BIOLOGY

NEET

CRASH COURSE

LOCOMOTION AND MOVEMENT

SMART ACHIEVERS

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LOCOMOTION AND MOVEMENT

MUSCLES

MUSCLES

- Mesodermal origin
- 40 – 50% by body weight
- Properties – excitability contractility, extensibility and elasticity

Type of muscles :

Skeletal Muscles	Visceral Muscles	Cardiac Muscles
Striped muscle	Unstriped muscles	Striated muscles
Voluntary muscles	Involuntary muscles	Involuntary muscles
These muscles are primarly involved in locomotory action and change in body postures.	Located in wall of hollow organs	Found in heart

1. Skeletal muscle is made of muscle bundles or fascicles. Fascicles held together by fascia.
2. Each muscle bundle madeup of many muscle fibres.
3. Skeletal muscle fibre is long, unbranched, multinucleated (syncitium).
4. Skeletal muscle fibre contains sarcoplasmic reticulum which is store house of calcium ions.
5. Many parallely arranged filaments are present in sarcoplasm called myofilaments or myofibrils.
6. Each myofibril has alternate dark and light band on it.
7. Light band or I-band or isotropic band contains actin proteins where dark band or A-band or anisotropic band contains myosin proteins.
8. Z-Line (elastic fibre) is found in the centre of each 'I' band.
9. M Line (thin fibrous membrane) is found in middle of A-band.

   "The portion of the myofibril between two successive 'Z' - Lines is considered as the functional unit of contraction is called Sarcomere."
10. In resting stage, the edges of thin filaments partially overlap the free ends of the thick filaments leaving the central part of the thick filaments.
11. This central part of thick filament , not overlapped by thin filaments is called the 'H' Zone.

Structure of Contractile Proteins :

12. Each actin is made of two 'f' (filaments) actins which are helically coiled to each other.
13. 'f' actin is polymer of 'G' (Globular) actins.

14. Two filaments of tropomyosin protein also run close to 'f' actins throughout it's length.
15. A complex protein troponin is distributed at regular intervals on the tropomyosin.
16. In the resting state troponin masks the active binding sites for myosin on the actin filaments.
17. Each myosin filament is a polymerized protein. Many meromyosin (monomeric protein) found in one thick filament.

Mechanism of muscle contraction :

18. It is best explained by sliding filaments theory.
19. During this, thin filaments slide over the thick filaments.
20. Muscle contraction is initiated by a signal sent by the central nervous system.
21. A neural signal reacting at neuromuscular junction or motor end plate (junction between motor neuron and sarcolemma) releases a neuro-transmitter (Acetylcholine) which generates an action potential in sarcolemma.
22. Action potential spreads through the sarcolemma and causes release of Ca^{+2} into sarcoplasm.
23. When Ca^{+2} level increase it leads to binding of Ca^{+2} with subunit of troponin on actin filament remove masking of active sites on actin to form a cross-bridge. (Energy obtained from ATP hydrolysis).
24. Actin filaments move towards centre of A-band.
25. Length of sarcomere decreases.
26. I-band get reduced where as 'A' band retain the length.
27. The myosin releasing ADP and P goes back to its relaxed stage.

Muscle Fatigue :

28. Repeated activation of muscle can lead to accumulation of lactic acid due to anaerobic breakdown of glycogen causing fatigue .

Types of muscles fibres :

Red Muscle Fibre	White Muscle Fibre
• Myoglobin content is high (myoglobin is red coloured oxygen storing pigment.	• Myoglobin content is low.
• More number of mitochondria present.	• Less number of mitochondria present.
• Aerobic muscle fibres.	• Anaerobic muscle fibres.
• Amount of sarcoplasmic reticulum is low.	• Amount of sarcoplasmic reticulum is high.

BONES

29. Human endoskeleton is madeup of 206 bones. It is grouped into two pa:ts -
    - Axial Skeleton - 80 bones
    - Appendicular skeleton -126 bones

Axial Skeleton

30. It consist skull, vertebral column, sternum and ribs.
    - Skull is composed of cranial and facial bones. Total -22 bones
    - Cranial bones are 8 in number. Frontal(1), parietal(2), occipital(1), temporal(2), sphenoid(1), ethmoid(1)
    - Facial bones are 14 in number. Mandible(1), maxilla(2), palatine(2), nasal, vomer(1), inferior turbinals(2), zygomatic(2), lacrimal bones(2).
31. Each middle ear contains three tiny bones malleus, incus and stapes, collectively called ear ossicles.
32. **Hyoid bone :** A single U-shaped bone which is present at the base of the buccal cavity.
33. **Vertebral column :** Formed by 26 serially arranged vertebrae. Cervical (7) Thoracic (12) Lumber (5) Sacral (1 fused), coccygeal (1 fused)
34. The number of cervical vertebrae are seven in almost all mammals including human beings.
35. First vertebra is the atlas and it articulates with the occipital condyles of skull.
    - **Sternum :** A flat bone on the midventral line of thorax.

    Ribs - 12 pairs
    - 1st 7 pairs - True ribs (vertebra-sternal ribs)
    - 8, 9, 10th pairs - vertebra-chondral ribs.
    - 11, 12th pairs - vertebral ribs (floating ribs)
36. Each rib is a thin flat bone. It has two articulation surfaces on its dorsal end and is hence called bicephalic.
37. Thoracic vertebrae, ribs and sternum together form the rib cage.

Appendicular Skeleton

38. The bones of limbs along with their girdles.
    - **Fore Limb -** 30 bones. Humerus, radius, ulna, carpals (wrist bones-8) metacarpals (palm-5) phalanges (digits-14)
    - **Hind Limb -** 30 bones. Femur, Patella, Tibia, Fibula, Tarsals (Ankle-7), metatarsals (sole-5), Phalanges (digits-14)
39. Femur is the longest bone of body.

    Pectoral girdle - Each half is made up of a clavical (collar bone) and a scapula bones.

40. Glenoid cavity is a depression in the scapula bone in which the head of the humerus bone articulate and form the shoulder joint.

Pelvic girdle - It consists of two coxal bones.

41. Each coxal bone is formed by fusion of ilium, ischium and pubis. At the point of fusion of the above bones acetabulum cavity is present in which head of femur articulates. The two halves of the pelvic girdle meet ventrally to form the pubic symphysis containing fibrous cartilage.

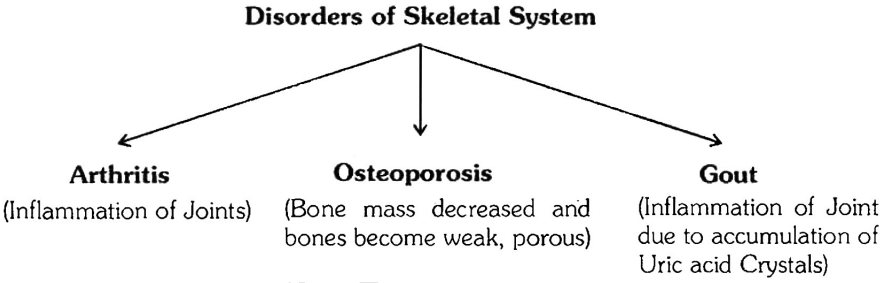
JOINTS

42. **Fibrous joint -** Do not allow any movement e.g.: Sutures (between skull bones)

43. **Cartilaginous Joint -** The bones involved are joined together with the help of cartilage e.g.: Intervertebral disc, pubic symphysis.

44. **Synovial joint -** Characterised by the presence of a fluid filled synovial cavity between the articulating surface of two bones. e.g.: Ball and Socket, Hinge, Pivot, Gliding, Saddle joints.

- Ball and socket joint (between Humerus and Pectorial girdle)
- Hinge Joint (Knee Joint, Elbow Joint)
- Pivot Joint (between atlas and axis)
- Gliding Joint (between the carpals, between the adjacent vertebrae).
- Saddle Joint (between carpal and metacarpal of thumb)



EXERCISE

Q.1 Sarcolemma is a membrane found over in
(1) Nerve fibre (2) Cardiac muscle
(3) Skeletal muscle fibre (4) Heart

Q.2 The sliding filament theory to explain muscular contraction was given by
(1) Corti (2) H.E. Huxley (3) A.F. Huxley (4) Huxley and Huxley

Q.3 Muscles are red because of the presence of
(1) Myoglobin and mitochondria (2) Haemoglobin and golgi bodies
(3) Globulin and mitochondria (4) Protein and lysosome

Q.4 The functional unit of the contractile system in the striped muscle is
(1) Z–band (2) A–band (3) Myofibril (4) Sarcomere

Q.5 Muscles of the heart are
(1) Voluntary striated (2) Voluntary smooth (3) Involuntary striated (4) Involuntary smooth

Q.6 The dark bands (A–bands) of a skeletal muscle are known as
(1) Isotropic bands (2) Anisotropic bands
(3) Intercalated disc (4) Cross bridges

Q.7 During muscle contraction
(1) Chemical energy is changed into electrical energy
(2) Chemical energy is changed into mechanical energy
(3) Chemical energy is changed into physical energy
(4) Mechanical energy is changed into chemical energy

Q.8 The term refractory period with reference of muscle tissue refers to
(1) A period when stimulation does not lead to contraction
(2) A period when maximum contraction occurs
(3) Time gap between application of stimulus and occurrence of contraction
(4) Loss of transluscency in muscle fibres due to death of animal

Q.9 Striated muscles contract by -
(1) Sliding of actin filament upon myosin filaments
(2) Sliding of myosin filaments upon actin filaments
(3) Pulling together of myosin filaments
(4) Pulling together of actin filaments

Q.10 Ions that must be present for binding the cross bridges is
(1) Na^+ (2) Ca^{++} (3) K^+ (4) None of these

Q.11 Tetanus is sustained contraction of muscle, is due to-
(1) Parathyroid deficiency (2) Ca^{2+} deficiency
(3) Bacterial disease (4) Auto immune disease

Q.12 Find out the incorrect statement-
(1) Muscle fibre is a syncitium as the sarcoplasm contains many nuceli.
(2) A characterstic feature of the muscle fibre is the presence of a large number of parallely arranged filaments in the sarcoplasm called myofilaments or myofibrils.
(3) Actin & myosin are rod like structures, arranged perpendicular to each other and also to the longitudnal axis of myofibrils
(4) The protein of the myofibril between 2 successive Z-line is considered as the functional unit of contraction, is called a sarcomere.

Q.13 Find out the set of correct statements
(A) Meromyosin is the monomeric protein of myosin.
(B) Each meromyosin has head as HMM and tail as LMM
(C) Increase in Ca^{2+} level leads to binding of Ca with a subunit of tropomyosin on actin filament
(D) ATP hydrolysis is done by myosin head to make cross bridge.
(1) A, B (2) A, B, C (3) B, C, D (4) A, B, D

Q.14 Inter-vertebral disc is a
(1) Fibro cartilage between the centrum of vertebrae
(2) Pad in the centrum of bone
(3) Cartilage bone in the body
(4) Body of vertebrae

Q.15 The hardest substance present in the
(1) Bone– Ossein (2) Chitin – Protein (3) Tooth– Enamel (4) Muscle–Myosin

Q.16 Axial skeleton is made up of
(1) Skull only (2) Sternum only
(3) Complete vertebral column (4) All of the above

Q.17 In man the axial skeleton is made up of
(1) 80 bones (2) 100 bones (3) 103 bones (4) 106 bones

Q.18 Cervical vertebrae are located in
(1) Thoracic region (2) Abdominal region (3) Neck region (4) Lumbar region

Q.19 Find out the correct option regarding true sentence/s from the followings-
(i) Human skull is dicondylic like reptiles.
(ii) Foramen of Magnum is found at the anterior side of skull
(iii) Atlas vertebrae helps in rotation of neck.
(iv) Spinal cord passes to the brain through Foramen of Magnum.
(1) only iv (2) i, ii, iv (3) i, iii, iv (4) all are correct

Q.20 A shallow depression in the scapula which receives the head of the upper arm bone is known as the
(1) Acetabulum (2) Neural arch (3) Glenoid cavity (4) None of these

Q.21 The bone of mammals contains Haversian canals which are connected by transverse canals known as
(1) Bidder's canal (2) Inguinal canal (3) Volkmann's canal (4) Semicircular canal

Q.22 Haversian system is found in
(1) Atlas of man (2) Ilium of man (3) Femur of man (4) Lumbar of man

Q.23 The pectoral and pelvic girdles and the bones of limb form
(1) Axial skeleton (2) Appendicular skeleton
(3) Visceral skeleton (4) Outer skeleton

Q.24 Patella is associated with
(1) Elbow (2) Knee (3) Neck (4) Wrist

Q.25 Ball and socket joints can be seen in
(1) Wrist (2) Fingers (3) Neck (4) Shoulders

Q.26 Joint of wrist is of
(1) Hinge type (2) Ball and socket type
(3) Pivot type (4) None of these

Q.27 Joint between femur and acetabulum is known as
(1) Hinge joint (2) Saddle joint (3) Gliding joint (4) Ball and socket joint

Q.28 Tendon is a structure which connects
(1) A bone with another bone (2) A nerve with a muscle
(3) A muscle with a bone (4) A muscle with a muscle

Q.29 Synovial joints is
(1) Pivot joint (2) Hinge joint (3) Ball and socket joint (4) All of these

AIIMS Special

Instructions for following questions (Q.30 to Q.49).

(1) If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).
(2) If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).
(3) If Assertion is true statement but Reason is false, then mark (3).
(4) If both Assertion and Reason are false statements, then mark (4).

Q.30 **Assertion :** Maximum movement is possible at the amphiarthroses joint.
Reason : Such joints are also called Synovial joints and have almost frictionless movement due to Synovial fluid.

Q.31 **Assertion :** Ca^{2+} play important role in the muscle contraction.
Reason : Ca^{2+} combine with troponin chain, displacing tropomyosin allowing the myosin head part to combine with actin to from actomyosin complex.

Q.32 **Assertion :** On repeated application of stimuli, involuntary striped muscles undergo fatigue.
Reason : This is due to non availability of ATP molecules.

Q.33 **Assertion :** All muscles follow 'All or None' principle.
Reason : All muscles contract either fully or not contract at all depending upon threshold stimulus availability.

Q.34 **Assertion :** Tibia is stronger and inner whereas fibula is outer and slender bone of lower leg or shank.
Reason : Tibia has a sharp crest in the shaft and a projection on the inner side of ankle called lateral malleolus.

Q.35 **Assertion :** Skeleton helps in blood cell formation.
Reason : Blood flows through skeleton.

Q.36 **Assertion :** Skeleton serves as a storage depot.
Reason : Skeleton stores carbohydrate and protein.

Q.37 **Assertion :** Ball and-socket-joints are the most mobile joints.
Reason : Synovial fluid is present here.

Q.38 **Assertion :** Arthritis or inflammation of a joint makes the joint painful.
Reason : Some toxic substances are deposited at the joint.

Q.39 **Assertion :** The contraction and relaxation of muscle fibre are controlled by nerve impulses.
Reason : The threshold stimulus is the minimum stimulus required for the beginning of contraction.

Q.40 **Assertion :** Muscle twitch is related with tetanus.
Reason : Tetanus is caused by many nerve impulses at a time.

Q.41 **Assertion :** Human skeleton also helps in hearing.
Reason : Internal ear of man is surrounded by bony labyrinth.

Q.42 **Assertion :** Jaw suspension of man is craniostylic.
Reason : Squamosal of lower jaw is suspended from dentary of upper jaw.

Q.43 **Assertion :** Human vertebrae are called amphiplatyan type.
Reason : Centrum of vertebrae is flat on both sides.

Q.44 **Assertion :** Osteoarthritis is also called wear and tear disease.
Reason : In osteoarthritis, there is inflammation and degeneration of cartilages at the joints.

Q.45 **Assertion :** Osteoporosis is characterized by increases in density of bones.
Reason : There is increased activity of the osteoblasts.

Q.46 **Assertion :** Intervertebral discs are tough and strong than the pinna of man.
Reason : Intervertebral discs are formed of fibro cartilages while pinna is with calcified cartilage.

Q.47 **Assertion :** Birds are with pneumatic bones.
Reason : Air sacs make the bones lighter which helps in the flight of the birds.

Q.48 **Assertion :** In muscle concentration, length of the both A-bands and I-bands decreases.
Reason : Both myosin of A-bands and actin of I-bands are contractile proteins and decrease in size during muscle contraction.

Q.49 **Assertion :** During exercise, a person undergoes fatigue very soon.
Reason : During this period, muscle fibres undergo oxygen debt.

ANSWER KEY

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