

EXAM DRILL

ANSWERS

- (d)** : The factors responsible for osteoporosis are : imbalances of parathyroid, thyrocalcitonin and sex hormones, deficiency of calcium and vitamins.
- (a)** : In isotonic contraction, the tension remains the same whereas the change occurs in the length of the muscle fibres. This can occur only when a muscle's maximal force of contraction exceeds the total load on the muscle.
- (b)**
- (c)** : Ellipsoid or condyloid joint allows movement in two planes, back-and-forth and side-to-side.
- (a)** : The part of the myofibril between two successive Z-lines is called sarcomere. The sarcomere comprises of a central A-band and two halves of adjacent I-bands.

OR

(a)

- Locomotion is helpful to the animals in many ways. Some of the significances are as follows:
 - Locomotion helps us to move from one place to other in search of food, shelter, etc.
 - It helps animals to run through various conditions of environment and helps the animals to move far from their predators.
- Malleus, incus and stapes
 - Ilium, ischium and pubis.
- Two characteristics of skeletal muscles are :
 - Skeletal muscles are found in limbs, tongue, etc., and are voluntary in nature.
 - They have oxygen carrying pigment myoglobin or muscle haemoglobin.
- Myasthenia gravis is a chronic autoimmune disease. It causes breakdown of neuromuscular junction due to which the brain loose control over muscles, resulting in fatigue, weakening and paralysis of skeletal muscles.
- The site of initial damage in rheumatoid arthritis is synovial membrane. This type of arthritis tends to affect smaller joints first particularly the joints between fingers and hands and between toes and feet. As the disease progresses, symptoms may spread to knees, ankles, hips, shoulders, etc.
- (b)** : Each myofibril contains actin and myosin filaments which give it striated appearance due to dark and light bands.

The light bands are made of actin and are called I bands or isotropic band, whereas the dark bands are called 'A' or anisotropic bands and contain myosin. Both the proteins are arranged as rod-like structures, parallel to each other and also to the longitudinal axis of the myofibrils. In the centre of each 'I' band is an elastic fibre called 'Z' line which bisects it. The portion of the myofibrils between two successive 'Z' lines attached to the actins are pulled inwards thereby causing a short shortening of the sarcomere, i.e., contraction. Hence, during shortening of the muscle, i.e., contraction, the 'I' bands get reduced, whereas the 'A' bands retain the length.

(c) : Antagonistic muscles are those muscles which contract to produce opposite movements at the same joint. When a muscle contracts just relax to allow that movement to take place. Biceps and triceps are called antagonistic muscles. Because during flexion at the elbow, biceps contracts and triceps relaxes; during extension at the same joint, triceps contract and biceps relax.

(c) : The muscle fibre always contracts with the maximum force and this force doesn't rise on increasing the strength of the stimulus. If the stimulus is of strength below the threshold, then the muscle fibre doesn't contract at all. This is known as all or none law. But the entire muscle doesn't obey this law, it means that force of contraction of muscle increase with rise in strength of the stimulus. This is due to the fact that the strength of the threshold stimulus varies from muscle fibre to muscle fibre in a muscle.

(c) : The phase of muscle contraction occurs when myosin binds and releases actin. Muscle contraction is initiated by a signal sent by the central nervous system *via* a motor neuron. A motor neuron along with the muscle fibres connected to it constitutes a motor unit.

(i) (b): Flagellum (A) is locomotory structure of spermatozoa (sperms), hence the movement is flagellar movement. Cilia (B) is present in the upper respiratory tract of humans that keep the invading microbes and dust particles out, hence the movement is ciliary movement.

(ii) (d) : I-band has thin Z-line. This band shortens during muscle contraction and also known as light band.

(iii) (a)

(iv) (d) : 'G' is red muscle fibres. They comprise of less sarcoplasmic reticulum.

(v) 'D' is myosin filament. It consists of four light chains in the head.

16. (i) In the given figure, P, Q, R, S, T and U represent parietal bone, temporal bone, frontal bone, maxilla, mandible and occipital bone respectively.

(ii) (b) : Parietal (P), temporal (Q), frontal (R) and occipital (U) bones are bones of cranium.

(iii) (d)

(iv) The given figure shows the human skull which has fibrous or immovable joints. This type of joint lacks synovial cavity and synovial fluid and there is no movement between the concerned bones.

17. (i) Ligament is the fibrous connective tissue that connects bones to other bones. They are also known as fibrous or articular ligaments and help to maintain stability in the body.
(ii) Tropomyosin is a double stranded, α helical rod that attaches to F-actin. In the resting state, the tropomyosin molecules lie on top of the active sites of the actin strands to avoid attraction between the actin and myosin filaments that causes contraction.

18. The differences between movable and immovable joints are as follows :

S.No.	Movable joints	Immovable joints
(i)	They allow free movement and called synovial joints.	They do not allow any movement and are fibrous (fixed) joints.
(ii)	At these joints, there is a space between the bones called synovial cavity which is filled with synovial fluid.	At these joints, bones are very tightly held with the help of white fibrous connective tissue. Synovial cavity and fluid are absent.
(iii)	The articular surfaces of the bones are covered by cartilage called articular cartilage.	The articular surfaces of the bones are not covered by any cartilage.
(iv)	Example : Joints between atlas and axis, elbow joint, knee joint, hip joint, etc.	Example : Sutures between the skull bones, joints between root of teeth with socket of maxilla and mandible.

19. Differences between ball and socket joint and hinge joint are as follows:

S.No.	Ball and socket joint	Hinge joint
(i)	One bone of this joint forms a rounded head while the other bones forms a cup-shaped structure.	Both the bones are fitted like a hinge of a door.

(ii)	It allows free movement in all directions.	It allows movement primarily in one direction.
(iii)	It is the most movable joint.	It is comparatively less movable joint.
(iv)	<i>E.g.</i> , hip joint and shoulder joint	<i>E.g.</i> , knee joint and elbow joint

20. Contractile proteins consists of actin (thin filament) and myosin (thick filament). Each actin filament is composed of two helical F-actin and each F-actin is made up of multiple units of 'G' actin. Alongwith the F-actin, two filaments of regulatory proteins tropomyosin and troponin at regular intervals are present. Each myosin is composed of multiple units of meromyosin which has two important parts-a globular head known as heavy meromyosin with a short arm and a tail known as light meromyosin.

OR

Cervical vertebrae are seven in number and are present in neck. The first cervical vertebra is called atlas. It is ring-like and supports the skull. The second vertebra (axis) is known as axis, characterised by odontoid process. The axis allows side-to side or turning movement of the atlas and skull together on it. The cervical vertebrae are the smallest and allow the widest range of motion to let the head turn in many directions.

21. Significance of movements of internal organs are:

(i) Food and urine are moved forward by the movements of the muscles (peristalsis) present in the digestive and urinary tracts respectively.

(ii) Movement of cardiac muscles enables the heart to receive and distribute the blood.

(iii) Inspiration and expiration occur with the help of internal movement of diaphragm, ribs, etc.

(iv) Visceral movements are also responsible for sound production, defaecation and micturition.

(v) Movements of genital tract affect egg release and delivery of the baby.

22. The number of bones in vertebral column is 33 but vertebrae consists of 26 bones because 5 sacral vertebrae are fused to form one sacrum, and 4 coccygeal vertebrae are fused to form one coccyx. 7 cervical vertebrae are present in the neck, 12 thoracic vertebrae in the chest, 5 lumbar vertebrae in abdomen, 1 sacrum vertebra between the innominate bones of the pelvic girdle and 1 coccyx present in tail region.

23. Following are the differences between A-and I-bands :

S.No.	A-band	I-band
(i)	It has wide H-zone.	It has thin Z-line.
(ii)	It gives dark appearance and hence also called dark band.	It gives light appearance hence also called light band.

(iii)	Its length remains unchanged during muscle contraction.	It shortens during muscle contraction.
(iv)	It contains myosin filaments and parts of actin filaments.	It contains part of actin filaments.

24. Difference between pronator and supinator muscles:

Pronator	Supinator
This muscle turns the palm downwards or to the posterior <i>E.g., pronator teres</i>	This muscle turns the palm upward or to the anterior. <i>E.g., supinator</i>

25. (i) Slipped disc is a displacement of vertebrae and the intervertebral disc from their normal position, while a sprain can be defined as a twisting of a joint, without dislocating it. Slipped disc could may be due to mechanical injury or defects in ligaments holding the vertebrae together. But in a sprain, an injury causes damage to ligaments and also often damages to muscles, tendons, blood vessels and nerves.

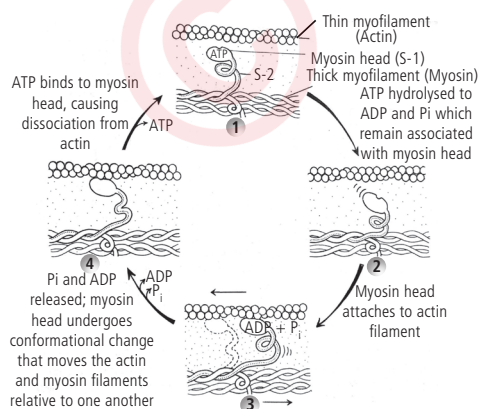
(ii) Two functions of rib cage are as follows:

- (i) It protects the delicate organs like heart and lungs.
- (ii) It provides the surface for attachment of the muscles concerned with respiratory mechanism.

26. (a) If a person is unable to excrete uric acid from his body then he may suffer from gouty arthritis or gout. Gout is the accumulation of uric acid and crystals of its salts in the region of joints which results in painful movements. The excess of urates can form kidney stones.

(b) Tetany is caused due to low Ca^{2+} in body fluid. This results in rapid spasms or wild contractions in muscles.

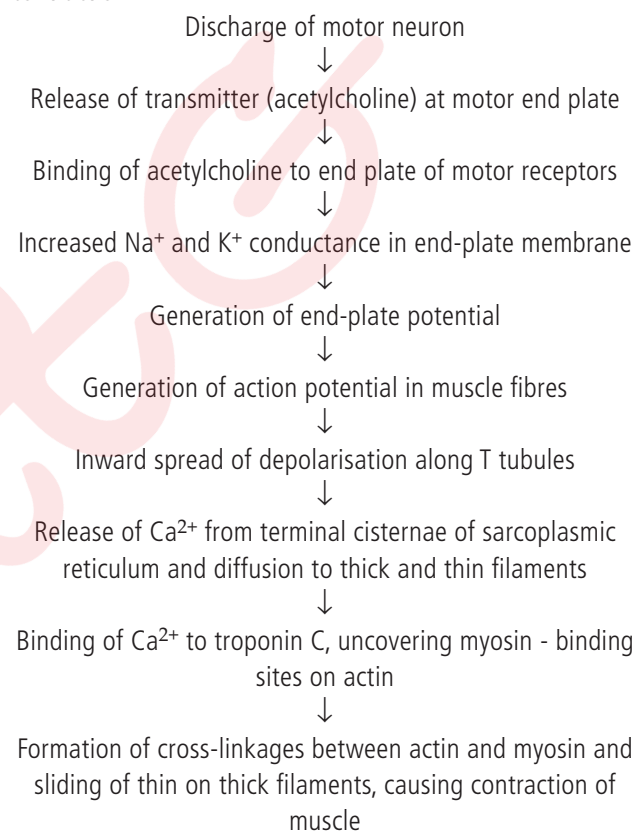
27. Four major steps of muscle contractions are:



28. The duration for which a muscle can keep contracting depends on its ability to supply adenosine triphosphate energy to the contractile proteins. When the supply of energy in the muscles decreases, its force of contraction is reduced and lost at last. A muscle is now fatigued due to the reduction in the

force of contraction of muscle after prolonged stimulation. A muscle can contract in the absence of oxygen, but it gets fatigued sooner. The reason behind this event is that lactic acid is not disposed of without oxygen and gets stored in the muscle fibres. Fatigue thus, mainly occurs by excessive build up of lactic acid within the muscles. A completely fatigued muscle does not show any action to neural stimuli. It seems that the site of fatigue is the junction between nerve and muscle, the neuromuscular junction. A muscle gets fatigued sooner by heavy exercise than mild exercise.

29. The following flow chart describes the steps of muscle contraction :



30. (a) Oxygen debt is the requirement of extra oxygen during recovery phase of muscle after vigorous exercise. During strenuous exercise, muscles do not get sufficient oxygen to meet its energy need immediately; so it contracts anaerobically and accumulates lactic acid produced by anaerobic glycolysis. The increased oxygen consumption of muscle during recovery is called oxygen debt. The extra oxygen required during recovery phase is for regeneration of oxyhemoglobin, restoration of depleted ATPs and creatine phosphate and oxidation of lactic acid.

(b) Muscle twitch or muscle fasciculations are fine movements of small area of muscle, caused by minor muscle contractions in the area, or uncontrollable twitching of muscle group served by single motor nerve fibre, *e.g.,* fluttering eye lids.

(c) Rigor mortis is a condition that sets few hours after the death. In this, muscles and joints become rigid, *i.e.*, can neither contract nor stretch as cellular processes come to halt. Rigor mortis subsides about 15-24 hours after death.

OR

(a) Rickets occurs in childhood. It is a disease in which the bones contain insufficient amounts of calcium and phosphorus. It is called osteomalacia in adults. Three causes of this disease are kidney disease, vitamin D deficiency and an inherited defect.

(b) Osteoporosis is a disease in which bone loses minerals and fibres from its matrix. There are more chances of fractures. Individuals who are under prolonged treatment of cortisone, are prone to bone loss, leading to osteoporosis. Major causative factors of osteoporosis are imbalances of hormones like calcitonin of thyroid, parathormone of parathyroids, sex hormones and deficiencies of calcium and vitamin D.

(c) Muscular dystrophy : In this disorder the mutated gene on middle of the short arm of the X-chromosome is unable to produce a protein called dystrophin in the skeletal muscles. Protein relay the nerve's signal to the calcium storage in the muscle cell. This protein is associated with the sarcolemma where it plays a role in transmembrane signalling and in stabilising the plasma membrane. Due to its deficiency, calcium is not released from the muscle cell. As a result the muscle contraction does not take place. Abnormal rise of calcium levels in the muscle releases an enzyme that destroys actin and myosin resulting in fatal muscular weakness.

31. Each forelimb consists of 30 bones. It includes humerus (1), radius (1), ulna (1), carpals (8) metacarpals (5) and phalanges (14). The phalangeal formula is 2, 3, 3, 3, 3. Humerus has a rounded head at proximal end which articulates into the glenoid cavity of the pectoral girdle. A greater and lesser tubercles occur near the head. The shaft of the humerus has a V-shaped deltoid ridge at about its middle. A pulley like trochlea is present between two ridges. Ulna is longer than radius and its upper end has a larger olecranon process that forms the eminence of elbow. The head of the radius articulates with the humerus. Each wrist is composed of 8 carpals that are arranged into two rows scaphoid, lunate, triquetrum and pisiform in proximal row and trapezium, trapezoid, capitate and humate in distal row.

OR

Skull is the endoskeleton of head and has 29 bones. It is the heaviest part of the body. The skull rests upon the upper end of the vertebral column and its bony structure consists of the following parts:

(i) Bones of the cranium (8) : The cranium is large and hollow part of the skull, which encloses and protects the brain in the cranial cavity. The cranium is formed by 8 bones. The

bones which form the cranium are : 1 frontal bone, 2 parietal bones, 2 temporal bones, 1 occipital bone, 1 sphenoid bone and 1 ethmoid bone. Temporal bone has a projection called mastoid process. The cranial cavity has a large opening called foramen magnum at the posterior end through which brain is continuous with the spinal cord. These bones are joined by immovable fibrous joints called sutures.

(ii) Bones of the face (14) : Face forms the front and lower part of the skull. It is formed of 14 bones, which include 2 nasals, 2 maxilla, 2 zygomatic, 2 lacrimals, 2 palatine, 2 inferior nasal conchae, 1 mandible and 1 vomer. Mandible also known as lower jaw is the largest, strongest and only movable bone of the face.

(iii) Hyoid (tongue) bone (1) : The hyoid bone is a U-shaped bone situated in the wall of the upper part of the throat, just above the larynx. Although, it is not a bone of the skull proper, it is customarily considered with that portion of the skeleton. It serves as a point of attachment for some muscles of the tongue and floor of the mouth but it does not articulate with any other bone

(iv) Ear ossicles : In each middle ear, there are three small irregular, movably attached bones called ear ossicles namely, malleus, incus and stapes.

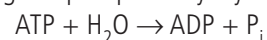
32 (a) Hard parts present inside the body of the animal comprises the endoskeleton. Endoskeleton protects the delicate parts of body and provides attachment for large muscles.

(b) Acetabulum. Pubic symphysis is made up of white fibrous cartilage.

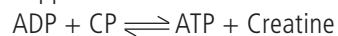
(c) $C_7 T_{12} L_5 S_{(5)} C_{(4)}$

OR

(a) The muscle gets its energy for contraction from ATP. During muscular contraction, ATP is hydrolysed to ADP and inorganic phosphate by myosin ATPase.



After that, ATP is soon replenished in the muscle fibres. For this, muscles contain another energy compound called creatine phosphate (CP). It helps in the conversion of ADP to ATP. This happens at the end of muscular contraction.



(b) As a muscle contracts,

- the thin myofilaments slide inward towards the H-zone
- the Z lines come closer together
- the width of the I bands decreases
- the width of the H zones decreases
- there is no change in the width of the A band.

33. According to the mobility, joints are classified as fibrous or fixed or immovable joints, cartilaginous or slightly movable joints and synovial or freely movable joints.

(i) Fibrous or immovable joints : This type of joints does not allow any movement. Here, the bones are fused end to end

with the help of dense fibrous connective tissues *e.g.*, sutures between skull bones and the teeth in their sockets.

(ii) Cartilaginous or slightly movable joints : In these joints, bones are joined together with the help of cartilages that permits limited movement. In these joints, there is a pad of white fibrocartilage between the ends of the bones taking part in the joints which allow for very slight movement. Movement is only possible because of compression of pad of cartilages, *e.g.*, joints between the adjacent vertebrae, the joints in symphysis which binds the pubic bones together at the front of pelvic girdle.

(iii) Synovial or freely movable joints : Most of the joints in the body are of synovial type. These are freely movable joints. Depending on shape of bones and types of the movements they allow, the synovial joints are of following six types:

(a) Ball and socket joints are movable joints that consists of a bone with round head, fitted into a cup-like depression of another bone. This helps the bone to rotate freely in all directions. It is multiaxial joint, *e.g.*, shoulder and hip joints.

(b) Hinge joint allows movement primarily in one plane only. In a hinge joint, *spool (reel)* like surface of one bone fits into the concave surface of another bone. It is monoaxial joint. The elbow, the knee and ankle and interphalangeal joints are examples of hinge joints.

(c) Pivot joint is type of joint where one bone rotates around another. In a pivot joint rounded or pointed bone fits into a shallow depression in another bone, *e.g.*, joints between atlas and axis.

(d) Condyloid or ellipsoid joints allow movement in two planes, back-and-forth and side-to-side. It is biaxial joint, *e.g.*, the joints between the metacarpals and phalanges (metacarpophalangeal joint) of the fingers.

(e) Gliding joints permit only back-and-forth and side-to-side movements. No rotation or twisting is possible as bones are packed together or held in place by ligaments. It is monoaxial joint, *e.g.*, joints between carpals and between the tarsals.

(f) Saddle joint is a type of joint in which bone is movable on another fixed bone in many directions, *e.g.*, joints between the carpal and metacarpal of thumb of the hand.

OR

Sternum is a flat and elongated bone present on the ventral midline of thorax. It is about 15 cm long. Its shape is like a dagger and consists of three parts – manubrium, the uppermost part, the body is the middle portion and xiphoid process is the tip of the bone.

Functions of sternum : (i) It protects the internal organs in the thoracic region. (ii) It also provides the surface for muscle attachment. (iii) The sternum also helps in the respiratory mechanism.

Diagram representing the anterior view of sternum is as follows:

