DAY TWENTY THREE

Movement and Locomotion

Learning & Revision for the Day

- Movement
- Locomotion
- Muscles
- Muscle Contraction
- Common Terms of Muscle Physiology
- Human Skeletal System
- Joints
- Disorders of Muscular and Skeletal System

Movement

It is one of the fundamental characteristics of all living beings, because non-living objects do not move themselves. The movements of living things are autonomic (self-sustained) while, the movements of a non-living object are induced (due to external force). The cells of human body show three types of movements as follows

(i) **Amoeboid movement** helps in food capture and change of place in unicellular organisms like *Amoeba*. The leucocytes (phagocytes and macrophages) of the human lymphatic system also show this type of movement.

(ii) **Ciliary movement** is the characteristic of ciliated protozoans like *Paramecium*. It is also found in starfish, respiratory tract of human, Fallopian tubes of females and vasa efferentia of males.

(iii) **Muscular movement** is used by at most vertebrates, including human. The characteristic of this is to exert a force by alternate contraction and relaxation, e.g. movement of our limbs, jaws, tongue, etc.

Locomotion

- It is the movement of individual from one place to another, e.g. walking, running, creeping, swimming, flying, etc.
- It helps an individual in shifting from an unfavourable surroundings to favourable one, for food intake, defence against predators, etc.

Muscles

- It is a specialised tissue of mesodermal origin.
- About 40-50% of the body weight of an adult human is contributed by muscles.
- They have special properties like elasticity, excitibility, contractibility and extensibility.
- Muscle tissue contains about 75% water, 20% proteins, 5% non-proteins organic matter and minerals. Potassium is the most abundant mineral element in muscle.
- The red coloured, oxygen carrying iron-protein pigment of muscle is called **myoglobin**. It has only one haeme group.
- Depending upon the presence or absence of myoglobin muscle fibre can be of two types
  (i) The myoglobin content is high in some muscles, which gives them reddish appearance and they are called as **red fibres** or **aerobic muscles**.
  (ii) Some of the muscles possess very less myoglobin, hence are pale in appearance or white. These are called **white fibres**. They depend on anaerobic process of respiration.

Differences Between Red and White Muscle Fibres

Red Muscle Fibre	White Muscle Fibre
They are thin.	They are much thicker.
Rich in mitochondria.	Poor in mitochondria.
Dark red as they contain the haem protein myoglobin.	Light in colour as they lack myoglobin.
Their myoglobin store O_2 as oxymyoglobin that releases O_2 for oxidation during muscle contraction.	They do not store oxygen.
Get energy for contraction by aerobic respiration.	Get energy for contraction mainly by anaerobic respiration.
They accumulate a little amount of lactic acid.	They accumulate high amount of lactic acid during strenuous work.
They undergo slow sustained contraction for long periods.	They undergo fast contraction for short periods.
They are not fatigued with work, e.g. extensor muscles of the back in man.	They soon get fatigued with work, e.g. eyeball muscles.

Types of Muscles

On the basis of the location of muscle cells (fibres), vertebrate muscles are broadly classified into three groups:

1. Striated or Skeletal or Voluntary Muscles

- They are typically organised into strong and compact bundles or bands.
- These are called skeletal muscles because they are attached to the skeletal elements and are responsible for movement of trunk, appendages, respiratory organs, eyes, mouthparts and so on.
- Skeletal muscle fibres are extremely long, cylindrical and multinucleate cells that may reach from one end of the muscle to the other.
- These are packed into bundles called **fascicles** (*L. fasciculus*, small bundle), which are enclosed by tough connective tissue called **perimycium**.
- The fascicles are in turn grouped into a discrete muscle, surrounded by a thin connective tissue layer called **epimycium**.
- Most skeletal muscles taper at their ends, where they connect to bones by **tendons**. Other muscles such as the ventral abdominal muscles are in the form of flattened sheets.
- On the basis of type of movement, skeletal muscles are of following types
  - **Flexor** that bend one part of a limb on another at a joint, e.g. biceps.
  - **Extensor** that straighten a limb, e.g. triceps.
  - **Adductor** bring a limb towards the mid-line of the body, e.g. latissimus dorsi.
  - **Abductor** pulls a limb away from the mid-line of the body, e.g. deltoideus.
  - **Pronator** turns the palm downward, e.g. pronator teres.
  - **Suprinator** turns the palm upward, e.g. suprinator.

2. Unstriated or Smooth or Visceral or Involuntary Muscles

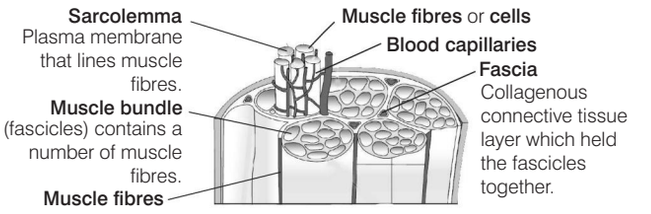
- They lack the striations as seen in skeletal muscle.
- Smooth muscle cells are long, tapering, spindle-shaped and contain a single centrally located nucleus.
- Each fibre has an envelope, which is derived from plasma membrane.
- Smooth muscle cells are organised into sheets of muscles circling the walls of the alimentary canal, blood vessels, respiratory passages, urinary and genital ducts.
- These muscles are typically slow acting and can maintain prolonged contractions with very little energy expenditure.
- It is under the control of the autonomic nervous system thus, unlike skeletal muscles, its contractions are involuntary and unconscious.
- The principal functions of smooth muscles are to push the material in a tube, such as the intestine, along its way by active contractions or to regulate the diameter of a tube, such as a blood vessel, by sustained contraction.

3. Cardiac or Heart Muscles

- These are found in heart wall.
- Structurally, they resemble striated muscles but functionally, they resemble smooth muscles.
- Each cardiac fibre is a short, cylindrical and uninucleate structure. They are placed end to end in rows.
- Intercalated disc or *zig-zag* junction occurs in between two fibres of cardiac muscles and these fibres are covered by sarcolemma and somehow branched.
- Cardiac muscles are fast acting muscles and they contract under the involuntary autonomic control.

Structure of Skeletal Muscles

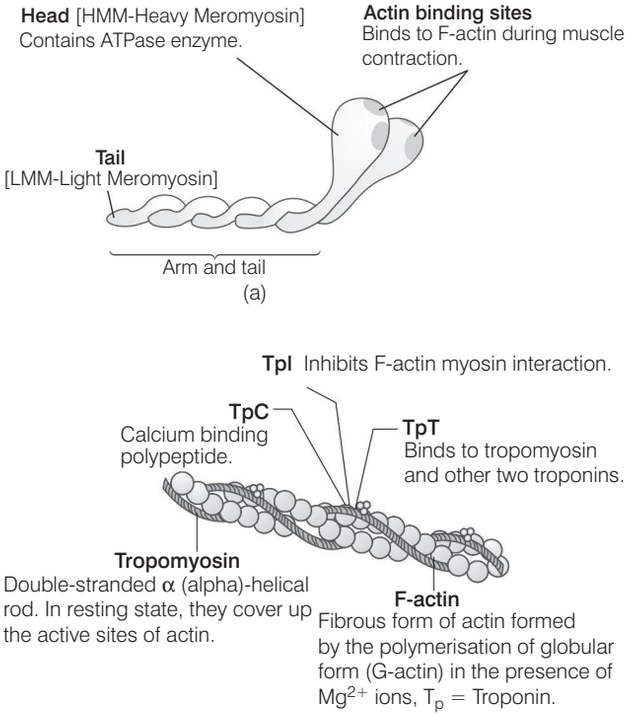
- Skeletal muscle is made up of a number of muscle bundles or fascicles held together by a connective tissue layer called **fascia**.
- Each muscle fibre is lined by sarcolemma enclosing the sarcoplasm.
- A large number of filaments are parallely arranged called **myofilaments** or **myofibrils**.
- Each myofibril has alternate light and dark bands on it.
- The light bands contain actin and is called **I-band** or **isotropic band**, whereas the dark bands contain myosin and called **A-band** or **anisotropic band**.
- Actin filaments are thinner as compared to the myosin filaments, hence are also called **thin** and **thick filaments,** respectively.
- The thin filaments are firmly attached to the 'Z' line in the centre.
- The 'A' and 'I' bands are arranged alternately throughout the length of the myofibrils.



Syncytium fibres (as its sarcoplasm contains many nuclei and calcium ions). Contains parallely arranged filaments in sarcoplasm called myofibrils.

Diagrammatic cross-sectional view of a muscle

- The portion of the myofibril between two successive Z-lines is considered as the functional unit of contraction and is called a **sarcomere**.
- In a resting state, the edges of thin filaments on either sides of the thick filaments partially overlap the free ends of the thick filaments leaving the central part of the thick filaments. This central part of the thick filament, not overlapped by thin filament is called the **H-zone**.
- The protein part of the muscles can be divided into the myofibrillar proteins, which make up about 50-55% of the total and are responsible for the actual contraction of muscles.
- The major proteins are myosin, actin, tropomyosin and troponin. **Actin** is a globular protein. In the presence of ATP, G-actin causes hydrolysis of ATP and aggregates into a double helical structure called F-actin, which interacts with troponin and tropomyosin.



Diagrammatic representation of (a) Myosin filament (b) Actin filament

- **Troponin** is made up of three subunits. One set of three troponin subunits is associated with each molecule of tropomyosin and is involved with the activity of seven actin molecules.
- **Myosin** is a polymerised protein made of many monomeric proteins called meromyosins. It is composed of 6 polypeptide chains, 2 identical heavy chains and 4 light chains. 2 heavy chains wrap spirally to form a double helix whose one end forms 2 globular heads and other elongated end forms tail.

Muscle Contraction

- It is initiated by a signal sent by the Central Nervous System (CNS) *via* a motor neuron.
- The mechanism of muscle contraction is best explained by **sliding-filament theory**.

- The junction between a motor neuron and the sarcolemma of the muscle fibre is called the **neuromuscular junction** or **motor-end** plate.
- At junction, a neurotransmitter- acetylcholine generates an action potential in the sarcolemma.
- Utilising the energy from ATP hydrolysis, the myosin head now binds to the exposed active sites on actin to form a cross bridge, which pulls the attached actin filaments towards the centre of A-band.
- The Z-line attached to these actins are also pulled inwards thereby causing a shortening of sarcomere, i.e. contraction, the I-bands get reduced, whereas A-band retains the length.
- A new ATP binds and the cross-bridge is broken.
- The ATP is again hydrolysed by the myosin head and the cycle of cross-bridge formation and breakage is repeated causing further sliding.
- The process continues till the Ca^{2+} ions are pumped back to the sarcoplasmic cisternae resulting in the masking of actin filaments.
- This causes the return of Z-lines back to the original position, i.e. relaxation.
- Repeated activation of muscles can lead to the accumulation of lactic acid due to the anaerobic breakdown of glycogen in them, causing fatigue.

Common Terms of Muscle Physiology

The muscles play a variety of roles in working of body. The various common terms of muscle physiology are as follows

(i) **Motor unit,** collectively refers to the muscles fibres and the motor neuron that supplies them.

(ii) **Muscle twitch** can be defined as a response to a single brief stimulus. It consists of three phases, e.g. latent phase (0.01 s), contraction phase (0.04 s) and relaxation phase (0.05 s).

(iii) **Refractory period** is the period, during which a muscle will not respond is called the refractory period.

(iv) **Tetanus** is a continued state of contraction caused by rapid succession of many stimuli.

(v) **Muscle fatigue** is the inability of a muscle to contract due to the depletion of its chemical and lactic acid accumulation by repeated contraction.

(vi) **Threshold intensity or Rheobase** is the nerve impulse of intensity required to stimulate a motor unit so as to produce a contraction.

(vii) **All or None law** states that, if a muscle fibre contracts in response to a stimulus, it contracts maximally or not at all.

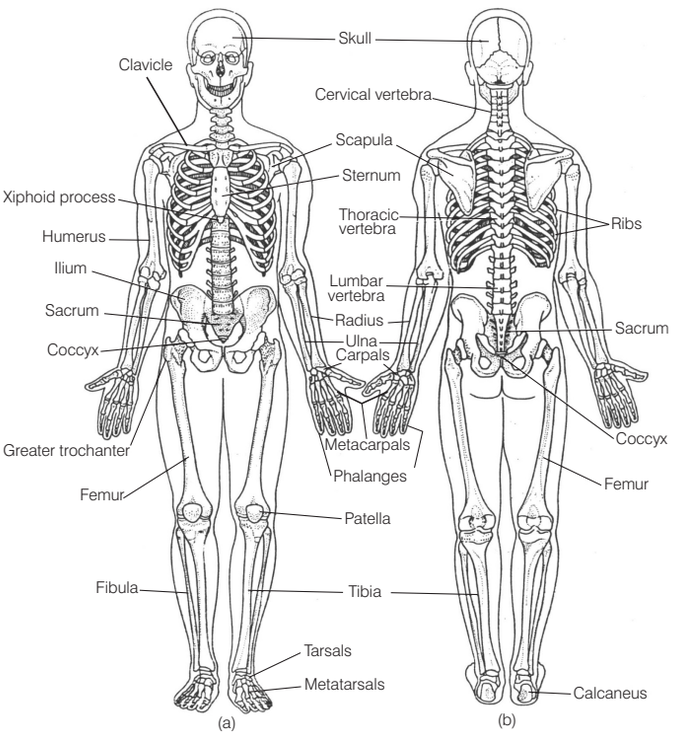
(viii) **Kymograph** is the apparatus used to record muscle contraction.

Human Skeletal System

The total number of bones in adult human is 206. The **axial skeleton** of human consists of 80 bones and the **appendicular skeleton** of human consists of 126 bones. Different types of bones of skeleton are

- **Long bones,** e.g. humerus, radius, femur, etc.
- **Short bones**, e.g. metacarpals of palm and metatarsals, phalanges.
- **Flat bones,** e.g. scapula, sternum, cranial bones.
- **Irregular bones,** e.g. vertebrae, carpals, tarsals.
- **Femur** is the longest bone, while **stapes** is the smallest bone.
- **Fibula** is the thinnest bone.
- **Tibia** is skin bone. Tibia-fibula is the longest bone in frog.
- **Funny bone** is found in the bend of elbow.

NOTE Fibrocartilage is the shortest cartilage.



Structure of human skeleton

Important Bones in Human Skeleton

Part of Body	Part of Endoskeleton	Region	Name of Bone
I. **Axial Skeleton** (Total Bones 80)			
Head	Skull	Cranium	• Occipital(1) • Parietal (2) • Frontal (1) • Temporal (2) • Sphenoid (1) • Ethmoid (1)
		Facial region	• Nasal (2) • Vomer (1) • Turbinal (2) • Lacrymal (2) • Zygomatic (2) • Palatine (2) • Maxilla (2) • Mandible (1)
		Ear ossicles	• Malleus (2) • Incus (2)
			• Stapes (2)
		Hyoid	• Hyoid body (1)
Backbone	Vertebral column	Neck	• Cervical vertebrae (7)
		Thorax	• Thoracic vertebrae (12)
		Waist	• Lumbar vertebrae (5)
		Sacrum	• Sacral vertebrae or Sacrum (5 in child) (1)
		Tail	• Caudal vertebrae or coccyx (4 in child) (1)
Thorax	Sternum	–	• Sternum (1)
	Ribs	–	• True ribs (14) • False ribs (6) • Floating ribs (4)
II. **Appendicular Skeleton** (Total Bones 128)			
Thorax	Pectoral girdle	Shoulder	• Scapula (2) • Clavicle (2)
Hip	Pelvic girdle		• Innominate (2)
Forelimbs		Upper arm	• Humerus (2)
		Forearm	• Radius-ulna (4)
		Wrist	• Carpals (16)
		Palm	• Metacarpals (10)
		Fingers	• Phalanges (28)
Hindlimbs		Thigh	• Femur (2)
		Shank	• Tibio-fibula (4)
		Knee	• Patella (2)
		Ankle	• Tarsals (14)
		Sole	• Metatarsals (10)
		Fingers	• Phalanges (28)

Functions of Skeleton System

Functions of skeletal system are as follows

- It provides support to the body.
- It provides delicate support to internal organs, such as heart, brain and lungs.
- It provides surface for muscles attachment.
- It helps in blood cells formation.
- It acts as the storehouse of minerals such as calcium and phosphorus.
- It also helps in breathing and hearing.
- The skeleton protects many vital organs.
- The skull protects the brain, eyes, and middle and inner ears.
- The vertebrae protects the spinal cord.
- The ribcage, spine and sternum protect the lungs, heart and major blood vessels.
- The clavicle and scapula protect the shoulder.
- The ilium and spine protect the digestive and urogenital system and the hip.
- The patella and the ulna protect the knee and the elbow, respectively.
- The carpals and tarsals protect the wrist and ankle, respectively.
- Extremities of long bones possess hyaline cartilage. These bones function in support, erythrocyte and leucocyte synthesis.

Joints

A joint is the point of contact between bones. **Arthrology** is the study of joints. Joints can be classified into three types

1. Immovable Joints (Fibrous or Synarthrose)

- In these joints, the adjoining bones are joined by strong bundles of collagen fibres, so that, the bones cannot move freely.
- The bones of the skull articulate with one another with a type of immovable joint called **suture**.
- Articulation of teeth with mandible and maxillae. Here, peg-shaped roots fit into cone-shaped sockets in the jawbones.
- Articulation between the first pair of ribs and the breast bone.

2. Slightly Movable Joints (Cartilaginous)

- In these joints, there is a pad of fibro-cartilage between two adjoining bones, which allows very slight movements.
- These are also called symphysis, e.g. joints between pubic bones of pelvic girdles and the joints between the vertebrae (intervertebral disc).

3. Freely Movable Joints (Synovial)

- In these joints, the movement is possible in one or other directions. The ends of articulating bones are covered by smooth articular cartilages. A synovial cavity is present between two bones, which is filled with a gelatinous **synovial fluid**.
- These joints are further classified according to the types of movements

(i) **In ball and socket joint**, the ball-like head of one bone fits into the socket or the concavity of the other. In this, movements are possible in all directions For example,

(a) Shoulder joint between head of humerus and glenoid cavity of pectoral girdle.

(b) Hip joint between head of femur and acetabulum of pelvic girdle.

(ii) **In hinge joint,** a protuberance (condyle) at the end of one bone fits into corresponding depression of the other. A hinge joint allows movement in one plane only, similar to a door which opens and close by means of its hinges, e.g. ankle, knee and elbow joints and joints between phalanges of digits.

(iii) **In pivot or Rotatory or Trochoid joint**, one bone is fixed and bears a peg-like projection of pivot, while other bone fits over the pivot by a concavity and freely rotates around, e.g. head of the radius and capitulum of humerus, between atlas and axis of mammals.

(iv) **In saddle joint**, one bone of the joint shaped like a saddle and the other like the back of a horse.

These are like ball and socket joints but both ball and socket are poorly developed, i.e. movements take place in many directions, e.g. joint between metacarpal and carpal of thumb.

(v) **In gliding joint**, the articulating bones can slide upon one another at this joint, e.g. the joint between zygapophyses of successive vertebrae and between radio-ulna and carpals.

(vi) **In ellipsoid or Condyloid or Angular joint,** one bone is movable on another bone in two planes, back and forth and side to side, e.g. joint between radius and carpals and between skull and first vertebra.

Disorders of Muscular and Skeletal System

The muscular and skeletal system are prone to injury, wear and tear, inflammations and other metabolic dysfunctions. Some common disorders of muscular and skeletal system are as follows

1. **Muscular dystrophy** is the progressive degeneration of muscle fibres due to some genetic disorder leading to weakness and loss of mobility.
2. **Myasthenia gravis** is the chronic autoimmune disorder which affects the neuromuscular junction, in which the body produces antibodies that block the muscle from receiving messages from nerve cells. It leads to fatigue, weakening and paralysis of skeletal muscle.
3. **Tetany** is the rhythmic cramping of the muscle due to low Ca^{2+} (hypocalcemia) in body fluid.
4. **Arthritis** is the inflammation of joints leading to stiffness, swelling and pain in joint. Its various types are as follows
   - **Osteoarthritis** is caused due to the wearing away of the cartilage which covers the bones in the joints. It can affect middle aged and older people.
   - **Rheumatoid arthritis** is caused due to the inflammation of synovial membrane that protects and lubricated the joint. It affects individual of all age groups.
   - **Still's disease or Juvenile rheumatoid arthritis** is another kind of rheumatoid arthritis that occurs in younger people.

   There is no cure for arthritis. However, pain releiving (analgesic) drugs are available to give comfort.
5. **Gout** is the inflammation of joints due to the accumulation of uric acid. It is an inherited disorder of purine metabolism.
6. **Spondylitis** is a chronic inflammatory disorder that affects vertebrae causing pain and stiffness.
7. **Sprain** is the twisting of joint without dislocation.
8. **Dislocation** occurs when bones are forced out of a joint, often accompanied by sprains, inflammation and joint immobilisation.
9. **Cartilage tears** are caused when joints are twisted or when pressure is applied to them.
10. **Osteoporosis** is caused due to reduction in bone tissue mass, causing weakness of skeletal strength. It results from excessive resorption of calcium and phosphorus from the bone. Decreased level of oestrogen is a common cause for this.

DAY PRACTICE SESSION 1

FOUNDATION QUESTIONS EXERCISE

1 Macrophages and leucocytes exhibit

(a) ciliary movement (b) flagellar movement
(c) amoeboid movement (d) gliding movement

2 Muscle that bends one part over another is called

(a) extensor (b) flexor
(c) abductor (d) adductor

3 Abductor muscle is antagonist of

(a) adductor (b) flexor
(c) pronator (d) rotator

4 Name the ion responsible for unmasking of active sites for myosin for cross-bridge activity during muscle contraction. → NEET-II 2016

(a) Calcium (b) Magnesium
(c) Sodium (d) Potassium

5 The contractile protein of skeletal muscle involving ATPase activity is

(a) myosin (b) a-actinin
(c) troponin (d) tropomyosin

6 Smooth muscles are → NEET-II 2016

(a) involuntary, fusiform, non-striated
(b) voluntary, multinucleate, cylindrical
(c) involuntary, cylindrical, striated
(d) voluntary, spindle-shaped, uninucleate

7 What is sarcomere?

(a) Part between two H-lines (b) Part between two A-lines
(c) Part between two I-bands (d) Part between two Z-lines

8 Calcium is important in skeletal muscle contraction because it → NEET 2018

(a) detaches the myosin head from the actin filament
(b) activates the myosin ATPase by binding to it
(c) binds to troponin to remove the masking of active sites on actin for myosin
(d) prevents the formation of bonds between the myosin cross bridges and the actin filament

9 The correct statement regarding muscular tissue is

(a) muscular tissue is mesodermal in origin
(b) plasma membrane covering the muscle fibre is sarcolemma
(c) sarcomere, the functional unit of myofibril is the region between two Z-lines
(d) All of the above

10 The H-zone in the skeletal muscle fibre is due to → NEET 2013

(a) the absence of myofibrils in the central portion of A-band
(b) the central gap between myosin filments in the A-band
(c) the central gap between actin filaments extending through myosin filaments in the A-band
(d) extension of myosin filaments in the central portion of the A-band

11 Stimulation of a muscle fibre by a motor neuron occurs at → CBSE-AIPMT 2014

(a) the neuromuscular junction
(b) the transverse tubules
(c) the myofibril
(d) the sarcoplasmic reticulum

12 Long bones function in

(a) support
(b) support, erythrocyte and leucocyte synthesis
(c) support and erythrocyte synthesis
(d) erythrocyte formation

13 Which of the following is not a function of the skeletal system? → CBSE-AIPMT 2015

(a) Production of erythrocytes
(b) Storage of minerals
(c) Production of body heat
(d) Locomotion

14 The lower jaw in mammals is made up of

(a) mandible (b) dentary
(c) maxilla (d) angulars

15 The number of floating ribs, in the human body, is

(a) 6 pairs (b) 5 pairs
(c) 3 pairs (d) 2 pairs

16 Total number of bones in the hindlimb of man is

(a) 14 (b) 30
(c) 24 (d) 21

17 Which is a part of pectoral girdle?

(a) Glenoid cavity (b) Sternum
(c) Ileum (d) Acetabulum

18 Phalangeal/digital formula for human hand/foot is

(a) 0, 2, 2, 3, 3 (b) 0, 2, 3, 3, 3
(c) 2, 2, 3, 3, 3 (d) 2, 3, 3, 3, 3

19 The number of carpals per limb of human beings is

(a) 5 (b) 6 (c) 7 (d) 8

20 The only movable bone in the skull is

(a) maxilla (b) frontoparietal
(c) mandible (d) nasal

21 Number of bones in human axial skeleton is

(a) 80 (b) 100 (c) 106 (d) 126

22 What will happen if ligaments are cut or broken?

(a) Bones will move freely at joints
(b) No movement at joint
(c) Bone will become unfix
(d) Bone will become fixed

23 Extremities of long bones possess cartilage

(a) calcified (b) fibrous
(c) elastic (d) hyaline

24 A deltoid ridge occurs in

(a) radius (b) ulna
(c) femur (d) humerus

25 The optic foramen is located within the

(a) ethmoid bone (b) occipital bone
(c) palatine bone (d) sphenoid bone

26 Foramen magnum and occipital condyles are found in

(a) frontoparietal bone
(b) occipital bone
(c) prootic bones
(d) squamosal bone

27 The mastoid process is a structural prominence of

(a) sphenoid bone (b) parietal bone
(c) occipital bone (d) temporal bone

28 Inter-articulated disc is found in

(a) muscles of arms (b) vertebrae
(c) muscles of legs (d) pubic symphysis

29 Pectoral girdle constitutes

(a) scapula and clavicle
(b) radius and ulna
(c) ilium and ischium
(d) maxilla and mandible

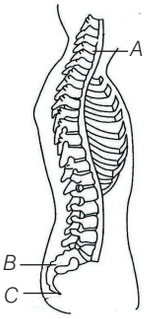
30 A fractured coracoid process would involve the

(a) clavicle (b) scapula
(c) ulna (d) radius

31 Out of '*X*' pairs of ribs in humans only '*Y*' pairs are true ribs. Select the option that correctly represents values of *X* and *Y* and provides their explanation. → NEET 2017

(a)	$X = 12, Y = 7$	True ribs are attached dorsally to vertebral column and ventrally to the sternum.
(b)	$X = 12, Y = 5$	True ribs are attached dorsally to vertebral column and sternum on the two ends.
(c)	$X = 24, Y = 7$	True ribs are dorsally attached to vertebral column, but are free on ventral side.
(d)	$X = 24, Y = 12$	True ribs are dorsally attached to vertebral column, but are free on ventral side.

32 Identify *A*, *B* and *C* in the given diagram and choose the correct option.



(a) *A*–Cervical vertebrae, *B*–Coccyx, *C*–Sacrum
(b) *A*–Cervical vertebrae, *B*–Coccyx, *C*–Atlas
(c) *A*–Cervical vertebrae, *B*–Coccyx, *C*–Axis
(d) *A*–Cervical vertebrae, *B*–Sacrum, *C*–Coccyx

33 Acetabulum forms

(a) hip joint (b) shoulder joint
(c) knee joint (d) elbow joint

34 Elbow joint is

(a) ball and socket joint (b) hinge joint
(c) suture joint (d) gliding joint

35 The pivot joint between atlas and axis is a type of → NEET 2017

(a) fibrous joint (b) cartilaginous joint
(c) synovial joint (d) saddle joint

36 Which of the folowing joints would allow no movement? → CBSE-AIPMT 2015

(a) Fibrous joint (b) Cartilaginous joint
(c) Synovial joint (d) Ball and socket joint

37 Synovial fluid that lubricates a synovial joint is produced by

(a) a meniscus (b) the synovial membrane
(c) a bursa (d) the articular cartilage

38 The joint of radio-ulna with the upper arm is

(a) hinge joint (b) pivot joint
(c) socket joint (d) None of these

39 Select the correct matching of the type of the joint with the example in human skeletal system. → CBSE-AIPMT 2014

	Types of Joint	Example
(a)	Cartilaginous joint	Between frontal and parietal
(b)	Pivot joint	Between third and fourth cervical vertebrae
(c)	Hinge joint	Between humerus and pectoral girdle
(d)	Gliding joint	Between carpals

40 Cartilaginous joints

(a) permit slight movements
(b) are found in symphysis
(c) are found in the bodies of vertebrae
(d) All of the above

41 Lack of relaxation between successive stimuli in sustained muscle contraction is known as → NEET-I 2016

(a) fatigue
(b) tetanus (tetany)
(c) tonus
(d) spasm

42 Myasthenia gravis is a …*A*… disorder affecting …*B*… junction leading to fatigue, weakening and paralysis of skeletal muscle.

Fill in the blanks *A* and *B* with an appropriate option.

(a) *A*–autoimmune, *B*–neuromuscular
(b) *A*–liver, *B*–neuromuscular
(c) *A*–spleen, *B*–neuromuscular
(d) *A*–bone and muscle, *B*–neuromuscular

43 Which of the following hormones can play a significant role in osteoporosis? → NEET 2018

(a) Oestrogen and parathyroid hormone
(b) Progesterone and aldosterone
(c) Aldosterone and prolactin
(d) Parathyroid hormone and prolactin

44 Select the correct statement regarding the specific disorder of muscular or skeletal system. → CBSE-AIPMT 2012

(a) Muscular dystrophy – Age related shortening of muscles
(b) Osteoporosis –Decrease in bone mass and higher chances of fractures with advancing age
(c) Myasthenia gravis –Autoimmune disorder which inhibits sliding of myosin filaments
(d) Gout –Inflammation of joints due to extra deposition of calcium

45 Osteoporosis, an age-related disease of skeletal system, may occur due to → NEET-II 2016

(a) immune disorder affecting neuromuscular junction leading to fatigue
(b) high concentration of Ca^{2+} and Na^{+}
(c) decreased level of oestrogen
(d) accumulation of uric acid leading to inflammation of joints

46 Match the following columns.

	Column I		Column II
A.	Sternum	1.	Synovial fluid
B.	Glenoid cavity	2.	Vertebrae
C.	Freely movable joint	3.	Pectoral girdle
D.	Cartilaginous joint	4.	Flat bones

Codes

	A	B	C	D		A	B	C	D
(a)	2	1	3	4	(b)	4	3	1	2
(c)	2	1	4	3	(d)	4	1	2	3

47 Match the following columns.

	Column I		Column II
A.	Hinge joint	1.	Triceps
B.	Ball and socket joint	2.	Biceps
C.	Extensor muscles	3.	Eyeballs
D.	Flexor muscles	4.	Knee joint
		5.	Hip joint

Codes

	A	B	C	D		A	B	C	D
(a)	2	4	5	1	(b)	4	5	1	2
(c)	1	5	4	3	(d)	2	5	1	3

Directions (Q. Nos. 48-50) *In each of the following questions a statement of Assertion is given followed by a corresponding statement of Reason just below it. Of the statements, mark the correct answer as*

(a) If both Assertion and Reason are true and Reason is the correct explanation of the Assertion
(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(c) If Assertion is true, but Reason is false
(d) If both Assertion and Reason are false

48 **Assertion** Knee joint is a type of hinge joint.
Reason Femur, patella and fibula are associated with knee joint.

49 **Assertion** Body muscles are arranged in antagonistic pairs to move the body parts.
Reason It is essential for the maintenance of the body posture.

50 **Assertion** On receiving action potential *via* F tubules, the sarcoplasmic reticulum releases Ca^{2+} into sarcoplasm.
Reason Ca^{2+} uncover the active site of actin myofilament allowing a meromyosin head to join this site.

DAY PRACTICE SESSION 2

PROGRESSIVE QUESTIONS EXERCISE

1 Number of cervical vertebrae in camel is
(a) more than that of rabbit
(b) less than that of rabbit
(c) same as that of whale
(d) more than that of horse

2 Which one of the following is a skull bone?
(a) Atlas (b) Coracoid
(c) Arytenoid (d) Pterygoid

3 An acromion process is characteristically found in the
(a) pelvic girdle of mammals
(b) pectoral girdle of mammals
(c) skull of frog
(d) sperm of mammals

4 Six of the 206 bones of human skeleton occur in
(a) skull (b) middle ear
(c) pectoral girdle (d) pelvic girdle

5 Which of the following is not the part of pelvic girdle?
(a) Acetabulum (b) Ischium
(c) Pubis (d) Capitulum

6 Ellipsoid joint is also known as
(a) rotatory joint (b) candyloid joint
(c) trochoid joint (d) gliding joint

7 The bones common to face and cranium are
(a) parietal (b) frontal
(c) temporal (d) palatine

8 Cheek bones are
(a) lacrimal (b) zygomatic
(c) parietal (d) ethmoid

9 A joint characterised by an epiphyseal plate is called a
(a) synovial joint (b) suture
(c) symphysis (d) synchondrosis

10 A cricket player is fast chasing a ball in the field. Which one of the following groups of bones are directly contributing in this movement?
(a) Femur, malleus, tibia, metatarsals
(b) Pelvis, ulna, patella, tarsals
(c) Sternum, femur, tibia, fibula
(d) Tarsals, femur, metatarsals, tibia

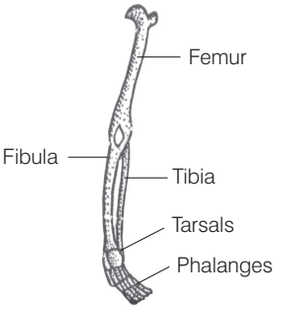
11 Which one of the following is the correct pairing of a body part and the kind of muscle tissue that moves it?

(a)	Heart wall	—	Involuntary unstriated muscle
(b)	Biceps of upper arm	—	Smooth muscle fibres
(c)	Abdominal wall	—	Smooth muscle
(d)	Iris	—	Involuntary smooth muscle

12 Select the correct statement with respect to locomotion in humans
(a) A decreased level of progesterone causes osteoporosis in old people
(b) Accumulation of uric acid crystals in joints causes their inflammation
(c) The vertebral column has 10 thoracic vertebrae
(d) The joint between adjacent vertebrae is a fibrous joint

13 Which of the following bones is characterised by the presence of a diaphyses and epiphyses, articular cartilages and a medullary cavity?
(a) Scapula (b) Sacrum
(c) Tibia (d) Patella

14 Given below is a diagram of the bones of the left human hindlimb as seen from front. It has certain mistakes in labelling. Two of the wrongly labelled bones are



(a) tibia and tarsals (b) femur and fibula
(c) fibula and tibia (d) tarsals and femur

15 Which of the following pairs is correctly matched?
(a) Hinge joint — Between vertebrae
(b) Gliding joint — Between zygapophyses of the successive vertebrae
(c) Cartilaginous joint — Skull bones
(d) Fibrous joint — Between phalanges

16 Which statement is correct for muscle contraction?
(a) Length of H-zone decreases
(b) Length of A-band remains constant
(c) Length of I-band increases
(d) Length of two Z-lines increases

17 Fused vertebrae in humans are
I. Sacral II. Coccygeal
III. Thoracic IV. Cervical
V. Lumber
(a) I and II (b) III and IV
(c) IV and V (d) II and V

18 Which one of the following statements is true?

(a) Head of humerus bone articulates with acetabulum of pectoral girdle

(b) Head of humerus bone articulates with glenoid cavity of pectoral girdle

(c) Head of humerus bone articulates with a cavity called acetabulum of pelvic girdle

(d) Head of humerus bone articulates with a glenoid cavity of pelvic girdle

19 Sliding filament theory can be best exlpained as

(a) when myofilaments slide pass each other actin filaments shorten while myosin filament do not shorten

(b) actin and myosin filaments shorten and slide pass each other

(c) actin and myosin filaments do not shorten but rather slide pass each other

(d) when myofilament slide pass each other myosin filament shorten while actin filaments do not shorten

20 The characteristics and an example of a synovial joint in humans is

	Characteristics	Example
(a)	Fluid cartilage between two bones, limited movements	Knee joints
(b)	Fluid-filled between two joints, provides cushion	Skull bones
(c)	Fluid-filled synovial cavity between two bones	Joint between atlas and axis
(d)	Lymph filled between two bones, limited movement	Gliding joint between carpals

21. Match the following columns.

	Column I		Column II
A.	Starfish	1.	Second vertebra
B.	Atlas vertebra	2.	12 in number
C.	Axis vertebra	3.	5 in number
D.	Thoracic vertebra	4.	Tube feet
		5.	Centrum absent

Codes

	A	B	C	D		A	B	C	D
(a)	4	5	1	2	(b)	2	1	3	4
(c)	4	1	2	3	(d)	2	3	1	5

22 Match the following columns.

	Column I		Column II
A.	Patella	1.	Foot
B.	Carpals	2.	Top of shoulder
C.	Metatarsals	3.	Knee
D.	Clavicle	4.	Wrist

Codes

	A	B	C	D
(a)	1	2	3	4
(b)	4	3	2	1
(c)	3	4	1	2
(d)	2	4	3	1

Directions (Q. Nos. 23-24) *In each of the following questions a statement of Assertion is given followed by a corresponding statement of Reason just below it. Of the statements, mark the correct answer as*

(a) If both Assertion and Reason are true and Reason is the correct explanation of the Assertion

(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion

(c) If Assertion is true, but Reason is false

(d) If both Assertion and Reason are false

23 **Assertion** Eukaryotic cells have the ability to adopt a variety of shapes and carry out directed movements.

Reason There are three principal types of protein filaments, i.e. actin filament, microtubules and intermediate filaments, which constitute the cytoskeleton.

24. **Assertion** Females pelvis is larger and has a wider bottom opening.

Reason Females have more circumstaneous fat.

ANSWERS

SESSION 1	**1** (c)	**2** (b)	**3** (a)	**4** (a)	**5** (a)	**6** (a)	**7** (d)	**8** (c)	**9** (d)	**10** (c)
	11 (a)	**12** (b)	**13** (c)	**14** (b)	**15** (d)	**16** (b)	**17** (a)	**18** (d)	**19** (d)	**20** (c)
	21 (a)	**22** (c)	**23** (d)	**24** (d)	**25** (d)	**26** (b)	**27** (d)	**28** (b)	**29** (a)	**30** (b)
	31 (a)	**32** (d)	**33** (a)	**34** (b)	**35** (c)	**36** (a)	**37** (b)	**38** (a)	**39** (d)	**40** (d)
	41 (b)	**42** (a)	**43** (a)	**44** (b)	**45** (c)	**46** (b)	**47** (b)	**48** (b)	**49** (a)	**50** (b)
SESSION 2	**1** (c)	**2** (d)	**3** (b)	**4** (b)	**5** (d)	**6** (b)	**7** (b)	**8** (b)	**9** (d)	**10** (d)
	11 (d)	**12** (b)	**13** (c)	**14** (c)	**15** (b)	**16** (b)	**17** (b)	**18** (b)	**19** (c)	**20** (c)
	21 (a)	**22** (c)	**23** (a)	**24** (c)						