

**GCSE Biology A (Gateway)**

**J247/03 B1-B3 and B7 Higher (Higher Tier)**

**Question Set 19**

1 (a)

Investigating brain function may involve the following techniques:

- External recording of the brain using EEG.
- Scanning techniques such as CAT and MRI.
- Case studies of humans with accidental damage.
- Deliberate damage in animal experimentation.

(i) Understanding of brain function has increased in recent years. However, there are still problems that scientists face that are preventing a complete understanding.

Evaluate the reasons why understanding has increased but also why problems still exist.

[4]

**Understanding of brain function has increased due to the development of new technologies and methods to investigate the roles of different brain regions. fMRI scanners enable the identification of greater brain activity when performing specific tasks (e.g. recalling a memory). Neuroscientists can also observe the effects of electrical stimulation of certain areas of the brain on an individual. Studying patients with brain damage also increases understanding. However, the ability of scientists to investigate brain function is limited. The brain is very complex, so some regions are difficult to access. It may be difficult to get informed consent in order to study severely brain damaged patients. Moreover, the results of tests may be difficult to interpret.**

(ii) When scientists complete their research, they usually publish it in journals or online.

Give **two** reasons why scientists publish their results.

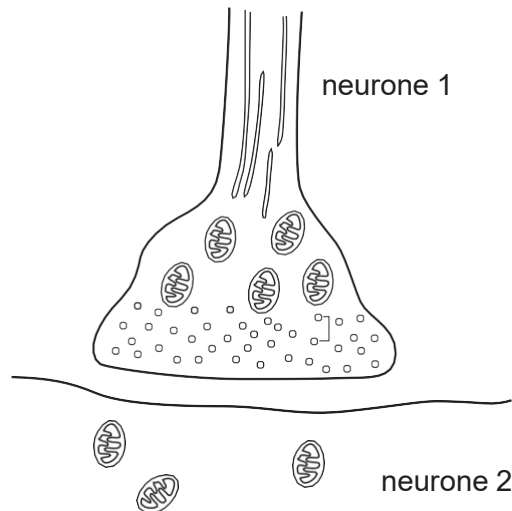
[2]

**To enable peer review by other scientists.**

**To share new knowledge with other scientists, politicians and the public so that informed decisions can be made.**

- (b) Alzheimer's disease involves damage to nerve transmission.

Symptoms include difficulties in judging distance, concentrating and making decisions. The diagram shows a synapse between two neurones in the brain.



Acetylcholine is a neurotransmitter in the brain. It diffuses across the 32 nanometre synaptic gap.

In a brain from a person with Alzheimer's disease, the time for acetylcholine to diffuse between neurones is  $6.4 \times 10^{-7}$  s.

1 metre =  $10^9$  nanometres

- (i) Calculate the speed of diffusion in a person with Alzheimer's disease.

Use this formula: speed = distance  $\div$  time

Give your answer in metres per second.

$$32 \text{ nm} = 32 \div 10^9 = 3.2 \times 10^{-8} \text{ m}$$
$$\text{Speed} = \frac{3.2 \times 10^{-8}}{6.4 \times 10^{-7}} = \underline{\underline{0.05 \text{ m/s}}}$$

[3]

- (ii) In the brain of a healthy person the speed of diffusion is 0.2 metres per second.

How does the result obtained in part (i) account for the symptoms of Alzheimer's disease?

[2]

**Neurotransmitter diffusion in a person with Alzheimer's disease is 0.15 m/s slower than in a healthy individual. This will delay the binding of neurotransmitter to receptor molecules on the neurone after the synapse so the initiation of a new electrical impulse will take longer. The slower transmission of information between neurones accounts for reduced concentration, difficulty making decisions etc.**

**Total Marks for Question Set 19: 11**

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