**WORKING MUSCLES REVISION MK 2014 WACE**





Q 40 WACE 2013

# Question 40 (20 marks)

1. Outline the events involved in the nervous stimulation and subsequent contraction of skeletal muscle. In your answer include the role of calcium ions. (9 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Nervous impulse reaches the axon terminal of a motor neuron | 1–4 |
| **\*Impulse causes calcium ions to enter axon terminal** |
| Some vesicles undergo exocytosis |
| Neurotransmitter/ acetylcholine released from vesicles |
| The neurotransmitter/ acetylcholine diffuses across the gap/synaptic cleft/ synapse |
| Neurotransmitter/ acetylcholine attaches to receptors located on the sarcolemma |
| Neurotransmitter/ acetylcholine causes sodium channels to open/ sodium ions to enter the cell/ depolarisation of muscle fibre | 1–5 |
| The action potential is propagated over the sarcolemma/ along the fibre |
| **\*Action potential causes calcium ions to be released** |
| Calcium released from sarcoplasmic reticulum |
| **\*Calcium ions expose myosin binding sites (on the actin)** |
| Myosin cross bridges attach to actin |
| Muscle contraction occurs / filaments slide past each other |
| Following depolarisation, the sarcolemma becomes repolarised |
| **Total** | **9** |

**\*Bolded statements:** must include at least two of these points

1. Explain how blood flow increases to working skeletal muscles during exercise.

(11 marks)

|  |  |  |
| --- | --- | --- |
| **Description** | | **Marks** |
| Stimulus | | 1 |
| Any one of the following:   * Decreased blood pressure/ blood flow during exercise * Exercise/increased rate of cell respiration causes high blood CO2 levels/low pH/ high hydrogen ions * Thought processes in cerebrum of excitement/ anticipation | |
| Receptor | | 1 |
| Any one of the following:   * Detected by baroreceptors/pressure receptors in the aortic and carotid bodies * Detected by chemoreceptors in aortic and carotid bodies/ medulla/ cardiovascular centre | |
| Modulator | | 1 |
|  | Cardiovascular centre/ vasomotor centre/ medulla oblongata |
| Effector | | 1–2 |
|  | Sympathetic stimulation/ parasympathetic inhibition of |
|  | sinoatrial node |
|  | Sympathetic stimulation/ parasympathetic inhibition of |
| arterioles/ arteries |
| Response | | 1–2 |
|  | Increases heart rate/ stroke volume/ cardiac output/ blood |
|  | pressure |
|  | Vasodilation of blood vessels in working skeletal muscles |
| Feedback | | 1 |
|  | Increasing blood flow to skeletal muscles |
| Additional points, any three of: Effector   * Adrenaline stimulation of sinoatrial node Response * Vasoconstriction blood vessels to non-essential organs Feedback   + Reducing blood flow to blood vessels to non-essential organs * Nervous impulses are sent to the medulla from receptors * A rise in body temperature during exercise increases heart rate * Lactic acid accumulation in more active muscles leads to vasodilation/ more blood flow * Contraction of skeletal muscles assists venous return to heart increasing blood returning to heart | | 1–3 |
| **Total** | | **11** |

OR A FEEDBACK LOOP AS FOLLOWS

*6 essential points in bold*

*2 points must come from the first two boxes Any 3 of the other points*

Stimulus

*Must have at least one mark from this box*

* Decreased blood pressure/ blood flow during exercise
* Exercise/increased rate of cell respiration causes high blood CO2 levels/low pH/ high hydrogen ions
* Thought processes in cerebrum of excitement/ anticipation

Feedback

* **Increasing blood flow to**

**skeletal muscles**

* Reducing blood flow to blood vessels to non-essential organs

Receptor

*Must have at least one mark from this box*

* Detected by baroreceptors/pressure receptors in the aortic and carotid bodies
* Detected by chemoreceptors in aortic and carotid bodies/ medulla/ cardiovascular centre

Response

* **Increases heart rate/ stroke**

**volume/ cardiac output/ blood pressure**

* **Vasodilation of blood vessels in working skeletal muscles**
* Vasoconstriction blood vessels to non-essential organs
* Nervous impulses are sent to the medulla from receptors

**Cardiovascular centre/**

**vasomotor centre/ medulla oblongata**

* **Sympathetic stimulation/ parasympathetic**

**inhibition of sinoatrial node**

* Adrenaline stimulation of sinoatrial node
* **Sympathetic stimulation/ parasympathetic inhibition of arterioles/ arteries**

Effector

* + A rise in body temperature during exercise increases heart rate
  + Lactic acid accumulation in more active muscles leads to vasodilation/ more blood flow
  + Contraction of skeletal muscles assists venous return to heart increasing blood returning to heart