A biologist looked at how to stimulate a Pacinian corpuscle in a fingertip's skin. She measured a Pacinian corpuscle maximal membrane potential and its sensory neuron's response to varying fingertip pressures using microelectrodes.

The Pacinian corpuscle, its sensory neuron, and the locations of the microelectrodes are depicted in the picture below.



Some of the biologist's findings are displayed in the table below.

Pressure applied to the fingertip	Membrane potential at P / millivolts	Membrane potential at Q / millivolts
None	-70	-70
Light	-50	-70
Medium	+30	+40
Heavy	+40	+40

(a) Explain how the resting potential of -70 mV is maintained in the sensory neuron when no pressure is applied. **(2)**

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(b) Describe how the Pacinian corpuscle membrane potential changes in response to pressure, as detected by microelectrode P. **(3)**



(c) Whether medium or high pressure was applied to the fingertip, the membrane potential at Q remained constant. Describe your reasoning. **(2)**

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(d) Parts of the myelin sheaths enclosing neurons are damaged in multiple sclerosis. Describe how this causes a slower reaction time to stimuli. **(2)**



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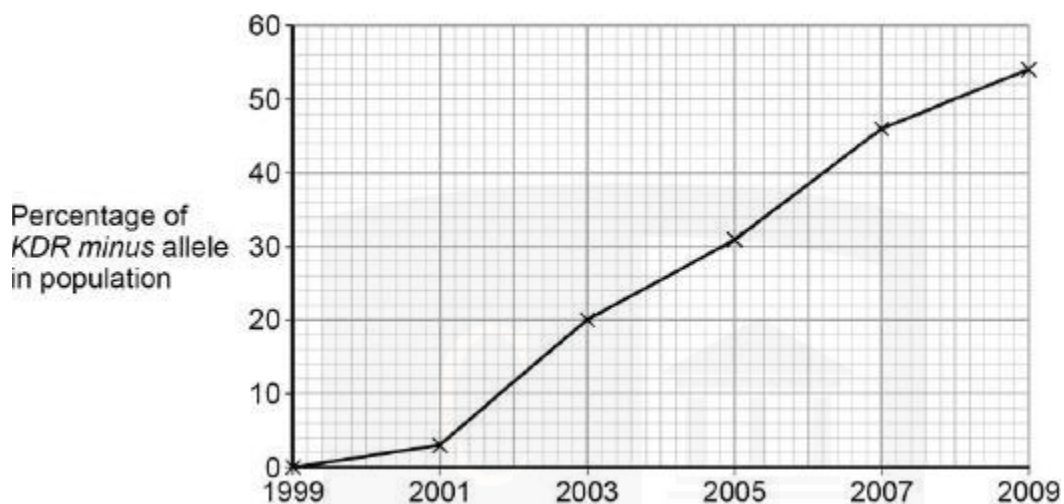
3.

Mosquitoes are insects that carry the malaria virus. DDT is a chemical that is used in Africa to try and stop the spread of malaria by killing mosquitoes.

There is a gene in mosquitoes called KDR. A KDR minus allele of this gene is present in some mosquitoes today, providing them with resistance to DDT. KDR +, the other allele, does not produce resistance.

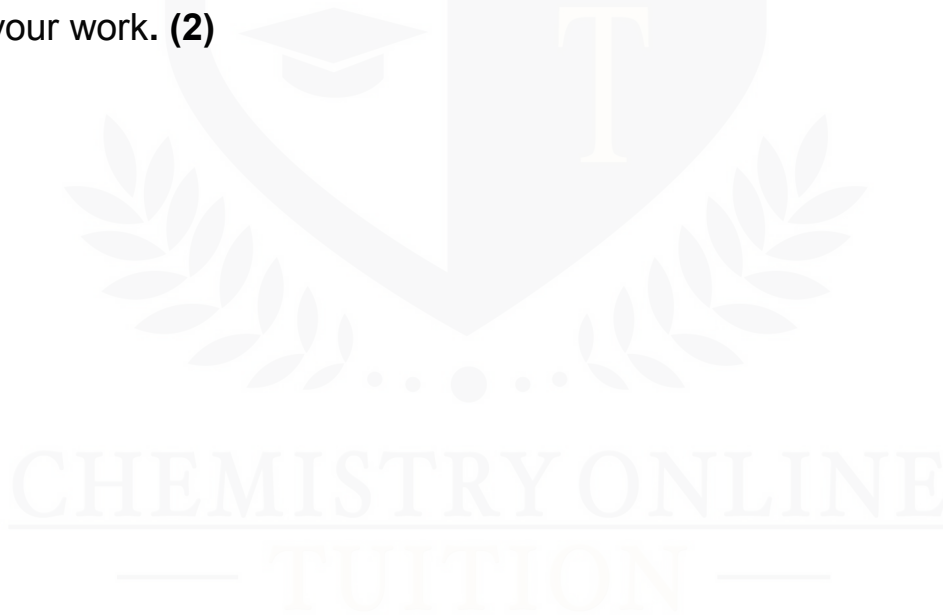
Over a ten-year period, researchers looked into the prevalence of the KDR minus allele in a population of mosquitoes in an African nation.

The scientists' findings are depicted in the image below.



(a) Determine the percentage of mosquitoes in this population that are heterozygous for the *KDR* gene in 2003 using the Hardy–Weinberg equation.

Display your work. (2)



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(b) Make an explanation suggestion for the outcomes seen in the preceding image. **(4)**



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Neuronal sodium ion channels are encoded by the KDR + allele.

(c) A sodium ion channel that has been bound by DDT stays open all the time. Make suggestions about how DDT kills insects based on this information. **(2)**



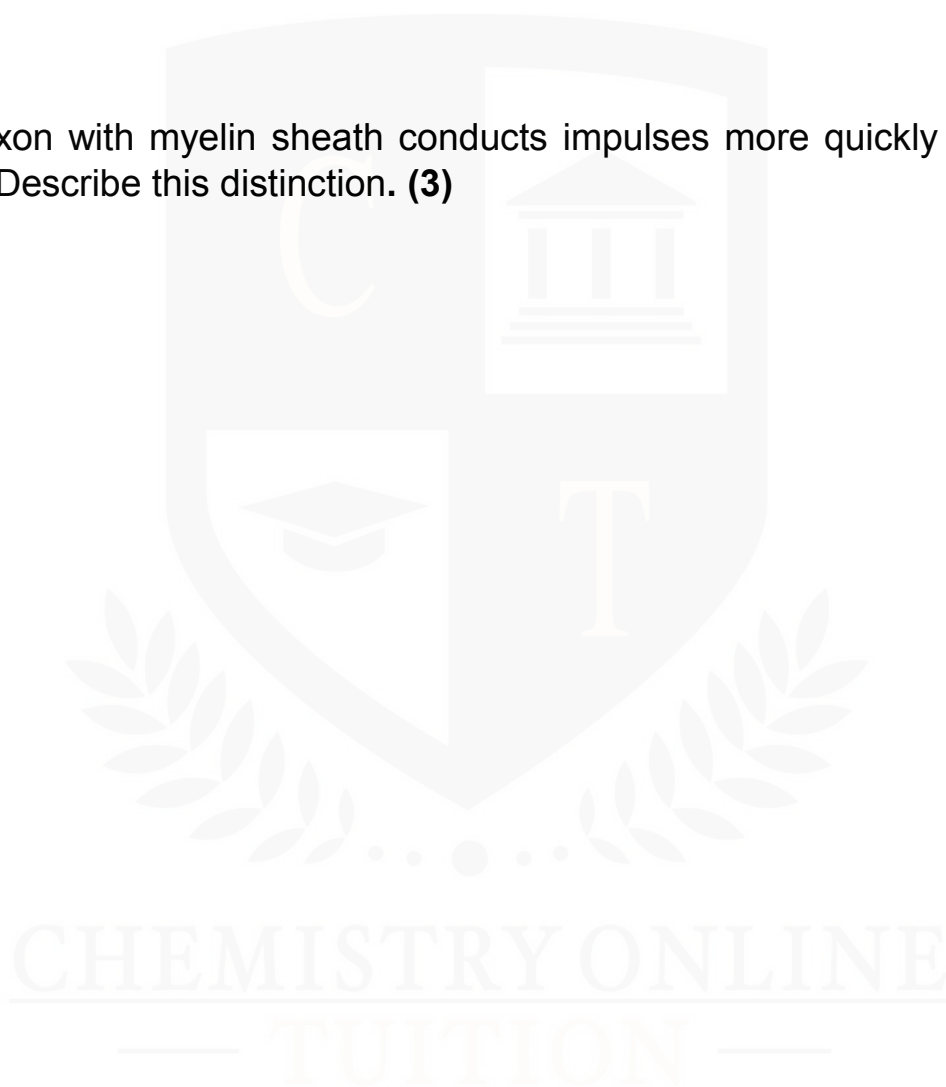
(a) Explain how resistance to DDT is provided by the KDR minus allele. **(2)**

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4.

(a) An axon with myelin sheath conducts impulses more quickly than one without. Describe this distinction. **(3)**



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5.

Researchers looked into the connection between various forms of dementia and the myelin found in brain tissue. Mental capacity is lost in all forms of dementia.

In samples of brain tissue from the following patients, the researchers determined the mean amount of myelin:

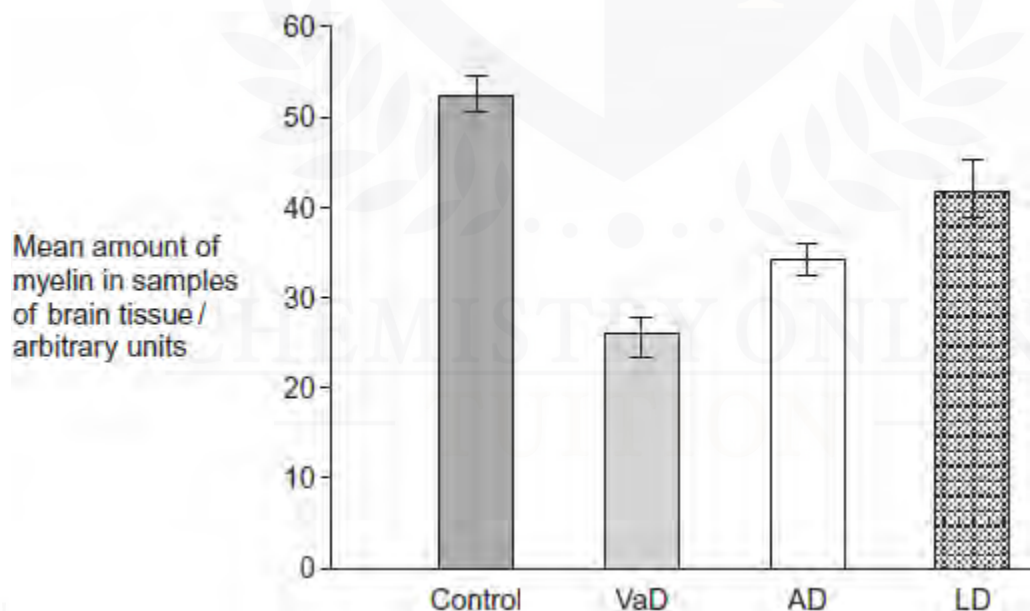
12 individuals in the control group did not have dementia;

20 individuals had vascular dementia (VaD);

19 individuals had Alzheimer's dementia (AD);

and 31 individuals had Lewy body dementia (LD).

The figure displays the doctors' findings. Standard errors are shown by the vertical bars.



(a) To compare the outcomes for AD and LD, the physicians used a statistical test. They came up with a P value of 0.047.

What does the difference between the means for AD and LD reveal, according to this result?

In your response, use the terms' chance and probability. **(2)**

(b) After reading about this experiment, a student came to the conclusion that dementia risk and brain myelin content were related.

Do the data lend credence to this conclusion? Provide justification for your response. **(4)**

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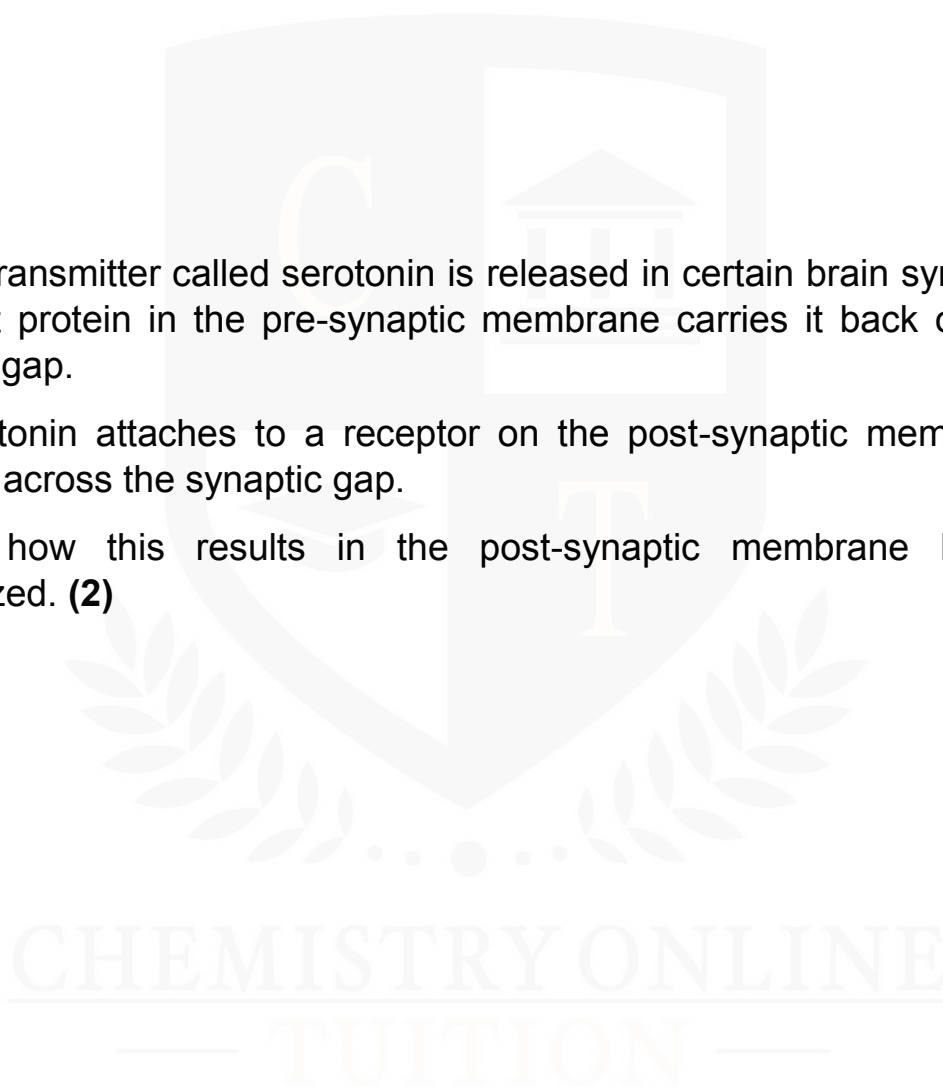
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6.

A neurotransmitter called serotonin is released in certain brain synapses. A transport protein in the pre-synaptic membrane carries it back out of the synaptic gap.

(a) Serotonin attaches to a receptor on the post-synaptic membrane by diffusing across the synaptic gap.

Explain how this results in the post-synaptic membrane becoming depolarized. **(2)**



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(b) The proper transport of a neurotransmitter like serotonin out of synapses is crucial. Describe your reasoning. **(2)**

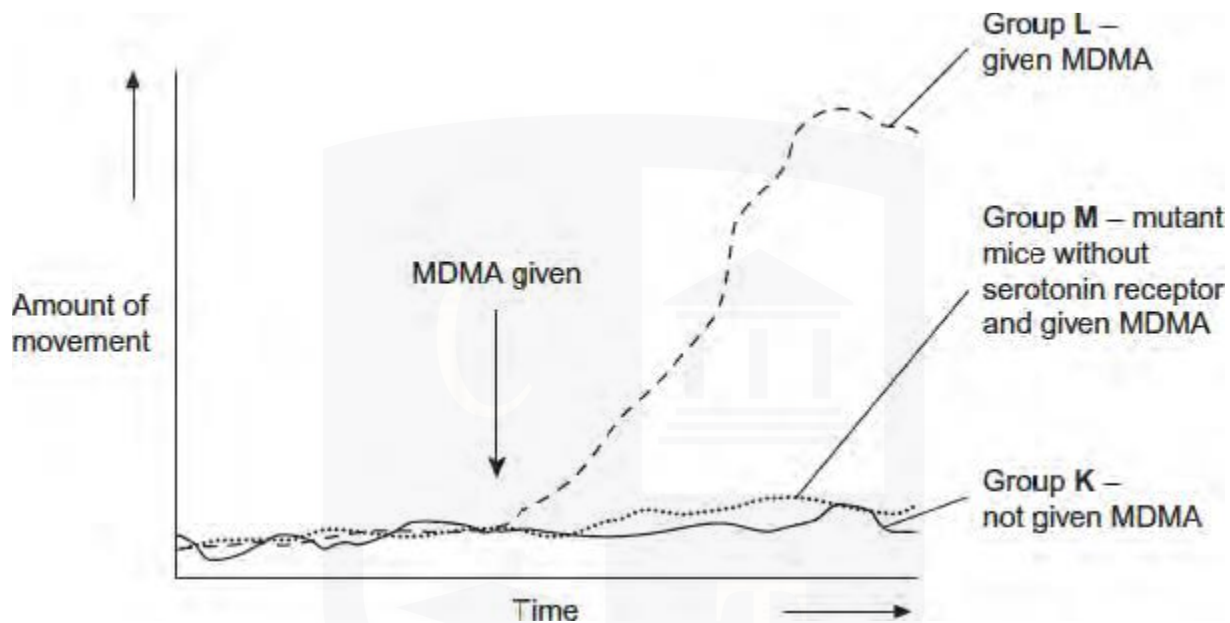
(c) Researchers looked into how mice's locomotion was affected by the medication MDMA. Three mouse groups K, L, and M were measured for movement intensity.

Group K mice did not receive MDMA.

- Mice in Group L were administered MDMA.
- Group M: MDMA was administered to mutant mice lacking a serotonin receptor on their post-synaptic membranes.

Their results are displayed in the graph.

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The researchers came to the conclusion that MDMA binds to serotonin receptors and influences locomotion.

How do these findings lend credence to this conclusion? (3)

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- Founder & CEO of Chemistry Online Tuition Ltd.
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