Question 39

Caffeine has been known to help long haul truck drivers carry their load over long distances with minimum sleep. Caffeine results in increases in adrenaline at the synapse.

1. Explain how a nerve impulse is transmitted across a synaptic gap. (8 marks)

|  |  |  |
| --- | --- | --- |
|  | **Description** | **Marks** |
| (a) | Action potential opens calcium channels in membrane | **1-8** |
| Calcium ions flow into pre-synaptic knob |
| Vesicles stimulated to release transmitter |
| Vesicle releases neurotransmitter by exocytosis into the gap/synaptic cleft/synapse |
| Neurotransmitter diffuses across the gap |
| Neurotransmitter attaches/binds to receptors/post synaptic receptors on dendrite |
| Nerve impulse can then travel down the neuron/receptor triggers a  postsynaptic response specific for that receptor |
| Excitatory response produced causing the depolarisation of the postsynaptic membrane. |
| Neurotransmitter destroyed after impulse gone |
|  | **Total** | **8** |

1. Discuss how caffeine would affect the transmission the nerve impulses and the side effects a person would experience overconsumption of caffeine. (4 marks)

|  |  |  |
| --- | --- | --- |
|  | **Description** | **Mark** |
| (b) | Caffeine blocks the neurotransmitter adenosine preventing the slowdown of neural activity [1] | Any two for 2 marks  **1-2** |
| Caffeine encourages the release of a number of neurotransmitter such as dopamine and noradrenaline [1] |
| which increases the number of nerves firing [1] increasing brain alertness |
| Caffeine is a stimulant so too much caffeine can lead to: dizziness, insomnia [inability to sleep] | **2** |
| Can cause headaches and irritability |
| In severe cases: |
| Muscles can go into spasm/tremors/convulsions/twitching/paralysis |
| Vomiting |
| Hallucinations |
| Irregular or fast heart beat |
| **Total** | **4** |

1. The sympathetic and parasympathetic nervous systems are vital part of the peripheral nervous system. Compare and contrast the structure and function of the two systems.

(8 marks)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| (c) |  | | | **Marks** |
|  | **Similarities** | Both part of autonomic nervous system Both efferent branch of nervous system Both are under involuntary control  Both have two sets of nerve fibres | | **2**  **marks** |
|  | **Differences** | **Sympathetic** | **Parasympathetic** | **Betwee n 1-6**  **marks** |
| (c | Neurotransmitter | Noradrenaline/adrenaline | Acetylcholine |
| Purpose | Fight or flight | Moderates all functions/homeostasis |
| Heart | Increase rate/strength of contractions | Decrease rate/strength of contractions |
| Lungs | Dilate bronchi | Constrict bronchi |
| Stomach/intestines | Decrease movement | Increase movement |
| Liver | Increase breakdown of glycogen to glucose | Increase uptake of glucose and synthesis of glycogen |
| Iris of eye | Dilates pupil | Constricts pupil |
| Salivary glands | Decrease production of saliva | Increase production of saliva |
| Urinary bladder | Relax muscle wall | Constrict muscle wall |
| Sweat glands | Increase sweat production | No effect |
| Blood vessels Skin  Skeletal Internal organs | Constricts Vasodilates  Constricts (except heart and lungs) | Little effect No effect Little effect |
| Adrenal medulla | Stimulates hormone secretion | No effect |
|  | **Total** | | | **8** |

**Question 35. (12 marks)**

**a) (Any 4, 1 from each box)**

|  |  |  |
| --- | --- | --- |
|  | **Sensory Neuron** | **Connector Neuron** |
| **Structure** | **Cell body off to one side /**  **axons and dendrites differ in length /**  **cell body can be found outside of the CNS (1)** | **Cell body central /**  **axons and dendrites similar in length / cell body only found in the CNS (1)** |
| **Function** | **Conducts impulses towards the CNS (1)** | **Conducts impulses between the sensory and motor neurons (1)** |

**b) i) protection / insulation / increases rate of transmission of nerve impulses (Any 1, 1)**

**ii) grey matter of the CNS / brain / spinal cord / named brain structure (Any 1, 1)**

**iii) (1)**

**c) i) a person is born with them / they are not learned (Any 1, 1)**

**ii) An inability to cause effector to contract (1)**

**iii) reflex arc would not occur / no stimulation would be received / reflex arc would not be initiated (Any 1, 1)**

**iv) Nervous – the reflex arc allows extremely rapid responses to prevent harm / damage (1)**

**Endocrine – hormones can continue to affect their target cells over an extended period of time (1)**

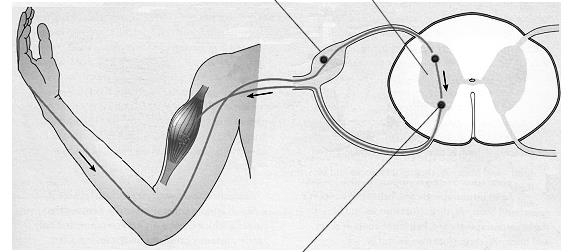
Question 43

1. An individual’s spinal cord is severed below the level of the shoulder in a car accident. When examined, it is noticed that the patient’s leg moves in response to a sharp stimulus to the foot. Explain how this response can occur. Include in your answer details of specific components of the pathway involved in this response. (10 marks) **10 marks**

**Sensory receptor (1) (in the foot) is stimulated; sensory neuron (1) carries impulse to the spinal cord/CNS (1); via dorsal root ganglion / dorsal root (1) impulse passes to motor neuron (1) via (at least one) synapse / connector neuron / interneuron (1); motor neuron carries impulse out of the spinal cord(1) via the ventral root (1) to effector (1); effector in this case is muscle cells (1) which respond by contracting to move the leg (1). Response occurs at the level of the spinal cord (brain not needed) (1) 10 marks**

Question 36 (7 marks)

A reflex is a rapid response to a change in the internal and external environment. The diagram below shows the main component of a reflex arc.



Grey matter [4]

Receptor or stimulus

Dorsal root ganglion [3]

Sensory neuron from receptor to spinal cord [2]

|  |  |
| --- | --- |
| Motor neuron | Interneuron/ |
| [6] | connector |
|  | neuron/ |
|  |
| association |
| neuron [5] |

1. Identify the main parts involved in the reflex arc indicated by the lines on the diagram above.

(5 marks)

1. Explain why the reflex arc is considered to be protective (2 marks)

Protective reflex protects the body from injury or infection (1) OR

Can be by forcing a foreign antigen out from the body so it cannot cause harm eg vomiting, sneezing(1)

To maintain homeostasis (1)

OR rapid (1) and reduces harm (1)