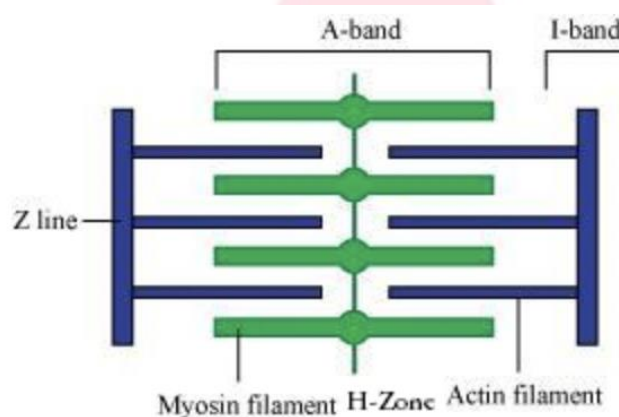


## 20. Locomotion and Movement

**Question 1. Draw the diagram of a sarcomere of skeletal muscle showing different regions.**

Answer: The diagrammatic representation of a sarcomere is as follows:



**Question 2. Define sliding filament theory of muscle contraction.**

Answer:

1. The sliding filament theory was mainly proposed to explain the process of muscle contraction. This theory proposes that during muscle contraction the thin filaments slide over the thick filaments leading to shortening of the myofibrils.
2. Each muscle fibre possesses alternate light and dark bands, which contains a specialised contractile protein known as actin and myosin respectively.
3. Actin refers to a thin contractile protein present in the light band and is known as the I-band, on the other hand, myosin is a thick contractile protein present in the dark band and is known as the A-band.
4. An elastic fibre called z line bisects each I-band. to this z line, the thin filament is firmly anchored. The central part of the thick filament that is not overlapped by the thin filament is known as the H-zone.

5. During muscle contraction, the myosin heads or cross bridges come in close contact with the thin filaments causing the thin filaments to be pulled towards the middle of the sarcomere. The Z line attached to the actin filaments is also pulled leading to the shortening of the sarcomere. Hence, the length of the band remains constant as its original length and the I-band shortens and the H-zone disappears.

**Question 3. Describe the important steps in muscle contraction.**

Answer: Muscle contraction is initiated by a signal sent by the central nervous system (CNS) via a motor neuron. A motor neuron along with the muscle fibres connected to it constitute a motor unit. The junction between a motor neuron and the sarcolemma of the muscle fibre is called the neuromuscular junction or motor-end plate. A neural signal reaching this junction releases a neurotransmitter (Acetyl choline) which generates an action potential in the sarcolemma. This spreads through the muscle fibre and causes the release of calcium ions into the sarcoplasm. Increase in  $Ca^{++}$  level leads to the binding of calcium with a subunit of troponin on actin filaments and thereby remove the masking of active sites for myosin.

Utilising the energy from ATP hydrolysis, the myosin head now binds to the exposed active sites on actin to form a cross bridge. This pulls the attached actin filaments towards the centre of 'A' band. The 'Z' line attached to these actin are also pulled inwards thereby causing a shortening of the sarcomere, i.e., contraction.

The process continues till the  $Ca^{++}$  ions are pumped back to the sarcoplasmic cisternae resulting in the masking of actin filaments. This causes the return of 'Z' lines back to their original position, i.e., relaxation.

**Question 4. 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) Muscle fibers are composed of myofibrils. The filaments of myofibrils consist of two types, thick and thin. The thick filaments are made of the protein myosin. The thin filaments are made of the protein actin.

So, the statement is true.

(b) The region of a striated muscle fibre that contains only thick (myosin) filaments is the H zone. It appears as a lighter band in the middle of the dark A band at the centre of a sarcomere.

So, the statement is false. H-zone of striated muscle fibre represents thick filament.

(c) The human skeleton is the internal framework of the body. It is composed of around 270 bones at birth which decreases to around 206 bones by adulthood after some bones get fused together.

So, the statement is true.

(d) Ribs are the long curved bones which form the rib cage. They protect the lungs, heart, and other internal organs of the thorax. There are 24 ribs in the human body, divided into two sets of 12 curved, flat bones.

So, the statement is false. There are 12 pairs of ribs in man.

(e) The sternum or breastbone is a long flat bone shaped located in the center of the chest. It lies at the anterior (ventral) middle part of the chest.

So, the statement is true.

**Question 5. Write the difference between:**

(a) Actin and Myosin

(b) Red and White muscles

(c) Pectoral and Pelvic girdle

Answer:

(a) Actin and Myosin

Actin	Myosin
Actin is a thin contractile protein.	Myosin is a thick contractile protein.
It is present in light bands and is called an isotropic band.	It is present in dark bands and is called an anisotropic band.

(b) Red and white muscles

<b>Red muscle fibres</b>	<b>White muscle fibres</b>
Red muscle fibres are thin and smaller in size.	White muscle fibres are thick and larger in size.
They are red in colour as they contain large amounts of myoglobin.	They are white in colour as they contain small amounts of myoglobin
They contain numerous mitochondria.	They contain less number of mitochondria.
They carry out slow and sustained contractions for a long period.	They carry out fast work for short duration.
They provide energy by aerobic respiration.	They provide energy by anaerobic respiration.

(c) Pectoral and pelvic girdle

<b>Pectoral girdle</b>	<b>Pelvic girdle</b>
It is a skeletal support from where the forelimbs of vertebrates are attached.	It is a skeletal support form where the hind limbs of vertebrates are attached.
It is composed of two Bones namely, clavicle or collar bones and scapula or shoulder bone.	It is composed of three bones, upper ileum, inner pubic, and ischium.

**Question 6. Match Column I with Column II:**

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

Answer:

<b>Column I</b>	<b>Column II</b>
(a) Smooth muscle	(iv) Involuntary
(b) Tropomyosin	(ii) Thin filament
(c) Red muscle	(i) Myoglobin

(d) Skull

(iii) Sutures

**Question 7. What are the different types of movements exhibited by the cells of human body?**

Answer: Cells of the human body exhibit three main types of movements-amoeboid, ciliary and muscular.

1. Amoeboid Movement: Some specialised cells in our body like macrophages and leucocytes in blood exhibit amoeboid movement. It is effected by pseudopodia formed by the streaming of protoplasm (as in Amoeba). Cytoskeletal elements like microfilaments are also involved in amoeboid movement.
2. Ciliary Movement: Ciliary movement occurs in most of our internal tubular organs which are lined by ciliated epithelium. The coordinated movements of cilia in the trachea help us in removing dust particles and some of the foreign substances inhaled along with the atmospheric air. Passage of ova through the female reproductive tract is also facilitated by the ciliary movement.
3. Muscular Movement : Movement of our limbs, jaws, tongue, etc., require muscular movement. Locomotion requires a perfect coordinated, activity of muscular, skeletal and neural systems.

**Question 8. How do you distinguish between a skeletal muscle and a cardiac muscle?**

Answer: The differences between skeletal muscles and cardiac muscles are as follows:

Skeletal muscle	Cardiac muscle
The function of skeletal muscles is voluntary.	Cardiac muscles function involuntarily.
The cells of these muscles are unbranched	The cells of these muscles are branched
Intercalated discs between the cells are absent	Intercalated discs between the cells are present

These consists of alternate light and dark bands	These possess bands that are faded
These are voluntary in nature	These are involuntary in nature
They help in locomotory actions and body posture	Cardiac muscles help in movements of the heart

**Question 9. 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) Gliding joint
- (d) Ball and socket joint
- (e) Fibrous joint
- (f) Cartilagenous pint

**Question 10. 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 2 'F' actin and two other proteins namely \_\_\_\_\_ and \_\_\_\_\_.
- (d) In a muscle fibre  $\text{Ca}^{++}$  is stored in \_\_\_\_\_
- (e) \_\_\_\_\_ and \_\_\_\_\_ pairs of ribs are called floating ribs.
- (f) The human cranium is made of \_\_\_\_\_ bones

Answer:

- (a) All mammals (except a few) have seven cervical vertebra.
- (b) The number of phalanges in each limb of human is 14.
- (c) Thin filament of myofibril contains 2 'F' actins and two other proteins namely troponin and tropomyosin.
- (d) In a muscle fibre  $\text{Ca}^{++}$  is stored in sarcoplasmic reticulum.
- (e) 11th and 12th pairs of ribs are called floating ribs.
- (f) The human cranium is made of eight bones.