



## BIOLOGY

### BOOKS - MODERN PUBLISHERS BIOLOGY (HINGLISH)

#### LOCOMOTION AND MOVEMENT

#### Practice Problems

1. Name two muscles of human body which are ectodermal in origin.

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2. What are myofibrils?

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3. Why do the muscle cells and nerve cells not have power of growth and regeneration?

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4. Name three types of muscles found inside the human body.

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5. list two structural difference between striated and unstriated muscle fibres.

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6. What is structural and functional unit of a muscle fibre?

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7. What do you mean by striations of muscle fiber?

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8. List two differences between A - band and I - band.

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9. List two structural adaptations in striated muscle fibres to draw more energy.

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10. Why are striated muscles called skeletal muscles?

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11. What do you mean by single- unit smooth muscles?



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12. List two structural peculiarities of cardiac muscle fibres.



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13. What is Z- line? Give its function.



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14. What is sarcoplasmic reticulum? What is its function?



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15. Why we shiver during winter months?



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16. What is most accepted theory of muscle contraction?



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17. Give the value of rest potential in a polarized muscle fibre.



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18. Who explained the biochemical changes occurring during muscle contraction?



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19. What is action potential?



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20. Name two energy sources for muscle contraction.

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21. What is the function of  $Ca^{++}$  in muscle contraction.

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22. Which chemical causes the muscle fatigue?

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23. Which type of skeletal flight muscles are found in kite?

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24. What is myoglobin?

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25. \_\_proposed the sliding filament theory of muscle contraction.

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26. Name two types of elements of human skeleton.

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27. What are the number of bones in axial and appendicular skeleton of man?

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**28.** Which part of human skeleton forms the helmet for the protection of human brain?

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**29.** Through which aperture, brain is continuous with spinal cord?

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**30.** Which types of jaw suspension is found in man?

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**31.** Name the tongue bone.

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**32.** Give the vertebral formula of man?



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**33.** Which vertebra has the odontoid process ?



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**34.** What is the function of odontoid process?



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**35.** Name a vestigial bony part of human skeleton.



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**36.** Give the function of intervertebral discs.



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37. Give the number of true, false and floating ribs in man.



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38. Name the breast bone.



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39. Name two bones of a pectoral girdle of man.



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40. Give the position of glenoid cavity.



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41. Name three bones of a pelvic girdle of man.

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42. Which cup lies at the junction of 3 bones of pelvic girdle?

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43. On which bone, deltoid ridge is present?

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44. carpals and tarsals?

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45. What is patella?



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**46.** Define arthritis.



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**47.** What is Osteoporosis?



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**48.** Name an autoimmune disorder of skeletal muscles.



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**49.** Define rigor mortis.



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**50.** What is the function of pubic symphysis?

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**51.** Which are the sutures immovable?

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**52.** Which types of joint lies at the shoulder joint and hip joint?

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**53.** List two sites with hinge joint.

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**54.** TETANY



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55. What is the cause of muscular dystrophy?



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## Ncert Solved Exercise Questions

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



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2. Define sliding filament theory of muscle contraction.



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3. Describe the important steps in muscle contraction.



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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.



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5. Write the difference between:

(a) Actin and Myosin

(b) Red and White muscles

(c) Pectoral and Pelvic girdle



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6. Match Column - I with Column - II :



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



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



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9. Name the type of the 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



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10. Fill in the blank spaces :

- (a) All mammals (except 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.



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## Ncert Solved Exemplar Problems A Multiple Choice Questions

1. Ribs are attached to

- A. Scapula
- B. Sternum
- C. Clavicle
- D. Ilium

**Answer: B**



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2. What is the type of movable joint present between the atlas and axis?

- A. Pivot

B. Saddle

C. Hinge

D. Gliding

**Answer: A**



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**3. ATPase of the type muscle is located in**

A. Actinin

B. Troponin

C. Myosin

D. Actin

**Answer: C**



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4. Intervertebral disc is found in the vertebral column of

- A. Birds
- B. Reptiles
- C. Mammals
- D. Amphibians

**Answer: C**



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5. Which one of the following is showing the correct sequential order of vertebrae in the vertebral column of human beings ?

- A. Cervical - lumbar - thoracic - sacral - coccygeal
- B. Cervical - thoracic - sacral - lumbar - coccygeal
- C. Cervical -sacral - thoracic - lumbar - coccygeal
- D. Cervical -thoracic - lumbar -sacral -coccygeal

**Answer: D**



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**6. Which one of the following options is incorrect?**

- A. Hinge joint- between Humerus and Pectoral girdle
- B. Pivot joint- between atlas, axis and occipital condyle
- C. Gliding joint - between the carpals
- D. Saddle joint - between carpals and metacarpals of thumb

**Answer: A**



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**7. Knee joint and elbow joints are examples of**

- A. Saddle joint

B. Ball and socket joint

C. Pivot joint

D. Hinge joint

**Answer: D**



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**8. Macrophages and leucocytes exhibit**

A. Ciliary movement

B. Flagellar movement

C. Amoeboid movement

D. Gliding movement

**Answer: C**



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9. Which one of the following is not a disorder of bone ?

- A. Arthritis
- B. Osteoporosis
- C. Rickets
- D. Atherosclerosis

**Answer: D**



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10. Which one of the following statement is incorrect?

- A. Heart muscles are striated and involuntary
- B. the muscles of hands and legs are striated and voluntary
- C. The muscles located in inner walls of alimentary canal are striated and involuntary

D. Muscles located in inner walls of alimentary canal are smooth and involuntary

**Answer: C**



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**11.** Which one of the following statement is true?

- A. Head of humerus bone articulates with acetabulum of pectoral girdle.
- B. Head of jumerus bone articulates with glenoid cavity of pectoral gridle.
- C. Head of humerus bone articulates with a cavity called acetabulum of pelvic gridle.
- D. Head of humerus bone articulates with a glenoid cavity of pelvic girdle.



**Answer: B**



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**12. Muscles with characteristic striations and involuntary are**

- A. Muscles in the wall alimentary canal
- B. Muscles of the heart
- C. Muscles assisting locomotion
- D. muscles of the eyelids

**Answer: B**



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1. Name the cells / tissues in the human body, which

(i) Exhibit amoeboid movement (ii) Exhibit ciliary movement

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2. Locomotion requires a perfect coordinated activity of muscular.....systems.

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3. Sarcolemma, sarcoplasm and sarcoplasmic reticulum refer to particular type of cell in our body. Which is this cell and to what parts of that cell do these names refer to ?

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4. Label the difference components of actin filament in the diagram given below:



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5. The three tiny bones present in middle ear are called ear ossicles. Write them in correct sequence beginning from ear drum.



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6. What is difference between the matrix of bones and cartilage?



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7. Which tissue is afflicted by myasthenia gravis? What is the underlying cause.



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8. How do our bone joints function without grinding noise and pain?



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9. Give the location of a ball and socket joint in a human body



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10. Our forearm is made of three different bones. Comment.



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**Ncert Solved Exemplar Problems C Short Answer Type Questions**

1. With respect to rib cage, explain the following

(a) bicephalic ribs (b) true ribs

(c) floating ribs



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2. In old age, people often suffer from stiff and inflamed joints. What is this condition called? What are the possible reasons for these symptoms?



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3. Exchange of calcium between bone and extracellular fluid takes place under the influence of certain hormones

(a) What will happen if more of  $Ca^{2+}$  is in extracellular fluid?

(b) What will happen if very less amount of  $Ca^{2+}$  is in the extracellular fluid?



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4. Name at least two hormones which result in fluctuation of  $Ca^{2+}$  level.

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5. Rahul exercises regularly by visiting a gymnasium. Of late he is gaining weight. What could be the reason? Choose the correct answer and elaborate.

- A. Rahul has gained weight due to accumulation of fats in the body.
- B. Rahul has gained weight due to increased muscle and less of fat.
- C. Rahul has gained weight because his muscle shape has changed .
- D. Rhaul has gained weight because of accumulation of waterin the body .

**Answer: b**

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6. Radha was running on a treadmill at a great speed for 15 minutes continuously. She stopped the treadmill and abruptly came out. For the next few minutes, she was breathing heavily/fast. Answer the following questions.

(a) What happened to her muscles when she did strenuously exercised?

(b) How did her breathing rate change?



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7. Write a few lines about gout.



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8. What is the source of energy for muscle contraction?



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9. What are the points for articulation of pelvic and pectoral girdles?



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10. The following parts in our body have specific name in osteology. Write against each :

(a) Knee cap (b) Collar bone (c) Skull.



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### Ncert Solved Exemplar Problems C Long Answer Type Questions

1. Calcium ion concentration in blood affects muscle contraction. Does it lead to tetany in certain cases? How will you correlate fluctuation in blood calcium with tetany?



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2. An elderly woman slipped in the bathroom and had severe pain in her lower back. After X-ray examination doctors told her it is due to a slipped disc. What does that mean?



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3. Explain sliding filament theory of muscle contraction with neat sketches.



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4. How does a muscle shorten during its contraction and return to its original form during relaxation ?



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5. Discuss the role of  $Ca^{2+}$  ions in muscle contractions. Draw neat sketches to illustrate your answer.

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6. Differentiate between pectoral and pelvic girdle.

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## Higher Order Thinking Skills Brain Twisting Very Short Answer Questions

1. Name the proteins present in A- band and I- band.

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2. which chemical causes depolarisation of sarcolemma at neuromuscular junction?

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3. Give the location of glenoid cavity and acetabulum.

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4. Why the jaw suspension of man is called craniostylic?

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5. What vertebral formula of man?

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6. Actin vinding sites are located on

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7. Which bones from the thoracic cage in man ?

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8. Name an autoimmune muscular disorder.

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9. Given the distribution of 29 skull bones .

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10. state the main cause of osteoporosis

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1. Why the white skeletal muscles undergo earline fatigue than the red skeletal muscles?

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2. Repolarization of muscles fibre is not immediately followed by next depolarization. Why?

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3. Give the reason for that after menopause, human female generally suffers from osteoporosis.

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4. Supra scapula is very large sized in frog and toad but is absent from human skeleton. Justify the statement.



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5. Differentiate between red and white skeletal muscles.

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6. What will happen if extracellular fluid has low amount of calcium?

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7. Give a list of number of bones in various parts of human skeleton.

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8. Differentiate between :

(i) Osteoarthritis and Rheumatoid arthritis.

(ii) Suture and symphysis.

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9. Define the following:

(i) Single muscle twitch (ii) muscle fatigue (iii) Motor unit.



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## Higher Order Thinking Skills Brain Twisting Long Answer Questions

1. Briefly describe the biochemical changes that occur in muscle contraction.



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2. Differentiate between:

(i) True ribs, false ribs and floating ribs.

(ii) Pectoral girdle and pelvic girdle.



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## Quick Memory Test A Say True Or False

1. Write "True" or "False".

Sarcomere is covering of striated muscle fibre.



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2. Write "True" or "False".

Red muscles are slow acting while white muscles are fast acting.



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3. Write "True" or "False".

Glenoid cavity is present in pelvic girdle while acetabulum is present in pectoral girdle.



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4. Write "True" or "False".

Bone forming cells are called osteoclasts while bone dissolving cells are called osteoblasts.

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5. Write "True" or "False".

In the vertebrates, the ATP is regenerated by phosphagens like phosphocreatine and phosphoarginine.

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6. Write "True" or "False".

Bones of wrist are tarsals while bone of ankle are carpals.

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7. Write "True" or "False".

Man has dicondylic jaw suspension.

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8. Write "True" or "False".

Astragalus and calcaneum bones are found in fore limb of frog.

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9. Write "True" or "False".

Obturator foramen is found in pelvic girdle.

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10. Write "True" or "False".

Stapes is smallest bone of human skeleton while Tibia is longest bone of

human skeleton.

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## Quick Memory Test B Complete The Missing Links

1. Minimum strength of stimulus required to initiate muscle contraction is .....

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2. ....is the structural and functional unit of muscle fibres.

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3. The skull bones are joined at the sutures by \_\_tissues and the bodies of vertebrae are joined by \_\_\_tissue.

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4. Dark bands of muscle fibres are made of ..... Protein while light bands of muscle fibres are made of .....

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5. Bio chemical changes in muscle contraction were explained by .....

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6. Deltoid ridge is present on the shaft of .....bone.

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7. Pelvic girdle is formed by fusion of three bones - ilium, ischium and .....

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8. Depressed activity of osteoblasts lead to disease called .....

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9. .... is cup-like depression in pelvic girdle.

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10. ....bones are present in wrist of hand while.....bones are present in ankle of foot.

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11. ....muscle fibres are involved in rapid contraction for short duration while .....in slow contraction for long period.

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12. Joint of femur with pelvic girdle is ..... Joint.

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13. ....is an example of hinge joint.

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14. Humerus, radius and ..... Bones are found in the forearm.

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15. Acetabulum is present in the ..... Girdle.

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1. Movements of body parts and location in organisms are induced/autonomic.

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2. Actin binding sites lie on tail of myosin/head of myosin.

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3. During muscle contraction, A - band/I-band remains unchanged.

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4. Absence of acetylcholine receptors/dystrophin causes myasthenia gravis.

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5. Muscle relaxation involves release/trapping of calcium ion by sarcoplasmic reticulum.

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6. Gout occurs due to accumulation of uric acid/lactic acid.

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7. Cranium of human skull is formed of 8/14 bones.

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8. Axis vertebra is characterized by presence of deltoid ridge/odontoid process.

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9. Acetabulum lies in pelvic girdle/pectoral girdle.

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10. Patella bone is a cartilaginous bone/sesamoid bone.

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### Revision Exercises Very Short Answer Questions

1. Name two types of filaments in a sarcomere.

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2. Give an example of slightly movable joint.

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3. Give the smallest and longest bone of human skeleton.

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4. Give the location of foramen magnum and neural canal.

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5. Give the location of carpals and tarsals.

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6. Name three bones forming the pelvic girdle.

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7. Where are deltoid ridge and odontoid process located ?



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8. Which bones are associated with : (a) supporting of head, (b) rotatory movements of head.



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9. How many true, false and floating ribs are there in the rib-basket of man?



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10. Name a sesamoid bone. Give its position.



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11. Name the kind of joint which permits movements in a single plane.



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12. What is fibrous root?



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13. What is a pivot joint?



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14. What is a muscle twitch?



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15. Name the pigment present in red muscle fibres.



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16. Name the type of filaments which constitute A-bands (dark bands) of striated muscle fibres.

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17. State any two characteristics of muscle fatigue. How is it caused?

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18. How many bones are present in human cranium?

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19. Give two example of Hinge joints.

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**20.** Name the cavity in the girdle, into which the head of the femur fits.



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**21.** Mention the role of ligaments in human body.



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**22.** What is total numbers of bones present in the left pectoral girdle and left arm respectively in a normal human?



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**23.** What causes Gouty arthritis ?



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24. What is rheumatoid arthritis ?

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25. What is osteoporosis?

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### Revision Exercises Short Answer Questions

1. How many vertebrae are found in the vertebral column of man ? Give the vertebral formula.

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2. Differentiate fibrous joint and cartilaginous joint.

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3. Differentiate between true, false and floating ribs.

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4. Osteoarthritis and Rheumatoid arthritis.

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5. What is arthritis ? How is it caused?

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6. What are synovial joints? Explain.

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7. What is a pivot joint? Explain with an example.

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8. Why a red muscle fibre can work for a prolonged period while a white muscle fibre suffers from a fatigue after a short period?

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9. List any four functions of Skeletal System.

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10. What makes the synovial joint freely movable? List the various type of synovial joints.

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**11.** What is synovial joint? With the help of one example for each, point out the difference between a ball and socket joint, and a pivot joint.

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**12.** Differentiate between muscle twitch and tetanus.

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**13.** What is the role of calcium ions in muscle contraction ?

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**14.** What makes the synovial joint freely movable ? List any two of synovial joints.

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15. What causes muscle fatigue ? How is it removed?



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16. Humans have 3 kinds of ribs. Name these with examples.



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17. Give two difference between rheumatoid arthritis and gouty arthritis



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18. What is osteoporosis? Name two factors responsible for this condition.



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19. What is a joint ? Write its type with examples.



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20. Write briefly the biological importance of the following : (a) Myoglobin , (b) Actin and myosin myofilaments , (c ) Synovial joints, (d) Fibrous joints , (e ) Lactic acid.



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21. Which neurotransmitter causes depolarization of muscle fibre? What is the role of calcium in muscle contraction ? Why is there need of a refractory period?



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22. How are thick and thin filaments arranged in a muscle fibre ?





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**23.** Elucidate the types of movements found among the animals.



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**24.** Answer the following briefly :

- (a) How does the muscle shorten during its contraction and lengthen during its relaxation ?
- (b) What biological functions are served by the skeletal system ?
- (c ) What type of muscles will be antagonistic to pronators and abductors respectively, and why ?
- (d) Why a red muscle fibre can work for a prolonged period while a white muscle fibre suffers from fatigue after a shorter work?
- (e ) Where from the muscle gets energy for its contraction ?



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**25.** What is synovial joint? With the help of one example for each, point out the difference between a ball and socket joint, and a pivot joint.

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**26.** Give a summary of the electrical and biochemical events that occur in muscle contraction.

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**27.** Why are movement and locomotion necessary among the animals?

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**28.** Define sliding filament theory of muscle contraction.

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**29.** Explain the initiation of muscle contraction. What is the role of sarcoplasmic reticulum, myosin head and F-actin during contraction in striated muscles?

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**30.** Name the category of bones forming the rib cage. How are these articulated to each other to form the cage ?

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**31.** What is the role of calcium ions , troponin and F-actin during contraction of striated muscles of humans?

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**32.** Explain giving one example of each, the three types of joints in human skeleton, based on the capacity of movement.

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**33.** Write short notes on synovial joints.

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**34.** What causes muscle fatigue ? How is it removed?

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## Revision Exercises Long Answer Questions

**1.** Briefly describe the biochemical changes that occur in muscle contraction.





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2. Write the basic functions of human skeleton.



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3. How do you account for 206 bones in the human skeleton ?



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## Objective Type Questions A Multiple Choice Questions

1. An acromian process is characteristically found in the : —

- A. Pelvic girdle of mammals
- B. Skull of frog
- C. Pectoral girdle of mammals

D. Sperm of mammals

**Answer: C**



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2. Which of the following pairs, is correctly matched ?

- A. Cartilaginous joint - skull bones
- B. Hinge joint - between vertebrae
- C. Fibrous joint - between phalanges
- D. Gliding joint - between zygapophyses

**Answer: D**



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3. Some vertebrae in birds fuse to form:

- A. Sacrum
- B. Synsacrum
- C. Coccyx
- D. None of these

**Answer: B**

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**4. Knee joint is**

- A. Synovial joint
- B. Cartilaginous joint
- C. Hyaline joint
- D. Fibrous joint

**Answer: A**

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5. In a muscle undergoes rapid contraction and relaxation, the sarcoplasmic reticulum extension

- A. Requires constant plugging in and out of calcium
- B. Rapid synthesis of myosin
- C. Do not require energy
- D. All of these

**Answer: A**



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6. The muscle fatigue is due to :

- A.  $Na^+$
- B.  $K^+$
- C. Lactic acid

D. Citric acid

**Answer: C**

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7. Lumbar vertebrae in human skeleton are:

A. 5

B. 7

C. 9

D. 12

**Answer: A**

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8. Lactic acid deposition leads to

- A. Spasm
- B. Convulsion
- C. Muscle fatigue
- D. Tetany

**Answer: C**

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**9. Muscles which bend the joint is**

- A. Flexor
- B. Twitch
- C. Extensor
- D. Involution

**Answer: A**

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10. Muscle band that remains unchanged during contraction and relaxation of skeletal muscle is

- A. I
- B. H
- C. A
- D. Z - line

**Answer: C**



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11. The contractile protein of skeletal muscle involving ATPase activity is

- A. Tropomyosin
- B. Myosin
- C.  $\alpha$ -Actinin

D. Troponin

**Answer: B**



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12. A cricket player is fast chasing ball in the field. Which one of the following group of bones is directly contributing in this movement ?

A. Femur, malleus, tibia , metatarsals

B. Pelvis, ulna, patella, tarsals

C. Sternum, femur, tibia, fibula

D. Tarsals, femur, metatarsals, tibia

**Answer: D**



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13. Largest muscle in the human body is

A. Sartorius

B. Gluteus

C. Stapedius

D. Masseter

**Answer: B**



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14. Articulation of femur with pelvic girdle is an example of:

A. Gliding joint

B. Ball and socket joint

C. Hinge joint

D. Pivot joint

**Answer: B**



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**15. Lower jaw of man is formed of :**

- A. One bone
- B. Two bones
- C. No bone, only muscles
- D. Three bones

**Answer: A**



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**16. Functional unit of muscle is :**

- A. Fasciculi

B. Muscle fibre

C. Bundle

D. Both (a) and (c )

**Answer: A**



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17. The number of vertebrae present in cervical, thoracic, lumber, sacral and coccyx regions respectively are

A. 12,7,5,1,1

B. 1,7,5,12,1

C. 7,5,1,12,1

D. 7,12,5,1,1

**Answer: D**



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18. In human body , which one of the following is anatomically correct ?

- A. Carnial nerves, 10 pairs
- B. Floating ribs : 2 pairs
- C. Collar bones : 3 pairs
- D. Salivary glands : 1 pair

**Answer: B**



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19. Which one of the following is a skull bone?

- A. Coracoid
- B. Arytenoid
- C. Atlas
- D. Pterygoid

**Answer: D**



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**20.** ATPase enzyme needed for muscle contraction is located in

- A. Actinin
- B. Troponin
- C. Myosin
- D. Actin

**Answer: C**



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**21.** The first digit of forearm is called:

- A. Pollex

B. Hallux

C. Index

D. None of these

**Answer: A**



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**22. Spongy or cancellous bones are:**

(1) Skull bones (2) Vertebrae (3) Femur (4) Ribs

A. 1,2 and 3 are correct

B. 1 and 2 are correct

C. 2 and 4 are correct

D. 1 and 3 are correct

**Answer: B**



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**23.** Glenoid cavity is found in:

- A. Pelvic gridle
- B. Pectoral girdle
- C. Sternum
- D. Humerus

**Answer: B**



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**24.** Bones becomes fragile in

- A. Osteoporosis
- B. Gout
- C. Arthritis
- D. None of these

**Answer: A**



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**25.** An acromian process is characteristically found in the : –

- A. Pelvic girdle of mammals
- B. Skull of frog
- C. Pectoral girdle of mammals
- D. Sperm of mammals

**Answer: C**



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**26.** Which of the following pairs, is correctly matched ?

- A. Cartilaginous joint - skull bones



- B. Hinge joint - between vertabrae
- C. Fibrous joint - between phalanges
- D. Gliding joint - between zygapophyses

**Answer: D**



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**27. Synsacrum of fowl is consist of about**

- A. 29 vertebrae
- B. 3 vertebrae
- C. 16 vertebrae
- D. single vertebra

**Answer: C**



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**28.** A sesamoid bone is

- A. Palatine
- B. Pterygoid
- C. Patella
- D. Presphenoid

**Answer: C**



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**29.** Globular protein molecule which masks the active sites on F-actin is:

- A. Troponin
- B. Tropomyosin
- C. Myosin
- D. Light meromyosin

**Answer: B**



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**30.** Find out the correct order of number of bones in the parts of skull such as cranial bone, facial bone, hyoid bone and middle ear bone respectively

- A. 14,8,1 and 3
- B. 3, 8 , 14 and 1
- C. 14,8,3 and 1
- D. 8, 14, 1 and 3

**Answer: D**



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### 31. Statements

A-bands of the muscle are dark and contain myosin

I-band are the light bands and contain actin

During muscle contraction the A-band contracts

The part between the two Z-lines is called as saromere

The central part of thin filament, not over-lapped by thick filament is called H-zone of the above statements.

A. A, B and C are correct while D and E are incorrect

B. A, C and E are correct while B and D are incorrect

C. A and B are correct while C,D and E are incorrect

D. A, B and D are correct while C and E are incorrect

**Answer: D**



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**32.** Consider the following statements.

I. In man, vertebral column has 33 bones which are organised as 28 bones.

II. Pelvic girdle is made up of two fused bones only.

III. Osteoporosis is characterised by microarchitectural deterioration of the bone.

Identify the correct statement.

A. A alone is correct

B. B alone is correct

C. C alone is correct

D. A alone is incorrect

**Answer: C**



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**33.** Acoelus vertebrae in frog is

- A. 5th vertebra
- B. Atlas vertebra
- C. 8th vertebra
- D. None of these

**Answer: D**

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**34.** Number of bones in skull is

- A. 26
- B. 28
- C. 107
- D. 29

**Answer: D**

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35. Hinge joint is present between

- A. Femur and ulna
- B. Humerus and ulna
- C. Femur and pectoral girdle
- D. Femur and pelvic girdle

**Answer: B**



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36. Select a sesamoid bone:

- A. Patella
- B. Femur
- C. Ulna

D. Pterygoid

**Answer: A**



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**37.** Accumulation of which of following in muscle causes fatigue?

A. Acetic acid

B. Carboxylic acid

C. Hydrochloric acid

D. Lactic acid

**Answer: D**



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**38.** What connects muscle to bone ?



A. Ligament

B. Cartilage

C. Tendon

D. Sarcomere

**Answer: C**



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**39.** The basic unit of vertebrate kidney is the

A. Cell

B. Nephron

C. Neuron

D. Ommatidium

**Answer: B**



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**40.** Which one of the following items gives its correct total number

- A. Types of diabetes - 3
- B. Cervical vertebrae in human - 8
- C. Floating ribs in humans - 4
- D. Amino acid found in proteins - 16

**Answer: C**



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**41.** During strenuous exercise glucose is converted into

- A. Glycogen
- B. Pyruvic acid
- C. Strach

D. Lactic acid

**Answer: D**



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**42.** Which of the following is essential for muscle contraction?

A.  $Ca^{2+}$

B.  $Mg^{2+}$

C. Both (a) and (b)

D.  $Fe^{2+}$

**Answer: C**



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**43.** Number of bones in skull is

A. 26

B. 28

C. 107

D. 29

**Answer: D**



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**44.** In the thin filament of skeletal muscle fibre, a small globular protein, that masks the active sites on the F-actin is

A. G-actin

B. Actin

C. Tropomyosin

D. Troponin

**Answer: D**

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45. Number of cervical vertabrae in mammals are:

- A. 7
- B. 8
- C. 12
- D. 6

**Answer: A**

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46. Joint between atlas and axis is :

- A. Ball and Socket joint
- B. Pivot joint
- C. Saddle joint

D. Angular joint

**Answer: B**



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47. Elbow joint is an example of

A. Pivot joint

B. Hinge joint

C. Gliding joint

D. Ball and Socket joint

**Answer: B**



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48. Which one of the following is the correct matching of three items and their grouping category ?

- |    |                               |                              |
|----|-------------------------------|------------------------------|
| A. | Items                         | Group                        |
|    | Malleus, incus and cochlea    | Pyrimidines                  |
| B. | Items                         | Group                        |
|    | Ilium, ischium and pubis      | Muscle proteins              |
| C. | Items                         | Group                        |
|    | Actin, myosin and rhodopsin   | Coxal bones of pelvic girdle |
| D. | Items                         | Group                        |
|    | Cytosine, Uracil and Thaimine | Ear ossicle                  |

**Answer: B**



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49. Pick out the correct match :

- A. Sternum = 14 bones
- B. Pelvis = 3 bones
- C. Ribs = 20 bones
- D. Face = 5 bones

**Answer: B**



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**50.** Which cartilage is present at the joints of long bones?

A. Calcified

B. Elastic

C. Hyaline

D. Fibrous

**Answer: C**



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**51.** Innominate is

A. A nerve



B. A vein

C. An artery

D. A part of skeleton and an artery

**Answer: D**



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**52. Thoracic cage in rabbit is made up of**

A. Ribs , vertebral column and diaphragm

B. Ribs, diaphragm and sternum

C. Vertebral column, diaphragm and sternum

D. Ribs, vertebral column and sternum

**Answer: D**



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53. Centrum of 8th vertebra of frog is

- A. Procoelous
- B. Acoelous
- C. Amphicoelous
- D. Amphiplatyan

**Answer: C**



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54. Axis vertebra is identified by

- A. Sigmoid notch
- B. Deltoid ridge
- C. Odontoid process
- D. Centrum

**Answer: C**



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**55.** Which one of the following is the correct description of a certain part of a normal human skeleton ?

- A. Parietal bone and temporal bone of the skull are joined by fibrous joint
- B. First vertebra is axis which articulates with the occipital condyles
- C. The 9th and 10th pairs of ribs are called floating ribs.
- D. Glenoid cavity is a depression to which the thigh bone articulates

**Answer: A**



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**56.** Pectoral girdle constitute

- A. Scapula and clavicle
- B. Radius and ulna
- C. Ilium and ischium
- D. Maxilla and mandible

**Answer: A**

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57. End plate junction is present between

- A. Neuron and striated muscle
- B. Neuron and neuron
- C. Muscle and muscle
- D. Both (a) and (c)

**Answer: A**

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58. Acetabulum is present in

- A. Pelvic girdle of rabbit
- B. Pectoral girdle of rabbit
- C. Both (a) and (b)
- D. None of these

**Answer: A**



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59. Opening in the skull of rabbit is:

- A. Foramen of Monro
- B. Coronal suture
- C. Foramen magnum

D. Lambdoidal suture

**Answer: C**



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**60.** The membrane areas between the cranial bones of the foetal skull are called

A. Areolas

B. Foramina

C. Sutures

D. Fontanella

**Answer: D**



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61. The example of pivot joint is

- A. Hip joints
- B. Metacarpophalangeal joints
- C. Ankle joint
- D. Radio ulnar joint

**Answer: D**



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62. The major function of the intervertebral discs is to

- A. Absorb shock
- B. String the vertebrae together
- C. Prevent injuries
- D. Prevent hyper extension

**Answer: A**



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**63.** Read the statements regarding muscle proteins

(A) Actin is a thin filament and is made up of two F-actins

(B) The complex protein, tropomyosin is distributed at regular intervals on the troponin

(C) Myosin is a thick filament which is also a polymerized protein

(D) The globular head of meromyosin consists of light meromyosin (LMM)

Of the above statements

A. (i), (ii) and (iii) are correct

B. (i) , (ii) and (iv) are correct

C. (i) and (iii) are correct

D. (ii) and (iv) are correct

**Answer: C**







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64. Which ribs have "buckle-handle" type of movements?

- A. Rib no. 1 - 2
- B. Rib no. 3 - 5
- C. Rib no. 6 - 10
- D. Rib no. 11 - 12

Answer: C



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65. In the resting muscle fibre, tropomyosin partially covers

- A. Ca-binding sites of troponin
- B. Actin-binding sites on myosin
- C. Myosin -binding sites on actin

D. Ca-binding sites on actin

**Answer: C**



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**66.** In human beings the cranium is formed by

- A. Eight bones of which two are paired
- B. Fourteen bones of which six are paired
- C. Ten bones of which two are paired
- D. Twelve bones of which four are paired

**Answer: A**



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**67.** Actin binding sites are located on

- A. Troponin
- B. Tropomyosin
- C. Meromyosin
- D. Both tropomyosin and meromyosin

**Answer: C**

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**68.** The scapula is a large triangular flat bone situated in the dorsal part of the thorax between

- A. The second and fifth ribs
- B. The second and seventh ribs
- C. The third and sixth ribs
- D. The third and eighth ribs

**Answer: B**

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69. The coxal of the pelvic girdle is formed by the fusion of

- A. Ilium, ischium and pubis
- B. Scapula and clavicle
- C. Ilium and scapula
- D. Ilium, scapula and ischium

**Answer: A**

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70. Which of the statements about the mechanism of muscle contraction are correct

- (I) Acetylcholine is released when the neural signal reaches the motor end plate
- (II) Muscle contraction is initiated by a signal sent by CNS via a sensory

neuron

(III) During muscle contraction, isotropic band gets elongated

(IV) Repeated activation of the muscles can be lead to lactic acid eccumulation

A. A and D are correct

B. A and C are correct

C. B and C are correct

D. A, B and C are correct

**Answer: A**



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**71.** Select the correct statement regarding the specific disorder of musclular or skeletal system.

A. Muscular dystrophy - Age related shorting of muscles

B. Osteoporosis - Decrease in bone mass and higher chance of fractures with age

C. Myasthenia gravis - Autoimmune disorder which inhibits sliding of myosin filaments

D. Gout - Inflammation of joint due to extra deposition of calcium.

**Answer: B**



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**72.** During muscular contraction, which of the following events occur?

H-zone disappears

(ii) A-band widens

(iii) I-band reduces in width

(iv) Width of A-is unaffected

(v) M-line and Z-lne come closer

(v) M-line and Z-line come closer

A. (i), (iii), (iv) and (v)

B. (i) , (ii) and (v)

C. (ii) , (iv) and (v)

D. (i), (ii) and (iii)

**Answer: A**



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**73.** Symphysis contains

A. Hyaline cartilage

B. Fibrous cartilage

C. Calcified cartilage

D. None of these

**Answer: B**



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74. Gout is caused due to accumulation of :

- A. Oxalic acid
- B. Uric acid
- C. Calcium carbonate
- D. Lactic acid

**Answer: B**



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75. Human vertebra is

- A. Amphicoelous
- B. Acoelous
- C. Procoelous



D. Heterocoelous

**Answer: B**



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76. Human vertabral column is formed of 33 vertebrae and .....bones

:

A. 33

B. 26

C. 27

D. 29

**Answer: C**



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77. The important muscles proteins that help in movement are

- A. Actin and myosin
- B. Tropomyosin
- C. Troponin
- D. All of these

**Answer: D**



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78. Choose the correct option regarding a normal human

- A. The skull is dicondylic
- B. Metacarpals are five in numbers
- C. Patella is a cup-shaped bone covering the knee dorsally
- D. Scapula is a large triangular flat bone, situated on the ventral side of the thorax

A. A and E along are wrong

B. A and B along are wrong

C. B and E alone are wrong

D. C and D along are wrong

**Answer: D**

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**79.** Decreased levels of estrogen is a common cause of

A. Myasthenia gravis

B. Tetany

C. Osteoporosis

D. Gout

**Answer: C**

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80. Select the correct statement with respect to locomotion in humans

- A. A decreased level of progesterone cause osteoporosis in old people
- B. Accumulation of uric acid crystals in joints causes their inflammation
- C. Vertebral column has 10 thoracic vertebrae
- D. Joint between adjacent vertebrae is a fibrous joint

**Answer: B**



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81. The characteristics and an example of a synovial joint in human is

Characteristics	Examples
(a) lymph filled between two bones, limited movement	gliding joint between carpals
(b) fluid cartilage between two bones, limited movements.	knee joint
(c) Fluid filled between two joints, provides cushion	skull bones
(d) fluid filled synovial cavity between two bones	joint between atlas and axis

A.

Characteristics

Examples

Fluid cartilage between two bones, limited movements    Knee joint

B.

Characteristics

Examples

Fluid filled between two joints, provides cushion    Skull bones

C.

Characteristics

Examples

Fluid filled synovial cavity between two bones    Joint between axis and atlas

D.

Characteristics

Examples

Lymph-filled between two bones, limited movements    Gliding joints

**Answer: C**



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82. Stimulation of a muscle fibre by a motor neuron occurs at

- A. the myofibril
- B. the sarcoplasmic reticulum
- C. the neuromuscular junction
- D. the transverse tubules

**Answer: C**



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83. Select the correct matching of the type of the joint with the example in human skeletal system

- |    |               |                                     |
|----|---------------|-------------------------------------|
| A. | Type of Joint | Example                             |
|    | Hinge joint   | Between humerus and pectoral girdle |
| B. | Type of Joint | Example                             |
|    | Gliding joint | Between carpals                     |

- |    |                     |   |
|----|---------------------|---|
|    | Type of Joint       | Example                                     |
| C. | Cartilaginous joint | Between frontal and parietal                |
|    | Type of Joint       | Example                                     |
| D. | Pivot joint         | Between third and fourth cervical vertebrae |

**Answer: B**



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**84.** Sliding filament theory can be best explained as

- A. When myofilaments slide past each other, Actin filaments shorten while myosin filaments do not shorten.
- B. Actin and Myosin filaments shorten and slide past each other.
- C. Actin and Myosin filaments do not shorten but rather slide past each other.
- D. When myofilaments slide past each other, Myosin filament shorten while Actin filaments do not shorten.

**Answer: C**



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**85.** Glenoid cavity articulates

- A. Clavicle with acromion
- B. Scapula with acromion
- C. Clavicle with scapula
- D. Humerus with scapula

**Answer: C**



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**86.** Which of the following joints would allow no movement

- A. Fibrous joint
- B. Cartilagenous joint
- C. Synovial joint



D. Ball & socket joint

**Answer: A**



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**87.** Which of the following is not a function of the skeletal system ?

A. Production of erythrocytes

B. Storage of minerals

C. Production of heat

D. Locomotion

**Answer: C**



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**88.** Deposition of .....in the joints causes gout:

- A. Urea
- B. Uric acid
- C. Guanine
- D. Ammonia

**Answer: B**

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**89.** Gliding joint is present between

- A. Carpals
- B. Humerus and pectoral girdle
- C. Knee
- D. Atlas and axis

**Answer: A**

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90. Lumber region of the vertebral column in man is made up of:

- A. 1 Fused vertebra
- B. 7 Vertebrae
- C. 12 Vertebrae
- D. 5 Vertebrae

**Answer: D**



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91. Name the ion responsible for unmasking of active sites for myosin for crossbridge activity during muscle contraction:

- A. Potassium
- B. Calcium
- C. Magnesium

D. Sodium

**Answer: B**



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92. Osteoporosis, an age related disease of skeletal system, may occur due to

- A. Accumulation of uric acid leading to inflammation of joints
- B. Immune disorder affecting neuromuscular junction leading to fatigue
- C. High concentration of calcium and sodium
- D. Decreased level of estrogens

**Answer: D**



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93. Lack of relaxation between successive stimuli in striated muscle contraction is known as

- A. Tonus
- B. Spasm
- C. Fatigue
- D. Tetanus

**Answer: D**



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94. The pivot joint between atlas and axis is a type of

- A. Fibrous joint
- B. Cartilaginous joint
- C. Synovial joint
- D. Saddle joint

**Answer: C**



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**95.** Out of 'X' pairs of ribs in humans only 'Y' pairs are true ribs. Select the option that correctly represents values of X and Y and provides their explanation

- A.  $X = 12$ ,  $Y = 7$  : True ribs are attached dorsally to vertebral column ventrally to sternum.
- B.  $X = 12$ ,  $Y = 5$  : True ribs are attached dorsally to vertebral column sternum on two ends
- C.  $X = 24$ ,  $Y = 7$  : True ribs are dorsally attached to vertebral column sternum on two ends.
- D.  $X = 24$ ,  $Y = 12$  : True ribs are doraslly attached to vertebral column but are free on ventral side.

**Answer: A**



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**96.** Which of the following hormones can play a significant role in osteoporosis

- A. Estrogen and parathyroid hormone
- B. Progesterone and Aldosterone
- C. Aldosterone and Prolactin
- D. Parathyroid hormone and prolactin

**Answer: A**



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**97.** Calcium is important in skeletal muscle contraction because it

- A. Detaches the myosin head from the actin filament
- B. Activates the myosin ATPase by binding to it.
- C. Binds to troponin to remove the masking of active sites on actin for myosin.
- D. Prevents the formation of bonds between the myosin cros bridges and the actin filament.

**Answer: C**

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## Objective Type Questions B Cbse Pmt Main Examination Questions

1. Answer the question according to instruction:

Knee joint : Name of lubricating fluid, name of two bones, type of joint.

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2. Differentiate between human and bird on the basis of number of condyles.

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3. The given figure is of elbow joint. Answer the question given below the figure :



(a) Give the names of parts 1,2,3 and 4 in the above figure.

(b) Give functions of 2 and 3.

(c) Besides connective tissue, which other tissue is present in the figure and write its function and how does it work?

(d) Name one other such joint found in our body and give the name of structure analogous to part (1) in the above figure.

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4. Correct the following statements by changing only the underlined words:

Skull, Ribs, Scapula and Vertebral column form axial skeleton.



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5. Three of the following pairs of the human skeletal parts are correctly matched with their respective inclusive skeletal category and one pair is not matched. Identify the non-matching pair

- |    | Pairs of skeletal parts     | Category              |
|----|-----------------------------|-----------------------|
| A. | Humerus and ulna            | Appendicular skeleton |
| B. | Malleus and stapes          | Ear ossicles          |
| C. | Sternum and Ribs            | Axial skeleton        |
| D. | Clavicle and Glenoid cavity | Pelvic girdle         |

**Answer: D**



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1. Assertion : Human vertebrae are called amphiplatyan type.

Reason : Centrum of vertebrae is flat on both side.

- A. If both Assertion and Reason are true and Reason is correct explanation of Assertion.
- B. If both Assertion and Reason are true but Reason is not correct explanation of Assertion.
- C. If Assertion is true but Reason is false
- D. If both Asssertion and Reason are false.

**Answer: A**



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2. Assertion : Osteoarthritis is also called wear and tear disease .

Reason : In osteoarthritis , there is inflammation and degeneration of

cartilages at the joints.

- A. If both Assertion and Reason are true and Reason is correct explanation of Assertion.
- B. If both Assertion and Reason are true but Reason is not correct explanation of Assertion.
- C. If Assertion is true but Reason is false
- D. If both Assertion and Reason are false.

**Answer: A**



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**3. Assertion :** Osteoporosis is characterized by increase in density of bones.

**Reason :** There is increased activity of the osteoblasts.

A. If both Assertion and Reason are true and Reason is correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not correct explanation of Assertion.

C. If Assertion is true but Reason is false

D. If both Assertion and Reason are false.

**Answer: D**



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4. 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.

A. If both Assertion and Reason are true and Reason is correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not correct explanation of Assertion.

C. If Assertion is true but Reason is false

D. If both Assertion and Reason are false.

**Answer: C**

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5. Assertion : Birds are with pneumatic bones.

Reason : Air sacs make the bones lighter which helps in the flight of the birds.

A. If both Assertion and Reason are true and Reason is correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not correct explanation of Assertion.

C. If Assertion is true but Reason is false

D. If both Asssertion and Reason are false.

**Answer: A**

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**6.** Assertion : In muscle contraction, length of both A-bands and I-bands decrease.

Reason : Both myosin of A-band and actin of I-bands are contractile proteins and decrease in size during muscle contraction.

- A. If both Assertion and Reason are true and Reason is correct explanation of Assertion.
- B. If both Assertion and Reason are true but Reason is not correct explanation of Assertion.
- C. If Assertion is true but Reason is false
- D. If both Asssertion and Reason are false.

**Answer: D**

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7. Assertion : During exercise, a person undergoes fatigue very soon.

Reason : During this period , muscle fibres undergo oxygen debt.

- A. If both Assertion and Reason are true and Reason is correct explanation of Assertion.
- B. If both Assertion and Reason are true but Reason is not correct explanation of Assertion.
- C. If Assertion is true but Reason is false
- D. If both Assertion and Reason are false.

**Answer: A**

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8. Assertion : Pigeons and kites can fly for long period without undergoing fatigue.

Reason : These birds have white muscle fibres which undergo slow and sustained contraction for long period.

A. If both Assertion and Reason are true and Reason is correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not correct explanation of Assertion.

C. If Assertion is true but Reason is false

D. If both Assertion and Reason are false.

**Answer: C**



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9. Assertion : Cartilage (protein matrix) and bone (calcium matrix) are rigid connective tissue.

Reason : Blood is connective tissue in which plasma is the matrix.

- A. If both Assertion and Reason are true and Reason is correct explanation of Assertion.
- B. If both Assertion and Reason are true but Reason is not correct explanation of Assertion.
- C. If Assertion is true but Reason is false
- D. If both Assertion and Reason are false.

**Answer: B**



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**10.** Assertion. Inflammation of a skeletal joint may immobilize the movements of the joint.

Reason. Uric acid crystals in the joint cavity and ossification of articular cartilage lead to this.

- A. If both Assertion and Reason are true and Reason is correct explanation of Assertion.
- B. If both Assertion and Reason are true but Reason is not correct explanation of Assertion.
- C. If Assertion is true but Reason is false
- D. If both Assertion and Reason are false.

**Answer: A**



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## Objective Type Questions E Additional Multiple Questions

1. Volkman's canals occur in

- A. Cartilage
- B. Bone

C. Internal ear

D. Troponin

**Answer: B**



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2. ATPase enzyme needed for muscle contraction is located in

A. Myosin

B. Actin

C. Actinin

D. Troponin

**Answer: A**



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3. Total number of bones found in right upper limb is:

A. 25

B. 26

C. 30

D. 60

**Answer: C**



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4. Nucleus pulposus occurs in

A. Brain

B. Liver

C. Kidney

D. Intervertebral discs

**Answer: D**



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**5. Correct order of ear ossicles in rabbit is :**

- A. Incus, stapes, malleus
- B. Malleus, incus, stapes
- C. Malleus, stapes, incus
- D. Incus, malleus, stapes

**Answer: B**



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**6. Colle's fracture is associated with :**

- A. Femur

B. Ulna

C. Radius

D. Humerus

**Answer: C**



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7. Achilles tendon is associated with

A. Gluteus muscle

B. Hamstring muscle

C. Quadriceps muscle

D. Gastrocnemius muscle

**Answer: D**



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8. Ribs attached to sternum are

- A. First seven pairs
- B. All ten pairs
- C. First ten pairs
- D. First five pairs

**Answer: A**



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9. Which of the following lubricates ligament and tendon and is the important constituent of synovial fluid ?

- A. Pectins
- B. Lipids
- C. Hyaluronidase
- D. Hyaluronic acid



**Answer: D**



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**10.** The joint of radio-ulna with the upper arm is

- A. Hinge joint
- B. Pivot joint
- C. Socket joint
- D. None of these

**Answer: A**



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**11.** Joints of femur with pelvic girdle is

- A. Ball and socket

B. Pivot

C. Saddle

D. Hinge

**Answer: A**



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**12. Synovial joint is :**

A. Pivot joint

B. Fibrous joint

C. Ball and socket joint

D. All of these

**Answer: C**



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13. \_\_\_ acts as a shock absorber to cushion when tibia and femur came together

- A. Disc
- B. Tendon
- C. Ligament
- D. Cartilage

**Answer: D**



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14. Which of the following assists in the locomotion of the organism stated ?

- A. Pedicellaria of starfish
- B. Epithelium of Pheretima
- C. Trichocysts of Paramecium

D. Posterior sucker of Hirudinaria

**Answer: D**



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**15.** Human cranium has .....bones :

A. 8

B. 14

C. 20

D. None of these

**Answer: A**



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**16.** Ear ossicle incus is modified form of :

- A. Jugal bone
- B. Quadrate bone
- C. Articular bone
- D. Hyomandibular bone

**Answer: B**

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17. exoskeleton is absent in

- A. Scolidon
- B. Frog
- C. Rabbit
- D. Fowl

**Answer: B**

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18. Inter-articulated disc is found in

- A. Muscles of arm
- B. Vertebrae
- C. Muscles of leg
- D. Pubic symphysis

**Answer: B**



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19. Which of the following is important for muscle contraction and nerve impulse transmission?

- A.  $Ca^{++}$
- B.  $Ca^{++}$  and  $Mg^{++}$
- C.  $Mg^{++}$

D.  $Fe^{++}$

**Answer: B**



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20. During strenuous exercise glucose is converted into

- A. Starch
- B. Glycogen
- C. Pyruvic acid
- D. Lactic acid

**Answer: D**



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1. Which system of the body are involved in locomotion of organisms?

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2. Give the location of myosin ATPase enzyme.

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3. What is the main reason of muscle fatigue?

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4. Define sutures. Give their significance.

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5. Give the cause of muscular dystrophy.





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6. Define following characteristics of muscle fibres :

(i) Tonicity (ii) Tetany.

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7. State the number of bones in various parts of human skull.

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8. What is sesamoid bone ? Give one example and its significance.

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9. Differentiate between rheumatoid arthritis and osteoarthritis.

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10. Define sliding filament theory of muscle contraction.



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11. Differentiate between red and white skeletal muscles fibres.



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12. Give cause and symptoms of :

(i) Myaesthaemia gravis (ii) Osteroporosis.



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## Objective Type Questions

1. Which of the following muscular disorders is inherited?

- A. Tetany
- B. Muscular dystrophy
- C. Myasthenia gravis
- D. Botulism

**Answer: B**

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2. Select the correct option.

- A. 8th, 9th ,and 10 pairs of ribs articulate directly with the sternum.
- B. 11th and 12th pairs of ribs are connected to sternum by hyaline cartilage.
- C. Each rib is a flat thin bone and all the ribs are connected dorsally to the thoracic vertebrae and ventrally to the sternum

D. There are seven pairs of vertebrosteral , three pairs of vertebrochondral and two pairs of vertebral ribs.

**Answer: D**



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