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# SIMPLIFIED FORM 4 BIOLOGY NOTES

QUESTIONS AND ANSWERS

**1. a) i) Define the term genetics**

- the study of heredity (inheritance) and variation or study of mechanisms by which characteristics are passed from parents to offspring

**iii) List some characteristics which are inherited**

- size
- height/length
- colour/type
- shape
- yield

**iii) State the importance of genetics**

- helps to explain differences between organisms of the same species
- helps to explain the transmission of characters from generation to generation
- improvement in livestock
- improvement in crops
- can be used to treat some difficult diseases

**b) i) Explain the meaning of the following terms**

**Heredity**

- the resemblance among individuals related by descent
- transmission of traits from parents to offspring

**Trait**

- also called character
- A character of the organism e.g. type of ear, colour of eyes, height, yield etc.

**Gene**

- unit of inheritance
- it is the heredity factor which transmits traits from parents to offspring
- genes are located at fixed points on chromosomes
- each point is called a locus (loci)

**Allele**

- genes can exist in a series of alternative forms at a particular locus
- allele refers to alternative forms of genes controlling a particular characteristic

**Chromosomes**

- threadlike structures found in nuclei of all plants and animals
- they carry genes which are hereditary materials
- they consist of substances called DNA and proteins called histones

**DNA**

- deoxyribonucleic acid
- substances that make up chromosomes
- double helix (strand) molecule that contains genes
- DNA consists of nucleotides
- A nucleotide consists of an inorganic phosphate, ribose sugar and a base
- There are four bases in a DNA molecule i.e. Adenine (A), guanine (G), thymine (T) and cytosine (C)

- Ribose sugar has four bases attached to it i.e. adenine, cytosine, guanine and thymine
- Adenine pairs with thymine while guanine pairs with cytosine
- Nucleotide initiates and controls protein synthesis

**ii) List the types of chromosomes**

- somatic (body) chromosomes also called autosomes
- sex chromosomes (related to reproduction)

**c) i) What is variation?**

- sequence of differences occurring among individuals of the same species

**ii) State the causes of variation in organisms**

- random assortment of genes during meiosis
- crossing over
- fertilization
- doubling of chromosome numbers (mutation)
- environmental conditions

**iii) Name the types of variation**

- Continuous variation (differences not clear cut) e.g. height, length, weight, skin colour, intelligence etc. They are quantitative and show intermediates
- discontinuous variation (differences are clear cut) e.g. ability to roll tongue, ABO blood grouping system, RH factor, patterns of fingerprints, and ability to taste PTC. They are qualitative and have no intermediates

**iv) Explain the following terms**

**Acquired characteristics**

- they are as a result of adaptations due to the environment and are not inherited

**Inherited characteristics**

- are passed down to offspring during sexual reproduction

**Genotype**

- genetic constitution of an individual/genetic makeup

**Phenotype**

- characteristics of an individual observed or discernible by other means i.e. observable character

**Dominant gene (character)**

- expressed in the phenotype when homozygous or heterozygous

**Recessive gene**

- only expressed in homozygous state

**Homozygous**

- when two alleles are identical e.g. LL, ll

**Heterozygous**

- when two alleles are different at a particular locus e.g. Ll

**F1 and F2**

- F1 means first filial generation i.e. the first generation produced when two varieties can be crossed
- F2 means second generation i.e. product of offspring or from F1 generation

**d) i) Explain Mendel's first law of inheritance**

- also called law of segregation

- it states that genes are responsible for the development of individual characters
- these characters are transmitted individually without any alterations
- Only one character from a contrasting pair can be carried in a gamete, hence only one character can be inherited.

**ii) Give an example of this law**

- In an experiment, *Drosophila* (fruit fly) with long wings were crossed with those having short wings. Assume letter L denotes gene for wing size. The gene for long wings is dominant to that for short wings
- the genes for dominant are LL and for recessive ll.
- State the expected results for the first cross

**iii) What is monohybrid inheritance?**

- when inheritance of one character is studied one at a time e.g. wing size only
- the F<sub>2</sub> generation (when selfed) always gives a phenotypic ratio of 3:1 and a genotypic ratio of 1:2:1 in a complete dominance

**i) What is complete dominance?**

- refers to where only one dominant character is expressed while the other character which is recessive is not expressed in the heterozygous state e.g. the case of wing size above

**e) i) What is meant by co dominance?**

- When genes produce independent effects when heterozygous/none of the genes is dominant over the other/where two or more alleles does not show complete dominance/recessiveness due to the failure of any allele to be dominate in a heterozygous condition.

**ii) Give an example of co dominance**

In a certain plant species, some individual plants may have only white, red or pink flowers. In an experiment a plant with white flowers was crossed with a parent with red flowers. Show results of F<sub>1</sub> generation. Use letter R for red gene and W for white gene.

**If the plants from F<sub>1</sub> were selfed, work out the phenotype ratio for the F<sub>2</sub> generation**

Phenotypic ratio 1red:2pink:1white

Genotypic ratio 1:2:1

**f) i) What is a test cross?**

- A cross between an individual showing a character for a dominant gene(that is homozygous or heterozygous) with a homozygous recessive individual

**OR**

- a cross between individual(organism) of unknown genotype with a homozygous recessive individual

**ii) State the importance of a test cross in genetics**

- helps in determining the genetic constitution/genotype of an organism

**iii) What are multiple alleles?**

- a set of more than two alleles that may determine a character

- example is blood group which can be determined by any two of three alleles i.e. A,B and O

**iv) Explain the inheritance of ABO blood groups**

- in humans blood groups are determined by three alleles i.e. A,B and O
- it is only possible to have two genes at a time
- genes A and B are co-dominant while gene O is recessive to genes A and B

**Give a worked example using parents with heterozygous blood groups AO and BO**

**ii) Explain the inheritance of Rhesus factor (Rh) in human beings**

- in humans blood is either Rh positive or Rh negative
- people who have Rh antigen are Rh(+ve) while those without Rh antigen in their blood are Rh(-ve)
- Rh(+ve) is due to a dominant gene while the recessive gene causes lack of Rh factor. When a person who is homozygous dominant marries a person who is homozygous recessive the result is as shown below

Let the gene for dominant Rh factor be R while gene for recessive be r

**iii) How is sex determined in human beings?**

- there are two sex chromosomes in humans, x and y
- males are xy and females are xx
- in females all ova have x chromosome
- in males 50% of sperms contain x chromosomes while 50% of sperms contain y chromosome
- when a sperm containing x chromosome fuses with an ovum this results into a girl
- when a sperm containing y chromosome fuses with an ovum the result is a boy
- an example is given below

**i) What does the term linkage mean?**

- These are genes which occur together on a chromosome and are passed to offspring without being separated

**ii) Define the term sex-linked genes**

- genes carried in the sex chromosome that are transmitted along with genes that determine sex

**iii) What is meant by the term sex linkage?**

- genes are located on the sex chromosome
- they are transmitted along with those that determine sex

**iv) Name the sex-linked traits in humans**

- colour blindness
- haemophilia
- Hairy ears. pinna, nose
- Baldness
- Duchene muscular dystrophy (DMD) muscular wasting

v) Give an example of a sex linked trait in humans on:

**Y Chromosome**

- tuft of hair sprouting from pinna/baldness

**X Chromosome**

- colour blindness/haemophilia

vi) In humans red-green colour blindness is caused by a recessive gene C, which is sex-linked. A normal man married to a carrier woman transmits the trait to his children. Show the possible genotypes of the children.

Let C represent the gene for normal colour vision (dominant)

Let c represent the gene for colour blindness

Parental phenotype Norman man x carrier woman

iv) State the importance of sex linkage

- possible to determine sex of day old chicks

v) Haemophilia is due to a recessive gene. The gene is sex-linked and located on the x chromosome. The figure below shows sworn offspring from phenotypically normal parents

What are the parental genotypes?

- XY and X<sup>h</sup>X

Work out the genotypes of the offspring

h) i) What is mutation?

- sudden change in the structure of DNA at a particular locus/chromosome/gene

ii) Describe how mutations arise

- mutations arise due to alterations in normal number of chromosomes
- change in a portion of a chromosome affecting one or more genes
- by chromosomal aberration e.g. deletion/duplication/substitution/inversion/translocation/crossing over
- caused by mutagenic agents e.g. radiation (x-rays, ultra violet light, gamma rays) and chemicals e.g. mustard gas/colchicines

iii) State the factors that may cause mutation

- these are chemicals and radiations

**Radiations**

X-rays

Ultra violet rays

**Effects**

gene/chromosome alteration

structural distortion of DNA

**Chemicals**

- colchicines

Cyclamate

Mustard gas

Nitrous acid

**Effect**

prevents spindle formation

chromosome aberrations

chromosomes aberrations

adenine in DNA is deaminated so behaves like guanine

Acridone orange  
Formaldehyde

addition and removal of bases of DNA

**iv) State the characteristics of mutations**

- arise suddenly
- are unpredictable
- random
- generally rare
- may breed true
- some are desirable while others are lethal

**v) Explain chromosomal mutation**

- Change in nature, structure or number of chromosomes

**vi) Explain how the following types of chromosomal mutations occur**

**Duplication**

- a section of a chromosome is repeated/replicates
- therefore genes are repeated

**Inversion**

- occurs when chromatids break at 2 places and when rejoining the middle piece rotates and joins in an inverted position

**Deletion**

- portion of a chromosome is left out after it breaks off
- alters number and sequence of genes

**Translocation**

- occurs when a section of a chromatid breaks off and becomes attached to another chromatid of another chromosome

**Non-disjunction**

Failure of homologous chromosomes/sister chromatids to separate/segregate during meiosis

**Polyplody**

- where number of chromosomes double or triple
- beneficial in plants due to the following
- increased yields/hybrid vigour//heterosis
- resistance to pests
- early maturity
- resistance to drought
- resistance to diseases

**vii) What are gene mutations?**

- an alteration in the structure of a gene
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**i) Explain how the following occur during gene mutation**

**Deletion**

- some bases/nucleotides of a gene are removed

**Inversion**

- the order of some bases/nucleotides of a gene is reversed

**Insertion**

- addition of a base between two existing bases

**Substitution**

- a portion of a gene is replaced by a new portion

**ii) Name the disorders in humans caused by gene mutation**

- albinism
- sickle cell anaemia
- achondroplasia/chondrodystrophic dwarfism
- haemophilia
- colour blindness
- phenylketonuria

**I. State the practical applications of genetics**

**i. Breeding programmes (research)**

- high yielding/hybrid vigour/heterosis
- resistance to diseases
- resistance to drought/salinity
- early maturing

**ii. Genetic engineering**

- genetic manipulation to produce desired characteristics

**iii. Law**

- legal questions of paternity knowledge of blood groups or blood transfusion

**iv) Genetic counseling**

- aimed at reducing harmful traits e.g. albinism, congenital idiots, colour blindness e.t.c

**v) Others**

- Pre-sex determination

Understanding human evolution and origin of other species.

**2. a) i) Explain the meaning of evolution**

- a gradual change in living organisms from simple life forms to more complex forms over a long period of time.

**ii) Differentiate organic evolution from chemical evolution as theories of origin of life**



- organic evolution refers to the emergence of present forms of organisms gradually from pre-existing forms (some of which no longer exist)
- chemical evolution explains the origin of life as having occurred when simple chemical compounds reacted to form the simplest life forms

### iii) What is special creation?

- maintains that the whole universe and all living organisms came into being due to the act of a supernatural being

## b) Discuss the various kinds of evidence for evolution

### i) Fossils

- fossils are remains of organisms preserved in naturally occurring materials for many years
- they give evidence of types of plants/animals that existed at certain geological age/long ago/millions of years ago
- gives evidence of morphological/anatomical/structural changes that have taken place over a long period of time e.g. human skull, leg of horse

### ii) Comparative anatomy

- gives evidence of relationship among organisms/gives evidence of a common ancestry of a group of organisms
- organisms have similar structures/organs performing the same function e.g. digestive system/ urinary system/nervous system/vestigial structures and vertebrate heart
- Divergence where the basic structural form is modified to serve different functions e.g. vertebrate forelimb/beak structure in birds/birds feet/parts of a flower. These are called homologous structures
- homologous structures have a common embryonic origin but are modified to perform different functions e.g. the pentadactyl limb
- adaptive radiation is a situation where organism have a homologous structure with common embryonic origin which is modified to perform different functions to adapt organisms to different ecological niches/habitats e.g. beaks of Darwinian finches(birds)
- Convergence is where different structures are modified to perform a similar function e.g. wings of birds and insects/eyes of humans and octopuses. These are called analogous structures
- Vestigial structures are greatly reduced in size and have ceased to function e.g. human appendix/caecium/coccyx in humans, wings of kiwi (flightless bird), presence of hind limb pad in python, halteres in insects, human hair nictitating membrane in human eye, human ear muscle, pelvic girdle in whale and third digit of wing of bird.

### iii) Comparative embryology

- some embryos of different animals appear very similar thus showing relationship and possibility of a common ancestry
- e.g. different classes of vertebrates larvae of annelida and mollusca are similar (tocophere)

**iv) Comparative serology/physiology**

- these show biochemical and immunological comparisons of blood groups/components to show immunological similarities of tissues therefore showing relatedness of different organisms
- e.g. antigen antibody reactions, human blood groups/Rh factor reveal some phylogenic relationship among organisms/common ancestry

**v) Geographical distribution**

- organisms differ in various geographical regions
- present continents are thought to have been a large land mass joined together/pangea/Eurasia/Gondwanaland
- present continents drifted apart from one land mass/continental drift
- as a result of continental drift isolation of organisms occurred bring about different patterns of evolution
- organisms in each continent evolved along different lines hence emergence of new species/divergence/convergence

**Examples**

- marsupials in Australia
- llama, jaguar, panther in S. America
- lion, camel in Africa
- tiger in Asia

**vi) Cell biology (cytology)**

- structures and functioning of cells are similar
- occurrence of organelles e.g. mitochondria in all cells/both plant and animal cells
- these point at a common ancestry

**c) i) State the evolutionary characteristics that adopt human beings to the environment**

- Brain
- Eyes
- Upright posture/bipedal locomotion
- prehensile arm/hand
- Speech

**ii) State the ways in which Homo sapiens differs from Homo habilis**

- standing upright/erect posture
- intellectual capacity/higher thinking capacity/bigger brain/higher brain capacity
- communication through language/speech

**d) i) Explain Larmarck's theory of evolution**

- Inheritance of acquired characteristics/environment induces production of a favorable trait which is then inherited

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**ii) Explain why Lamarck's theory of evolution is not accepted by biologists today**

- evidence does not support Lamarck's theory

- acquired characteristics are not inherited/inherited characteristics are found in reproductive cells only

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### **iii) Explain Darwin's theory of evolution**

- inheritance of genetically acquired characteristics
- a character happens to appear spontaneously which gives advantage to an organism therefore adapted then inherited through natural selection

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### **e) i) What is natural selection?**

- Organisms with certain characteristics are favoured by the environment

Such organisms tend to survive and produce viable offspring

Others not favored are eliminated from subsequent generations

### **ii) With examples, explain how natural selection takes place**

- organism with certain characteristics are favored by their environment
- such organisms tend to survive and produce viable offspring
- others not favored are eliminated from subsequent generations
- as the environmental conditions change the survival value of a character may alter with time so that characteristics which were favored may no longer have advantage and other characters may then become favorable
- if a favorable character is inherited, then offspring produce generations which are better adapted to survive in a population
- more offspring are produced than can survive which results in struggle for survival
- the fittest survive

### **iii) State the advantages of natural selection to organisms**

- assist to eliminate disadvantageous characteristics/perpetuates advantageous characteristics
- allows better adapted organisms to survive adverse changes in the environment/less adapted organisms are eliminated

### **iv) State the ways in which sexual reproduction is important in the evolution of plants and animals**

- brings about useful variations/desirable characters
- variations make offspring better adapted for survival/more resistant to diseases
- may lead to origin of new species

### **v) Explain the significance of mutation in evolution**

- Mutation bring about variation which can be inherited
- Some of these variations are advantageous to the organism
- Others are disadvantageous
- The advantageous variations favour the organism to compete better in the struggle for survival
- This results into a more adapted organism to its environment or new species/varieties
- Those with disadvantageous characters will be discriminated against therefore eliminated from the population/death/perish

### **vi) Plain why it is only mutations in genes of gametes that influence evolution**

- gametes form the new offspring

**vii) How would you prove that evolution is still taking place?**

- resistance of organism to antibiotics, pesticides and drugs
- new varieties of bacteria are resistant to certain antibiotics such as penicillin
- houseflies and mosquitoes are resistant to DDT

**vii) Explain why some bacteria develop resistance to a drug after they have been subjected to it for some time**

- bacteria mutate/develops a new strain/chemical composition is altered hence is able to produce enzymes/chemicals which degrade the drug rendering it non-susceptible to the drug
- the new strain is favoured by selection pressure/ natural selection

**f) How has industrial melaninism i.e. peppered moth contributed towards the mechanism of evolution**

- This is an example of natural selection
- The peppered moth exists in two distinct forms, the speckled white form (normal form) and a melanic form (the black/dark)
- They usually rest on leaves and barks of trees that offer camouflage for protection
- Originally the “speckled white” form predominated the unpolluted area of England
- This colouration offered protection against predatory birds
- Due to industrial pollution tree barks have blackened with soot
- The white form underwent mutation
- A black variety/mutant emerged suddenly by mutation
- It had selective advantage over the white forms that were predated upon in the industrial areas
- The speckled white form is abundant in areas without soot/smoke

**3. a) i) Define irritability, stimulus and response irritability**

- also called sensitivity
- Responsiveness to change in environment

**Stimulus**

A change in the environment of organism which causes change in organism's activity

**Response**

- change in activity of an organism caused by a stimulus

**ii) State importance of irritability to living organisms**

- Adjusting to environmental conditions. Sensitive/defect/responding

**iii) List the examples of external stimuli to organisms**

- air/oxygen (aero)
- light(photo)
- osmotic pressure (osmo)

- current (Rheo)
- chemical concentration (chemo)
- \water/moisture (hydro)
- Touch/contact (hapto/thigmo)
- Gravity/soil (geo)
- Temperature (thermo)
- 

**b) i) What are tactic responses?**

- response in which whole organism or its motile parts move e.g. gamete

**ii) What causes tactic responses?**

- caused by unidirectional stimulus
- usually doesn't involve growth
- response is either positive or negative
- named according to source of stimulus
- e.g phototaxis, aerotaxis, chemotaxis

**iii) State the importance of tactic response to:**

**Members of kingdom protista**

- move towards favorable environment/move away from unfavorable environment
- move towards their prey/food

**Microscopic plants**

- escape injurious stimuli/seek favorable habitats

**iv) Name the type of response exhibited by:**

Euglena when they swim towards the source of light

- phototaxis
- sperms when they swim towards the ovum
- chemotaxis

**v) State the advantages of tactic responses to organisms**

- to avoid unfavorable environment/injurious stimuli
- escape from predators
- to seek favorable environment
- to seek for food/prey

**c) i) Define the term tropism**

- growth movement of plants in response to external unilateral/unidirectional stimuli

**ii) Explain the various types of tropism in plants**

**Phototropism**

- growth movements of plant shoots in response to unilateral sources of light
- the tip of the shoots produce auxins down the shoot
- light causes auxins to migrate to outer side/darker side causing growth on the side away from light hence growth curvature towards source of light roots are negatively phototropic

### **Geotropism**

- response of roots/parts of a plant to the direction of force of gravity
- auxins grow towards the direction of force of gravity causing positive geotropism in roots while shoot grows away from force of gravity (negatively geotropic)

### **Thimotropism/Haptotropism**

- growth response of plant when in contact with an object
- contact with support causes migration of auxins to outer side causing faster growth on the side away from contact surface
- this causes tendrils/stem to twin around a support

### **Hydrotropism**

- growth movement of roots in response to unilateral source of water/moisture
- the root grows towards the source of water/ positively hydrotropic while leaves are negatively hydrotropic

### **chemotropism**

- growth movement of parts of plant to unilateral source of chemicals
- the chemicals form a gradient between two regions e.g. pollen tube growing towards the ovary through the style

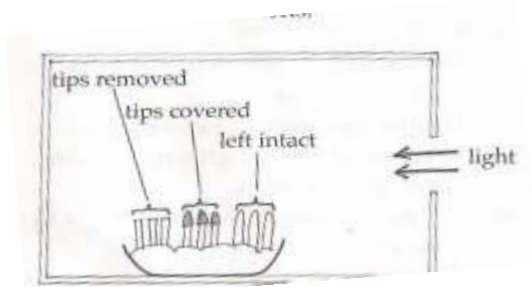
### **iii) State the ways in which tropisms are important to plants**

- expose leaves/shoots in positions for maximum absorption of sunlight for photosynthesis
- enables roots of plants to seek/look/search for water
- enables plant stems/tendrils to obtain mechanical support especially those that lack woody stems
- enables roots to grow deep into the soil for anchorage
- enables pollen tube grow to embryo sac to facilitate fertilization

### **iv) Explain the differences between tropic and tactic responses**

<b>Tropisms</b>	<b>Taxes</b>
<ul style="list-style-type: none"><li>- growth curvature in response</li><li>- slow</li><li>- influenced by hormones</li></ul>	<ul style="list-style-type: none"><li>- locomotory response</li><li>- fast</li><li>- external influence</li></ul>

**d) The diagram below represents growing seedlings which were subjected to unilateral light at the beginning of an experiment**



R

**i) State the results of P, Q and R after 5 days**

- P will bend/grow towards light
- Q will remain straight/have little or no growth
- R will remain/grow straight/grow upwards

**ii) Account for your results in (i) above**

P- Growth substance/growth hormone/IAA/auxin are produced by the stem tip

- they move (downwards and get distributed) to the side away from light where they cause rapid/more growth/cell division/elongation that results in bending

Q- Source of auxin has been removed

R- The auxins cannot be affected by light because the tip has been covered

**iii) If the tin foil were removed from the tip of seedling R, what results would be observed after two days**

- it will bend/grow towards light

**iv) State the expected results after 3 days if the box were removed**

- all seedlings will grow straight/upwards

**e) In an experiment to investigate a certain aspect of plant response, a seedling was placed horizontally as shown in diagram I below. After seven days the appearance of the seedling was as shown in diagram 2**

**Account for the curvature of the shoot and root after the seven days**

**i) Shoot**

- auxins accumulate on the lower side of the seedling due to gravity
- high concentration of auxins in shoot stimulates faster growth causing more elongation on the lower side than the upper side hence curvature occurs upwards

**ii) Root**

- the high concentration of auxins inhibits growth hence the upper side with less auxins grows faster than the lower side therefore the curvature occurs downwards

**f) What is etiolation?**

- phenomenon exhibited by plants when grown in darkness
- such plants are pale yellow due to absence of chlorophyll, have small leaves, long stems/hypocotyle and slender stems
- plants exhibit etiolation to reach light/obtain light
- this is a survival response

**4. a) i) What is coordination in animals**

- The linking together of all physiological activities that occur in the body so that they take place at the right time and in the correct place

**ii) Name the main systems for coordination in animals**

- Nervous system/sensory system
- Endocrine (hormonal system)

**iii) List the components of the mammalian sensory system**

- Central nervous system (CNS), brain & spinal cord
- Peripheral nervous system (PNS) cranial and spinal nerves
- Sense organs
- Autonomic nervous system (ANS) nerve fibers and ganglia

**iv). Explain the terms receptors, conductors and effectors**

- Receptors are structures that detect stimuli i.e. sense organs
- Conductors transmit impulses from receptors to effectors e.g. neurons
- Effectors are the responding parts e.g. muscles, glands

**v) What are the functions of the central nervous system?**

- provides a fast means of communication between receptors and effectors
- coordinates the activities of the body

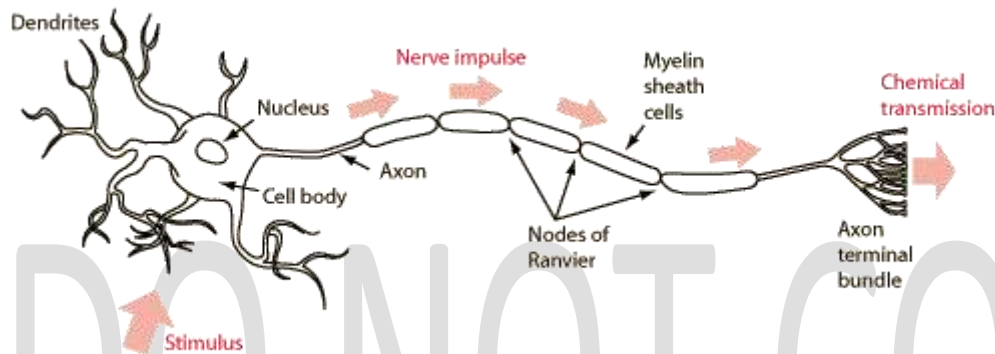
**vi) State the differences between somatic and autonomic systems of peripheral nervous system**



- Somatic is concerned with controlling the conscious or voluntary actions of the body i.e. skin, bones, joints and skeletal muscles
- the autonomic (automatic) nervous system controls involuntary actions of internal organs, digestive system, blood vessels, cardiac muscles and glandular products.

**b) i) What is a neurone?**

- the basic unit of the nervous system
- also called nerve cell
- conducts impulses
- include monitor sensory and relay neurons

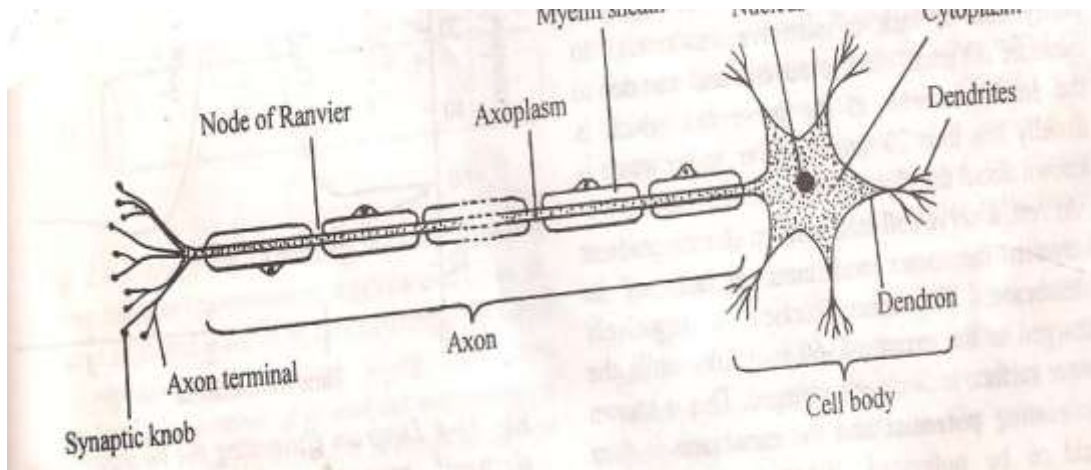


**ii) Name the parts of a typical neurone and state the functions of each part**

- cell body/centron contains nucleus and cytoplasm
- axon transmits impulses away from cell body
- dendrites relays impulses across adjacent neurons
- myelin sheath insulates axon and speeds up transmission of impulses
- schwan cells forms myelin sheath and aid in nutrition and regeneration of axon
- node of ranvier occur between schwan cells, where axon is not covered, speeds up impulse transmission
- nissils granules contain mitochondria that provide cell body with energy for metabolic process

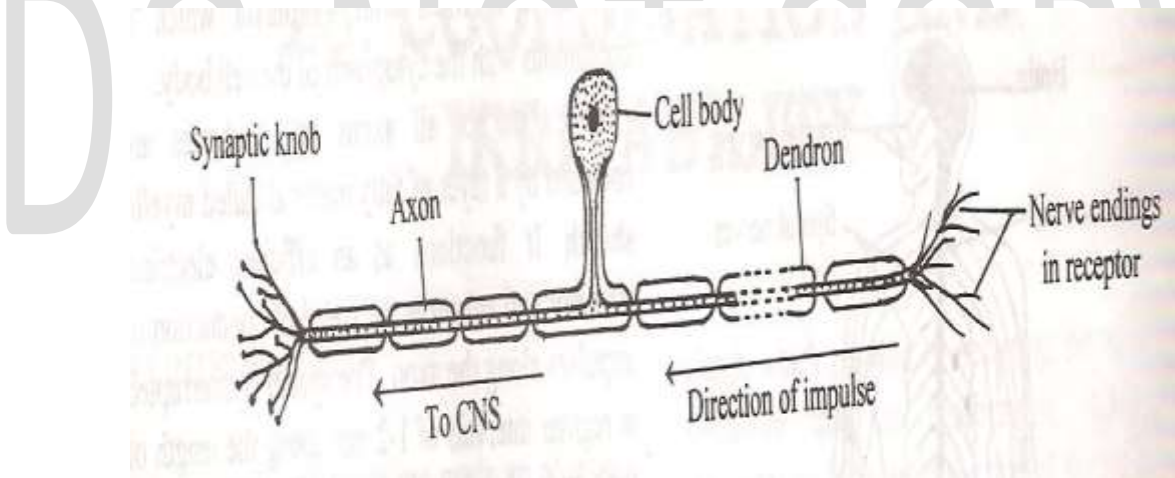
**i) Describe the structure and function of a motor neurone**

- motor neurone relays impulses from CNS (brain/spinal cord) to effectors ( muscles/glands)



**ii) Describe the structure and function of sensory neurone**

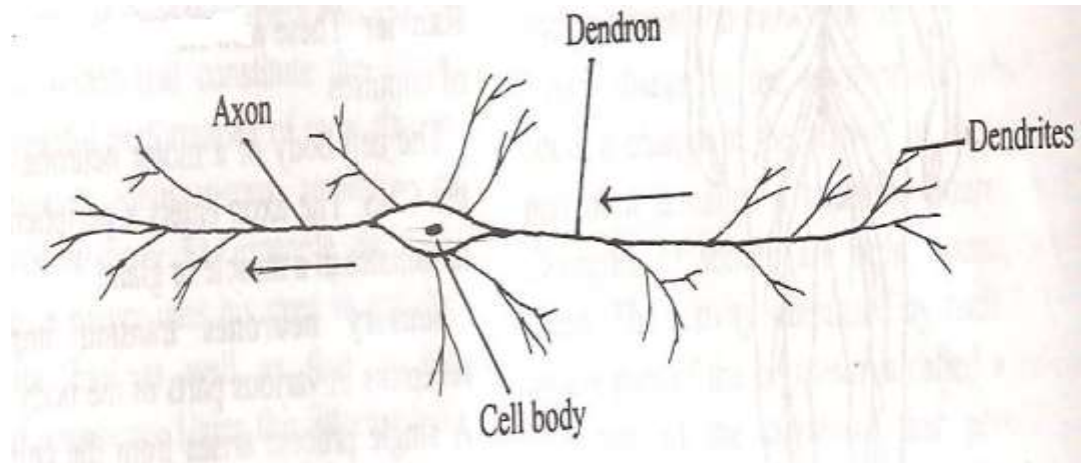
- sensory neurone relays impulses from receptors (sense organs) to CNS



**iii) State structural differences between motor and sensory neurones**

- Cell body in motor neurone is terminal (at the end) and inside central nervous system.
- Cell body in sensory neurone is terminal but has axon at both ends (bipolar)

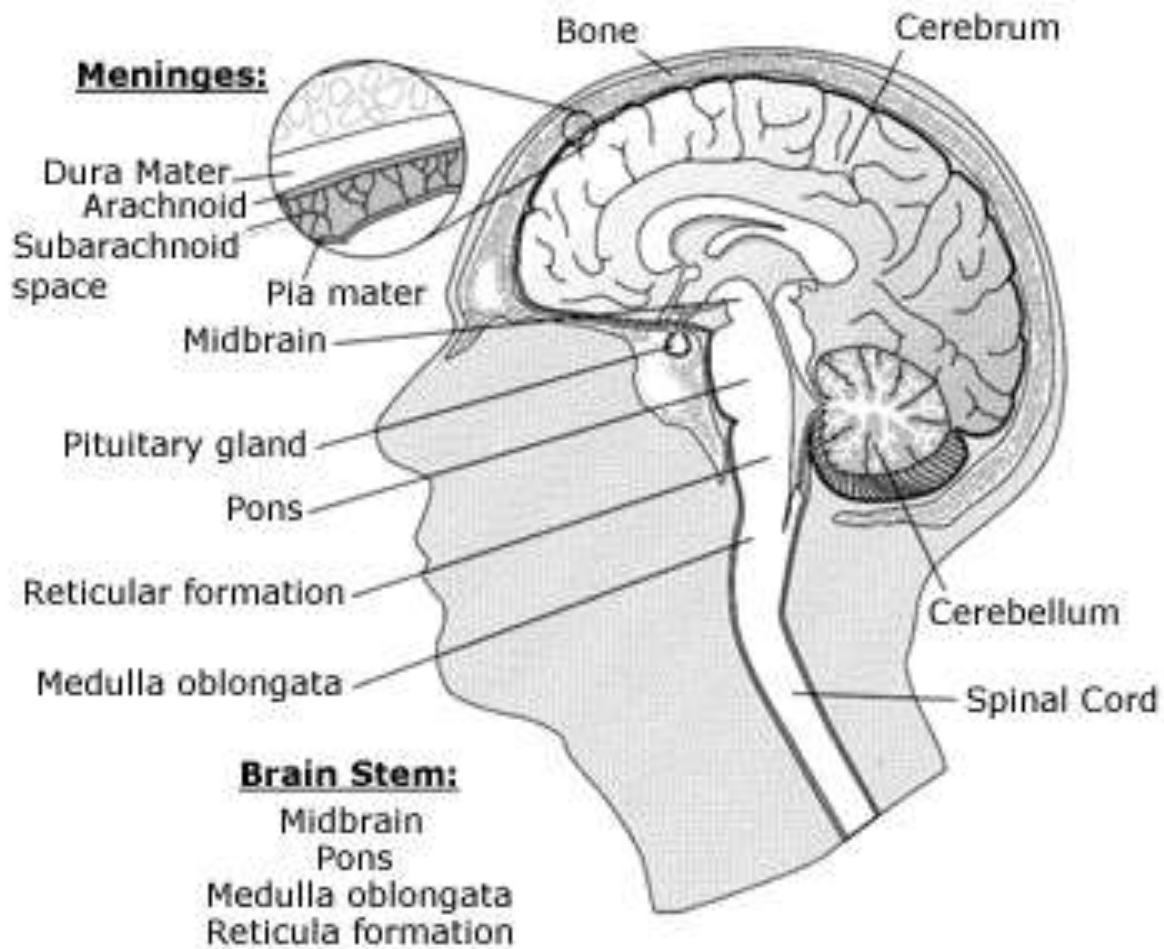
**iv) Describe the structure and function of a relay neurone**



- also called intermediate/internuncial/associate/connector/interneurone
- locate inside central nervous system and spinal cord
- usually lack myelin sheath

c) **State the functions of the major parts of the human brain**

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### i) Cerebrum

- called forebrain
- occupies most of the brain
- consists of four lobes each with specific function
- temporal lobe controls taste smell hearing learning and memory
- parietal lobe controls sensory output and touch
- occipital lobe controls vision, motor output and speech
- frontal lobe controls personality, learning thought and speech
- also has parts called thalamus and hypothalamus
- thalamus helps to sort sensory information
- hypothalamus controls hunger, heartbeat body temperature and aggression

## ii) Mid brain

- quite small in humans
- relay centre for audio and visual information
- also involves in some sight, hearing and orientation responses

## i) Hind brain

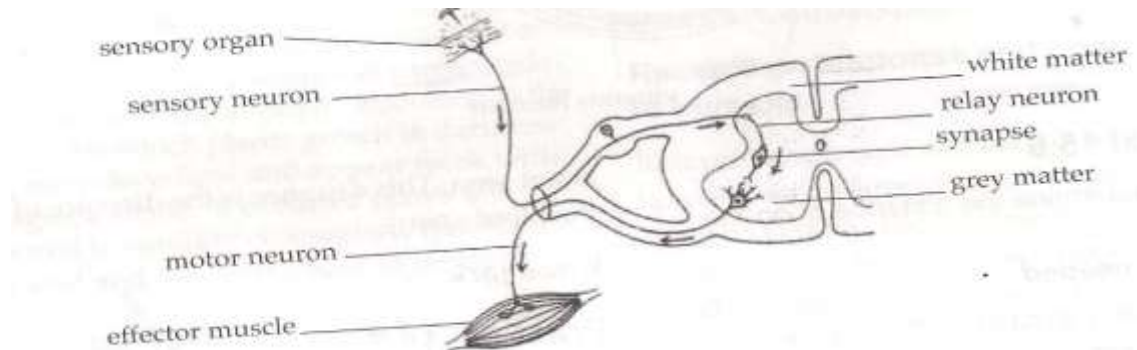
- consists of cerebral and medulla oblongata
- cerebellum is responsible for coordinating impulses, posture and balance, motor coordination and muscle tone
- medulla oblongata controls heartbeat, blood pressure breathing rate, coughing and sneezing

### a) i) What is reflex action?

- an automatic response to an external stimulus e.g. sneezing or withdrawing hand from a hot object

## ii) Describe a reflex action that will lead to the withdrawal of a hand from a hot object

- Receptors in the skin respond to stimuli. Are stimulated
- an impulse is transmitted through the sensory neurone, across a synapse to the central nervous system (white matter), through the relay neurone into grey matter, then to the motor neurone and finally to the effect muscle which contracts
- the hand is then withdrawn



## iii) Explain how an impulse is transmitted across the synapse (gap)

- impulse initiates release of transmitter substance acetylcholine at the end of the sensory neurone
- acetylcholine diffuses across the synapse and generates an impulse in the next neurone

## ii) Briefly describe the transmission of a nervous impulse across a neuro-muscular junction

- impulse arrives at synaptic knob and causes vesicle to move to the pre-synaptic membrane
- vesicle discharges transmitter substance into synaptic cleft
- transmitter substance/acetylcholine diffuses across the cleft and attaches to post-synaptic membrane
- the membrane is depolarized, generating the action potential

**iii) What are the functions of a synapse?**

- allows transmission of nerve impulses from neurone to neurone
- ensures nerve impulses travel in only one direction
- in the brain they store information/memory

**b) i) What is a conditioned reflex?**

- A response caused by a unilateral stimulus (associated stimulus) which substitutes the normal stimulus

**ii) Explain a conditioned reflex**

- it is automatic
- it involves the spinal cord
- it is usually learned e.g. writing, cycling, dancing
- it involves the interaction of highly specialized centers of the brain with a large number of neurone necessary to bring about conditioning
- example is experiments carried out by Pavlov using dogs

**iii) Compare a simple reflex action with a conditioned reflex**

<b>Simple reflex</b>	<b>Conditioned reflex</b>
<ul style="list-style-type: none"> <li>• independent of experience</li> <li>• one stimulus to evoke response</li> <li>• some sensory and motor neurons used</li> <li>• reflex is simple</li> </ul>	<ul style="list-style-type: none"> <li>• dependent on experience</li> <li>• both substitute and original reflex evoke response</li> <li>• sensory component replaced but motor remains unchanged</li> <li>• reflex is modified</li> </ul>

**c) i) What are endocrine glands?**

- ductless glands that produce hormones in animals
- hormones are chemical substances which help to coordinate the functions of the body

**ii) State the functions of hormones in animals**

- regulate growth and development
- control behavior during breeding
- proper functioning of cells
- regulate metabolic activities

**iii) Name the main endocrine glands, their secretions and functions in the human body**

Gland	Hormone	Functions
Thyroid	Thyroxine	Increases rate of metabolism
Parathyroid	Parathyroid hormone	Regulates calcium and phosphate levels
Pituitary	Hormone growth	Regulate growth of body
	Gonadotrophic hormone	Stimulates the development of male and female sex organs
	Lactogenic hormone (prolactin)	Stimulates secretion of milk after child birth
	Thyrotropic hormone(TSH)	- proper functioning of thyroid gland/thyroxine production
	Adrenocorticotropic hormone (ACTH)	- stimulates release of adrenal cortex hormone
	Oxytocin	<ul style="list-style-type: none"> <li>• regulates blood pressure</li> <li>• stimulates smooth muscles</li> <li>• stimulates contraction of uterus during childbirth</li> <li>• aids in flow of milk from mammary glands</li> </ul>
	Follicle stimulating hormone(FSH)	<ul style="list-style-type: none"> <li>• causes maturation of egg in females</li> <li>• stimulates sperm production in males</li> </ul>
	Vasopressin (ADH) Antidiuretic hormone	- regulates water balance by kidneys
Adrenal	Adrenaline (epinephrine)	<ul style="list-style-type: none"> <li>• for emergency</li> <li>• prepares body to cope up with stress</li> </ul>
	Aldosterone	- maintains balance of salt and water in blood
	Cortisone	<ul style="list-style-type: none"> <li>• breaks down stored proteins to amino acids</li> <li>• aids in breakdown</li> </ul>

		<ul style="list-style-type: none"> <li>of adipose tissue</li> <li>regulates sugar level in blood</li> <li>prevents inflammation</li> </ul>
	Sex hormones	<ul style="list-style-type: none"> <li>supplements sex hormones produced by gonads</li> <li>promotes development of sexual characteristics</li> </ul>
Pancrease	Insulin	<ul style="list-style-type: none"> <li>regulates level of sugar in blood</li> <li>enables liver to store sugar</li> </ul>
	Glucagons	<ul style="list-style-type: none"> <li>regulates level of sugar in blood</li> </ul>
Ovaries	Oestrogen	<ul style="list-style-type: none"> <li>causes sexual secondary characteristics in females</li> <li>prepares uterus for pregnancy</li> </ul>
	Progesterone	<ul style="list-style-type: none"> <li>growth of mucus lining of uterus</li> <li>maintains uterus during pregnancy</li> </ul>
Testes	Androgens(testosterone)	<ul style="list-style-type: none"> <li>causes secondary sexual characteristics in males</li> </ul>
Stomach cells	Gastrin	<ul style="list-style-type: none"> <li>stimulates release of gastric juice</li> </ul>
Intestinal cells	Secretin	<ul style="list-style-type: none"> <li>stimulate release of pancreatic juice</li> </ul>

**iv) Give the differences between nervous and endocrine (hormonal) communication**

Nervous	Hormonal (endocrine)
Response confined to effector organs (localized targets)	Response more widespread (various targets)



Speed of response is rapid	Response less rapid
Nervous impulse through nerves/nerve cell/neurons	Hormones transferred through blood
Duration of response is short	Persist for long
Speed of transmission is rapid	Speed of transmission is slower
Transmission is electrical	Transmission is chemical

**v) State the effects of over secretion and under secretion of adrenaline and thyroxine in humans**

Hormone	Over secretion	Under secretion
Adrenaline	<ul style="list-style-type: none"> <li>• thin toneless muscles</li> <li>• high blood pressure</li> <li>• weak bones</li> <li>• obesity</li> <li>• early onset of sexual development</li> </ul>	<ul style="list-style-type: none"> <li>• low blood pressure</li> <li>• inability to withstand stress</li> <li>• fatigue</li> <li>• muscular weakness</li> <li>• muscle wasting</li> <li>• increased dark pigmentation of skin</li> </ul>
Thyroxine	<ul style="list-style-type: none"> <li>• increased metabolism</li> <li>• increased heartbeat</li> <li>• physical restlessness</li> <li>• mental restlessness</li> <li>• protruding eyeballs</li> <li>• enlarged thyroid gland</li> </ul>	<ul style="list-style-type: none"> <li>• cretinism (retarded growth and low mental development)</li> <li>• lowered metabolism</li> <li>• low ventilation rate of lungs</li> <li>• low body temperature</li> <li>• lowered mental activity</li> <li>• coarse hair</li> <li>• puffy eyes</li> <li>• enlarged thyroid gland</li> </ul>

**g) i) Define the following terms**

**Drug**

- a substance that causes a change in body function

**Drug abuse**

- indiscriminate use of drugs without minding their side effects
- misuse or wrong use of drugs

**ii) State the types of drugs, examples and side effects**

**Sedatives**

- also called depressant

- a drug that decreases the action of the central nervous system
- reduce anxiety, and tension, induce sleep and act as muscle relaxants
- when abused they cause withdrawal effects such as anxiety, delirium and death
- includes barbiturates, other sedatives, tranquilizers and alcohol

#### **Pain-killers**

- suppress centers of pain in the brain

#### **Hallucinogens**

- given to people with hallucination or mentally ill patients to calm them down
- when abused they lead to a feeling of confusion, agitation, depression and violent behavior that can lead to murder or suicide
- examples include valium, LSD, bhang, narcotics and cannabis

#### **Stimulants**

- drugs that temporarily increase the action of the central nervous system
- they create a feeling of alertness, wakefulness, a sense of self confidence and well being
- used to decrease fatigue and mild depression
- when abused they cause feelings of persecution, hallucination and addiction
- include amphetamines, cocaine, caffeine, miraa and nicotine

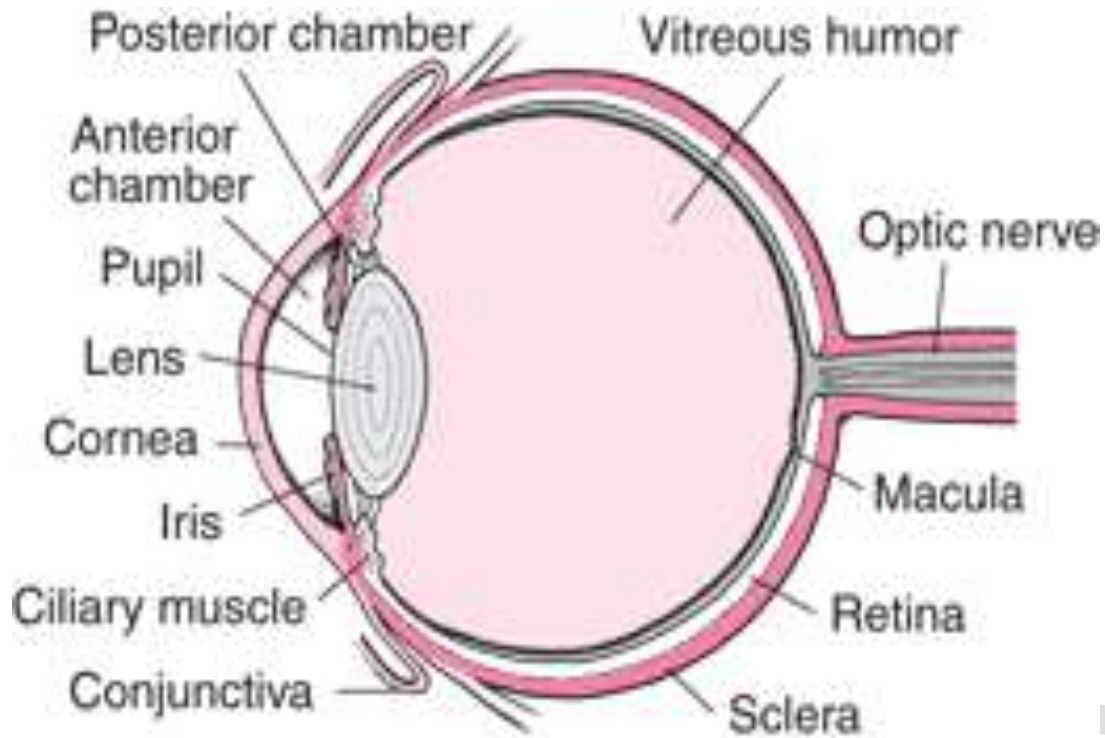
#### **iii) State the general effects of drug abuse on human health**

- damage to body organs e.g. liver cirrhosis
- drug addiction
- impaired judgment resulting in clumsiness
- socio-economic problems e.g. crime, loss of jobs, divorce, prostitution, HIV/AIDS
- may cause poor health

#### **h) i) List the special sense organs in mammals and the major function of each**

- Eye for sight
- Ear for hearing and balance
- Nose for smell
- Skin for touch, temperature detection, pain detection

#### **iii) How is the human eye adapted to its function?**



- conjunctiva is thin/transparent/tough to allow light to pass through/to protect the eye
- Sclerotic layer is made up of (collagen) fibers/fibrous. It maintains shape of the eyeball/protects the eye
- cornea is transparent/curved thus refracts light rays/allows light to pass through
- Choroid is a layer of tissue with black pigment/dark pigment. Prevents internal reflection of light in the eye/contains blood vessels that supply oxygen/nutrients/remove (metabolic) wastes from the eye
- retina has cones/rods for bright colour vision/low light vision
- yellow spot has a high concentration of cones for accurate vision/visual acuity
- Blind spot has no cones and rods. Place where optic nerve leaves/enters the eye
- optic nerve has (sensory) nerve fibers for transmission of impulses to the brain (for interpretation)
- Lens is biconvex/made up of elastic material/transparent. Adjust focus on far or near objects allow light to pass through/for refraction of light rays
- ciliary body is made up of muscle fibers/glandular which contract/relax to change shape
- suspensory ligaments are inelastic to hold lens in position/attach it to ciliary body
- iris(is the coloured part of the eye it) has radial and circular muscles which control size of pupil
- pupil is the small hole at the centre of iris through which light passes into the eye
- aqueous humor is a fluid through which oxygen/nutrients pass to the cornea/lens/maintains shape of the eyeball/refracts light rays
- vitreous humor is a fluid which maintains shape of eye/refracts light rays

**iii) What is accommodation of the eye?**

- ability of the eye to adjust to bring an image from a near or far object into sharp focus on the retina

**iv) Explain how an eye viewing a near object adjusts to viewing a far object**

- ciliary muscles relax
- suspensory ligaments become taut/tight
- lens decreases curvature/becomes thinner
- radial muscles relax
- circular muscles contract
- size of pupil decreases to reduce amount of light

**v) What changes occur in the eye if it changes from observing an object at a distance to one at a closer range?**

- ciliary muscles contract
- Tension in suspensory ligaments reduces/relax/ slackens
- Lens bulges/thickens/increases curvature
- Radial muscles contract
- Circular muscles relax
- Size of pupil becomes large to allow in more light.

**viii) State the changes which would take place in the eye if a person in a dark room had lights switched on**

- circular muscles contract and radial muscles relax
- pupil becomes small to allow less light into the eye

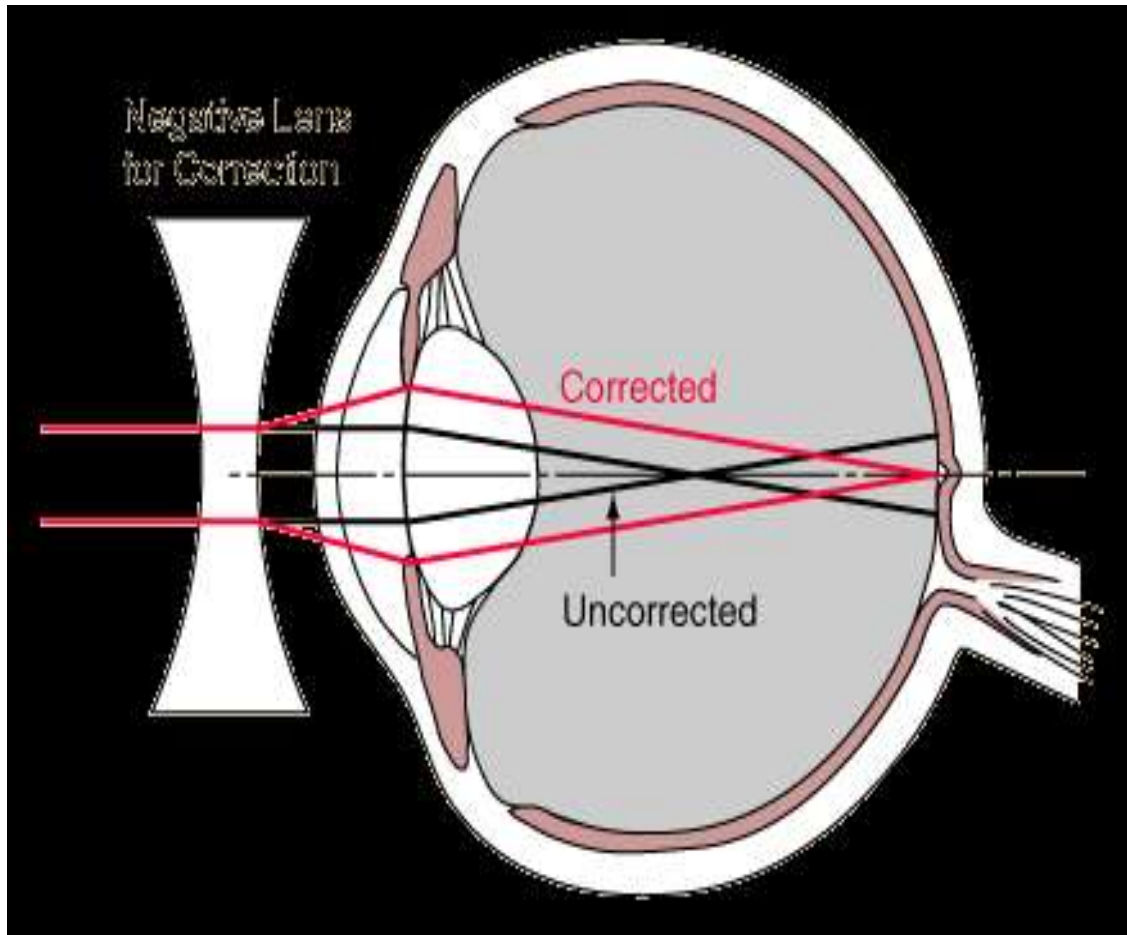
**ix) Explain how the eye forms an image**

- the mammalian eye works like a camera
- light rays enter the cornea pass through the pupil, aqueous humor, lens and vitreous humor
- light rays are refracted by the aqueous and vitreous humors and lenses
- finally light falls on the retina to form an image
- the image is real and inverted and smaller than object, back to front/reversed
- Retina forms a fine image when light rays reach it.

**x) Name the defects of the eye and state how they can be corrected**

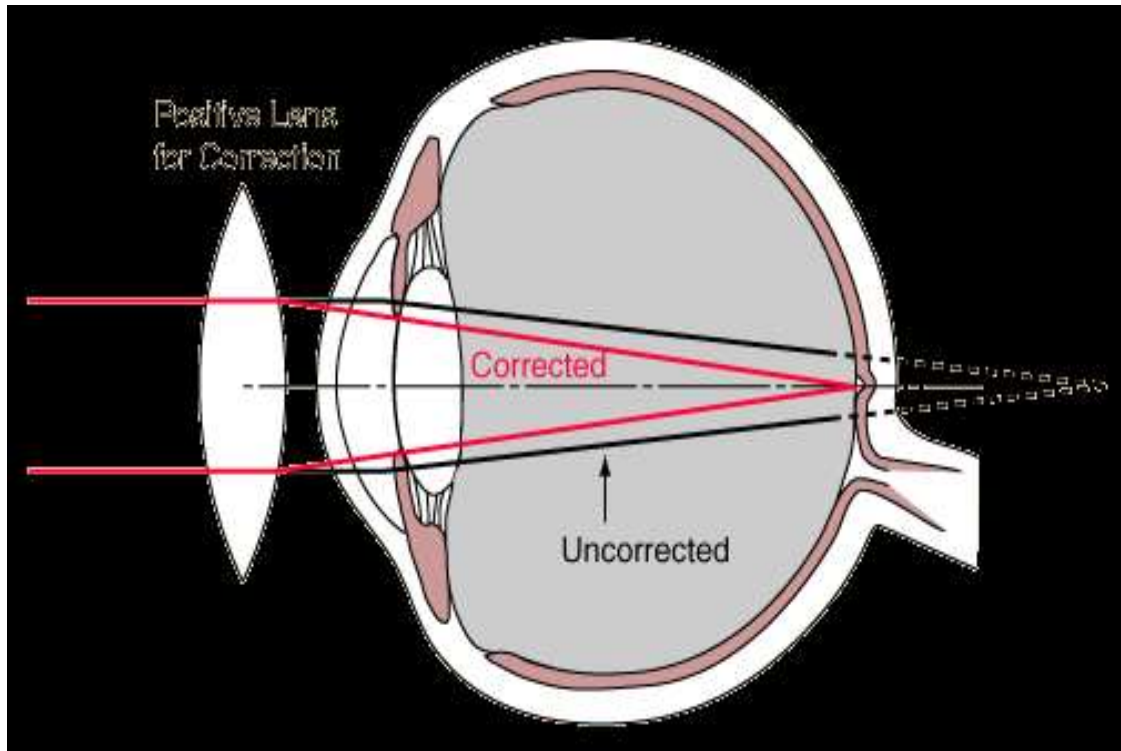
**Short sight (Myopia)**

- eye cannot focus on far objects
- image is formed in front of the retina because light rays converge in front of retina
- the lens is too thick, curve and eyeball too long
- corrected by wearing concave/biconcave/lenses
- these lenses diverge light rays onto retina



### Long sight (Hypermetropia)

- eye lenses are unable to focus because they are flat, thin and weak hence unable to focus image on the retina
- they are unable to accommodate/change the focal length
- near image is formed behind the retina but a distant one is correctly focused on the retina
- corrected by wearing convex/biconvex/converging lenses



### Presbyopia

- occurs in old age hence called old sight
- caused due to loss of elasticity of lenses, weakness of ciliary muscles hence lack of focus of light rays
- this causes long sight
- corrected by wearing biconvex/convex/converging lenses

### Squinting

- eyeballs are uncoordinated/do not turn at the same time
- eye muscles move in different directions
- this makes accommodation and focusing difficult
- corrected through surgery

### Astigmatism

- surface of cornea is uneven
- leads to weak focus of light rays on retina
- corrected by using cylindrical lenses/lenses with combined curvature

### xi) State the advantages of having two eyes in human beings

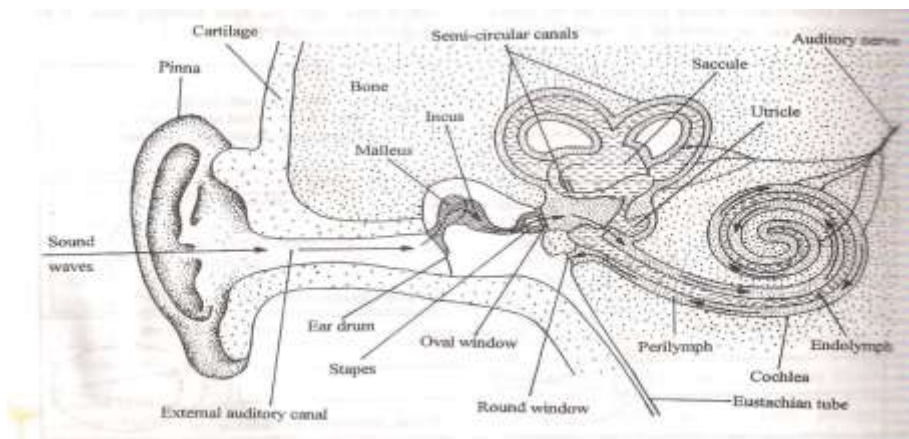
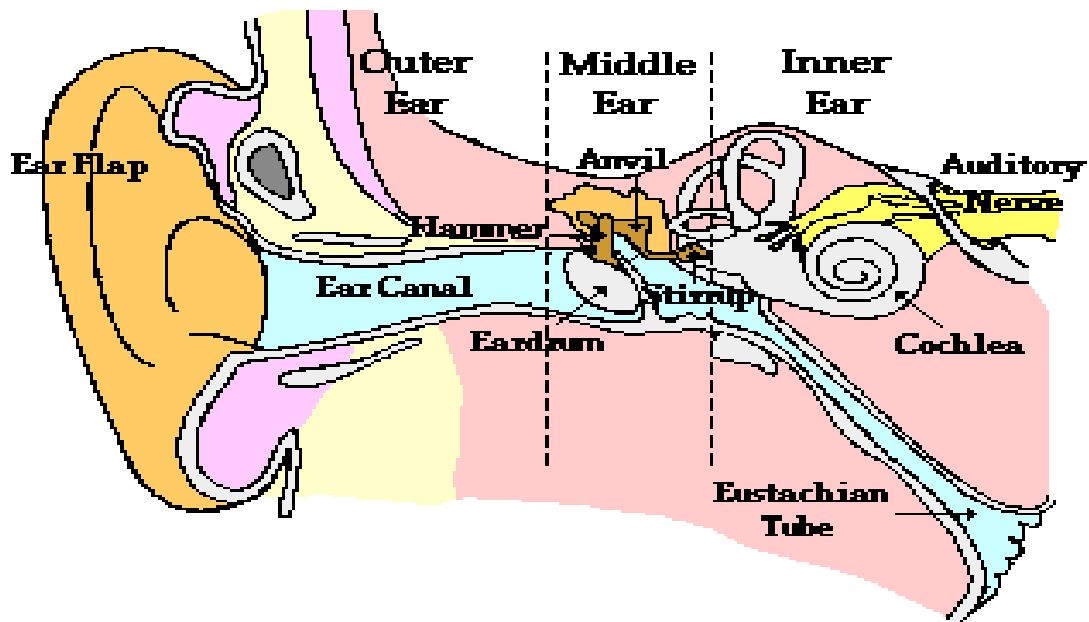
- stereoscopic vision
- gives a wider angle of binocular vision

- if one is damaged human is not blinded

**I i) What are the functions of the human ear?**

- hearing
- maintaining body balance and posture

**iv) How are the structures of the human ear suited to perform the function of hearing?**



- Pinna is funnel shaped allows collection of sound waves and channels them down the auditory canal/auditory meatus
- auditory canal is a tube that concentrates and directs sound waves to tympanic membrane/ tympanum/eardrum
- Eardrum is thin and tight. It sets into vibration/vibrates/converts sound waves into vibrations
- the vibrations are transmitted to the ear ossicles/malleus, incus and stapes that amplify the sound vibrations
- the vibrations are then transmitted to the fenestra ovalis/oval window
- Oval window is a membrane which amplifies/transmits vibrations to the fluids (perilymph and endolymph) then to cochlea.
- The cochlea is coiled to occupy a small space and accommodate a large number of sensory cells
- The sensory cells/hairs (in the cochlea) are set into vibrations/stimulated producing nerve impulses in the auditory nerve
- Impulses in the auditory nerve are transmitted to the brain for interpretation for hearing
- Eustachian tube connects the inner ear to the throat. It equalizes air pressure in the middle ear with the atmospheric air pressure (in outer ear)
- Fenestra rotundus/round window dissipates/discharges/discards vibrations from inner ear to middle ear

**iii) Explain how the structure of the human ear performs the function of balancing**

- there are three semi-circular canals/utriculus/succulus/vestibular apparatus arranged in planes at right angles to each other
- at the end of each canal is a swelling called ampulla which contains receptors
- the movement of the head causes movement of the fluid/endolymph in at least one canal
- the fluid movement causes stimulation of the receptors/sensory hairs
- sensory impulses are generated
- the auditory nerve transmits the impulses to the brain for interpretation for the position of body/posture/balance

**iv) State what would happen if the auditory nerve was completely damaged**

- deafness
- loss of body balance
- impulse not transmitted to the brain

**5. a) i) What is support?**

- to support is to carry part of the weight/mass of an organism

**ii) What is locomotion?**

- progressive change in the position of an organism

**iii) State the importance of support systems in living organisms**

- they provide a framework for the body of organisms and help to determine their shape
- provide land animals with means for support to their weights against gravity



- organs are attached to the skeleton for support and stability to avoid entanglement and crushing each other
- they protect very important and delicate organs whether inside or outside the body e.g. eyes, heart
- in large plants the rigid trunks of trees support the greater mass of leaves and fruits

**iv) State the importance of locomotion in animals**

- in search of food
- search for mates
- escaping predators

**b) i) Name the tissues in higher plants that provide mechanical support**

- sclerenchyma
- collenchyma (not lignified)
- xylem/tracheids and vessels

**ii) State the importance of support in plants**

- exposing the surface area of leaf to sunlight for photosynthesis
- ensure flowers are exposed to pollination agents
- expose fruits and seeds to agents of dispersal
- to resist breakages due to their own weight and that of other organisms
- for proper transport and translocation of materials

**iii) Name the types of plant stems**

- herbaceous e.g. shrubs
- woody e.g. trees
- weak stems in creepers, twining plants and plants bearing tendrils

**iv) Name the tissues in plants that are strengthened with lignin**

- sclerenchyma
- xylem vessels/tracheids/xylem

**v) What makes young herbaceous plants remain upright?**

- turgidity
- presence of collenchyma

**vi) State the ways by which plants compensate for lack of ability to move from one place to another**

- ability to pollinate
- response to nastic and tropic movement
- ability to exploit localized nutrients
- ability to disperse seed or fruit propagation

**c) i) Explain the ways in which erect posture is maintained in a weak herbaceous stem**

- This is the function of turgidity and presence of collenchyma  
Cells take in water and become turgid

**ii) Explain how support in plants is achieved**

- Turgor pressure due to absorption of water keeps cells firm hence hold herbaceous plants upright
- collenchyma and sclerenchyma tissues are closely packed in stem and roots to provide support
- inelastic cuticle on epidermis is covered by a waxy layer hence keeping shape of plant and setting inward pressure against turgid cells and this causes a force to hold plant upright
- xylem vessels and tracheids are lignified to provide support to stems, roots and leaves
- climbing plants obtain mechanical support from other plants and objects
- they have climbing structures like tendrils which hold on to other objects

**d) i) Give the reasons why support is necessary in animals**

- for attachment of muscles
- For attachment of other body organs
- to protect delicate body organs
- to maintain body shape/form
- to enable movement/locomotion

**ii) Why is movement necessary in animals?**

- enables animals to search for food
- enables animals to search for shelter
- enables animals to escape predators/harmful conditions
- enables animals to search for water
- enables animals to search for mates
- enables animals to search for breeding sites

**e) i) Name the organ used for support by animals**

- Skeleton

**ii) Name the different types of skeletons in animals, giving an example of an animal for each type of skeleton named**

- exoskeleton e.g. arthropoda (crab, insect)
- endoskeleton e.g. chordata (cat, fish)

**iii) State the difference between exoskeleton and endoskeleton**

- endoskeleton is a rigid framework covered by body tissues of an animal
- exoskeleton is a rigid framework found on the surface of an animal

**iv) State the advantages of having an exoskeleton**

- supports/protects delicate inner parts
- water proof/prevents drying up of body
- provided surface for muscle attachment

**v) Explain the importance of having an endoskeleton**

- support the body
- give body its shape
- protect delicate organs e.g. skull, brain, ribs
- used in locomotion e.g. bones serve as levers
- red blood cells are formed in bone marrow
- minerals are stored in bones e.g. calcium and phosphorus

**f) i) Explain how a fish is adapted to living in water**

- streamlined body for easy movement in water
- swim bladder controls depth of swimming
- fins for movement, balance, direction and stability
- gills for gaseous exchange in water
- presence of lateral line to sense vibrations
- scales provide protection
- colour which offers camouflage against predators

**ii) Explain how a finned fish is adapted to locomotion in water**

- streamlined body to reduce resistance/friction (to swim smoothly)
- the vertebral column consists of a series of vertebrae held together loosely so that it is flexible
- myotomes/muscles associated with vertebral column produce movement
- the sideways and backwards thrust of the tail and body against water results in resistance of water pushing the fish sideways and forwards in a direction opposed to thrust
- head not flexible so as to maintain forward thrust
- presence of fins help in propulsion/balance/paired fins (pectoral and pelvic) for controlling pitch and slow down movement/unpaired fins (dorsal, ventral, anal) for yawing and rolling (caudal) for swimming/propulsion and steering/change of direction
- presence of swim bladder to make fish buoyant
- scales tip towards the back to provide smooth surface
- body covered with mucus to reduce friction
- flattened surface for easy floating

**g) i) Name the main parts of the vertebral column giving the types of bones found in each part**

**Axial skeleton**

- forms the main axis of the body
- formed by the skull, sternum, ribs and vertebrae

**Appendicular skeleton**

- composed of limbs and girdles
- the forelimbs are connected to the trunk by the pectoral girdles (shoulder bones)
- hind limbs are connected to the pelvic girdle (hips)
- bones are scapular, clavicle, humerus, ulna, femur, tibia, fibula, metacarpals, carpals, tarsals, metatarsals, phalanges, ilium, ischium and pubis

**ii) What are the vertebrae?**

- bones of the vertebral column

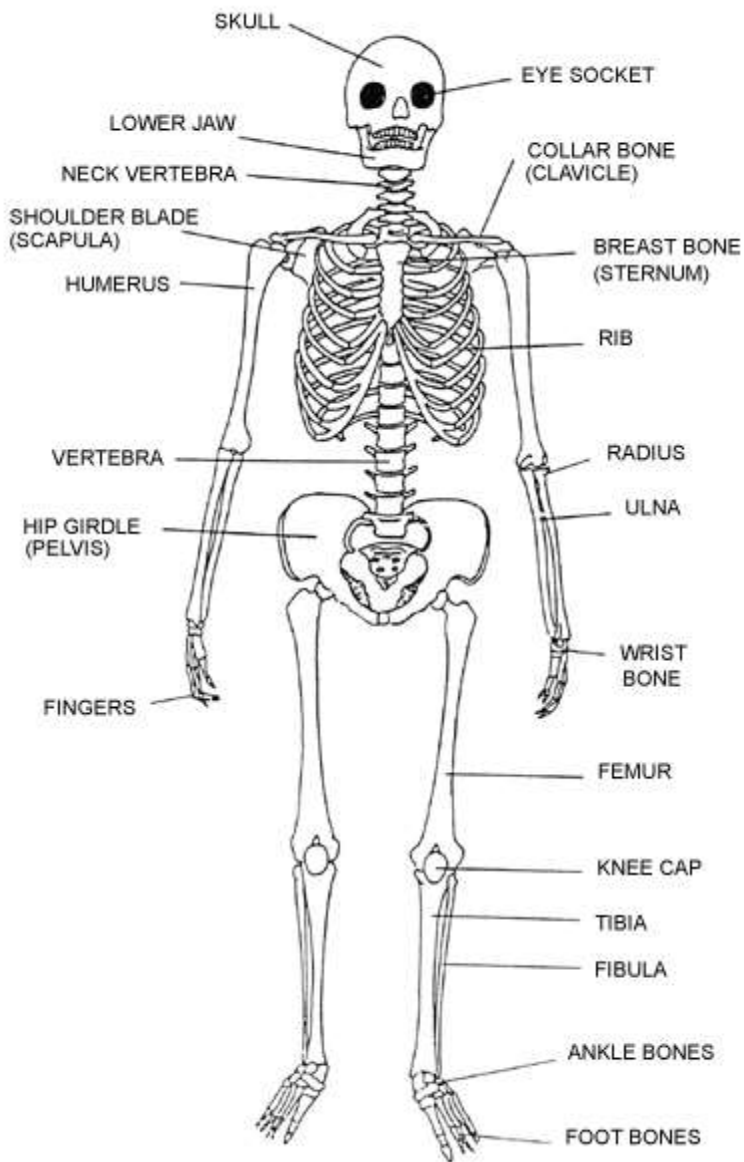
**iii) State the functions of the vertebral column**

- gives flexibility
- absorbs shock
- protects spinal cord
- supports weight of body
- provide surface for muscle attachment
- between the vertebrae are soft discs which offer cushioning called intervertebral discs

**iv) State the general characteristics of vertebrae**

- have solid structure called centrum to support weight of body
- has transverse process lateral to centrum for muscle attachment
- neural spine is dorsal to centrum and provides surface area for muscle attachment
- neural canal a passage for spinal cord and offers protection to it
- has facets for articulation with other vertebrae
- neural arch encloses neural canal

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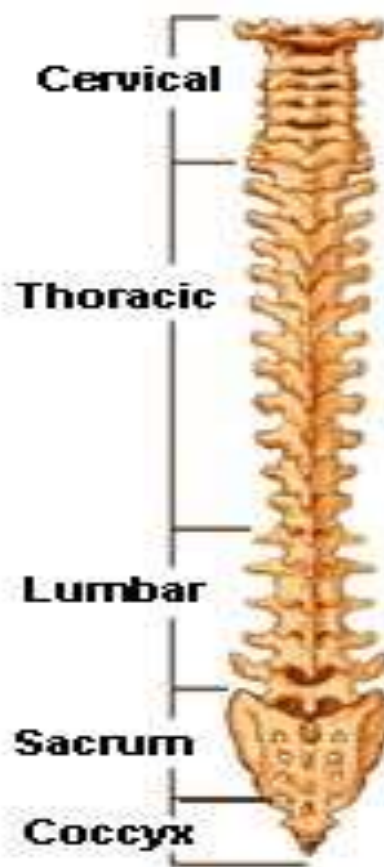
**v) Name the bones of the vertebral column**

- Cervical vertebra
- Thoracic vertebra
- Lumbar vertebra
- Sacral vertebra
- Caudal vertebra

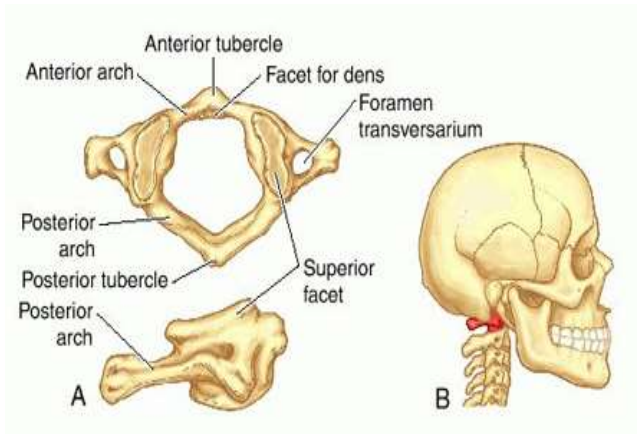
**Lateral (Side)  
Spinal Column**



**Posterior (Back)  
Spinal Column**



vi) Describe how the various vertebrae are adapted to their functions

Bone	Structure	Function
<p>Skull</p> 	<ul style="list-style-type: none"> <li>• cranium and jaw bones</li> <li>• made of several bones joined together</li> <li>• large box called cranium and smaller paired boxes for eyes, ears, nose, jaws</li> <li>• has large hole called foramen magnum for the passage of spinal cord</li> </ul>	<ul style="list-style-type: none"> <li>• attachment of jaws</li> <li>• protect brain and other delicate parts</li> </ul>
<p>Cervical region Atlas (first cervical)</p>	<ul style="list-style-type: none"> <li>• ring shaped</li> <li>• no Centrum</li> <li>• broad, flat transverse processes</li> <li>• vertebrarterial canal for passage of vertebral artery</li> <li>• facet for articulation of condyles of skull</li> </ul>	<ul style="list-style-type: none"> <li>• protect spinal cord</li> <li>• attachment of muscles</li> <li>• allow nodding of head</li> </ul>
<p>Axis (second cervical)</p>	<ul style="list-style-type: none"> <li>• adontoid peg projects from Centrum</li> <li>• large flattened neural spine</li> <li>• vertebrarterial canal</li> <li>• small transverse process</li> </ul>	<ul style="list-style-type: none"> <li>• allows head to rotate</li> <li>• protects spinal cord</li> <li>• provides surface for muscle attachment</li> </ul>

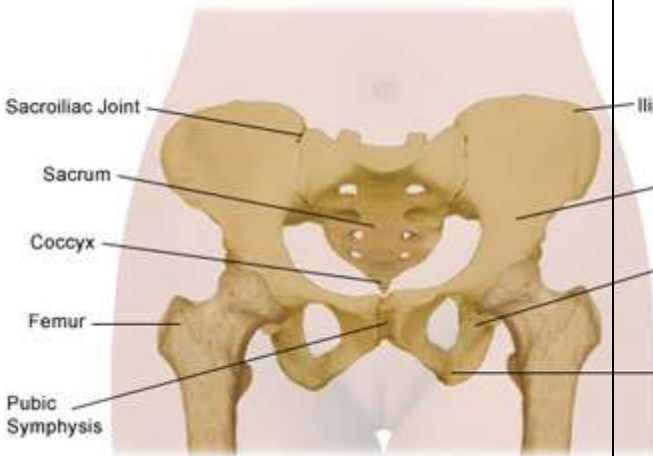


Cervical (others)	<ul style="list-style-type: none"> <li>• short neural spine</li> <li>• branched transverse process for neck muscles</li> <li>• vertebrarterial canals</li> <li>• wide neural canal</li> </ul>	<ul style="list-style-type: none"> <li>• support weight of head</li> <li>• protect spinal cord</li> <li>• neck muscle attachment</li> </ul>
Thoracic	<ul style="list-style-type: none"> <li>• long backward pointing neural spine</li> <li>• transverse process that points sideways</li> <li>• facets for articulation of ribs</li> <li>• notch for spinal nerves to pass through</li> </ul>	<ul style="list-style-type: none"> <li>• forms rib cage</li> <li>• articulation with one end of a rib</li> <li>• protects, spinal cord</li> <li>• muscle attachment</li> </ul>
Lumbar	<ul style="list-style-type: none"> <li>• short neural spine</li> <li>• long transverse process pointing towards abdomen</li> <li>• large Centrum</li> <li>• extra processes e.g. prezygapophysis, hypapophysis, anapophysis, metapophysis</li> </ul>	<ul style="list-style-type: none"> <li>• protect organs of abdomen</li> <li>• support upper part of body</li> <li>• protect spinal cord</li> <li>• muscle attachment</li> </ul>
Sacral	<ul style="list-style-type: none"> <li>• fused bones to form sacrum</li> <li>• well developed transverse process of first vertebra</li> <li>• vertebrarterial</li> </ul>	<ul style="list-style-type: none"> <li>• protects alimentary canal</li> <li>• attachment of hip girdles</li> <li>• protect</li> </ul>

	<ul style="list-style-type: none"> <li>• canals</li> <li>• short neural spine</li> </ul>	<ul style="list-style-type: none"> <li>• spinal cord</li> <li>• muscle attachment</li> </ul>
Rib	<ul style="list-style-type: none"> <li>• long</li> <li>• flattened</li> <li>• attached to sternum from front</li> </ul>	<ul style="list-style-type: none"> <li>• protect internal organs</li> <li>• muscle attachment</li> </ul>

**vii) Describe the bones that form the appendicular skeleton**

Bone	Structure	Function
Pectoral girdle scapular (shoulder bone)	<ul style="list-style-type: none"> <li>• Broad i.e. Flattened blade</li> <li>• glenoid cavity to articulate with humerus</li> <li>• metacromion/acromion for muscle attachment</li> <li>• hard to provide support</li> <li>• socket with cartilage/smooth surface to reduce friction</li> </ul>	<ul style="list-style-type: none"> <li>• Support</li> <li>• Muscle attachment</li> <li>• Articulates with humerus</li> </ul>
Humerus	<ul style="list-style-type: none"> <li>• long shaft for muscle attachment</li> <li>• round head to articulate with glenoid cavity</li> <li>• trochlea for articulation with ulna</li> <li>• olecranon fossa to prevent arm bending the other way</li> </ul>	<ul style="list-style-type: none"> <li>• movement</li> <li>• muscle attachment</li> </ul>
Ulna and radius	<ul style="list-style-type: none"> <li>• ulna longer and on side of little finger</li> <li>• has sigmoid notch</li> </ul>	<ul style="list-style-type: none"> <li>• movement</li> <li>• muscle</li> </ul>

	<p>and olecranon process to form hinge joint with humerus</p> <ul style="list-style-type: none"> <li>• radius is smaller and lies along thumb side and does not join ulna</li> <li>• allows articulation with wrist bones</li> </ul>	<p>attachments</p>
<p>Pelvic girdle(hip bone)</p> <p style="text-align: center;"><b>Female Pelvis</b></p>  <p>The diagram shows the female pelvic girdle with the following labels: Sacroiliac Joint, Sacrum, Coccyx, Femur, Pubic Symphysis, Iliac Crest, Ilium, Ischium, and Pubis. The femur is shown articulating with the acetabulum of the hip bone.</p>	<ul style="list-style-type: none"> <li>• composed of three fused bones (ilium, ischium, pubis)</li> <li>• upper end fused to sacrum</li> <li>• lower end has acetabulum for articulation with femur</li> <li>• has abductor foramen for passage of nerves and blood vessels</li> </ul>	<ul style="list-style-type: none"> <li>• movement</li> <li>• muscle attachment</li> <li>• support</li> <li>• absorbs pressure exerted by ground when animal moves</li> </ul>
<p>Femur</p>	<ul style="list-style-type: none"> <li>• rounded head to fit</li> </ul>	<ul style="list-style-type: none"> <li>• movement</li> </ul>

	<p>in acetabulum of pelvis</p> <ul style="list-style-type: none"> <li>• projections called trochanter for attachment of thigh muscles</li> <li>• condyles at lower end for articulation with tibia</li> <li>• patella that covers knee and prevents leg from bending backwards</li> </ul>	<p>t</p> <ul style="list-style-type: none"> <li>• muscle attachment</li> </ul>
Tibia and fibula	<ul style="list-style-type: none"> <li>• tibia is longer than fibula</li> <li>• tibia is outer bone and fibula is inner bone</li> <li>• tibia lies on side of large toe</li> <li>• fibula is fused to tibia (on outer side)</li> </ul>	<ul style="list-style-type: none"> <li>• movement</li> <li>• muscle attachment</li> </ul>

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**6. a) What is a joint?**

- the point where bones meet

**ii) State the functions of joints**

- provide a point of articulation between bones

**iii) Name the main types of joints**

- immovable joints e.g. skull, pelvic girdles and sacrum
- slightly movable joints e.g. between vertebrae
- Freely movable joints e.g. knee, elbow

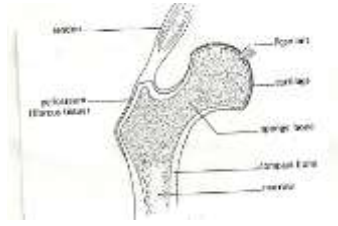
**iv) Give the features of movable joints**

- ends of bones covered with articular cartilage
- ends bound by capsules of ligaments
- have joint cavity filled with lubricating fluid called synovial fluid secreted by synovial membrane
- they are called synovial joints

**b) Describe the synovial joints**

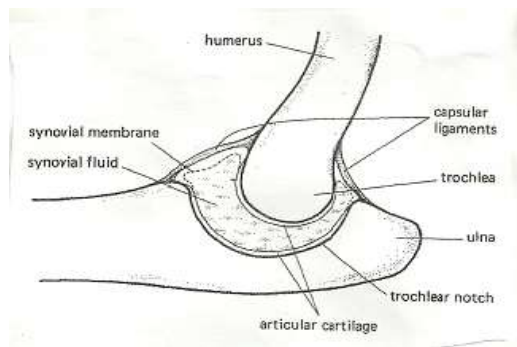
**iv) Ball and socket**

- allow movement in all planes /directions i.e. 360°
- rounded end of bone fits into a rounded cavity in another bone
- e.g. shoulder joint and hip joint



v) **Hinge joint**

- convex surface of one bone fits into the concave surface of another bone
- this allows movement in only one plane/direction 180°
- e.g. elbow joint and knee joint



vi) **Pivot joint**

- allows rotation e.g. where atlas pivots on olecranon process of axis

c) i) **What is synovial fluid?**

- lubricating fluid produced by synovial membrane at movable joints

ii) **State the functions of synovial fluid**

- absorbs shock
- reduces friction/gives lubrication
- nourishment
- distributes pressure

d) **Explain the following terms**

v) **Ligament**

- connective tissue joining one bone to another

vi) **Cartilage**

- supporting soft tissue found at joints
- they cushion the bones and absorb shock

vii) **Tendon**

- tissue that connects muscle to bones

## 7. Muscles

### e) i) What is a muscle?

- fleshy part of body
- composed of long cells enclosed in a sheath
- specialized cells capable of contracting

### ii) State the functions of muscles

- cover the skeleton
- provide shape
- contract and relax to enable body to move

### f) Describe the structure and function of various types of muscles

#### i) skeletal muscles

- also called voluntary/striated/stripped muscles
- they are attached to skeleton
- they consist of striated, multinucleated, long fibers and are cylindrical shaped
- found on legs, arms, eyes, neck where they cause movement

#### ii) Involuntary muscles

- also called smooth/visceral/unstriated/unstripped
- their movement is not controlled by the will
- they are unstriated, nucleated, short fibred and spindle shaped
- are found in alimentary canal, blood vessels, secretory glands, other tubular visceral organs, bladder, uterus, urinary tract, reproductive system, respiratory tract, ciliary body, iris

#### iii) Cardiac muscles

- also called myocardium
- found in the walls of the heart
- are not under control of the will
- composed of long cylindrical cells with special junctions
- myogenic i.e. generate their own contraction
- they are not fatigued
- their function is contraction of the heart to pump blood

### g) Explain how muscles cause movement of the human arm

- the muscles which bring about these movements are called biceps and triceps
- biceps are attached to scapula and radius for bending
- triceps are attached to scapula, humerus and ulna for stretching
- when the biceps contracts, it pulls the radius (forearm) and the hand bends
- the triceps relaxes at the same time
- when the triceps contracts and biceps relaxes(extends) the arm is stretched
- biceps flexes the arm (flexor) and triceps extend(extensor muscle) the arm

### h) i) State the structural differences between skeletal muscles e.g. biceps and smooth muscles e.g. gut muscle

Skeletal (biceps)	Smooth (gut) muscle
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<ul style="list-style-type: none"><li>• multinucleated</li><li>• striated/stripped</li><li>• long muscle fibers</li><li>• block/cylindrical</li></ul>	<ul style="list-style-type: none"><li>• uninucleated</li><li>• unstriated</li><li>• short muscle fibers</li><li>• spindle shaped</li></ul>
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**ii) Name the cartilage found between the bones of the vertebral column**

- intervertebral disc

**iv) What are the functions of the cartilage named in (d) ii) above**

- acts as a cushion/absorbs shock
- reduces friction
- flexibility of vertebral column

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