

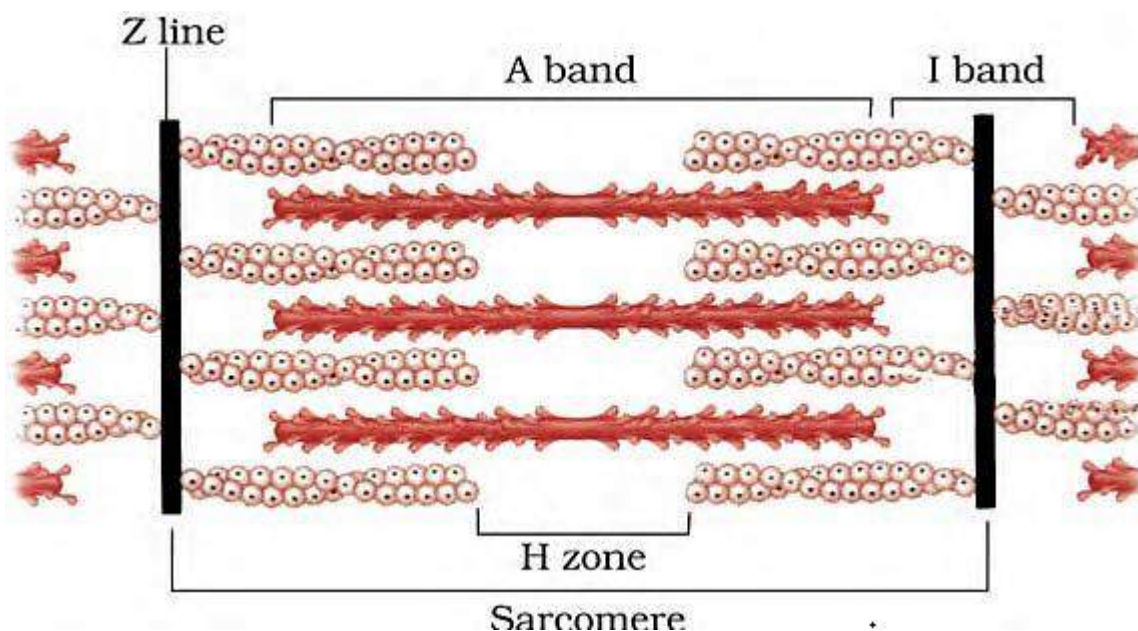
Exercise Questions

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

Solution:

The figure below represents the sarcomere of skeletal muscle showing different regions:



2. Define sliding filament theory of muscle contraction.

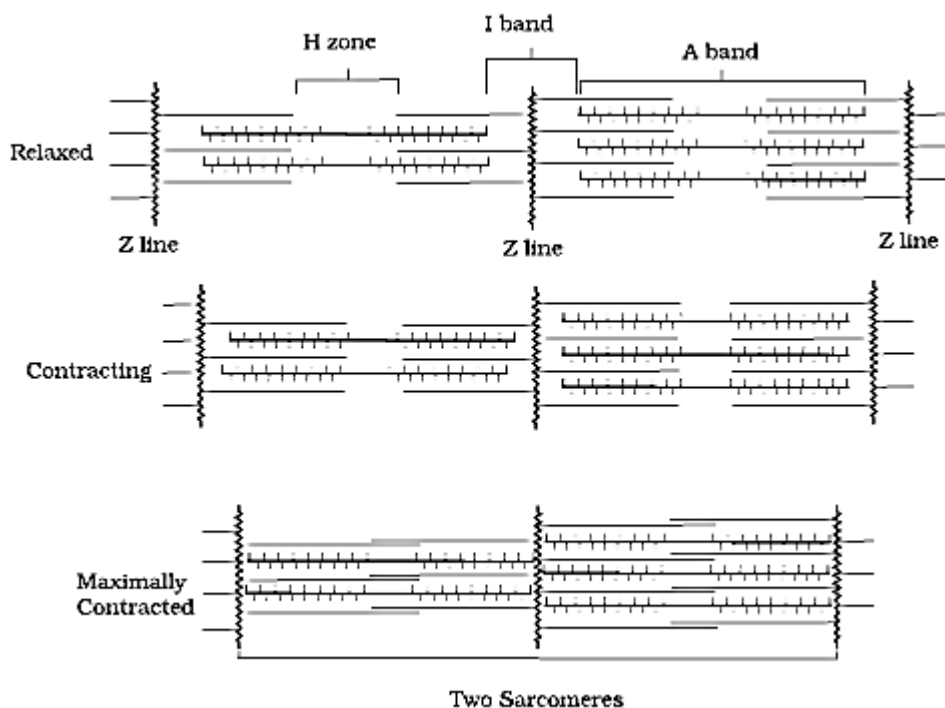
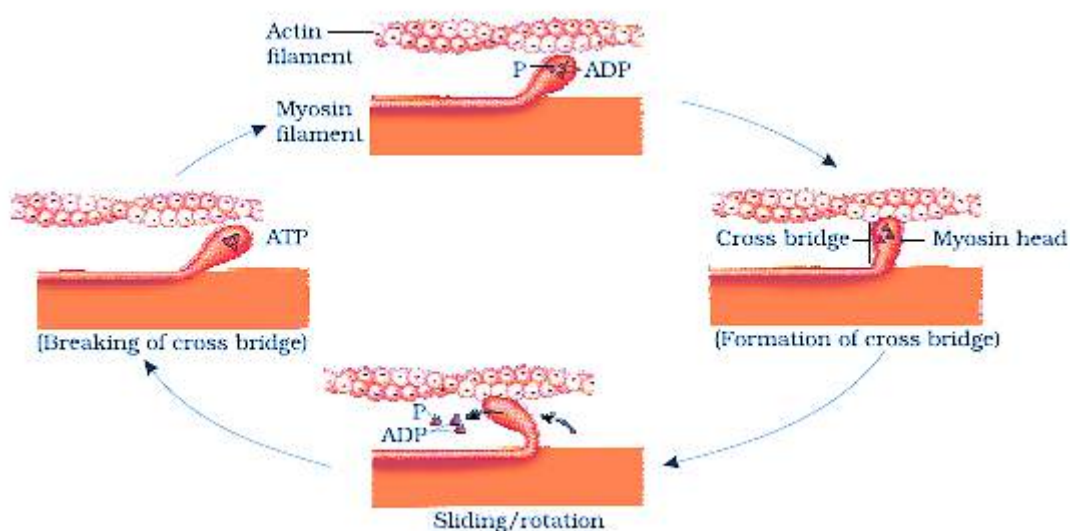
Solution:

Sliding filament theory can be defined as a theory which states that the contraction of a muscle fibre occurs due to the sliding of the thin filaments over thick filaments.

3. Describe the important steps in muscle contraction.

Solution:

The mechanism of muscle contraction is best explained by the sliding filament theory which states that the contraction of a muscle fibre occurs due to the sliding of the thin filaments over the thick filaments.



Mechanism of muscle contraction:

Step 1 : Sarcolemma depolarizes

- The central nervous system(CNS) sends a signal through a motor neuron that arrives at the motor end plate or the neuromuscular junction
- The neuromuscular junction is the junction present between the sarcolemma of the muscle fiber and the motor neuron
- The signal that arrives at the neuromuscular junction triggers the release of a neurotransmitter known as acetylcholine. This release sets the action potential in the sarcolemma.

Step 2 : Calcium ions are released

- The action potential is transmitted by the sarcolemma to the sarcoplasmic reticulum in order to release the calcium ions in the sarcoplasm

Step 3 : Actin filaments are subjected to conformational changes

- The calcium ions that are released, tend to bind to the tropomyosin and troponin located on the active filaments
- The linkage causes a modification in the three-dimensional structure of the actin-troponin-tropomyosin complex. The active site for myosin located on the actin filament is exposed.

Step 4 : Myosin heads are activated

- The release of the calcium ions causes the myosin heads to get activated which in turn causes the release of energy in the form of ATP
- Hydrolysis of ATP releases energy that causes the binding of myosin heads to the active sites found on the actin filaments thereby forming a cross-bridge

Step 5 : Actin filaments slide over Myosin

- Formation of cross-bridge causes the myosin head to rotate, pulling the actin filaments to the centre of the A-band which is the H-zone
- The z-line that is attached to the actin filaments is pulled inwards too
- The sarcomere contracts when the actin filaments are pulled in the opposite ends
- The I-band shortens during the process of contraction whereas the A-band maintains its length causing the muscles to contract.

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.**

Solution:

- (a) Actin is present in thin filament – True
- (b) H-zone of striated muscle fibre represents both thick and thin filaments – False
Corrected statement: H-zone of the striated muscle fiber represents only thick filaments
- (c) Human skeleton has 206 bones - True
- (d) There are 11 pairs of ribs in man – False
Corrected statement: There are 12 pairs of ribs in man.
- (e) Sternum is present on the ventral side of the body - True

5. Write the difference between:

- (a) Actin and Myosin**
- (b) Red and White muscles**
- (c) Pectoral and Pelvic girdle**

Solution:

The differences are as follows:

(a) Actin and myosin

Actin	Myosin
Forms thin filaments (I-bands) of the myofilament	Forms thick filaments (A-bands) of the myofilament
Built of globular actin monomers	Built of meromyosin monomers
Tropnin and tropomyosin – the regulatory proteins, are linked with the actin	The regulatory proteins are not linked, instead each of the meromyosin is built of four light chains and two identical heavy chains

(b) Red and white muscles

Parameters	Red muscles	White muscles
Myoglobin content	High	Low
Amount of sarcoplasmic reticulum	Moderate	High
Fibers	Narrow and thin	Broad and thick
Mitochondria	Possess many	Few
Fatigue	Not fatigued	Fatigued
Type of respiration from which energy is derived	Aerobic	Anaerobic

(c) Pectoral and Pelvic girdle

Pectoral girdle	Pelvic girdle
Pectoral girdle is also known as the shoulder girdle	Pelvic girdle is also known as the hip girdle
Each part/half of the girdle consists of two bones – clavicle and scapula	Each part/half of the girdle consists of three bones – ischium, ilium and pubis
It offers forelimb articulation	It offers hindlimb articulation
Head of the humerus articulates with the glenoid cavity of the pectoral girdle	Head of the femur articulates with the acetabulum of the pelvic girdle

6. 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

Solution:

Column I	Column II
(a) Smooth muscle	(iv) Involuntary

(b) Tropomyosin	(ii) Thin filament
(c) Red muscle	(i) Myoglobin
(d) Skull	(iii) Sutures

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

Solution:

Movement is one of the fundamental characteristics observed in the living entities. The different types of movements exhibited by the human body cells are as follows:

- Amoeboid Movement – The cells that exhibit this type of movement are leucocytes found in blood. Leucocytes from the circulatory system move towards the injury site when there is a damage to the tissue in order to initiate an immune response.
- Muscular movement – this type of movement is exhibited by muscle cells
- Ciliary movement – The type of cells that exhibit this type of movement are sex cells(sperms and ova). This movement facilitates the passage of ova via the fallopian tube on its way to the uterus

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

Solution:

The differences between a skeletal muscle and a cardiac muscles is as follows:

Skeletal muscle	Cardiac muscle
Linked to the primary bones	Located in the walls of the heart
Voluntary in nature	Involuntary in nature
Nucleus is peripherally located	Nucleus is centrally located
The muscle fibers of the skeletal muscles are unbranched	The muscle fibers of the cardiac muscles are branched
Muscle fibers of the skeletal muscles do not show intercalated discs	Intercalated discs are found in the muscle fibers of the cardiac muscles
Bring about the locomotory actions of the body and maintains body posture	Responsible for the movement/motion of the heart

9. Name the type of joint between the following:-

- atlas/axis
- carpal/metacarpal of thumb
- Between phalanges
- femur/acetabulum
- Between cranial bones
- Between pubic bones in the pelvic girdle

Solution:

The types of joints are as follows:

- (a) atlas/axis – Pivot joint
- (b) carpal/metacarpal of thumb – Saddle joint
- (c) Between phalanges – Hinge joint
- (d) femur/acetabulum – Ball and socket joint
- (e) Between cranial bones – Fibrous joint
- (f) Between pubic bones in the pelvic girdle – cartilaginous joint

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' 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

Solution:

- (a) Seven
 - (b) Fourteen
 - (c) Troponin, tropomyosin
 - (d) Sarcoplasmic reticulum
 - (e) Eleventh, twelfth
 - (f) Eight
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