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LIFE SCIENCES

Support Document

for COVID 19 lockdown

Nervous Co-ordination

GRADE 12

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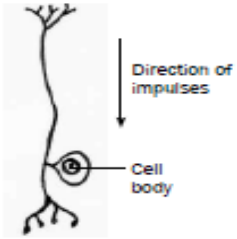
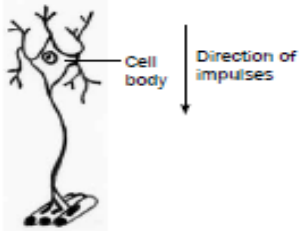
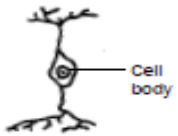
NERVOUS CO-ORDINATION

TABLE OF CONTENTS

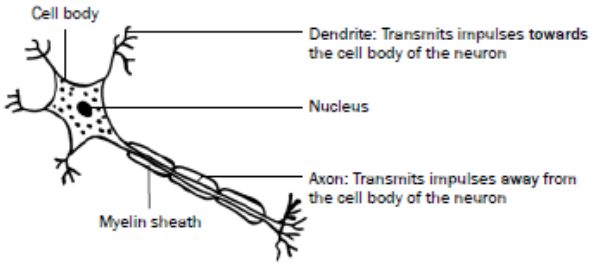
NERVOUS CO-ORDINATION

1. Neurons

1.1 Types of neurons and their functions

Type of neuron	Function	Structure
Sensory (afferent) neuron **Senses the stimulus**	Transmits impulses from the sense organs or receptors to the spinal cord and brain.	 *Figure 6.3 Sensory neuron*
Motor (efferent) neuron **Response to the stimulus**	Transmits impulses from the brain and spinal cord to the effectors (muscles and glands). The effectors bring about the response.	 *Figure 6.4 Motor neuron*
Interneuron (connector) **Found in the brain and spinal cord**	Links the sensory neuron to the motor neuron.	 *Figure 6.5 Interneuron*

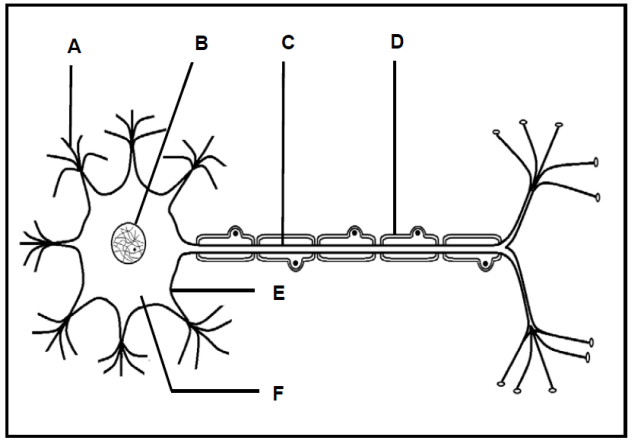
1.2 Structure of a neuron



1.3 Questions

Question 1

Study the diagram below.



1.1 Name the type of neuron in the diagram above. (1)

1.2 Identify part:

(a) **B** (1)

(b) **F** (1)

(c) **A** (1)

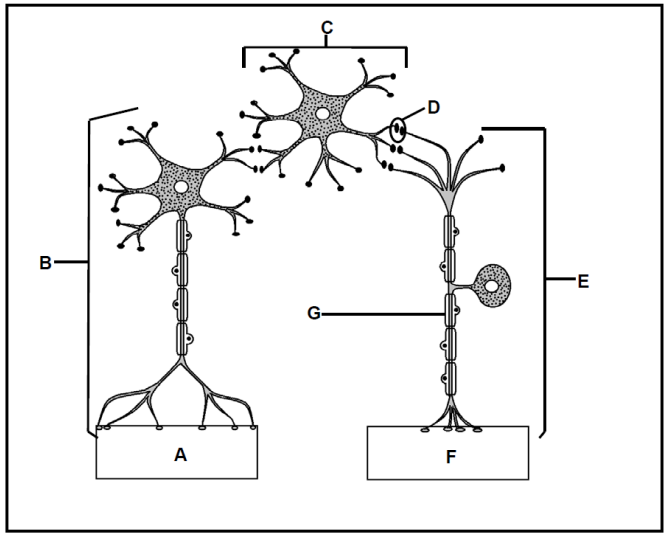
1.3 Give the LETTER and NAME of the part that:

(a) Transmits impulses away from the cell body (2)

(b) Insulates and speeds up the transmission of impulses (2)

1.4 Name the condition caused by the progressive degradation of part **D**. (1)
(9)

Question 2



2.1 Identify the type of neuron represented by:

(a) **B** (1)

(b) **C** (1)

(c) **E** (1)

2.2 Give the LETTER only of the part that represents the:

(a) Receptor (1)

(b) Effector (1)

2.3 Give the LETTER and NAME of the:

(a) Region where the impulse is transmitted chemically (2)

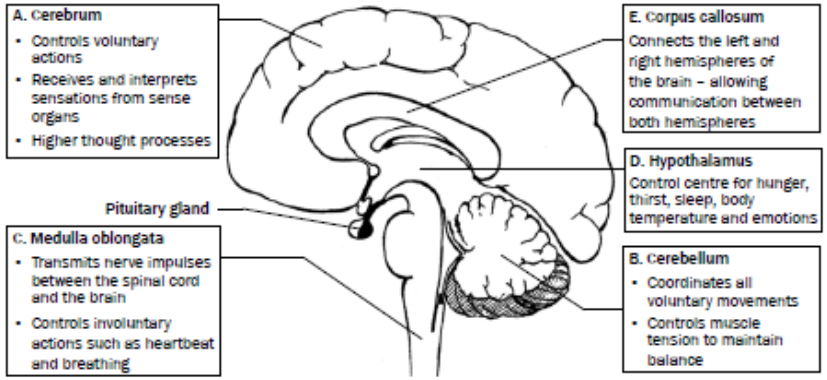
(b) Part that has an insulating function (2)

Question 3

Make a fully labelled diagram of a sensory neuron. (5)

2. Brain

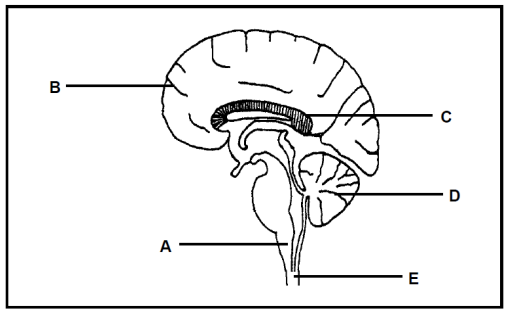
2.1 Parts and Functions



2.2 Questions

Question 1

Study the diagram below.



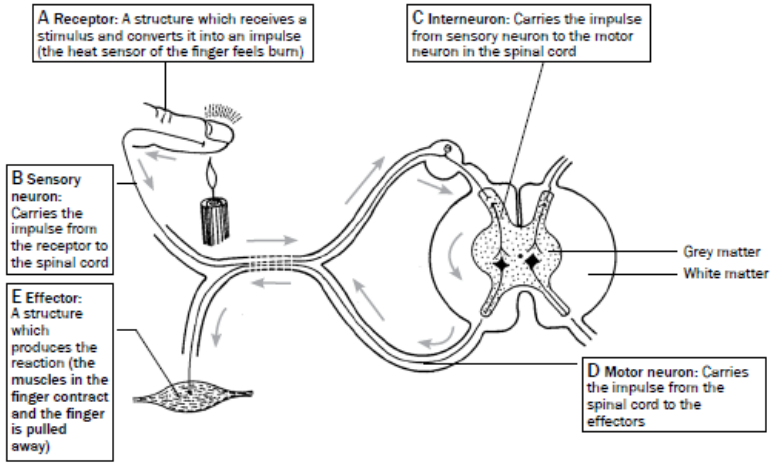
1.1 Identify parts **A**, **B**, **C**, **D** and **E**. (5)

1.2 Give the LETTER only of the part that:

1.2.1 Is not a part of the brain
1.2.2 Receives impulses from all sense organs
1.2.3 Co-ordinates balance
1.2.4 Is responsible for reflex actions
1.2.5 Controls breathing
1.2.6 Controls all voluntary actions
1.2.7 Connects the two hemispheres of the cerebrum
1.2.8 Co-ordinates voluntary movements
1.2.9 Is responsible for memory, intelligence and judgement
1.2.10 Controls heartbeat (10)

3. Spinal Cord

3.1 Parts and Functions



3.2 Reflex Action

A reflex action is a rapid automatic response to a stimulus received by a sense organ.

A reflex arc is the path taken by an impulse during a reflex action.

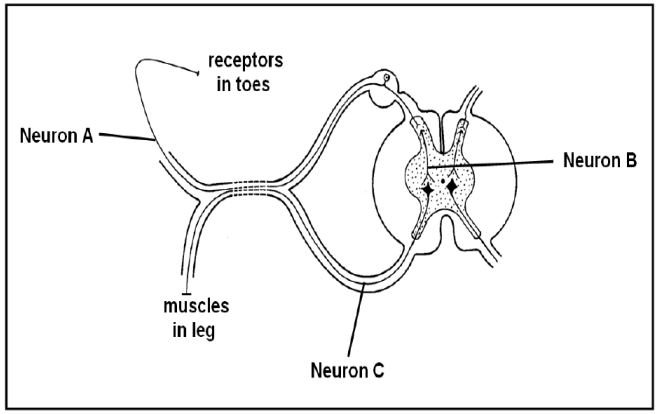
Example of a reflex action: accidentally placing one's hand on a hot object.

- Heat receptors in the skin receive the stimulus of heat
- and convert the stimulus into an impulse
- which is then transmitted by a sensory neuron
- into the spinal cord through the dorsal root of the spinal nerve
- Here the sensory neuron makes synaptic contact with the interneuron
- The interneuron makes a further synaptic contact with the motor neuron
- The motor neuron transmits the impulse
- through the ventral root of the spinal nerve
- to the effectors/muscles
- which contract, causing the hand to be pulled away.

3.3 Questions

Question 1

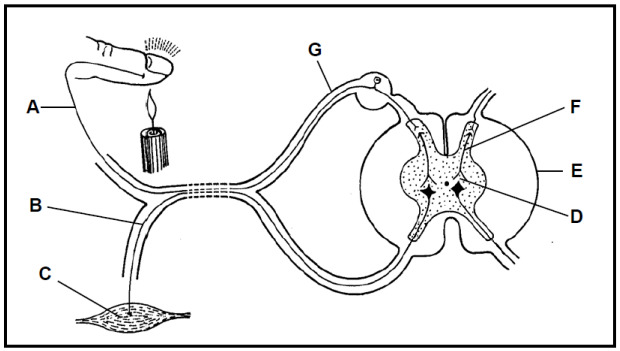
Study the diagram below.



Copy and complete the following table in your book:

Parts on the diagram	Label	Function
Toes	Receptor	
Neuron A		
Neuron B		
Neuron C		
Muscle in leg	Effector	

Question 2



2.1 Give labels for each of the following:

(a) **C**

(b) Microscopic gap **D**

(c) **E**

(d) **F**

(e) **G** (5)

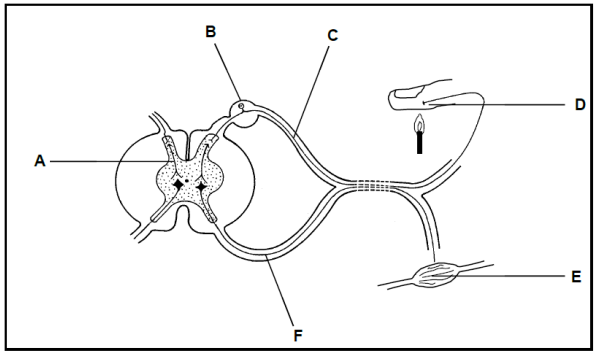
2.2 Explain ONE consequence for the body if **A** is damaged. (2)

2.3 Give TWO examples of reflex actions. (2)

2.4 Draw a labelled diagram of neuron **B** to show its structure. (5)
(14)

Question 3

Study the diagram below.



3.1 Identify parts **A**, **C** and **D**. (3)

3.2 Give the LETTER only of the part that:
3.2.1 Transmits impulses through a synapse to the motor neuron
3.2.2 Contains the cell body of the sensory neuron
3.2.3 Receives the stimulus and converts it into an impulse
3.2.4 Brings about a response to the stimulus
3.2.5 Transmits the impulse from the receptor into the spinal cord

3.3 Which neuron is possibly damaged if:
3.3.1 A person cannot feel pain caused by a stimulus (1)
3.3.2 A person can feel the pain but cannot respond to the stimulus (1)

3.4. State if the impulse travels from D → E or E → D? (1)

Question 4

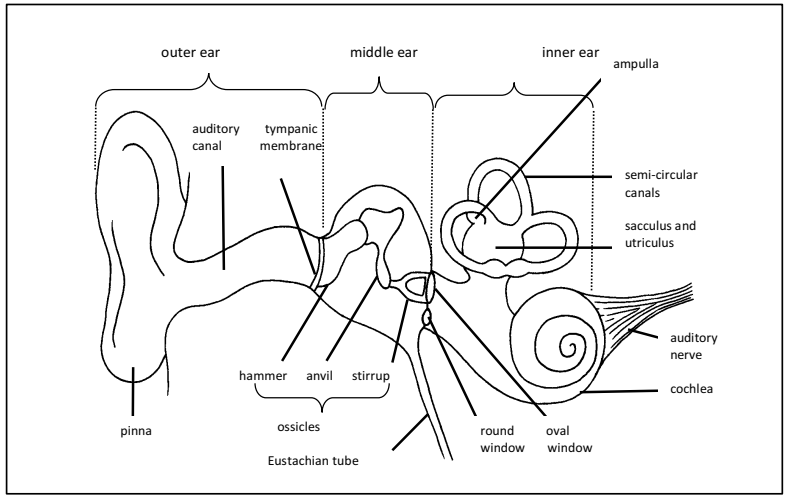
Write down the correct biological term for each of the following:

4.1 Neuron that transmits impulses from the sense organs to the central nervous system
4.2 Neuron that transmits impulses from the central nervous system to the effectors
4.3 Structures in sense organs that receive stimuli and convert them into nerve impulses
4.4 Structures such as muscles or glands that bring about a response to a stimulus
4.5 A part of the neuron that conducts impulses towards the cell body
4.6 A part of the neuron that conducts impulses away from the cell body
4.7 Part that insulates a neuron, speeding up the transmission of an impulse
4.8 Rapid automatic response to a stimulus
4.9 Paths taken by an impulse during a reflex action
4.10 A collective name for the membranes that protect the brain
4.11 Part of the nervous system made up of cranial and spinal nerves
4.12 Part of the nervous system made of the brain and spinal cord (12)

4. Ear

The ear play a role in hearing and in maintaining balance

4.1 Parts and Functions of the Ear



Part	Function
Pinna	traps sound waves and directs it towards the auditory canal
Auditory canal	directs sound waves towards the tympanic membrane
Tympanic membrane	vibrates, passing vibrations into the middle ear
Eustachian tube	maintains equal pressure on either side of the tympanic membrane allowing it to vibrate
Ossicles	vibrate, passing vibrations towards the oval window
Oval window	vibrates, passing vibrations into the inner ear
Cochlea	contains the organ of Corti which converts the sound stimulus into a nerve impulse
Auditory Nerve	transmits impulse to the brain for interpretation
Semi-circular canals	contain receptors called cristae which are sensitive to changes in speed and direction of movement
Sacculus and utriculus	contain receptors called maculae which are sensitive to changes in the position of the body
Round window	eases pressure out of the inner ear into the Eustachian tube to prevent distortion of sound

4.2 Hearing

- The pinna traps sound waves and directs it towards the auditory canal
- The auditory canal directs the sound waves towards the tympanic membrane
- The tympanic membrane vibrates, passing sound vibrations into the middle ear
- This causes the ossicles to vibrate, passing sound vibrations towards the oval window
- The oval window thus vibrates, passing sound vibrations into the inner ear
- These sound vibrations form pressure waves in the endolymph of the cochlea
- These pressure waves stimulate the organ of Corti
- which converts the sound stimulus into a nerve impulse
- The auditory nerve transmits the nerve impulse to the cerebrum
- where the impulse is interpreted
- The round window eases pressure out of the inner ear to prevent distortion of sound

4.3 Balance

- When there is a change in speed and direction of movement
- receptors called cristae
- in the ampullae of the semi-circular canals are stimulated

- When there is a change in the position of the body
- receptors called maculae
- in the sacculus and utriculus are stimulated

- The cristae and maculae convert the stimuli into impulses
- Impulses are then transmitted by the auditory nerve to the cerebellum
- where the impulses are interpreted
- If there is imbalance, impulses are then sent to the muscles to restore balance

4.4 Defects

Middle ear infections

- Caused by viruses and bacteria. Fluid accumulates in the middle ear.
- Grommets are inserted into the tympanic membrane. The grommets allow the middle ear to be ventilated allowing accumulated fluid to pass down and out of the Eustachian tube.

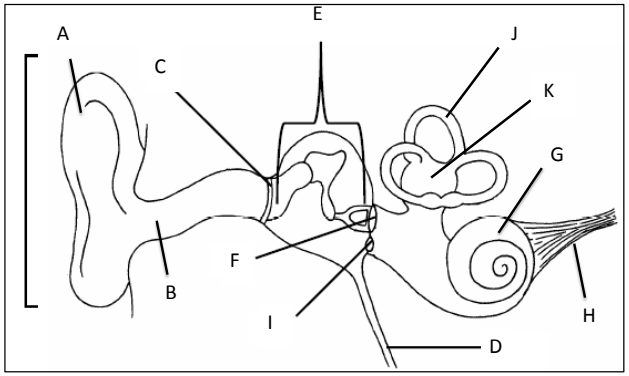
Deafness

- Hearing aids help to amplify the sound
- Cochlear implants stimulate any functioning auditory nerves in the cochlea

4.5 Questions

Question 1

Study the diagram and answer the questions set.



1.1 Identify parts **A**, **B**, **E**, **F** and **I**. (5)

1.2 Give the LETTER and NAME of the part that contains:

1.2.1 Cristae
1.2.2 Maculae
1.2.3 The organ of Corti 3 x 2 (6)

1.3 State the function of part:

1.3.1 **C**
1.3.2 **D**
1.3.3 **H** (3)

1.4 Name the receptors that are stimulated by:

1.4.1 Changes in speed and direction
1.4.2 Pressure waves caused by sound vibrations
1.4.3 Changes in the position of the body (3)

1.5 Which part of the brain receives impulses from part:

1.5.1 **J and K**
1.5.2 **G** (2)

Question 2

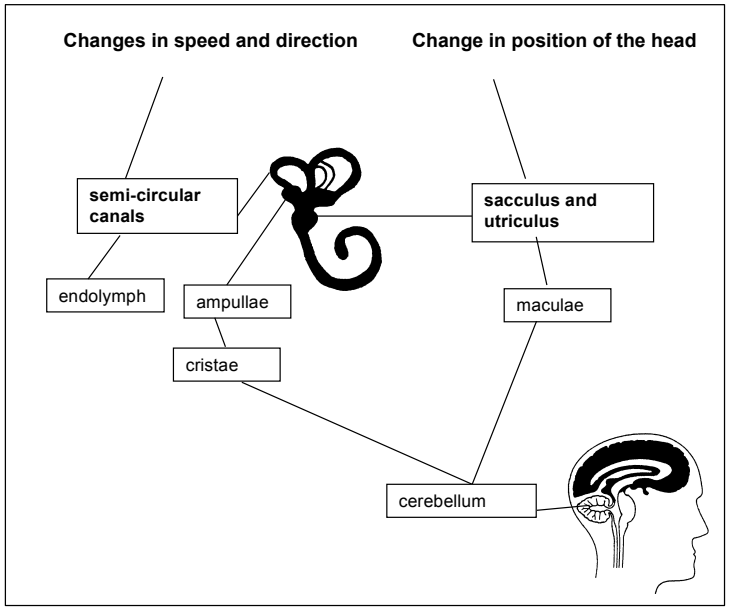
Study the flow diagram below.

Pinna → auditory canal → tympanic membrane → ossicles → oval window → cochlea → auditory nerve → cerebrum

Use the flow diagram above to assist you in writing an account on how hearing takes place. (10)

Question 3

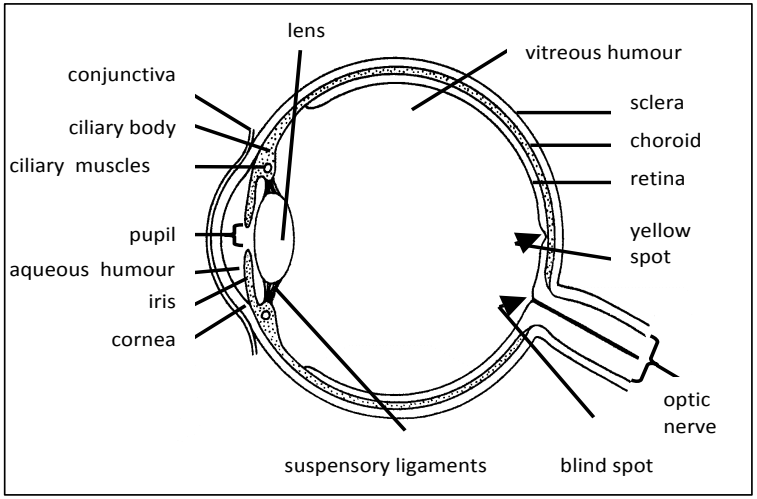
Study the flow diagram below.



Use the information in the flow diagram to write an account of the role of the ear in balance. (7)

5. Eye

5.1 Parts and Functions

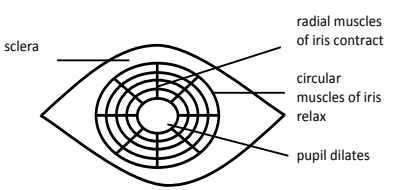
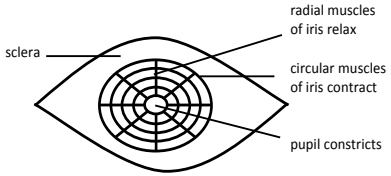


Part	Function
Sclera	- Protects the inner structures - Maintains the round shape of the eye
Cornea	- Permits entry of light into the eye - Refracts light rays to focus them on the retina
Choroid	- Contains a pigment that prevents the reflection of light within the eye by absorbing light rays - Contains blood vessels to supply nutrition to the eye
Retina	- Contains photoreceptors (rods and cones) that receive the stimulus of light and convert it into an impulse
Ciliary muscles	- Changes the shape/convexity of the lens
Suspensory ligaments	- Holds the lens in position
Iris	- Has radial and circular muscles, which control the diameter of the pupil
Pupil	- Controls the amount of light entering the eye
Aqueous humour	- It maintains the shape of the cornea - It supplies the lens and cornea with food and oxygen - It plays a minor role in the refraction of light
Vitreous humour	- It maintains the shape of the eyeball - It plays a minor role in the refraction of light
Optic nerve	- Transmits impulses from the retina to the cerebrum
Blind spot	- Area on the retina where no image forms due to the absence of photoreceptors
Yellow spot	- Area on the retina where the clearest image forms due to the high concentration of photoreceptors
Lens	- Refracts light rays to focus them on the retina

5.2 Pupillary mechanism

Pupillary mechanism

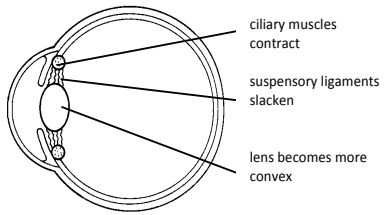
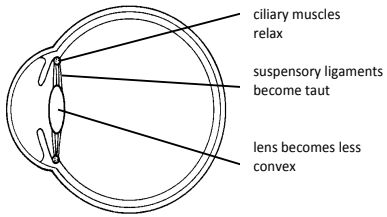
The pupillary mechanism refers to the process by which the diameter of the pupil is altered so as to control the amount of light entering the eye.

In dim light	In bright light
▫ The radial muscles of the iris contract ▫ The circular muscles relax ▫ The pupil dilates ▫ The amount of light entering the eye is increased	▫ The circular muscles of the iris contract ▫ The radial muscles relax ▫ The pupil constricts ▫ The amount of light entering the eye is reduced
	

5.3 Accommodation

Accommodation

Accommodation refers to the ability of the eye to alter the convexity (shape) of the lens to ensure that a clear image always fails on the retina whether the object is near or distant.

For near vision (object less than 6 metres away)	For distant vision (object more than 6 metres away)
▫ The ciliary muscles contract ▫ The suspensory ligaments become slack ▫ The tension on the lens decreases ▫ The lens becomes more convex ▫ The refractive power of the lens is increased ▫ A clear image of the near object is now formed on the retina	▫ Ciliary muscles relax ▫ Suspensory ligaments become taut ▫ Tension on the lens capsule increases ▫ The lens becomes flattened (less convex) ▫ The refractive power of the lens is decreased ▫ A clear image of the distant object is now formed on the retina
	

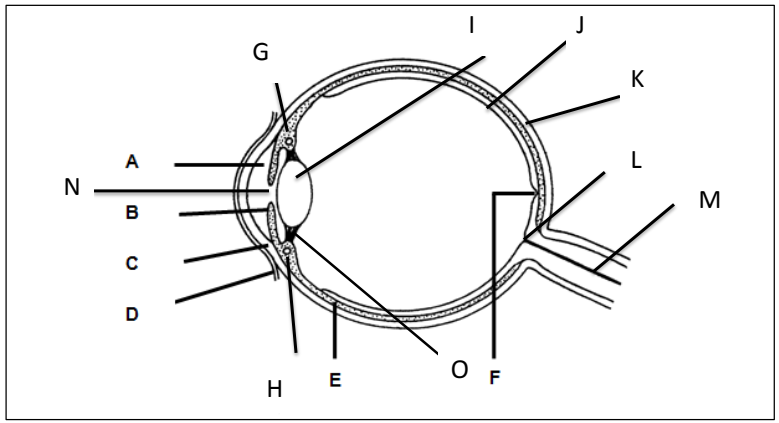
5.4 Defects

Defect	Characteristic	Treatment
Cataracts	Lens becomes cloudy and opaque making it difficult to see	Removal of lens by surgery and replacing it with a synthetic lens
Astigmatism	Uneven surface of cornea leading to blurred vision	Prescription lenses
Long-sightedness (Hypermetropia)	Able to see distant objects clearly but close objects are unclear	Convex lenses
Short-sightedness (Myopia)	Able to see close objects clearly but distant objects are unclear	Concave lenses

5.5 Questions

Question 1

Study the diagram and answer the questions set.



1.1 Identify parts **A**, **C**, **D**, **G** and **K.** (5)

1.2 Give the LETTER and NAME of the part that:

1.2.1 Contains a pigment to prevent internal reflection in the eye
1.2.2 Has no photoreceptors
1.2.3 Contains sensory neurons
1.2.4 Regulates the diameter of part **N**
1.2.5 Has the highest number of photoreceptors 5 x 2 (10)

1.3 State the function of part:

1.3.1 **I**
1.3.2 **M**
1.3.3 **H** (3)

1.4 Write down the LETTER and NAME of:

1.4.1 TWO parts that are involved in the pupillary mechanism 2 x 2 (4)
1.4.2 THREE parts that are involved in accommodation 3 x 2 (6)
1.4.3 The part that is affected by cataracts (2)
1.4.4 The part that is affected by astigmatism (2)

Question 2

Write an account on changes that occur in the eye:

a. To adjust for vision in bright light (4)

b. To adjust for distant vision (4)

Question 3

Study the following essay question:

A goalkeeper in a soccer match prevented a goal from being scored when he dived to his right after the ball was kicked towards him. Just before he dived, he heard his team-mate shout, 'your ball'.

Describe how his eyes adjusted to see the ball as it travelled towards him and describe how he heard his team-mate and maintained his balance as he dived to save the ball.

Content: **(17)**
Synthesis: **(3)**

NOTE: NO marks will be awarded for answers in the form of flow charts, diagrams or tables.

a. Develop a plan for the above essay.

b. Now write out the answer to the essay.