Physics

Chapter: Kinematics

Question 1: A particle starts from rest and moves with a constant acceleration of 2m/s2. The distance covered by the particle in the 5th second of its motion is: (A) 9m, (B) 18,m (C) 2,5m (D) 50m

Answer: (A) 9m

Solution: Distance covered in the nth second is given by sn= u + a (n−1/2). Here, u=0, a=2m/s2, n=5. s5=0+2(5−0.5)=2(4.5)=9m.

Chapter: Laws of Motion

Question 2: A block of mass m is placed on a smooth inclined plane of angle θ with the horizontal. The force required to keep the block stationary on the inclined plane is: (A) mg, (B) mgsinθ,θ (C) mgcosθ,sθ (D) mgtanθ

Answer: (B) mgsinθ

Solution: For the block to be stationary, the net force along the inclined plane must be zero. The component of gravitational force acting down the incline is mgsinθ. Therefore, an equal and opposite force is required to keep it stationary.

Chemistry

Chapter: Chemical Bonding and Molecular Structure

Question 3: Which of the following molecules has the highest bond order? (A) O2 (B) N2 (C) Li2 (D) F2

Answer: (B) N2

Solution: Bond order can be calculated using Molecular Orbital Theory:

- O2: (σ2s)2(σ∗2s)2(σ2pz)2(π2px)2(π2py)2(π∗2px)1(π∗2py)1; Bond order = (8−4)/2=2
- N2: (σ2s)2(σ∗2s)2(σ2pz)2(π2px)2(π2py)2; Bond order = (10−4)/2=3
- Li2: (σ2s)2; Bond order = (2−0)/2=1
- F2: (σ2s)2(σ∗2s)2(σ2pz)2(π2px)2(π2py)2(π∗2px)2(π∗2py)2; Bond order = (10−8)/2=1
  Nitrogen (N2) has the highest bond order of 3.

Chapter: Solutions

Question 4: The molarity of a solution containing 4g of Naoh in 500 ml of solution is: (A) 0.1M (B) 0.2M (C) 0.5M (D) 1.0M

Answer: (B) 0.2M

Solution: Molar mass of Naoh = 23 + 16 + 1 = 40 g/mol. Number of moles of Naoh = 40 g/mol4 g 0.1 moll. Volume of solution in litres = 1000mlL500mlL= 0.5l. Molarity (M) litres of solution moles of solute= 0.5l0.1mol 0.2m2m.

Mathematics

Chapter: Sets, Relations and Functions

Question 5: If A {1,2,3} and B {4,5}, then the number of relations from A to B is: (A) 6 (B) 8 (C) 32 (D) 64

Answer: (D) 64

Solution: A relation from set A to set B is a subset of A×B. A×B={(1,4),(1,5),(2,4),(2,5),(3,4),(3,5)}. The number of elements in A×B is $|A|\times|B|=3\times2=6$. The number of subsets of a set with n elements is 2n. Therefore, the number of relations from A to B is 26=64.

Chapter: Calculus (Limits and Derivatives)

Question 6: The value of $\lim_{x\to0}x\sin(2x)$ is: (A) 0 (B) 1 (C) 2 (D) ∞

Answer: (C) 2

Solution: We know that $\lim_{x\to0}x\sin(x)=1$. $\lim_{x\to0}x\sin(2x)=\lim_{x\to0}2x\sin(2x)\times2$. Let y=2x. As x→0, y→0. So, $\lim_{y\to0}y\sin(y)\times2=1\times2=2$.

Biology (If Applicable to your KEAM Stream)

Chapter: Cell: The Unit of Life

Question 7: The "powerhouse of the cell" is: (A) Nucleus, (B) Mitochondria (C) Ribosome, (D) Golgi apparatus

Answer: (B) Mitochondria

Solution: Mitochondria are organelles responsible for cellular respiration, the process that generates ATP (adenosine triphosphate), which is the main energy currency of the cell. Hence, they are called the "powerhouse of the cell."

Chapter: Genetics and Evolution

Question 8: A dihybrid cross involves parents differing in how many pairs of contrasting traits? (A) One (B) Two (C) Three (D) Four

Answer: (B) Two

Solution: A dihybrid cross is a cross between two individuals that are heterozygous for two different traits (i.e., they differ in two pairs of contrasting characters).

Physics

Chapter: Work, Energy and Power

Question 9: A body of mass 2kg is initially at rest. A horizontal force of 5n is applied on it for 4s. The kinetic energy of the body at the end of 4s is: (A) 20J (B) 40J (C) 100J (D) 200J

Answer: (C) 100j

Solution: Acceleration a=F/m=5N/2kg=2.5m/s2. Final velocity v=u+at=0+(2.5m/s2)(4s)=10m/s. Kinetic energy KE=21mv2=21(2kg)(10m/s)2=100J.

Chapter: Rotational Motion

Question 10: A solid sphere and a hollow sphere of the same mass and radius are released from the top of an inclined plane. Which one will reach the bottom first? (A) Solid sphere (B), Hollow sphere (C). Both will reach simultaneously (D.) It depends on the angle of inclination

Answer: (A) Solid sphere

Solution: The solid sphere has a smaller moment of inertia (I=52MR2) compared to the hollow sphere (I=32MR2) for the same mass and radius. Since less energy is lost in rotational kinetic energy for the solid sphere, it will have a greater translational kinetic energy at the bottom and hence reach first.

Chapter: Gravitation

Question 11: The acceleration due to gravity at a height h above the surface of the Earth (radius R) is approximately (for h<<R): (A) g(1+Rh) (B) g(1−Rh) (C) g(1+R2h) (D) g(1−R2h)

Answer: (D) g(1−R2h)

Solution: The acceleration due to gravity at height h is g′=(R 2 gg mgm=r2 1+r2gm2gmM=g(1 + Rh)−2. For h<<R, using binomial approximation (1+x)n≈1+nx, we get g′≈g(1−R2h).

Chapter: Thermodynamics

Question 12: In an adiabatic process, which of the following is true? (A) ΔQ=0 (B) ΔW=0 (C) ΔU=0 (D) ΔT=0

Answer: (A) ΔQ=0

Solution: An adiabatic process is defined as a thermodynamic process in which there is no heat exchange between the system and its surroundings, i.e., $\Delta Q=0$.

Chapter: Electrostatics

Question 14: Two point charges +q and −q are placed at a small distance d apart. The electric field at a point on the equatorial line at a distance r (r>>d) from the centre of the dipole is proportional to: (A) r (B) 1/r (C) 1/r2 (D) 1/r3

Answer: (D) 1/r3

Solution: For an electric dipole, the electric field at a point on the equatorial line at a large distance r from the centre is given by E = r3kp, where p is the dipole moment (q×d) and k is a constant. Thus, $E \propto 1/r3$.

Chapter: Current Electricity

Question 15: The equivalent resistance of two resistors R1 and R2 connected in parallel is given by: (A) R1+R2 (B) R1+R2R1R2 (C) R11+R21 (D) R1R2R1+R2

Answer: (B) R1+r2R1R2

Solution: For resistors connected in parallel, the reciprocal of the equivalent resistance is the sum of the reciprocals of individual resistances: Req1=R11+r21=R1R2R1+r2. Therefore, Req=R1+R2R1R2.

Chapter: Magnetism and Matter

Question 16: The angle of dip at the Earth's magnetic equator is: (A) 0◦ (B) 45◦ (C) 90◦ (D) 180◦

Answer: (A) 0◦

Solution: The angle of dip (or magnetic inclination) is the angle made by the Earth's magnetic field lines with the horizontal at a given location. At the magnetic equator, the horizontal component of the Earth's magnetic field is maximum, and the vertical component is zero, resulting in a dip angle of 0◦.

Chapter: Optics

Question 18: The focal length of a convex lens is positive. Its power is: (A) Positive, (B) Negative, (C) Zero, or (D) Can be positive or negative.

Answer: (A) Positive

Solution: The power of a lens is defined as the reciprocal of its focal length in meters (P=1/f). For a convex lens, the focal length (f) is positive, therefore its power (P) is also positive.

Chemistry

Chapter: Chemical Kinetics

Question 19: For a zero-order reaction, the rate of the reaction: (A) Increases with the concentration of reactants, (B) decreases with the concentration of reactants, (C) is independent of the concentration of reactants, (D) is proportional to the square of the concentration of reactants

Answer: (C) Is independent of the concentration of reactants

Solution: For a zero-order reaction, the rate law is given by rate =k[A]0=k, where k is the rate constant. This shows that the rate of the reaction is independent of the concentration of the reactants.

Chapter: Electrochemistry

Question 20: The standard electrode potential of a hydrogen electrode is taken as: (A) 1v (B) 0v (C) −1v (D) 100v

Answer: (B) 0v

Solution: By convention, the standard electrode potential of the standard hydrogen electrode (SHE) is taken as zero volts at 298K and 1 atm pressure.

Chapter: Surface Chemistry

Question 21: The phenomenon of adsorption in which the adsorbate is chemically bonded to the surface of the adsorbent is called: (A) Physisorption, (B) Chemisorption, (C) Absorption, (D) Desorption

Answer: (B) Chemisorption

Solution: Chemisorption (chemical adsorption) involves the formation of chemical bonds between the adsorbate molecules and the surface of the adsorbent. It is usually irreversible and involves a higher enthalpy of adsorption compared to physisorption.

Chapter: General Principles and Processes of Isolation of Elements

Question 22: The principal ore of aluminium is: (A) Bauxite ($Al_2O_3 \cdot 2H_2O$) (B) Hematite (Fe_2O_3) (C) Magnetite (Fe_3O_4) (D) Chalcopyrite ($CuFeS_2$)

Answer: (A) Bauxite ($Al_2o_3O_3 \cdot 2h_2o$)

Solution: Bauxite is the primary ore from which aluminium is extracted. It mainly consists of hydrated aluminium oxide.

Chapter: p-Block Elements

Question 23: Which of the following oxides of nitrogen is acidic? (A) N_2O (B) NO (C) N_2O_3 (D) NO_2

Answer: (C) N_2O_3

Solution: N_2O_3 reacts with water to form nitrous acid (HNO_2), which is an acidic oxide. NO_2 in water forms both nitrous acid and nitric acid. N_2O and NO are neutral oxides.

Chapter: d- and f-Block Elements

Question 24: Transition metals exhibit variable oxidation states primarily due to: (A) their high ionisation energies, (B) the involvement of d-electrons in bonding, (C) their large atomic radii, (D) their paramagnetic nature

Answer: (B) The involvement of d-electrons in bonding

Solution: Transition metals have incompletely filled d-orbitals, and the energy difference between the $(n-1)d$ and ns electrons is small. This allows both d and s electrons to participate in chemical bonding, leading to variable oxidation states.

Chapter: Coordination Compounds

Question 25: The IUPAC name of $K_3[Fe(CN)_6]$ is: (A) Potassium hexacyanoferrate(II) (B) Potassium hexacyanoferrate(III) (C) Tripotassium hexacyanoiron(II) (D) Tripotassium hexacyanoiron(III)

Answer: (B) Potassium hexacyanoferrate(III)

Solution: The complex ion is $[Fe(CN)_6]^{3-}$. The oxidation state of iron (Fe) is $x+6(-1)=-3$, so $x=+3$. The IUPAC name is Potassium hexacyanoferrate(III).

Chapter: Haloalkanes and Haloarenes

Question 26: SN1 reactions are favoured by: (A) Primary alkyl halides, (B) Polar aprotic solvents, (C) Strong nucleophiles, (D) Tertiary alkyl halides

Answer: (D) Tertiary alkyl halides

Solution: SN1 reactions proceed via a carbocation intermediate. Tertiary alkyl halides form more stable carbocations due to hyperconjugation and inductive effects, thus favouring SSN1 reactions.

Chapter: Alcohols, Phenols and Ethers

Question 27: The order of reactivity of alcohols towards sodium metal is: (A) Primary > Secondary > Tertiary (, B) Tertiary > Secondary > Primary, (C) Secondary > Primary > Tertiary, (D) Tertiary > Primary > Secondary

Answer: (A) Primary > Secondary > Tertiary

Solution: The reactivity of alcohols towards sodium metal depends on the ease with which they can lose a proton to form an alkoxide ion. Primary alcohols are the least sterically hindered, making it easier for the sodium metal to attack the hydrogen atom bonded to the oxygen.

Chapter: Aldehydes, Ketones and Carboxylic Acids

Question 28: Tollens' reagent is used to distinguish between: (A) Alcohols and phenols, (B) Aldehydes and ketones, (C) Ketones and carboxylic acids, (D) Primary, secondary, and tertiary alcohols

Answer: (B) Aldehydes and ketones

Solution: Tollens' reagent (ammoniacal silver nitrate solution) oxidises aldehydes to carboxylic acid salts, forming a silver mirror. Ketones generally do not react with Tollens' reagent.

Mathematics

Chapter: Matrices and Determinants

Question 29: If A (1324), then the determinant of A is: (A) -2 (B) 2 (C) 10 (D) -10

Answer: (A) -2

Solution: The determinant of a 2×2 matrix (acbd) is ad−bc. So, $|A|=(1\times4)-(2\times3)=4-6=-2$.

Chapter: Inverse Trigonometric Functions

Question 30: The principal value of sin−1(21) is: (A) 6π (B) 4π (C) 3π (D) 2π

Answer: (B) 4π

Solution: We need to find an angle θ in the principal value range of sin−1(x), which is [−2π,2π], such that sin(θ)=2

1. The angle is θ=4π.

Chapter: Application of Derivatives

Question 31: The slope of the tangent to the curve y=x2−2x+1 at the point (1,0) is: (A) 0 (B) 1 (C) 2 (D) -1

Answer: (A) 0

Solution: The slope of the tangent is given by the derivative dxdy. dxdy=2x−2. At the point (1,0), the slope is 2(1)−2=0.

Chapter: Integration

Question 32: The value of ∫01x2dx is: (A) 1 (B) 1/2 (C) 1/3 (D) 2/3

Answer: (C) 1/3

Solution: ∫01x2dx=[3x3]01=313−303=31−0=31.

Chapter: Differential Equations

Question 33: The order of the differential equation (dx2d2y)3+(dxdy)4+y=0 is: (A) 1 (B) 2 (C) 3 (D) 4

Answer: (B) 2

Solution: The order of a differential equation is the highest order of the derivative present in the equation. In this case, the highest order derivative is dx2d2y, which is of order 2.