CHAPTER – 17

LOCOMOTION AND MOVEMENT

EXERCISES

2 Mark Questions

Q1: Define sliding filament theory of muscle contraction.

Answer:According to sliding filament theory of muscle contraction, the actin and myosin filaments slide past each other with the help of cross-bridges to reduce the length of the sarcomeres.

Q2:Match Column I with Column II:

Column I	Column II
(a) Smooth muscle	**(i) Myoglobin**
(b) Tropomyosin	**(ii) Thin filament**
(c) Red muscle	**(iii) Sutures**
(d) Skull	**(iv) Involuntary**

Answer: (a) – (iv), (b)-(ii), (c)-(i), (d)-(iii)

Q3: Name the type of joint between the following:

(a) atlas/axis

(b) carpal/metacarpal of thumb

(c) between phalanges

(d) femur/acetabulum

(e) between cranial bones

(f) between pubic bones in the pelvic girdle

Answer: (a) Pivot joint

(b) Saddle joint

(c) Hinge joint

(d) Ball and socket joint

(e) Fibrous joint

(f) Cartilaginous joint

Q4:Write true or false. If false change the statement so that it is true.
(a) Actin is present in thin filament.
(b) H-zone of striated muscle fibre represents both thick and thin filaments.
(c) Human skeleton has 206 bones.
(d) There are 11 pairs of ribs in man.
(e) Sternum is present on the ventral side of the body.
Answer: (a) True
(b) False – H-Zone of striated muscle fibres represents only thick filaments.
(c) True
(d) False – There are 12 pairs of ribs in man.
(e) True

4 Mark Questions

Q1: Draw the diagram of a sarcomere of skeletal muscle showing different regions.
Answer:

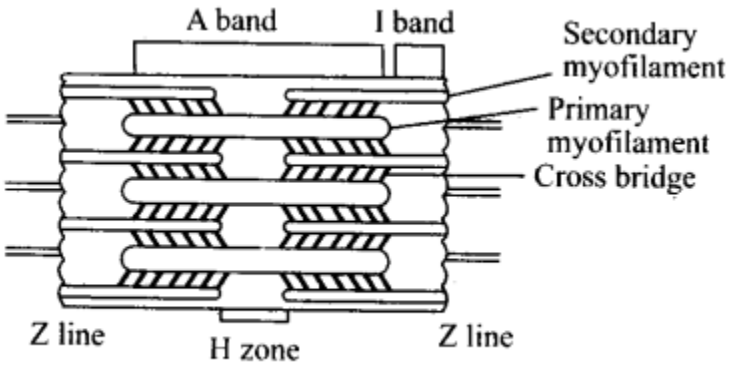

Fig.: Structure of a sarcomere.

Q2:Fill in the blank spaces:
(a) All mammals (except a few) have……. cervical vertebra.
(b) The number of phalanges in each limb of human is…….
(c) Thin filament of myofibril contains two 'F' actins and two other proteins namely…….and…….
(d) In a muscle fibre Ca^{++} is stored in …….
(e)…….and…….pairs of ribs are called floating ribs.
(f) The human cranium is made of……. bones.
Answer: (a) 7
(b) 14

(c) tropomyosin, troponin
(d) sarcoplasmic reticulum
(e) 11th and 12th
(f) 8

Q3:How do you distinguish between a skeletal muscle and a cardiac muscle?
Answer:We can distinguish between a skeletal muscle and a cardiac muscle on the basis of the features discussed in the following table:

	Skeletal or striated muscle	Cardiac muscle
(i)	They are present in the limbs, body walls, tongue, pharynx and beginning of oesophagus.	They are present in wall of the heart, pulmonary veins and superior vena cava.
(ii)	Fibres unbranched.	Fibres branched.
(iii)	Multinucleate	Uninucleate
(iv)	Light and dark bands present.	Faint light and dark bands present.
(v)	No oblique bridges and intercalated discs.	Oblique bridges and intercalated discs present.
(vi)	Nerve supply from central nervous system.	Nerve supply from the brain and autonomic nervous system.
(vii)	Very rapid contraction.	Rapid contraction.
(viii)	They soon get fatigued.	They never get fatigued.
(ix)	Voluntary	Involuntary

Q4:List functions of the skeleton in higher animals?
Answer:Functions of the skeleton in higher animals are as follows: -
(i) The skeleton forms the framework/structure of the body.

(ii) The bones of the skeletal system protect the delicate internal organs of the body.

(iii) The skeleton serves as an attachment surface for the body's muscles, tendons, and other similar structures, thus helping in movement.

(iv) It gives the body form and posture.

(v) It helps in the formation of certain blood cells such as RBCs and WBCs.

(vi) It stores minerals such as calcium and phosphorous releases into blood whenever needed.

7 Mark Questions

Q1: What are the different types of movements exhibited by the cells of human body?

Answer:The cells of human body show three types of movements: amoeboid, ciliary and muscular. Amoeboid movements: These are found in leucocytes of blood and phagocytes of certain body organs. In such cells, movements are brought with the help of temporary finger-like cytoplasmic projections, called pseudopodia or false feet. So it is also called pseudopodial movement. These pseudopodia are formed by flow of cytoplasm, called cyclosis (simplest form of movement), and cytoskeletal structures like microfilaments.
Ciliary movements: Large number of our internal tubular organs are lined by ciliated epithelium. For instance, the cilia of the cells lining the trachea, oviducts and vasa efferentia propel dust particles, eggs and sperms respectively by their coordinated movements in specific directions in these organs. Muscular movements: These are brought about by the action of skeleton, joints and muscles. These are of two types: movements of body parts and locomotion.

Q2:Write the differences between:
(a) Actin and Myosin
(b) Red and White muscles
(c) Pectoral and Pelvic girdle

Answer: (a) Actin filaments and myosin filaments can be differentiated as follows:

	Actin filaments (Thin myofilaments)	Myosin filaments (Thick myofilaments)
(i)	Found in both A and I bands.	Found only in A band of sarcomere.
(ii)	Thinner (0.005 mm) but shorter (2–2.6 mm) than myosin filaments.	Thicker (0.01 mm) but longer (4.5 mm) than actin filaments.
(iii)	Cross bridges absent, hence have smooth surface.	Cross bridges present, hence have rough surface.
(iv)	More numerous than myosin filaments, six of them surround each myosin filament.	Fewer than actin filaments.
(v)	Free at one end and are joined to Z-line by other end.	Free at both the ends.
(vi)	Consist of 3 proteins : actin, tropomyosin and troponin.	Consist of 2 proteins : myosin and meromyosin.
(vii)	Slide into H-zone during muscle contraction.	Do not slide during muscle contraction.

(b) Differences between red muscle fibres and white muscle fibres are given in the following table:

	Red muscle fibres	White muscle fibres
(i)	They are thin.	They are much thicker.

(ii)	They contain abundant mitochondria, low glycogen content and poorly formed sarcoplasmic reticulum.	They are poor in mitochondria, and have abundant glycogen granules and well formed sarcoplasmic reticulum.
(iii)	They are dark red as they contain abundant pigment myoglobin.	They are light in colour as they have very little myoglobin.
(iv)	Their myoglobin stores O_2 as oxymyoglobin that releases O_2 for oxidation during muscle contraction.	hey have little or no store of oxygen.
(v)	They get energy for contraction by aerobic respiration.	They get energy for contraction mainly by anaerobic respiration.

(vi)	They accumulate little lactic acid.	They accumulate lactic acid during strenuous work.
(vii)	They undergo slow sustained contractions for long periods.	They undergo fast contractions for short periods.
(viii)	They are not fatigued with work	They soon get fatigued with work.
(ix)	They are innervated by thin, slow-conducting nerve fibres. Example : Extensor muscles of the back in man.	They are innervated by thick, fast-conducting nerve fibres. Example : Eyeball muscles.

(c) Differences between pectoral and pelvic girdles are given in the table:

	Pectoral girdle	Pelvic girdle
(i)	It lies on the postero-lateral aspect of the upper region of the thorax.	It is located in the lower part of the trunk.
(ii)	It consists of 2 dissimilar bones: scapula and clavicle.	It consists of 2 similar bones, innominate.
(iii)	Scapula and clavicle are not further divided into any type of bone.	Each innominate bone consists of three bones : ilium, ischium and pubis.
(iv)	It provides articulation to the arm bones.	It provides articulation to the bones of the leg.
(v)	It has at its lateral angle a shallow concavity, the glenoid cavity, for articulation of the head of the humerus.	It has at the middle of its lateral surface a deep, cup-shaped hollow, acetabulum.

Q3: Describe the important steps in muscle contraction.

Answer:Mechanism of muscle contraction is explainei by sliding filament theory which states that contraction of a muscle fibre takes place by the sliding of the thin filaments over the th' ck filaments. As a nerve impulse reaches the terminal end of the axon, synaptic vesicles fuse with the axon membrane and release a chemical transmitter, acetylcholine and binds to receptor sites of the motor end plate. When depolarization of the motor end plate reaches a certain level, it creates an action potential. An action potential (impulse) passes from the motor end plate over the sarcolemma and then into the T-tubules and sarcoplasmic reticulum and stimulates the sarcoplasmic reticulum to release calcium ions into the sarcoplasm. The calcium ions bind to troponin causing a change in its shape and position. This in turn alters shape and the position of tropomyosin, to which troponin binds. This shift exposes the active sites on the F-actin molecules. Myosin cross-bridges are then able to bind to these active sites. The heads of myosin molecules project

laterally from thick myofilaments towards the surrounding thin myofilaments. These heads are called cross bridges. The head of each myosin molecule contains an enzyme mysoin ATPase. In the presence of myosin ATPase,Ca^{++} and Mg^{++} ions, ATP breaks down into ADP and inorganic phosphate, releasing energy in the head.

Energy from ATP causes energized myosin cross bridges to bind to actin.

$$ATP \xrightarrow[Ca^{++}, Mg^{++}]{\text{Myosin ATPase}} ADP + Pi + Energy$$

The energized cross-bridges move, causing thin myofilaments to slide along the thick myofilaments.

Q4:Why can a red muscle fiber work for a prolonged period, while a white muscle fibre suffers from fatigue soon?

Answer:Red muscle fibres work for a prolonged period because:
(i) They are thin and small muscle fibres.

(ii) They possess large amounts of myoglobin.

(iii) They have mitochondria in large numbers.

(iv) They provide energy by performing aerobic respiration.

(v) They carry out a slow rate of contractions for a long period.

White muscle fibres suffer from fatigue soon because:
(i) They are thick and large muscle fibres.

(ii) They possess small amounts of myoglobin.

(iii) They have a comparatively smaller number of mitochondria.

(iv) They provide energy by performing anaerobic respiration.

(v) They carry out a fast rate of contraction for a short duration.

Q5:What is the function of girdles?

Answer:There are two girdles in the body, the pectoral girdle and the pelvic girdle.
A. The function of pectoral girdle:

- It helps in the articulation of the upper limbs with the axial skeleton. It is composed of two bones: - Clavicle or collar bones and scapula or shoulder bone.
- It supports your shoulder, facilitates a full range of motion, and protects the nerves and blood vessels that run from the spine to the upper limbs.
- It performs functions like lifting, holding etc.

B. The function of pelvic girdle:

- It helps in the articulation of the lower limbs with the axial skeleton. It is composed of three bones: - the upper ileum, inner pubic, and ischium.
- It helps in carrying the weight of the body.
- It supports and balances the trunk and the intestines, urinary bladder, and internal sex organs.
- It performs functions like walking, standing, jumping, running etc.

Multiple Choice Questions

1.The _____ secretes a fluid that cushions and lubricates the joints

1. Cutaneous membrane
2. Synovial membrane
3. Mucous membrane
4. None of the above

Answer: Synovial membrane

2. **Which of the following is accurate?**
    1. Humans have 2 pairs of false floating ribs
    2. Humans have 1 pair of false floating ribs

3. Humans have 3 pairs of false floating ribs
4. Humans have 7 pairs of false floating ribs

Answer: Humans have 2 pairs of false floating ribs

3.**_____ is an example of an imperfect joint**

1.Ball & socket joint

2.Pubic symphysis

3.Elbow joint

4.None of the above

Answer: Pubic symphysis

4.The _____ is the largest sesamoid bone in the human body

1.Pelvis

2.Femur

3.Ulna

4.Patella

Answer: Patella

5.The _____ is the only movable part of the skull.

1.Nasal Conchae

2.Mandible

3.Vomer

4.Maxilla

Answer: Mandible

6._____ is the muscle's contractile protein.

1Globulin

2.Elastin

3.Myosin

4.None of the above

Answer: Myosin

SUMMARY

Movement is an essential feature of all living beings. Protoplasmic streaming, ciliary movements, movements of fins, limbs, wings, etc., are some forms exhibited by animals. A voluntary movement which causes the animal to change its place, is called locomotion. Animals move generally in search of food, shelter, mate, breeding ground, better climate or to protect themselves. The cells of the human body exhibit amoeboid, ciliary and muscular movements. Locomotion and many other movements require coordinated muscular activities. Three types of muscles are present in our body. Skeletal muscles are attached to skeletal elements. They appear striated and are voluntary in nature. Visceral muscles, present in the inner walls of visceral organs are nonstriated and involuntary. Cardiac muscles are the muscles of the heart. They are striated, branched and involuntary. Muscles possess excitability, contractility, extensibility and elasticity. Muscle fibre is the anatomical unit of muscle. Each muscle fibre has many parallelly arranged myofibrils. Each myofibril contains many serially arranged units called sarcomere which are the functional units. Each sarcomere has a central 'A' band made of thick myosin filaments, and two half 'I' bands made of thin actin filaments on either side of it marked by 'Z' lines. Actin and myosin are polymerised proteins with contractility. The active sites for myosin on resting actin filament are masked by a protein-troponin. Myosin head contains ATPase and has ATP binding sites

and active sites for actin. A motor neuron carries signal to the muscle fibre which generates an action potential in it. This causes the release of Ca++ from sarcoplasmic reticulum. Ca++ activates actin which binds to the myosin head to form a cross bridge. These cross bridges pull the actin filaments causing them to slide over the myosin filaments and thereby causing contraction. Ca++ are then returned to sarcoplasmic reticulum which inactivate the actin. Cross bridges are broken and the muscles relax. Repeated stimulation of muscles leads to fatigue. Muscles are classified as Red and White fibres based primarily on the amount of red coloured myoglobin pigment in them. Bones and cartilages constitute our skeletal system. The skeletal system is divisible into axial and appendicular. Skull, vertebral column, ribs and sternum constitute the axial skeleton. Limb bones and girdles form the appendicular skeleton. Three types of joints are formed between bones or between bone and cartilage – fibrous, cartilaginous and synovial. Synovial joints allow considerable movements and therefore, play a significant role in locomotion.