

Exercise walk-through

5.7

Neurones, nerve impulses and synapses (statements 8.1–8.7)

Pearson Edexcel · International A-Level · Biology

Four stages, one purpose

Stage	Where	Yield
Glycolysis	cytoplasm	2 ATP + 2 reduced NAD
Link reaction	matrix	CO ₂ + reduced NAD
Krebs cycle	matrix	ATP + reduced NAD + reduced FAD
Oxidative phosphorylation	cristae	most ATP; O ₂ to water

Recombinant DNA: cut, paste, select

Cut : the same restriction enzyme opens plasmid and gene



Paste : complementary sticky ends sealed by DNA ligase



Transform : heat shock carries plasmids into bacteria



Select : antibiotic marker - only transformants survive

Check yourself

Your turn

Why is the human insulin gene made from mRNA before inserting into bacteria?

- A.** bacteria cannot splice introns, and mature mRNA has none
- B.** mRNA is more stable than DNA
- C.** mRNA is double-stranded and easier to cut
- D.** restriction enzymes only cut RNA

Exercises 2.1·2.3

2.1 State the value of a neurone's resting potential. [1]

2.2 Explain why an action potential is described as all-or-nothing. [2]

2.3 Name the ion that enters the presynaptic knob to trigger transmitter release. [1]

Exercises 2.1·2.3

2.1 State the value of a neurone's resting potential. [1]

2.1 About -70 mV.

2.2 Explain why an action potential is described as all-or-nothing. [2]

2.2 Below threshold nothing happens; at or above threshold a full-size action potential fires regardless of stimulus strength.

2.3 Name the ion that enters the presynaptic knob to trigger transmitter release. [1]

2.3 Calcium ions (Ca^{2+}).

Exercises 3.1·3.2

3.1 Describe the events that produce an action potential, from the resting potential to the start of the refractory period. [6]

3.2 Explain two ways the structure of a myelinated axon speeds conduction compared with an unmyelinated one, and state what limits the speed in both. [5]

Exercises 3.1·3.2

3.1 Describe the events that produce an action potential, from the resting potential to the start of the refractory period. [6]

3.1 Resting: pump holds -70 mV, interior negative; stimulus depolarises the membrane to threshold -55 mV; voltage-gated sodium channels open and Na⁺ floods in - depolarisation to about +30 mV; potassium channels open and K⁺ flows out, repolarising and overshooting to hyperpolarisation; the refractory period begins as channels reset and the pump restores the resting gradient.

3.2 Explain two ways the structure of a myelinated axon speeds conduction compared with an unmyelinated one, and state what limits the speed in both. [5]

3.2 Myelin insulates the membrane, so depolarisation jumps between nodes of Ranvier (saltatory conduction) - far less membrane to depolarise per unit distance; this saves the time and ATP that pumping at every point would need. Limits: the nodes' channel density and axon diameter (resistance), and temperature up to the channel proteins' optimum.

Exercise 3.3

3.3 Tetrodotoxin (TTX) from puffer fish blocks voltage-gated sodium channels. Explain why TTX stops nerve conduction, and predict its effect on the heart, whose muscle conducts electrical excitation between cells. [5]

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3.3 With sodium channels blocked, Na^+ cannot enter and the membrane cannot depolarise; no action potential is generated or propagated, so nerve impulses stop entirely. Cardiac muscle's excitation also depends on ion-channel depolarisation passing cell to cell, so conduction fails and the heart's coordinated beat stops.