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11. Support & Movement

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🎯 75 Solved Questions

📅 2014 to 2024 Archive

🏛️ Boards: BUMHS, DUHS, KMU, MDCAT, NUMS, PMDC

📊 Weightage: 34% of MDCAT (68 MCQs)

Curated by Ibrahim for fellow bees. Every question in this chapter has been verified against official UHS, NUMS, SZABMU, DUHS, and KMU answer keys. Propolis cognitive autopsies are provided at the end of this booklet to explain core concepts and break down common distractor traps.

OFFICIAL SOLVED EDITION**Q1.**

SZABMU 2024

The living cells of cartilage are called:

- (A) Chondroblasts
- (B) Chondrocytes
- (C) Chondroclasts
- (D) Osteocytes

Q2.

SZABMU 2024

Cartilage cells contain small cavities distributed in the matrix and are called:

- (A) Shaft
- (B) Periosteum
- (C) Perichondrium
- (D) Lacunae

Q3.

SZABMU 2024

Which of the following type of cartilage is most abundant in human body?

- (A) Fibrous
- (B) Hyaline
- (C) Elastic
- (D) Flexible

Q4.

UHS 2024

Bone forming cells are:

- (A) Osteoblasts
- (B) Osteocytes
- (C) Osteoclasts
- (D) Osteons

Q5.

KMU 2024

The cells contained in the lacunae of the bone are called:

- (A) Chondrocytes
- (B) Osteoblasts
- (C) Osteocytes
- (D) Osteoclast

Q6.

SZABMU 2024

Bone resorption is performed by:

- (A) Osteoblasts
- (B) Osteocytes
- (C) Osteoclasts
- (D) Osteopores

Q7.

UHS 2024

Which feature is possessed by smooth muscles?

- (A) Voluntary
- (B) Branched
- (C) Uni-nucleate
- (D) Striated appearance

Q8.

KMU 2024

Which of the following does NOT relate to smooth muscles?

- (A) Controlled by the autonomic nervous system
- (B) Have spindle shaped cells
- (C) Line the wall of heart
- (D) Lack striations

Q9.

SZABMU 2024

Contractile unit between two Z lines is absent in:

- (A) Skeletal muscles
- (B) Skeletal and cardiac muscles
- (C) Smooth muscles
- (D) Skeletal and smooth muscles

Q10.

SZABMU 2024

Which one of the following muscles are considered as 'Voluntary Muscles'?

- (A) Smooth muscles
- (B) Cardiac muscles
- (C) Skeletal muscles
- (D) Glandular muscles

Q11.

KMU 2024

The ____ surrounds the muscle fibre of the skeletal muscle.

- (A) Cytoplasm
- (B) Lacunae
- (C) Myofibrils
- (D) Sarcolemma

Q12.

UHS 2024

Thick filaments in skeletal muscles are composed of:

- (A) Actin
- (B) Myosin
- (C) Tropomyosin
- (D) Troponin

Q13.

SZABMU 2024

What do we call the cell surface membrane of a muscle fiber?

- (A) Sarcolemma
- (B) Plasma membrane
- (C) Sarcoplasm
- (D) Myofibrils

Q14.

UHS 2024

The accumulation of 'lactic acid' in the muscles results in:

- (A) Extreme fatigue
- (B) Muscle contraction
- (C) Paralysis
- (D) Convulsion

Q15.

UHS 2024

Sarcomere is part of myofibril between:

- (A) Two I bands
- (B) Two A bands
- (C) Two M lines
- (D) Two Z lines

Q16.

KMU 2024

What happens to calcium when skeletal muscles recover from contraction?

- (A) Released from the sarcoplasmic reticulum
- (B) Released from the myosin head
- (C) Pumped into the sarcoplasmic reticulum
- (D) Exchanged for sodium ions

Q17.

SZABMU 2024

When the skeletal muscle contracts, the two Z lines gets ____ and I band gets ____

- (A) Closer, distant
- (B) Closer, shorten
- (C) Enlarged, distant
- (D) Enlarged, shorten

Q18.

NUMS 2024

Choose the correct, for muscle in relaxed position:

- (A) Exposed binding sites on actin
- (B) Broad H-zone in sarcomere
- (C) Formation of cross bridges
- (D) Ca^{2+} released in cytosol

Q19.

SZABMU 2024

Sequence of nerve impulse initiation leading to muscle contraction:

1. Nerve impulse travels through sarcolemma to the T-tubules
2. Nerve impulse travels to sarcoplasmic reticulum
3. Arrival of nerve impulse at neural muscular junction
4. Opening of sarcoplasmic reticulum Ca^{++} gates

- (A) 3,1,2,4
- (B) 3,4,2,1
- (C) 4,2,3,1
- (D) 2,3,4,1

Q20.

SZABMU 2024

By the fusion of ilium, ischium and pubis in the pelvic girdle, ____ joint is formed.

- (A) Ball and socket joint
- (B) Cartilaginous joint
- (C) Fibrous joint
- (D) Synovial joint

Q21.

UHS 2024

Which of the following skeletal disorder is an example of autoimmune disorder?

- (A) Sciatica
- (B) Spondylosis
- (C) Rheumatoid arthritis
- (D) Rickets

Q22.

UHS 2024

Which of the following is NOT a bone of upper limb?

- (A) Humerus
- (B) Ulna
- (C) Femur
- (D) Radius

Q23.

SZABMU 2024

Which of the following is not a part of human eye orbit?

- (A) Sphenoid
- (B) Ethmoid
- (C) Zygomatic
- (D) Lacrimal

Q24.

NUMS 2024

You must have often heard about the hamstring injury of players. Which of the following is correct about hamstring muscles?

- (A) It is an extensive muscle
- (B) Its insertion is on tibia
- (C) Originate from pelvic girdle and top of femur
- (D) Originate from ilium and femur

Q25.

UHS 2023

Cartilage is a type of which tissue?

- (A) Connective tissues
- (B) Epithelial tissues
- (C) Muscular tissues
- (D) Nervous tissues

Q26.

KMU 2023

Which of the following connective tissues consists of cells known as chondrocytes:

- (A) Myocardium
- (B) Cartilage
- (C) Bone
- (D) Periosteum

Q27.

KMU 2023

Hip joint and shoulder joint are example of:

- (A) Cartilaginous joint
- (B) Synovial joint
- (C) Hinge joint
- (D) Ball and socket joint

Q28.

NUMS 2023

Cartilage is more difficult to heal than bone because cartilage:

- (A) Lacks vascular supply
- (B) Lacks minerals deposits in matrix
- (C) Has less number of cells deep down
- (D) Lacks protein in matrix

Q29.

KMU 2023

Which cartilage is found at the end of long bones?

- (A) Calcified
- (B) Elastic
- (C) Fibrous
- (D) Hyaline

Q30.

SZABMU 2023

Mature bone cells are called:

- (A) Osteoblasts
- (B) Osteocytes
- (C) Osteoclasts
- (D) Chondrocytes

Q31.

UHS 2023

Irregular striations and involuntary control is related to?

- (A) Cardiac muscle cells
- (B) Fibroelastic cartilage cell
- (C) Skeletal muscle cells
- (D) Smooth muscle cells

Q32.

SZABMU 2023

Which feature is possessed by smooth muscles?

- (A) Multinucleate cells
- (B) Contractile sarcomeres
- (C) Uninucleate cells
- (D) Striated appearance

Q33.

NUMS 2023

Which feature is absent in cardiac muscles?

- (A) Intercalated discs
- (B) Multinucleated cells
- (C) Light and dark bands
- (D) Contractile sarcomeres

Q34.

UHS 2023

The cell membrane of muscle cell is:

- (A) Sarcoplasm
- (B) Sarcolemma
- (C) Sarcomere
- (D) Myofibrils

Q35.

SZABMU 2023

What do we call the cell surface membrane of a muscle fibre?

- (A) Sarcolemma
- (B) Plasma membrane
- (C) Sarcoplasm
- (D) Myofibrils

Q36.

KMU 2023

A sarcomere is the region of a myofibril between two successive:

- (A) I-lines
- (B) A-lines
- (C) Z-line
- (D) M-lines

Q37.

KMU 2023

How many actin filaments surround the myosin at each end?

- (A) 2
- (B) 4
- (C) 6
- (D) 8

Q38.

UHS 2023

During sliding of actin filaments, ATP is used for?

- (A) Cross bridge formation
- (B) Cross bridge breaking
- (C) Dragging filaments
- (D) Shortening of filaments

Q39.

KMU 2023

According to sliding filament hypothesis, the release of ____ ions from the sarcoplasmic reticulum causes the reorientation of certain components in thin filament, permitting them to bind with extensions from the thick myosin filaments:

- (A) Sodium
- (B) Calcium
- (C) Magnesium
- (D) Potassium

Q40.

KMU 2023

Muscle fatigue results due to deficiency of ____ and excess accumulation of ____.

- (A) Adenosine triphosphate, lactic acid
- (B) Adenosine triphosphate, ionic imbalance
- (C) Glucose, lactic acid
- (D) Glucose, ionic imbalance

Q41.

NUMS 2023

Pubic symphysis and intervertebral disc are example of:

- (A) Fibrous joints
- (B) Synovial joints
- (C) Cartilaginous joints
- (D) Gliding joints

Q42.

SZABMU 2023

A condition in which a joint becomes swollen painful and immovable is called:

- (A) Spondylosis
- (B) Arthritis
- (C) Sciatica
- (D) Rickets

Q43.

KMU 2023

The joint present between wrist bones is:

- (A) Fibrous joint
- (B) Cartilaginous joint
- (C) Synovial joint
- (D) Ball and socket joint

Q44.

UHS 2022

What is false about cartilage?

- (A) There are many blood vessels in cartilage
- (B) It is a form of connective tissue
- (C) It covers ends of the bone at joints
- (D) It is much softer than bone

Q45.

NUMS 2022

Which of the following type of cartilage is most abundant in human body?

- (A) Fibrous
- (B) Hyaline
- (C) Elastic
- (D) Flexible

Q46.

BUMHS 2022

Which of the following is a connective tissue?

- (A) Cartilage
- (B) Epithelium
- (C) Muscle
- (D) Nerve

Q47.

UHS 2022

Hinge joint is present between which of the following bones?

- (A) Humerus and radio-ulna
- (B) Femur and pectoral girdle
- (C) Femur and acetabulum
- (D) Humerus and pectoral girdle

Q48.

NUMS 2022

Which of the following is an example of joint called 'suture'?

- (A) Intervertebral discs
- (B) Skull bones
- (C) Costal cartilage
- (D) Pubic symphysis

Q49.

SZABMU 2022

A joint in which ends of bones are covered with hyaline cartilage and held together by surrounding tube like capsule of dense fibrous tissue:

- (A) Cartilaginous joint
- (B) Synovial joint
- (C) Fibrous joints
- (D) Immoveable joints

Q50.

KMU 2022

Those joints in which the articulating bones are separated by a fluid-containing joint cavity are called:

- (A) Fibrous joints
- (B) Cartilaginous joints
- (C) Synovial joints
- (D) Immovable joints

Q51.

KMU 2022

The joints present in the elbow and knee are the example of which type of joint:

- (A) Immovable joint
- (B) Slightly movable joint
- (C) Hinge joint
- (D) Ball and socket joint

Q52.

BUMHS 2022

What is the study of joints:

- (A) Arthralgia
- (B) Arthrology
- (C) Mycology
- (D) Cytology

Q53.

SZABMU 2022

_____ is the inflammation of joints.

- (A) Osteoarthritis
- (B) Osteoporosis
- (C) Arteriosclerosis
- (D) Osteosclerosis

Q54.

KMU 2022

Which one of the following is not related to arthritis?

- (A) Inflammation of joint
- (B) An autoimmune disease
- (C) The leading cause of disability in patients over the age of 65
- (D) Inflammation of nerve

Q55.

NUMS 2022

Smooth muscles are long and spindle shaped with _____ nucleus per cell.

- (A) One
- (B) Two
- (C) Three
- (D) Many

Q56.

UHS 2022

Which of the following is not found in skeletal muscle fibers in human?

- (A) Multiple nuclei
- (B) Multiple mitochondria
- (C) Large amount of myoglobin
- (D) Large amount of hemoglobin

Q57.

KMU 2022

The hollow elongated tube formed when muscle fiber penetrates deep into the cell is known as:

- (A) A-tubule
- (B) M-tubule
- (C) T-tubule
- (D) Z-tubule

Q58.

DUHS 2022

Each myosin is surrounded by:

- (A) Motor nerves
- (B) Myosin head
- (C) 6-actin filaments
- (D) 2-actin filaments

Q59.

UHS 2022

Which of the following is a muscle component that acts as store for energy?

- (A) ATP
- (B) Creatine- PO_4
- (C) Myoglobin
- (D) Creatinine- PO_4

Q60.

NUMS 2022

Which event does not occur during muscle contraction?

- (A) I-band shortens
- (B) A-band shorten
- (C) H-zone disappears
- (D) Z-line move closer

Q61.

SZABMU 2022

The muscle contraction involves the breakdown of cross bridges of actin and myosin filaments due to the following process:

- (A) ATP is oxidized
- (B) ATP is reduced
- (C) ATP is hydrolyzed
- (D) ATP is synthesized

Q62.

SZABMU 2022

What is the function of myoglobin?

- (A) Store oxygen
- (B) Store CO_2
- (C) Transport Oxygen
- (D) Transport CO_2

Q63.

PMDC 2020

Which one of the following muscles are considered as 'voluntary muscles'?

- (A) Smooth muscles
- (B) Skeletal muscles
- (C) Cardiac muscles
- (D) Glandular muscles

Q64.

PMDC 2020

Which one of the following are 'myogenic' type of muscles?

- (A) Smooth muscles
- (B) Skeletal muscles
- (C) Cardiac muscles
- (D) Glandular muscles

Q65.

PMDC 2020

What do we call the cell surface membrane of a muscle fiber?

- (A) Sarcolemma
- (B) Sarcoplasm
- (C) Plasma membrane
- (D) Myofibrils

Q66.

SZABMU 2019

Each muscle fiber contains long threads that extend along its entire length. These are called as:

- (A) Myosin
- (B) Microtubules
- (C) Microfilaments
- (D) Myofibrils

Q67.

MDCAT 2019

Thin filaments of muscles contain ____ chains of actin molecules.

- (A) Four
- (B) Three
- (C) One
- (D) Two

Q68.

MDCAT 2019

The thick filaments in a myofibril of muscles are made up of ____.

- (A) Haemoglobin
- (B) Actin
- (C) Myoglobin
- (D) Myosin

Q69.

MDCAT 2019

The function of calcium ions in muscle contraction is to:

- (A) Bind to troponin molecule and cause them to move
- (B) Polarize visible light
- (C) Aid in the transmission of nerve impulse
- (D) Bind to tropomyosin molecule and cause them to form cross bridges

Q70.

MDCAT 2017

Overlapping of thick filament occurs in:

- (A) A-Band
- (B) M-line
- (C) I-Band
- (D) Z-line

Q71.

KMU 2017

Sarcolemma is the membrane around?

- (A) Bone
- (B) Joints
- (C) Muscle fiber
- (D) Heat

Q72.

MDCAT 2016

Each muscle fiber is surrounded by a modified cell membrane called:

- (A) Sarcolemma
- (B) Myosin Filament
- (C) Sarcomere
- (D) Myofilament

Q73.

MDCAT 2015

A sarcomere is the region of a myofibril between two successive:

- (A) M-lines
- (B) I-bands
- (C) Z-lines
- (D) T-tubules

Q74.

MDCAT 2015

According to sliding filament theory, when muscle fibers are stimulated by nervous system, which of the following changes occurs?

- (A) I-bands shorten
- (B) Z-lines move further apart
- (C) H-zone becomes more visible
- (D) A-bands shorten

Q75.

MDCAT 2014

The repeated protein pattern of myofibrils is called:

- (A) Sarcomere
- (B) Sarcolemma
- (C) Zyomere
- (D) Cross bridges

RAPID 5–COLUMN ANSWER KEY

Official PMDC verified answer keys for 11. Support & Movement.

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Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD
1	B	SZABMU 2024	16	C	KMU 2024	31	A	UHS 2023	46	A	BUMHS 2022	61	C	SZABMU 2022
2	D	SZABMU 2024	17	B	SZABMU 2024	32	C	SZABMU 2023	47	A	UHS 2022	62	A	SZABMU 2022
3	B	SZABMU 2024	18	B	NUMS 2024	33	B	NUMS 2023	48	B	NUMS 2022	63	B	PMDC 2020
4	A	UHS 2024	19	A	SZABMU 2024	34	B	UHS 2023	49	B	SZABMU 2022	64	C	PMDC 2020
5	C	KMU 2024	20	C	SZABMU 2024	35	A	SZABMU 2023	50	C	KMU 2022	65	A	PMDC 2020
6	C	SZABMU 2024	21	C	UHS 2024	36	C	KMU 2023	51	C	KMU 2022	66	D	SZABMU 2019
7	C	UHS 2024	22	C	UHS 2024	37	C	KMU 2023	52	B	BUMHS 2022	67	D	MDCAT 2019
8	C	KMU 2024	23	C	SZABMU 2024	38	B	UHS 2023	53	A	SZABMU 2022	68	D	MDCAT 2019
9	C	SZABMU 2024	24	B	NUMS 2024	39	B	KMU 2023	54	D	KMU 2022	69	A	MDCAT 2019
10	C	SZABMU 2024	25	A	UHS 2023	40	A	KMU 2023	55	A	NUMS 2022	70	A	MDCAT 2017
11	D	KMU 2024	26	B	KMU 2023	41	C	NUMS 2023	56	D	UHS 2022	71	C	KMU 2017
12	B	UHS 2024	27	D	KMU 2023	42	B	SZABMU 2023	57	C	KMU 2022	72	A	MDCAT 2016
13	A	SZABMU 2024	28	A	NUMS 2023	43	C	KMU 2023	58	C	DUHS 2022	73	C	MDCAT 2015
14	A	UHS 2024	29	D	KMU 2023	44	A	UHS 2022	59	B	UHS 2022	74	A	MDCAT 2015
15	D	UHS 2024	30	B	SZABMU 2023	45	B	NUMS 2022	60	B	NUMS 2022	75	A	MDCAT 2014

TOTAL
MCQS

75

CORRECT

INCORRECT

BLANK

ACCURACY

%

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autopsies.

PROPOLIS COGNITIVE ERROR AUTOPSIES

Step-by-step conceptual derivations, formula working, and distractor autopsies for every question.

Question #1 Key: (B)

SZABMU 2024

The living cells of cartilage are called:

CORE CONCEPT AND DERIVATION

Nomenclature of connective tissue cells.

Formula:

N/A (Conceptual)

Solution:

- The biological prefix *chondro-* refers strictly to cartilage.
- The mature, living cells that maintain the structural cartilage matrix and reside within its lacunae are called **Chondrocytes**.

Why other options are incorrect:

Osteocytes are the living cells of *bone*. Chondroblasts are immature, actively dividing precursor cells. Chondroclasts are theoretically cells that break down cartilage, but 'chondrocytes' is the definitive answer for the standard living residents.

Question #3 Key: (B)

SZABMU 2024

Which of the following type of cartilage is most abundant in human body?

CORE CONCEPT AND DERIVATION

Distribution of cartilage types.

Formula:

N/A (Conceptual)

Solution:

- **Hyaline cartilage** is universally the most widespread and abundant type of cartilage in the human body.
- It forms the entire embryonic skeleton, lines the respiratory tract (nose, trachea, larynx), and coats the articulating surfaces of nearly all movable joints.

Why other options are incorrect:

Elastic and fibrous cartilages are highly localized to specific regions (ears/epiglottis and intervertebral discs, respectively). 'Flexible' is an adjective, not a scientific class of cartilage.

Question #2 Key: (D)

SZABMU 2024

Cartilage cells contain small cavities distributed in the matrix and are called:

CORE CONCEPT AND DERIVATION

Microscopic anatomy of cartilage.

Formula:

N/A (Conceptual)

Solution:

- Because the extracellular matrix of cartilage is extremely dense and rubbery, the resident cells (chondrocytes) cannot freely float.
- Instead, they are permanently trapped within tiny, fluid-filled hollow spaces or 'little lakes' distributed throughout the matrix. These specific cavities are called **Lacunae**.

Why other options are incorrect:

The perichondrium is the outer fibrous membrane wrapping the whole cartilage. The periosteum wraps bone. The shaft refers to the diaphysis of a long bone.

Question #4 Key: (A)

UHS 2024

Bone forming cells are:

CORE CONCEPT AND DERIVATION

The life cycle and function of bone cells.

Formula:

N/A (Conceptual)

Solution:

- Bone remodeling relies on a balance of building and destroying tissue.
- The specialized cells tasked strictly with synthesizing and secreting the new unmineralized bone matrix (osteoid) are the **Osteoblasts** (remember: *B* for Builder).

Why other options are incorrect:

Osteoclasts (*C* for Consumer/Crusher) break down bone. Osteocytes are mature, resting cells. Osteons are the massive structural cylindrical units of compact bone, not individual cells.

Question #5 Key: (C)

KMU 2024

The cells contained in the lacunae of the bone are called:

CORE CONCEPT AND DERIVATION

Anatomy of the Haversian system.

Formula:

N/A (Conceptual)

Solution:

- Once active osteoblasts secrete enough matrix to completely surround and trap themselves, the matrix calcifies and hardens.
- The trapped cells mature into **Osteocytes**, which permanently reside inside these tiny bony chambers known as lacunae. They maintain local bone metabolism.

Why other options are incorrect:

Chondrocytes reside in the lacunae of *cartilage*, not bone. Osteoblasts and osteoclasts operate directly on the outer surfaces of the bone tissue, not inside trapped internal lacunae.

Question #6 Key: (C)

SZABMU 2024

Bone resorption is performed by:

CORE CONCEPT AND DERIVATION

Calcium regulation and bone dissolution.

Formula:

N/A (Conceptual)

Solution:

- To release stored calcium into the blood or reshape bone structures, the hardened matrix must be actively broken down (resorption).
- This destructive task is performed by **Osteoclasts**, which are massive, multi-nucleated cells that secrete highly concentrated acids and proteolytic enzymes directly onto the bone surface.

Why other options are incorrect:

Osteoblasts perform the exact opposite function (bone deposition). Osteocytes simply maintain existing bone. 'Osteopores' is a fabricated term.

Question #7 Key: (C)

UHS 2024

Which feature is possessed by smooth muscles?

CORE CONCEPT AND DERIVATION

Histological characteristics of smooth muscle.

Formula:

N/A (Conceptual)

Solution:

- Smooth muscle cells line internal organs (like the gut and blood vessels) and act entirely involuntarily.
- Under a microscope, they appear as isolated, non-striated, spindle-shaped cells. Unlike fused skeletal fibers, each individual smooth muscle cell possesses exactly one central nucleus, making them definitively **Uninucleate**.

Why other options are incorrect:

They are strictly involuntary (not voluntary). They are spindle-shaped (not branched like cardiac cells). They lack sarcomeres entirely, meaning they have no striated appearance.

Question #8 Key: (C)

KMU 2024

Which of the following does NOT relate to smooth muscles?

CORE CONCEPT AND DERIVATION

Anatomical placement of muscle tissue types.

Formula:

N/A (Conceptual)

Solution:

- Smooth muscles are spindle-shaped, unstriated, and involuntarily controlled by the autonomic nervous system.
- However, smooth muscle does **NOT** line the walls of the heart. The muscular layer of the heart (the myocardium) is composed exclusively of specialized *cardiac muscle* tissue, which is structurally distinct and highly adapted for relentless, autonomous rhythmic pumping.

Why other options are incorrect:

Options A, B, and D are perfectly accurate, defining physiological characteristics of smooth muscle.

Question #9 Key: (C)

SZABMU 2024

Contractile unit between two Z lines is absent in:

CORE CONCEPT AND DERIVATION

The presence of sarcomeres in muscle types.

Formula:

N/A (Conceptual)

Solution:

- The precise repeating contractile unit bounded by two Z-lines is scientifically defined as a **sarcomere**.
- Sarcomeres naturally align to form visible light and dark bands (striations) under a microscope.
- Because **Smooth muscles** completely lack this highly ordered, rigid sarcomere structure (their actin and myosin are arranged diagonally across the cell), they exhibit no striations and therefore lack Z-lines entirely.

Why other options are incorrect:

Both skeletal and cardiac muscles rely heavily on perfectly aligned sarcomeres (Z-line to Z-line) to generate force, which is why both appear heavily striated.

Question #10 Key: (C)

SZABMU 2024

Which one of the following muscles are considered as 'Voluntary Muscles'?

CORE CONCEPT AND DERIVATION

Nervous control systems over muscle tissues.

Formula:

N/A (Conceptual)

Solution:

- Voluntary muscles are directly innervated by the somatic nervous system, meaning their contraction requires conscious thought and deliberate nerve firing.
- Because they are attached to bones and facilitate all conscious body movements (walking, lifting, talking), **Skeletal muscles** are strictly classified as voluntary muscles.

Why other options are incorrect:

Smooth and cardiac muscles are governed by the autonomic (involuntary) nervous system. You cannot consciously command your heart to stop beating or your intestines to stop digesting.

Question #11 Key: (D)

KMU 2024

The ____ surrounds the muscle fibre of the skeletal muscle.

CORE CONCEPT AND DERIVATION

Outer boundary terminology of muscle cells.

Formula:

N/A (Conceptual)

Solution:

- A skeletal muscle fiber is simply a single, massive, elongated muscle cell.
- Like all cells, it requires an outer plasma membrane to separate its interior from the extracellular environment and to conduct electrical impulses.
- In muscle biology, this specialized surrounding membrane is universally termed the **Sarcolemma**.

Why other options are incorrect:

Myofibrils are the internal contractile rods. Cytoplasm (sarcoplasm) is the fluid inside. Lacunae are the bone/cartilage cavities.

Question #12 Key: (B)

UHS 2024

Thick filaments in skeletal muscles are composed of:

CORE CONCEPT AND DERIVATION

Protein composition of sarcomere filaments.

Formula:

N/A (Conceptual)

Solution:

- The sarcomere relies on the interaction between two primary filament types to contract: thin and thick.
- The **thick filaments** are extremely dense and are constructed entirely from hundreds of individual **Myosin** molecules, bound together with their globular heads protruding outward to grab the thin filaments.

Why other options are incorrect:

Actin is the primary structural protein of the *thin* filaments. Tropomyosin and Troponin are regulatory proteins intimately wrapped around the thin actin filaments, not the thick ones.

Question #13 Key: (A)

SZABMU 2024

What do we call the cell surface membrane of a muscle fiber?

CORE CONCEPT AND DERIVATION

Nomenclature of the muscle cell membrane.

Formula:

N/A (Conceptual)

Solution:

- While chemically it is indeed a lipid bilayer plasma membrane, standard physiological terminology demands extreme specificity.
- The highly specialized cell surface membrane of a skeletal muscle fiber, which is heavily modified to contain deep T-tubule invaginations for rapid action potential propagation, is definitively termed the **Sarcolemma**.

Why other options are incorrect:

Sarcoplasm is the interior fluid. Myofibrils are the protein filaments. 'Plasma membrane' is too generic and not the preferred specific anatomical term.

Question #14 Key: (A)

UHS 2024

The accumulation of 'lactic acid' in the muscles results in:

CORE CONCEPT AND DERIVATION

Metabolic consequences of anaerobic respiration.

Formula:

N/A (Conceptual)

Solution:

- When strenuous exercise outpaces oxygen delivery, muscle cells resort to anaerobic glycolysis to generate emergency ATP.
- This process rapidly produces a highly acidic byproduct: **lactic acid**.
- The buildup of lactic acid violently drops the intracellular pH, directly interfering with enzyme activity and calcium binding, forcing the muscle to lose its ability to contract efficiently. This state is known as **Extreme fatigue**.

Why other options are incorrect:

Lactic acid inherently *hinders* further muscle contraction; it does not cause it. It causes severe burning and exhaustion, but not total neurological paralysis or systemic convulsions.

Question #15 Key: (D)

UHS 2024

Sarcomere is part of myofibril between:

CORE CONCEPT AND DERIVATION

Anatomical boundaries of the contractile unit.

Formula:

N/A (Conceptual)

Solution:

- The skeletal muscle myofibril is a long chain of repeating structural units called sarcomeres.
- By strict biological definition, exactly one single functional sarcomere is the highly organized region extending exactly from one **Z line** (or Z disc) to the very next adjacent **Z line**.

Why other options are incorrect:

The M-line marks the exact center, not the boundary. A-bands and I-bands represent thick filament length and thin filament isolation, respectively, but do not serve as structural dividing borders.

Question #16 Key: (C)

KMU 2024

What happens to calcium when skeletal muscles recover from contraction?

CORE CONCEPT AND DERIVATION

Termination of the excitation-contraction coupling.

Formula:

N/A (Conceptual)

Solution:

- For a contracted muscle to safely relax and recover, the internal signal to contract (high cytosolic Calcium) must be rapidly removed.
- To achieve this, high-affinity, ATP-driven Calcium pumps immediately engage, aggressively vacuuming the Ca^{2+} off the troponin molecules and actively **pumping it back into the sarcoplasmic reticulum** for safe storage until the next nerve impulse arrives.

Why other options are incorrect:

Releasing calcium *from* the SR causes contraction. Calcium never binds to the myosin head (it binds troponin). Exchanging it for sodium is part of cardiac regulation, not the primary skeletal muscle relaxation mechanism.

Question #17 Key: (B)

SZABMU 2024

When the skeletal muscle contracts, the two Z lines gets ____ and I band gets ____

CORE CONCEPT AND DERIVATION

Geometric changes in the sarcomere during sliding.

Formula:

N/A (Conceptual)

Solution:

- During the power stroke, thick myosin filaments act like ratchets, dragging the thin actin filaments inward toward the M-line.
- Because the thin filaments are physically anchored to the Z-lines, pulling them inward forces the two **Z-lines to move closer together**, shortening the entire sarcomere.
- Simultaneously, the region containing only isolated thin filaments (the **I-band**) is pulled into the overlap zone, causing it to visually **shorten** and nearly disappear.

Why other options are incorrect:

Z-lines never move further apart (distant/enlarged) during an active concentric contraction. The I-band physically must shorten as it slides into the A-band.

Question #18 Key: (B)

NUMS 2024

Choose the correct, for muscle in relaxed position:

CORE CONCEPT AND DERIVATION

Sarcomere state prior to nervous stimulation.

Formula:

N/A (Conceptual)

Solution:

- In a completely relaxed muscle, no calcium is present in the cytosol, and tropomyosin is actively blocking the actin binding sites, meaning zero cross-bridges can form.
- Because the thin filaments have slid back out and are resting far apart from the center line, the central gap containing only thick filaments (the **H-zone**) is extremely wide and **broad**.

Why other options are incorrect:

Options A, C, and D are all definitive physiological markers of a muscle that is actively contracting, not relaxing.

Question #19 Key: (A)

SZABMU 2024

Sequence of nerve impulse initiation leading to muscle contraction: Nerve impulse travels through sarcolemma t...

CORE CONCEPT AND DERIVATION

Chronological sequence of Excitation-Contraction Coupling.

Formula:

N/A (Conceptual)

Solution:

- **Step 3:** The action potential from the motor neuron first arrives at the **neuromuscular junction**, releasing acetylcholine.
- **Step 1:** This depolarizes the muscle cell, sending the electrical wave sweeping across the **sarcolemma** and diving deep into the cell via the **T-tubules**.
- **Step 2:** The deep T-tubules physically contact the terminal cisternae of the **sarcoplasmic reticulum**, passing the shockwave to it.
- **Step 4:** This final shock forces the voltage-gated **Ca²⁺ channels** in the SR to blast open, flooding the cell with calcium to trigger contraction.

Why other options are incorrect:

Any other sequence breaks the laws of physical causality. The signal must hit the outside of the cell (junction) before it can dive inside (T-tubules) to unlock the internal calcium vault (SR).

Question #20 Key: (C)

SZABMU 2024

By the fusion of ilium, ischium and pubis in the pelvic girdle, ____ joint is formed.

CORE CONCEPT AND DERIVATION

Bony fusion of the pelvic girdle.

Solution: The ilium, ischium, and pubis ossify and fuse into a single immovable pelvic bone (os coxae). This completely fused articulation is classified as a **fibrous joint** (synostosis).

Question #21 **Key: (C)**

UHS 2024

Which of the following skeletal disorder is an example of autoimmune disorder?

CORE CONCEPT AND DERIVATION

Etiology of skeletal pathologies.

Formula:

N/A (Conceptual)

Solution:

- An autoimmune disorder occurs when the body's own white blood cells tragically misidentify healthy host tissue as a foreign invader and attack it.
- **Rheumatoid arthritis** is a classic systemic autoimmune disease where the immune system violently attacks the synovial membranes of joints, leading to massive inflammation, pain, and eventual joint destruction.

Why other options are incorrect:

Sciatica is mechanical nerve compression. Spondylosis is age-related wear-and-tear degeneration of the spine. Rickets is a severe nutritional deficiency (Vitamin D/Calcium) in children.

Question #22 **Key: (C)**

UHS 2024

Which of the following is NOT a bone of upper limb?

CORE CONCEPT AND DERIVATION

Appendicular skeleton layout.

Formula:

N/A (Conceptual)

Solution:

- The upper limb consists of the arm and forearm, containing bones perfectly adapted for high dexterity and reach.
- These include the humerus (upper arm) and the radius/ulna pair (forearm).
- The **Femur**, however, is the massive, heavy thigh bone. It is strictly part of the *lower* limb, designed for immense weight-bearing and locomotion.

Why other options are incorrect:

Options A, B, and D all correctly identify major long bones situated within the human arm.

Question #23 **Key: (C)**

SZABMU 2024

Which of the following is not a part of human eye orbit?

CORE CONCEPT AND DERIVATION

Bones forming the cranial eye socket.

Solution: The orbital cavity is formed by the sphenoid, ethmoid, lacrimal, frontal, palatine, maxilla, and zygomatic bones. (Select Zygomatic based on standard test classification).

Question #24 **Key: (B)**

NUMS 2024

You must have often heard about the hamstring injury of players. Which of the following is correct about hamst...

CORE CONCEPT AND DERIVATION

Anatomy and attachments of the posterior thigh compartment.

Formula:

N/A (Conceptual)

Solution:

- The hamstrings are a massive, powerful group of three muscles (semimembranosus, semitendinosus, and biceps femoris) located on the back of the thigh.
- They originate high up on the ischial tuberosity of the pelvis.
- To fulfill their primary function of forcefully bending the knee during running, their long tendons must cross the knee joint and firmly anchor downward. **Their insertion is primarily on the tibia** (with biceps femoris inserting on the adjacent fibula).

Why other options are incorrect:

They do not originate from the ilium or the top of the femur. 'Extensive muscle' is vague and non-anatomical. The specific, biomechanically defining feature listed is their tibial insertion point across the knee.

Question #25 Key: (A)

UHS 2023

Cartilage is a type of which tissue?

CORE CONCEPT AND DERIVATION

Basic tissue classifications.

Formula:

N/A (Conceptual)

Solution:

- Tissues are grouped into four main categories.
- Because cartilage consists of widely spaced cells (chondrocytes) suspended within a dense, structural extracellular matrix (collagen and proteoglycans), it perfectly fits the definition of a **connective tissue**.

Why other options are incorrect:

Epithelial tissue lines surfaces. Muscular tissue is contractile. Nervous tissue conducts electrical impulses. None of these describe a structural, matrix-heavy support tissue.

Question #26 Key: (B)

KMU 2023

Which of the following connective tissues consists of cells known as chondrocytes?

CORE CONCEPT AND DERIVATION

Cell nomenclature based on tissue type.

Formula:

N/A (Conceptual)

Solution:

- The biological prefix *chondro-* universally refers to cartilage.
- Therefore, **chondrocytes** are specifically the mature, maintaining cells embedded in the lacunae of **cartilage** tissue.

Why other options are incorrect:

Bone cells are called osteocytes/osteoblasts. Myocardium cells are cardiomyocytes. The periosteum is a fibrous membrane.

Question #27 Key: (D)

KMU 2023

Hip joint and shoulder joint are example of:

CORE CONCEPT AND DERIVATION

Functional classifications of highly mobile synovial joints.

Formula:

N/A (Conceptual)

Solution:

- The hip and shoulder require extreme mobility, allowing for flexion, extension, abduction, adduction, and full circumduction.
- This 360-degree, multi-axial freedom is strictly facilitated by a spherical bone head fitting into a cup-like depression, mechanically defining a **ball and socket joint**.

Why other options are incorrect:

While they are technically synovial joints, 'ball and socket' is the highly specific and exact answer required for this joint class. Hinge joints (elbow) restrict movement to one plane.

Question #28 Key: (A)

NUMS 2023

Cartilage is more difficult to heal than bone because cartilage:

CORE CONCEPT AND DERIVATION

Tissue regeneration dependencies.

Formula:

N/A (Conceptual)

Solution:

- Tissue healing relies strictly on the rapid delivery of immune cells, oxygen, and nutrients to the site of damage.
- Unlike highly vascularized bone, cartilage is essentially **avascular** (lacks direct blood vessels).
- Consequently, repair materials must slowly percolate through the dense matrix via diffusion, making cartilage healing notoriously sluggish or completely ineffective.

Why other options are incorrect:

Cartilage contains abundant proteins (collagen/elastin). While it lacks mineral deposits (calcium), that factor contributes to its flexibility, not its inability to heal.

Question #29 Key: (D)

KMU 2023

Which cartilage is found at the end of long bones?

CORE CONCEPT AND DERIVATION

Anatomical distribution of cartilage types.

Formula:

N/A (Conceptual)

Solution:

- To prevent bone-on-bone friction at movable joints, the articulating surfaces of long bones are capped with a glassy, smooth, friction-reducing layer.
- This specific layer is composed entirely of **hyaline cartilage**, earning it the alternative name 'articular cartilage'.

Why other options are incorrect:

Elastic cartilage is in the ear. Fibrous cartilage is found in high-compression areas like intervertebral discs. Calcified cartilage is an intermediate stage in bone formation.

Question #30 Key: (B)

SZABMU 2023

Mature bone cells are called:

CORE CONCEPT AND DERIVATION

Bone cell life cycle nomenclature.

Formula:

N/A (Conceptual)

Solution:

- The prefix osteo- signifies bone.
- Osteoblasts** actively secrete new matrix. Once they become permanently trapped within the hardened lacunae of their own making, they mature into resting **osteocytes**, which simply maintain the surrounding matrix.

Why other options are incorrect:

Osteoclasts are massive, multi-nucleated macrophage derivatives that dissolve bone. Chondrocytes are cartilage cells.

Question #31 Key: (A)

UHS 2023

Irregular striations and involuntary control is related to?

CORE CONCEPT AND DERIVATION

Identifying muscle types by their microscopic appearance and nervous control.

Formula:

N/A (Conceptual)

Solution:

- We must satisfy two constraints: It must be striated, and it must be involuntary.
- Skeletal muscle is striated but completely voluntary. Smooth muscle is involuntary but entirely lacks striations.
- Cardiac muscle** perfectly fits both criteria: it possesses irregular branching striations and operates autonomously via involuntary autonomic control.

Why other options are incorrect:

Smooth muscle lacks striations entirely. Skeletal muscle is voluntary. Cartilage is not a contractile muscle tissue.

Question #32 Key: (C)

SZABMU 2023

Which feature is possessed by smooth muscles?

CORE CONCEPT AND DERIVATION

Histological features of smooth muscle.

Formula:

N/A (Conceptual)

Solution:

- Unlike skeletal muscles which form massive syncytia, smooth muscle cells exist as distinct, individual, spindle-shaped units.
- Each of these individual cells contains strictly one central nucleus, making them **uninucleate**.

Why other options are incorrect:

Smooth muscles uniquely lack highly organized sarcomeres, hence they do not possess a striated appearance. They are never multinucleate.

Question #33 Key: (B)

NUMS 2023

*Which feature is absent in cardiac muscles?***CORE CONCEPT AND DERIVATION**

Differentiating cardiac vs. skeletal muscle.

Formula:

N/A (Conceptual)

Solution:

- Cardiac muscles are highly specialized, branching cells linked by intercalated discs. They contain sarcomeres resulting in light and dark bands (striations).
- However, unlike skeletal muscles which fuse into massive fibers with hundreds of nuclei, cardiac muscle cells are almost always distinctly uninucleate (or occasionally binucleate). Thus, the classic **multinucleated** state is considered absent.

Why other options are incorrect:

Intercalated discs, sarcomeres, and distinct banding patterns are all hallmark, highly visible features of cardiac tissue.

Question #34 Key: (B)

UHS 2023

*The cell membrane of muscle cell is:***CORE CONCEPT AND DERIVATION**

Muscle cell anatomy and prefixes.

Formula:

N/A (Conceptual)

Solution:

- In muscle histology, the prefix *sarco-* (flesh) replaces standard cell prefixes.
- The suffix *-lemma* means husk or sheath. Therefore, the specialized excitable plasma membrane wrapping the muscle cell is universally known as the **sarcolemma**.

Why other options are incorrect:

Sarcoplasm is the interior cytoplasm. A sarcomere is the internal contractile unit. Myofibrils are the long protein cords inside the cell.

Question #35 Key: (A)

SZABMU 2023

*What do we call the cell surface membrane of a muscle fibre?***CORE CONCEPT AND DERIVATION**

Specific muscle terminology.

Formula:

N/A (Conceptual)

Solution:

- While it functions fundamentally as a phospholipid bilayer plasma membrane, the strict anatomical term dedicated to muscle fibers is the **sarcolemma**.
- It is highly specialized to plunge into the cell via T-tubules to quickly conduct electrical action potentials.

Why other options are incorrect:

Sarcoplasm refers to the fluid interior. 'Plasma membrane' is a generic term lacking the required muscle-specific specificity.

Question #36 Key: (C)

KMU 2023

*A sarcomere is the region of a myofibril between two successive:***CORE CONCEPT AND DERIVATION**

Anatomical boundaries of the contractile unit.

Formula:

N/A (Conceptual)

Solution:

- A myofibril consists of repeating sub-units called sarcomeres.
- The distinct, zig-zag structural proteins that physically anchor the thin actin filaments mark the outer boundaries of these units.
- The space situated strictly between two adjacent **Z-lines** (or Z-discs) defines exactly one functional sarcomere.

Why other options are incorrect:

M-lines anchor myosin in the exact center of the sarcomere. A-bands and I-bands represent wide regions of overlapping or isolated proteins, not boundary lines.

Question #37 Key: (C)

KMU 2023

How many actin filaments surround the myosin at each end?

CORE CONCEPT AND DERIVATION

Cross-sectional lattice geometry of the sarcomere.

Formula:

N/A (Conceptual)

Solution:

- To maximize contraction force, thick and thin filaments are tightly packed into a crystalline lattice.
- In vertebrate skeletal muscle, taking a slice through the zone of overlap reveals a hexagonal arrangement.
- Exactly **6** thin actin filaments geometrically surround every single thick myosin filament.

Why other options are incorrect:

The geometry strictly dictates a hexagon (6). Any other number would result in inefficient structural gaps or impossible protein binding angles.

Question #38 Key: (B)

UHS 2023

During sliding of actin filaments, ATP is used for?

CORE CONCEPT AND DERIVATION

The role of ATP in the cross-bridge cycle.

Formula:

N/A (Conceptual)

Solution:

- Counterintuitively, myosin physically binds to actin spontaneously when calcium exposes the binding sites; this initial attachment does *not* require new ATP.
- The 'power stroke' (dragging) is powered by the *release* of stored ADP and Phosphate.
- However, for the myosin head to physically detach and let go of the actin filament, a fresh molecule of ATP must physically bind to it. Thus, ATP is strictly required for **cross bridge breaking**.

Why other options are incorrect:

Without ATP, cross bridges lock permanently (causing Rigor Mortis). Filaments themselves never shorten; they only slide.

Question #39 Key: (B)

KMU 2023

According to sliding filament hypothesis, the release of _____ ions from the sarcoplasmic reticulum causes the ...

CORE CONCEPT AND DERIVATION

Excitation-contraction chemical triggers.

Formula:

N/A (Conceptual)

Solution:

- The sarcoplasmic reticulum is a specialized organelle designed to aggressively pump and store large quantities of **Calcium ions (Ca^{2+})**.
- When an action potential arrives, gated channels open, flooding the sarcoplasm with Calcium.
- This Calcium physically binds to troponin, causing a massive structural shift that moves tropomyosin out of the way, exposing actin to myosin.

Why other options are incorrect:

Sodium and Potassium are strictly responsible for conducting the electrical action potential along the membrane, but they do not interact directly with the internal contractile proteins.

Question #40 **Key: (A)**

KMU 2023

Muscle fatigue results due to deficiency of ____ and excess accumulation of ____.

CORE CONCEPT AND DERIVATION

Metabolic basis of muscle fatigue.

Formula:

N/A (Conceptual)

Solution:

- During extreme exertion, oxygen delivery falls behind demand, forcing the muscle to rely entirely on anaerobic glycolysis.
- This highly inefficient pathway inevitably results in a severe deficit of the energetic currency, **Adenosine triphosphate (ATP)**.
- Simultaneously, the anaerobic breakdown of glucose forces the production and rapid, painful accumulation of the toxic byproduct **lactic acid**, which drops tissue pH and inhibits enzyme function.

Why other options are incorrect:

While glucose depletion contributes to general exhaustion, the direct physiological cause of acute mechanical fatigue is the lack of ATP coupled with lactic acid poisoning.

Question #41 **Key: (C)**

NUMS 2023

Pubic symphysis and intervertebral disc are example of:

CORE CONCEPT AND DERIVATION

Joint classification by tissue structure.

Formula:

N/A (Conceptual)

Solution:

- Joints that allow slight, highly restricted movement to absorb shock are typically united by massive pads of tough fibrocartilage.
- Both the pubic symphysis (connecting the pelvic halves) and the intervertebral discs (stacking the spine) fit this description perfectly, classifying them strictly as **Cartilaginous joints**.

Why other options are incorrect:

Synovial joints contain fluid and are freely movable. Fibrous joints (like skull sutures) are completely immobile.

Question #42 **Key: (B)**

SZABMU 2023

A condition in which a joint becomes swollen painful and immovable is called:

CORE CONCEPT AND DERIVATION

Pathologies of the articulation system.

Formula:

N/A (Conceptual)

Solution:

- The universal medical term for the acute or chronic inflammation of a joint—resulting in severe swelling, deep pain, and eventual loss of mobility—is **Arthritis**.
- This includes various sub-forms like osteoarthritis, rheumatoid arthritis, and gouty arthritis.

Why other options are incorrect:

Spondylosis is spinal degeneration. Sciatica is the compression/inflammation of the sciatic nerve. Rickets is a bone-softening disease caused by extreme Vitamin D deficiency in children.

Question #43 **Key: (C)**

KMU 2023

The joint present between wrist bones is:

CORE CONCEPT AND DERIVATION

Structural classification of wrist joints.

Formula:

N/A (Conceptual)

Solution:

- The wrist joint (radiocarpal joint) and the articulations between the individual carpal bones themselves are highly mobile.
- To facilitate this friction-free movement in multiple planes, they are enclosed in a fluid-filled articular capsule, definitively classifying them as **Synovial joints**.
- *Note: While structurally synovial, functionally the main wrist joint acts as a condyloid joint, allowing limited rotation and movement in two planes.*

Why other options are incorrect:

Fibrous joints are completely immovable (like skull sutures). Cartilaginous joints have very limited mobility (like intervertebral discs). Ball and socket joints strictly require a spherical bone head, which carpals lack.

Question #44 Key: (A)

UHS 2022

*What is false about cartilage?***CORE CONCEPT AND DERIVATION**

Structural properties of cartilage connective tissue.

Formula:

N/A (Conceptual)

Solution:

- Cartilage is an avascular structure of the endoskeleton. It is not supplied with blood vessels.
- Because it lacks a direct blood supply, nutrients must diffuse through the extracellular matrix to reach the chondrocytes, which makes it heal very slowly compared to bone.
- Therefore, the statement 'There are many blood vessels in cartilage' is entirely false.

Why other options are incorrect:

Options B, C, and D are true biological facts about cartilage. It is a flexible connective tissue that caps the ends of articulating bones to reduce friction.

Question #45 Key: (B)

NUMS 2022

*Which of the following type of cartilage is most abundant in human body?***CORE CONCEPT AND DERIVATION**

Types of cartilage and their distribution in the human body.

Formula:

N/A (Conceptual)

Solution:

- **Hyaline cartilage** is the most abundant type of cartilage in the human body.
- It provides strong, flexible support and is found in the respiratory tract (trachea, bronchi), lines the articular joints, and caps the ends of long bones.

Why other options are incorrect:

Fibrous cartilage (found in intervertebral discs) and Elastic cartilage (found in the ear pinna and epiglottis) are much less widely distributed than Hyaline cartilage. 'Flexible' is a property, not a distinct biological class of cartilage.

Question #46 Key: (A)

BUMHS 2022

*Which of the following is a connective tissue?***CORE CONCEPT AND DERIVATION**

Primary tissue types in human anatomy.

Formula:

N/A (Conceptual)

Solution:

- The human body is composed of four primary tissue types: Epithelial, Connective, Muscular, and Nervous tissue.
- **Cartilage**, along with bone and blood, is a specialized form of connective tissue that provides structural framework and support.

Why other options are incorrect:

Epithelium (lining tissue), Muscle (contractile tissue), and Nerve (conductive tissue) represent the other three distinct primary tissue categories.

Question #47 Key: (A)

UHS 2022

*Hinge joint is present between which of the following bones?***CORE CONCEPT AND DERIVATION**

Classification of synovial joints based on movement.

Formula:

N/A (Conceptual)

Solution:

- A hinge joint allows movement in only one plane (flexion and extension), similar to the hinge of a door.
- The joint between the **humerus** (upper arm) and the **radio-ulna** (forearm) forms the elbow joint, which is a classic example of a hinge joint.

Why other options are incorrect:

Femur and acetabulum (hip joint) and Humerus and pectoral girdle (shoulder joint) are both examples of ball-and-socket joints, which allow multi-directional movement.

Question #48 Key: (B)

NUMS 2022

Which of the following is an example of joint called 'suture'?

CORE CONCEPT AND DERIVATION

Fibrous joints and their locations.

Formula:

N/A (Conceptual)

Solution:

- Sutures are incredibly strong, immovable fibrous joints.
- They are specifically found connecting the various flat **skull bones** together, protecting the brain.

Why other options are incorrect:

Intervertebral discs, costal cartilage, and the pubic symphysis are all examples of cartilaginous joints, which allow limited flexibility and movement.

Question #49 Key: (B)

SZABMU 2022

A joint in which ends of bones are covered with hyaline cartilage and held together by surrounding tube like c...

CORE CONCEPT AND DERIVATION

Structural anatomy of synovial joints.

Formula:

N/A (Conceptual)

Solution:

- A **synovial joint** is uniquely characterized by the presence of an articular capsule surrounding a fluid-filled joint cavity.
- The ends of the articulating bones are covered in hyaline (articular) cartilage, and the entire structure is enclosed by a dense fibrous capsule that secretes lubricating synovial fluid.

Why other options are incorrect:

Fibrous joints lack a capsule and are firmly bound by collagen. Cartilaginous joints are connected entirely by cartilage without a fluid-filled cavity.

Question #50 Key: (C)

KMU 2022

Those joints in which the articulating bones are separated by a fluid-containing joint cavity are called:

CORE CONCEPT AND DERIVATION

Defining features of synovial joints.

Formula:

N/A (Conceptual)

Solution:

- The defining hallmark of a **synovial joint** is the fluid-filled joint cavity separating the articulating bones.
- This synovial fluid acts as a heavily viscous lubricant to dramatically reduce friction during movement.

Why other options are incorrect:

Fibrous and cartilaginous joints do not possess any joint cavity. Therefore, they do not contain synovial fluid.

Question #51 Key: (C)

KMU 2022

The joints present in the elbow and knee are the example of which type of joint:

CORE CONCEPT AND DERIVATION

Movement axes of synovial joints.

Formula:

N/A (Conceptual)

Solution:

- The elbow and knee allow movement strictly in two directions along a single plane (flexion and extension).
- Because their articulating surfaces are molded to permit motion in only one axis, they are classified as **hinge joints**.

Why other options are incorrect:

Ball and socket joints (like the hip) allow multi-directional, rotational movement. Immobile and slightly movable joints do not allow the wide range of motion seen in the knee and elbow.

Question #52 Key: (B)

BUMHS 2022

What is the study of joints:

CORE CONCEPT AND DERIVATION

Biological terminology.

Formula:

N/A (Conceptual)

Solution:

- The root word *arthro-* means 'joint', and the suffix *-logy* means 'the study of'.
- Therefore, **Arthrology** is the scientific study of joints and articulations.

Why other options are incorrect:

Arthralgia refers strictly to joint pain. Mycology is the study of fungi. Cytology is the study of cells.

Question #53 Key: (A)

SZABMU 2022

_____ is the inflammation of joints.

CORE CONCEPT AND DERIVATION

Pathologies of the skeletal system.

Formula:

N/A (Conceptual)

Solution:

- The suffix *-itis* denotes inflammation. *Arthritis* broadly means joint inflammation.
- **Osteoarthritis** is a specific, progressive degenerative disease where articular cartilage softens and disintegrates, leading to severe joint inflammation.

Why other options are incorrect:

Osteoporosis is a loss of bone density due to calcium/estrogen depletion. Arteriosclerosis affects blood vessels (hardening of arteries). Osteosclerosis is abnormal hardening of bone tissue.

Question #54 Key: (D)

KMU 2022

Which one of the following is not related to arthritis?

CORE CONCEPT AND DERIVATION

Characteristics of Arthritis.

Formula:

N/A (Conceptual)

Solution:

- Arthritis strictly refers to pathological conditions affecting the **joints**.
- It encompasses joint inflammation (Option A), autoimmune conditions like Rheumatoid arthritis (Option B), and is a primary driver of disability in the elderly (Option C).
- **Inflammation of a nerve** is called neuritis, which is completely unrelated to the direct definition of arthritis.

Why other options are incorrect:

Options A, B, and C are all highly accurate medical descriptors and consequences associated with various forms of arthritis.

Question #55 Key: (A)

NUMS 2022

Smooth muscles are long and spindle shaped with _____ nucleus per cell.

CORE CONCEPT AND DERIVATION

Histological structure of smooth muscle cells.

Formula:

N/A (Conceptual)

Solution:

- Smooth muscle cells are involuntary, non-striated, and characteristically spindle-shaped.
- Unlike skeletal muscle, each individual smooth muscle cell contains only a **single, centrally located nucleus** (they are uninucleate).

Why other options are incorrect:

Skeletal muscle cells form from the fusion of many myoblasts, resulting in long, multinucleated syncytia. Smooth muscles do not undergo this fusion.

Question #56 Key: (D)

UHS 2022

Which of the following is not found in skeletal muscle fibers in human?

CORE CONCEPT AND DERIVATION

Cellular contents of skeletal muscle.

Formula:

N/A (Conceptual)

Solution:

- Skeletal muscle fibers are highly metabolically active syncytia. They naturally contain multiple nuclei, dense arrays of mitochondria (for ATP production), and myoglobin, a local oxygen-storing protein.
- Hemoglobin**, however, is strictly confined within Red Blood Cells circulating in the vascular system. It is **not** found inside the actual cytoplasm of skeletal muscle cells.

Why other options are incorrect:

Options A, B, and C describe structures specifically adapted to and found within human skeletal muscle tissue.

Question #57 Key: (C)

KMU 2022

The hollow elongated tube formed when muscle fiber penetrates deep into the cell is known as:

CORE CONCEPT AND DERIVATION

Excitation-contraction coupling anatomy.

Formula:

N/A (Conceptual)

Solution:

- For a muscle to contract simultaneously throughout its entire thickness, the nerve impulse must be delivered deep inside the cell instantly.
- This is achieved by inward invaginations of the sarcolemma that plunge deep into the interior sarcoplasm. These transverse structures are called **T-tubules** (Transverse tubules).

Why other options are incorrect:

A, M, and Z refer to specific protein bands and lines within the sarcomere structure, not hollow membrane invaginations.

Question #58 Key: (C)

DUHS 2022

Each myosin is surrounded by:

CORE CONCEPT AND DERIVATION

Geometric lattice arrangement of myofilaments in skeletal muscle.

Formula:

N/A (Conceptual)

Solution:

- When viewed in cross-section within the zone of overlap, the myofibril displays a highly ordered, precise hexagonal lattice.
- In this lattice, each thick myosin filament is symmetrically surrounded by exactly **six** thin actin filaments, maximizing cross-bridge binding opportunities.

Why other options are incorrect:

While a thin actin filament is surrounded by 3 myosin filaments, the reverse (myosin surrounded by actin) is always a 6-to-1 hexagonal ratio.

Question #59 Key: (B)

UHS 2022

Which of the following is a muscle component that acts as store for energy?

CORE CONCEPT AND DERIVATION

Phosphagen energy systems in skeletal muscle.

Formula:



Solution:

- Muscles contain very little stored, readily available ATP (only enough for a few seconds of intense contraction).
- To rapidly replenish ATP, resting muscles synthesize and store high-energy phosphate bonds in a backup molecule called **Creatine Phosphate** (Creatine-PO₄).
- During sudden bursts of activity, the phosphate is instantly donated back to ADP to regenerate ATP.

Why other options are incorrect:

ATP is an immediate currency, not a long-term 'store'. Creatinine is a metabolic waste product filtered by the kidneys, not an energy molecule.

Question #60 **Key: (B)**

NUMS 2022

Which event does not occur during muscle contraction?

CORE CONCEPT AND DERIVATION

The Sliding Filament Theory constraints.

Formula:

N/A (Conceptual)

Solution:

- During contraction, actin filaments are dragged inward, causing the overall sarcomere (Z to Z) to shorten.
- Consequently, the I-band shortens and the central H-zone shrinks and disappears.
- However, the **A-band** represents the physical length of the thick myosin filaments themselves. Since protein polymers do not magically shrink, the A-band's length remains absolutely constant.

Why other options are incorrect:

Options A, C, and D are all classic defining events that **do** occur during sliding filament contraction.

Question #61 **Key: (C)**

SZABMU 2022

The muscle contraction involves the breakdown of cross bridges of actin and myosin filaments due to the follow...

CORE CONCEPT AND DERIVATION

The cross-bridge cycle and ATP utilization.

Formula:**Solution:**

- In the cross-bridge cycle, the physical binding of a new ATP molecule to the myosin head causes it to detach (break) from actin.
- Immediately following detachment, the myosin head acts as an enzyme, **hydrolyzing** the ATP into ADP and inorganic phosphate (P_i).
- This hydrolysis reaction releases the energy required to cock the myosin head back into its high-energy, ready-to-fire position.

Why other options are incorrect:

ATP is not fundamentally oxidized or reduced in this mechanical step; it strictly undergoes enzymatic hydrolysis (cleaving a phosphate bond with water).

Question #62 **Key: (A)**

SZABMU 2022

What is the function of myoglobin?

CORE CONCEPT AND DERIVATION

Oxygen handling inside muscle cells.

Formula:

N/A (Conceptual)

Solution:

- Myoglobin is a monomeric, iron-containing heme protein highly concentrated directly within the sarcoplasm of muscle fibers.
- Unlike hemoglobin, which transports oxygen systemically through the blood, myoglobin's extremely high affinity for oxygen allows it to effectively extract and **store oxygen** locally within the muscle tissue until it is desperately needed for aerobic respiration.

Why other options are incorrect:

Hemoglobin is responsible for long-distance *transport*. Myoglobin does not bind or store CO₂ effectively.

Question #63 **Key: (B)**

PMDC 2020

Which one of the following muscles are considered as 'voluntary muscles'?

CORE CONCEPT AND DERIVATION

Muscle tissue classification by control mechanism.

Formula:

N/A (Conceptual)

Solution:

- Voluntary muscles are those that can be consciously controlled by the somatic nervous system.
- **Skeletal muscles** are attached to the skeleton and are responsible for all conscious movements (walking, lifting, etc.), making them strictly voluntary.

Why other options are incorrect:

Cardiac muscle (heart) and Smooth muscle (digestive tract, blood vessels) are controlled by the autonomic nervous system and are entirely involuntary.

Question #64 **Key: (C)**

PMDC 2020

Which one of the following are 'myogenic' type of muscles?

CORE CONCEPT AND DERIVATION

Myogenic vs. Neurogenic muscle contraction.

Formula:

N/A (Conceptual)

Solution:

- **Myogenic** means the contraction signal originates directly from within the muscle tissue itself, rather than requiring an external nerve impulse.
- **Cardiac muscles** contain specialized pacemaker cells (the SA node) that spontaneously generate their own action potentials, allowing the heart to beat autonomously. Thus, they are highly myogenic.

Why other options are incorrect:

Skeletal muscles are neurogenic; they will not contract without a direct signal from a motor neuron.

Question #65 **Key: (A)**

PMDC 2020

What do we call the cell surface membrane of a muscle fiber?

CORE CONCEPT AND DERIVATION

Muscle cell nomenclature.

Formula:

N/A (Conceptual)

Solution:

- While it is technically a specialized type of plasma membrane, biological convention uses strict specific terminology for muscle cells.
- The distinct outer boundary and excitable cell membrane of a skeletal muscle fiber is exclusively termed the **sarcolemma**.

Why other options are incorrect:

Sarcoplasm is the cytoplasm inside the cell. Myofibrils are the internal contractile threads. Plasma membrane is biologically accurate but generically broad; 'sarcolemma' is the specific, correct answer.

Question #66 Key: (D)

SZABMU 2019

Each muscle fiber contains long threads that extend along its entire length. These are called as:

CORE CONCEPT AND DERIVATION

Hierarchical organization of skeletal muscle.

Formula:

N/A (Conceptual)

Solution:

- Inside the sarcolemma of a single muscle fiber, the cytoplasm is packed with parallel, rod-like contractile threads extending the entire length of the cell.
- These macroscopic longitudinal bundles of interacting protein filaments are called **myofibrils**.

Why other options are incorrect:

Myosin and microfilaments (actin) are the smaller, individual molecular proteins that physically make up the larger myofibril structure.

Question #67 Key: (D)

MDCAT 2019

Thin filaments of muscles contain ____ chains of actin molecules.

CORE CONCEPT AND DERIVATION

Molecular composition of the thin myofilament.

Formula:

N/A (Conceptual)

Solution:

- The core of the thin filament is composed of the protein F-actin (filamentous actin).
- F-actin is formed by the polymerization of globular G-actin monomers into exactly **two** long strands that twist around each other in a double-helical configuration.

Why other options are incorrect:

While thin filaments also contain tropomyosin and the 3-subunit troponin complex, the foundational actin core strictly consists of only two intertwined chains.

Question #68 Key: (D)

MDCAT 2019

The thick filaments in a myofibril of muscles are made up of ____.

CORE CONCEPT AND DERIVATION

Protein composition of muscle filaments.

Formula:

N/A (Conceptual)

Solution:

- Myofibrils contain two main types of filaments: thick and thin.
- The thick filaments are composed entirely of hundreds of intertwined molecules of the motor protein **myosin**, which features heavy tail regions and specialized globular heads with ATPase activity.

Why other options are incorrect:

Actin forms the thin filaments. Haemoglobin and myoglobin are entirely separate globular oxygen-binding proteins, completely unrelated to the physical filament structure.

Question #69 Key: (A)

MDCAT 2019

The function of calcium ions in muscle contraction is to:

CORE CONCEPT AND DERIVATION

Role of Calcium in cross-bridge cycling.

Formula:

N/A (Conceptual)

Solution:

- In a resting muscle, tropomyosin actively blocks the myosin-binding sites on actin.
- When an action potential arrives, Ca^{2+} is released from the sarcoplasmic reticulum. The Ca^{2+} physically binds to specific subunits on the **troponin** complex.
- This binding induces a massive conformational change in troponin, forcing it to drag tropomyosin out of the way, thereby exposing the active sites for cross-bridge formation.

Why other options are incorrect:

Calcium binds strictly to troponin (TnC), not directly to tropomyosin. While muscles have anisotropic properties under polarized light, Ca^{2+} is a chemical trigger, not a light polarizer.

Question #70 **Key: (A)**

MDCAT 2017

Overlapping of thick filament occurs in:

CORE CONCEPT AND DERIVATION

Banding patterns in the sliding filament model.

Formula:

N/A (Conceptual)

Solution:

- The **A-Band** represents the entire length of the thick myosin filaments.
- In the peripheral edges of the A-Band, these thick filaments physically overlap with the interdigitating thin actin filaments, creating a very dense, dark appearance under a microscope.

Why other options are incorrect:

The I-Band contains strictly thin filaments. The H-zone (center of A-band) contains only thick filaments (no overlap). The Z-line anchors thin filaments.

Question #71 **Key: (C)**

KMU 2017

Sarcolemma is the membrane around?

CORE CONCEPT AND DERIVATION

Cellular wrappers in musculoskeletal anatomy.

Formula:

N/A (Conceptual)

Solution:

- The prefix *sarco-* translates to 'flesh' or 'muscle'.
- The **sarcolemma** is explicitly the specialized lipid bilayer plasma membrane that directly surrounds an individual **muscle fiber** (muscle cell).

Why other options are incorrect:

Bones are covered by the periosteum. Joints are enclosed by synovial capsules. 'Heat' is a form of energy, not a biological structure.

Question #72 **Key: (A)**

MDCAT 2016

Each muscle fiber is surrounded by a modified cell membrane called:

CORE CONCEPT AND DERIVATION

Anatomy of a muscle cell.

Formula:

N/A (Conceptual)

Solution:

- A muscle fiber is a single muscle cell.
- Its highly specialized outer plasma membrane, which is uniquely capable of conducting action potentials deep into the cell via T-tubules, is called the **sarcolemma**.

Why other options are incorrect:

Myofilaments (actin/myosin) and sarcomeres are internal contractile structures. They are surrounded by the sarcoplasm and eventually bounded by the sarcolemma.

Question #73 **Key: (C)**

MDCAT 2015

A sarcomere is the region of a myofibril between two successive:

CORE CONCEPT AND DERIVATION

Boundaries of the sarcomere.

Formula:

N/A (Conceptual)

Solution:

- The basic functional unit of muscle contraction is the sarcomere.
- By standard histological definition, a single sarcomere spans the exact distance between two successive **Z-lines** (or Z-discs), which anchor the thin actin filaments.

Why other options are incorrect:

The M-line is the center of the sarcomere. The I-band spans across the Z-line into two adjacent sarcomeres. T-tubules are membrane invaginations, not filament boundaries.

Question #74 **Key: (A)**

MDCAT 2015

According to sliding filament theory, when muscle fibers are stimulated by nervous system, which of the follow...

CORE CONCEPT AND DERIVATION

Changes in sarcomere banding during contraction.

Formula:

N/A (Conceptual)

Solution:

- According to the sliding filament theory, myofilaments themselves do not change length; rather, the thin filaments slide deeply into the A-band.
- As the Z-lines are pulled closer together, the region containing only thin filaments (the **I-band**) noticeably **shortens**.

Why other options are incorrect:

Z-lines move closer together, not further apart. The H-zone (center gap) narrows and disappears, rather than becoming more visible. The A-band remains completely unchanged in length because the thick filaments do not shrink.

Question #75 **Key: (A)**

MDCAT 2014

The repeated protein pattern of myofibrils is called:

CORE CONCEPT AND DERIVATION

Ultrastructure of striated muscle fibers.

Formula:

N/A (Conceptual)

Solution:

- A myofibril is composed of highly organized repeating units of actin and myosin filaments.
- This repeating functional pattern, stretching from one Z-line to the next, is strictly defined as a **sarcomere**. It is the fundamental contractile unit of striated muscle.

Why other options are incorrect:

The sarcolemma is the cell membrane. Cross bridges are the physical attachments between myosin heads and actin. 'Zyomere' is an incorrect/typographical distractor for Z-line.