

HUMAN NERVOUS SYSTEM (LIVE)

06 MAY 2015

Section A: Summary Content Notes

The nervous system: controls the functioning of all the systems in the body allowing humans to react to stimuli from their environment. The central nervous system controls all voluntary movements and internal organs, glands and blood vessels. It responds to information received by the brain and then responds. The nervous system can be divided into three systems that coordinate the functioning of the body namely: the Central nervous system, the Peripheral nervous system and the Autonomic nervous system.

Nervous Tissue

Nervous tissue consists of a complex system called neurons or nerve cells that are adapted to conduct and react to all stimuli.

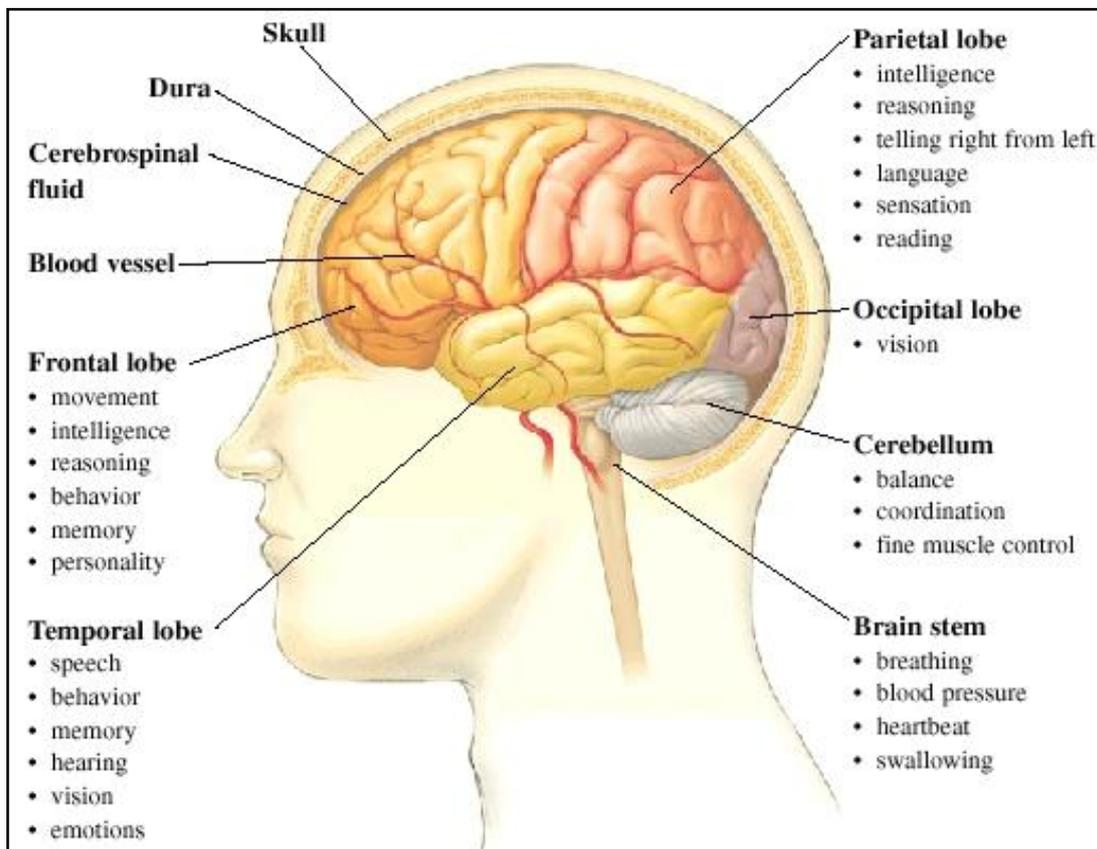
- Sensory neurons: Sensory neurons always conduct impulses from the receptor to the CNS (spinal cord and brain).
- Motor neurons: Motor neurons always carry impulses away from the CNS (spinal cord and brain).
- Connector / inter-neurons: They connect sensory neurons to motor neurons in the spinal cord and the brain.

The Central Nervous System (CNS)

Brain

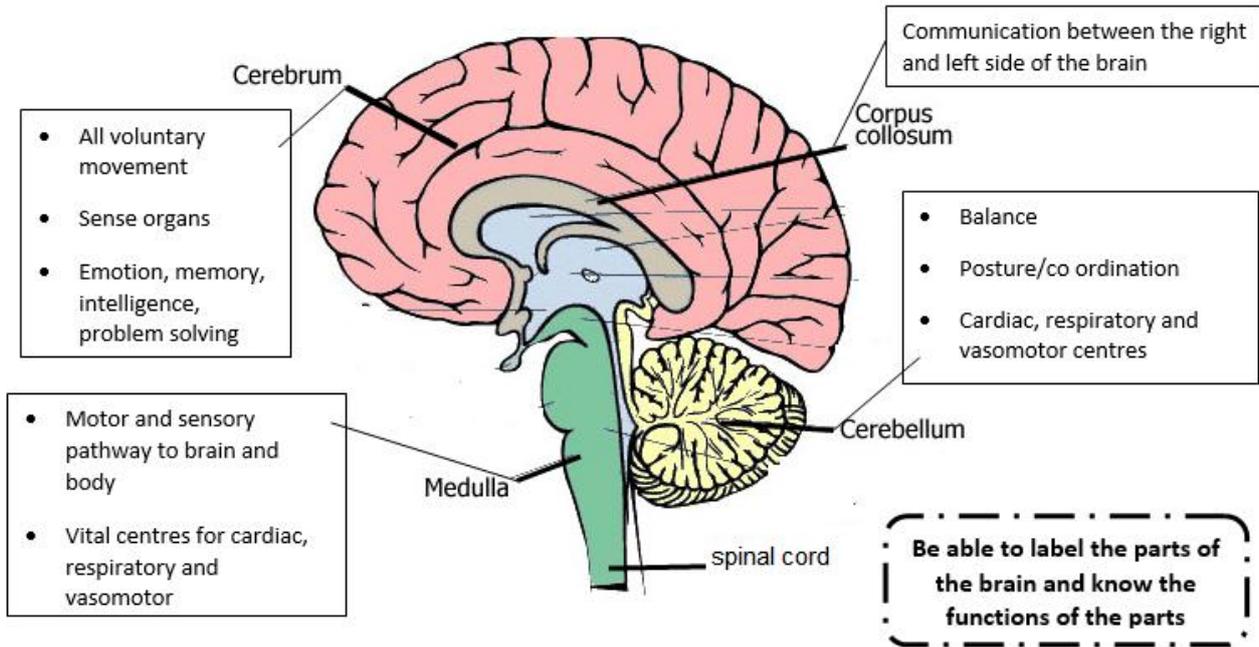
Protected by the bones of the cranium and is surrounded by three layers of membranes or **meninges** for protection. The cortex consists of cell bodies and is called the grey matter. The medulla consists of the nerve fibres or axons and is called the white matter.

External structure of the human brain



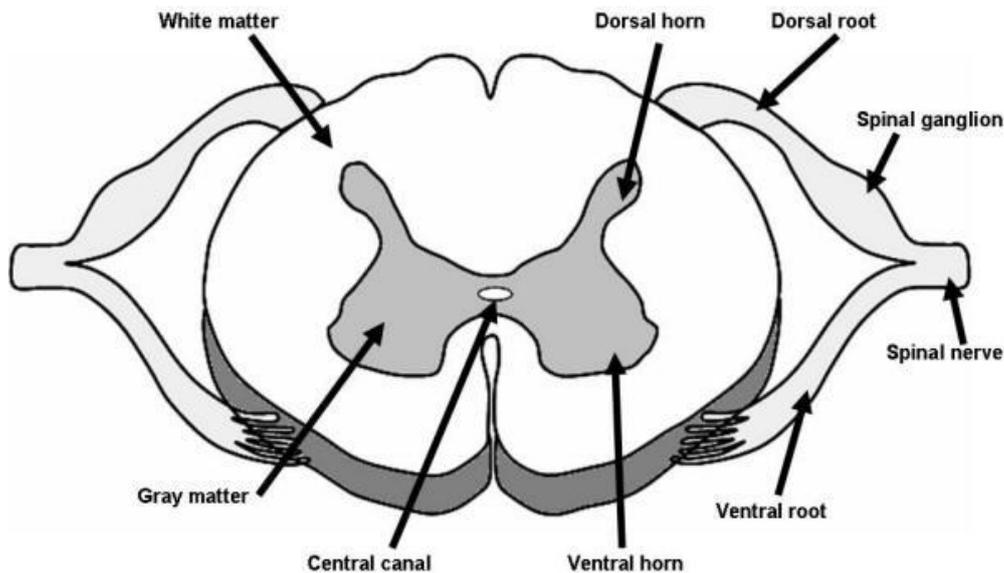
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Internal structure of the human brain



Spinal Cord

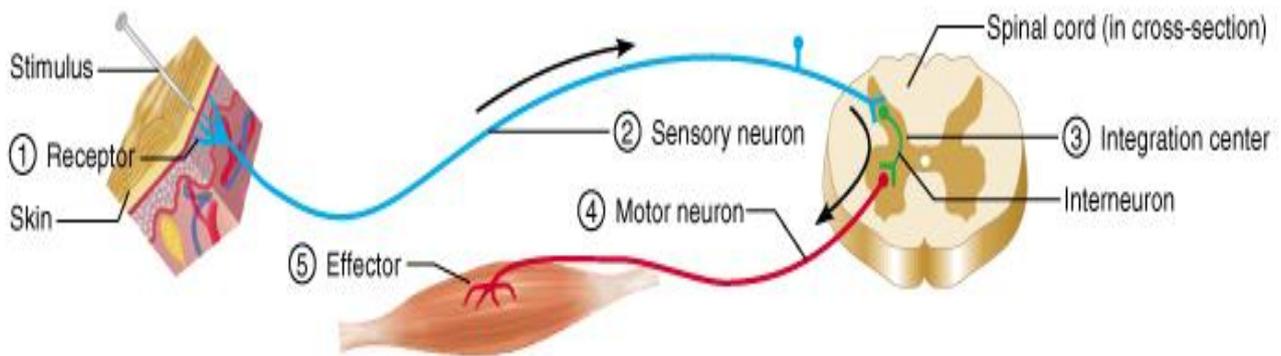
Protected by the vertebrae and cerebrospinal fluid. Nerves from the body parts enter the spinal cord as 31 pairs of spinal nerves. The spinal cord is the pathway for all the impulses that are conducted to and from the brain and also processes reflex actions. Sympathetic and parasympathetic nerve impulses are conducted along the spinal cord to all organs.



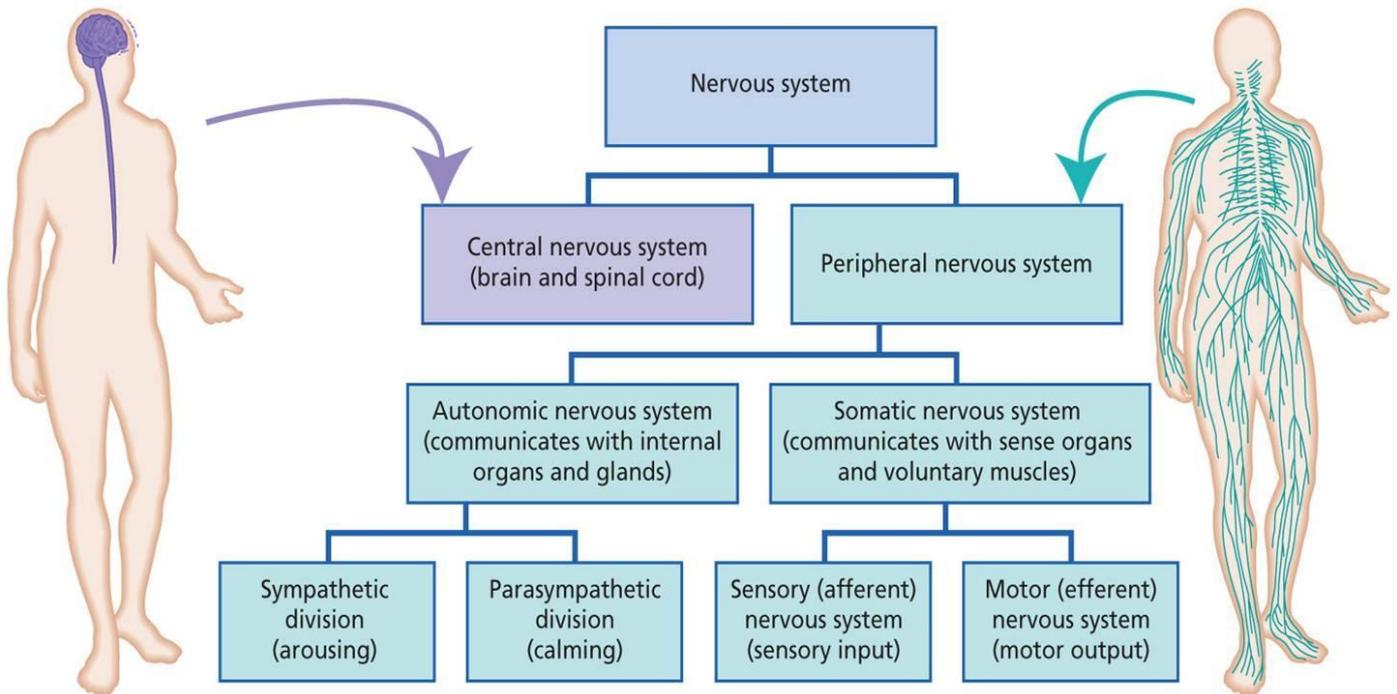
The Reflex Arc

Is the path travelled by the nerve impulses and is a rapid automatic response to a stimulus, received by a sensory organ. The reflex arc will cause a reflex action allowing the body to respond very quickly to protect itself and prevent severe injury.

Hint – it is easier if you remember the order 1-5 as is shown on the diagram below



The Peripheral Nervous System (PNS)



Transmission of Nerve Impulses

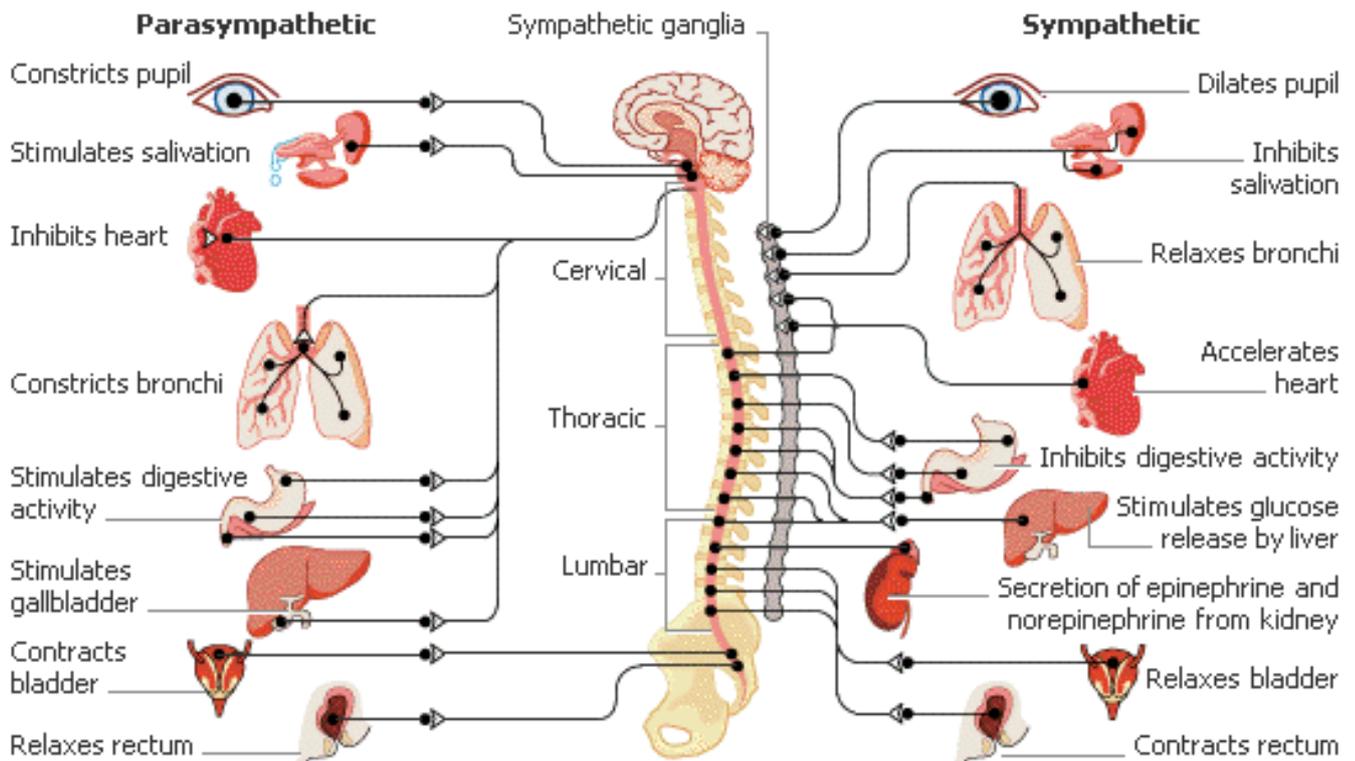
The synapse is the point where an impulse passes from the terminal branch of one neuron to the dendrite of the next neuron. The neurons do not touch each other and the gap between the two neurons is called the synaptic gap. Neurotransmitters carry the impulse across the synaptic gap. Once they reach the opposite side, enzymes destroy the neurotransmitters to prevent the impulse from being carried back so that the impulse can only travel in one direction.

Autonomic Nervous System

- Controls the involuntary actions of the body

The autonomic nervous system consists of the sympathetic and parasympathetic systems.

- Sympathetic system – prepares the body for an emergency – increase heart rate, higher blood pressure, faster respiration, increased rate and depth of breathing
- Parasympathetic system – allows the body to return to normal after an emergency situation.



If you look at the diagram each line represents a nerve. Each target organ has a nerve from both the sympathetic and parasympathetic systems – this is called **DOUBLE INNERVATION**

Diseases and Injuries to the Nervous System

The best way would be to draw up a table of the diseases and injuries under the given criteria i.e. cause, effect etc.

You need to be able to do the following:

- Make sure you know the causes, symptoms and treatment of the following **diseases**:
 - Alzheimer's and Multiple sclerosis
- Make sure you can know the causes, symptoms and effects of brain and spinal damage
- Make sure you know how stem cells can be used in the treatment of diseases and injuries

Stem cells are defined by their ability to self-renew and differentiate into multiple different cell types. Because of this ability, it is hoped that they can be used for a variety of applications ranging from developing novel therapies to drug discovery and toxicity as well as understanding basic biology

Effects of drugs on the central nervous system

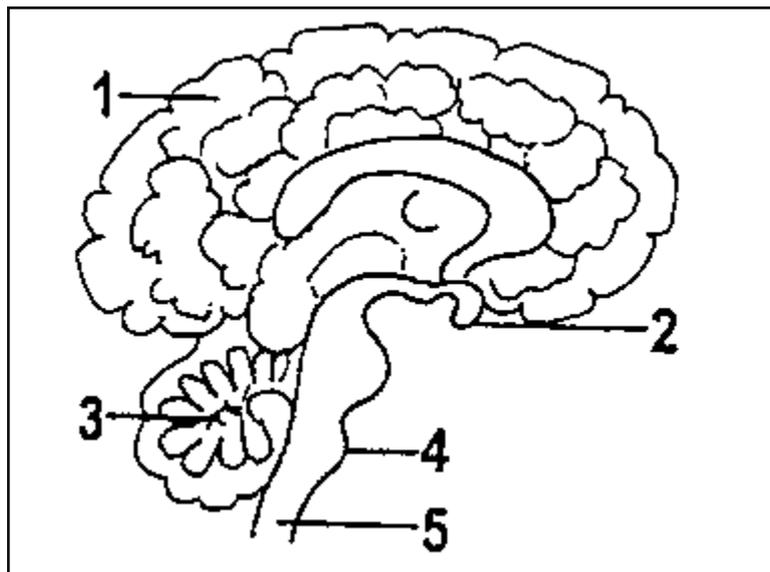
Drugs that are legally prescribed by a doctor and are used according to instructions, are acceptable as they are used to treat illness and alleviate pain in patients. When drugs are used to enhance performance or as a psychoactive for non-therapeutic and non-medical effects, it becomes a problem. Drugs that are addictive and harmful are alcohol, amphetamines, barbiturates, cocaine and opium alkaloids. It is a criminal offence to abuse any of these drugs.

- Some drugs can stimulate the nervous system. Effects like alertness, wakefulness, endurance, increased heart rate, increased blood pressure and a reduction in appetite and need for sleep, are stimulated. Examples of stimulants are amphetamines, caffeine, cocaine and nicotine. Stimulants are addictive. Examples are tik, ecstasy, heroin and dagga.
- **Sedatives:** Doctors use these drugs to target specific receptors, for example to treat anxiety, to sedate a patient, as antipsychotics (tranquillisers) and for psychological problems. Sedatives work directly on the central nervous system by slowing down and blocking function. Examples are alcohol, barbiturates
- **Pain killers:** These include opium and derivatives of opium like morphine, codeine and heroin. Analgesics are used to relieve pain by working on the central and peripheral nervous system to inhibit the transmission and reception of pain stimuli.

Section B: Practice Questions

Question 1

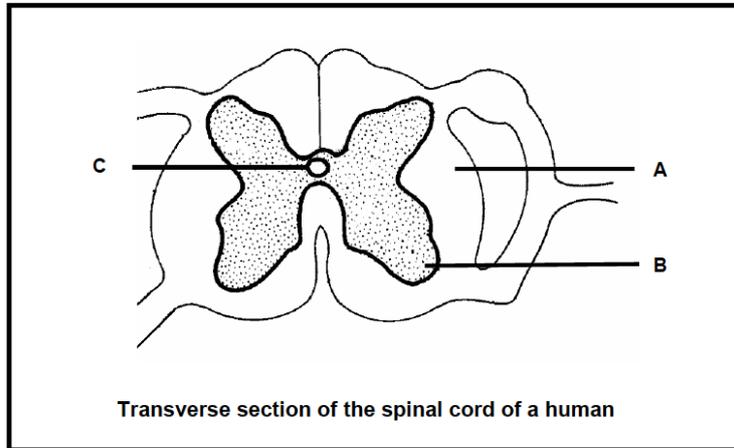
Study the diagram below and answer the questions that follow



- 1.1. Identify parts numbered 1 to 5. (5)
- 1.2. Number 1 is made up of two similar halves. How are these two halves attached to one another? (1)
- 1.3. What type of tissue is controlled by number 3? (1)
- 1.4. Name TWO functions of number 4. (2)
- 1.5. List THREE ways in which the brain is protected. (3)

Question 2

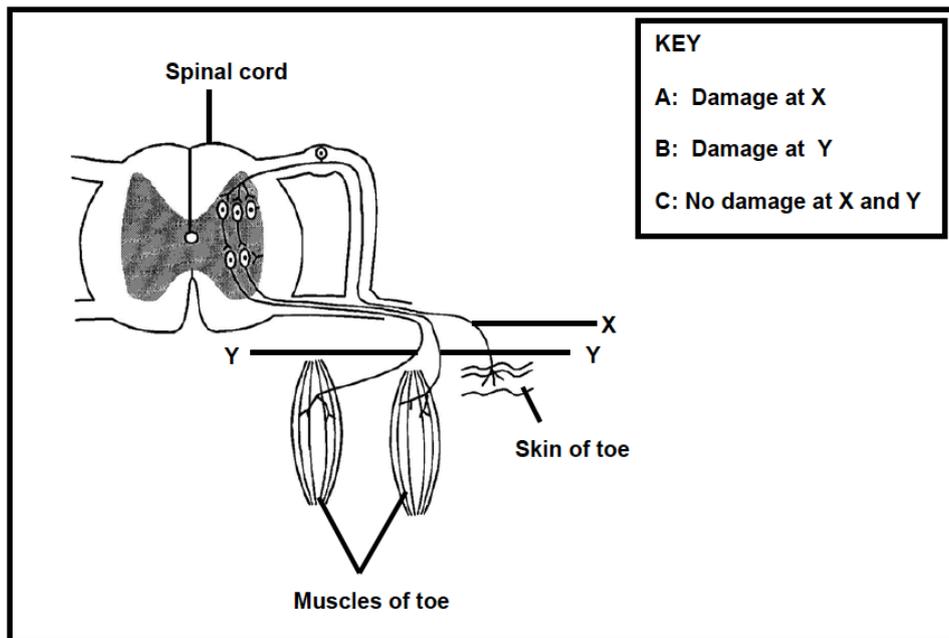
Study the diagram on the following page and answer the questions that follow.



- 2.1 Identify parts A, B and C. (3)
- 2.2 State TWO ways in which the spinal cord is protected. (2)

Question 3

Letters X and Y represent neurons that conduct impulses to and from the brain via the spinal cord. Study the diagram and answer the questions that follow.

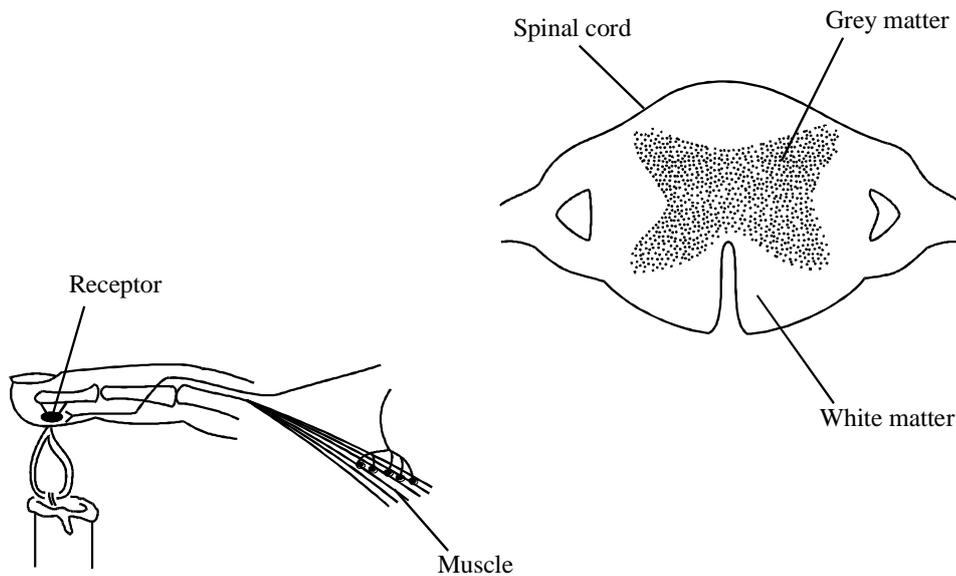


Using the given key, write down the correct letter (A, B or C in key) of the condition that explains each of the following:

- 3.1 When the skin of the toe is stimulated, the toe moves and the person knows that it is moving. (1)
- 3.2 The person can move the toe, but cannot feel the movement. (1)
- 3.3 The person can feel a pin pricking the toe, but cannot move the toe. (1)

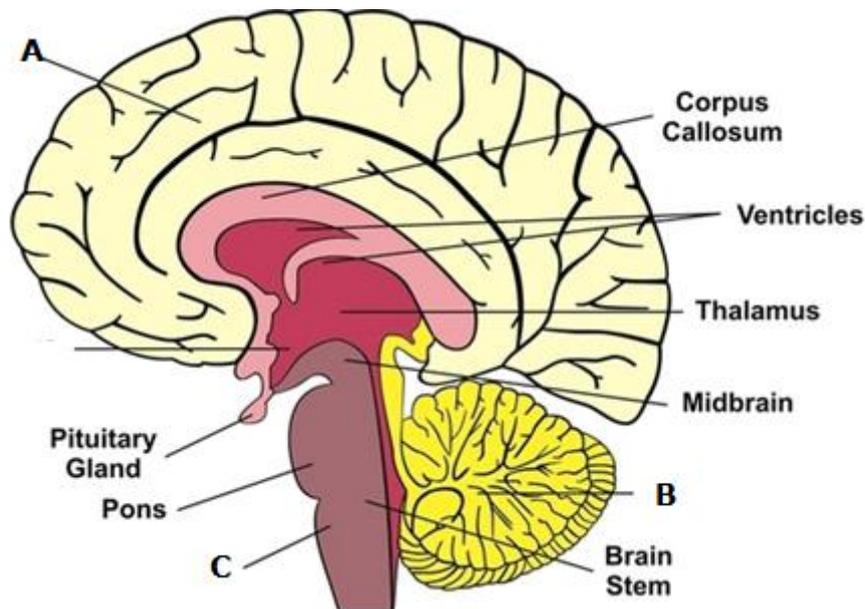
Question 4

The following diagram shows part of a simple reflex arc containing three neurons.



- 4.1 Complete the diagram by drawing and labelling the structures that conduct impulses into, through, and out of the spinal cord. (6)
- 4.2 Explain how synapses ensure that a nerve impulse is transmitted in only one direction. (2)

Question 5



[<http://i.livescience.com/images>]

- 5.1 What type of section is shown in the diagram (cross or longitudinal)? (1)
- 5.2 Give a reason for your answer from the diagram. (1)
- 5.3 Name parts **A**, **B** and **C**. (3)
- 5.4 A criminal stabbed her victim to death with a single strike whilst travelling on a fast Moving train. Describe how part **B** enabled her to perform this act effectively. (2)
- 5.5 In some countries execution by hanging is the punishment for murder because this method of death is considered to be quick. It results in the breaking of one or more of the cervical vertebrae,

which causes damage to the spinal cord. Referring to the functions of the medulla oblongata, give an explanation of why hanging results in a quick death. (3)

Section C: Solutions

Question 1

- 1.1. 1 cerebrum
2 pituitary gland / hypophysis
3 cerebellum
4 medulla oblongata
5 spinal cord (5 x 1) (5)
- 1.2. Corpus callosum (1)
- 1.3. Skeletal muscles (1)
- 1.4. Medulla oblongata contains the reflex centres which control and regulate the following:
- The breathing rate and depth
 - The heartbeat rate
 - Vaso-motor activity /dilation and constriction of the blood vessels
 - The secretion of saliva
 - Controls peristalsis (Any two functions) (2)
- 1.5.
- Bones of the skull ✓
 - The 3 meninges ✓
 - Cerebrospinal fluid ✓ (3)

Question 2

- 2.1 A: White matter
B: Grey matter
C: Central canal / Cerebrospinal fluid (3)
- 2.2 By three meninges
it is inside the bony vertebrae
cerebrospinal fluids (Mark first 2 answers only) (2)

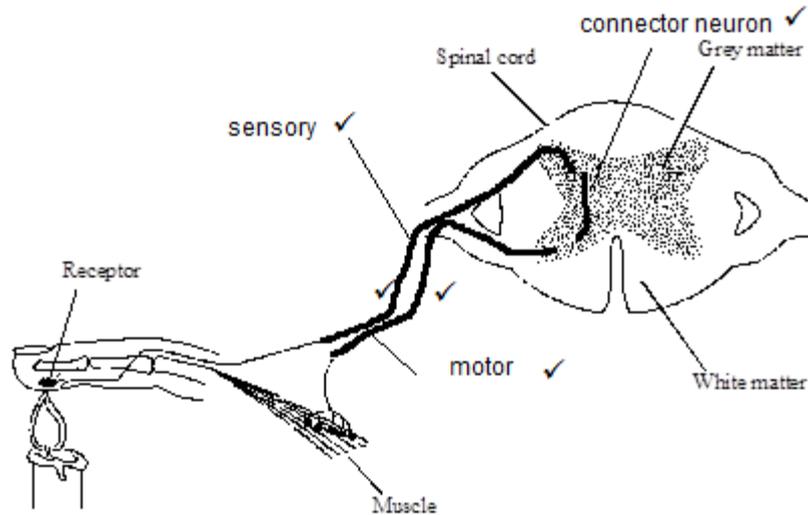
Question 3

- 3.1 C✓
3.2 A✓
3.3 B✓

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Question 4

4.1



4.2 Neurotransmitters✓ are only released at the one end of the neuron – the axon✓ so can only go from axon to dendrite✓ (2)

Question 5

- 5.1 Longitudinal (1)
- 5.2 Can see from cerebrum to medulla, cut through longest part of structure. (any 1)
- 5.3 A – cerebrum B – cerebellum C – medulla / spinal cord (3)
- 5.4 Cerebellum coordinates movements✓ and controls balance✓. Therefore coordinated all impulses to allow smooth controlled movement. ✓ (2)
- 5.5 Controls autonomic functions✓, and reflexes e.g. heart rate✓ – therefore critical things for survival✓. Damage to spinal cord so therefore die✓, as no impulses can travel between CNS and body✓. (3)