The Seventh Sense (October 2020 Paper 3 Scientific Article): Edexcel SNAB A Level Biology Exam Questions

12 questions · 37 marks · about 44 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 3 · October 2020 · Q7(a) · 5 marks

7 The scientific article you have studied is from *Scientific American*.

Use the information from the scientific article and your own knowledge to answer the following questions.

(a) Describe how 'eyes relay visual information' to the brain (paragraph 2).

(5)

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Question 2 · A level Paper 3 · October 2020 · Q7(b) · 2 marks

(b) 'Most drugs cannot easily penetrate the brain' (paragraph 3).

Explain how the treatment of Parkinson's disease overcomes the difficulty of drugs passing from the blood into the brain.

(2)

Question 3 · A level Paper 3 · October 2020 · Q7(c) · 4 marks

(c) 'Innate immunity initiates the inflammatory response, in which white blood cells swarm the site of infection' (paragraph 5).

Explain how white blood cells 'swarm' to accumulate at the site of inflammation.

(4)

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Question 4 · A level Paper 3 · October 2020 · Q7(d) · 2 marks

(d) The protein α4β1 integrin projects out from the cell surface membrane of white blood cells.

Deduce how molecules such as α4β1 integrin help immune cells cross the blood-brain barrier (paragraph 8).

(2)

Question 5 · A level Paper 3 · October 2020 · Q7(e) · 2 marks

(e) The immune system plays a role in recovery following spinal cord injuries.

Give **two** ethical arguments to support the use of rats and mice with spinal cord injuries in these experiments (paragraph 10).

(2)

1

2

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Question 6 · A level Paper 3 · October 2020 · Q7(f) · 3 marks

(f) 'The lymphatic vessels also ferry antigens—substances capable of inducing an immune response—from the tissues into tissue-draining lymph nodes, where they are presented to immune cells' (paragraph 15).

Describe how these antigens are presented to immune cells.

(3)

Question 7 · A level Paper 3 · October 2020 · Q7(g) · 4 marks

(g) 'A cytokine produced by immune cells in the meninges can change the activity of neurons, thereby altering the function of the circuit' (paragraph 20).

Cytokine has been found to affect neurotransmitter systems in the brain.

Explain how a cytokine could modify the activity of a neural circuit.

(4)

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Question 8 · A level Paper 3 · October 2020 · Q7(h) · 4 marks

(h) Compare and contrast the structure of a sensory neurone and a motor neurone (paragraph 21).

(4)

Question 9 · A level Paper 3 · October 2020 · Q7(i) · 2 marks

(i) Sight is a sense that develops during a critical period, 'providing a basis on which the brain can compute the activity needed for self-preservation.' (paragraph 22).

Describe what is meant by a critical period.

(2)

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Question 10 · A level Paper 3 · October 2020 · Q7(j) · 2 marks

(j) It has been suggested that there is a critical period for the development of the hard wiring of the immune response into the brain (paragraphs 22 and 23).

Explain how this critical period could be investigated using animal experiments.

(2)

Question 11 · A level Paper 3 · October 2020 · Q7(k) · 4 marks

(k) Describe how bacteria can be genetically modified to produce a cytokine for the treatment of neurological and mental disorders (paragraph 24).

(4)

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Question 12 · A level Paper 3 · October 2020 · Q7(l) · 3 marks

(l) An immune system that interacts adversely with the CNS might be described as 'flawed' (paragraph 24).

Explain why a bone marrow transplant can be used to replace a flawed immune system.

(3)

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Mark schemes

Question 1 · A level Paper 3 · October 2020 · Q7(a) · 5 marks

Question number	Answer
7(a)	A description that makes reference to five of the following: • light is detected by rod cells (1) • rod cell membrane is hyperpolarised (1) • stopping the release of the inhibitory neurotransmitter glutamate (1) • bipolar neurone is depolarised (1) • impulse transmitted along {ganglion neurone / optic nerve} (1) • (impulse transmitted) to visual cortex of the brain (1)

Additional guidance	Mark
ALLOW description of role of rhodopsin ALLOW occipital lobe	**(5)**

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Question 2 · A level Paper 3 · October 2020 · Q7(b) · 2 marks

Question number	Answer
7(b)	An explanation that makes reference to the following: • (give) {a precursor of dopamine / L-dopa} which can cross the blood brain barrier (1) • L-dopa is converted into dopamine (in the brain) (1) OR • (give) a {drug that stops the breakdown of dopamine / MAO inhibitor} (1) • that can cross the blood brain barrier (1)

Additional guidance	Mark
ALLOW • use of {electrode / deep brain stimulation} • to stimulate basal ganglia to produce dopamine	**(2)**

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Question 3 · A level Paper 3 · October 2020 · Q7(c) · 4 marks

Question number	Answer
7(c)	An explanation that makes reference to four of the following: • (cytokines / histamine) increases permeability of the capillaries (1) • (cytokines / histamine) cause vasodilation (1) • increasing blood flow to site of inflammation (1) • allowing white blood cells to {migrate / move } from the blood into the tissue space (1) • cytokines attract white blood cells (1)

Additional guidance	Mark
ALLOW cause arterioles to dilate MP4 and 5 ALLOW immune cells / phagocytes / macrophages / monocytes ALLOW chemicals in place of cytokines	**(4)**

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Question 4 · A level Paper 3 · October 2020 · Q7(d) · 2 marks

Question number	Answer
7(d)	An answer that makes reference to two of the following: • the integrin binds to receptors • on (the surface of capillary) endothelial cells (1) • holding the immune cell in place / stopping the immune cell moving with the blood (1) • giving the immune cells time to squeeze between the endothelial cells (into the brain) (1)

Additional guidance	Mark
ALLOW (complementary) proteins in placxe of receptors IGNORE activates (capillary) endothelial cells ALLOW trapping the immune cell ALLOW allowing immune cells to cross {the basement membrane / capillary wall}	**(2)**

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Question 5 · A level Paper 3 · October 2020 · Q7(e) · 2 marks

Question number	Answer
7(e)	An answer that makes reference to the following: • the benefits of the research outweigh any harm done (1) • need to carry out experiments on animals with a well-developed CNS (1)

Additional guidance	Mark
ALLOW CNS and spinal cord injuries are difficult to treat / CNS and spinal cord injuries have serious impact on people's lives / important research ALLOW experiments on tissues or invertebrates would not be sufficient IGNORE better than using humans / humans have more rights etc IGNORE have similar immune system / have less well developed nervous system	(2)

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Question 6 · A level Paper 3 · October 2020 · Q7(f) · 3 marks

Question number	Answer
7(f)	A description that makes reference to the following: • { phagocytes / macrophages } engulf antigens (1) • antigen is presented on the surface of antigen presenting cells (1) • lymphocytes with receptors that are (specific / complementary) to (particular) antigens bind to APC (1)

Additional guidance	Mark
ALLOW reference to production of APCs / antigen presenting cells ALLOW CD4 receptors ALLOW T cells for lymphocytes	**(3)**

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Question 7 · A level Paper 3 · October 2020 · Q7(g) · 4 marks

Question number	Answer
7(g)	An explanation that makes reference to four of the following: • cytokine can bind to receptor on synaptic membrane (1) • effect on an ion channel (1) • therefore affecting the movement of ions across the membrane (1) • affecting the depolarisation of the membrane (1) • therefore affecting action potentials (in the neural circuit) (1)

Additional guidance	Mark
ALLOW inhibitory or stimulatory effects ALLOW binds to acetylcholinesterase e.g. opens chloride ion channel ALLOW other described effects on membrane e.g. chloride ions moving in or potassium ions moving out e.g. threshold potential is not reached	**(4)**

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Question 8 · A level Paper 3 · October 2020 · Q7(h) · 4 marks

Question number	Answer
7(h)	An answer that makes reference to the following: Similarities • both have a cell body containing a nucleus (1) • both have an axon (1) • both have dendrites at one end of neurone and terminal branches at the other end (1) Difference • location of cell body (1)

Additional guidance	Mark
IGNORE descriptions of function ALLOW motor neurone cell body is at one end of the axon whereas in the sensory neurone the cell body is located along the axon	**(4)**

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Question 9 · A level Paper 3 · October 2020 · Q7(i) · 2 marks

Question number	Answer
7(i)	A description that makes reference to two of the following: • period of time during early development (1) • when the nervous system must obtain specific experiences to develop properly (1) • so that synapses are strengthened / unstimulated synapses are removed (1)

Additional guidance	Mark
ALLOW retina needs to be exposed to light ALLOW when visual columns are organised	(2)

Question 10 · A level Paper 3 · October 2020 · Q7(j) · 2 marks

Question number	Answer
7(j)	An explanation that makes reference to two of the following: • {immunise / infect} animals at different times during early development (1) • investigate animals later in life for { effects on learning / the development of neurological conditions } (1)

Additional guidance	Mark
ALLOW compare animals with intact and with deficient (innate) immune systems ALLOW test animals' senses at different stages in development	(2)

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Question 11 · A level Paper 3 · October 2020 · Q7(k) · 4 marks

Question number	Answer
7(k)	A description that makes reference to four of the following: • (isolate) the gene for ~~the~~ cytokine (from human DNA) (1) • use a bacterial plasmid (as a vector) (1) • cut the human DNA and the plasmid using the same restriction enzyme (1) • splice the gene and plasmid together using (DNA) ligase (1) • put the (modified) plasmids into bacterial cells (1)

Additional guidance	Mark
e.g. ue a restriction enzyme to cut the DNA and the plasmid ALLOW 'join' for 'splice' ALLOW produce lots of bacteria {with the plasmid / expressing the cytokine gene}	**(4)**

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Question 12 · A level Paper 3 · October 2020 · Q7(l) · 3 marks

Question number	Answer
7(l)	An explanation that makes reference to the following: • bone marrow provided by a donor (1) • bone marrow will contains stem cells (1) • which can be differentiate into white blood cells (1)

Additional guidance	Mark
ALLOW white blood cells are produced in the bone marrow ALLOW examples of white blood cells e.g. lymphocytes, T cells, B cells, etc	**(3)**

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