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KMU Peshawar MDCAT 2026 Official Paper

Official Annual Full-Length Practice Examination (FLP) · Complete Solved Paper

🛡️ Official Admitting Board: Khyber Medical University Peshawar 🎯 Archive Code: BEAMBE-FLP-KMU-2026 ⌚ Duration: 210 Minutes (3h 30m)

180

TOTAL QUESTIONS

210m

OFFICIAL DURATION

+1 / 0.00

ZERO NEGATIVE MARKING

180

MAXIMUM MARKS

📄 EXAMINATION BLUEPRINT & SUBJECT WEIGHTAGE

Biology**81 MCQs**

45.0% weight

Physics**36 MCQs**

20.0% weight

Chemistry**45 MCQs**

25.0% weight

English**9 MCQs**

5.0% weight

Logical Reasoning**9 MCQs**

5.0% weight

BIO SECTION: BIOLOGY

Questions 1 to 81 (81 MCQs)

Q1. BIO

Human beings are involved in an intense struggle for existence because resources such as food, water and space:

- (A) Double every year
- (B) Cannot increase at the same rate
- (C) Increase at the same rate
- (D) Remain constant

Q2. BIO

Lamarck explained the long neck of Giraffe on the basis of:

- (A) Mutation
- (B) Natural selection
- (C) Inheritance of acquired characteristics
- (D) Genetic drift

Q3. BIO

A population of rabbits shows variation in fur colour. During snowy winters, white rabbits are less visible to predators and survive in greater numbers than brown rabbits. According to Darwin, this is an example of:

- (A) Overproduction
- (B) Natural selection
- (C) Artificial selection
- (D) Genetic drift

Q4. BIO

According to Lamarck, what would be expected if an organism loses or modifies a body part during its lifetime?

- (A) It is passed to offspring
- (B) It has no effect on offspring
- (C) It causes genetic mutation
- (D) It occurs through natural selection

Q5. BIO

Post ovulation, the ruptured follicle is transformed into a glandular structure called _____.

- (A) Cervix
- (B) Fimbriae
- (C) Endometrium
- (D) Corpus luteum

Q6. BIO

Both vas deferens of a male are surgically cut (vasectomy done). Which process remains unaffected after the procedure?

- (A) Testosterone secretion
- (B) Sperm transport
- (C) Ejaculation of sperms
- (D) Fertilization ability

Q7. BIO

A woman has irregular menstruation due to failure of proliferative endometrial thickening. Which hormone is deficient in her body?

- (A) Estrogen
- (B) Oxytocin
- (C) Luteinizing
- (D) Follicle stimulating

Q8. BIO

A patient having a painless, non-itching ulcerated sore with hard edges on genitals is most likely suffering from:

- (A) Gonorrhea
- (B) Syphilis
- (C) Genital Herpes
- (D) AIDS

Q9. BIO

The ribs not attached to the sternum are called:

- (A) True ribs
- (B) False ribs
- (C) Floating ribs
- (D) Vertebro-sternal ribs

Q10. BIO

A tissue is found to have cells embedded in a firm matrix, lacks blood vessels and receives nutrients by diffusion. It also resists compression forces in joints. This tissue is most likely:

- (A) Compact bone
- (B) Spongy bone
- (C) Adipose
- (D) Cartilage

Q11. BIO

A tissue sample shows striated, multinucleated cells and has voluntary control. Which fundamental role is most associated with this tissue?

- (A) Pumping blood
- (B) Movement of internal organs
- (C) Maintenance of posture and locomotion
- (D) Production of digestive enzymes

Q12. BIO

The T-tubule and the terminal portion of the adjacent sarcoplasmic reticulum collectively form:

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

Q13. BIO

During skeletal muscle contraction, the A-band of fiber:

- (A) Shortens
- (B) Elongates
- (C) Disappears
- (D) Remains constant

Q14. BIO

The joint formed between adjacent vertebrae, allows slight movement and has no synovial cavity is classified as:

- (A) Synovial joint
- (B) Fibrous joint
- (C) Hinge joint
- (D) Cartilaginous joint

Q15. BIO

A cricketer rotates his shoulder joint to throw the ball in any direction. What type of joint is this?

- (A) Pivot joint
- (B) Ball and socket joint
- (C) Hinge joint
- (D) Condylloid joint

Q16. BIO

In arthritis, friction and inflammation of joints, primarily affects which body function?

- (A) Exchange of gases
- (B) Production of RBCs
- (C) Deposition of calcium in bones
- (D) Smooth movement of joints

Q17. BIO

If green is a dominant and yellow is a recessive trait, then what percentage of the F_2 generation will be homozygous recessive?

- (A) 0%
- (B) 25%
- (C) 50%
- (D) 75%

Q18. BIO

In a monohybrid cross of round (RR) and wrinkled seeded (rr) pea plants, all F_1 offspring are round seeded (Rr). If an F_1 plant is crossed with a homozygous recessive (rr) plant, what will be the phenotypic ratio of round to wrinkled offspring?

- (A) 1:3
- (B) 1:4
- (C) 0:4
- (D) 1:1

Q19. BIO

Which condition results in a 1: 1: 1: 1 phenotypic ratio in the offspring of a dihybrid test cross?

- (A) Complete linkage
- (B) No linkage
- (C) Sex linkage
- (D) Mutation

Q20. BIO

An X-linked recessive allele inherited from a carrier mother (father is unaffected) is most likely to be expressed in which child?

- (A) Son
- (B) Daughter
- (C) Both equally
- (D) None of them

Q21. BIO

Which of the following is a disorder caused by a recessive X-linked trait?

- (A) Vitamin D resistant rickets
- (B) Anemia
- (C) Colour blindness
- (D) Cystic Fibrosis

Q22. BIO

Identify the X-linked dominant disorder from the following:

- (A) Haemophilia
- (B) Colour blindness
- (C) Baldness
- (D) Hypophosphatemic rickets

Q23. BIO

The genetic basis of haemophilia is:

- (A) A dominant allele on chromosome 21
- (B) A recessive allele on the X chromosome
- (C) A recessive allele on the Y chromosome
- (D) A mitochondrial mutation

Q24. BIO

The fluid present in the pericardial cavity functions to:

- (A) Nourish the heart muscles
- (B) Prevent blood clotting
- (C) Reduce friction during heart movement
- (D) Generate electrical impulse

Q25. BIO

The phase of the cardiac cycle during which blood is pumped to lungs and the entire body is called:

- (A) Atrial systole
- (B) Atrial diastole
- (C) Ventricular systole
- (D) Ventricular diastole

Q26. BIO

Hepatic portal subsystem carries nutrients from the small intestine to the:

- (A) Vena cava
- (B) Liver
- (C) Pancreas
- (D) Kidney

Q27. BIO

Why are arteries thicker than veins?

- (A) To store more blood
- (B) To prevent back flow
- (C) To increase diffusion rate
- (D) To withstand high pressure

Q28. BIO

Lymph is most closely related to:

- (A) Blood plasma
- (B) Interstitial fluid
- (C) Sweat
- (D) Saliva

Q29. BIO

B-Lymphocytes produce a small, soluble and specific protein called _____.

- (A) Antigen
- (B) Antibody
- (C) Prostaglandin
- (D) Perforin

Q30. BIO

A vaccine containing weakened microbes is administered to a person. Which aspect of adaptive immunity is responsible for providing long-lasting protection against future infections?

- (A) Inflammatory response
- (B) Rise in body temperature
- (C) Engulfment by phagocytes
- (D) Formation of memory cells

Q31. BIO

Which has NO cartilage in its structure?

- (A) Larynx
- (B) Trachea
- (C) Bronchioles
- (D) Bronchi

Q32. BIO

The mucus and cilia of the nasal cavity work together to:

- (A) Increase the rate of diffusion of oxygen
- (B) Produce mucus for vocal cord lubrication
- (C) Filter air and prevent the entry of microorganisms
- (D) Exchange oxygen and carbon dioxide with blood

Q33. BIO

During gaseous exchange in human body, maximum percentage of CO_2 is transported from body tissues to lungs as:

- (A) Bicarbonate ion
- (B) Carbaminohemoglobin
- (C) Dissolved CO_2 in plasma
- (D) Gaseous form as bubbles

Q34. BIO

Smoking causes alveolar destruction in:

- (A) Pneumonia
- (B) Chronic bronchitis
- (C) Emphysema
- (D) Asthma

Q35. BIO

Which of the following is NOT a function of liver?

- (A) Detoxification
- (B) Insulin synthesis
- (C) Producing bile
- (D) Storage of Vitamin A

Q36. BIO

Find the correct sequence of phases in the swallowing mechanism: 1. Pharyngeal, 2. Oral, 3. Esophageal.

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

Q37. BIO

The release of bicarbonate rich fluid from the pancreas is stimulated by the action of:

- (A) Pepsin
- (B) Gastrin
- (C) Secretin
- (D) Trypsin

Q38. BIO

Which structures in the intestinal villus are directly involved in nutrient absorption?

- (A) Blood capillaries and lacteals
- (B) Arteries and goblet cells
- (C) Circular and longitudinal muscles
- (D) Crypts of Lieberkühn and microvilli

Q39. BIO

The primary function of peristalsis in the large intestine is to:

- (A) Digest carbohydrates
- (B) Move undigested food toward the rectum
- (C) Absorb fats
- (D) Secrete digestive enzymes

Q40. BIO

A patient experiences chronic gastric discomfort and endoscopy confirms gastric ulcers. Which finding best explains the underlying cause?

- (A) Deficiency of pepsinogen secretion
- (B) Excess absorption of hydrochloric acid
- (C) Spread of *Helicobacter pylori* into stomach wall
- (D) Lack of intrinsic factor and Vitamin B12

Q41. BIO

Which region of kidney contains glomeruli and Bowman's capsules?

- (A) Renal medulla
- (B) Renal cortex
- (C) Renal pelvis
- (D) Hilum

Q42. BIO

If glucose appears in urine of a patient, it indicates failure of which process?

- (A) Pressure filtration
- (B) Selective reabsorption
- (C) Tubular secretion
- (D) Osmoregulation

Q43. BIO

Which part of nephron is impermeable to water?

- (A) Glomerulus
- (B) Descending limb
- (C) Ascending limb
- (D) Proximal tubule

Q44. BIO

When water intake is high:

- (A) ADH secretion increases, producing concentrated urine
- (B) Aldosterone secretion increases, producing concentrated urine
- (C) ADH release is inhibited, resulting in a large volume of dilute urine
- (D) Ultrafiltration stops until water balance is restored

Q45. BIO

Peritubular capillaries are formed from:

- (A) Glomerulus
- (B) Afferent arteriole
- (C) Efferent arteriole
- (D) Interlobular artery

Q46. BIO

Dialysis or kidney transplantation is usually required when kidney function falls below _____ of normal.

- (A) 70%
- (B) 50%
- (C) 25%
- (D) 10%

Q47. BIO

Which nitrogenous waste is the MAIN excretory product in humans, and has relatively low toxicity compared to ammonia?

- (A) Urea
- (B) Uric acid
- (C) Creatinine
- (D) Ammonia

Q48. BIO

DNA probes enable faster identification of disease causing bacteria than conventional methods because of advances in:

- (A) Non-biological methods
- (B) Biotechnology
- (C) Antibiotics
- (D) Surgery

Q49. BIO

The most common vector used to deliver a therapeutic gene into target cells is:

- (A) Plasmid
- (B) Liposome
- (C) Genetically altered virus
- (D) Restriction enzyme

Q50. BIO

Monoclonal antibodies are:

- (A) A mixture of different antibodies
- (B) A group of identical antibodies produced by identical immune cells
- (C) Antibodies produced only by T-lymphocytes
- (D) Radioactively labelled antibodies

Q51. BIO

Which of the following correctly matches the biotechnology product with its application?

- (A) Biochips: Supply biologically fixed nitrogen to crops
- (B) Mycorrhiza: Deliver drugs to target cells using nanoparticles
- (C) Nanoparticles: Efficient drug delivery at target cells and diagnosis of disease
- (D) Biofertilizers: Detect bioterrorism agents using miniaturized laboratories

Q52. BIO

Which of the following is correctly matched with its morphological type?

- (A) Tobacco mosaic virus: Polyhedral virus
- (B) Poliovirus: Rod shaped virus
- (C) Bacteriophage: Tadpole virus
- (D) Tobacco mosaic virus: Spherical virus

Q53. BIO

A patient diagnosed with AIDS has an increased susceptibility to infections due to:

- (A) Destruction of red blood cells
- (B) Excess production of antibodies
- (C) Weakening of the immune system
- (D) Overproduction of digestive enzymes

Q54. BIO

Which of the following is converted into a two-carbon molecule with the release of carbon dioxide?

- (A) Acetyl-CoA
- (B) Lactate
- (C) Pyruvate
- (D) Glycerol

Q55. BIO

Metabolism of an 18 carbon fatty acid results in _____ number of Acetyl-CoA?

- (A) 3
- (B) 6
- (C) 9
- (D) 18

Q56. BIO

Which of the following are classified as organic molecules in humans?

- (A) Water, mineral, oxygen, carbon dioxide
- (B) Carbohydrates, proteins, lipids, nucleic acids
- (C) Vitamins, minerals, water, oxygen
- (D) Glucose, sodium chloride, water, calcium

Q57. BIO

The structural similarity between DNA and RNA nucleotides is due to the presence of:

- (A) Thymine
- (B) Ribose
- (C) Deoxyribose
- (D) Phosphoric acid

Q58. BIO

Which property of water is primarily helpful in providing a cooling effect to plants and animals?

- (A) Heat Capacity
- (B) Heat of Vaporization
- (C) Solvent Properties
- (D) Force of Cohesion

Q59. BIO

The reduction of water content in protoplasm to about 10% results in:

- (A) Increased metabolic activity
- (B) Faster cell division
- (C) Loss of survival of protoplasm
- (D) Increased protein synthesis

Q60. BIO

Maltose is classified as:

- (A) Monosaccharide
- (B) Disaccharide
- (C) Trisaccharide
- (D) Polysaccharide

Q61. BIO

Haemoglobin is an example of which level of protein structure?

- (A) Primary
- (B) Secondary
- (C) Tertiary
- (D) Quaternary

Q62. BIO

In cell, glycoproteins are found in the:

- (A) Mitochondria
- (B) DNA
- (C) RNA
- (D) Plasma membrane

Q63. BIO

A DNA molecule has a length of 340 nm. How many base pairs does it contain?

- (A) 100
- (B) 340
- (C) 500
- (D) 1000

Q64. BIO

Fatty acids and glycerol are related to _____, whereas _____ are related to protein.

- (A) Nucleic acids; amino acids
- (B) Lipids; amino acids
- (C) Polymers; polypeptides
- (D) Amino acids; polypeptides

Q65. BIO

A student observes a discoid organelle with a double membrane stroma and thylakoids in plant cell. Which organelle is this?

- (A) Golgi apparatus
- (B) Endoplasmic reticulum
- (C) Chloroplast
- (D) Mitochondria

Q66. BIO

Which of the following is a COMMON FEATURE of Prokaryotic and Eukaryotic cells?

- (A) Mitochondria
- (B) Ribosomes
- (C) Endoplasmic reticulum
- (D) Golgi complex

Q67. BIO

Which one of the following is a self-replicating organelle?

- (A) Golgi apparatus
- (B) Lysosome
- (C) Peroxisome
- (D) Mitochondria

Q68. BIO

If a cell's smooth endoplasmic reticulum is destroyed, which processes will be most affected?

- (A) Protein synthesis and protein folding
- (B) Lipid synthesis and detoxification
- (C) ATP production and aerobic respiration
- (D) DNA replication and cell division

Q69. BIO

The centromere is important because it:

- (A) Synthesizes proteins
- (B) Holds identical chromatids together
- (C) Replicates DNA
- (D) Produces ATP

Q70. BIO

Which of the following correctly describes the action of the sodium-potassium pump in a resting neuron?

- (A) Two Na^+ ions are pumped in and three K^+ ions are pumped out
- (B) Three Na^+ ions are pumped in and two K^+ ions are pumped out
- (C) Three Na^+ ions are pumped out and two K^+ ions are pumped in
- (D) Equal numbers of Na^+ and K^+ ions are exchanged

Q71. BIO

Which of the following structures can be found in a typical neuron?

- (A) Dendrites, cell body, cilia
- (B) Dendrites, cell body, axon
- (C) Dendrites, cell body, ganglion
- (D) Cauda equina, cell body, myelin sheath

Q72. BIO

The reversal of polarity across two sides of membrane from -70 mV to $+50 \text{ mV}$ is called _____.

- (A) Polarization
- (B) Hyperpolarization
- (C) Repolarization
- (D) Depolarization

Q73. BIO

A student quickly pulls his hand away from a hot iron after accidentally touching it. This response is best classified as:

- (A) Conditioned reflex
- (B) Cranial reflex
- (C) Spinal Reflex
- (D) Voluntary action

Q74. BIO

A patient suffers a brain injury following a head trauma. During recovery, the patient experiences disturbed sleep patterns and is unable to dream normally. Which part of the brain is most likely affected?

- (A) Cerebellum
- (B) Medulla oblongata
- (C) Pons
- (D) Thalamus

Q75. BIO

Damage to the area containing dopamine-releasing neurons would most likely affect the:

- (A) Midbrain
- (B) Cerebellum
- (C) Pons
- (D) Medulla

Q76. BIO

The amygdala is a part of the:

- (A) Cerebellum
- (B) Limbic system
- (C) Reticular formation
- (D) Medulla oblongata

Q77. BIO

Which characteristic distinguishes enzymes during a chemical reaction?

- (A) They change the final product
- (B) They slow down metabolic steps
- (C) They remain chemically unchanged
- (D) They become part of reaction product

Q78. BIO

According to the lock and key hypothesis, the active site in enzyme action is regarded as _____ structure.

- (A) Rigid
- (B) Flexible
- (C) Dynamic
- (D) Elastic

Q79. BIO

Enzyme pepsin shows maximum activity at pH:

- Ⓐ 1.5 to 1.6
 - Ⓑ 4.5 to 4.7
 - Ⓒ 7.8 to 8.7
 - Ⓓ 8.7 to 9.1
-

Q80. BIO

pH affects the activity of an enzyme by causing the:

- Ⓐ Ionization of an active site
 - Ⓑ Increase in the activation energy
 - Ⓒ Removal of prosthetic group from enzyme
 - Ⓓ Decreasing the temperature of reaction mixture
-

Q81. BIO

Which molecule has a similar structure to the normal substrate?

- Ⓐ Competitive inhibitor
 - Ⓑ Non-competitive inhibitor
 - Ⓒ Heavy metal ion
 - Ⓓ Cyanide
-

PHY SECTION: PHYSICS

Questions 82 to 117 (36 MCQs)

Q82. PHY

In an adiabatic process if a gas is allowed to expand suddenly, its temperature will:

- (A) Decrease
- (B) Increase
- (C) Remain constant
- (D) Become absolute zero

Q83. PHY

According to Coulomb's law, if the distance between two point charges is doubled while their magnitudes remain unchanged, the electrostatic force between them becomes:

- (A) One-fourth of its original value
- (B) One-half of its original value
- (C) Twice its original value
- (D) Four times its original value

Q84. PHY

A 12 V battery transfers 5000 C of charge through a circuit. The energy delivered is:

- (A) 4.17×10^2 J
- (B) 4.17×10^3 J
- (C) 6.0×10^4 J
- (D) 6.0×10^5 J

Q85. PHY

An infinite plane sheet has a surface charge density: $\sigma = 8.85 \times 10^{-6} \text{ C m}^{-2}$. The electric field on either side of the sheet is:

- (A) $0.25 \times 10^6 \text{ N C}^{-1}$
- (B) $0.5 \times 10^6 \text{ N C}^{-1}$
- (C) $1 \times 10^6 \text{ N C}^{-1}$
- (D) $2 \times 10^6 \text{ N C}^{-1}$

Q86. PHY

Steady current in a metallic conductor is due to the _____ under an electric field.

- (A) Directed flow of free electrons
- (B) Random electron motion
- (C) Positive ion movement
- (D) Continuously changing electron flow

Q87. PHY

Which expression correctly represents the SI unit of magnetic flux density?

- (A) $\text{N A}^{-1}\text{m}^{-1}$
- (B) $\text{N A}^{-1}\text{m}$
- (C) N C^{-1}
- (D) Wb m^2

Q88. PHY

If the number of turns of a coil is doubled while the rate of change of magnetic flux remains constant, the induced e.m.f. will be:

- (A) Halved
- (B) Unchanged
- (C) Doubled
- (D) One-fourth

Q89. PHY

In an alternating current wave, the phase of the maximum positive value is:

- (A) 0°
- (B) 90°
- (C) 180°
- (D) 270°

Q90. PHY

When a diode is reverse biased, it:

- (A) Almost stops the current
- (B) Reduces the resistance of the junction
- (C) Allows current to pass
- (D) Increases the current

Q91. PHY

According to Planck's theory, an atom in one quantum state:

- (A) Emits energy continuously
- (B) Absorbs energy continuously
- (C) Neither emits nor absorbs energy
- (D) Emits one photon every second

Q92. PHY

Which type of spectrum consists of bright lines of various frequencies?

- (A) Line emission
- (B) Line absorption
- (C) Continuous
- (D) Band

Q93. PHY

The half-life of a radioactive element is:

- (A) Constant
- (B) Variable
- (C) Dependent on the quantity
- (D) Dependent on temperature and pressure

Q94. PHY

When two vectors A and B are added, which statement is correct?

- (A) $A + B$ and $B + A$ have different magnitudes but the same direction
- (B) The resultant depends on which vector is drawn first
- (C) $A + B = B + A$, so changing the order does not change the resultant
- (D) The commutative law applies only when the vectors are perpendicular

Q95. PHY

The direction of linear momentum is the same as the direction of:

- (A) Force
- (B) Acceleration
- (C) Velocity
- (D) Displacement

Q96. PHY

Which situation represents uniform acceleration?

- (A) Velocity changes by unequal amounts during equal time intervals
- (B) Acceleration changes continuously with time
- (C) Velocity changes by equal amount in equal intervals of time
- (D) Velocity remains constant throughout the motion

Q97. PHY

A particle moves from 40m at 10s to 20m at 15s. Its average velocity is:

- (A) 4 m/s
- (B) -4 m/s
- (C) 0.04 m/s
- (D) -0.04 m/s

Q98. PHY

A 4 kg block and an 8 kg block are pushed with the same force on a frictionless surface. Which statement is CORRECT?

- (A) Both blocks have the same acceleration
- (B) The 4 kg block has double the acceleration of the 8 kg block
- (C) The 8 kg block has double the acceleration of the 4 kg block
- (D) Both blocks move with the same velocity

Q99. PHY

The maximum height reached by a projectile is directly proportional to:

- (A) $\sin^2 \theta$
- (B) $\cos^2 \theta$
- (C) $\cos \theta$
- (D) $\sin \theta$

Q100. PHY

In an isolated system, total energy and momentum is _____ in all situations.

- (A) Conserved
- (B) Lost
- (C) Doubled
- (D) Halved

Q101. PHY

A person pushes against a stationary wall with a constant force for 2 mins. The work done on the wall is:

- (A) Positive
- (B) Negative
- (C) Zero
- (D) Equal to the applied force

Q102. PHY

A motor performs 2400 J of work in 2 minutes. The power generated is:

- (A) 10 W
- (B) 20 W
- (C) 1200 W
- (D) 4800 W

Q103. PHY

The equation $P.E = mgh$ is NOT applicable when:

- (A) The body's height is much lesser than earth's radius
- (B) The body's height is much greater than earth's radius
- (C) The mass is zero
- (D) Gravity is constant

Q104. PHY

If the string breaks while a ball is moving in a circle, the ball will:

- (A) Continue moving in a circle
- (B) Stop immediately
- (C) Move in a straight line tangent to the circle
- (D) Fall directly towards the centre

Q105. PHY

One radian is the angle subtended at the centre by an arc whose length is equal to the _____ of the circle.

- (A) Diameter
- (B) Radius
- (C) Circumference
- (D) Chord

Q106. PHY

The SI unit of angular displacement is:

- (A) Degree
- (B) Revolution
- (C) Radian
- (D) Rad/s

Q107. PHY

A raindrop falls through the air and eventually reaches terminal velocity. At this instant, the net force acting on the raindrop is:

- (A) Zero
- (B) Greater than its weight
- (C) Equal to the air resistance
- (D) Equal to the weight

Q108. PHY

As the skydiver slows down after opening the parachute and approaches terminal velocity 2, the air resistance is:

- (A) Zero
- (B) Increased
- (C) Reduced
- (D) Not changed

Q109. PHY

A hosepipe ejects water with a velocity of 2 m/s from an opening of 0.05 m². To double the velocity the cross-sectional area should be:

- (A) 0.025 m²
- (B) 0.0125 m²
- (C) 0.05 m²
- (D) 0.10 m²

Q110. PHY

If the radius of an artery is reduced due to arteriosclerosis, the heart must increase blood pressure to:

- (A) Increase the blood flow rate
- (B) Maintain the same blood flow rate
- (C) Reduce the blood flow rate
- (D) Increase the radius of the artery

Q111. PHY

In a progressive wave, a wave crest moves a distance of _____ during one complete period (T).

- (A) Half a wavelength
- (B) One wavelength
- (C) Two wavelengths
- (D) Multiple wavelengths

Q112. PHY

In transverse waves, the particles of the medium vibrate _____ to the direction of wave propagation, whereas in longitudinal waves they vibrate _____.

- (A) Perpendicular; parallel
- (B) Parallel; perpendicular
- (C) Parallel; parallel
- (D) Perpendicular; perpendicular

Q113. PHY

A wave travels through a string with a frequency of 25 Hz and a wavelength of 1.6 m. How far does the wave travel in 8 seconds?

- (A) 160 m
- (B) 240 m
- (C) 320 m
- (D) 400 m

Q114. PHY

The increase in speed of sound in gas for each 1°C rise in temperature is:

- (A) 0.2 m/s
- (B) 0.6 m/s
- (C) 1.2 m/s
- (D) 2.0 m/s

Q115. PHY

According to Laplace, sound waves travel through air so rapidly that:

- (A) Heat is completely lost to the surroundings
- (B) Heat is completely gained from the surroundings
- (C) No heat is exchanged with surroundings
- (D) Heat is exchanged slowly with the surroundings

Q116. PHY

A gas absorbs 1.5×10^3 J of heat and performs 5.0×10^2 J of work. Its change in internal energy (ΔU) is:

- (A) 1.0×10^3 J
- (B) -1.0×10^3 J
- (C) 2.0×10^3 J
- (D) -2.0×10^3 J

Q117. PHY

One mole of an ideal gas is heated through 20K at constant pressure, where $R = 8.315 \text{ J mol}^{-1}\text{K}^{-1}$. If $C_v = 21 \text{ J mol}^{-1}\text{K}^{-1}$, the heat supplied is:

- (A) 166 J
- (B) 420 J
- (C) 586 J
- (D) 752 J

CHEM SECTION: CHEMISTRY

Questions 118 to 162 (45 MCQs)

Q118. CHEM

When chlorine is present in excess during chlorination of methane, the major product is:

- (A) Carbon tetrachloride
- (B) Chloroform
- (C) Methyl chloride
- (D) Methylene chloride

Q119. CHEM

Which carbon chain is selected first when assigning the IUPAC name of an alkene?

- (A) Cyclic carbon chain
- (B) Most highly branched carbon chains
- (C) Longest with maximum number of double bonds
- (D) Longest with maximum number of triple bonds

Q120. CHEM

Which method prepares an alkene by removing water from an alcohol?

- (A) Dehydration
- (B) Dehydrohalogenation
- (C) Halogenation
- (D) Hydrogenation

Q121. CHEM

Which statement best describes the structure of benzene? It is a:

- (A) Planar molecule with six sp^2 hybridized carbon atoms
- (B) Tetrahedral molecule with six sp^3 hybridized carbon atoms
- (C) Linear molecule with sp hybridized carbon atoms
- (D) Non-planar molecule with alternating single and double bonds

Q122. CHEM

Compared with alkenes, benzene undergoes _____ reaction to retain its aromatic character.

- (A) Addition
- (B) Elimination
- (C) Polymerization
- (D) Substitution

Q123. CHEM

Hydration of ethyne in the presence of H_2SO_4 and $HgSO_4$ ($100^\circ C$) ultimately gives:

- (A) Acetaldehyde
- (B) Acetic acid
- (C) Ethanol
- (D) Ethene

Q124. CHEM

According to IUPAC, when two different halogens are present in a haloalkane at the same position, which rule is used to decide which substituent is written first?

- (A) Alphabetical
- (B) Branching
- (C) Chain length
- (D) Molecular mass

Q125. CHEM

Which alkyl halide has the highest carbon-halogen bond energy?

- (A) C-Br
- (B) C-Cl
- (C) C-F
- (D) C-I

Q126. CHEM

An alcohol that produces cloudiness immediately with Lucas reagent is:

- (A) Primary
- (B) Secondary
- (C) Tertiary
- (D) Trihydric

Q127. CHEM

Reduction of an ester with lithium aluminium hydride mainly produces:

- (A) Alkene
- (B) Alcohol
- (C) Aldehyde
- (D) Ketone

Q128. CHEM

Which carbonyl compound is generally more reactive toward nucleophilic addition?

- (A) Aldehyde
- (B) Alcohol
- (C) Ether
- (D) Ketone

Q129. CHEM

Which reagent distinguishes aldehydes from ketones by producing a silver mirror?

- (A) Benedict's
- (B) Clemmensen
- (C) Fehling's
- (D) Tollen's

Q130. CHEM

Which of the following protein–prosthetic group combinations is correctly matched?

- (A) Chromoproteins: Carbohydrates
- (B) Glycoproteins: Lipids
- (C) Lipoproteins: Lipids
- (D) Nucleoproteins: Carbohydrates

Q131. CHEM

A manufacturer needs an adhesive that solidifies on cooling and is widely used in bookbinding and packaging. Which type of adhesive is most suitable?

- (A) Contact
- (B) Hot-melt
- (C) Pressure-sensitive
- (D) Solvent-based

Q132. CHEM

Which polymer is produced through condensation polymerization?

- (A) Nylon-6,6
- (B) Polyethylene
- (C) Polyvinyl chloride
- (D) Polystyrene

Q133. CHEM

What is the mass of 1 mole of calcium carbonate (CaCO_3)? (Molar mass of calcium: 40 g/mol, carbon: 12 g/mol, oxygen: 16 g/mol)

- (A) 25 g
- (B) 50 g
- (C) 75 g
- (D) 100 g

Q134. CHEM

A limiting reagent:

- (A) Is present in maximum amount
- (B) Produces minimum number of moles of product
- (C) Produces maximum number of moles of product
- (D) Does not affect the amount of product

Q135. CHEM

Which of the following is a CORRECT statement about yield?

- (A) Theoretical yield is the amount of product that is actually produced experimentally during a chemical reaction
- (B) The percent yield of a reaction tells us the total mass of the reactants used in the reaction
- (C) Chemists use percentage yield to express the efficiency of a chemical reaction
- (D) Actual yield is the amount of the product calculated based on a balanced equation

Q136. CHEM

The shape of an orbital depends on the _____ quantum number.

- (A) Azimuthal
- (B) Magnetic
- (C) Principle
- (D) Spin

Q137. CHEM

According to Pauli's Exclusion Principle, no two electrons in an atom can have the same set of _____ quantum numbers.

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

Q138. CHEM

What is the electronic configuration of Calcium?

- (A) $[\text{Ar}], 4s^1$
- (B) $[\text{Ar}], 4s^2$
- (C) $[\text{Ne}], 3s^2$
- (D) $[\text{He}], 2s^2$

Q139. CHEM

The average kinetic energy of gas molecules is directly proportional to _____ of the gas.

- (A) Density
- (B) Pressure
- (C) Absolute temperature
- (D) Volume

Q140. CHEM

If the pressure of a gas is doubled at constant temperature, its volume will:

- (A) Double
- (B) Halve
- (C) Remain unchanged
- (D) Triple

Q141. CHEM

If the absolute temperature of a gas doubles at constant pressure, its volume will:

- (A) Remain unchanged
- (B) Double
- (C) Halve
- (D) Triple

Q142. CHEM

Absolute zero is equal to _____ °C.

- (A) -100
- (B) -173
- (C) -273
- (D) -373

Q143. CHEM

The kinetic energy of liquid molecules is _____ compared to that of solids.

- (A) Constant
- (B) Equal
- (C) Greater
- (D) Lower

Q144. CHEM

At the boiling point, added heat is used to break _____ forces.

- (A) Intermolecular
- (B) Ionic
- (C) Magnetic
- (D) Nuclear

Q145. CHEM

Hydrogen bonding occurs between hydrogen and a highly _____ atom.

- (A) Electronegative
- (B) Electropositive
- (C) Nonpolar
- (D) Radioactive

Q146. CHEM

In a sodium chloride lattice, each ion is surrounded by ions of _____ charge.

- (A) Equal
- (B) Negative
- (C) Opposite
- (D) Positive

Q147. CHEM

Ionic solids conduct electricity in _____ state.

- (A) Frozen
- (B) Molten
- (C) Solid
- (D) Vapour

Q148. CHEM

A unit cell of crystal lattice is characterized by _____ parameters.

- (A) 4
- (B) 5
- (C) 6
- (D) 7

Q149. CHEM

When gaseous ions of opposite charge combine to form an ionic crystal, lattice energy is _____.

- (A) Absorbed
- (B) Released
- (C) Stored
- (D) Vaporized

Q150. CHEM

An increase in temperature shifts the equilibrium in favor of the _____ reaction.

- (A) Endothermic
- (B) Exothermic
- (C) Irreversible
- (D) Static

Q151. CHEM

Addition of sodium acetate to aqueous solution of acetic acid suppresses its:

- (A) Condensation
- (B) Ionization
- (C) Evaporation
- (D) Reduction

Q152. CHEM

The Haber process is exothermic; therefore, decreasing the temperature favors:

- (A) Decomposition of ammonia
- (B) Formation of ammonia
- (C) Formation of nitrogen gas
- (D) No change in equilibrium

Q153. CHEM

Activation energy is the minimum energy to:

- (A) Increase the reaction yield
- (B) Break all chemical bonds in the reactants
- (C) Initiate a chemical reaction
- (D) Separate mixture

Q154. CHEM

A reaction with a lower activation energy proceeds at a _____ rate.

- (A) Faster
- (B) Later
- (C) Slower
- (D) Unchanged

Q155. CHEM

When heat is absorbed by the system from the surroundings, the sign of heat (q) is:

- (A) Negative
- (B) Positive
- (C) Variable
- (D) Zero

Q156. CHEM

According to Hess's Law, the overall enthalpy change depends only on the:

- (A) Activation energy
- (B) Reaction pathway
- (C) Initial and final states
- (D) Reaction mechanism

Q157. CHEM

Which change in oxidation number represents reduction?

- (A) $+1 \rightarrow +3$
- (B) $+2 \rightarrow 0$
- (C) $0 \rightarrow +2$
- (D) $-1 \rightarrow +1$

Q158. CHEM

According to VSEPR theory, what determines the shape of a molecule?

- (A) Electron charge
- (B) Electron mass
- (C) Electron pairs
- (D) Electron volume

Q159. CHEM

In the excited state, carbon has _____ half-filled orbitals.

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

Q160. CHEM

The dipole moment is used to estimate the _____ character of a bond.

- (A) Acidic
- (B) Basic
- (C) Ionic
- (D) Organic

Q161. CHEM

Which Group IV-A tetrachloride DOES NOT react with water at room temperature?

- (A) CCl_4
- (B) GeCl_4
- (C) PbCl_4
- (D) SiCl_4

Q162. CHEM

Copper shows an exceptional electronic configuration because it has a more stable _____ subshell.

- (A) Half-filled
- (B) Filled
- (C) Paired
- (D) Vacant

ENG SECTION: ENGLISH

Questions 163 to 171 (9 MCQs)

Q163. ENG

Which one of the following sentences employs CORRECT subject-verb agreement?

- (A) The number of students in Class 9 is twenty.
- (B) The number of students in Class 9 are twenty.
- (C) The numbers of students in Class 9 is twenty.
- (D) The numbers of student in Class 9 are twenty.

Q164. ENG

My parents do not allow me to stay out _____.

- (A) Latter
- (B) Lately
- (C) Late
- (D) Later

Q165. ENG

Which of the following is the FALSE cause and effect claim?

- (A) Smoking causes lung cancer.
- (B) Rain causes wet roads.
- (C) Wearing red clothes causes intelligence.
- (D) Exercise improves health.

Q166. ENG

I like cake, however my friend likes chocolate. The transitional device is used for:

- (A) Exception
- (B) Sequence
- (C) Addition
- (D) Contrast

Q167. ENG

Electric cars are becoming increasingly popular due to concerns about air pollution and fossil fuels. They produce zero emissions and are powered by rechargeable batteries.

According to the passage, why are electric cars becoming popular?

- (A) They are faster than other cars.
- (B) They are cheaper to manufacture.
- (C) They reduce air pollution.
- (D) They use petrol efficiently.

Q168. ENG

Which of the following sentences uses the gerund as a subject?

- (A) I love singing in the shower.
- (B) Singing is my favorite hobby.
- (C) She is singing a beautiful song.
- (D) The singing bird is a nightingale.

Q169. ENG

My cat is hiding _____ the bed. Use correct preposition.

- (A) From
- (B) Inside
- (C) Under
- (D) To

Q170. ENG

Turn left _____ the traffic signal and the cafe will be on your right.

- (A) Into
- (B) On
- (C) At
- (D) Between

Q171. ENG

Which one of the following options contains the appropriate use of tense?

- (A) The light went out while I am reading.
- (B) The light has gone out while I was reading.
- (C) The light went out while I was reading.
- (D) The light goes out while I am reading.

LOGIC SECTION: LOGICAL REASONING

Questions 172 to 180 (9 MCQs)

Q172. LOGIC

Why is it important to monitor the implementation of a decision?

- (A) To hinder progress
- (B) To improve and adapt
- (C) To assign blame for mistakes
- (D) To shut down feedback

Q173. LOGIC

Human rights protection leads to economic growth. In light of the statement, Pakistan improved its labor laws for protection of rights of labors. However, economic growth is still low. Therefore, human rights protection does not support economic growth. What is the weakness in the argument?

- (A) Human rights are only one of many factors influencing economic growth.
- (B) Labor laws alone guarantee economic growth.
- (C) Economic growth depends only on labor rights.
- (D) Human rights have no impact on national development.

Q174. LOGIC

In a shop having 3 fruits, the oranges are cheaper than grapefruit and pricier than grapes, then _____.

- (A) Grapefruit is more expensive than grapes
- (B) Grapes are more expensive than grapefruit
- (C) Oranges are cheaper than grapes
- (D) Grapefruit and grapes cost the same

Q175. LOGIC

In how many different ways can four persons be seated on four chairs for a photograph?

- (A) 8
- (B) 12
- (C) 16
- (D) 24

Q176. LOGIC

What is the missing term of the sequence? 1, 3, 6, 10, 15, 21, 28, _____

- (A) 30
- (B) 32
- (C) 34
- (D) 36

Q177. LOGIC

Meetings are at 9am, 11am, and 2pm. Finance meets before HR. IT meets last. HR does not meet at 9am. Which team meets at 11am?

- (A) HR
- (B) IT
- (C) Finance
- (D) Cannot be determined

Q178. LOGIC

Almen is Amna's daughter and Salman is Amna's Father. Sarah is Salman's daughter. What is Almen to Salman?

- (A) Grandmother
- (B) Granddaughter
- (C) Daughter
- (D) Mother

Q179. LOGIC

A hospital performs 25 surgeries daily for 6 days a week. How many surgeries are performed weekly?

- (A) 120
- (B) 145
- (C) 150
- (D) 175

Q180. LOGIC

You park your car in a no-parking zone and are approached by a traffic police officer. What is the most appropriate response?

- (A) Argue with the officer to resolve the issue
- (B) Leave immediately without permission
- (C) Cooperate with the officer and comply with traffic regulations
- (D) Try to run away from the location

OFFICIAL VERIFIED ANSWER KEY

KMU Peshawar MDCAT 2026 Official Paper · Rapid Self-Grading Grid

[Online Portal >](#)

Q#	KEY	SUB	Q#	KEY	SUB	Q#	KEY	SUB	Q#	KEY	SUB	Q#	KEY	SUB
1	B	BIO	37	C	BIO	73	C	BIO	109	A	PHY	145	A	CHEM
2	C	BIO	38	A	BIO	74	C	BIO	110	B	PHY	146	C	CHEM
3	B	BIO	39	B	BIO	75	A	BIO	111	B	PHY	147	B	CHEM
4	A	BIO	40	C	BIO	76	B	BIO	112	A	PHY	148	C	CHEM
5	D	BIO	41	B	BIO	77	C	BIO	113	C	PHY	149	B	CHEM
6	A	BIO	42	B	BIO	78	A	BIO	114	B	PHY	150	A	CHEM
7	A	BIO	43	C	BIO	79	A	BIO	115	C	PHY	151	B	CHEM
8	B	BIO	44	C	BIO	80	A	BIO	116	A	PHY	152	B	CHEM
9	C	BIO	45	C	BIO	81	A	BIO	117	C	PHY	153	C	CHEM
10	D	BIO	46	D	BIO	82	A	PHY	118	A	CHEM	154	A	CHEM
11	C	BIO	47	A	BIO	83	A	PHY	119	C	CHEM	155	B	CHEM
12	B	BIO	48	B	BIO	84	C	PHY	120	A	CHEM	156	C	CHEM
13	D	BIO	49	C	BIO	85	B	PHY	121	A	CHEM	157	B	CHEM
14	D	BIO	50	B	BIO	86	A	PHY	122	D	CHEM	158	C	CHEM
15	B	BIO	51	C	BIO	87	A	PHY	123	A	CHEM	159	D	CHEM
16	D	BIO	52	C	BIO	88	C	PHY	124	A	CHEM	160	C	CHEM
17	B	BIO	53	C	BIO	89	B	PHY	125	C	CHEM	161	A	CHEM
18	D	BIO	54	C	BIO	90	A	PHY	126	C	CHEM	162	B	CHEM
19	B	BIO	55	C	BIO	91	C	PHY	127	B	CHEM	163	A	ENG
20	A	BIO	56	B	BIO	92	A	PHY	128	A	CHEM	164	C	ENG
21	C	BIO	57	D	BIO	93	A	PHY	129	D	CHEM	165	C	ENG
22	D	BIO	58	B	BIO	94	C	PHY	130	C	CHEM	166	D	ENG
23	B	BIO	59	C	BIO	95	C	PHY	131	B	CHEM	167	C	ENG
24	C	BIO	60	B	BIO	96	C	PHY	132	A	CHEM	168	B	ENG
25	C	BIO	61	D	BIO	97	B	PHY	133	D	CHEM	169	C	ENG
26	B	BIO	62	D	BIO	98	B	PHY	134	B	CHEM	170	C	ENG
27	D	BIO	63	D	BIO	99	A	PHY	135	C	CHEM	171	C	ENG
28	B	BIO	64	B	BIO	100	A	PHY	136	A	CHEM	172	B	LOGIC
29	B	BIO	65	C	BIO	101	C	PHY	137	C	CHEM	173	A	LOGIC
30	D	BIO	66	B	BIO	102	B	PHY	138	B	CHEM	174	A	LOGIC
31	C	BIO	67	D	BIO	103	B	PHY	139	C	CHEM	175	D	LOGIC
32	C	BIO	68	B	BIO	104	C	PHY	140	B	CHEM	176	D	LOGIC
33	A	BIO	69	B	BIO	105	B	PHY	141	B	CHEM	177	A	LOGIC
34	C	BIO	70	C	BIO	106	C	PHY	142	C	CHEM	178	B	LOGIC
35	B	BIO	71	B	BIO	107	A	PHY	143	C	CHEM	179	C	LOGIC
36	A	BIO	72	D	BIO	108	C	PHY	144	A	CHEM	180	C	LOGIC

SUBJECT-WISE PERFORMANCE BREAKDOWN

SUBJECT	MAX	YOUR SCORE	ACCURACY
Biology	81		-----%
Physics	36		-----%
Chemistry	45		-----%
English	9		-----%
Logical Reasoning	9		-----%
TOTAL	180	-----	-----%

PMDC PROVINCIAL MERIT FORMULA

Official Weightage Law:

- MDCAT Component (50%): (Your Score / 180) × 50
- FSc / HSSC Component (40%): (FSc Marks / 1100) × 40
- Matric / SSC Component (10%): (Matric Marks / 1100) × 10

Estimated Provincial Merit Aggregate: ----- %

PROPOLIS COGNITIVE ERROR AUTOPSIES

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

Question #1 Key: (B)

BIOLOGY
KMU 2026

Human beings are involved in an intense struggle for existence because resources such as food, ...

CORE CONCEPT & DERIVATION

Thomas Malthus demonstrated that populations expand exponentially (geometrically) whereas environmental resources and food supplies increase only arithmetically.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Because biological reproduction inherently outpaces the growth rate of available food, fresh water, and living space, resources cannot increase at the same rate as the human population.
- This fundamental mismatch creates an unavoidable competition among individuals for limited necessities, driving the struggle for existence.

Why other options are incorrect:

- **Option A:** Environmental resources do not double every year; their production is constrained by land, technology, and ecological limits.
- **Option C:** Resources increase at an arithmetic rate at best, falling far behind geometric population growth.
- **Option D:** Resources fluctuate over time due to climate, agricultural yield, and consumption rather than remaining strictly constant.

Question #2 Key: (C)

BIOLOGY
KMU 2026

Lamarck explained the long neck of Giraffe on the basis of:

CORE CONCEPT & DERIVATION

Jean-Baptiste Lamarck proposed that anatomical modifications acquired through continuous use or disuse during an organism's life are transmitted directly to its progeny.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Lamarck asserted that ancestral giraffes stretched their necks continuously to browse on higher foliage in trees.
- This physical effort caused elongation of the neck during their lifetime, an acquired somatic trait that was subsequently passed to the next generation according to his theory.

Why other options are incorrect:

- **Option A:** Hugo de Vries introduced the concept of mutations decades after Lamarck's publication.
- **Option B:** Natural selection is the core mechanism formulated by Charles Darwin and Alfred Russel Wallace.
- **Option D:** Genetic drift refers to random fluctuations in allele frequencies in small populations, a modern population genetics concept unknown to Lamarck.

Question #3 Key: (B)

BIOLOGY
KMU 2026

A population of rabbits shows variation in fur colour. During snowy winters, white rabbits are ...

CORE CONCEPT & DERIVATION

Natural selection is the differential survival and reproductive success of individuals possessing inherited traits better adapted to their immediate environment.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- White fur provides camouflage against snow, shielding rabbits from visual predators and granting a distinct survival advantage over brown rabbits.
- Because surviving individuals reproduce and pass down the advantageous white fur trait, natural selection increases its frequency over successive generations.

Why other options are incorrect:

- **Option A:** Overproduction refers to producing more offspring than the environment can support, which serves as a prerequisite rather than the selective survival event itself.
- **Option C:** Artificial selection involves intentional human intervention to breed specific desirable traits in domesticated species.
- **Option D:** Genetic drift consists of non-adaptive, random fluctuations in allele frequencies rather than survival dictated by adaptive fitness.

Question #4 Key: (A)BIOLOGY
KMU 2026

According to Lamarck, what would be expected if an organism loses or modifies a body part during...

CORE CONCEPT & DERIVATION

Lamarckism states that any phenotypic modification developed during an organism's lifetime via environmental interaction, use, or disuse is directly transmitted to offspring.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Under Lamarck's doctrine of the inheritance of acquired characters, physical modifications or anatomical losses acquired somatically were believed to be inherited by progeny.
- August Weismann later disproved this concept through the germ-plasm theory, demonstrating that somatic changes do not affect germ cells.

Why other options are incorrect:

- Option B:** Having no effect on offspring represents the modern genetic understanding, directly contradicting Lamarck's premise.
- Option C:** Lamarck formulated his hypothesis long before the discovery of chromosomes, DNA, or genetic mutations.
- Option D:** Natural selection is Darwin's evolutionary mechanism, not Lamarck's.

Question #5 Key: (D)BIOLOGY
KMU 2026

Post ovulation, the ruptured follicle is transformed into a glandular structure called _____.

CORE CONCEPT & DERIVATION

Following ovulation under the influence of luteinizing hormone (LH), the collapsed Graafian follicle luteinizes to form a temporary endocrine gland termed the corpus luteum.

Formula / Rule / Reaction:

Ruptured Follicle $\xrightarrow{\text{LH surge}}$ Corpus Luteum $\xrightarrow{\text{Secretes}}$ Progesterone + Estrogen

Solution:

- The extrusion of the secondary oocyte leaves behind granulosa and theca cells within the ovarian cortex.
- These cells undergo hypertrophy and vascularization, accumulating lutein pigment to become the corpus luteum, which secretes progesterone to maintain the secretory endometrium.

Why other options are incorrect:

- Option A:** The cervix is the lower fibromuscular portion of the uterus opening into the vagina.
- Option B:** Fimbriae are finger-like ciliated projections at the ovarian end of the fallopian tube that collect the ovulated egg.
- Option C:** The endometrium is the inner epithelial and mucosal lining of the uterine cavity.

Question #6 Key: (A)BIOLOGY
KMU 2026

Both vas deferens of a male are surgically cut (vasectomy done). Which process remains unaffected...

CORE CONCEPT & DERIVATION

Vasectomy interrupts the luminal continuity of the ductus deferens without compromising the testicular blood supply or the endocrine function of Leydig (interstitial) cells.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Leydig cells located in the interstitial tissue between seminiferous tubules secrete testosterone directly into the venous bloodstream.
- Because endocrine hormones travel through systemic circulation rather than the vas deferens, circulating testosterone levels and male secondary sex characteristics remain completely normal.

Why other options are incorrect:

- Option B:** Sperm transport through the reproductive tract is severed at the site of transection.
- Option C:** Ejaculation continues but the semen is completely devoid of spermatozoa (azoospermia).
- Option D:** Fertilization ability is intentionally prevented, rendering the male sterile.

Question #7 Key: (A)BIOLOGY
KMU 2026

A woman has irregular menstruation due to failure of proliferative endometrial thickening. Which...

CORE CONCEPT & DERIVATION

The proliferative (follicular) phase of the uterine cycle is governed primarily by estrogens secreted by developing ovarian follicles.

Formula / Rule / Reaction:

Estrogen $\rightarrow$ Endometrial Mitosis and Vascular Proliferation

Solution:

- During days 5 to 14 of the typical menstrual cycle, rising estrogen levels stimulate mitotic renewal of the functional layer of the endometrium, restoring stromal and epithelial thickness.
- A deficiency in estrogen prevents this proliferative repair, resulting in an abnormally thin endometrium and irregular menstrual cycles.

Why other options are incorrect:

- Option B:** Oxytocin stimulates myometrial contraction during parturition and myoepithelial cell contraction for milk ejection.
- Option C:** Luteinizing hormone triggers ovulation and maintains the corpus luteum for the subsequent secretory phase.
- Option D:** Follicle-stimulating hormone acts primarily to stimulate ovarian follicular maturation; estrogen is the direct effector on endometrial cell proliferation.

Question #8 Key: (B)BIOLOGY
KMU 2026

A patient having a painless, non-itching ulcerated sore with hard edges on genitals is most lik...

CORE CONCEPT & DERIVATION

Primary syphilis manifests as an indurated, painless ulcer known as a hard chancre at the initial site of inoculation.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Infection with the spirochete bacterium *Treponema pallidum* causes primary syphilis, characterized by a solitary, painless genital ulcer with sharply defined, firm, indurated borders.
- The lack of pain and pruritus distinguishes the syphilitic chancre from other sexually transmitted ulcerations.

Why other options are incorrect:

- **Option A:** Gonorrhea presents with burning micturition and profuse, purulent urethral or vaginal discharge without solitary indurated ulcers.
- **Option C:** Genital herpes (caused by HSV-2) causes clusters of intensely painful, burning, and pruritic fluid-filled vesicles that erode.
- **Option D:** AIDS is an advanced systemic immune deficiency state characterized by CD4+ T cell depletion, opportunistic infections, and constitutional symptoms.

Question #9 Key: (C)BIOLOGY
KMU 2026

The ribs not attached to the sternum are called:

CORE CONCEPT & DERIVATION

Human ribs are anatomically categorized by their anterior connections: true ribs attach directly, false ribs attach indirectly, and floating ribs have completely free anterior ends.

Formula / Rule / Reaction:

Ribs 11 and 12 = Floating Ribs (No sternal attachment)

Solution:

- Pairs 1 to 7 attach directly to the sternum via individual costal cartilages (true or vertebrosteral ribs).
- Pairs 8 to 10 join the cartilage of the 7th rib (false or vertebrochondral ribs).
- Pairs 11 and 12 (floating ribs) have no anterior attachment to the sternum or costal cartilage, terminating freely within the abdominal wall musculature.

Why other options are incorrect:

- **Option A:** True ribs attach directly to the sternal body and manubrium.
- **Option B:** False ribs is an umbrella term for pairs 8 to 12; specifically, pairs 8 to 10 do have indirect sternal attachment, whereas floating ribs completely lack any attachment to the sternum.
- **Option D:** Vertebro-steral ribs is the anatomical synonym for true ribs (pairs 1 to 7).

Question #10 Key: (D)BIOLOGY
KMU 2026

A tissue is found to have cells embedded in a firm matrix, lacks blood vessels and receives nut...

CORE CONCEPT & DERIVATION

Cartilage is an avascular specialized connective tissue consisting of chondrocytes embedded within a resilient, gel-like extracellular matrix rich in proteoglycans and chondroitin sulfate.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Cartilage tissue contains chondrocytes residing in lacunae embedded in a dense, hydrated matrix that absorbs shock and withstands high compressive loads.
- Because it lacks internal blood vessels and lymphatics, nutrients and oxygen must slowly diffuse through the extracellular matrix from the perichondrium or synovial fluid.

Why other options are incorrect:

- **Option A:** Compact bone is highly vascularized by Haversian and Volkmann canals with a rigid, mineralized hydroxyapatite matrix.
- **Option B:** Spongy (cancellous) bone contains trabeculae bathed in richly vascularized red or yellow bone marrow.
- **Option C:** Adipose tissue is a cellular storage tissue packed with lipid droplets, not a firm compressive matrix for joints.

Question #11 Key: (C)BIOLOGY
KMU 2026

A tissue sample shows striated, multinucleated cells and has voluntary control. Which fundament...

CORE CONCEPT & DERIVATION

Skeletal muscle tissue is composed of elongated, multinucleated, striated fibers under somatic (voluntary) nervous control, functioning to move the skeleton and maintain posture.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- The histological description (multinucleated peripheral nuclei, cross-striations, somatic voluntary control) uniquely defines skeletal muscle.
- Skeletal muscles span articular joints through tendons, providing the contractile force required for locomotion, body stabilization, and posture maintenance.

Why other options are incorrect:

- **Option A:** Pumping blood is the role of cardiac muscle, which contains uninucleated, branched, striated cells with intercalated discs under involuntary control.
- **Option B:** Movement of internal visceral organs (such as the alimentary canal) is carried out by unstriated, involuntary smooth muscle.
- **Option D:** Synthesis and secretion of digestive enzymes is executed by specialized glandular epithelial cells.

Question #12 Key: (B)BIOLOGY
KMU 2026

The T-tubule and the terminal portion of the adjacent sarcoplasmic reticulum collectively form:

CORE CONCEPT & DERIVATION

In skeletal muscle fibers, a central transverse tubule (T-tubule) flanked by two dilated terminal cisternae of the sarcoplasmic reticulum constitutes an anatomical triad.

Formula / Rule / Reaction:

$$\text{Triad} = 1 \text{ T-tubule} + 2 \text{ Terminal Cisternae}$$

Solution:

- The transverse tubule is an invagination of the sarcolemma that conducts electrical action potentials into the interior of the muscle fiber.
- The flanking terminal cisternae store high concentrations of calcium ions; the triad arrangement couples sarcolemmal depolarization to rapid intracellular calcium release.

Why other options are incorrect:

- Option A:** A sarcomere is the structural and functional contractile unit of a myofibril bounded between two consecutive Z-lines.
- Option C:** Sarcoplasm is the cytoplasm of a muscle cell containing glycogen, myoglobin, and organelles.
- Option D:** Sarcolemma is the specialized plasma membrane encompassing a muscle fiber.

Question #13 Key: (D)BIOLOGY
KMU 2026

During skeletal muscle contraction, the A-band of fiber:

CORE CONCEPT & DERIVATION

Under the sliding filament model of muscle contraction, thick and thin filaments slide past one another without altering their individual lengths.

Formula / Rule / Reaction:

$$\text{Length of A-band} = \text{Length of Thick (Myosin) Filaments} = \text{Constant}$$

Solution:

- The A-band spans the entire physical length of the thick (myosin) filaments in the sarcomere.
- During contraction, actin filaments slide toward the center of the sarcomere, shortening the I-band and H-zone, while the A-band maintains a constant dimension.

Why other options are incorrect:

- Option A:** The I-band and the H-zone shorten, but the A-band does not shorten.
- Option B:** Filament lengths do not elongate during active cross-bridge cycling.
- Option C:** The H-zone may disappear during maximal contraction, whereas the A-band remains visible.

Question #14 Key: (D)BIOLOGY
KMU 2026

The joint formed between adjacent vertebrae, allows slight movement and has no synovial cavity ...

CORE CONCEPT & DERIVATION

Cartilaginous joints (amphiarthroses) unite adjacent bones via fibrocartilage or hyaline cartilage, permitting limited motion in the absence of a synovial cavity.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Intervertebral discs consist of an outer anulus fibrosus and inner nucleus pulposus connecting vertebral bodies.
- Because there is no synovial capsule or fluid-filled space and only slight flexibility is allowed, intervertebral symphyses are classical cartilaginous joints.

Why other options are incorrect:

- Option A:** Synovial joints possess a fluid-filled synovial cavity enclosed by a fibrous capsule and permit free movement (diarthroses).
- Option B:** Fibrous joints (such as cranial sutures) are bound by dense connective tissue and permit no movement (synarthroses).
- Option C:** A hinge joint is a uniaxial subtype of synovial joint (such as the elbow).

Question #15 Key: (B)BIOLOGY
KMU 2026

A cricketer rotates his shoulder joint to throw the ball in any direction. What type of joint is...

CORE CONCEPT & DERIVATION

A ball and socket (spheroidal) joint is a multiaxial synovial joint allowing movement in all three planes, including circumduction and rotation.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- The glenohumeral (shoulder) joint is formed by the spherical head of the humerus articulating within the shallow glenoid cavity of the scapula.
- This anatomical arrangement confers the highest range of motion of any joint in the human body, enabling rotation and multi-directional swing required in cricket bowling.

Why other options are incorrect:

- Option A:** A pivot joint permits uniaxial rotation only around a central longitudinal axis (such as the atlanto-axial joint).
- Option C:** A hinge joint allows movement in a single plane (flexion and extension, as in the knee and elbow).
- Option D:** A condyloid (ellipsoid) joint permits biaxial motion (flexion, extension, abduction, adduction) but lacks free multiaxial rotation.

Question #16 Key: (D)BIOLOGY
KMU 2026

In arthritis, friction and inflammation of joints, primarily affects which body function?

CORE CONCEPT & DERIVATION

Arthritis is an inflammatory disease of articular surfaces characterized by degradation of articular cartilage, synovial membrane hypertrophy, and impaired joint articulation.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Healthy articular hyaline cartilage provides a smooth, low-friction surface for frictionless bone articulation.
- Inflammatory damage and cartilage wear increase bone-on-bone friction, directly degrading the smooth, painless movement of joints and producing stiffness and restricted mobility.

Why other options are incorrect:

- **Option A:** Gas exchange is a respiratory function executed by the pulmonary alveoli and alveolar capillaries.
- **Option B:** Red blood cell synthesis (erythropoiesis) takes place within the red bone marrow, stimulated by erythropoietin.
- **Option C:** Calcium deposition in osteoid is regulated by osteoblasts, calcitonin, and parathyroid hormone.

Question #17 Key: (B)BIOLOGY
KMU 2026

If green is a dominant and yellow is a recessive trait, then what percentage of the [Formula] g...

CORE CONCEPT & DERIVATION

In a standard Mendelian monohybrid cross, selfing heterozygous F_1 individuals produces a predictable 1:2:1 genotypic ratio in the F_2 generation.

Formula / Rule / Reaction:

Genotypic ratio: 1 GG (homozygous dominant) : 2 Gg (heterozygous) : 1 gg (homozygous recessive)

Solution:

- Crossing heterozygous F_1 plants ($Gg \times Gg$) yields gametes carrying allele G or g in equal 1 : 1 proportions.
- The Punnett square outcomes are $\frac{1}{4}$ GG, $\frac{1}{2}$ Gg, and $\frac{1}{4}$ gg.
- The percentage of homozygous recessive (gg) progeny is:

$$\frac{1}{4} \times 100\% = 25\%$$

Why other options are incorrect:

- **Option A:** 0% occurs only when at least one parent is homozygous dominant (GG).
- **Option C:** 50% corresponds to the proportion of heterozygous offspring (Gg).
- **Option D:** 75% is the phenotypic percentage exhibiting the dominant green trait ($GG + Gg$).

Question #18 Key: (D)BIOLOGY
KMU 2026

In a monohybrid cross of round (RR) and wrinkled seeded (rr) pea plants, all [Formula] offsprin...

CORE CONCEPT & DERIVATION

A cross between a heterozygous individual (F_1) and a homozygous recessive individual is a test cross, yielding a 1:1 phenotypic and genotypic ratio.

Formula / Rule / Reaction:

$$\text{Cross: } Rr \times rr \longrightarrow \frac{1}{2}Rr \text{ (round)} : \frac{1}{2}rr \text{ (wrinkled)}$$

Solution:

- The heterozygous parent (Rr) produces gametes R and r in a 1:1 ratio.
- The homozygous recessive parent (rr) produces only gametes bearing r .
- Combining these gametes produces 50% round (Rr) and 50% wrinkled (rr) plants, establishing a phenotypic ratio of 1:1.

Why other options are incorrect:

- **Option A:** A 1:3 ratio is the inverted monohybrid selfing phenotypic ratio (wrinkled to round).
- **Option B:** A 1:4 ratio does not correspond to any standard monohybrid test cross outcome.
- **Option C:** A 0:4 ratio implies complete absence of one phenotypic class, seen only in true-breeding parental crosses.

Question #19 Key: (B)BIOLOGY
KMU 2026

Which condition results in a 1: 1: 1: 1 phenotypic ratio in the offspring of a dihybrid test cr...

CORE CONCEPT & DERIVATION

According to Mendel's law of independent assortment, unlinked genes located on non-homologous chromosomes segregate independently during meiosis, yielding four gamete classes in equal proportions.

Formula / Rule / Reaction:

$$AaBb \times aabb \longrightarrow 1 AaBb : 1 Aabb : 1 aaBb : 1 aabb$$

\text{(Phenotypic ratio)} 1:1:1:1

Solution:

- When there is no linkage (genes are on separate chromosomes or far apart on the same chromosome), a dihybrid ($AaBb$) produces four gamete types (AB, Ab, aB, ab) in equal 25% frequencies.
- Crossing with a homozygous recessive tester ($aabb$) reveals the gametic frequencies directly, yielding a 1:1:1:1 phenotypic ratio.

Why other options are incorrect:

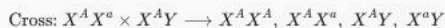
- **Option A:** Complete linkage prevents recombinant gametes, generating only parental phenotypes in a 1:1 ratio.
- **Option C:** Sex linkage causes distorted ratios that differ significantly between male and female offspring.
- **Option D:** Mutations represent rare, random structural alterations rather than regular Mendelian independent assortment.

Question #20 Key: (A)BIOLOGY
KMU 2026

An X-linked recessive allele inherited from a carrier mother (father is unaffected) is most lik...

CORE CONCEPT & DERIVATION

Males are hemizygous for the X chromosome (XY), meaning that a single recessive allele on their maternally inherited X chromosome will be phenotypically expressed.

Formula / Rule / Reaction:**Solution:**

- A son inherits his only X chromosome from his mother and the Y chromosome from his father. If he receives the X^a allele, he lacks a homologous allele to mask it and develops the trait.
- Daughters receive a normal dominant X^A from the unaffected father ($X^A Y$), rendering them unaffected carriers rather than expressing the trait.

Why other options are incorrect:

- **Option B:** Daughters inherit the normal dominant allele from the father, shielding them from expressing recessive X-linked phenotypes.
- **Option C:** X-linked recessive disorders do not affect sexes equally due to male hemizygosity.
- **Option D:** Approximately 50% of sons born to carrier mothers will express the recessive condition.

Question #21 Key: (C)BIOLOGY
KMU 2026

Which of the following is a disorder caused by a recessive X-linked trait?

CORE CONCEPT & DERIVATION

Red-green colour blindness is caused by a recessive gene mutation on the long arm of the human X chromosome, altering photopigment opsin proteins in retinal cones.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Because red-green colour blindness is an X-linked recessive trait, hemizygous males ($X^c Y$) display the deficiency with higher frequency than homozygous females ($X^c X^c$).
- Heterozygous carrier females ($X^C X^c$) possess normal colour vision because the normal dominant opsin gene compensates.

Why other options are incorrect:

- **Option A:** Vitamin D-resistant (hypophosphatemic) rickets is an X-linked dominant condition.
- **Option B:** Anemia is a broad clinical disorder caused by nutritional deficiencies, chronic disease, or autosomal mutations (such as sickle cell anemia, which is autosomal recessive).
- **Option D:** Cystic fibrosis is an autosomal recessive disorder caused by mutations in the CFTR gene on chromosome 7.

Question #22 Key: (D)BIOLOGY
KMU 2026

Identify the X-linked dominant disorder from the following:

CORE CONCEPT & DERIVATION

In X-linked dominant inheritance, a single mutant allele on the X chromosome is sufficient to produce the disease phenotype in both males and females.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Hypophosphatemic rickets (vitamin D-resistant rickets) is caused by a dominant mutation on the X chromosome (PHEX gene).
- Affected fathers transmit the dominant phenotype to 100% of their daughters and 0% of their sons, characteristic of X-linked dominant pedigree transmission.

Why other options are incorrect:

- **Option A:** Haemophilia (A and B) is inherited as an X-linked recessive trait.
- **Option B:** Colour blindness is inherited as an X-linked recessive trait.
- **Option C:** Pattern baldness is an autosomal sex-influenced trait mediated by systemic androgen levels.

Question #23 Key: (B)BIOLOGY
KMU 2026

The genetic basis of haemophilia is:

CORE CONCEPT & DERIVATION

Haemophilia is a congenital coagulopathy resulting from recessive mutations in clotting factor genes located on the X chromosome.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Haemophilia A is caused by a deficiency of clotting factor VIII, while haemophilia B is caused by factor IX deficiency.
- Both factor VIII and factor IX genes are located on the non-homologous region of the X chromosome and behave in a classic X-linked recessive manner.

Why other options are incorrect:

- **Option A:** Chromosome 21 trisomy is responsible for Down syndrome; haemophilia is not autosomal.
- **Option C:** Genes on the Y chromosome exhibit holandric male-to-male transmission, which is not the case for haemophilia.
- **Option D:** Mitochondrial mutations follow strict maternal inheritance patterns affecting metabolic and oxidative phosphorylation pathways.

Question #24 Key: (C)BIOLOGY
KMU 2026

The fluid present in the pericardial cavity functions to:

CORE CONCEPT & DERIVATION

The pericardial cavity contains serous pericardial fluid that acts as a physical lubricant between the visceral and parietal layers of the pericardium.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- During each cardiac cycle, vigorous myocardial systole and diastole cause movement against adjacent thoracic walls.
- The thin film of pericardial fluid prevents mechanical abrasion and friction between the epicardium and the fibrous pericardium.

Why other options are incorrect:

- **Option A:** Nourishment and oxygenation of the myocardium are supplied via the coronary arteries and coronary circulation.
- **Option B:** Anticoagulant factors within blood plasma prevent intravascular thrombosis, unrelated to serous cavities.
- **Option D:** Pacemaker electrical impulses are generated intrinsically by specialized auto-rhythmic cells of the sinoatrial (SA) node.

Question #25 Key: (C)BIOLOGY
KMU 2026

The phase of the cardiac cycle during which blood is pumped to lungs and the entire body is called...

CORE CONCEPT & DERIVATION

Ventricular systole involves the coordinated contraction of both ventricles, generating intraventricular pressure to open semilunar valves and eject blood into the pulmonary and systemic circuits.

Formula / Rule / Reaction:

Right Ventricle $\xrightarrow{\text{Systole}}$ Pulmonary Trunk $\rightarrow$ Lungs

Left Ventricle $\xrightarrow{\text{Systole}}$ Aorta $\rightarrow$ Systemic Organs

Solution:

- During ventricular systole (spanning roughly 0.3 seconds), intraventricular pressures exceed arterial pressures.
- This forces the aortic and pulmonary semilunar valves open, driving deoxygenated blood to the lungs and oxygenated blood throughout the rest of the body.

Why other options are incorrect:

- **Option A:** Atrial systole contracts the atria to deliver the final 20% to 30% of blood into the relaxed ventricles.
- **Option B:** Atrial diastole is the passive relaxation phase of the atria as they refill with venous blood.
- **Option D:** Ventricular diastole is the ventricular relaxation phase during which the chambers fill with incoming blood.

Question #26 Key: (B)BIOLOGY
KMU 2026

Hepatic portal subsystem carries nutrients from the small intestine to the:

CORE CONCEPT & DERIVATION

The hepatic portal system connects capillary beds of the gastrointestinal viscera directly to capillary sinusoids of the liver before returning blood to the general systemic circulation.

Formula / Rule / Reaction:

Intestinal Capillaries $\rightarrow$ Hepatic Portal Vein $\rightarrow$ Hepatic Sinusoids

Solution:

- Venous blood draining the villi of the small intestine is enriched with absorbed glucose, amino acids, and water-soluble vitamins.
- The hepatic portal vein channels this nutrient-rich blood straight into the liver, enabling hepatocytes to metabolize, store, and detoxify substances prior to systemic release.

Why other options are incorrect:

- **Option A:** Blood leaves the liver via hepatic veins to empty into the inferior vena cava, which does not receive direct portal blood from the intestine.
- **Option C:** The pancreas delivers secretions and venous blood into the portal circulation; it is not the recipient of intestinal portal blood.
- **Option D:** Kidneys receive blood from renal arteries originating from the abdominal aorta.

Question #27 Key: (D)BIOLOGY
KMU 2026

Why are arteries thicker than veins?

CORE CONCEPT & DERIVATION

Arteries possess prominent tunica media layers containing robust elastic laminae and smooth muscle to tolerate and dampen high hydrostatic pressures generated by ventricular ejection.

Formula / Rule / Reaction:

$$P_{\text{arterial}} \gg P_{\text{venous}}$$

Solution:

- Blood discharged from the left ventricle enters the arterial tree under high pulsatile pressure (typically 120 mmHg systolic).
- The reinforced, muscular and elastic walls of arteries prevent vessel rupture while maintaining systemic blood pressure through elastic recoil.

Why other options are incorrect:

- **Option A:** Veins act as capacitance vessels (blood reservoirs), possessing wider lumens and storing approximately 60% of total blood volume.
- **Option B:** Internal endothelial valves prevent retrograde flow in veins, not the thickness of arterial walls.
- **Option C:** Diffusion occurs across the thin, single-layered endothelium of capillaries, not across thick muscular arteries.

Question #28 Key: (B)BIOLOGY
KMU 2026*Lymph is most closely related to:***CORE CONCEPT & DERIVATION**

Lymph is formed directly when interstitial fluid draining from extracellular tissue spaces enters blind-ended lymphatic capillaries.

Formula / Rule / Reaction:

Interstitial Fluid $\xrightarrow{\text{Uptake by Lymph Capillaries}}$ Lymph

Solution:

- Hydrostatic pressure in tissue spaces drives interstitial fluid into lymphatic microvessels.
- Because lymph is simply collected interstitial fluid, its ionic composition and protein concentrations are virtually identical to those of the interstitial fluid from which it originates.

Why other options are incorrect:

- Option A:** Blood plasma contains much higher concentrations of high-molecular-weight plasma proteins (such as albumin and fibrinogen) that cannot readily cross capillary walls.
- Option C:** Sweat is an exocrine hypotonic solution secreted by eccrine and apocrine glands for thermoregulation.
- Option D:** Saliva is an exocrine digestive secretion containing amylase, mucins, and lysozyme.

Question #29 Key: (B)BIOLOGY
KMU 2026*B-Lymphocytes produce a small, soluble and specific protein called _____.***CORE CONCEPT & DERIVATION**

Differentiated B-lymphocytes (plasma cells) synthesize and secrete immunoglobulins (antibodies) that specifically bind foreign antigens in humoral immunity.

Formula / Rule / Reaction:

Activated B-cell $\rightarrow$ Plasma Cell $\xrightarrow{\text{Secretes}}$ Antibody (Immunoglobulin)

Solution:

- Upon clonal selection and activation, B-lymphocytes proliferate into plasma cells.
- Plasma cells release thousands of soluble, Y-shaped gamma-globulin proteins (antibodies) per second, each featuring antigen-binding sites complementary to a specific antigenic epitope.

Why other options are incorrect:

- Option A:** An antigen is any foreign molecular structure that triggers an immune response.
- Option C:** Prostaglandins are lipid autacoid mediators derived from arachidonic acid involved in pain and inflammation.
- Option D:** Perforin is a pore-forming cytolytic protein synthesized and released by cytotoxic T cells and natural killer (NK) cells.

Question #30 Key: (D)BIOLOGY
KMU 2026*A vaccine containing weakened microbes is administered to a person. Which aspect of adaptive im...***CORE CONCEPT & DERIVATION**

Active immunization introduces attenuated antigens to elicit a primary immune response, generating long-lived memory B and T cells that confer immunological memory.

Formula / Rule / Reaction:

Primary Antigen Exposure $\rightarrow$ Effector Cells + Memory B and T Cells

Solution:

- Weakened (attenuated) pathogens stimulate lymphocyte expansion without causing full disease.
- A subpopulation of these antigen-experienced lymphocytes differentiates into quiescent memory cells that persist for decades, mounting a rapid secondary immune response upon subsequent re-exposure.

Why other options are incorrect:

- Option A:** Inflammation is an acute, non-specific innate immune reaction mediated by histamine and prostaglandins lacking memory.
- Option B:** Elevated body temperature (fever) is an innate systemic acute-phase response driven by pyrogens.
- Option C:** Phagocytic engulfment by neutrophils and macrophages is a non-specific innate mechanism that does not generate adaptive immunological memory.

Question #31 Key: (C)BIOLOGY
KMU 2026*Which has NO cartilage in its structure?***CORE CONCEPT & DERIVATION**

As the respiratory conducting zone branches distally, supportive cartilaginous rings and plates progressively diminish and disappear completely at the level of the bronchioles.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Bronchioles are airway passages with an internal diameter of approximately 1 mm or less.
- Their walls completely lack cartilaginous support, consisting instead of smooth muscle, elastic fibers, and cuboidal/columnar epithelium, allowing dynamic changes in airway diameter.

Why other options are incorrect:

- Option A:** The larynx is composed of multiple cartilages, including the thyroid, cricoid, and epiglottic cartilages.
- Option B:** The trachea is kept patent by 16 to 20 C-shaped hyaline cartilage rings.
- Option D:** Bronchi maintain patency via irregular cartilaginous plates in their subepithelial walls.

Question #32 Key: (C)BIOLOGY
KMU 2026*The mucus and cilia of the nasal cavity work together to:***CORE CONCEPT & DERIVATION**

The respiratory mucosa functions as a mucociliary escalator, trapping inhaled airborne particles and microbes and sweeping them away from the lower respiratory tract.

Formula / Rule / Reaction:*Factual recall / Qualitative concept.***Solution:**

- Goblet cells and seromucous glands secrete sticky mucus that traps dust, pollen, and pathogenic microorganisms present in inspired air.
- Synchronous ciliary beating propels the mucus blanket toward the pharynx to be swallowed or expectorated, purifying the air before it reaches delicate alveoli.

Why other options are incorrect:

- Option A:** Diffusion of oxygen is determined by surface area and membrane thickness in the alveolar walls, not the nasal cavity.
- Option B:** Vocal cords are lubricated by laryngeal secretions rather than nasal mucociliary action.
- Option D:** Blood gas exchange occurs exclusively across the alveolar-capillary membrane, not in the upper nasal passages.

Question #33 Key: (A)BIOLOGY
KMU 2026*During gaseous exchange in human body, maximum percentage of [Formula] is transported from body...***CORE CONCEPT & DERIVATION**

The primary mechanism of carbon dioxide transport in systemic venous blood is in the form of dissolved bicarbonate ions (HCO_3^-).

Formula / Rule / Reaction:**Solution:**

- Approximately 70% of all CO_2 diffuses into erythrocytes, is converted by carbonic anhydrase into carbonic acid, and dissociates into bicarbonate ions, which are transferred into plasma via the chloride shift.
- Only about 20% to 23% is transported bound to hemoglobin amino groups as carbamino hemoglobin, and roughly 7% remains physically dissolved in plasma.

Why other options are incorrect:

- Option B:** Carbamino hemoglobin accounts for only 20% to 23% of total carbon dioxide transport.
- Option C:** Dissolved CO_2 in blood plasma constitutes approximately 7% of total transported gas.
- Option D:** Free gaseous bubbles within the circulatory system do not occur normally; their presence constitutes a life-threatening air embolism.

Question #34 Key: (C)BIOLOGY
KMU 2026*Smoking causes alveolar destruction in:***CORE CONCEPT & DERIVATION**

Emphysema is a chronic obstructive pulmonary disease (COPD) characterized by irreversible enzymatic breakdown of alveolar septa, decreasing surface area for gas exchange.

Formula / Rule / Reaction:

Tobacco Smoke $\rightarrow$ $\uparrow$ Elastase Activity + $\downarrow$ α_1 -Antitrypsin $\rightarrow$ Alveolar Septal Destruction

Solution:

- Cigarette smoke attracts alveolar macrophages and neutrophils, which release elastase that digests alveolar wall elastic fibers.
- This breakdown results in enlarged, confluent air spaces with loss of surface area and reduced lung compliance, a defining pathology of emphysema.

Why other options are incorrect:

- Option A:** Pneumonia is an acute microbial infection characterized by exudative fluid accumulation in alveolar spaces without architectural wall lysis.
- Option B:** Chronic bronchitis is defined by chronic productive cough with goblet cell hyperplasia and inflammation of bronchial mucosa.
- Option D:** Asthma is a reversible obstructive airway disease mediated by smooth muscle hyperresponsiveness and bronchoconstriction.

Question #35 Key: (B)BIOLOGY
KMU 2026*Which of the following is NOT a function of liver?***CORE CONCEPT & DERIVATION**

Insulin is an endocrine peptide hormone produced and secreted exclusively by the beta cells of the islets of Langerhans located in the pancreas.

Formula / Rule / Reaction:*Factual recall / Qualitative concept.***Solution:**

- Hepatocytes perform extensive metabolic functions, including bile production, toxic drug biotransformation, and lipid-soluble vitamin storage.
- However, insulin is synthesized exclusively by pancreatic beta-cells; the liver is an insulin target organ, not its source of synthesis.

Why other options are incorrect:

- Option A:** The liver actively detoxifies ammonia, alcohol, and endogenous metabolites via cytochrome P450 enzymes and the urea cycle.
- Option C:** Hepatocytes synthesize and continuously secrete bile salts and bilirubin for dietary fat emulsification.
- Option D:** Hepatic stellate cells store high quantities of fat-soluble vitamins, predominantly vitamin A.

Question #36 Key: (A)BIOLOGY
KMU 2026

Find the correct sequence of phases in the swallowing mechanism: 1. Pharyngeal, 2. Oral, 3. Eso...

CORE CONCEPT & DERIVATION

Deglutition (swallowing) is divided into three consecutive chronological phases: the voluntary oral phase, the involuntary pharyngeal phase, and the involuntary esophageal phase.

Formula / Rule / Reaction:

Oral (2) → Pharyngeal (1) → Esophageal (3)

Solution:

- The mechanism begins with the oral (buccal) phase (2), where the tongue propels the food bolus posteriorly into the oropharynx.
- This triggers the pharyngeal phase (1), during which the soft palate seals the nasopharynx and the epiglottis covers the laryngeal inlet.
- Finally, the upper esophageal sphincter relaxes to initiate the esophageal phase (3), where peristaltic waves drive the bolus toward the stomach.

Why other options are incorrect:

- Option B:** The sequence 1–2–3 erroneously places the pharyngeal phase before the food bolus has left the oral cavity.
- Option C:** The sequence 2–3–1 skips directly from the oral cavity into the esophagus before closing the pharyngeal respiratory passages.
- Option D:** The sequence 3–1–2 reverses the digestive anatomical progression.

Question #37 Key: (C)BIOLOGY
KMU 2026

The release of bicarbonate rich fluid from the pancreas is stimulated by the action of:

CORE CONCEPT & DERIVATION

Secretin is an enteroendocrine peptide hormone released by duodenal S-cells in response to acidic chyme entering from the stomach.

Formula / Rule / Reaction:

Low Duodenal pH → Secretin Secretion → Pancreatic Duct Cells release HCO_3^-

Solution:

- When gastric hydrochloric acid lowers duodenal luminal pH below 4.5, S-cells secrete secretin into the bloodstream.
- Secretin acts on pancreatic ductal epithelial cells to stimulate the secretion of an aqueous, bicarbonate-rich fluid that neutralizes duodenal acidity and protects the intestinal mucosa.

Why other options are incorrect:

- Option A:** Pepsin is a proteolytic enzyme of gastric juice, active only at an acidic pH of 1.5 to 2.0.
- Option B:** Gastrin is secreted by gastric G-cells to stimulate hydrochloric acid production from parietal cells.
- Option D:** Trypsin is a pancreatic endopeptidase that hydrolyzes peptide bonds, not a signaling hormone.

Question #38 Key: (A)BIOLOGY
KMU 2026

Which structures in the intestinal villus are directly involved in nutrient absorption?

CORE CONCEPT & DERIVATION

Each intestinal villus possesses a central lymphatic vessel (lacteal) surrounded by an extensive capillary plexus to absorb digested micronutrients.

Formula / Rule / Reaction:

Monosaccharides / Amino acids → Blood Capillaries

Chylomicrons (Fats) → Central Lacteal

Solution:

- Water-soluble nutrients such as monosaccharides, amino acids, minerals, and water-soluble vitamins diffuse into the dense network of blood capillaries within the core of the villus.
- Dietary lipids packaged into chylomicrons enter the central blind-ended lacteal for lymphatic drainage into the general circulation.

Why other options are incorrect:

- Option B:** Goblet cells secrete protective mucin and arteries deliver oxygenated blood; neither directly absorbs processed nutrients.
- Option C:** Smooth muscle layers provide mechanical motility and segmentation, not absorptive uptake.
- Option D:** Crypts of Lieberkühn secrete succus entericus and house stem cells; microvilli amplify apical epithelial surface area but do not transport absorbed nutrients on their own without vascular networks.

Question #39 Key: (B)BIOLOGY
KMU 2026

The primary function of peristalsis in the large intestine is to:

CORE CONCEPT & DERIVATION

Colonic peristalsis and mass movements propel unabsorbed digestive residue through the colon for fecal compaction and terminal elimination.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- The large intestine receives indigestible residue from the ileum, absorbs remaining water and electrolytes, and compacts the contents into feces.
- Involuntary propulsive contractions (mass peristalsis) drive this undigested material forward into the rectum for eventual defecation.

Why other options are incorrect:

- Option A:** Carbohydrate digestion is completed in the small intestine via pancreatic amylase and brush border disaccharidases.
- Option C:** Dietary lipid absorption occurs almost entirely in the duodenum and jejunum.
- Option D:** The colon does not secrete digestive enzymes; it secretes alkaline mucus solely for lubrication.

Question #40 Key: (C)BIOLOGY
KMU 2026

A patient experiences chronic gastric discomfort and endoscopy confirms gastric ulcers. Which f...

CORE CONCEPT & DERIVATION

Peptic and gastric ulcer disease is caused primarily by infection with *Helicobacter pylori*, which disrupts the protective mucosal barrier against gastric acid.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- *Helicobacter pylori* colonizes the gastric antrum and body, producing urease to neutralize local acid while generating cytotoxins (such as CagA and VacA).
- This causes chronic inflammation, degrading the mucus gel barrier and exposing the underlying epithelial lamina propria to erosive digestion by hydrochloric acid and pepsin.

Why other options are incorrect:

- **Option A:** Reduced pepsinogen secretion would diminish proteolytic activity, lowering mucosal irritation rather than creating ulcers.
- **Option B:** Hydrochloric acid is secreted by parietal cells into the lumen, not absorbed across the stomach wall.
- **Option D:** Absence of intrinsic factor results in pernicious anemia, which is hematological rather than ulcerative.

Question #41 Key: (B)BIOLOGY
KMU 2026

Which region of kidney contains glomeruli and Bowman's capsules?

CORE CONCEPT & DERIVATION

The renal corpuscles (composed of the glomerulus and Bowman's capsule) are located exclusively within the outer renal cortex.

Formula / Rule / Reaction:

Renal Corpuscle = Glomerular Capillary Tuft + Bowman's Capsule $\subset$ Renal Cortex

Solution:

- In both cortical and juxtamedullary nephrons, the initial filtration units (renal corpuscles) alongside the proximal and distal convoluted tubules reside strictly within the renal cortex.
- The deeper renal medulla contains primarily the loops of Henle and collecting ducts arranged in renal pyramids.

Why other options are incorrect:

- **Option A:** The renal medulla houses loops of Henle, collecting tubules, and vasa recta, but no glomeruli.
- **Option C:** The renal pelvis is the funnel-shaped expansion at the upper end of the ureter that collects urine.
- **Option D:** The hilum is the medial notch of the kidney through which blood vessels, nerves, and the ureter pass.

Question #42 Key: (B)BIOLOGY
KMU 2026

If glucose appears in urine of a patient, it indicates failure of which process?

CORE CONCEPT & DERIVATION

Under normal physiological conditions, 100% of filtered blood glucose is reabsorbed along the proximal convoluted tubule via sodium-glucose cotransporters (SGLT2).

Formula / Rule / Reaction:

$$\text{Excretion} = \text{Filtration} - \text{Reabsorption} + \text{Secretion}$$

Solution:

- Glucose freely passes through the glomerular filtration barrier into the initial filtrate during ultrafiltration.
- The appearance of glucose in urine (glucosuria) indicates that tubular selective reabsorption has failed or its transport maximum (T_m) has been overwhelmed by hyperglycemia.

Why other options are incorrect:

- **Option A:** Pressure filtration is functioning properly because glucose reached the tubular lumen from blood capillaries.
- **Option C:** Tubular secretion actively removes excess potassium, hydrogen ions, and drugs; it does not handle glucose.
- **Option D:** Osmoregulation is the broad homeostatic regulation of systemic water and electrolyte balance.

Question #43 Key: (C)BIOLOGY
KMU 2026

Which part of nephron is impermeable to water?

CORE CONCEPT & DERIVATION

The thick and thin segments of the ascending limb of the loop of Henle are structurally impermeable to water, allowing active electrolyte transport to establish the corticomedullary osmotic gradient.

Formula / Rule / Reaction:

$$\text{Ascending Limb of Henle: High active transport of } \text{Na}^+, \text{K}^+, \text{Cl}^- \mid P_{\text{H}_2\text{O}} = 0$$

Solution:

- The ascending limb lacks aquaporin water channels in its plasma membrane, rendering it completely impermeable to water.
- Active solute efflux via the $\text{Na}^+/\text{K}^+/\text{2Cl}^-$ symporter without accompanying water movement causes the tubular fluid to become progressively dilute (hypotonic).

Why other options are incorrect:

- **Option A:** The glomerulus has fenestrated endothelial walls freely permeable to water and small solutes.
- **Option B:** The descending limb of Henle contains constitutive aquaporin-1 channels and is freely permeable to water.
- **Option D:** The proximal convoluted tubule obligatorily reabsorbs approximately 65% of filtered water via aquaporin-1 channels.

Question #44 Key: (C)BIOLOGY
KMU 2026*When water intake is high:***CORE CONCEPT & DERIVATION**

Excessive water intake lowers plasma osmolarity, which is detected by hypothalamic osmoreceptors that suppress antidiuretic hormone (ADH) secretion from the posterior pituitary.

Formula / Rule / Reaction:

↑ Hydration → ↓ Plasma Osmolarity → ↓ ADH Release → ↓ Aquaporin Insertion → Diuresis

Solution:

- In the absence of ADH, the collecting ducts and late distal tubules remain impermeable to water.
- Because water cannot be reabsorbed from the hypotonic luminal fluid into the hypertonic medullary interstitium, a large volume of dilute (hypotonic) urine is excreted.

Why other options are incorrect:

- **Option A:** ADH secretion increases during systemic dehydration and hyperosmolarity to conserve water.
- **Option B:** Aldosterone secretion is stimulated by hypovolemia and hyperkalemia via the renin-angiotensin-aldosterone system.
- **Option D:** Glomerular ultrafiltration continues continuously to eliminate nitrogenous metabolic waste regardless of hydration levels.

Question #45 Key: (C)BIOLOGY
KMU 2026*Peritubular capillaries are formed from:***CORE CONCEPT & DERIVATION**

The renal microcirculation is a portal system in which the efferent arteriole emerging from the glomerulus branches into a secondary capillary network around the nephron tubules.

Formula / Rule / Reaction:

Afferent Arteriole → Glomerulus → Efferent Arteriole → Peritubular Capillaries

Solution:

- Glomerular capillaries converge into the efferent arteriole, which exits Bowman's capsule.
- In cortical nephrons, the efferent arteriole breaks up into the peritubular capillary plexus, which surrounds the proximal and distal convoluted tubules to reabsorb solutes and water.

Why other options are incorrect:

- **Option A:** The glomerulus is the initial capillary bed that feeds directly into the efferent arteriole.
- **Option B:** The afferent arteriole supplies oxygenated arterial blood to the glomerular capillary tuft.
- **Option D:** Interlobular (cortical radiate) arteries give rise to individual afferent arterioles.

Question #46 Key: (D)BIOLOGY
KMU 2026

Dialysis or kidney transplantation is usually required when kidney function falls below

CORE CONCEPT & DERIVATION

End-stage renal disease (ESRD) occurs when functional nephron capacity declines to a point where conservative medical management cannot maintain fluid, electrolyte, and waste homeostasis.

Formula / Rule / Reaction:

ESRD Indication: GFR or Functional Capacity < 10% to 15% of normal

Solution:

- The kidneys possess a substantial physiological reserve; clinical symptoms of uremia become life-threatening only when renal function drops below 10% to 15% of normal baseline.
- At this stage, renal replacement therapy through maintenance hemodialysis, peritoneal dialysis, or allograft kidney transplantation is mandatory for patient survival.

Why other options are incorrect:

- **Option A:** A reduction to 70% of normal function is asymptomatic and requires no dialytic intervention.
- **Option B:** At 50% capacity (mild renal impairment), the remaining functional nephrons undergo compensatory hypertrophy to maintain biochemical balance.
- **Option C:** At 25% capacity (moderate to severe chronic kidney disease), patients are managed medically with dietary restrictions and pharmacotherapy without immediate dialysis.

Question #47 Key: (A)BIOLOGY
KMU 2026

Which nitrogenous waste is the MAIN excretory product in humans, and has relatively low toxicity...

CORE CONCEPT & DERIVATION

Humans are ureotelic organisms that convert highly toxic ammonia derived from amino acid deamination into less toxic, water-soluble urea via the hepatic ornithine cycle.

Formula / Rule / Reaction:**Solution:**

- Ammonia is extremely cytotoxic and requires large volumes of water for safe excretion, making direct excretion impractical for terrestrial mammals.
- The liver converts ammonia into urea, which is roughly 100,000 times less toxic and serves as the principal nitrogenous waste excreted by human kidneys.

Why other options are incorrect:

- **Option B:** Uric acid is an insoluble purine degradation product excreted in minor quantities in humans (primary waste in birds and reptiles).
- **Option C:** Creatinine is a breakdown product of muscle creatine phosphate excreted in relatively small, constant quantities.
- **Option D:** Free ammonia is highly toxic and present only in trace amounts in human urine.

Question #48 Key: (B)BIOLOGY
KMU 2026

DNA probes enable faster identification of disease causing bacteria than conventional methods b...

CORE CONCEPT & DERIVATION

Molecular biotechnology utilizes nucleic acid hybridization probes to detect pathogen-specific nucleotide sequences directly from clinical specimens without requiring time-consuming bacterial culture.

Formula / Rule / Reaction:**Solution:**

- A DNA probe consists of a short, single-stranded oligonucleotide labeled with a fluorophore or radioisotope designed complementary to a pathogen's unique diagnostic sequence.
- Biotechnological molecular techniques allow rapid hybridization in hours, bypassing days of microbial growth in standard media.

Why other options are incorrect:

- **Option A:** DNA probes are nucleic acid biological macromolecules synthesized and hybridized through molecular biological mechanisms.
- **Option C:** Antibiotics are pharmacological agents used for antimicrobial treatment rather than diagnostic nucleic acid hybridization.
- **Option D:** Surgery is an invasive clinical procedure for physical tissue repair or excision.

Question #49 Key: (C)BIOLOGY
KMU 2026

The most common vector used to deliver a therapeutic gene into target cells is:

CORE CONCEPT & DERIVATION

In human gene therapy, replication-defective viral vectors are the primary vehicles utilized to transduce and insert therapeutic functional genes into patient host cells.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Genetically modified viruses (such as retroviruses, adenoviruses, and adeno-associated viruses) are engineered by replacing pathogenic genes with therapeutic human transgenes.
- Their natural evolutionary ability to penetrate mammalian cell membranes and deliver nucleic material into host nuclei makes them the most common clinical vectors.

Why other options are incorrect:

- **Option A:** Plasmids are primarily used for molecular cloning in bacterial hosts; naked plasmid DNA has very low transfection efficiency in vivo.
- **Option B:** Liposomes are non-viral lipid vesicles that exhibit lower gene transfer efficiency compared to engineered viral systems.
- **Option D:** Restriction enzymes are bacterial endonucleases that cleave DNA at specific palindromic recognition sites; they do not function as delivery vehicles.

Question #50 Key: (B)BIOLOGY
KMU 2026*Monoclonal antibodies are:***CORE CONCEPT & DERIVATION**

Monoclonal antibodies are homogeneous immunoglobulins derived from a single clone of hybridoma cells, exhibiting identical paratopes specific to a single antigenic epitope.

Formula / Rule / Reaction:

B-lymphocyte + Myeloma Cell → Hybridoma Clone → Monoclonal Antibodies

Solution:

- Köhler and Milstein developed hybridoma technology by fusing an antibody-producing B-lymphocyte with an immortal myeloma cell.
- Cloning this single hybrid cell produces an immortal cell line that secretes identical antibody molecules with uniform affinity and epitope specificity.

Why other options are incorrect:

- **Option A:** A heterogeneous mixture of antibodies targeting multiple epitopes is termed a polyclonal antibody mixture.
- **Option C:** T-lymphocytes do not synthesize or secrete soluble antibodies; antibodies are produced exclusively by differentiated B-lineage plasma cells.
- **Option D:** Radioactive labeling is an optional modification for immunoassays and not a defining characteristic of monoclonal antibodies.

Question #51 Key: (C)BIOLOGY
KMU 2026*Which of the following correctly matches the biotechnology product with its application?***CORE CONCEPT & DERIVATION**

Nanotechnology in medicine employs nanoscale materials to encapsulate pharmaceutical agents for targeted cellular delivery, localized drug release, and high-sensitivity diagnostic imaging.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Nanoparticles can be surface-functionalized with specific ligands to bind target cell receptors selectively, improving drug efficacy while reducing systemic adverse effects.
- Their unique physicochemical properties also permit high-contrast cellular imaging and molecular disease diagnosis.

Why other options are incorrect:

- **Option A:** Biochips are miniaturized microarrays used for rapid genetic analysis, gene expression profiling, and pathogen detection.
- **Option B:** Mycorrhizae are symbiotic fungal associations with plant roots that enhance water and mineral (particularly phosphorus) uptake.
- **Option D:** Biofertilizers are microbial inoculants (such as *Rhizobium* and *Azotobacter*) that enrich agricultural soil fertility via nitrogen fixation.

Question #52 Key: (C)BIOLOGY
KMU 2026*Which of the following is correctly matched with its morphological type?***CORE CONCEPT & DERIVATION**

Viruses are classified morphologically by capsid symmetry into helical (rod-shaped), icosahedral (polyhedral/spherical), and complex (binal/tadpole-shaped) architectures.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- T-even bacteriophages (such as T2 and T4) possess a binal complex symmetry consisting of an icosahedral head encapsulating the genome joined to a helical contractile tail, giving them a distinct tadpole-like morphology.
- This structure facilitates attachment and direct injection of viral DNA into bacterial hosts.

Why other options are incorrect:

- **Option A:** Tobacco mosaic virus (TMV) has a rigid, helical rod-shaped capsid, not a polyhedral structure.
- **Option B:** Poliovirus is an icosahedral (polyhedral/spherical) non-enveloped RNA virus, not a rod.
- **Option D:** TMV is cylindrical and rod-shaped rather than spherical.

Question #53 Key: (C)BIOLOGY
KMU 2026*A patient diagnosed with AIDS has an increased susceptibility to infections due to:***CORE CONCEPT & DERIVATION**

Human Immunodeficiency Virus (HIV) selectively infects and depletes CD4+ T-helper lymphocytes, collapsing both cell-mediated and humoral adaptive immunity.

Formula / Rule / Reaction:

HIV gp120 + CD4 Receptor → Viral Entry → Lysis of CD4+ T-cells → Immune

Solution:

- CD4+ T-helper cells coordinate the activation of cytotoxic T cells, macrophages, and antibody-secreting B-lymphocytes.
- Progressive destruction of CD4+ cells compromises the entire adaptive immune system, leaving the host vulnerable to life-threatening opportunistic infections and rare malignancies.

Why other options are incorrect:

- **Option A:** HIV targets CD4-bearing immune cells, not erythrocytes; red blood cell destruction is not the primary mechanism of AIDS pathogenesis.
- **Option B:** B-cell function becomes dysregulated and antibody production against new antigens declines sharply.
- **Option D:** Synthesis and regulation of digestive enzymes are unaffected by HIV infection.

Question #54 Key: (C)BIOLOGY
KMU 2026

Which of the following is converted into a two-carbon molecule with the release of carbon dioxide...

CORE CONCEPT & DERIVATION

During the transition (link) reaction in the mitochondrial matrix, pyruvate dehydrogenase oxidatively decarboxylates three-carbon pyruvate into a two-carbon acetyl fragment.

Formula / Rule / Reaction:**Solution:**

- Glycolysis yields two molecules of three-carbon pyruvate per glucose molecule in the cytosol.
- Pyruvate is transported into the mitochondrial matrix where it undergoes oxidative decarboxylation, releasing one molecule of CO_2 and yielding a two-carbon acetyl group coupled to Coenzyme A.

Why other options are incorrect:

- Option A:** Acetyl-CoA is already the two-carbon intermediate that combines with four-carbon oxaloacetate to enter the Krebs cycle.
- Option B:** Lactate is a three-carbon molecule produced by anaerobic reduction of pyruvate without carbon dioxide release.
- Option D:** Glycerol is a three-carbon alcohol phosphorylated and oxidized to dihydroxyacetone phosphate in glycolysis.

Question #55 Key: (C)BIOLOGY
KMU 2026

Metabolism of an 18 carbon fatty acid results in _____ number of Acetyl-CoA?

CORE CONCEPT & DERIVATION

Beta-oxidation breaks down saturated fatty acids into two-carbon acetyl-CoA units sequentially through repetitive spiral cycles.

Formula / Rule / Reaction:

$$\text{Number of Acetyl-CoA molecules} = \frac{n}{2}$$

(where n is the total number of carbon atoms in an even-chain saturated fatty acid)

Solution:

- For an 18-carbon fatty acid (such as stearic acid), the number of two-carbon units generated is:
$$\frac{18}{2} = 9 \text{ molecules of Acetyl-CoA}$$
- This requires 8 cycles of beta-oxidation, as the final cleavage of a four-carbon intermediate yields two acetyl-CoA units simultaneously.

Why other options are incorrect:

- Option A:** 3 molecules of acetyl-CoA would correspond to a 6-carbon fatty acid.
- Option B:** 6 molecules of acetyl-CoA would correspond to a 12-carbon fatty acid (lauric acid).
- Option D:** 18 would represent the total number of individual carbon atoms, not two-carbon acetyl fragments.

Question #56 Key: (B)BIOLOGY
KMU 2026

Which of the following are classified as organic molecules in humans?

CORE CONCEPT & DERIVATION

Biological organic compounds are carbon-based macromolecules characterized by covalent carbon-carbon and carbon-hydrogen backbones.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- The four major classes of biological macromolecules found in living cells are carbohydrates, proteins, lipids, and nucleic acids.
- Each of these groups possesses structural carbon frameworks synthesized and utilized by living organisms.

Why other options are incorrect:

- Option A:** Water (H_2O), inorganic minerals, molecular oxygen (O_2), and carbon dioxide (CO_2) are classified as inorganic compounds.
- Option C:** Minerals, water, and oxygen are inorganic entities.
- Option D:** Sodium chloride (NaCl), water, and elemental calcium ions are inorganic.

Question #57 Key: (D)BIOLOGY
KMU 2026

The structural similarity between DNA and RNA nucleotides is due to the presence of:

CORE CONCEPT & DERIVATION

Nucleotides consist of a pentose sugar, a nitrogenous base, and an inorganic phosphate group derived from phosphoric acid (H_3PO_4), which is structurally identical in both DNA and RNA.

Formula / Rule / Reaction:**Solution:**

- DNA and RNA differ fundamentally in their pentose sugars (2-deoxyribose in DNA versus ribose in RNA) and pyrimidine bases (thymine in DNA versus uracil in RNA).
- The esterified phosphate group derived from phosphoric acid is chemically and structurally identical in the nucleotides of both nucleic acids.

Why other options are incorrect:

- Option A:** Thymine is unique to DNA; RNA contains uracil instead.
- Option B:** Ribose is the pentose sugar exclusive to RNA nucleotides.
- Option C:** Deoxyribose is the pentose sugar exclusive to DNA nucleotides.

Question #58 Key: (B)BIOLOGY
KMU 2026

Which property of water is primarily helpful in providing a cooling effect to plants and animal...

CORE CONCEPT & DERIVATION

Water possesses a high latent heat of vaporization due to extensive intermolecular hydrogen bonding, requiring substantial thermal energy to transition from liquid to vapor.

Formula / Rule / Reaction:

$$\Delta H_{\text{vap}} \approx 2260 \text{ J g}^{-1} \text{ (540 cal g}^{-1}\text{)}$$

Solution:

- As liquid water evaporates from a surface, it absorbs large amounts of heat energy from the underlying tissue to overcome intermolecular hydrogen bonds.
- This phase change dissipates excess thermal energy, producing evaporative cooling during transpiration in plants and perspiration in animals.

Why other options are incorrect:

- Option A:** High specific heat capacity buffers cellular temperature against rapid ambient fluctuations rather than generating active cooling.
- Option C:** Solvent properties enable water to dissolve and transport biochemical solutes.
- Option D:** Cohesive forces facilitate continuous water column transport within xylem vessels through surface tension and hydrogen bonding.

Question #59 Key: (C)BIOLOGY
KMU 2026

The reduction of water content in protoplasm to about 10% results in:

CORE CONCEPT & DERIVATION

Protoplasm typically consists of 70% to 90% water, which serves as the indispensable fluid medium for biochemical reactions, enzyme conformation, and membrane integrity.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Enzymatic catalysis and macromolecular structure require an aqueous shell of hydration.
- If protoplasmic water content drops drastically to approximately 10%, cellular dehydration causes irreversible protein denaturation, membrane collapse, and loss of protoplasmic viability (cell death).

Why other options are incorrect:

- Option A:** Severe dehydration shuts down enzymatic activity, halting metabolic pathways completely.
- Option B:** Cell division requires turgor pressure, protein synthesis, and active ATP production, all of which cease upon desiccation.
- Option D:** Ribosomal translation requires an aqueous environment; protein synthesis ceases under severe dehydration.

Question #60 Key: (B)BIOLOGY
KMU 2026

Maltose is classified as:

CORE CONCEPT & DERIVATION

Maltose is a reducing disaccharide consisting of two alpha-D-glucose units joined by an alpha-1,4-glycosidic bond.

Formula / Rule / Reaction:**Solution:**

- Maltose (malt sugar) is formed by the enzymatic cleavage of starch by salivary or pancreatic amylase.
- Because it is composed of exactly two monosaccharide subunits linked covalently, it is classified as a disaccharide.

Why other options are incorrect:

- Option A:** Monosaccharides are simple single-unit sugars such as glucose, fructose, and galactose.
- Option C:** Trisaccharides consist of three linked monosaccharide units, such as raffinose.
- Option D:** Polysaccharides are high-molecular-weight polymers composed of hundreds or thousands of monosaccharide units, such as starch and glycogen.

Question #61 Key: (D)BIOLOGY
KMU 2026

Haemoglobin is an example of which level of protein structure?

CORE CONCEPT & DERIVATION

Quaternary protein structure describes the spatial arrangement and non-covalent association of two or more independent polypeptide subunits into a multi-subunit functional complex.

Formula / Rule / Reaction:**Solution:**

- Hemoglobin is a globular tetrameric protein composed of four separate polypeptide subunits (two alpha and two beta globin chains).
- Because multiple polypeptide chains assemble together to form the functional oxygen-carrying unit, it exhibits quaternary protein organization.

Why other options are incorrect:

- Option A:** Primary structure is the linear sequence of amino acids joined by covalent peptide bonds.
- Option B:** Secondary structure refers to localized repeating conformations such as alpha-helices and beta-pleated sheets stabilized by hydrogen bonds.
- Option C:** Tertiary structure is the overall three-dimensional folding of a single polypeptide chain, as seen in monomeric myoglobin.

Question #62 Key: (D)BIOLOGY
KMU 2026*In cell, glycoproteins are found in the:***CORE CONCEPT & DERIVATION**

According to the fluid mosaic model, glycoproteins are integral or peripheral membrane proteins possessing branched oligosaccharide chains projecting into the extracellular environment.

Formula / Rule / Reaction:*Factual recall / Qualitative concept.***Solution:**

- Membrane proteins post-translationally glycosylated in the rough ER and Golgi apparatus are embedded into the lipid bilayer of the plasma membrane.
- Their exposed carbohydrate moieties form the glycocalyx, functioning in cell-cell recognition, adhesion, and receptor-ligand interactions.

Why other options are incorrect:

- **Option A:** Mitochondria possess phospholipid membranes with metabolic transport proteins and respiratory complexes, not the characteristic surface glycoprotein glycocalyx.
- **Option B:** DNA is a pure polymer of deoxyribonucleotides lacking carbohydrate-protein conjugations.
- **Option C:** RNA is a nucleic acid composed of ribonucleotides, not conjugated glycoproteins.

Question #63 Key: (D)BIOLOGY
KMU 2026*A DNA molecule has a length of 340 nm. How many base pairs does it contain?***CORE CONCEPT & DERIVATION**

In B-form double-helical DNA, adjacent stacked base pairs are separated by an axial distance of 0.34 nm (with 10 base pairs per 3.4 nm helical pitch).

Formula / Rule / Reaction:

$$\text{Number of Base Pairs} = \frac{\text{Total Length}}{\text{Distance per Base Pair}} = \frac{L}{0.34 \text{ nm}}$$

Solution:

- Given the total length of the DNA molecule:

$$L = 340 \text{ nm}$$

- Dividing by the axial rise per base pair gives:

$$\text{Base Pairs} = \frac{340 \text{ nm}}{0.34 \text{ nm/bp}} = 1000 \text{ bp}$$

Why other options are incorrect:

- **Option A:** 100 base pairs corresponds to a length of only 34 nm.
- **Option B:** 340 erroneously assumes an axial rise of 1 nm per base pair.
- **Option C:** 500 base pairs corresponds to a length of 170 nm.

Question #64 Key: (B)BIOLOGY
KMU 2026*Fatty acids and glycerol are related to _____, whereas _____ are related to protein.***CORE CONCEPT & DERIVATION**

Triglyceride lipids are synthesized by esterifying fatty acids to a glycerol backbone, whereas proteins are polymers constructed from amino acid monomers.

Formula / Rule / Reaction:**Solution:**

- Glycerol and fatty acids serve as the fundamental biochemical precursors and constituents of neutral lipids.
- Correspondingly, amino acids are the constituent building-block monomers linked by peptide bonds to form proteins.

Why other options are incorrect:

- **Option A:** Fatty acids and glycerol have no structural connection to nucleic acids, which are built from nucleotides.
- **Option C:** Lipids are non-polymeric macromolecules; fatty acids and glycerol are not polymers.
- **Option D:** Inverts the lipid relationship and incorrectly pairs amino acids with fatty acids and glycerol.

Question #65 Key: (C)BIOLOGY
KMU 2026*A student observes a discoid organelle with a double membrane stroma and thylakoids in plant ce...***CORE CONCEPT & DERIVATION**

Chloroplasts are double-membrane photosynthetic plastids containing a protein-rich internal stroma and a system of membranous flattened thylakoid sacs.

Formula / Rule / Reaction:*Factual recall / Qualitative concept.***Solution:**

- Chloroplasts feature an outer and inner membrane enclosing the ground fluid termed stroma.
- Embedded within the stroma are chlorophyll-bearing thylakoid disks organized into stacks called grana, matching the student's microscopic observation.

Why other options are incorrect:

- **Option A:** The Golgi apparatus consists of stacks of single-membrane flattened cisternae without stroma or thylakoids.
- **Option B:** The endoplasmic reticulum is an extensive network of single-membrane tubules and sheets continuous with the nuclear envelope.
- **Option D:** Mitochondria possess a folded inner membrane (cristae) and internal matrix, but lack stroma and thylakoid membranes.

Question #66 Key: (B)BIOLOGY
KMU 2026

Which of the following is a COMMON FEATURE of Prokaryotic and Eukaryotic cells?

CORE CONCEPT & DERIVATION

Ribosomes are universally conserved, non-membrane-bound ribonucleoprotein complexes present in all living cells for polypeptide translation.

Formula / Rule / Reaction:

Prokaryotic Ribosome: 70S (50S + 30S) | Eukaryotic Cytosolic Ribosome: 80S (60S + 40S) *Factual recall / Qualitative concept.*

Solution:

- Protein synthesis is an essential requirement of all cellular life.
- While prokaryotes and eukaryotes differ regarding membrane-bound organelles, both domains contain ribosomes to translate mRNA into functional proteins.

Why other options are incorrect:

- **Option A:** Mitochondria are membrane-bound organelles found exclusively in eukaryotic cells.
- **Option C:** Endoplasmic reticulum is a membrane-bound organelle absent in prokaryotes.
- **Option D:** Golgi apparatus is an endomembrane system found solely in eukaryotic cells.

Question #67 Key: (D)BIOLOGY
KMU 2026

Which one of the following is a self-replicating organelle?

CORE CONCEPT & DERIVATION

Under the endosymbiotic theory, mitochondria and chloroplasts are semi-autonomous organelles possessing their own circular DNA and 70S ribosomes, replicating independently by binary fission.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Mitochondria replicate within the eukaryotic cytoplasm independently of the host cell nuclear division cycle.
- They contain mitochondrial DNA (mtDNA), tRNA, and 70S ribosomes that direct the synthesis of several mitochondrial inner-membrane respiratory proteins.

Why other options are incorrect:

- **Option A:** The Golgi apparatus is synthesized from vesicles budding off the endoplasmic reticulum and cannot replicate autonomously.
- **Option B:** Lysosomes are single-membrane vesicles formed by budding from the trans-Golgi network.
- **Option C:** Peroxisomes form from ER-derived vesicles and incorporate cytosolic proteins; they lack autonomous genomes.

Question #68 Key: (B)BIOLOGY
KMU 2026

If a cell's smooth endoplasmic reticulum is destroyed, which processes will be most affected?

CORE CONCEPT & DERIVATION

The smooth endoplasmic reticulum (SER) contains membrane-bound enzymes specialized for lipid and steroid hormone biosynthesis, carbohydrate metabolism, and drug biotransformation.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- The smooth ER synthesizes phospholipids, cholesterol, and steroid hormones, and houses cytochrome P450 enzymes that detoxify lipid-soluble drugs and toxic metabolites.
- Destruction of the SER impairs lipid production and hepatic detoxification processes.

Why other options are incorrect:

- **Option A:** Translation of secretory and membrane proteins occurs on ribosomes attached to the rough endoplasmic reticulum (RER).
- **Option C:** Aerobic cellular respiration and ATP synthesis are executed inside the inner mitochondrial membrane and matrix.
- **Option D:** DNA replication and spindle-mediated chromosome distribution are carried out in the nucleus and mitotic apparatus.

Question #69 Key: (B)BIOLOGY
KMU 2026

The centromere is important because it:

CORE CONCEPT & DERIVATION

The centromere is the constricted chromosomal region containing specialized heterochromatin that maintains cohesion between sister chromatids and coordinates kinetochore assembly for spindle attachment.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Following S-phase DNA replication, replicated sister chromatids are held together at the centromere by cohesin protein complexes.
- This physical linkage ensures accurate chromosome alignment at the metaphase plate and coordinated disjunction during anaphase.

Why other options are incorrect:

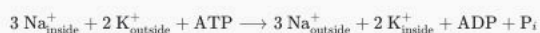
- **Option A:** Protein synthesis is carried out by ribosomes and transfer RNAs in the cytoplasm.
- **Option C:** DNA replication is executed by DNA polymerase holoenzymes along replication forks across chromatin.
- **Option D:** ATP is produced primarily by ATP synthase complexes located in the inner mitochondrial membrane.

Question #70 Key: (C)BIOLOGY
KMU 2026

Which of the following correctly describes the action of the sodium-potassium pump in a resting...

CORE CONCEPT & DERIVATION

The Na^+/K^+ -ATPase is an electrogenic primary active transport pump that consumes one molecule of ATP to export three sodium ions and import two potassium ions against their concentration gradients.

Formula / Rule / Reaction:**Solution:**

- During the maintenance of the resting membrane potential (around -70 mV), the pump expels three Na^+ ions out of the neuronal cytoplasm.
- Simultaneously, it translocates two K^+ ions into the cell per cycle, sustaining high internal K^+ and low internal Na^+ .

Why other options are incorrect:

- **Option A:** Inverts both the stoichiometric ratio and the directional transport of both cations.
- **Option B:** Reverses the transport directions of sodium and potassium across the neurolemma.
- **Option D:** The pump is electrogenic and asymmetric; it transports an unequal 3:2 cation ratio rather than an electroneutral 1:1 exchange.

Question #71 Key: (B)BIOLOGY
KMU 2026

Which of the following structures can be found in a typical neuron?

CORE CONCEPT & DERIVATION

A typical multipolar neuron consists morphologically of three primary anatomical components: receptive dendrites, a central cell body (soma or perikaryon), and an impulse-conducting axon.

Formula / Rule / Reaction:**Solution:**

- Dendrites extend from the soma to receive synaptic inputs from neighboring neurons.
- The cell body contains the nucleus, Nissl bodies, and metabolic machinery.
- A single cylindrical axon propagates action potentials away from the soma toward target effector tissues or downstream synapses.

Why other options are incorrect:

- **Option A:** Cilia are motile apical cell surface modifications found on epithelial linings, not intrinsic structural components of neurons.
- **Option C:** A ganglion is an anatomical cluster of multiple neuron cell bodies located outside the central nervous system, not a single-neuron structure.
- **Option D:** The cauda equina is a collection of spinal nerve roots occupying the lumbar cistern of the spinal canal.

Question #72 Key: (D)BIOLOGY
KMU 2026

The reversal of polarity across two sides of membrane from [Formula] to [Formula] is called ____.

CORE CONCEPT & DERIVATION

Depolarization is the rapid shift in transmembrane electrical potential from a negative resting baseline toward a positive intracellular charge driven by voltage-gated sodium influx.

Formula / Rule / Reaction:

$$V_m : -70 \text{ mV} \xrightarrow{\text{Inward Na}^+ \text{ Current}} +50 \text{ mV}$$

Solution:

- When an excitatory stimulus depolarizes the axonal membrane to threshold, voltage-gated sodium channels open rapidly.
- The influx of Na^+ down its electrochemical gradient reverses the membrane polarity from a negative resting state (-70 mV) to a positive overshoot potential (around $+50 \text{ mV}$), representing depolarization.

Why other options are incorrect:

- **Option A:** Polarization is the steady resting state in an unstimulated neuron with an electronegative interior (-70 mV).
- **Option B:** Hyperpolarization refers to the membrane potential becoming more negative than the resting value (for example, falling from -70 mV to -80 mV).
- **Option C:** Repolarization is the recovery phase returning the membrane potential from positive values back down toward the negative resting baseline via potassium efflux.

Question #73 Key: (C)BIOLOGY
KMU 2026

A student quickly pulls his hand away from a hot iron after accidentally touching it. This resp...

CORE CONCEPT & DERIVATION

The withdrawal (flexor) reflex is an innate, involuntary polysynaptic somatic spinal reflex mediated by circuitry within the gray matter of the spinal cord.

Formula / Rule / Reaction:**Solution:**

- High thermal stimuli activate nociceptors in the skin, which conduct afferent signals directly into the dorsal horn of the spinal cord.
- Interneurons immediately excite motor neurons in the ventral horn, contracting flexor muscles to retract the hand before sensory information reaches the cerebral cortex for conscious awareness.

Why other options are incorrect:

- **Option A:** A conditioned reflex (such as Pavlovian salivation) is acquired through prior training and learned association.
- **Option B:** Cranial reflexes (such as the pupillary light reflex or corneal reflex) are integrated within the brainstem via cranial nerves.
- **Option D:** Voluntary actions are consciously initiated and modulated by the motor cortex of the cerebrum.

Question #74 Key: (C)BIOLOGY
KMU 2026

A patient suffers a brain injury following a head trauma. During recovery, the patient experien...

CORE CONCEPT & DERIVATION

The pons contains sleep-regulating nuclei and the locus coeruleus that initiate and regulate rapid eye movement (REM) sleep, during which active dreaming occurs.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- The pontine reticular formation acts as the primary neuroanatomical center for switching sleep architecture into REM sleep.
- Lesions or traumatic contusions to the pons disrupt the regulation of REM sleep states, leading to insomnia, fragmented sleep architecture, and dream suppression.

Why other options are incorrect:

- **Option A:** The cerebellum coordinates voluntary motor movements, precision, and balance without regulating sleep cycles.
- **Option B:** The medulla oblongata regulates autonomic survival centers, including respiration, vasomotor tone, and cardiac rate.
- **Option D:** The thalamus is the major sensory relay station for all senses (except olfaction) to the cerebral cortex.

Question #75 Key: (A)BIOLOGY
KMU 2026

Damage to the area containing dopamine-releasing neurons would most likely affect the:

CORE CONCEPT & DERIVATION

The substantia nigra and ventral tegmental area, located in the mesencephalon (midbrain), contain the primary dopaminergic cell bodies of the central nervous system.

Formula / Rule / Reaction:

Substantia Nigra (Midbrain) $\xrightarrow{\text{Dopamine}}$ Nigrostriatal Pathway $\rightarrow$ Basal Ganglia

Solution:

- The pars compacta of the substantia nigra in the midbrain contains densely packed dopaminergic neurons.
- Degeneration of these dopaminergic neurons disrupts the nigrostriatal pathway to the basal ganglia, leading to the motor deficits characteristic of Parkinson's disease.

Why other options are incorrect:

- **Option B:** The cerebellum uses primarily GABA and glutamate for motor coordination circuitry.
- **Option C:** The pons contains noradrenergic (locus coeruleus) and cholinergic nuclei rather than the principal dopaminergic populations.
- **Option D:** The medulla houses cardiovascular and respiratory autonomic centers.

Question #76 Key: (B)BIOLOGY
KMU 2026

The amygdala is a part of the:

CORE CONCEPT & DERIVATION

The amygdala is an almond-shaped nuclear complex located deep within the anterior temporal lobe and forms an integral component of the limbic system.

Formula / Rule / Reaction:

Limbic System = Amygdala + Hippocampus + Cingulate Gyrus + Hypothalamus

Solution:

- The limbic system is the neural network responsible for emotional processing, motivation, and memory consolidation.
- Within this circuit, the amygdala processes emotional reactions, classical fear conditioning, and aggressive behavioral responses.

Why other options are incorrect:

- **Option A:** The cerebellum is a separate hindbrain structure devoted to motor control, balance, and fine coordination.
- **Option C:** The reticular formation is a diffuse polysynaptic network spanning the brainstem core that modulates arousal and consciousness.
- **Option D:** The medulla oblongata is the caudal myelencephalic portion of the brainstem managing visceral autonomic reflexes.

Question #77 Key: (C)BIOLOGY
KMU 2026

Which characteristic distinguishes enzymes during a chemical reaction?

CORE CONCEPT & DERIVATION

Enzymes are true biological catalysts that accelerate chemical reactions by lowering activation energy without undergoing permanent chemical changes or being consumed.

Formula / Rule / Reaction:**Solution:**

- Enzymes interact transiently with substrates at their active sites through non-covalent or temporary covalent interactions to stabilize the transition state.
- Following product dissociation, the enzyme returns to its original native structural and chemical state, free to catalyze subsequent reaction cycles.

Why other options are incorrect:

- **Option A:** Enzymes alter reaction kinetics and rates, but have no effect on the chemical identity of the final equilibrium products.
- **Option B:** Enzymes accelerate metabolic reaction rates by factors of 10^6 to 10^{12} , never slowing them down.
- **Option D:** Enzymes are released unchanged and do not become covalently incorporated into the reaction products.

Question #78 Key: (A)BIOLOGY
KMU 2026

According to the lock and key hypothesis, the active site in enzyme action is regarded as _____.

CORE CONCEPT & DERIVATION

Emil Fischer's classic lock and key hypothesis (1894) posits that an enzyme's active site possesses a static, pre-formed, rigid geometric shape perfectly complementary to its substrate.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Fischer proposed that just as a specific key fits into a rigid lock without altering the lock's shape, a substrate fits into a rigid active site.
- This model emphasized strict structural complementarity, in contrast to Daniel Koshland's later induced-fit model which introduced the concept of conformational flexibility.

Why other options are incorrect:

- Option B:** Flexibility is the hallmark of the induced-fit model, not the lock and key model.
- Option C:** Dynamic structural remodeling describes Koshland's induced-fit hypothesis.
- Option D:** Elastic deformability is contrary to the rigid active site premise of the lock and key hypothesis.

Question #79 Key: (A)BIOLOGY
KMU 2026

Enzyme pepsin shows maximum activity at pH:

CORE CONCEPT & DERIVATION

Pepsin is an aspartic endopeptidase secreted into the stomach that requires a strongly acidic environment to maintain its catalytically active tertiary conformation.

Formula / Rule / Reaction:

Optimum pH for Pepsin $\approx$ 1.5 to 2.0

Solution:

- Hydrochloric acid secreted by gastric parietal cells lowers the luminal pH of the stomach to 1.5 to 2.0.
- This low pH protonates specific aspartate carboxylic acid groups within pepsin's catalytic site, giving it maximal proteolytic activity between pH 1.5 and 1.6.

Why other options are incorrect:

- Option B:** A pH of 4.5 to 4.7 is optimal for certain fungal amylases and lysosomal acid hydrolases.
- Option C:** A pH of 7.8 to 8.7 represents the alkaline optimum of pancreatic enzymes like trypsin and chymotrypsin.
- Option D:** A pH of 8.7 to 9.1 corresponds to the optimum for pancreatic lipase and intestinal arginase.

Question #80 Key: (A)BIOLOGY
KMU 2026

pH affects the activity of an enzyme by causing the:

CORE CONCEPT & DERIVATION

Changes in hydrogen ion concentration alter the charge and ionization states of amino acid side chains within an enzyme's active site and substrate, modulating catalytic binding affinity.

Formula / Rule / Reaction:**Solution:**

- Catalytic residues in the active site (such as histidine, aspartate, and lysine) must maintain specific protonation states to bind substrates and facilitate catalysis.
- Shifting the pH away from the optimum changes these ionic charges, impairing substrate binding or denaturing the tertiary fold.

Why other options are incorrect:

- Option B:** Altering pH can prevent catalysis, but it does not inherently increase the activation energy of the uncatalyzed reaction pathway.
- Option C:** Prosthetic groups are typically tightly or covalently bound; physiological pH changes do not simply dissociate them.
- Option D:** The pH of a solution is independent of the thermodynamic kinetic temperature of the reaction mixture.

Question #81 Key: (A)BIOLOGY
KMU 2026

Which molecule has a similar structure to the normal substrate?

CORE CONCEPT & DERIVATION

Competitive inhibitors are chemical analogues that closely mimic the three-dimensional geometry and charge distribution of the native substrate, competing directly for the active site.

Formula / Rule / Reaction:**Solution:**

- Due to steric similarity to the natural substrate, a competitive inhibitor fits directly into the active site.
- A classic example is malonic acid, which structurally mimics succinic acid and competitively inhibits succinate dehydrogenase.

Why other options are incorrect:

- Option B:** Non-competitive inhibitors bind to distinct allosteric sites and do not require structural similarity to the substrate.
- Option C:** Heavy metal ions (such as Pb^{2+} and Hg^{2+}) disrupt disulfide bridges non-specifically throughout the protein scaffold.
- Option D:** Cyanide is a small metabolic poison that binds heme iron in cytochrome c oxidase rather than mimicking large biological substrates.

Question #82 Key: (A)PHYSICS
KMU 2026

In an adiabatic process if a gas is allowed to expand suddenly, its temperature will:

CORE CONCEPT & DERIVATION

In an adiabatic expansion, there is no heat exchange with the environment ($Q = 0$), so the work done by the gas is performed entirely at the expense of its internal energy.

Formula / Rule / Reaction:

$$\Delta U = Q - W \xrightarrow{Q=0} \Delta U = -W$$

Solution:

- During expansion, the gas performs positive external work on its surroundings ($W > 0$).
- According to the First Law of Thermodynamics, $\Delta U = -W$, which causes internal energy to decrease ($\Delta U < 0$).
- Because the internal energy of an ideal gas is directly proportional to its absolute temperature ($U \propto T$), this reduction in internal energy lowers the temperature of the gas.

Why other options are incorrect:

- **Option B:** The temperature increases during adiabatic compression, not expansion.
- **Option C:** Temperature remains constant in an isothermal process ($\Delta T = 0$), which requires slow heat exchange with a thermal reservoir.
- **Option D:** Absolute zero cannot be reached in a single expansion process according to the Third Law of Thermodynamics.

Question #83 Key: (A)PHYSICS
KMU 2026

According to Coulomb's law, if the distance between two point charges is doubled while their ma...

CORE CONCEPT & DERIVATION

Coulomb's law states that the electrostatic force between two stationary point charges is inversely proportional to the square of the separation distance between them.

Formula / Rule / Reaction:

$$F = \frac{1}{4\pi\epsilon_0} \frac{|q_1 q_2|}{r^2} \Rightarrow F \propto \frac{1}{r^2}$$

Solution:

- Let the initial separation distance be r and the initial force be F_1 .
- When the separation distance is doubled to $r' = 2r$:

$$F_2 = \frac{k|q_1 q_2|}{(2r)^2} = \frac{k|q_1 q_2|}{4r^2} = \frac{1}{4} F_1$$
- Therefore, the electrostatic force decreases to one-fourth of its original magnitude.

Why other options are incorrect:

- **Option B:** One-half would result if the force had a simple inverse linear dependence on distance ($F \propto 1/r$).
- **Option C:** The force decreases with increasing separation, rather than doubling.
- **Option D:** Four times would occur if the distance were halved, not doubled.

Question #84 Key: (C)PHYSICS
KMU 2026

A 12 V battery transfers 5000 C of charge through a circuit. The energy delivered is:

CORE CONCEPT & DERIVATION

Electrical potential difference is defined as the work done or energy transferred per unit electric charge moved between two points.

Formula / Rule / Reaction:

$$W = q \times V$$

Solution:

- Given values: Potential difference $V = 12$ V and charge transferred $q = 5000$ C.
- Calculate the energy delivered:

$$W = 5000 \text{ C} \times 12 \text{ V} = 60000 \text{ J} = 6.0 \times 10^4 \text{ J}$$

Why other options are incorrect:

- **Option A:** Results from an erroneous division of charge by voltage:
 $\frac{5000}{12} \approx 4.17 \times 10^2 \text{ J}$.
- **Option B:** Represents a calculation error off by an order of magnitude.
- **Option D:** Represents an arithmetic error off by an extra factor of 10.

Question #85 Key: (B)PHYSICS
KMU 2026

An infinite plane sheet has a surface charge density: [Formula]. The electric field on either ...

CORE CONCEPT & DERIVATION

By Gauss's law, the electric field intensity near an infinite, non-conducting plane sheet of uniform surface charge density is uniform and perpendicular to the sheet.

Formula / Rule / Reaction:

$$E = \frac{\sigma}{2\epsilon_0}$$

Solution:

- Given surface charge density: $\sigma = 8.85 \times 10^{-6} \text{ C m}^{-2}$ and permittivity of free space: $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$.

- Substitute into Gauss's formula:

$$E = \frac{8.85 \times 10^{-6}}{2 \times 8.85 \times 10^{-12}} = \frac{10^6}{2} = 0.5 \times 10^6 \text{ N C}^{-1}$$

Why other options are incorrect:

- Option A:** Results from using an incorrect denominator factor of 4: $\frac{\sigma}{4\epsilon_0}$.
- Option C:** Corresponds to the field between two oppositely charged conducting plates ($E = \frac{\sigma}{\epsilon_0}$).
- Option D:** Results from improperly multiplying rather than dividing by 2.

Question #86 Key: (A)PHYSICS
KMU 2026

Steady current in a metallic conductor is due to the _____ under an electric field.

CORE CONCEPT & DERIVATION

In metallic conductors, an applied electric field superimposes an organized net drift velocity on the otherwise random thermal motions of conduction electrons.

Formula / Rule / Reaction:

$$I = nAqv_d$$

Solution:

- In the absence of an external electric field, free conduction electrons move with high-speed random thermal velocities, resulting in zero net charge transport across any cross-section.
- When an external electric field is applied, it exerts a steady electrostatic force ($\vec{F} = -e\vec{E}$), establishing a coordinated, directed drift of free electrons that constitutes a steady electric current.

Why other options are incorrect:

- Option B:** Random thermal motion has an average vector velocity of zero and produces no net electric current.
- Option C:** Positive metal ions remain locked in fixed positions within the crystalline metallic lattice and do not translate.
- Option D:** A continuously changing electron flow describes alternating or transient currents, not a steady direct current.

Question #87 Key: (A)PHYSICS
KMU 2026

Which expression correctly represents the SI unit of magnetic flux density?

CORE CONCEPT & DERIVATION

The magnetic flux density (B), measured in tesla (T), is defined via the magnetic force exerted on a current-carrying conductor segment.

Formula / Rule / Reaction:

$$F = ILB \sin \theta \implies B = \frac{F}{IL}$$

Solution:

- From the Lorentz force equation for a straight conductor, magnetic flux density is:

$$B = \frac{F}{IL}$$

- Substituting fundamental SI units:

$$\text{Unit of } B = \frac{\text{Newton}}{\text{Ampere} \times \text{meter}} = \text{N A}^{-1} \text{m}^{-1} = \text{Tesla (T)}$$

Why other options are incorrect:

- Option B:** Inverts the meter dimension, yielding an incorrect unit for magnetic field.
- Option C:** N C^{-1} is the SI unit of electric field intensity (E), not magnetic flux density.
- Option D:** Magnetic flux density is magnetic flux per unit area (Wb m^{-2}), not webers multiplied by square meters.

Question #88 Key: (C)PHYSICS
KMU 2026

If the number of turns of a coil is doubled while the rate of change of magnetic flux remains c...

CORE CONCEPT & DERIVATION

Faraday's law of electromagnetic induction states that the magnitude of induced electromotive force in a coil is directly proportional to the total number of turns and the rate of change of magnetic flux.

Formula / Rule / Reaction:

$$\varepsilon = -N \frac{\Delta \Phi}{\Delta t}$$

Solution:

- Because each individual turn contributes an equal induced e.m.f. in series, the total induced e.m.f. is directly proportional to N :

$$\varepsilon \propto N$$

- Doubling the number of turns ($N' = 2N$) while holding the flux rate $\frac{\Delta \Phi}{\Delta t}$ constant doubles the total induced electromotive force.

Why other options are incorrect:

- Option A:** The induced e.m.f. is directly proportional, not inversely proportional, to the number of turns.
- Option B:** Induced e.m.f. remains unchanged only if the number of turns is held constant.
- Option D:** A one-fourth factor does not correspond to an increase in coil turns.

Question #89 Key: (B)PHYSICS
KMU 2026

In an alternating current wave, the phase of the maximum positive value is:

CORE CONCEPT & DERIVATION

A sinusoidal alternating current waveform follows a standard sine function, reaching its positive crest at a phase angle of $\frac{\pi}{2}$ radians (90°).

Formula / Rule / Reaction:

$$I(t) = I_0 \sin(\theta)$$

Solution:

- The sine function evaluates to its maximum positive value of +1 when:

$$\sin(\theta) = +1 \implies \theta = 90^\circ \left(\frac{\pi}{2} \text{ rad} \right)$$

- Therefore, the phase angle corresponding to the positive peak value $+I_0$ is 90° .

Why other options are incorrect:

- Option A:** At $\theta = 0^\circ$, $\sin(0^\circ) = 0$, which corresponds to the initial zero-crossing.
- Option C:** At $\theta = 180^\circ$, $\sin(180^\circ) = 0$, representing the central zero-crossing.
- Option D:** At $\theta = 270^\circ$, $\sin(270^\circ) = -1$, which corresponds to the maximum negative peak (trough).

Question #90 Key: (A)PHYSICS
KMU 2026

When a diode is reverse biased, it:

CORE CONCEPT & DERIVATION

Under reverse bias, an external voltage widens the p-n junction depletion region and elevates the potential barrier, blocking the flow of majority charge carriers.

Formula / Rule / Reaction:

$$I_{\text{reverse}} \approx I_0 \text{ (Reverse Saturation Current } \approx 10^{-6} \text{ A to } 10^{-9} \text{ A)}$$

Solution:

- Connecting the positive terminal to the n-type region and the negative terminal to the p-type region pulls majority carriers away from the junction.
- This widens the depletion layer and increases junction resistance to a very high value, halting majority current flow and leaving only a negligible minority carrier leakage current.

Why other options are incorrect:

- Option B:** Reverse bias increases junction resistance; forward bias reduces junction resistance.
- Option C:** Diodes conduct significant forward current under forward bias when the applied voltage overcomes the barrier potential.
- Option D:** Current is reduced to trace microamperes or nanoamperes, not increased.

Question #91 Key: (C)PHYSICS
KMU 2026

According to Planck's theory, an atom in one quantum state:

CORE CONCEPT & DERIVATION

In quantum mechanics and Bohr's atomic postulates, an atom residing in a discrete stationary state possesses a fixed energy and does not radiate or absorb electromagnetic energy.

Formula / Rule / Reaction:

$$\Delta E = E_2 - E_1 = h\nu \text{ (Energy exchange occurs only during transitions)}$$

Solution:

- According to quantum theory, bound electrons occupy non-radiating stationary energy levels.
- An atom neither emits nor absorbs photons while remaining in a single quantum eigenstate; radiation emission or absorption occurs only when transitioning between two distinct quantum states.

Why other options are incorrect:

- Option A:** Continuous energy emission is a prediction of classical electrodynamics that would lead to orbital collapse, disproven by quantum theory.
- Option B:** Energy absorption requires an external photon with energy matching the difference between two quantum states.
- Option D:** Photons are emitted only upon electronic de-excitation transitions, not at regular periodic time intervals.

Question #92 Key: (A)PHYSICS
KMU 2026

Which type of spectrum consists of bright lines of various frequencies?

CORE CONCEPT & DERIVATION

An atomic line emission spectrum consists of discrete, sharp bright spectral lines against a dark background, produced by radiative electronic transitions from higher to lower energy levels in excited atomic gases.

Formula / Rule / Reaction:

$$\Delta E = h\nu = \frac{hc}{\lambda}$$

Solution:

- When excited gas atoms transition from higher discrete energy states to lower states, they emit photons of specific, quantized wavelengths.
- When dispersed by a diffraction grating or prism, these emitted wavelengths appear as isolated bright lines corresponding to characteristic atomic frequencies.

Why other options are incorrect:

- Option B:** A line absorption spectrum consists of dark lines superimposed on a continuous bright background, caused by the selective absorption of transmitted frequencies.
- Option C:** A continuous spectrum displays an unbroken sequence of all wavelengths without discrete lines, emitted by hot, dense incandescent solids.
- Option D:** A band spectrum consists of closely spaced lines grouped into fluted bands, produced by molecular rotations and vibrations rather than isolated atoms.

Question #93 Key: (A)

PHYSICS
KMU 2026

The half-life of a radioactive element is:

CORE CONCEPT & DERIVATION

Radioactive decay is a spontaneous, first-order nuclear process governed by an intrinsic decay constant (λ), making the half-life an immutable constant characteristic of a given radionuclide.

Formula / Rule / Reaction:

$$T_{1/2} = \frac{\ln 2}{\lambda} = \frac{0.693}{\lambda} = \text{Constant}$$

Solution:

- The half-life represents the time required for one-half of the unstable nuclei in a sample to undergo radioactive decay.
- Because decay is dictated by nuclear forces within the nucleus, the half-life is entirely independent of initial sample quantity, chemical state, temperature, and pressure.

Why other options are incorrect:

- **Option B:** The decay rate is fixed by nuclear physics, so the half-life does not vary over time.
- **Option C:** Half-life is independent of the initial mass or number of undecayed nuclei present.
- **Option D:** Nuclear decay properties are independent of external macroscopic thermodynamic parameters such as pressure and temperature.

Question #94 Key: (C)

PHYSICS
KMU 2026When two vectors A and B are added, which statement is correct?

CORE CONCEPT & DERIVATION

Vector addition satisfies the commutative property, meaning the resultant vector is identical in both magnitude and direction regardless of the operational order of addition.

Formula / Rule / Reaction:

$$\vec{A} + \vec{B} = \vec{B} + \vec{A}$$

Solution:

- Geometric addition using either the head-to-tail rule or the parallelogram law demonstrates that both addition paths form opposite sides of the same geometric parallelogram.
- The diagonal representing the resultant vector maintains the exact same magnitude and spatial orientation in both cases.

Why other options are incorrect:

- **Option A:** Both the magnitude and the direction are identical for $\vec{A} + \vec{B}$ and $\vec{B} + \vec{A}$.
- **Option B:** The resultant vector is independent of which vector is plotted initially.
- **Option D:** The commutative property applies universally to all vectors regardless of the angle between them.

Question #95 Key: (C)

PHYSICS
KMU 2026

The direction of linear momentum is the same as the direction of:

CORE CONCEPT & DERIVATION

Linear momentum is defined as the product of an object's mass and its velocity vector; multiplying a vector by a positive scalar preserves its directional orientation.

Formula / Rule / Reaction:

$$\vec{p} = m\vec{v}$$

Solution:

- Mass (m) is an intrinsically positive scalar quantity.
- Because $\vec{p}$ is the direct scalar multiple of $\vec{v}$, the linear momentum vector points along the instantaneous velocity vector.

Why other options are incorrect:

- **Option A:** The net external force points in the direction of the rate of change of momentum ($\vec{F} = \frac{d\vec{p}}{dt}$), which may differ from the direction of instantaneous velocity (for example, in circular motion).
- **Option B:** Acceleration points in the direction of the change in velocity ($\Delta\vec{v}$), not necessarily the direction of instantaneous velocity.
- **Option D:** Displacement is a position difference vector measured from an origin, which can differ in direction from instantaneous velocity.

Question #96 Key: (C)

PHYSICS
KMU 2026

Which situation represents uniform acceleration?

CORE CONCEPT & DERIVATION

Uniform (constant) acceleration is defined as a steady rate of change of velocity where equal changes in velocity occur over equal increments of time.

Formula / Rule / Reaction:

$$\vec{a} = \frac{\Delta\vec{v}}{\Delta t} = \text{Constant}$$

Solution:

- When acceleration is constant, the derivative of velocity with respect to time is constant:

$$\frac{dv}{dt} = c$$

- This implies that the change in velocity (Δv) divided by any elapsed time interval (Δt) remains invariant across the entire trajectory.

Why other options are incorrect:

- **Option A:** Unequal velocity changes over equal time intervals describe variable (non-uniform) acceleration.
- **Option B:** Acceleration changing with time represents non-uniform acceleration (jerk).
- **Option D:** Constant velocity implies zero acceleration ($a = 0$), which represents uniform motion rather than accelerated motion.

Question #97 Key: (B)PHYSICS
KMU 2026

A particle moves from 40m at 10s to 20m at 15s. Its average velocity is:

CORE CONCEPT & DERIVATION

Average velocity is defined as the net displacement vector divided by the total elapsed time interval.

Formula / Rule / Reaction:

$$v_{\text{avg}} = \frac{\Delta x}{\Delta t} = \frac{x_2 - x_1}{t_2 - t_1}$$

Solution:

- Identify given kinematic parameters: initial position $x_1 = 40 \text{ m}$ at $t_1 = 10 \text{ s}$; final position $x_2 = 20 \text{ m}$ at $t_2 = 15 \text{ s}$.

- Calculate net displacement:

$$\Delta x = 20 \text{ m} - 40 \text{ m} = -20 \text{ m}$$

- Calculate elapsed time:

$$\Delta t = 15 \text{ s} - 10 \text{ s} = 5 \text{ s}$$

- Calculate average velocity:

$$v_{\text{avg}} = \frac{-20 \text{ m}}{5 \text{ s}} = -4 \text{ m/s}$$

Why other options are incorrect:

- Option A:** Omits the negative sign resulting from backward displacement: $x_2 < x_1$.
- Option C:** Erroneously divides time by position, misplacing the decimal by two orders of magnitude.
- Option D:** Inverts the velocity ratio while retaining the negative sign.

Question #98 Key: (B)PHYSICS
KMU 2026

A 4 kg block and an 8 kg block are pushed with the same force on a frictionless surface. Which...

CORE CONCEPT & DERIVATION

According to Newton's Second Law of Motion, the acceleration of an object is inversely proportional to its mass when subjected to a constant net force.

Formula / Rule / Reaction:

$$a = \frac{F}{m} \implies a \propto \frac{1}{m}$$

Solution:

- Let the applied horizontal force be F .

- Calculate the acceleration of the 4 kg block:

$$a_1 = \frac{F}{4}$$

- Calculate the acceleration of the 8 kg block:

$$a_2 = \frac{F}{8}$$

- Comparing the two accelerations:

$$a_1 = 2 \times \left(\frac{F}{8}\right) = 2a_2$$

- Hence, the 4 kg block accelerates at twice the rate of the 8 kg block.

Why other options are incorrect:

- Option A:** Equal acceleration requires forces proportional to mass; with identical forces, unequal masses produce unequal accelerations.
- Option C:** Inverts the relationship; greater mass yields lower acceleration for a given force.
- Option D:** Different accelerations under equal forces produce different velocities over time.

Question #99 Key: (A)PHYSICS
KMU 2026

The maximum height reached by a projectile is directly proportional to:

CORE CONCEPT & DERIVATION

The vertical peak of a projectile trajectory occurs when the vertical velocity component drops to zero under constant downward gravitational acceleration.

Formula / Rule / Reaction:

$$H = \frac{v_i^2 \sin^2 \theta}{2g}$$

Solution:

- Using the third equation of motion vertically:

$$v_{fy}^2 = v_{iy}^2 - 2gH$$

- At maximum height, $v_{fy} = 0$ and $v_{iy} = v_i \sin \theta$:

$$0 = (v_i \sin \theta)^2 - 2gH \implies H = \frac{v_i^2 \sin^2 \theta}{2g}$$

- For a given launch velocity v_i and local gravity g , the maximum height is directly proportional to $\sin^2 \theta$.

Why other options are incorrect:

- Option B:** $\cos^2 \theta$ governs the kinetic energy associated with the horizontal velocity component.
- Option C:** $\cos \theta$ determines the horizontal range and velocity components.
- Option D:** The total time of flight depends linearly on $\sin \theta$ ($T = \frac{2v_i \sin \theta}{g}$), whereas maximum height depends on $\sin^2 \theta$.

Question #100 Key: (A)PHYSICS
KMU 2026

In an isolated system, total energy and momentum is _____ in all situations.

CORE CONCEPT & DERIVATION

In an isolated thermodynamic and mechanical system, no matter or external net force/energy interacts with the system, guaranteeing the strict conservation of total energy and linear momentum.

Formula / Rule / Reaction:

$$\sum \vec{F}_{\text{ext}} = 0 \implies \vec{P}_{\text{total}} = \text{Constant} \quad | \quad E_{\text{total}} = \text{Constant}$$

Solution:

- An isolated system is closed to both external mass transfer and external forces.
- According to fundamental conservation laws, total mechanical/thermal energy and vector momentum remain strictly conserved over time regardless of internal collisions or transformations.

Why other options are incorrect:

- Option B:** Energy and momentum cannot be destroyed or lost in an isolated physical system.
- Option C:** Spontaneous doubling violates both the First Law of Thermodynamics and Newton's Third Law.
- Option D:** Spontaneous reduction without external interactions violates the fundamental conservation laws of physics.

Question #101 Key: (C)PHYSICS
KMU 2026

A person pushes against a stationary wall with a constant force for 2 mins. The work done on th...

CORE CONCEPT & DERIVATION

In classical mechanics, mechanical work is defined as the dot product of the applied force vector and the resulting displacement vector of the point of application.

Formula / Rule / Reaction:

$$W = \vec{F} \cdot \vec{d} = Fd \cos \theta$$

Solution:

- The wall remains stationary throughout the duration of the push, meaning displacement is zero ($d = 0$).

- Evaluating work:

$$W = F \times 0 \times \cos(0^\circ) = 0 \text{ Joules}$$

- Regardless of the person's muscular exertion and fatigue, zero physical work is performed on the wall.

Why other options are incorrect:

- Option A:** Positive work requires a non-zero displacement in the direction of the applied force vector.
- Option B:** Negative work requires displacement in the direction opposing the applied force vector.
- Option D:** Force and work have different physical dimensions (Newtons versus Joules) and cannot be equated.

Question #102 Key: (B)PHYSICS
KMU 2026

A motor performs 2400 J of work in 2 minutes. The power generated is:

CORE CONCEPT & DERIVATION

Power is the rate at which work is performed or energy is converted per unit time, requiring time to be expressed in standard SI units (seconds).

Formula / Rule / Reaction:

$$P = \frac{W}{t}$$

Solution:

- Given work: $W = 2400 \text{ J}$.

- Convert elapsed time to seconds:

$$t = 2 \text{ minutes} = 2 \times 60 \text{ s} = 120 \text{ s}$$

- Calculate generated power:

$$P = \frac{2400 \text{ J}}{120 \text{ s}} = 20 \text{ W}$$

Why other options are incorrect:

- Option A:** Results from doubling the denominator time interval to 240 seconds.
- Option C:** Fails to convert minutes to seconds, dividing directly by 2: $\frac{2400}{2} = 1200 \text{ W}$.
- Option D:** Erroneously multiplies work by elapsed time: $2400 \times 2 = 4800$.

Question #103 Key: (B)PHYSICS
KMU 2026

The equation $P.E = mgh$ is NOT applicable when:

CORE CONCEPT & DERIVATION

The approximation $P.E. = mgh$ assumes a constant gravitational field strength (g), which is valid only in the immediate vicinity of the Earth's surface where height $h \ll R_E$.

Formula / Rule / Reaction:

$$U(r) = -\frac{GM_E m}{r} \quad (\text{General Gravitational Potential Energy})$$

Solution:

- Gravitational acceleration diminishes with distance according to Newton's Law of Universal Gravitation:

$$g(r) = \frac{GM_E}{r^2}$$
- When the body's altitude h is comparable to or much greater than the Earth's radius ($h \gg R_E$), g varies significantly with altitude and the linear equation mgh fails, requiring the integration of gravitational force instead.

Why other options are incorrect:

- Option A:** When $h \ll R_E$, gravitational acceleration is effectively constant, making mgh a precise and standard approximation.
- Option C:** Mass is an intrinsic physical property of matter; if mass is zero, potential energy is trivially zero.
- Option D:** A constant gravitational field is the exact condition under which $P.E. = mgh$ is strictly valid.

Question #104 Key: (C)PHYSICS
KMU 2026

If the string breaks while a ball is moving in a circle, the ball will:

CORE CONCEPT & DERIVATION

According to Newton's First Law of Motion, when the centripetal force holding an object in circular motion abruptly ceases, the object continues moving in a straight line along its instantaneous tangential velocity vector.

Formula / Rule / Reaction:

$$\vec{F}_c = 0 \implies \vec{a} = 0 \implies \vec{v} = \vec{v}_{\text{tangential}} = \text{Constant}$$

Solution:

- The tension in the string provides the inward centripetal force necessary to continuously redirect the ball's velocity vector into a curved path.
- When the string snaps, the centripetal force drops to zero instantly. Due to inertia, the ball maintains its instantaneous velocity, flying off along a straight path tangent to the circular trajectory at the release point.

Why other options are incorrect:

- Option A:** Circular motion requires a continuous inward centripetal force, which cannot exist without the string.
- Option B:** An object in motion maintains its velocity unless acted upon by a retarding external force.
- Option D:** Inward motion toward the center would require an attractive central force rather than zero force.

Question #105 Key: (B)PHYSICS
KMU 2026

One radian is the angle subtended at the centre by an arc whose length is equal to the _____.

CORE CONCEPT & DERIVATION

A radian is the plane angle subtended at the center of a circle by an arc whose length along the circumference is equal to the radius of the circle.

Formula / Rule / Reaction:

$$\theta = \frac{s}{r} \quad (\text{radians})$$

Solution:

- From the arc length relationship $s = r\theta$, set arc length equal to radius:

$$s = r$$

- Substituting yields:

$$\theta = \frac{r}{r} = 1 \text{ radian} \approx 57.3^\circ$$

Why other options are incorrect:

- Option A:** An arc length equal to the diameter ($s = 2r$) subtends an angle of 2 radians.
- Option C:** An arc length equal to the full circumference ($s = 2\pi r$) subtends an angle of 2π radians (360°).
- Option D:** A chord is a straight line segment joining two points on a circle, not a curved arc length.

Question #106 Key: (C)PHYSICS
KMU 2026

The SI unit of angular displacement is:

CORE CONCEPT & DERIVATION

In the International System of Units (SI), angular displacement is a dimensionless derived quantity whose coherent SI unit is the radian (rad).

Formula / Rule / Reaction:

$$\theta = \frac{s}{r} \left[\frac{\text{meter}}{\text{meter}} \implies \text{Radian (rad)} \right]$$

Solution:

- Angular displacement represents the angle swept out by a position vector rotating about an axis.
- Although degrees and revolutions are widely used practical units, the coherent SI standard unit is the radian.

Why other options are incorrect:

- Option A:** The degree is a non-SI unit of plane angle equal to $\frac{\pi}{180}$ rad.
- Option B:** Revolution is a rotational unit equal to 2π rad or 360° .
- Option D:** Radians per second (rad/s) is the SI unit of angular velocity, not angular displacement.

Question #107 Key: (A)PHYSICS
KMU 2026

A raindrop falls through the air and eventually reaches terminal velocity. At this instant, the...

CORE CONCEPT & DERIVATION

Terminal velocity is the constant maximum velocity achieved by a falling body when the upward fluid drag force balances the downward force of gravity.

Formula / Rule / Reaction:

$$F_{\text{net}} = F_g - F_d = mg - 6\pi\eta r v_t = 0$$

Solution:

- As the raindrop accelerates downward, upward aerodynamic drag (air resistance) increases with speed.
- When the drag force equals the weight of the raindrop, the upward and downward forces balance:

$$\vec{F}_{\text{net}} = 0$$
- With zero net force, acceleration drops to zero ($a = 0$), and the raindrop continues falling at a steady terminal velocity.

Why other options are incorrect:

- Option B:** If net force exceeded weight, upward acceleration would occur, which does not happen during steady terminal descent.
- Option C:** Air resistance is one of the opposing component forces; the net force is the vector sum of weight and air resistance, which equals zero.
- Option D:** Net force is zero because weight is cancelled out by upward drag.

Question #108 Key: (C)PHYSICS
KMU 2026

As the skydiver slows down after opening the parachute and approaches terminal velocity 2, the...

CORE CONCEPT & DERIVATION

Aerodynamic drag depends directly on velocity; as a skydiver decelerates after parachute deployment, the upward air resistance progressively decreases from its peak until it matches the skydiver's weight.

Formula / Rule / Reaction:

$$F_d = \frac{1}{2} C_d \rho A v^2 \implies F_d \propto v^2$$

Solution:

- Upon opening the canopy, the enlarged surface area causes a sudden increase in drag force exceeding the skydiver's weight, producing upward acceleration that slows the skydiver down.
- Because drag force is proportional to the square of velocity ($F_d \propto v^2$), reducing speed continuously decreases (reduces) air resistance.
- The air resistance decreases until it equals the skydiver's weight at the second, lower terminal velocity.

Why other options are incorrect:

- Option A:** Air resistance remains non-zero throughout descent, balancing the skydiver's weight at terminal velocity.
- Option B:** Air resistance increases initially upon parachute opening, but decreases as the skydiver decelerates toward the new terminal velocity.
- Option D:** Air resistance changes dynamically as the skydiver's speed changes.

Question #109 Key: (A)

PHYSICS
KMU 2026

A hosepipe ejects water with a velocity of 2 m/s from an opening of 0.05 m². To double the velo...

CORE CONCEPT & DERIVATION

For the steady, incompressible flow of an ideal fluid, the equation of continuity dictates that the volume flow rate remains constant across different pipe cross-sections.

Formula / Rule / Reaction:

$$A_1 v_1 = A_2 v_2$$

Solution:

- Given: initial area $A_1 = 0.05 \text{ m}^2$, initial velocity $v_1 = 2 \text{ m/s}$, and target velocity $v_2 = 2 \times 2 = 4 \text{ m/s}$.
- Rearrange the continuity equation for A_2 :

$$A_2 = \frac{A_1 v_1}{v_2} = \frac{0.05 \text{ m}^2 \times 2 \text{ m/s}}{4 \text{ m/s}} = 0.025 \text{ m}^2$$
- Doubling the fluid ejection velocity requires halving the nozzle cross-sectional area.

Why other options are incorrect:

- Option B:** 0.0125 m² would quadruple the fluid velocity to 8 m/s.
- Option C:** 0.05 m² is the unadjusted initial area that maintains velocity at 2 m/s.
- Option D:** 0.10 m² would double the cross-sectional area, reducing velocity by half to 1 m/s.

Question #110 Key: (B)

PHYSICS
KMU 2026

If the radius of an artery is reduced due to arteriosclerosis, the heart must increase blood pr...

CORE CONCEPT & DERIVATION

Poiseuille's law governs laminar viscous flow through cylindrical vessels, where volumetric flow rate depends on the fourth power of the vessel radius.

Formula / Rule / Reaction:

$$Q = \frac{\pi \Delta P r^4}{8 \eta L} \Rightarrow \Delta P = \frac{8 \eta L Q}{\pi r^4}$$

Solution:

- Vascular narrowing from arteriosclerotic plaques reduces arterial luminal radius r , increasing vascular resistance proportional to $\frac{1}{r^4}$.
- To overcome this elevated resistance and maintain constant perfusion and flow rate (Q) to peripheral tissues, myocardial contraction must generate higher driving pressure (ΔP).

Why other options are incorrect:

- Option A:** Hypertensive compensation acts to restore baseline flow, not to exceed physiological perfusion requirements.
- Option C:** Reducing systemic perfusion would cause downstream tissue ischemia and hypoxia.
- Option D:** Blood pressure cannot reverse rigid calcified atherosclerotic plaques to restore luminal radius.

Question #111 Key: (B)

PHYSICS
KMU 2026

In a progressive wave, a wave crest moves a distance of _____ during one complete period (T)...

CORE CONCEPT & DERIVATION

By definition, wave speed is the distance traveled by a wave disturbance per unit time; in one complete period (T), a wavefront advances by one full wavelength (λ).

Formula / Rule / Reaction:

$$d = v \times T = (f\lambda) \times \left(\frac{1}{f}\right) = \lambda$$

Solution:

- The period T is the duration required for one complete oscillatory cycle at any fixed point in the medium.
- During this time interval, the wave profile propagates forward through the medium by a spatial distance corresponding to one full wavelength (λ).

Why other options are incorrect:

- Option A:** A wave travels half a wavelength in half a period ($\frac{T}{2}$).
- Option C:** Traveling two wavelengths requires two complete temporal cycles ($2T$).
- Option D:** Multiple wavelengths require multiple periods to propagate.

Question #112 Key: (A)PHYSICS
KMU 2026

In transverse waves, the particles of the medium vibrate _____ to the direction of wave prop...

CORE CONCEPT & DERIVATION

Mechanical waves are classified based on the orientation of particle oscillation relative to the direction of energy propagation: transverse (perpendicular) and longitudinal (parallel).

Formula / Rule / Reaction:

$$\text{Transverse: } \vec{v}_{\text{particle}} \perp \vec{v}_{\text{wave}} \quad \text{Longitudinal: } \vec{v}_{\text{particle}} \parallel \vec{v}_{\text{wave}}$$

Solution:

- In transverse waves (such as surface water waves and electromagnetic waves), particle displacements occur at right angles (perpendicular) to the axis of wave travel.
- In longitudinal waves (such as acoustic sound waves in air), medium particles oscillate back and forth parallel to the direction of wave travel.

Why other options are incorrect:

- Option B:** Inverts the particle displacement characteristics of both wave types.
- Option C:** Erroneously claims that transverse wave particles oscillate parallel to wave travel.
- Option D:** Erroneously claims that longitudinal wave particles oscillate perpendicularly to wave travel.

Question #113 Key: (C)PHYSICS
KMU 2026

A wave travels through a string with a frequency of 25 Hz and a wavelength of 1.6 m. How far do...

CORE CONCEPT & DERIVATION

Wave speed is determined by the wave equation ($v = f\lambda$); the distance traversed in a given time interval is calculated using kinematic distance ($d = vt$).

Formula / Rule / Reaction:

$$v = f\lambda \quad \text{and} \quad d = v \times t$$

Solution:

- Calculate wave propagation speed:
 $v = 25 \text{ Hz} \times 1.6 \text{ m} = 40 \text{ m/s}$
- Calculate distance traveled in $t = 8 \text{ s}$:
 $d = 40 \text{ m/s} \times 8 \text{ s} = 320 \text{ m}$

Why other options are incorrect:

- Option A:** 160 m corresponds to an elapsed time of 4 seconds.
- Option B:** 240 m corresponds to an elapsed time of 6 seconds.
- Option D:** 400 m corresponds to an elapsed time of 10 seconds.

Question #114 Key: (B)PHYSICS
KMU 2026

The increase in speed of sound in gas for each 1°C rise in temperature is:

CORE CONCEPT & DERIVATION

The speed of sound in an ideal gas is proportional to the square root of its absolute temperature; near 0°C, a first-order binomial expansion shows a linear increase of approximately 0.61 m/s per degree Celsius.

Formula / Rule / Reaction:

$$v_t \approx v_0 + 0.61t \text{ (m/s)}$$

Solution:

- Using the Laplace equation for sound speed in air:

$$v = \sqrt{\frac{\gamma RT}{M}} = v_0 \sqrt{1 + \frac{t}{273}}$$

- Expanding with the binomial theorem for small temperature changes yields:

$$v_t \approx v_0 \left(1 + \frac{t}{546}\right) = v_0 + \frac{332}{546}t \approx v_0 + 0.61t$$

- Thus, the speed of sound in air increases by approximately 0.61 m/s (rounded to 0.6 m/s) for every 1°C rise in temperature.

Why other options are incorrect:

- Option A:** 0.2 m/s underestimates the temperature coefficient of sound speed.
- Option C:** 1.2 m/s is roughly double the actual rate of increase in air.
- Option D:** 2.0 m/s overstates the thermal expansion effect in air.

Question #115 Key: (C)

PHYSICS
KMU 2026

According to Laplace, sound waves travel through air so rapidly that:

CORE CONCEPT & DERIVATION

Laplace corrected Newton's formula by recognizing that sound propagation through air involves rapid alternating acoustic compressions and rarefactions that occur adiabatically.

Formula / Rule / Reaction:

$$PV^\gamma = \text{Constant} \quad (Q = 0, \text{ Adiabatic condition})$$

Solution:

- Newton assumed sound travels isothermally, allowing heat exchange to maintain constant temperature.
- Laplace established that air is a poor thermal conductor and rapid acoustic pressure oscillations occur too quickly for heat to transfer between compressions and rarefactions.
- Consequently, the process is adiabatic: no heat is exchanged with the surroundings ($Q = 0$).

Why other options are incorrect:

- **Option A:** Complete heat loss would describe an isothermal process with infinite thermal conductivity.
- **Option B:** Net heat gain does not occur during self-contained acoustic pressure oscillations.
- **Option D:** Slow heat exchange contradicts the high frequencies of audible acoustic waves.

Question #116 Key: (A)

PHYSICS
KMU 2026

A gas absorbs [Formula] of heat and performs [Formula] of work. Its change in internal energy (...)

CORE CONCEPT & DERIVATION

The First Law of Thermodynamics states that the change in internal energy of a closed system equals the net heat added to the system minus the work done by the system on its surroundings.

Formula / Rule / Reaction:

$$\Delta U = Q - W$$

Solution:

- Given heat absorbed by the gas:
 $Q = +1.5 \times 10^3 \text{ J}$
- Given work performed by the gas:
 $W = +5.0 \times 10^2 \text{ J} = +0.5 \times 10^3 \text{ J}$
- Substitute into the First Law:
 $\Delta U = (1.5 \times 10^3 \text{ J}) - (0.5 \times 10^3 \text{ J}) = 1.0 \times 10^3 \text{ J}$

Why other options are incorrect:

- **Option B:** Inverts the thermodynamic sign convention, representing net energy loss.
- **Option C:** Erroneously adds work to heat absorbed instead of subtracting work performed.
- **Option D:** Represents the negative sum of both energy terms.

Question #117 Key: (C)

PHYSICS
KMU 2026

One mole of an ideal gas is heated through 20K at constant pressure, where [Formula]. If [Form...]

CORE CONCEPT & DERIVATION

The heat supplied to an ideal gas at constant pressure is governed by its molar heat capacity at constant pressure (C_p), related to C_v by Mayer's relation.

Formula / Rule / Reaction:

$$C_p = C_v + R \quad \text{and} \quad Q_p = nC_p\Delta T$$

Solution:

- Calculate molar heat capacity at constant pressure:
 $C_p = 21 \text{ J mol}^{-1}\text{K}^{-1} + 8.315 \text{ J mol}^{-1}\text{K}^{-1} = 29.315 \text{ J mol}^{-1}\text{K}^{-1}$
- Calculate heat supplied for $n = 1 \text{ mol}$ and $\Delta T = 20 \text{ K}$:
 $Q_p = 1 \times 29.315 \times 20 = 586.3 \text{ J} \approx 586 \text{ J}$

Why other options are incorrect:

- **Option A:** 166 J represents only the boundary work performed by the gas: $W = nR\Delta T = 1 \times 8.315 \times 20 = 166.3 \text{ J}$.
- **Option B:** 420 J represents heat supplied at constant volume: $Q_v = nC_v\Delta T = 1 \times 21 \times 20 = 420 \text{ J}$.
- **Option D:** 752 J results from adding work twice to the internal energy change.

Question #118 Key: (A)

CHEMISTRY
KMU 2026

When chlorine is present in excess during chlorination of methane, the major product is:

CORE CONCEPT & DERIVATION

Free radical halogenation of methane proceeds via progressive substitution; an excess of molecular chlorine drives the reaction toward complete substitution.

Formula / Rule / Reaction:



Solution:

- Chlorination initiates with homolytic cleavage of Cl_2 and continues through propagation steps yielding CH_3Cl , CH_2Cl_2 , and CHCl_3 .
- When chlorine is supplied in excess, all hydrogen atoms on the carbon backbone are substituted, yielding carbon tetrachloride (CCl_4) as the predominant final product.

Why other options are incorrect:

- Option B:** Chloroform (CHCl_3) is an intermediate product formed under limited chlorine conditions.
- Option C:** Methyl chloride (CH_3Cl) is the major product when methane is in excess relative to chlorine.
- Option D:** Methylene chloride (CH_2Cl_2) is an intermediate di-substituted alkane.

Question #119 Key: (C)

CHEMISTRY
KMU 2026

Which carbon chain is selected first when assigning the IUPAC name of an alkene?

CORE CONCEPT & DERIVATION

According to IUPAC nomenclature rules, the parent carbon chain for an unsaturated hydrocarbon must be the longest continuous carbon chain that contains the maximum number of carbon-carbon double bonds.

Formula / Rule / Reaction:

Parent Chain Priority: Max Double Bonds > Maximum Length > Max Substituents

Solution:

- The principal functional group of an alkene is the carbon-carbon double bond ($\text{C}=\text{C}$).
- The parent chain must contain the double bond, even if a longer continuous chain of saturated carbon atoms exists elsewhere in the molecule.

Why other options are incorrect:

- Option A:** Open-chain alkenes are named from acyclic parent chains; cyclic chains are selected only if the ring forms the primary scaffold.
- Option B:** Chain length and unsaturation take priority over branching in IUPAC rules.
- Option D:** Chains with triple bonds define alkynes rather than alkenes.

Question #120 Key: (A)

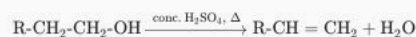
CHEMISTRY
KMU 2026

Which method prepares an alkene by removing water from an alcohol?

CORE CONCEPT & DERIVATION

Dehydration of an alcohol is an elimination reaction in which a molecule of water is removed in the presence of an acid catalyst, yielding an alkene.

Formula / Rule / Reaction:



Solution:

- Heating an alcohol with a concentrated mineral acid (such as H_2SO_4 or H_3PO_4) protonates the hydroxyl group, turning it into a good leaving group ($-\text{OH}_2^+$).
- Subsequent elimination of water and a beta-proton creates a carbon-carbon double bond, a process termed dehydration.

Why other options are incorrect:

- Option B:** Dehydrohalogenation eliminates a hydrogen halide (HX) from an alkyl halide using strong base (such as alcoholic KOH).
- Option C:** Halogenation adds molecular halogen across a double bond or substitutes halogens into alkanes.
- Option D:** Hydrogenation is the addition of molecular hydrogen (H_2) to an unsaturated bond.

Question #121 Key: (A)

CHEMISTRY
KMU 2026

Which statement best describes the structure of benzene? It is a:

CORE CONCEPT & DERIVATION

Benzene (C_6H_6) is an aromatic, regular hexagonal planar ring in which all six carbon atoms are sp^2 hybridized with delocalized pi-electrons above and below the ring plane.

Formula / Rule / Reaction:



Solution:

- Each carbon atom in benzene forms three planar sp^2 hybrid orbitals with bond angles of 120° , generating a flat hexagonal skeleton of six carbon-carbon sigma bonds and six carbon-hydrogen sigma bonds.
- The remaining unhybridized $2p_z$ orbitals overlap laterally, forming a continuous delocalized pi-electron cloud that stabilizes the planar aromatic ring.

Why other options are incorrect:

- Option B:** sp^3 hybridized carbons are tetrahedral (109.5°), characteristic of cyclohexane rather than benzene.
- Option C:** sp hybridization produces linear geometry (180°), as seen in alkynes.
- Option D:** Benzene is strictly planar; non-planar alternating geometries do not match the resonance-stabilized aromatic structure.

Question #122 Key: (D)

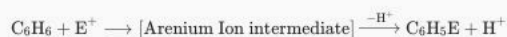
CHEMISTRY
KMU 2026

Compared with alkenes, benzene undergoes _____ reaction to retain its aromatic character.

CORE CONCEPT & DERIVATION

Benzene undergoes electrophilic aromatic substitution rather than addition reactions to preserve the resonance stabilization energy of its delocalized aromatic sextet.

Formula / Rule / Reaction:



Solution:

- Alkenes undergo addition reactions across localized pi-bonds because the resulting saturated products are thermodynamically favored.
- In benzene, addition reactions would destroy the aromatic pi-electron cloud (resonance energy of 150.6 kJ/mol).
- By substituting a ring hydrogen atom with an electrophile, benzene preserves its stable aromatic conjugated pi-system.

Why other options are incorrect:

- Option A:** Addition reactions disrupt aromatic stabilization, requiring harsh conditions (such as high temperature and UV light).
- Option B:** Benzene is already unsaturated and does not undergo simple elimination reactions.
- Option C:** Polymerization is characteristic of simple alkenes (such as ethene to polyethene), not benzene rings under standard conditions.

Question #123 Key: (A)

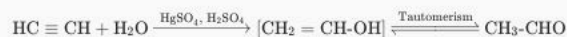
CHEMISTRY
KMU 2026

Hydration of ethyne in the presence of H_2SO_4 and HgSO_4 (100°C) ultimately gives:

CORE CONCEPT & DERIVATION

The mercury-catalyzed hydration of ethyne adds water across the triple bond to produce an unstable vinyl alcohol intermediate, which tautomerizes into acetaldehyde (ethanal).

Formula / Rule / Reaction:



Solution:

- Ethyne reacts with water in the presence of 1% HgSO_4 and 10% H_2SO_4 at 100°C via electrophilic addition.
- The initial enol adduct, vinyl alcohol ($\text{CH}_2 = \text{CH-OH}$), is thermodynamically unstable and tautomerizes into the stable carbonyl tautomer, acetaldehyde (CH_3CHO).

Why other options are incorrect:

- Option B:** Acetic acid requires further oxidation of acetaldehyde by strong oxidizing agents (such as KMnO_4).
- Option C:** Ethanol is produced by the reduction of acetaldehyde or the hydration of ethene.
- Option D:** Ethene is formed by the controlled catalytic hydrogenation of ethyne using Lindlar's catalyst.

Question #124 Key: (A)

CHEMISTRY
KMU 2026

According to IUPAC, when two different halogens are present in a haloalkane at the same positio...

CORE CONCEPT & DERIVATION

Under IUPAC rules for naming polyfunctional and substituted alkanes, prefix substituents are listed alphabetically regardless of position numbers or atomic masses.

Formula / Rule / Reaction:

Alphabetical Order: Bromo > Chloro > Fluoro > Iodo

Solution:

- When different halogen substituents occupy identical locant positions on a carbon skeleton, numerical numbering priority gives preference to the substituent that appears first alphabetically.
- In the final written IUPAC name, substituents are arranged alphabetically (for example, "bromo" precedes "chloro").

Why other options are incorrect:

- Option B:** Branching affects locant numbering across the carbon backbone, not substituent prefix ordering.
- Option C:** Chain length determines parent alkane root names, not substituent order.
- Option D:** Molecular mass is not used in IUPAC nomenclature ordering.

Question #125 Key: (C)

CHEMISTRY
KMU 2026

Which alkyl halide has the highest carbon-halogen bond energy?

CORE CONCEPT & DERIVATION

Carbon-halogen bond energy is inversely related to halogen atomic radius and bond length; smaller halogens exhibit superior orbital overlap and higher electrostatic bond polarity.

Formula / Rule / Reaction:

Bond Energy Order: C-F (467 kJ/mol) > C-Cl (346 kJ/mol) > C-Br (290 kJ/mol) > C-I (228 kJ/mol)

Solution:

- Fluorine is the most electronegative element and has the smallest atomic radius among the halogens.
- This produces the shortest carbon-halogen bond length (1.39 Å), leading to strong orbital overlap and the highest bond dissociation energy (~ 467 kJ/mol).

Why other options are incorrect:

- Option A:** The C-Br bond has a lower dissociation energy of 290 kJ/mol due to the larger bromine radius.
- Option B:** The C-Cl bond has a bond energy of 346 kJ/mol, weaker than C-F.
- Option D:** The C-I bond is the longest and weakest (228 kJ/mol), making alkyl iodides the most reactive alkyl halides.

Question #126 Key: (C)

CHEMISTRY
KMU 2026

An alcohol that produces cloudiness immediately with Lucas reagent is:

CORE CONCEPT & DERIVATION

The Lucas test distinguishes alcohols based on the stability of carbocation intermediates formed during S_N1 substitution by concentrated HCl and anhydrous ZnCl₂.

Formula / Rule / Reaction:



Solution:

- Lucas reagent (anhydrous ZnCl₂ in concentrated HCl) converts alcohols into insoluble alkyl chlorides, visible as milky turbidity.
- Tertiary alcohols react immediately due to the high stability of tertiary carbocation intermediates.
- Secondary alcohols require 5 to 10 minutes, and primary alcohols do not react at room temperature.

Why other options are incorrect:

- Option A:** Primary alcohols do not produce turbidity at room temperature unless heated.
- Option B:** Secondary alcohols produce turbidity within 5 to 10 minutes.
- Option D:** Trihydric alcohols (such as glycerol) possess multiple hydroxyl groups and do not react rapidly with Lucas reagent without heating.

Question #127 Key: (B)

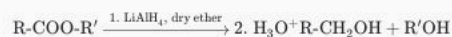
CHEMISTRY
KMU 2026

Reduction of an ester with lithium aluminium hydride mainly produces:

CORE CONCEPT & DERIVATION

Lithium aluminium hydride (LiAlH₄) is a powerful nucleophilic reducing agent that reduces carboxylic esters down to two molecules of primary alcohols.

Formula / Rule / Reaction:



Solution:

- Hydride ion (H⁻) nucleophilically attacks the ester carbonyl carbon, expelling an alkoxide leaving group (R'O⁻) to form a transient aldehyde intermediate.
- Because LiAlH₄ is a strong reducing agent, the aldehyde is rapidly reduced to a primary alcohol (R-CH₂OH).
- Aqueous workup releases the corresponding alcohol from the alkoxide leaving group as well.

Why other options are incorrect:

- Option A:** Esters are reduced to alcohols; reduction does not generate alkenes.
- Option C:** Aldehydes are transient reaction intermediates that cannot be isolated when using LiAlH₄.
- Option D:** Esters cannot be converted to ketones by hydride reduction.

Question #128 Key: (A)

CHEMISTRY
KMU 2026

Which carbonyl compound is generally more reactive toward nucleophilic addition?

CORE CONCEPT & DERIVATION

Aldehydes are more reactive than ketones toward nucleophilic addition due to lower steric hindrance and greater electrophilicity at the carbonyl carbon.

Formula / Rule / Reaction:



Solution:

- Sterically, an aldehyde has only one alkyl group and one small hydrogen atom attached to the carbonyl carbon, allowing nucleophiles easier access compared to ketones with two bulky alkyl groups.
- Electronically, ketones have two electron-donating alkyl groups (+I inductive effect) that disperse the partial positive charge on the carbonyl carbon more than the single alkyl group in aldehydes, reducing electrophilicity.

Why other options are incorrect:

- Option B:** Alcohols contain hydroxyl groups and are not carbonyl compounds.
- Option C:** Ethers contain an oxygen bridge between two alkyl groups and are not carbonyl compounds.
- Option D:** Ketones are less reactive than aldehydes toward nucleophilic addition due to steric hindrance and +I charge stabilization.

Question #129 Key: (D)

CHEMISTRY
KMU 2026

Which reagent distinguishes aldehydes from ketones by producing a silver mirror?

CORE CONCEPT & DERIVATION

Tollen's reagent (ammoniacal silver nitrate) oxidizes aldehydes to carboxylate ions while silver ions (Ag^+) are reduced to metallic silver, depositing a reflective silver mirror.

Formula / Rule / Reaction:



Solution:

- Aldehydes possess an oxidizable carbonyl hydrogen atom, allowing mild oxidation by ammoniacal silver nitrate (Tollen's reagent).
- The reduction of Ag^+ produces metallic silver that coats the inner glass wall of the reaction vessel as a silver mirror.
- Ketones lack a carbonyl hydrogen and do not react with Tollen's reagent under standard conditions.

Why other options are incorrect:

- Option A:** Benedict's reagent produces a brick-red cuprous oxide (Cu_2O) precipitate with aliphatic reducing sugars, not a silver mirror.
- Option B:** Clemmensen reduction ($\text{Zn-Hg}/\text{conc. HCl}$) reduces carbonyls to alkanes.
- Option C:** Fehling's solution forms a red precipitate of Cu_2O , not metallic silver.

Question #130 Key: (C)

CHEMISTRY
KMU 2026

Which of the following protein-prosthetic group combinations is correctly matched?

CORE CONCEPT & DERIVATION

Conjugated proteins consist of a simple apoprotein covalently or non-covalently linked to a non-protein prosthetic group that determines their biochemical classification.

Formula / Rule / Reaction:



Solution:

- Lipoproteins consist of proteins combined with lipids (such as phospholipids, cholesterol, and triglycerides) as their non-protein prosthetic group.
- They function in the transport of hydrophobic lipids through blood plasma (for example, HDL and LDL).

Why other options are incorrect:

- Option A:** Chromoproteins contain pigmented prosthetic groups (such as heme or riboflavin), not carbohydrates.
- Option B:** Glycoproteins contain carbohydrates (oligosaccharides) as their prosthetic group, not lipids.
- Option D:** Nucleoproteins contain nucleic acids (DNA or RNA) as their prosthetic group, not carbohydrates.

Question #131 Key: (B)

CHEMISTRY
KMU 2026

A manufacturer needs an adhesive that solidifies on cooling and is widely used in bookbinding a...

CORE CONCEPT & DERIVATION

Hot-melt adhesives are solvent-free thermoplastic formulations applied in molten form that rapidly gain bond strength and solidify upon cooling to ambient temperatures.

Formula / Rule / Reaction:



Solution:

- Hot-melt adhesives (often based on ethylene-vinyl acetate or polyolefins) are heated above their melting points and dispensed onto substrates.
- Upon rapid thermal cooling, the polymer solidifies, forming bonds within seconds. This rapid setting makes them suitable for high-speed industrial bookbinding and corrugated box packaging.

Why other options are incorrect:

- Option A:** Contact adhesives require solvent evaporation from both surfaces prior to pressure bonding.
- Option C:** Pressure-sensitive adhesives (such as those on adhesive tapes) remain permanently tacky and bond upon light applied pressure without temperature changes.
- Option D:** Solvent-based adhesives require solvent evaporation to dry, which is slower than thermal setting.

Question #132 Key: (A)

CHEMISTRY
KMU 2026

Which polymer is produced through condensation polymerization?

CORE CONCEPT & DERIVATION

Condensation polymerization involves the reaction of bifunctional or polyfunctional monomers accompanied by the elimination of small byproduct molecules such as water or hydrogen chloride.

Formula / Rule / Reaction:



Solution:

- Nylon-6,6 is synthesized by step-growth condensation polymerization of adipic acid (a dicarboxylic acid) and hexamethylenediamine (a diamine).
- Each peptide/amide bond formation releases a molecule of water, defining it as a condensation polymer.

Why other options are incorrect:

- Option B:** Polyethylene is synthesized via chain-growth addition polymerization of ethene monomers without byproducts.
- Option C:** Polyvinyl chloride (PVC) is produced by addition polymerization of vinyl chloride.
- Option D:** Polystyrene is synthesized by addition polymerization of styrene.

Question #133 Key: (D)

CHEMISTRY
KMU 2026

What is the mass of 1 mole of calcium carbonate (CaCO_3)? (Molar mass of calcium: 40 g/mol, carb...

CORE CONCEPT & DERIVATION

The molar mass of a chemical compound is the sum of the standard atomic weights of all constituent atoms present in its chemical formula.

Formula / Rule / Reaction:

$$M = M_{\text{Ca}} + M_{\text{C}} + 3(M_{\text{O}})$$

Solution:

- Identify the molar masses of the constituent elements: $M_{\text{Ca}} = 40 \text{ g/mol}$, $M_{\text{C}} = 12 \text{ g/mol}$, and $M_{\text{O}} = 16 \text{ g/mol}$.
- Calculate the molar mass of CaCO_3 :

$$M = 40 + 12 + 3(16) = 40 + 12 + 48 = 100 \text{ g/mol}$$
- Therefore, the mass of exactly one mole of calcium carbonate is 100 g.

Why other options are incorrect:

- Option A:** 25 g corresponds to the mass of 0.25 moles of CaCO_3 .
- Option B:** 50 g corresponds to the mass of 0.50 moles of CaCO_3 .
- Option C:** 75 g corresponds to the mass of 0.75 moles of CaCO_3 .

Question #134 Key: (B)

CHEMISTRY
KMU 2026

A limiting reagent:

CORE CONCEPT & DERIVATION

In a stoichiometric chemical reaction, the limiting reactant is completely consumed first, yielding the lowest theoretical amount of product and halting the reaction.

Formula / Rule / Reaction:

$$\text{Theoretical Yield} = \text{Moles of Product determined by Limiting Reactant}$$

Solution:

- Reactants are rarely present in exact stoichiometric ratios.
- The reactant that runs out first produces the minimum number of moles of product, terminating the reaction and leaving excess reactants unreacted.

Why other options are incorrect:

- Option A:** The reactant present in excess is available in larger amounts than required by the stoichiometry.
- Option C:** The limiting reagent limits and yields the least product, not the maximum.
- Option D:** The limiting reagent directly determines the final theoretical yield of the reaction.

Question #135 Key: (C)

CHEMISTRY
KMU 2026

Which of the following is a CORRECT statement about yield?

CORE CONCEPT & DERIVATION

Percentage yield compares the actual experimental yield to the theoretical stoichiometric maximum, serving as an index of reaction efficiency.

Formula / Rule / Reaction:

$$\text{Percentage Yield} = \frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100\%$$

Solution:

- In synthetic chemistry, incomplete reactions, side reactions, and mechanical transfer losses reduce product recovery below theoretical maximums.
- Chemists calculate percentage yield to evaluate the synthetic efficiency of a reaction protocol.

Why other options are incorrect:

- Option A:** The amount obtained experimentally is the actual yield, not the theoretical yield.
- Option B:** Percent yield measures product recovery efficiency relative to theoretical yield, not the mass of reactants used.
- Option D:** The amount calculated from a balanced chemical equation is the theoretical yield, not the actual yield.

Question #136 Key: (A)

CHEMISTRY
KMU 2026

The shape of an orbital depends on the _____ quantum number.

CORE CONCEPT & DERIVATION

The azimuthal (orbital angular momentum) quantum number (l) defines the three-dimensional geometric shape and angular distribution of an atomic orbital.

Formula / Rule / Reaction:

$$l = 0 \Rightarrow s \text{ (spherical)}, l = 1 \Rightarrow p \text{ (dumb-bell)}, l = 2 \Rightarrow d \text{ (cloverleaf / double dumb-bell)}$$

Solution:

- The principal quantum number (n) dictates orbital size and energy shell.
- The azimuthal quantum number (l), taking integer values from 0 to $n - 1$, specifies the orbital angular momentum and determines whether the electron cloud is spherical, dumbbell-shaped, or more complex.

Why other options are incorrect:

- Option B:** The magnetic quantum number (m_l) determines the spatial orientation of an orbital in three dimensions.
- Option C:** The principal quantum number (n) designates the primary electronic shell, radial distance from the nucleus, and major energy level.
- Option D:** The spin quantum number (m_s) specifies the intrinsic magnetic spin projection of an electron ($+\frac{1}{2}$ or $-\frac{1}{2}$).

Question #137 Key: (C)

CHEMISTRY
KMU 2026

According to Pauli's Exclusion Principle, no two electrons in an atom can have the same set of ...

CORE CONCEPT & DERIVATION

Pauli's Exclusion Principle states that no two fermions in the same quantum system can simultaneously occupy the same quantum state, meaning they cannot share identical values for all four quantum numbers.

Formula / Rule / Reaction:

$$\text{Quantum State Vector} = (n, l, m_l, m_s)$$

Solution:

- Each atomic electron is uniquely characterized by four quantum numbers: principal (n), azimuthal (l), magnetic (m_l), and spin (m_s).
- If two electrons share the same orbital (identical n , l , and m_l), their spin quantum numbers must be antiparallel ($+\frac{1}{2}$ and $-\frac{1}{2}$), preventing all four numbers from being identical.

Why other options are incorrect:

- Option A:** Two electrons can easily share two quantum numbers (such as being in the same subshell: identical n and l).
- Option B:** Two paired electrons in the same orbital routinely share three quantum numbers (n , l , and m_l).
- Option D:** Atomic electronic states are defined by exactly four quantum numbers, not five.

Question #138 Key: (B)

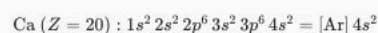
CHEMISTRY
KMU 2026

What is the electronic configuration of Calcium?

CORE CONCEPT & DERIVATION

The ground-state electronic configuration of an element is determined by filling atomic orbitals in order of increasing energy according to the Aufbau principle ($n + l$ rule).

Formula / Rule / Reaction:



Solution:

- Calcium has an atomic number of $Z = 20$.
- The first 18 electrons occupy the closed core shell of noble gas Argon: $1s^2 2s^2 2p^6 3s^2 3p^6 = [\text{Ar}]$
- The remaining two valence electrons occupy the lower-energy $4s$ subshell ahead of the $3d$ subshell, giving the ground-state configuration $[\text{Ar}] 4s^2$.

Why other options are incorrect:

- Option A:** $[\text{Ar}] 4s^1$ is the ground-state configuration of Potassium ($Z = 19$).
- Option C:** $[\text{Ne}] 3s^2$ is the configuration of Magnesium ($Z = 12$).
- Option D:** $[\text{He}] 2s^2$ is the configuration of Beryllium ($Z = 4$).

Question #139 Key: (C)CHEMISTRY
KMU 2026

The average kinetic energy of gas molecules is directly proportional to _____ of the gas.

CORE CONCEPT & DERIVATION

According to the kinetic molecular theory of ideal gases, macroscopic absolute temperature is a direct measure of the average translational kinetic energy of constituent gas particles.

Formula / Rule / Reaction:

$$\overline{\text{K.E.}} = \frac{3}{2} k_B T \implies \overline{\text{K.E.}} \propto T$$

Solution:

- The fundamental kinetic equation for an ideal gas equates translational kinetic energy to thermal energy.
- Because Boltzmann's constant (k_B) is an invariant physical constant, the mean kinetic energy of gas particles depends strictly and linearly on the thermodynamic absolute temperature in Kelvin (T).

Why other options are incorrect:

- Option A:** Density represents mass per unit volume and does not directly dictate particle kinetic velocity.
- Option B:** Pressure reflects wall collision frequency and momentum transfer, which varies with volume even at fixed kinetic energy.
- Option D:** Volume describes container geometry and space, independent of particle speed at constant temperature.

Question #140 Key: (B)CHEMISTRY
KMU 2026

If the pressure of a gas is doubled at constant temperature, its volume will:

CORE CONCEPT & DERIVATION

Boyle's law states that the volume occupied by a fixed mass of an ideal gas is inversely proportional to its applied pressure when temperature is held constant.

Formula / Rule / Reaction:

$$P_1 V_1 = P_2 V_2 \implies V_2 = V_1 \left(\frac{P_1}{P_2} \right)$$

Solution:

- Let initial pressure be P_1 and initial volume be V_1 .
- When pressure is doubled ($P_2 = 2P_1$) under isothermal conditions:

$$V_2 = V_1 \times \frac{P_1}{2P_1} = \frac{1}{2} V_1$$
- Thus, the volume of the gas is reduced by half.

Why other options are incorrect:

- Option A:** Doubling the volume occurs when pressure is halved, not doubled.
- Option C:** Volume cannot remain unchanged when external compressive pressure increases.
- Option D:** Tripling the volume requires reducing the pressure to one-third of its initial value.

Question #141 Key: (B)CHEMISTRY
KMU 2026

If the absolute temperature of a gas doubles at constant pressure, its volume will:

CORE CONCEPT & DERIVATION

Charles's law states that the volume of a given mass of dry gas is directly proportional to its absolute temperature under isobaric (constant pressure) conditions.

Formula / Rule / Reaction:

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \implies V_2 = V_1 \left(\frac{T_2}{T_1} \right)$$

Solution:

- Let initial absolute temperature be T_1 and initial volume be V_1 .
- When absolute temperature is doubled to $T_2 = 2T_1$ at constant pressure:

$$V_2 = V_1 \times \frac{2T_1}{T_1} = 2V_1$$

- Therefore, the gas expands to double its original volume.

Why other options are incorrect:

- Option A:** Volume must expand as molecules gain kinetic energy and exert outward pressure at fixed external resistance.
- Option C:** Halving occurs upon cooling the gas to half its absolute temperature.
- Option D:** Tripling volume requires tripling the absolute temperature ($T_2 = 3T_1$).

Question #142 Key: (C)CHEMISTRY
KMU 2026

Absolute zero is equal to _____ °C.

CORE CONCEPT & DERIVATION

Absolute zero (0 K) is the theoretical thermodynamic lower limit of temperature where particle translational kinetic energy approaches zero.

Formula / Rule / Reaction:

$$T (^{\circ}\text{C}) = T (\text{K}) - 273.15$$

Solution:

- To convert absolute zero from the Kelvin thermodynamic scale to the Celsius scale:

$$0 \text{ K} - 273.15 = -273.15^{\circ}\text{C}$$
- Rounding to the nearest whole integer gives -273°C .

Why other options are incorrect:

- Option A:** -100°C corresponds to 173.15 K.
- Option B:** -173°C corresponds to 100.15 K.
- Option D:** -373°C is below absolute zero, which is physically impossible.

Question #143 Key: (C)

CHEMISTRY
KMU 2026

The kinetic energy of liquid molecules is _____ compared to that of solids.

CORE CONCEPT & DERIVATION

Molecules in the liquid state possess greater thermal and kinetic energy than in the solid state, allowing translational and rotational freedom past one another.

Formula / Rule / Reaction:

$$K.E_{\text{gas}} > K.E_{\text{liquid}} > K.E_{\text{solid}}$$

Solution:

- In solids, strong intermolecular lattice forces restrict particles to vibrational motion about fixed equilibrium positions.
- Upon melting, absorbed latent heat of fusion provides sufficient kinetic energy for molecules to overcome rigid lattice constraints, gaining translational and rotational kinetic energy.

Why other options are incorrect:

- **Option A:** Kinetic energy varies dynamically with temperature and phase state.
- **Option B:** Even at the melting point, liquid particles require latent heat absorption to transition from solid, possessing higher enthalpy and entropy.
- **Option D:** Solid particles have lower kinetic energy due to confinement within rigid crystalline potential energy wells.

Question #144 Key: (A)

CHEMISTRY
KMU 2026

At the boiling point, added heat is used to break _____ forces.

CORE CONCEPT & DERIVATION

During liquid-to-vapor phase transitions at the boiling point, thermal energy (latent heat of vaporization) is consumed to overcome attractive intermolecular forces.

Formula / Rule / Reaction:**Solution:**

- Boiling is a physical phase change where molecules transition from a cohesive liquid state to a widely separated gaseous state.
- Added heat does not break intramolecular covalent bonds within molecules; it overcomes weaker intermolecular attractions (such as dipole-dipole, hydrogen bonds, and London dispersion forces) holding molecules together.

Why other options are incorrect:

- **Option B:** Ionic forces form strong crystal lattices in ionic salts; molecular liquids are held together by intermolecular van der Waals forces.
- **Option C:** Magnetic forces play no role in typical liquid boiling phenomena.
- **Option D:** Nuclear forces bind nucleons within atomic nuclei, requiring mega-electronvolt energy scales unrelated to boiling.

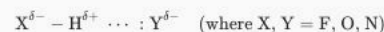
Question #145 Key: (A)

CHEMISTRY
KMU 2026

Hydrogen bonding occurs between hydrogen and a highly _____ atom.

CORE CONCEPT & DERIVATION

A hydrogen bond is an electrostatic dipole-dipole interaction between a hydrogen atom covalently bonded to a small, highly electronegative atom (F, O, or N) and another electronegative atom.

Formula / Rule / Reaction:**Solution:**

- High electronegativity differences polarize the covalent bond, drawing electron density away from hydrogen and leaving it with a strong partial positive charge ($\delta+$).
- The small size of hydrogen allows close approach to lone electron pairs of adjacent electronegative atoms (such as fluorine, oxygen, or nitrogen), forming a hydrogen bond.

Why other options are incorrect:

- **Option B:** Electropositive atoms (such as alkali metals) form ionic or metallic bonds, not hydrogen bonds.
- **Option C:** Nonpolar atoms lack the substantial permanent dipoles required for hydrogen bonding.
- **Option D:** Nuclear radioactivity is unrelated to electronic electronegativity and chemical bonding.

Question #146 Key: (C)

CHEMISTRY
KMU 2026

In a sodium chloride lattice, each ion is surrounded by ions of _____ charge.

CORE CONCEPT & DERIVATION

Ionic crystal lattices maximize electrostatic attractions and minimize repulsions by coordinating each cation with oppositely charged anions and vice versa.

Formula / Rule / Reaction:**Solution:**

- In the rock-salt (NaCl) crystal structure, each Na^+ cation is octahedrally coordinated by 6 oppositely charged Cl^- anions.
- Correspondingly, each Cl^- anion is surrounded by 6 oppositely charged Na^+ cations, maximizing electrostatic lattice stabilization.

Why other options are incorrect:

- **Option A:** Surrounding an ion with equally signed charges would produce electrostatic repulsion that destabilizes the lattice.
- **Option B:** Negative chloride ions are surrounded by positive sodium ions, not other negative ions.
- **Option D:** Positive sodium ions are surrounded by negative chloride ions, not other positive ions.

Question #147 Key: (B)

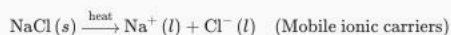
CHEMISTRY
KMU 2026

Ionic solids conduct electricity in _____ state.

CORE CONCEPT & DERIVATION

Electrical conduction requires mobile charge carriers; in ionic compounds, ions are immobilized within rigid crystal lattices in the solid state but become freely mobile in molten or aqueous states.

Formula / Rule / Reaction:



Solution:

- In solid ionic crystals, strong electrostatic bonds hold ions in fixed lattice positions, preventing charge transport.
- When melted into the liquid (molten) state or dissolved in water, the crystal lattice breaks down, freeing cations and anions to migrate toward oppositely charged electrodes and conduct electric current.

Why other options are incorrect:

- **Option A:** The frozen or solid crystalline state holds ions rigidly in place, acting as an electrical insulator.
- **Option C:** Solid-state ionic compounds do not conduct electricity due to the absence of mobile ions or free electrons.
- **Option D:** Vaporized ionic compounds dissociate into neutral molecular pairs or disperse at very high temperatures, not providing a standard conducting medium.

Question #148 Key: (C)

CHEMISTRY
KMU 2026

A unit cell of crystal lattice is characterized by _____ parameters.

CORE CONCEPT & DERIVATION

The geometry of any crystalline unit cell is defined by six lattice parameters: three edge lengths (axial dimensions) and three interaxial angles.

Formula / Rule / Reaction:

$$\text{Crystallographic Parameters} = (a, b, c, \alpha, \beta, \gamma)$$

Solution:

- The dimensional axes are defined by three edge lengths: a , b , and c .
- The orientations between these axes are defined by three interaxial angles: α (between b and c), β (between a and c), and γ (between a and b).
- Together, these six parameters fully define the shape and volume of any unit cell across all seven crystal systems.

Why other options are incorrect:

- **Option A:** 4 parameters are insufficient to describe three-dimensional space and angles.
- **Option B:** 5 parameters omit one of the spatial dimensions or angles.
- **Option D:** 7 refers to the number of fundamental crystal systems (cubic, tetragonal, etc.), not the parameters characterizing an individual unit cell.

Question #149 Key: (B)

CHEMISTRY
KMU 2026

When gaseous ions of opposite charge combine to form an ionic crystal, lattice energy is _____.

CORE CONCEPT & DERIVATION

Lattice energy is defined thermodynamically as the energy released when one mole of an ionic crystalline solid forms from its constituent gaseous ions under standard conditions.

Formula / Rule / Reaction:



Solution:

- Bringing separated gaseous cations and anions together allows attractive electrostatic forces to pull them into an ordered crystalline lattice.
- Because this transition moves the system into a lower potential energy state, energy is released to the surroundings as an exothermic enthalpy of lattice formation.

Why other options are incorrect:

- **Option A:** Energy is absorbed when breaking an ionic crystal lattice apart into isolated gaseous ions (lattice dissociation).
- **Option C:** Potential energy decreases overall, with the surplus energy released as heat rather than stored.
- **Option D:** Vaporization describes liquid-gas phase transitions, not ionic solid precipitation.

Question #150 Key: (A)

CHEMISTRY
KMU 2026

An increase in temperature shifts the equilibrium in favor of the _____ reaction.

CORE CONCEPT & DERIVATION

According to Le Chatelier's principle, elevating the temperature of an equilibrium mixture shifts the equilibrium position in the direction that absorbs thermal energy (the endothermic direction).

Formula / Rule / Reaction:



Solution:

- Heat can be treated as a reactant in an endothermic process and as a product in an exothermic process.
- When thermal energy is added to a system at equilibrium, the system counters the disturbance by favoring the pathway that consumes added heat, shifting in the endothermic direction.

Why other options are incorrect:

- **Option B:** Lowering temperature favors the exothermic pathway to release thermal energy.
- **Option C:** Dynamic equilibria remain reversible regardless of temperature changes.
- **Option D:** Chemical equilibrium is dynamic, involving balanced forward and reverse rates, never static.

Question #151 Key: (B)

CHEMISTRY
KMU 2026

Addition of sodium acetate to aqueous solution of acetic acid suppresses its:

CORE CONCEPT & DERIVATION

The common ion effect dictates that adding a strong electrolyte containing a common ion suppresses the ionization equilibrium of an existing weak electrolyte.

Formula / Rule / Reaction:



Solution:

- Sodium acetate dissociates completely into sodium ions and acetate ions.
- The sudden increase in acetate ion concentration ($[\text{CH}_3\text{COO}^-]$) shifts the acetic acid dissociation equilibrium to the left according to Le Chatelier's principle, suppressing the ionization of acetic acid and reducing hydrogen ion concentration.

Why other options are incorrect:

- Option A:** Condensation involves chemical coupling with loss of small molecules, not electrolytic dissociation.
- Option C:** Evaporation is a physical liquid-to-vapor phase change unaffected by trace ionic solute common ion shifts.
- Option D:** Ionization of carboxylic acids is an acid-base equilibrium, not a redox reduction process.

Question #152 Key: (B)

CHEMISTRY
KMU 2026

The Haber process is exothermic; therefore, decreasing the temperature favors:

CORE CONCEPT & DERIVATION

In an exothermic equilibrium reaction, heat acts as a product; decreasing the temperature shifts the equilibrium forward to produce heat, increasing product yield.

Formula / Rule / Reaction:



Solution:

- Because the forward synthesis of ammonia generates heat, removing thermal energy (lowering temperature) causes the system to respond by favoring the exothermic forward reaction.
- Consequently, lowering temperature shifts the equilibrium toward the formation of ammonia (NH_3).

Why other options are incorrect:

- Option A:** Decomposition of ammonia is endothermic and is favored by higher temperatures.
- Option C:** Formation of nitrogen and hydrogen gas occurs via reverse endothermic dissociation, which is disfavored by cooling.
- Option D:** Equilibrium positions in reactions with non-zero enthalpy changes are temperature-dependent according to the van 't Hoff equation.

Question #153 Key: (C)

CHEMISTRY
KMU 2026

Activation energy is the minimum energy to:

CORE CONCEPT & DERIVATION

Activation energy (E_a) is the minimum kinetic energy colliding reactant molecules must possess to overcome electrostatic repulsion and form the transition state complex to initiate a reaction.

Formula / Rule / Reaction:

$$k = Ae^{-E_a/RT}$$

Solution:

- Reacting molecules require sufficient energy during collision to deform existing bonds and reach the activated complex.
- This energetic threshold represents the activation energy necessary to initiate chemical transformation into products.

Why other options are incorrect:

- Option A:** Activation energy governs reaction rate and kinetics, not equilibrium yield or thermodynamic conversion limits.
- Option B:** Reactions proceed through concerted transition states and do not require breaking every chemical bond into isolated atoms.
- Option D:** Separating mixtures is a physical purification operation unrelated to chemical activation barriers.

Question #154 Key: (A)

CHEMISTRY
KMU 2026

A reaction with a lower activation energy proceeds at a _____ rate.

CORE CONCEPT & DERIVATION

According to collision theory and the Arrhenius equation, a lower activation energy barrier allows a greater fraction of molecular collisions to be effective, increasing the overall reaction rate.

Formula / Rule / Reaction:

$$k = Ae^{-E_a/RT} \implies \downarrow E_a \implies \uparrow k \implies \uparrow \text{Rate}$$

Solution:

- The Boltzmann distribution shows that only collisions with kinetic energy $E \geq E_a$ can lead to product formation.
- Lowering the activation energy increases the proportion of colliding particles that possess sufficient energy to react, resulting in a faster reaction rate.

Why other options are incorrect:

- Option B:** Reactions with lower activation energies initiate immediately and proceed faster, not later.
- Option C:** A slower rate results from a higher activation energy barrier.
- Option D:** The reaction rate increases exponentially as the activation energy barrier is reduced.

Question #155 Key: (B)

CHEMISTRY
KMU 2026

When heat is absorbed by the system from the surroundings, the sign of heat (q) is:

CORE CONCEPT & DERIVATION

By thermodynamic sign convention, energy transferred into a system as heat increases its internal energy and is defined as positive ($q > 0$).

Formula / Rule / Reaction:

Endothermic Process: $q > 0$ (Heat absorbed) | Exothermic Process: $q < 0$ (Heat released)

Solution:

- Heat added to a thermodynamic system from the surroundings increases internal energy.
- In IUPAC standard thermodynamic sign conventions, heat absorbed by the system is assigned a positive sign ($+q$).

Why other options are incorrect:

- Option A:** A negative sign ($-q$) represents an exothermic process where heat is transferred out of the system into the surroundings.
- Option C:** The sign convention for absorbed heat is strictly and consistently positive.
- Option D:** Heat is zero ($q = 0$) only in an adiabatic process with no thermal exchange.

Question #156 Key: (C)

CHEMISTRY
KMU 2026

According to Hess's Law, the overall enthalpy change depends only on the:

CORE CONCEPT & DERIVATION

Hess's Law of Constant Heat Summation reflects the state-function nature of enthalpy, stating that the total enthalpy change depends solely on the initial reactants and final products.

Formula / Rule / Reaction:

$$\Delta H_{\text{net}} = \sum \Delta H_{\text{steps}} = H_{\text{final}} - H_{\text{initial}}$$

Solution:

- Enthalpy (H) is a state function whose value depends entirely on the current thermodynamic state of the system, not on the path taken to reach it.
- Therefore, regardless of whether a reaction occurs in a single step or through a series of intermediate steps, the net enthalpy change depends strictly on the initial and final states.

Why other options are incorrect:

- Option A:** Activation energy is a kinetic parameter that affects reaction rate, but does not alter net thermodynamic enthalpy change.
- Option B:** The overall enthalpy change is independent of the intermediate reaction pathway.
- Option D:** Reaction mechanism governs intermediate kinetics, leaving net state functions unchanged.

Question #157 Key: (B)

CHEMISTRY
KMU 2026

Which change in oxidation number represents reduction?

CORE CONCEPT & DERIVATION

Reduction is defined as the gain of electrons, which manifests as an algebraic decrease (reduction) in the formal oxidation state of an atom.

Formula / Rule / Reaction:

Reduction: Oxidation Number decreases (Gain of electrons)

Solution:

- In the transition from $+2 \rightarrow 0$, the species gains two electrons:
 $M^{2+} + 2e^- \rightarrow M^0$
- Because the oxidation state decreases from $+2$ to 0 , this process represents chemical reduction.

Why other options are incorrect:

- Option A:** $+1 \rightarrow +3$ represents an algebraic increase of 2, which corresponds to oxidation (loss of electrons).
- Option C:** $0 \rightarrow +2$ represents an increase of 2, indicating oxidation.
- Option D:** $-1 \rightarrow +1$ represents an increase of 2, corresponding to oxidation.

Question #158 Key: (C)

CHEMISTRY
KMU 2026

According to VSEPR theory, what determines the shape of a molecule?

CORE CONCEPT & DERIVATION

Valence Shell Electron Pair Repulsion (VSEPR) theory posits that molecular geometry is governed by electrostatic repulsions among valence electron pairs surrounding the central atom.

Formula / Rule / Reaction:

Steric Number = (Bonding Electron Pairs) + (Lone Electron Pairs)

Solution:

- Electrons in valence shells are arranged in localized pairs (bonding pairs forming sigma bonds and non-bonding lone pairs).
- Because like charges repel, these electron pairs orient themselves as far apart as possible in three-dimensional space, directly establishing the molecular geometry.

Why other options are incorrect:

- Option A:** All electrons carry the same elementary charge ($-e$); charge magnitude alone does not dictate specific molecular angles.
- Option B:** Electron rest mass is uniform and plays no role in steric orientation.
- Option D:** Electron volume is not a distinct quantifiable physical property in VSEPR theory.

Question #159 Key: (D)

CHEMISTRY
KMU 2026

In the excited state, carbon has _____ half-filled orbitals.

CORE CONCEPT & DERIVATION

To achieve tetravalency, a ground-state carbon atom promotes one electron from its paired $2s$ orbital into an empty $2p_z$ orbital, producing four singly occupied (half-filled) valence orbitals.

Formula / Rule / Reaction:**Solution:**

- In the ground state, carbon has only two half-filled p -orbitals ($2p_x$ and $2p_y$), which would only permit divalent bonding.
- Excitation promotes one $2s$ electron into the vacant $2p_z$ orbital, yielding four unpaired, half-filled orbitals ($2s^1$, $2p_x^1$, $2p_y^1$, $2p_z^1$) capable of forming four covalent bonds.

Why other options are incorrect:

- Option A:** 1 half-filled orbital corresponds to monovalent elements such as hydrogen or the halogens.
- Option B:** 2 half-filled orbitals describes carbon in its unpromoted ground state.
- Option C:** 3 half-filled orbitals describes Group 15 elements like nitrogen ($2s^2 2p^3$).

Question #160 Key: (C)

CHEMISTRY
KMU 2026

The dipole moment is used to estimate the _____ character of a bond.

CORE CONCEPT & DERIVATION

The dipole moment measures charge separation in a polar covalent bond, allowing quantitative calculation of its percent ionic character.

Formula / Rule / Reaction:

$$\% \text{ Ionic Character} = \frac{\mu_{\text{observed}}}{\mu_{\text{ionic}}} \times 100\%$$

Solution:

- A pure covalent bond between identical atoms has a dipole moment of zero (0% ionic character).
- As the electronegativity difference between bonded atoms increases, electron density shifts toward the more electronegative atom, increasing the observed dipole moment (μ) and reflecting greater percent ionic character.

Why other options are incorrect:

- Option A:** Acidic character is determined by aqueous proton dissociation constants (K_a and pK_a).
- Option B:** Basic character is measured by base dissociation constants (K_b) and proton affinity.
- Option D:** Organic character describes the carbon-based framework of a molecule rather than bond polarity.

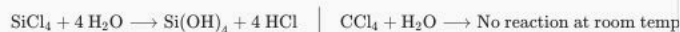
Question #161 Key: (A)

CHEMISTRY
KMU 2026

Which Group IV-A tetrachloride DOES NOT react with water at room temperature?

CORE CONCEPT & DERIVATION

Carbon tetrachloride (CCl_4) resists hydrolysis at ambient temperatures because carbon lacks accessible empty d -orbitals in its second shell to coordinate incoming water nucleophiles.

Formula / Rule / Reaction:**Solution:**

- Hydrolysis of group IV tetrahalides requires the central atom to expand its octet by accepting a lone pair from a water molecule into an empty d -orbital.
- Carbon has valence electrons only in the $n = 2$ shell (which has no d -subshell) and is sterically shielded by four chlorine atoms, rendering CCl_4 inert to water at room temperature.
- Heavier group members (Si, Ge, Pb) possess vacant low-energy d -orbitals and undergo rapid hydrolysis.

Why other options are incorrect:

- Option B:** GeCl_4 hydrolyzes readily via vacant $4d$ orbitals.
- Option C:** PbCl_4 hydrolyzes rapidly and decomposes into PbCl_2 and Cl_2 .
- Option D:** SiCl_4 hydrolyzes vigorously and exothermically in water using empty $3d$ orbitals.

Question #162 Key: (B)

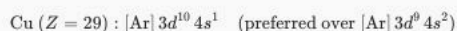
CHEMISTRY
KMU 2026

Copper shows an exceptional electronic configuration because it has a more stable _____ subs...

CORE CONCEPT & DERIVATION

Completely filled and exactly half-filled subshells possess heightened thermodynamic stability due to symmetrical electron distribution and maximized exchange energy.

Formula / Rule / Reaction:



Solution:

- The expected Aufbau configuration for copper would be $[\text{Ar}] 3d^9 4s^2$.
- However, promoting one $4s$ electron into the $3d$ subshell generates a completely filled $3d^{10}$ subshell.
- The symmetrical electron charge distribution and enhanced exchange energy of the filled d^{10} configuration lower the system's overall energy, making $[\text{Ar}] 3d^{10} 4s^1$ the stable ground state.

Why other options are incorrect:

- Option A:** A half-filled d^5 subshell stabilizes Chromium ($[\text{Ar}] 3d^5 4s^1$), whereas Copper attains a completely filled d^{10} configuration.
- Option C:** General pairing alone without subshell closure does not account for the promotional stabilization.
- Option D:** The $3d$ subshell in Copper is completely filled with 10 electrons, not vacant.

Question #163 Key: (A)

ENGLISH
KMU 2026

Which one of the following sentences employs CORRECT subject-verb agreement?

CORE CONCEPT & DERIVATION

In formal English grammar, the noun phrase "The number of..." functions as a singular collective subject requiring a singular verb, whereas "A number of..." acts as a plural quantifier.

Formula / Rule / Reaction:

"The number of" + Plural Noun + Singular Verb

Solution:

- In the sentence, the head noun is the singular "number", while "of students in Class 9" is a prepositional modifier.
- Because the grammatical subject is singular, it requires the singular third-person verb "is".

Why other options are incorrect:

- Option B:** Employs the plural verb "are" with the singular subject "The number".
- Option C:** Uses the awkward plural "The numbers" matched incorrectly with a singular verb "is".
- Option D:** Uses the ungrammatical singular noun "student" after "numbers of".

Question #164 Key: (C)

ENGLISH
KMU 2026

My parents do not allow me to stay out _____.

CORE CONCEPT & DERIVATION

The word "late" functions as an adverb of time meaning past the usual, expected, or permitted hour.

Formula / Rule / Reaction:

Verb phrase: "stay out" + Adverb of time ("late")

Solution:

- In the given sentence, the predicate requires an adverb modifying the phrasal verb "stay out".
- "Late" correctly conveys remaining away from home until an advanced hour of the night.

Why other options are incorrect:

- Option A:** "Latter" is an adjective referring to the second of two mentioned items.
- Option B:** "Lately" is an adverb meaning "recently" or "of late", which is semantically incorrect here.
- Option D:** "Later" is a comparative form requiring a point of reference (such as "later than 10 PM").

Question #165 Key: (C)

ENGLISH
KMU 2026

Which of the following is the FALSE cause and effect claim?

CORE CONCEPT & DERIVATION

A false cause fallacy (post hoc ergo propter hoc or spurious correlation) incorrectly asserts a direct causal link between two completely unrelated events.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Wearing red clothing is an external aesthetic choice that has no biological, psychological, or neurological causal relationship to cognitive intelligence.
- Therefore, claiming that red clothes cause intelligence is a false causal claim.

Why other options are incorrect:

- Option A:** Established scientific fact; carcinogens in cigarette smoke cause malignant cellular transformations in the lungs.
- Option B:** Valid physical causation; atmospheric precipitation deposits water directly onto road surfaces.
- Option D:** Established physiological fact; regular physical exercise enhances cardiovascular function and health.

Question #166 Key: (D)ENGLISH
KMU 2026

I like cake, however my friend likes chocolate. The transitional device is used for:

CORE CONCEPT & DERIVATION

Adversative transitional conjuncts (such as "however", "nevertheless", and "on the other hand") introduce an opposing, contrasting idea relative to the preceding clause.

Formula / Rule / Reaction:

Clause 1 (Preference A) + "however" (Contrast) + Clause 2 (Opposing Preference B)

Solution:

- The speaker's preference for cake is set against the friend's preference for chocolate.
- The transitional adverb "however" links these two contrasting propositions, establishing a clear semantic contrast.

Why other options are incorrect:

- **Option A:** Exception is signaled by markers such as "except", "apart from", or "with the exclusion of".
- **Option B:** Sequence is indicated by chronological words such as "firstly", "next", "then", or "finally".
- **Option C:** Addition is signaled by cumulative conjunctions such as "furthermore", "moreover", or "in addition".

Question #167 Key: (C)ENGLISH
KMU 2026

Electric cars are becoming increasingly popular due to concerns about air pollution and fossil ...

CORE CONCEPT & DERIVATION

Reading comprehension requires direct factual extraction based strictly on explicit textual evidence provided in the passage.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- The text states: "Electric cars are becoming increasingly popular due to concerns about air pollution and fossil fuels. They produce zero emissions..."
- This directly identifies reducing air pollution and zero emissions as the primary reason for their growing popularity.

Why other options are incorrect:

- **Option A:** The passage contains no claims comparing the top speed or acceleration of electric cars to other vehicles.
- **Option B:** Manufacturing costs are not mentioned in the passage.
- **Option D:** Electric cars run on rechargeable batteries and produce zero emissions; they do not use petrol.

Question #168 Key: (B)ENGLISH
KMU 2026

Which of the following sentences uses the gerund as a subject?

CORE CONCEPT & DERIVATION

A gerund is the *-ing* form of a verb functioning as a noun; when positioned before the main predicate verb as the primary actor or topic, it serves as the grammatical subject.

Formula / Rule / Reaction:

[Gerund (Subject)] + [Copular Verb ("is")] + [Subject Complement]

Solution:

- In "Singing is my favorite hobby", the verbal noun "Singing" occupies the subject position governing the verb "is".
- Therefore, it functions as the subject of the sentence.

Why other options are incorrect:

- **Option A:** "Singing" functions as the direct object of the transitive verb "love".
- **Option C:** "is singing" is a present continuous finite verb phrase, where "singing" serves as the present participle.
- **Option D:** "singing" functions as a participial adjective modifying the noun "bird".

Question #169 Key: (C)ENGLISH
KMU 2026

My cat is hiding _____ the bed. Use correct preposition.

CORE CONCEPT & DERIVATION

Prepositions of place express spatial relationships; "under" indicates a position directly below or beneath the lower surface of an object.

Formula / Rule / Reaction:

Spatial Preposition: "under" $\Rightarrow$ Beneath the horizontal frame of a raised object

Solution:

- Domestic beds are elevated furniture frames with open floor clearance underneath.
- "Under" is the correct preposition to denote concealment beneath the structure of the bed.

Why other options are incorrect:

- **Option A:** "From" designates source, origin, or separation, not static location.
- **Option B:** "Inside" implies containment within an enclosed interior (such as inside a box), which does not describe the open space beneath a bed.
- **Option D:** "To" indicates direction of movement toward a destination.

Question #170 Key: (C)ENGLISH
KMU 2026

Turn left _____ the traffic signal and the cafe will be on your right.

CORE CONCEPT & DERIVATION

The preposition "at" is used to specify a precise geographic location, intersection, or navigational reference landmark.

Formula / Rule / Reaction:

Directional command: "Turn [left/right]" + "at" + [Specific Junction / Landmark]

Solution:

- A traffic light acts as a specific point location along a travel route.
- The preposition "at" correctly indicates the precise point where the navigational turn must be executed.

Why other options are incorrect:

- **Option A:** "Into" indicates motion entering the interior of an enclosed space or street.
- **Option B:** "On" designates presence upon a horizontal surface or along a broad street name, not a specific landmark junction.
- **Option D:** "Between" requires two distinct reference points or objects.

Question #171 Key: (C)ENGLISH
KMU 2026

Which one of the following options contains the appropriate use of tense?

CORE CONCEPT & DERIVATION

When a sudden completed action interrupts an ongoing background activity in the past, English requires the past simple tense for the interrupting event and the past continuous tense for the ongoing background action.

Formula / Rule / Reaction:

[Past Simple (interruption)] + "while" + [Past Continuous (background action)]

Solution:

- The ongoing background activity was reading (expressed in the past continuous: "was reading").
- The sudden interrupting event was the power failure, properly expressed in the past simple: "went out".
- Combining these gives the grammatically correct sequence: "The light went out while I was reading."

Why other options are incorrect:

- **Option A:** Improperly mixes past simple ("went out") with present continuous ("am reading").
- **Option B:** Uses present perfect ("has gone out") with a past time clause ("while I was reading"), violating sequence of tenses rules.
- **Option D:** Uses present simple ("goes out") to describe an ongoing specific event.

Question #172 Key: (B)LOGICAL REASONING
KMU 2026

Why is it important to monitor the implementation of a decision?

CORE CONCEPT & DERIVATION

Decision monitoring and feedback loops allow organizations to evaluate performance against intended outcomes, identify operational bottlenecks, and make adaptive corrections.

Formula / Rule / Reaction:

Decision → Execution → Monitoring → Adaptive Improvement

Solution:

- Real-world conditions often diverge from initial assumptions during planning.
- Continuous monitoring tracks ongoing progress, providing actionable data to refine execution, adjust tactics, and ensure goals are successfully achieved.

Why other options are incorrect:

- **Option A:** Monitoring is intended to facilitate and optimize progress, not obstruct it.
- **Option C:** Constructive monitoring focuses on systemic optimization and problem solving rather than finding fault.
- **Option D:** Monitoring relies on active feedback mechanisms rather than suppressing them.

Question #173 Key: (A)LOGICAL REASONING
KMU 2026

Human rights protection leads to economic growth. In light of the statement, Pakistan improved...

CORE CONCEPT & DERIVATION

A common logical fallacy in policy analysis is the single-cause fallacy, which assumes an outcome is governed by one variable while ignoring other necessary contributing factors.

Formula / Rule / Reaction:

Economic Growth = $f(\text{Human Rights, Capital Investment, Fiscal Policy, Infrastructure, Trade, etc.})$

Solution:

- Economic growth is a complex macroeconomic outcome influenced by fiscal stability, infrastructure, energy availability, political stability, and capital investment.
- Improving labor rights is a positive contributing factor, but it alone cannot produce economic growth if other economic drivers remain constrained.
- Concluding that human rights do not support growth because growth remained low ignores these other contributing factors.

Why other options are incorrect:

- **Option B:** Labor laws alone do not guarantee economic growth, so treating them as a sole determinant is an analytical error.
- **Option C:** Economic growth depends on numerous macroeconomic variables, not solely on labor rights.
- **Option D:** Claiming human rights have no impact is an unsupported overgeneralization.

Question #174 Key: (A)LOGICAL REASONING
KMU 2026

In a shop having 3 fruits, the oranges are cheaper than grapefruit and pricier than grapes, the...

CORE CONCEPT & DERIVATION

Linear inequalities follow the transitive property: if $A > B$ and $B > C$, then $A > C$.

Formula / Rule / Reaction:

$$\text{Price(Grapefruit)} > \text{Price(Oranges)} > \text{Price(Grapes)}$$

Solution:

- From the premise: "oranges are cheaper than grapefruit" yields:
 $\text{Grapefruit} > \text{Oranges}$
- From the premise: "oranges are pricier than grapes" yields:
 $\text{Oranges} > \text{Grapes}$
- Combining both inequalities into a single ordered chain:
 $\text{Grapefruit} > \text{Oranges} > \text{Grapes}$
- By transitivity, grapefruit is more expensive than grapes.

Why other options are incorrect:

- **Option B:** Grapes are the cheapest of the three fruits, not more expensive than grapefruit.
- **Option C:** Directly contradicts the premise that oranges are pricier than grapes.
- **Option D:** Grapefruit has a strictly higher price than grapes according to the inequality chain.

Question #175 Key: (D)LOGICAL REASONING
KMU 2026

In how many different ways can four persons be seated on four chairs for a photograph?

CORE CONCEPT & DERIVATION

The number of distinct linear permutations of n distinct objects arranged in n distinct positions is given by $n!$ (n factorial).

Formula / Rule / Reaction:

$$P(n) = n! = n \times (n-1) \times (n-2) \times \dots \times 1$$

Solution:

- There are 4 chairs available:
- The first chair can be occupied by any of the 4 persons.
- The second chair can be occupied by any of the remaining 3 persons.
- The third chair can be occupied by either of the remaining 2 persons.
- The fourth chair must be occupied by the 1 remaining person.
- Total distinct arrangements:

$$4! = 4 \times 3 \times 2 \times 1 = 24$$

Why other options are incorrect:

- **Option A:** 8 results from multiplying 4 by 2.
- **Option B:** 12 represents 4×3 , accounting for only two positions.
- **Option C:** 16 represents 4^2 , which incorrectly assumes independent choices with replacement.

Question #176 Key: (D)LOGICAL REASONING
KMU 2026

What is the missing term of the sequence? 1, 3, 6, 10, 15, 21, 28, _____

CORE CONCEPT & DERIVATION

The sequence consists of triangular numbers where the difference between successive terms increases by +1 at each step.

Formula / Rule / Reaction:

$$T_n = T_{n-1} + n \quad \text{or} \quad T_n = \frac{n(n+1)}{2}$$

Solution:

- Calculate successive term differences:
- $3 - 1 = +2$
- $6 - 3 = +3$
- $10 - 6 = +4$
- $15 - 10 = +5$
- $21 - 15 = +6$
- $28 - 21 = +7$
- Following this arithmetic pattern, the next increment must be +8:
 $28 + 8 = 36$

Why other options are incorrect:

- **Option A:** 30 results from adding only 2 to 28.
- **Option B:** 32 results from adding 4 instead of 8.
- **Option C:** 34 results from adding 6 instead of 8.

Question #177 Key: (A)LOGICAL REASONING
KMU 2026

Meetings are at 9am, 11am, and 2pm. Finance meets before HR. IT meets last. HR does not meet at...

CORE CONCEPT & DERIVATION

Linear scheduling puzzles are resolved by assigning items to an ordered timeline according to explicit constraints until a single valid permutation remains.

Formula / Rule / Reaction:

Available Time Slots: 9 am, 11 am, 2 pm

Solution:

- Constraint 1: "IT meets last" places IT at the final time slot:
IT = 2 pm
- Remaining time slots are 9 am and 11 am for Finance and HR.
- Constraint 2: "Finance meets before HR" requires Finance to take the earlier slot and HR the later slot.
- This assigns Finance to 9 am and HR to 11 am.
- Constraint 3: "HR does not meet at 9am" is satisfied by this arrangement.
- Therefore, HR meets at 11 am.

Why other options are incorrect:

- **Option B:** IT is explicitly scheduled last at 2 pm.
- **Option C:** Finance must meet before HR, placing it at 9 am.
- **Option D:** The constraints yield a unique, fully determined schedule.

Question #178 Key: (B)LOGICAL REASONING
KMU 2026

Almen is Amna's daughter and Salman is Amna's Father. Sarah is Salman's daughter. What is Almen...

CORE CONCEPT & DERIVATION

Kinship relations track generational pedigrees: the daughter of one's daughter is one's maternal granddaughter.

Formula / Rule / Reaction:

Salman (Generation 1) $\xrightarrow{\text{Father of}}$ Amna (Generation 2) $\xrightarrow{\text{Mother of}}$ Almen (Generation 3)

Solution:

- Salman is the father of Amna.
- Almen is the daughter of Amna.
- Therefore, Almen is the daughter of Salman's daughter, making Almen the granddaughter of Salman.

Why other options are incorrect:

- **Option A:** Grandmother is two generations senior, whereas Almen is two generations junior.
- **Option C:** Amna and Sarah are Salman's daughters; Almen belongs to the subsequent generation.
- **Option D:** Mother is one generation senior, not two generations junior.

Question #179 Key: (C)LOGICAL REASONING
KMU 2026

A hospital performs 25 surgeries daily for 6 days a week. How many surgeries are performed week...

CORE CONCEPT & DERIVATION

Total weekly volume is calculated by multiplying the constant daily rate by the number of active operating days per week.

Formula / Rule / Reaction:

Weekly Surgeries = Daily Surgeries $\times$ Operating Days per Week

Solution:

- Given daily surgery rate: 25 surgeries/day.
- Given operational duration: 6 days/week.
- Calculate total surgeries performed per week:
 $25 \times 6 = 150$ surgeries

Why other options are incorrect:

- **Option A:** 120 surgeries corresponds to performing 20 surgeries daily for 6 days.
- **Option B:** 145 surgeries is an arithmetic miscalculation off by 5.
- **Option D:** 175 surgeries corresponds to operating for a full 7-day week ($25 \times 7 = 175$).

Question #180 **Key: (C)**LOGICAL REASONING
KMU 2026

You park your car in a no-parking zone and are approached by a traffic police officer. What is ...

CORE CONCEPT & DERIVATION

Situational judgment and civic responsibility require individuals to respect traffic law enforcement, maintain civility, and cooperate with law enforcement officers.

Formula / Rule / Reaction:

Factual recall / Qualitative concept.

Solution:

- Parking in a designated no-parking zone is a traffic violation.
- When approached by law enforcement, the correct response is to remain respectful, cooperate fully, acknowledge the infraction, and comply with any citations or lawful directives.

Why other options are incorrect:

- **Option A:** Arguing with an officer escalates conflict and does not address the underlying infraction.
- **Option B:** Leaving without authorization constitutes fleeing the scene of a traffic stop, which is an offense.
- **Option D:** Fleeing from an officer is illegal and risks personal safety and legal penalties.