

14.0 : Introduction :

Q.1. Define skeleton. How is it divided into vertebrates?

Ans: Skeleton: The body is supported internally and externally by a hard framework called skeleton.

Division of skeleton in vertebrates:

Skeletal system is divided into exoskeleton and endoskeleton.

Q.2. Define osteology.

Ans: The study of bones is called osteology.

Q.3. How many bones are there in human endoskeleton?

Ans: There are 206 bones in human endoskeleton.

Q.4. Name two types of elements of human skeleton.

Ans: Cartilage and bones.

Q.5. Enlist various functions of human endoskeleton.

Ans: i. Shape: Human endoskeleton gives definite shape to the body.

ii. Protection: Internal vital organs like heart, brain, lungs, etc. are protected by skeleton.

iii. Surface for attachment: The bones and cartilages provide surface for the attachment of muscles and also acts as a system of levers.

iv. Locomotion: They also help in the movement of body parts and in locomotion.

v. Haemopoiesis: Red bone marrow present in ends of long bones and spongy bones help in the formation of RBCs and other blood cells.

vi. Reservoir: Bones act as store house of Ca, P, Mg, etc.

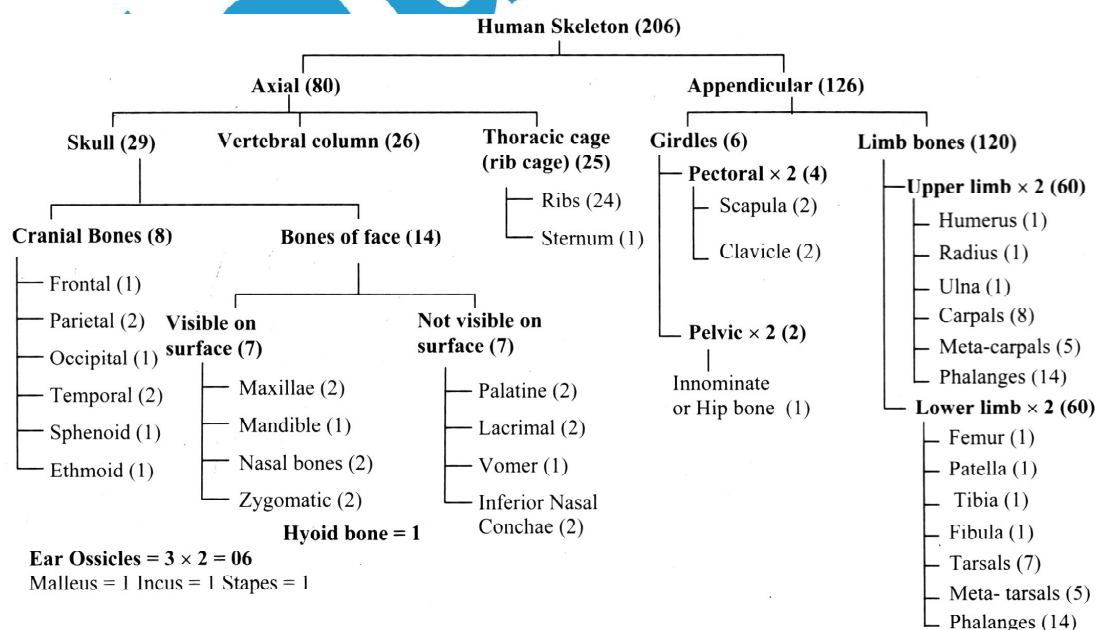
vii. Support: It gives support to the body organ.

viii. Weight: It bears the weight of the body.

14.1 : Human skeleton :

Q.6. Outline the parts of Human skeleton.

Ans:

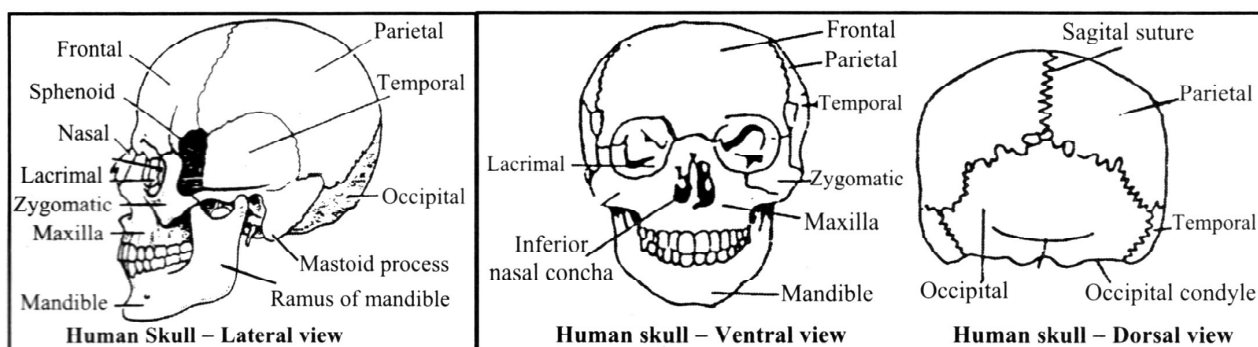


Q.7. How many bones are present in axial skeleton?

Ans: 80 bones are present in axial skeleton.

Q.8. Give an account of bones of human skull.

- Ans:**
- Skull is a part of axial skeleton consisting of 28 bones.
 - Human skull is dicondylar (presence of two occipital condyles at the base of the skull).
 - The only bone movable in skull is mandible.
 - It has parts like - cranium, face, ear ossicles.
 - Functions:**
 - It protects the brain.
 - It provides sockets for ear, nasal chamber and eyes.
 - Skull provides proper shape to head and face.
 - Mandible bone helps in opening and closing of the mouth.



Q.9. How many bones are there in skull?

Ans: 28 bones are present in skull.

Q.10. Why is human skull dicondylar?

Ans: As it has two occipital condyles at the base, human skull is dicondylar.

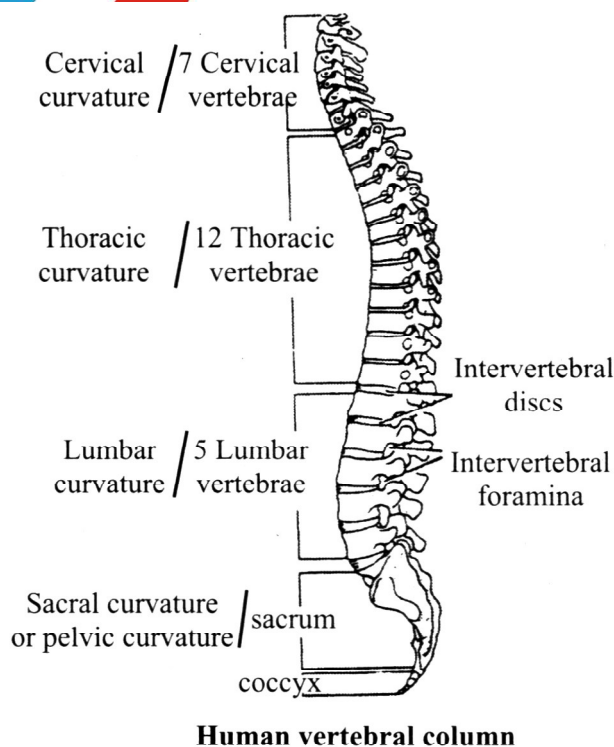
Q.11. Give a brief account of vertebral column.

Ans: Vertebral column consists of following vertebrae:

- Neck region (Cervical curve):** There are 7 cervical vertebrae.
- Back of chest (Thoracic curve):** There are 12 thoracic vertebrae.
- Back of abdomen (Lumbar region):** Lumbar region consists of 5 lumbar vertebrae.
- Hip region:** It consists of sacrum. In adult, 5 sacral vertebrae are fused to form sacrum.
- End part:** 4 coccygeal (tail bone) vertebrae are found in adult to form coccyx. Hip region and end part together form sacral curve.

Human vertebral column consists of a chain of 33 small ring like bones called vertebrae. However, in adult 5 sacral vertebrae are fused to form a sacrum and 4 coccygeal vertebrae are fused to form a coccyx. Thus in adult, vertebral column consists of 26 bones.

Human vertebrae are flat at both the surfaces of centrum, i.e. amphiplatyan.



Human vertebral column

Q.12. Enlist different types of vertebrae present in vertebral column.

Ans: The different types of vertebrae are:

- i. cervical vertebrae ii. thoracic vertebrae iii. lumbar vertebrae
- iv. sacral vertebrae v. coccygeal vertebrae

Q.13. How many types of curvatures are present in vertebral column of humans?

Ans: Human vertebral column shows four curvatures, viz:

- i. Cervical curvatures: consists of 7 cervical vertebrae
- ii. Thoracic curvatures: consists of 12 thoracic vertebrae
- iii. Lumbar curvatures: consists of 5 lumbar vertebrae
- iv. Sacral curvatures: consists of 5 sacral vertebrae which are fused in adult to form a sacrum and 4 coccygeal vertebrae fused in adult to form a coccyx.

Q.14. Man has an erect posture, why?

Ans: The four curves of the vertebral column (cervical, thoracic, lumbar and sacral) help to maintain the erect posture of the body.

Q.15. State the significance of curvatures of vertebral column.

Ans: Significance of curvatures of vertebral column:

- i. The curvatures help in maintaining erect posture of the body.
- ii. They also give more strength to the vertebral column.
- iii. They also provide flexibility to the vertebral column.
- iv. They also allow bending movement of the body at different regions.
- v. The 'S' shaped curvatures of the vertebral column and inter-vertebral spaces absorb shocks and do not allow it to pass to the head.

Q.16. Explain the structure of thoracic cage. Also enlist its functions.

- Ans:**
- i. The bony thoracic cage consists of 12 thoracic vertebrae, 12 pairs of ribs and a sternum.
 - ii. There are 12 pairs of ribs present laterally.
 - iii. Ribs are connected by intercostal muscles.
 - iv. Ribs are articulated dorsally with 12 thoracic vertebrae and ventrally with sternum.

Functions:

- i. It gives proper shape to the thorax.
- ii. It helps in breathing movements along with muscular diaphragm.
- iii. It protects the heart and lungs.
- iv. Attachment of muscles of neck, thorax and diaphragm.
- v. Supports pectoral girdle, helps in articulation with fore limb bones.

Q.17. Name the breast bone.

Ans: Sternum

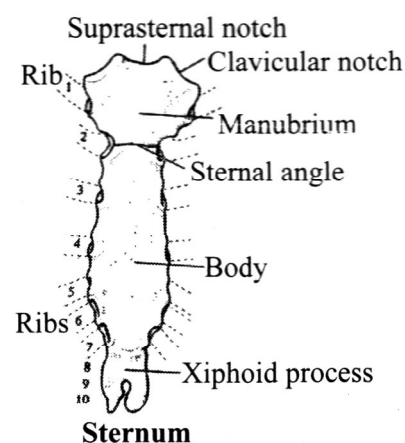
Q.18. List the bones forming thoracic cage.

- Ans:**
- i. Thoracic vertebrae ii. 12 pairs of ribs iii. Sternum

Q.19. Explain the structure and function of sternum with the help of suitable diagram.

Ans: Sternum (breast bone):

- i. Sternum is long and flat shaped bone.
- ii. In adult; it measures about 15 - 17 cm in length.
- iii. Location: It is present in mid-ventral region.
- iv. It is divided into three parts:
 - a. **Manubrium:**
It is uppermost part of sternum and looks like neck tie.



b. **Body:**

It bears lateral notches for articulation with 3rd to 7th pairs of ribs.

c. **Xiphoid process:**

It is the inferior narrow part of the sternum.

Q.20. Describe appendicular skeleton.

Ans: Appendicular skeleton:

- i. Appendicular skeleton is a part of endoskeleton. It helps in articulating the appendages of the body.
- ii. Appendicular skeleton has 126 bones. It consists of pectoral and pelvic girdle as well as bones of forelimbs and bones of hind limbs.
- iii. Pectoral girdle is made up of two symmetrical halves. Each half of pectoral girdle consists of two bones, scapula and clavicle. Pelvic girdle consists of two large hip bones or innominate bones which are articulated in midline by cartilagenous joint called pubic symphysis. Each hipbone is formed by ossification of ilium, pubis and ischium.
- iv. Each forelimb has 30 bones. Humerus, radius-ulna in forearm, 8 carpals, 5 metacarpals, 14 phalanges in five fingers.
- v. Each hindlimb has 30 bones, i.e. femur in thigh, tibia and fibula in shank regions, 1 patella, 7 tarsals, 5 metatarsals and 14 phalanges.

Q.21. How many bones are present in appendicular skeleton?

Ans: Appendicular skeleton contains 126 bones.

Q.22. How many bones are present in forelimb of man?

Ans: 30 bones are present in forelimb of man.

Q.23. Name the bones of forelimb.

Ans: Humerus, Radius-ulna and bones of hand.

14.2 : Locomotion :

Q.24. How many kinds of movements are observed in human beings?

Ans: In human beings, two kinds of movements are observed:

- i. Internal movements
- ii. Locomotion

Q.25. Describe the internal movements of the body and state their significance.

- Ans:**
- i. Internal movements include movements of body parts, which may be voluntary or involuntary.
 - ii. There are three different types of internal movements:
 - a. Peristaltic movement: It takes place in alimentary canal as well as constriction and dialation of blood vessels, etc.
 - b. Cardiac movement: It includes contraction and relaxation of heart by cardiac muscles.
 - c. **Muscular movement:** Movement of limb, head and trunk are controlled by voluntary or skeletal or striated muscles. Movement of eyeball is also included in this type of movement.

Significance:

- i. Body movements help to maintain equilibrium against gravity.
- ii. Functions such as food intake, speech are controlled by muscles.
- iii. Movements of diaphragm and rib cage help in breathing.
- iv. Rhythmic movement of heart helps in circulation of blood.

Q.26. Enlist the various actions that are included under locomotion.

Ans: Locomotion includes actions like walking, running, creeping, swimming, hopping, flying, leaping and jumping.

Q.27. Define Locomotion.

Ans: The change in locus of whole body of living organism from one place to another is called locomotion

(locus = position).

Q.28. How is human locomotion controlled?

- Ans:** i. Human locomotion is controlled by the combined action of bones, joints and skeletal muscles.
 ii. During locomotion, bones serve as lever, joints as fulcrum and the skeletal muscles generate energy in the form of ATP.

Q.29. Mention the basic types of locomotion found in animal kingdom.

Ans: Basic types of locomotion found in animal kingdom are:

- Amoeboid movement: performed by pseudopodia. e.g. Leucocytes.
- Ciliary movement: performed by cilia. e.g. ciliated epithelium, (Paramecium).
- Whorling movement: performed by flagella. e.g. sperms, (Euglena).
- Muscular movement: performed by muscles. e.g. man.

Q.30. State the significance of locomotion.

Ans: Significance of locomotion:

- It enables the animals to escape from predators.
- It helps the animals to move about in search of food, water and shelter.
- It enables the animals in mating for reproduction.
- It protects the animal from any danger or unfavourable surroundings.
- It improves the chances of survival of individuals and continuation of the race.

Q.31. Define the following:

i. Joint

Ans: A place where two or more bones get articulated with one another is called a joint.

ii. Ligament

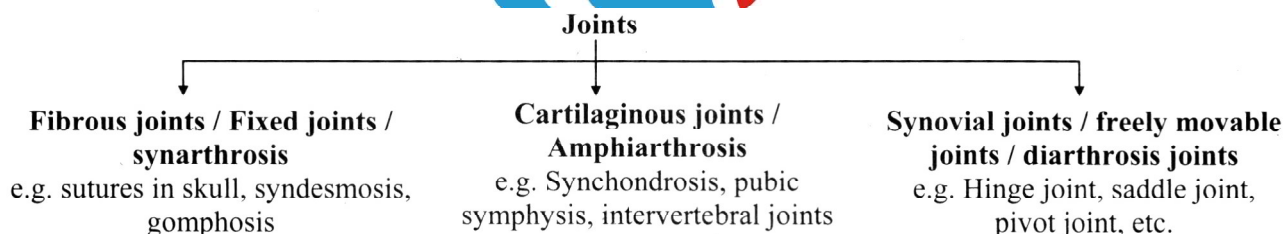
Ans: A sheet or band of tough elastic fibrous tissue connecting bone to bone at joint is called ligament.

iii. Arthrology

Ans: Branch of biology which deals with structure and function of various joints is called arthrology.

Q.32. Enlist main types of joints and give the basis on which they are classified.

Ans: There are three main types of joints based on the structure and degree of mobility of the joints:



Q.33. Give two important characteristics of:

- Fibrous joints**
- Cartilagenous joints**
- Synovial joints**

Ans: i. Fibrous joints / Fixed joints / synarthrosis:

- These are immovable or fixed joints.
- Articulating bones are firmly held together by dense layer of white fibrous connective tissue.
- They do not allow any movement.
- The line of fusion at joint is called suture.
e.g. sutures in skull, syndesmosis, gomphosis.

ii. Cartilaginous joints / Amphiarthrosis:

- They are also called amphiarthrosis or imperfect or slightly movable joints.
- They are called amphiarthrosis because they are neither fixed nor freely movable.
- Articulating bones are joined by thick elastic pads of fibro-cartilage.

- d. It is intermediate stage of joints when related to development and movement.
- e. The line of fusion between articulating bones is called synchondrosis or symphysis.
e.g. Synchondrosis, pubic symphysis, intervertebral joints.

iii. Synovial joints / freely movable joints / diarthrosis / perfect joints:

- a. These are called perfect/movable joints because they permit different kinds of movement.
- b. The connecting bones are covered by a smooth layer of hyaline cartilage.
- c. Between the articular surface of bone, there is a joint cavity filled with synovial fluid.
- d. Articulating bones are held in position by ligament.
e.g. Hinge joint, saddle joint, pivot joint, etc.

Q.34. Give two examples of cartilaginous joint.

Ans: Intervertebral disc, pubic symphysis.

Q.35. Distinguish between fibrous joints and cartilaginous joints.

Ans:

No.	Fibrous joints	Cartilaginous joints
i.	These joints are also called synarthrosis.	These joints are also called amphiarthrosis.
ii.	These are immovable or fixed joints.	These are slightly movable joints.
iii.	The bones are joined by thin or dense layer of white fibrous connective tissue.	The bones are joined by thick elastic pads of fibro-cartilage.
iv.	The line of fusion at joint is called suture.	The line of fusion between articulating bone is called synchondrosis or symphysis.

Q.36. Distinguish between fibrous joint and synovial joint.

Ans:

No.	Fibrous joint	Synovial joint
i.	In this joint, bones are united together by dense bands of fibrous tissue.	In this joint, synovial fluid is present between two bones.
ii.	In this type, bones are immovable.	In this joint, bones are freely movable.
iii.	Example: Sutures	Example: Ball and Socket joint

Q.37. Explain the significance of joints.

- Ans:**
- i. Joints help in locomotion.
 - ii. They also assist in desirable voluntary movements of body parts.
 - iii. Joints provide flexibility in rigid skeleton.
 - iv. Some joints are protective and act as shock absorbers.

Q.38. Write a note on synarthrosis.

- Ans:**
- i. Articulating bones are firmly held together by thin or dense layer of white fibrous connective tissue.
 - ii. The white fibres are made up of a protein collagen.
 - iii. These joints are fixed, i.e. they do not allow any movement of articulating bones.
 - iv. Short and thick fibres do not allow movement of articulating bones.
 - v. The line of fusion of joint is called suture.
 - vi. They are mainly meant for growth and may permit moulding during child birth.

Q.39. Which suture is present between parietal bones and occipital bone?

Ans: Lambdoidal suture is present between parietal bones and occipital bones.

Q.40. Which suture is present between frontal and parietal bones?

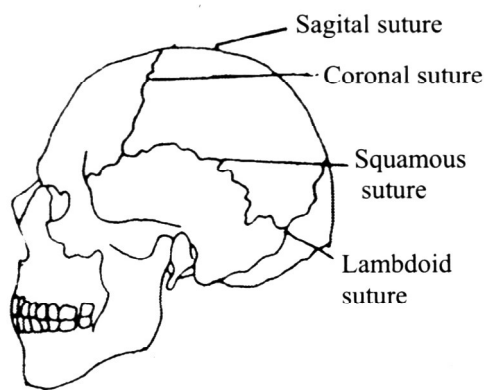
Ans: Coronal suture is present between frontal and parietal bones.

Q.41. Which suture is present between parietal bones?

Ans: Sagittal suture is present between parietal bones.

Q.42. Write a short note on sutures of skull.

- Ans:**
- These joints are found in flat and curved roofing bones of the skull.
 - The bones are repeatedly interlocked, therefore the joints become more fixed and protective in function.
 - The prominent sutures between cranial bones of skull are:
 - Coronal suture:** It is found in between frontal bone and parietal bone.
 - Sagittal suture:** It is present between two parietal bones.
 - Lambdoid suture:** It is found between parietal and occipital bones.
 - Lateral suture:** It is present between temporal and parietal bones.

**Human skull****Q.43. Which suture is present between temporal and parietal bones?**

Ans: Lateral suture is present between temporal and parietal bones.

Q.44. Why are sutures immovable?

Ans: Sutures are white fibrous joints which bind the bones very strongly. Hence, they are immovable.

Q.45. Define syndesmoses.

Ans: The fibrous connective tissue that connects two bones is known as syndesmoses.

Q.46. What are fontanelles?

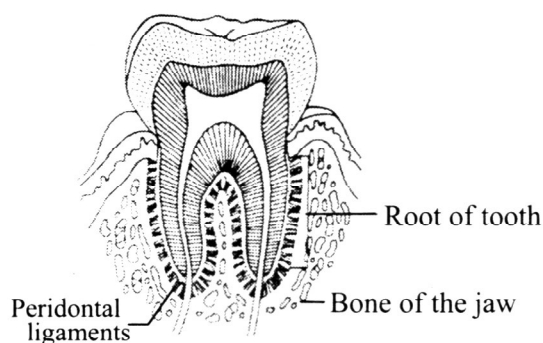
Ans: In newborn and infants, the roofing bones of the skull leave about six gaps called fontanelles. Fontanelles permit moulding during child birth and also provide flexibility for brain growth and parturition. After about 2 years age, the gaps are closed by ossification of membrane.

Q.47. Describe gomphosis with a suitable diagram and example.

Ans: Gomphosis

- Gomphosis joint is also known as peg and socket joint.
- It is the characteristic teeth of thecodont.
- The roots of teeth are fixed in cavities/alveoli of jaw bones.
- The fibrous connections in this case are many short periodontal ligaments.

Example: Tooth joint.

**Gomphosis (Root in bony socket)****Q.48. Describe two types of cartilaginous joints with examples.**

Ans: On the basis of types of connecting cartilage, amphiarthrosis/cartilaginous joints are divided into two types:

- Symphysis
- Symphysis

i. Synchondrosis:

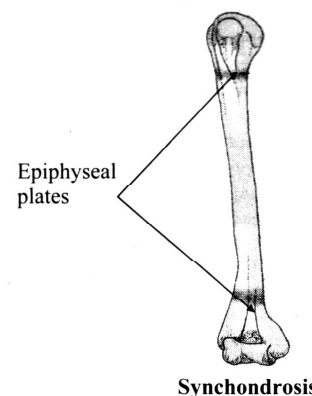
The connecting material is a hyaline cartilage.

It is very soft and elastic with minimum strength. e.g. Epiphyseal plate.

This epiphyseal plate is present between epiphysis and diaphysis of the long bones.

It is a temporary joint present in children and it gets ossified in adult.

Function:



This joint provides the sites and means for growth of the long bones in children.

It also contributes to the flexibility of the endoskeleton of children.

When the growth period is over, these joints tend to ossify and become immovable in adult.

ii. Symphysis:

The connecting material is a fibrocartilage.

Fibrocartilage is an opaque, comparatively strong but flexible structure, due to the presence of numerous white fibres of collagen.

For e.g. symphysis.

Symphysis is present in front of the pelvic region, between two similar pubic bones of the pelvic girdle.

The pubic bones are connected by a disc of fibrocartilage.

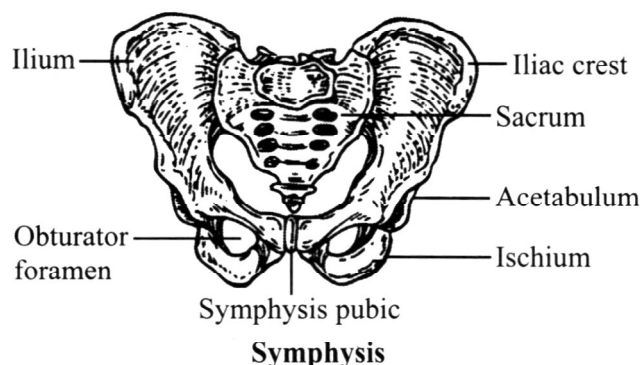
Functions:

It allows slight movements on compression, bending, twisting, etc.

It makes the joint more flexible.

In females, it helps to increase the size of the birth canal for easy parturition.

In males, it is comparatively less flexible.



Q.49. What is the function of Intervertebral joints?

Ans: Function of Intervertebral joints:

- Shock absorption.
- Protects spinal cord from mechanical injury.
- Make the vertebral column slightly flexible.

Q.50. Why pubic symphysis is flexible in women?

- Ans:**
- Women give birth to children and this process occurs through birth canal.
 - Birth canal is adjacent to pubic symphysis.
 - In females, it helps to increase the size of birth canal for easy parturition.
 - Hence, pubic symphysis is more flexible in women.

Q.51. Why are diarthroses called perfect joints?

Ans: Diarthroses are called perfect joints due to the presence of well-developed structures needed for free movements.

Q.52. Describe a typical synovial joint with a neat labelled diagram.

Ans: Typical Synovial joint:

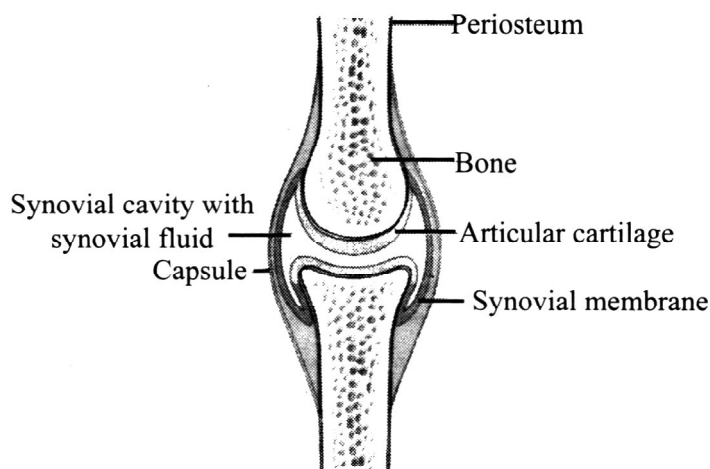
It consists of a synovial cavity, synovial fluid, synovial membrane, capsule, ligaments and articulating surfaces covered by a hyaline cartilage.

i. Synovial membrane:

It lines synovial cavity and forms a synovial capsule.

The membrane secretes a slimy viscous fluid called synovial fluid.

The membrane encloses a fluid filled synovial cavity that protects the internal parts of the joint.



Typical synovial or perfect joint

It contains fat cells, which form a cushion during the movement of the joint. Typical synovial or perfect joint

ii. Synovial fluid:

It is a clear, yellowish, slimy and viscous fluid similar to lymph.

The viscosity of the fluid is due to hyaluronic acid secreted by the cells of the synovial membrane.

It contains nutrients and mucus.

The fluid lubricates the joint and nourishes a vascular hyaline cartilage.

The fluid also contains phagocytes which remove microbes and cellular debris.

Deficiency of this fluid causes arthrosclerosis.

iii. Hyaline cartilage:

It covers the end of the articulating surfaces of the bone and prevents direct contact or friction between the bones.

iv. Ligaments:

The joints are provided with capsular ligaments and numerous accessory ligaments.

Accessory ligament may be intra or extra capsular.

Ligaments help to avoid dislocation of bones and make the joints stronger.

Q.53. What is the function of a ligament?

- Ans:** i. Ligaments keep the bones in proper position at joints.
ii. They avoid dislocation of bones during the movement.

Q.54. Which type of movable joint makes the hip joint?

Ans: Ball and socket joint makes the hip joint.

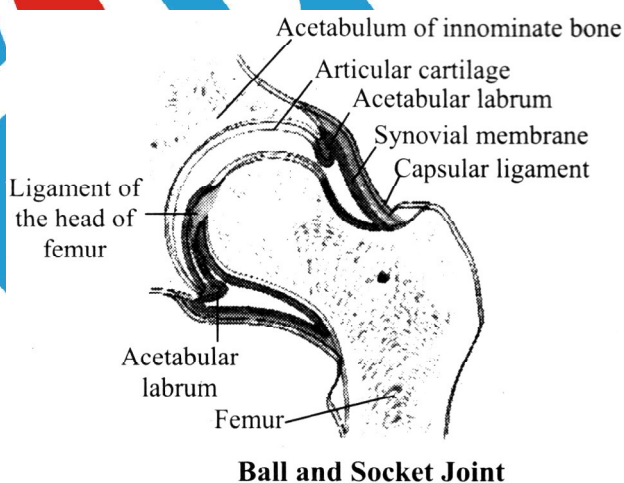
Q.55. Describe ball and socket joint and hinge joint.

Ans: Ball and socket joint:

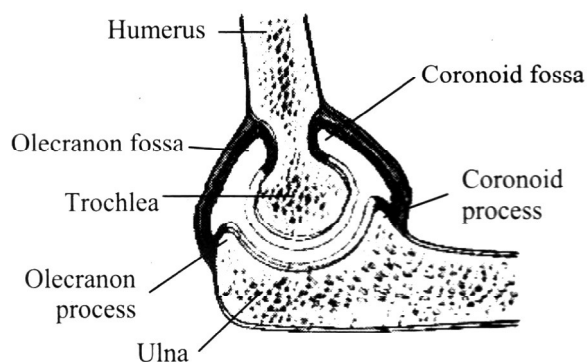
- It is also known as spheroidal joint or Enarthroses.
- In ball and socket joint, spherical head of one bone fits into a cup-shaped socket of another bone.
- These joints tend to get easily dislocated on sudden strain.
- These joints allow multi-axial movements like circumduction.
- The shoulder joint allows rotatory or circular movements (360°) and hip joint allows straight movement (180°).
- Example: Shoulder joints, hip joint.

Hinge joint:

- Hinge joints have spoon shaped surface of one bone fitting into the concave cavity of the other bone.
- The bones are held together by strong collateral ligaments.
- These joints resist dislocation.
- Hinge joints permit uniaxial (180°) movements like flexion - extension. These joints resemble the movements of a door or window.
- In the elbow joint, the ulna works as a hinge, so only forward movement is possible.



Ball and Socket Joint



Hinge Joint

- vi. In the knee joint, the patella or knee cap works as a hinge, so only backward movement is possible.
- vii. e.g. Elbow joint, Knee joint.

Q.56. Write a note on gliding joint.

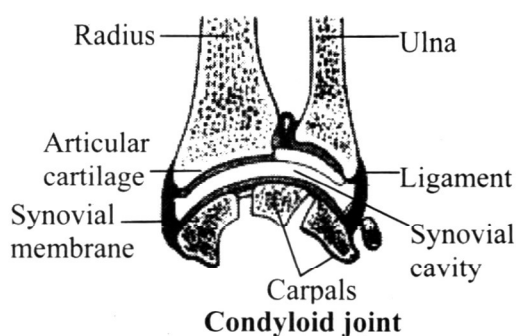
Ans: Gliding joint:

- i. The articular surfaces are plane and hence appear to glide over each other.
- ii. It is often referred to as displaying ice-on-ice type movement.
- iii. These joints allow non-axial movements, which are neither back-forth nor side to side but irregular.
- iv. The articulating surface is convex, so friction is avoided.
- v. e.g. Intercarpal joint, intertarsal joint.

Q.57. Describe condyloid joint with the help of suitable diagram.

Ans: Condyloid joints:

- i. These are also called ellipsoid joints.
- ii. In condyloid joint, oval shaped condyle of one bone fits into the elliptical cavity of the other bone.
- iii. These joints allow biaxial movements i.e. forward - backward and side to side but not rotation
- iv. e.g. Radius-carpal joints, metacarpo-phalangeal joints.



Q.58. Distinguish between Ball and socket joint and hinge joint.

Ans:

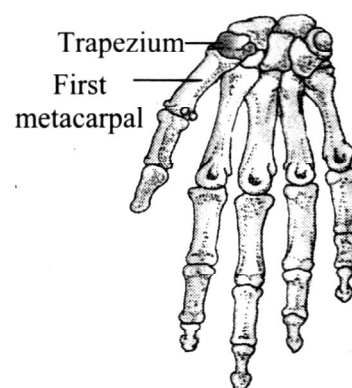
No.	Ball and socket joint	Hinge joint
i.	In ball and socket joint, one bone like ball fits into socket like cavity of another bone.	In hinge joint, spoon shaped structure fits into concave cavity of the other bone.
ii.	It allows multiaxial movement	It allows uniaxial movement
iii.	Ball and socket joint are prone for easy dislocation or separation	Hinge joint resist dislocation.
iv.	It allows circular(360°) and straight movement(180°)	Movement of these joints resembles movement of door and window.

Q.59. Give examples of Hinge joint.

Ans: Elbow joints, knee joints.

Q.60. Write a short note on saddle joint.

- Ans: i.** The articulating surfaces of bones in saddle joints are saddle shaped, i.e. each surface has both concave and convex area.
- ii. Each surface has convexity in one plane and concavity in perpendicular plane.
 - iii. Saddle joint allows biaxial movements, i.e. flexion - extension and adduction - abduction but not rotation.
 - iv. The edge of the metacarpal and the first phalange of the thumb is peripherally articulated so the saddle joint makes a free movement.
 - v. e.g. Carpo-metacarpal joint of thumb.



Q.61. Give the significance of saddle joint.

- Ans: i.** Saddle joint is the most flexible joint of the body.
- ii. It has evolutionary significance in human evolution.
 - iii. It increases grasping power of hands.

- iv. It makes hands skillful for writing, drawing, painting, etc.

Q.62. Saddle joint has evolutionary significance. Explain.

- Ans:** i. Saddle joint is the most flexible joint in human body.
 ii. Joint in phalanges and metacarpal is a saddle joint.
 iii. Due to this joint, human beings are able to perform skillful work like writing, drawing, etc.
 iv. It increases grasping power of fingers.
 v. This joint distinguishes human beings from other living beings.
 vi. Hence, saddle joint has evolutionary significance.

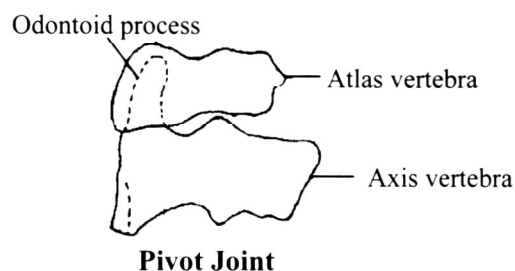
Q.63. Give one example of saddle joint.

Ans: Carpo-metacarpal joint of thumb.

Q.64. Write a short note on pivot joint.

Ans: Pivot joint:

- i. The articular surface in pivot joint comprises of a central bony pivot (dense), surrounded by an osteoligamentous ring.
 ii. One bone remains fixed, while the other bone rotates freely around the pivot shaped process of fixed bone.
 iii. It allows uniaxial movement, i.e. rotation.
 iv. e.g. First and second cervical vertebrae, Atlas-axis (Atlanto-axial joint).
 v. Atlas moves along with skull around the pivot like rotational movement of the skull.



Q.65. Name the type of joint between the following:

- i. Atlas - axis.

Ans: Pivot joint

- ii. Carpal/metacarpal of thumb.

Ans: Saddle joint

- iii. Between phalanges.

Ans: Hinge joint

- iv. Femur/acetabulum.

Ans: Ball and socket joint

- v. Between axial bones.

Ans: Sutures

- vi. Between pubic bones in the pelvic girdle.

Ans: Pubic symphysis (cartilaginous joint)

14.3 : Muscular movements :

Q.66. Define contractility.

Ans: The property of shortening of muscular tissue is called contractility.

Q.67. What are the various properties of muscular tissue?

Ans: The various properties of muscular tissues are:

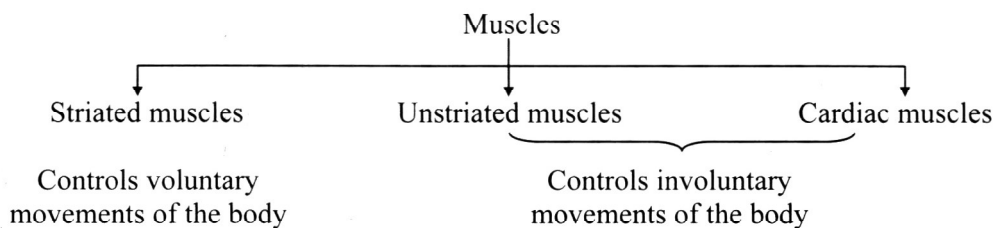
- i. contractility ii. extensibility iii. elasticity
 iv. flexibility v. conductivity

Q.68. Define muscle fibres.

Ans: The muscular tissue consists of highly elongated modified cells called muscle fibres.

Q.69. Classify muscles on the basis of movements.

Ans: Muscles can be classified on the basis of movements as:



Q.70. What are voluntary movements? Give few examples.

Ans: The movements of body parts carried under the control of our will are called voluntary movements.
e.g. Movements of limbs, movement of head, etc.

Q.71. Distinguish between myosin and actin filaments.

Ans:

No.	Myosin filament	Actin filament
i.	Their thickness is more as compared to actin.	These are thinner than myosin in filaments.
ii.	They are made up of meromyosin.	They are made up of filamentous proteins.
iii.	They are more in number.	They are fewer in number.

Q.72. What is the functional contractile unit of muscle?

Ans: Sarcomere, a part of myofibril is the functional contractile unit of muscle.

Q.73. Define sliding filament theory of muscle contraction.

Ans: The sliding filament theory states that contraction of muscle fibres involves inward sliding of thin (actin) filaments over thick (myosin) filaments.

Q.74. Name any two contractile proteins of the filaments of muscle fibre.

Ans: Myosin and actin are two contractile proteins of filaments of muscle fibre.

Q.75. Write a short note on contractile proteins.

- Ans:**
- Muscle fibres are made up of many myofibrils.
 - Each myofibril has many myofilaments made up of proteins, actin and myosin.
 - The contractile unit of muscles are sarcomeres.
 - Actin filament is thin and made up of a pair of filamentous protein (F) which is a polymer of globular (G) actins.
 - Myosin filaments are thick and they are made up of many meromyosins.
 - Each meromyosin is made up of globular head with short arm called heavy meromyosin (HMM) and tail called light meromyosin. (LMM)
 - Head shows an active ATPase enzyme and has binding site for ATP and active site for actin.

Q.76. Describe the important steps in muscle contraction.

- Ans:**
- Mechanism of muscle contraction is best explained by sliding filament theory.
 - It states that during muscle contraction, sliding of thin filaments over thick filaments take place.
 - Nerve ending of motor neuron innervates each muscle. The junction between motor neuron and sarcolemma of muscle fibre is called motor end plate.
 - At the axonic ends, neurotransmitter called acetylcholine is released on getting signals from CNS.
 - It generates an action potential in the sarcolemma. It causes release of Ca^{++} with troponin on actin filaments and removes masking of active site of actin filaments which are present between myosin filaments.
 - It results in shortening of sarcomere by reducing I band. Myosin releases ADP and becomes relaxed.
 - Again, whole process is repeated causing further sliding. This continues till Ca^{++} ions are pumped. When Ca^{++} ions are pumped back, the masking of actin filaments takes place.
 - Repeated activation of muscles leads to accumulation of lactic acid. It is due to anaerobic breakdown of glycogen causing muscle fatigue.

Q.77. How many muscles are present in human body?

Ans: Total 640 muscles are present in human body.

Q.78. What is tendon?

Ans: Tendon is an inelastic thick band of white fibrous connective tissue which give firm attachment to muscle with bone.

Q.79. Explain the location and structure of striated muscles.

Ans: Location of striated muscles:

The muscles which moves a body part usually do not lie in that part but are located in the upper part.
e.g. Biceps and triceps, that move forearm are located in the upper arm.

Structure of striated muscles:

At any joint, two types of bones are present, i.e. stationary and movable.

The end of muscle attached to stationary bone is called origin, while the opposite end attached to movable bone is called insertion.

The middle thick part of muscle is called belly.

All the fibres in a muscle do not extend from end to end and there is maximum concentration in the middle.

Thus, large muscles are most often fusiform in shape.

Q.80. Give an account of striated muscles and its types.

- Ans:** i. Striated muscle fibres are elongated, cylindrical, unbranched, multinucleated.
ii. They show striation due to alternate dark and light bands.
iii. The striated muscle fibres are covered by modified cell membrane called sarcolemma.
iv. The striated muscle fibres are packed in the connective tissue into distinct bundles called muscle bundles.
v. Each muscle bundle contains many fasciculi and each fasciculus contains bundle of muscle fibres. Striated muscles are found attached to the skeleton by means of tendons.

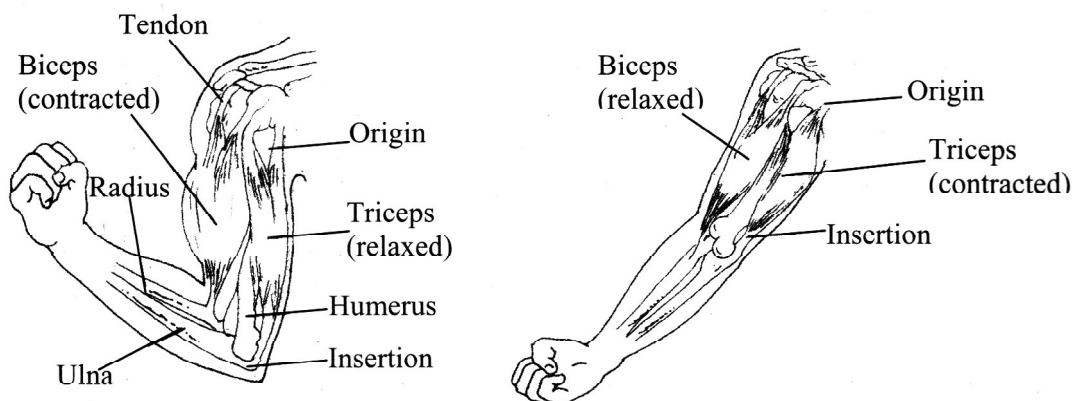
Types of striated muscles:

On the basis of movements, striated muscles are of three types:

- i. **Prime movers (agonist):** It brings initial movement of the concerned part, e.g. biceps.
- ii. **Antagonist:** It opposes the action of prime movers, e.g. Triceps.
- iii. **Synergist:** It assists prime movers, e.g. brachialis assist biceps.

Q.81. Explain the working of skeletal muscles of upper arm.

- Ans:** i. Muscles work in pair and produce opposite action to each other.
e.g. Biceps (flexors) bring flexion and triceps (extensors) bring extension of elbow joint.
ii. The muscles, which bring opposite action are called antagonistic.
iii. If one member of a pair is capable of bending the joint by pulling of bones, the other member is capable of straightening the same joint also by pulling.
e.g. Biceps and triceps of upper arm are antagonistic to each other.
iv. In antagonistic pair of muscles, one member is much stronger than the other.
e.g. The biceps which flex the arm are stronger than the triceps which extend it.
The fundamental characteristic of muscle is contraction. Therefore, muscle can only pull and not push the bone.
vi. The response or contraction of striated muscles is quick and for short duration.
vii. These muscles are prone to fatigue and neurogenic in nature.



Antagonistic muscle movement

Q.82. Name some antagonistic muscles and explain their functions.

Ans: Some antagonistic muscles with examples and their functions are as follows:

No.	Name	Functions
i.	Flexor	On contraction, results in bending or flexion of a joint.
	Extensor	On contraction, results in straightening or extension of a joint.
ii.	Abductor	It moves body part away from the body axis.
	Adductor	It moves body part towards the body axis.
iii.	Pronator	To turn the palm downward backward.
	Supinator	To turn the palm upward forward.
iv.	Levator	Raises a body part.
	Depressor	Lowers the body part.
v.	Protractor	To move forward.
	Retractor	To move backward.
vi.	Sphincters	For closure and opening.

Q.83. Name the antagonistic muscles of upper arm of human being.

Ans: Biceps and triceps are the antagonistic muscles of upper arm of human being.

Q.84. What are involuntary movements?

Ans: Involuntary movements are not under the control of our will and is controlled by Autonomous Nervous System (ANS).

Q.85. Explain neurogenic and myogenic muscles with examples.

Ans: Neurogenic muscles are those in which impulses originate from the nervous system and their actions are also controlled by nervous system. e.g. Visceral muscles.

Myogenic muscles are those which are of muscular origin. e.g. Cardiac muscles.

Q.86. Explain the movement of visceral muscles.

- Ans:**
- The visceral muscles are present in the walls of the visceral organs.
 - These muscle cells are elongated, spindle shaped, non-striated and uninucleated.
 - These are arranged in longitudinal and circular layers.
 - These are neurogenic and on receiving motor impulses from the Autonomous Nervous System (ANS), these muscle layers show alternate contraction and relaxation.
 - These muscles control the involuntary movements of the visceral organs.
 - Visceral muscles do not get fatigued because their contractions are slow and for longer duration.
 - e.g. Contraction of the urinary bladder, constriction and dilation of the blood vessels, peristaltic movements of the alimentary canal, gastric movements of the stomach.

Q.87. Explain the movement of cardiac muscles.

- Ans:**
- Cardiac muscles control the movements of the heart, i.e. contraction and relaxation of heart.
 - They are present in the wall of the heart, i.e. myocardium.
 - Cardiac muscle fibres are elongated, cylindrical, striated, uninucleate, involuntary and branched.
 - Muscle-fibres are connected to each other by intercalated discs.
 - These muscle fibres are arranged in the form of a network.
 - These muscles are myogenic because the impulse of contraction originates in the muscle node itself.
 - Once stimulated, these muscles show continuous, rhythmic contraction and relaxation.
 - These muscles are also immune to fatigue due to longer duration of relaxation than contraction period.

14.4 : Skeletal disorders :**Q.88. Write a short note on muscular dystrophy.**

- Ans:**
- It is a genetic disorder.
 - It is characterized by progressive skeletal muscle weakness, defects in muscle protein and death of muscle fibres and tissue.
 - Internal muscles such as the diaphragm are not affected.
 - The most common form of muscular dystrophy is Duchene type.

Note:**Duchene dystrophy:**

It is X-linked form of muscular dystrophy.

It causes muscle degeneration, difficulty in walking, breathing and ultimately death.

Only males are affected though females can be carriers.

The incidence is 1 in 3000.

Q.89. Define arthritis.

Ans: Inflammation of joints due to degeneration of cartilages is called arthritis.

Q.90. Name the disorder caused due to accumulation of uric acid in joints.

Ans: Gout is caused due to accumulation of uric acid in joints.

Q.91. Name any two disorders of skeletal system.

Ans: Arthritis and Osteoporosis.

Q.92. What is Osteoporosis? Name two factors which are responsible for osteoporosis.

- Ans:**
- Osteoporosis is an age dependent systemic disorder.
 - Bones become porous due to low bone mass.
 - Skeleton fails to bears stress of the body.

Factors responsible for osteoporosis:

- Deficiency of calcium and vitamin D.
- Imbalance of hormones like sex hormones, steroid hormones etc.

Q.93. What is Osteoarthritis? Name any two body parts usually affected by this disease.

- Ans:**
- It is a degenerative joint disease.
 - It is characterized by degeneration of articular cartilage and proliferation of the new bones.
 - It usually affects joints of knees, hands and spine.

Q.94. What is arthritis? Explain its types.

- Ans:**
- It is a disease of bone.
 - Inflammation of joints occurs in this disease.
 - It is of three types:
 - Rheumatoid arthritis: Inflammation of synovial membrane.
 - Gouty arthritis: Excessive uric acid get accumulated in joints.
 - Osteoarthritis: Degeneration of cartilage pads and joints becomes stiff.

Q.95. What is myasthenia gravis? What are causative reasons for this disease?

- Ans:**
- It is an autoimmune disease.
 - In this disease, antibodies are produced which block and bind to acetylcholine receptors of neuromuscular junction.
 - Transmission of nerve impulse to the muscle fibre is blocked. Due to this, extensive muscle weakness occurs.

Q.96. What are symptoms of myasthenia gravis?

- Ans:**
- Facial muscles, eye, eyelid movements are affected in this disease.
 - Affected facial muscles causes difficulty in swallowing, chewing and speech.
 - Degree of muscle weakness varies from local to general.

Q.97. Explain the cause and symptoms of tetany.

Ans: Tetany is a state in which impulses from nerves arrive to the skeletal muscle in rapid succession, resulting in summation of action potential causing steady contractions.

Causes: Low serum levels of calcium due to reduced activity of parathyroid glands.

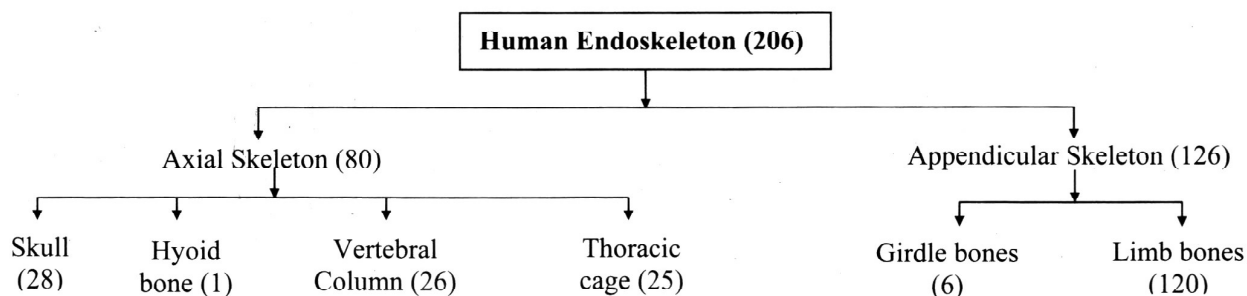
Symptoms: Patients suffer from persistent contraction of skeletal muscles.

Additional Theory Questions :

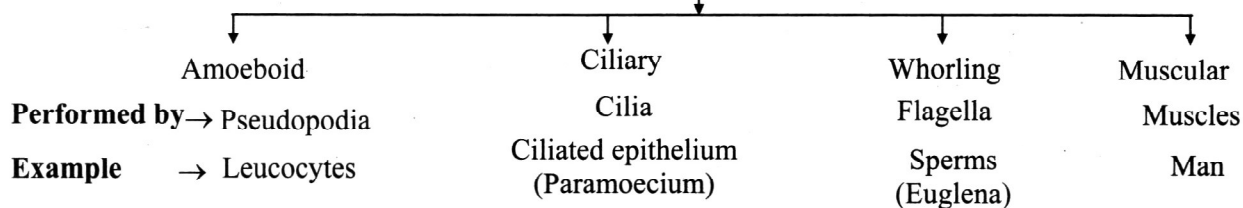
- Write a short note on Spondylosis. Refer Q.48. (i)
- Write a short note on symphysis. Refer Q. 48.(ii)
- Sketch and label typical synovial joint. Refer Q.52.
- Write a short note on ball and socket joint. Refer Q.55.
- With the help of a neat labelled diagram, describe the hinge joint. Refer Q.55.
- Explain the mechanism of muscle contraction. Refer Q.76.

Quick Review :

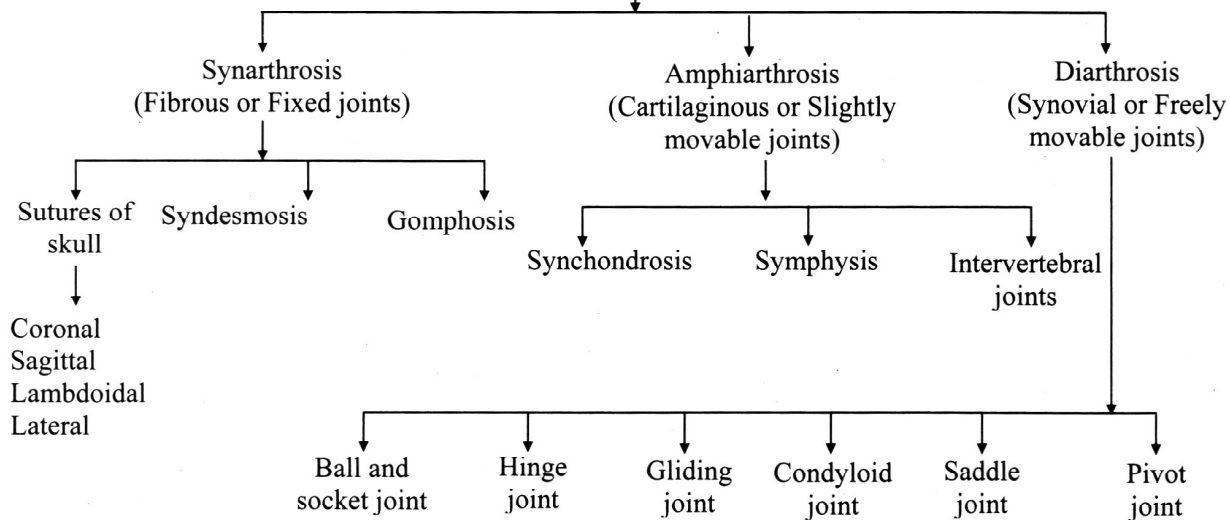
- Endoskeleton is made up of bones and cartilages. Human skeleton consists of 206 bones.
- The endoskeleton is divided into two parts: Axial and Appendicular skeleton.
- Axial skeleton is formed of skull, hyoid, vertebral column, sternum and ribs.
- Appendicular skeleton consists of pectoral girdle and bones of upper limbs.
- Locomotion is the movement of organism from place to place.
- Locomotion is brought about by muscles with the help of bones, joints and lever systems.
- Joints are of four main types: Hinge joint (elbow), Ball and Socket joint (shoulder and hip joints), pivotal joint (skull and first two vertebrae), gliding joints (wrist and ankle)
- Muscles can contract and relax but cannot be pushed. Hence, they are always arranged in antagonistic pairs. One contracts or bends (Flexor) the organ, while the other relaxes (extensor) extending the organ.
- Movements are of two types- Voluntary and Involuntary.



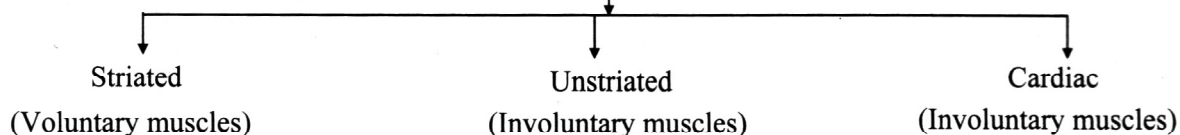
Types of locomotion in Animal Kingdom



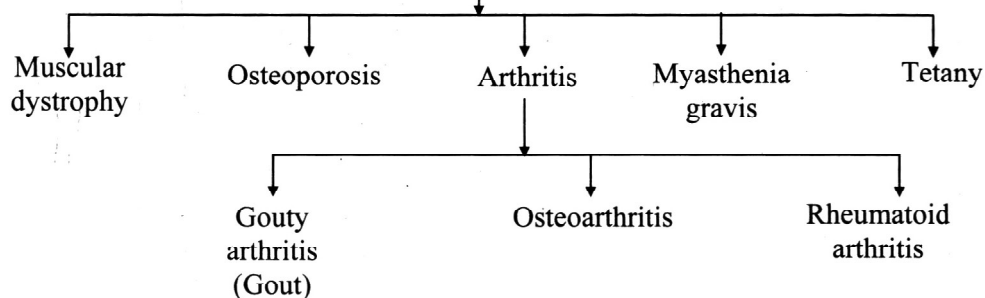
Joints



Type of Muscles



Skeletal disorders



Multipal Choice Question's

- Human adult endoskeleton consists of how many bones?
a) 270 b) 250
c) 206 d) 240
- Which among the following is a bone of skull?
a) Sphenoid b) Patella
c) Ischium d) Scapula
- Which of these is not a skull bone?
a) Frontal b) Scapula
c) Occipital d) Temporal
- Face is formed of how many bones?
a) 18 b) 12
c) 14 d) 10
- The smallest bone in man's skeleton is
a) palatine b) patella
c) stapes d) nasal
- The only movable bone in the skull is
a) maxilla b) frontal
c) mandible d) sphenoid
- Skull of man is
a) monocondylic b) dicondylic
c) tricondylic d) acondylic
- Total number of vertebrae in human beings is
a) 22 b) 33
c) 24 d) 12
- The coccyx of vertebral column is formed normally by the fusion of
a) four vertebrae b) nine vertebrae
c) eight vertebrae d) seven vertebrae
- In mammals, the number of cervical vertebrae are
a) 10 b) 12
c) 5 d) 7
- Locomotion is co-ordinate action of
a) bone and muscles
b) bone, joint and muscles
c) joint of muscles
d) bone and joint
- Locomotion in sperms takes place with the help of
a) flagella b) cilia
c) pseudopodia d) muscles
- Study of joints is called
a) Arthrology b) Archeology
c) Ornithology d) Anthropology
- Bones act as _____ during locomotion.
a) levers b) fulcrum
c) pulleys d) points
- The joints between the cranial bones are called
a) Apertures b) Hairlines
c) Sutures d) Fractures
- At birth, there are gaps in between the bones of skull called
a) Spaces b) Fontanelles
c) Cavities d) Ventricles
- Sutures on the skull are _____ joints.
a) freely movable b) slightly movable
c) fixed d) synovial
- Immovable joint is in between the bones of
a) frontal and parietal
b) metacarpal and phalangeal
c) femur and tibia
d) radius and ulna
- Syndesmosis is a
a) fibrous joint b) cartilaginous joint
c) synovial joint d) movable joint
- Gomphosis is the name of which joint?
a) Ball and socket joint
b) Gliding
c) Hinge
d) Peg and socket joint
- Slightly movable joints are known as
a) synarthrosis b) amphiarthrosis
c) diarthrosis d) synostosis
- Intervertebral joint is an example of
a) fibrous joint
b) synovial joint
c) cartilaginous joint
d) none of these
- Intervertebral disc consists of
a) fibrous connective tissue
b) fibrous cartilage
c) calcified cartilage
d) bone
- Synovial fluid is present in
a) freely movable joint
b) fixed joint
c) slightly movable joint
d) cartilaginous joint
- A synovial cavity is found in
a) human brain
b) synchondrosis
c) peg and socket joint
d) ball and socket joint
- Two articulating bones are connected by
a) tendon b) cartilage
c) ligament d) fibres

27. Elbow joints are ____ joint.
a) slightly movable b) immovable
c) freely movable d) movable
28. Elbow joint is
a) ball and socket joint
b) hinge joint
c) suture joint
d) gliding joint
29. Gliding joint is present between
a) femur and tibia b) axis and atlas
c) between carpals d) fibula
30. What is the collective name of wrist bones?
a) Tarsals b) Ribs
c) Carpals d) Vertebra
31. Pivot joint is present in
a) carpometacarpal joints
b) elbow joint
c) between atlas and axis
d) intervertebral joint
32. Sarcolemma is a membrane found over
a) heart
b) nerve fibre
c) cardiac muscle
d) skeletal muscle fibre
33. Contraction of muscles results from
a) a contraction of myosin molecules
b) the sliding of the actin and myosin filaments into each other
c) the formation of peptide bonds that link actin and myosin
d) contraction of actin molecules
34. Immediate source of energy for muscle contraction comes from
a) glycogen b) glucose
c) ATP d) creatine phosphate
35. Human body consists of about ____ different types of muscles.
a) 640 b) 460
c) 540 d) 400
36. Muscles attach to the bone with the help of
a) ligament b) cartilage
c) tendon d) movable
37. The biceps and triceps muscles are found in
a) hilum b) sternum
c) glenoid cavity d) forearm
38. Working of skeletal muscles is
a) gonistic
b) antagonistic
c) synergists
d) none of the above
39. Levator muscles result into the action of
a) lowering a body part
b) tensing a body part
c) relaxing a body part
d) raising a body part
40. Find the odd pair of antagonistic muscles.
a) Flexor-Extensor
b) Adductor-Abductor
c) Pronator-supinator
d) Protractor-dilator
41. Osteoporosis is characterized by
a) pore formation in skin
b) loss of calcium from bones
c) degeneration of cartilage pad
d) abnormal granule formation in synovial fluid
42. Inflammation of joint is called
a) Chondritis b) Poliomyelitis
c) Arthritis d) Synovitis
43. An autoimmune disorder in which an antibody reduces the efficiency of transmission between the motor neuron is called
a) Myasthenia Gravis
b) Tetany
c) Osteoarthritis
d) Osteoporosis
44. If one bone on one side of ball and socket joint is humerus, bone / bony structure on the other side must be
a) tibia b) ulna
c) scapula d) pelvic girdle

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Answer Keys

1. c)	2. a)	3. b)	4. c)	5. c)	6. c)	7. b)	8. b)	9. a)	10. d)
11. b)	12. a)	13. a)	14. a)	15. c)	16. b)	17. c)	18. a)	19. a)	20. d)
21. b)	22. c)	23. b)	24. a)	25. d)	26. c)	27. d)	28. b)	29. c)	30. c)
31. c)	32. d)	33. b)	34. c)	35. a)	36. c)	37. d)	38. b)	39. d)	40. d)
41. b)	42. c)	43. a)	44. c)						

