BCECE 2026 – Guess Question Paper

Bihar Combined Entrance Competitive Examination

Conducted by	Bihar Combined Entrance Competitive Examination Board (BCECEB)
Stream	PCM (Physics, Chemistry, Mathematics)
Questions	100 per subject (300 total)
Marks	400 per subject; +4 correct, −1 wrong
Duration	90 minutes per subject
Mode	Offline (OMR-based)
Prepared by	Career Decode

Instructions: All questions are MCQs with four options (A–D). Only one option is correct. Mark your answer carefully on the OMR sheet. There is a negative marking of 1 mark for each wrong answer.

1 Physics

1.1 Kinematics and Laws of Motion

Q.1. A body is projected at an angle θ with the horizontal with speed u. The time of flight is:

(A) $\dfrac{u\sin\theta}{g}$

(B) $\dfrac{2u\sin\theta}{g}$

(C) $\dfrac{u\cos\theta}{g}$

(D) $\dfrac{2u\cos\theta}{g}$

Q.2. A ball is dropped from a height h. Another ball is thrown horizontally from the same height at the same instant with speed v. Which ball reaches the ground first?

(A) The dropped ball

(B) The thrown ball

(C) Both reach simultaneously

(D) Depends on v

Q.3. A particle moves in a straight line with velocity $v = (3t^2 - 2t)$ m/s. Its acceleration at $t = 2$ s is:

(A) 8 m/s^2

(B) 10 m/s^2

(C) 6 m/s^2

(D) 12 m/s^2

Q.4. The horizontal range of a projectile is maximum when the angle of projection is:

(A) 30°

(B) 45°

(C) 60°

(D) 90°

Q.5. A block of mass 2 kg rests on a horizontal surface. If the coefficient of static friction is 0.4, the maximum static friction force is ($g = 10$ m/s^2):

(A) 4 N

(B) 6 N

(C) 8 N

(D) 10 N

Q.6. Two blocks of masses $m_1 = 3$ kg and $m_2 = 5$ kg are connected by a light string over a frictionless pulley. The acceleration of the system is ($g = 10$ m/s^2):

(A) 2.5 m/s^2

(B) 5 m/s^2

(C) 3.75 m/s^2

(D) 2 m/s^2

Q.7. A car moves with a constant speed on a circular track of radius 200 m. If the centripetal acceleration is 2 m/s^2, the speed of the car is:

(A) 10 m/s

(B) 15 m/s

(C) 20 m/s

(D) 25 m/s

Q.8. A body of mass 10 kg moving with velocity 5 m/s collides with and sticks to a body of mass 5 kg at rest. The velocity after collision is:

(A) 5 m/s

(B) 3.33 m/s

(C) 2.5 m/s

(D) 4 m/s

1.2 Work, Energy and Power

Q.9. A spring of force constant k is compressed by x. The potential energy stored is:

(A) kx

(B) $\frac{1}{2}kx^2$

(C) kx^2

(D) $2kx^2$

Q.10. A body of mass 2 kg is raised to a height of 5 m. Work done against gravity is ($g = 10$ m/s^2):

(A) 50 J

(B) 100 J

(C) 200 J

(D) 25 J

Q.11. Power is defined as:

(A) Force $\times$ velocity

(B) Work $\times$ time

(C) Force $\times$ distance

(D) Mass $\times$ acceleration

Q.12. A bullet of mass 20 g moving at 300 m/s embeds into a block of mass 980 g at rest. The kinetic energy lost is approximately:

(A) 810 J

(B) 900 J

(C) 891 J

(D) 820 J

1.3 Rotational Motion and Gravitation

Q.13. The moment of inertia of a solid sphere of mass M and radius R about a diameter is:

(A) $\frac{2}{5}MR^2$

(B) $\frac{1}{2}MR^2$

(C) MR^2

(D) $\frac{2}{3}MR^2$

Q.14. The escape velocity from Earth's surface is approximately:

(A) 8 km/s

(B) 11.2 km/s

(C) 16 km/s

(D) 3 km/s

Q.15. According to Kepler's third law, the square of the period of revolution T is proportional to:

(A) r (orbital radius)

(B) r^2

(C) r^3

(D) r^4

Q.16. A torque of 10 N·m acts on a body with moment of inertia 2 kg·m^2. The angular acceleration is:

(A) 2 rad/s^2

(B) 5 rad/s^2

(C) 10 rad/s^2

(D) 20 rad/s^2

Q.17. The orbital velocity of a satellite close to Earth's surface is approximately ($g = 9.8$ m/s^2, $R_E = 6.4 \times 10^6$ m):

(A) 5.6 km/s

(B) 7.9 km/s

(C) 11.2 km/s

(D) 3.2 km/s

1.4 Properties of Matter and Fluid Mechanics

Q.18. The bulk modulus is defined as:

(A) $\dfrac{\text{Longitudinal stress}}{\text{Longitudinal strain}}$

(B) $\dfrac{\text{Shear stress}}{\text{Shear strain}}$

(C) $-\dfrac{dP}{dV/V}$

(D) $\dfrac{FL}{A\Delta L}$

Q.19. Bernoulli's principle is based on conservation of:

(A) Mass

(B) Momentum

(C) Energy

(D) Angular momentum

Q.20. The terminal velocity of a sphere of radius r falling through a viscous fluid is proportional to:

(A) r

(B) r^2

(C) r^3

(D) $\sqrt{r}$

1.5 Heat and Thermodynamics

Q.21. In an adiabatic process for an ideal gas ($\gamma = C_P/C_V$), the relation between pressure and volume is:

(A) $PV = \text{constant}$

(B) $PV^\gamma = \text{constant}$

(C) $PV^2 = \text{constant}$

(D) $P^\gamma V = \text{constant}$

Q.22. The efficiency of a Carnot engine operating between temperatures T_1 (source) and T_2 (sink) is:

(A) $1 - \dfrac{T_1}{T_2}$

(B) $1 - \dfrac{T_2}{T_1}$

(C) $\dfrac{T_1 - T_2}{T_2}$

(D) $\dfrac{T_1 + T_2}{T_1}$

Q.23. Root mean square speed of gas molecules is given by:

(A) $\sqrt{\frac{2RT}{M}}$

(B) $\sqrt{\frac{3RT}{M}}$

(C) $\sqrt{\frac{RT}{M}}$

(D) $\sqrt{\frac{8RT}{\pi M}}$

Q.24. A gas undergoes an isothermal process. Which quantity remains constant?

(A) Pressure

(B) Volume

(C) Temperature

(D) Internal energy only

Q.25. The specific heat of a monoatomic ideal gas at constant volume (C_V) is:

(A) $\frac{3}{2}R$

(B) $\frac{5}{2}R$

(C) $\frac{7}{2}R$

(D) R

Q.26. During the melting of a solid at constant temperature, the heat absorbed is called:

(A) Specific heat

(B) Latent heat of vaporisation

(C) Latent heat of fusion

(D) Thermal capacity

1.6 Oscillations and Waves

Q.27. The time period of a simple pendulum of length l is:

(A) $2\pi\sqrt{\frac{g}{l}}$

(B) $2\pi\sqrt{\frac{l}{g}}$

(C) $\pi\sqrt{\frac{l}{g}}$

(D) $\pi\sqrt{\frac{g}{l}}$

Q.28. In a transverse wave, the displacement of particles is:

(A) Along the direction of wave propagation

(B) Perpendicular to the wave propagation

(C) At 45° to wave propagation

(D) In a circular path

Q.29. The speed of sound in air at 0°C is approximately:

(A) 232 m/s

(B) 332 m/s

(C) 432 m/s

(D) 532 m/s

Q.30. In the Doppler effect, when the source of sound moves towards a stationary observer, the observed frequency:

(A) Decreases

(B) Increases

(C) Remains the same

(D) First increases then decreases

Q.31. The resonance frequency of a pipe open at both ends of length L for the fundamental mode is:

(A) $\dfrac{v}{4L}$

(B) $\dfrac{v}{2L}$

(C) $\dfrac{2v}{L}$

(D) $\dfrac{v}{L}$

1.7 Electrostatics

Q.32. Coulomb's law gives the force between two point charges q_1 and q_2 separated by distance r as:

(A) $F = \dfrac{q_1 q_2}{4\pi\varepsilon_0 r}$

(B) $F = \dfrac{q_1 q_2}{4\pi\varepsilon_0 r^2}$

(C) $F = 4\pi\varepsilon_0 \dfrac{q_1 q_2}{r^2}$

(D) $F = \dfrac{q_1 q_2}{2\pi\varepsilon_0 r^2}$

Q.33. The electric field intensity inside a hollow charged conducting sphere is:

(A) Maximum at the centre

(B) Uniform throughout

(C) Zero

(D) Equal to the field outside

Q.34. The capacitance of a parallel plate capacitor with plate area A and separation d (in vacuum) is:

(A) $\frac{\varepsilon_0 d}{A}$

(B) $\frac{\varepsilon_0 A}{d}$

(C) $\frac{A}{d}$

(D) $\frac{\varepsilon_0 A}{2d}$

Q.35. Work done in bringing a unit positive charge from infinity to a point in an electric field is called:

(A) Electric field intensity

(B) Electric flux

(C) Electric potential

(D) Capacitance

Q.36. Gauss's law in electrostatics states that the total electric flux through a closed surface is:

(A) Zero

(B) $\frac{Q_{enc}}{\varepsilon_0}$

(C) $\varepsilon_0 Q_{enc}$

(D) Proportional to area

Q.37. When a dielectric is inserted between the plates of a charged (isolated) capacitor, the energy stored:

(A) Increases

(B) Decreases

(C) Remains constant

(D) First increases then decreases

1.8 Current Electricity

Q.38. Ohm's law states that (at constant temperature):

(A) $V \propto I^2$

(B) $V \propto I$

(C) $I \propto V^2$

(D) $R \propto V$

Q.39. The internal resistance of an ideal voltage source is:

(A) Infinite

(B) Zero

(C) Finite and fixed

(D) Equal to load resistance

Q.40. In the Wheatstone bridge at balance, if $P/Q = R/S$, then the galvanometer reads:

(A) Maximum current

(B) $V/2$

(C) Zero

(D) Full-scale deflection

Q.41. The resistivity of a conductor at temperature T is given by $\rho = \rho_0(1 + \alpha T)$. Here α is the:

(A) Coefficient of volume expansion

(B) Temperature coefficient of resistance

(C) Hall coefficient

(D) Seebeck coefficient

Q.42. Three resistances 2 Ω, 3 Ω, and 6 Ω are connected in parallel. The equivalent resistance is:

(A) 1 Ω

(B) 11 Ω

(C) 3 Ω

(D) 0.5 Ω

1.9 Magnetic Effects of Current and Magnetism

Q.43. A long straight wire carrying current I produces a magnetic field at perpendicular distance r equal to:

(A) $\dfrac{\mu_0 I}{4\pi r}$

(B) $\dfrac{\mu_0 I}{2\pi r}$

(C) $\dfrac{\mu_0 I}{r}$

(D) $\dfrac{\mu_0 I}{2r}$

Q.44. Lorentz force on a charge q moving with velocity $\vec{v}$ in magnetic field $\vec{B}$ is:

(A) $q\vec{v} \cdot \vec{B}$

(B) $q(\vec{v} \times \vec{B})$

(C) $q\vec{v} + \vec{B}$

(D) $\dfrac{q\vec{v}}{\vec{B}}$

Q.45. The principle used in a moving coil galvanometer is:

(A) Faraday's law

(B) Torque on a current-carrying coil in a magnetic field

(C) Lenz's law

(D) Ampere's law

Q.46. The magnetic moment of a current-carrying loop of area A carrying current I is:

(A) $\dfrac{I}{A}$

(B) IA

(C) $\dfrac{A}{I}$

(D) I^2A

Q.47. The cyclotron frequency of a charged particle of mass m and charge q in magnetic field B is:

(A) $\dfrac{qB}{2\pi m}$

(B) $\dfrac{2\pi m}{qB}$

(C) $\dfrac{qB}{m}$

(D) $\dfrac{m}{qB}$

1.10 Electromagnetic Induction and AC Circuits

Q.48. According to Faraday's law of electromagnetic induction, the induced EMF is:

(A) Proportional to the magnetic flux

(B) Equal to the rate of change of flux

(C) The negative rate of change of magnetic flux

(D) Independent of time

Q.49. In a series LCR circuit at resonance, the impedance is:

(A) Maximum

(B) $\sqrt{R^2 + (X_L - X_C)^2}$

(C) Equal to R only

(D) Zero

Q.50. The rms value of alternating current with peak value I_0 is:

(A) I_0

(B) $\dfrac{I_0}{\sqrt{2}}$

(C) $\dfrac{I_0}{2}$

(D) $\sqrt{2}\, I_0$

Q.51. The unit of self-inductance is:

(A) Tesla

(B) Weber

(C) Henry

(D) Farad

Q.52. Power factor in an AC circuit is defined as:

(A) $\sin\phi$

(B) $\tan\phi$

(C) $\cos\phi$

(D) $\cos^2\phi$

1.11 Optics

Q.53. The mirror formula relating object distance u, image distance v, and focal length f is:

(A) $\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$

(B) $\dfrac{1}{v} + \dfrac{1}{u} = \dfrac{1}{f}$

(C) $\dfrac{1}{f} = \dfrac{1}{u} - \dfrac{1}{v}$

(D) $v + u = f$

Q.54. Total internal reflection occurs when light travels from:

(A) Rarer to denser medium at any angle

(B) Denser to rarer medium beyond critical angle

(C) Rarer to denser medium beyond critical angle

(D) Any medium at 90° angle

Q.55. In Young's double slit experiment, the fringe width β is given by:

(A) $\beta = \dfrac{\lambda D}{d}$

(B) $\beta = \dfrac{d}{\lambda D}$

(C) $\beta = \dfrac{\lambda d}{D}$

(D) $\beta = \dfrac{D}{d\lambda}$

Q.56. A convex lens of focal length 20 cm forms a real inverted image. If the object is placed at 30 cm from the lens, the image distance is:

(A) 30 cm

(B) 60 cm

(C) 40 cm

(D) 20 cm

Q.57. Brewster's law states that for complete polarisation by reflection, the angle of incidence θ_B satisfies:

(A) $\tan\theta_B = n$

(B) $\sin\theta_B = n$

(C) $\cos\theta_B = n$

(D) $\sin^2\theta_B = n$

Q.58. The resolving power of a telescope increases when:

(A) Wavelength of light increases

(B) Aperture of objective decreases

(C) Aperture of objective increases

(D) Focal length decreases

1.12 Modern Physics

Q.59. Einstein's photoelectric equation is:

(A) $E = mc^2$

(B) $KE_{max} = h\nu - \phi$

(C) $KE_{max} = h\nu + \phi$

(D) $KE_{max} = \phi - h\nu$

Q.60. De Broglie wavelength of a particle of momentum p is:

(A) $\lambda = hp$

(B) $\lambda = \dfrac{h}{p}$

(C) $\lambda = \dfrac{p}{h}$

(D) $\lambda = h^2 p$

Q.61. In Bohr's model of hydrogen atom, the radius of the nth orbit is proportional to:

(A) n

(B) n^2

(C) n^3

(D) n^4

Q.62. The energy of a photon of frequency ν is:

(A) $h\nu^2$

(B) $\dfrac{h}{\nu}$

(C) $h\nu$

(D) h/c

Q.63. In radioactive decay, the half-life $T_{1/2}$ and decay constant λ are related as:

(A) $T_{1/2} = \dfrac{2\lambda}{\ln 2}$

(B) $T_{1/2} = \dfrac{\ln 2}{\lambda}$

(C) $T_{1/2} = \lambda \ln 2$

(D) $T_{1/2} = \dfrac{1}{\lambda}$

Q.64. In nuclear fission, the mass defect is converted into:

(A) Kinetic energy of fission products

(B) Potential energy

(C) Chemical energy

(D) Sound energy

Q.65. The threshold frequency in the photoelectric effect is the minimum frequency below which:

(A) Photons are absorbed but no electrons are emitted

(B) Light is reflected

(C) Photoelectric current is maximum

(D) No photoelectric effect occurs

1.13 Electronic Devices and Semiconductors

Q.66. In a p-n junction diode under forward bias, the barrier potential:

(A) Increases

(B) Decreases

(C) Remains constant

(D) Becomes zero instantly

Q.67. The truth table of a NAND gate shows output 0 only when:

(A) Both inputs are 0

(B) Both inputs are 1

(C) One input is 0

(D) Any input is 1

Q.68. In an n-type semiconductor, the majority charge carriers are:

(A) Holes

(B) Electrons

(C) Protons

(D) Neutrons

Q.69. A Zener diode is used primarily as:

(A) Amplifier

(B) Voltage regulator

(C) Rectifier

(D) Oscillator

Q.70. In a common-emitter transistor amplifier, the phase difference between input and output voltage is:

(A) 0°

(B) 90°

(C) 180°

(D) 270°

1.14 Communication Systems

Q.71. In amplitude modulation (AM), the bandwidth required is:

(A) Equal to the carrier frequency

(B) Twice the signal frequency

(C) Half the carrier frequency

(D) Equal to the signal frequency

Q.72. Ground waves are suitable for communication at frequencies:

(A) Above 30 MHz

(B) Below 2 MHz

(C) Between 2 MHz and 30 MHz

(D) Exactly 100 MHz

1.15 Units, Dimensions and Measurement

Q.73. The dimensional formula for coefficient of viscosity is:

(A) $[ML^{-1}T^{-1}]$

(B) $[MLT^{-1}]$

(C) $[M^0L^2T^{-1}]$

(D) $[ML^2T^{-2}]$

Q.74. The number of significant figures in 6.020×10^{23} is:

(A) 3

(B) 4

(C) 5

(D) 2

Q.75. If velocity, acceleration, and force are taken as fundamental quantities, the dimension of mass is:

(A) $[FV^{-1}A]$

(B) $[FA^{-1}V^{-1}]$

(C) $[FVA^{-1}]$

(D) $[FA^{-1}]$

1.16 Additional Physics Questions

Q.76. The refractive index of glass is 1.5. The critical angle for glass–air interface is:

(A) $\sin^{-1}(0.75)$

(B) $\sin^{-1}(1.5)$

(C) $\sin^{-1}(2/3)$

(D) $\cos^{-1}(0.75)$

Q.77. The binding energy per nucleon is highest for:

(A) Hydrogen

(B) Iron

(C) Uranium

(D) Helium

Q.78. The velocity of light in vacuum is $c = 3 \times 10^8$ m/s. In a medium of refractive index 1.5, the speed of light is:

(A) 4.5×10^8 m/s

(B) 2×10^8 m/s

(C) 1.5×10^8 m/s

(D) 3×10^8 m/s

Q.79. In simple harmonic motion, at the mean position the:

(A) Potential energy is maximum

(B) Kinetic energy is maximum

(C) Both KE and PE are equal

(D) Acceleration is maximum

Q.80. Stefan's law of black body radiation states that the power radiated is proportional to:

(A) T

(B) T^2

(C) T^3

(D) T^4

Q.81. Two capacitors of capacitances 4 μF and 6 μF are connected in series. Their equivalent capacitance is:

(A) 10 μF

(B) 2.4 μF

(C) 5 μF

(D) 1.5 μF

Q.82. A transformer steps up the voltage from 220 V to 2200 V. If the number of turns in the primary is 100, the number of turns in the secondary is:

(A) 1000

(B) 100

(C) 500

(D) 2000

Q.83. The electromagnetic wave that has the highest frequency is:

(A) Radio waves

(B) X-rays

(C) Infrared rays

(D) Gamma rays

Q.84. A particle performing SHM has displacement $x = A\sin(\omega t + \phi)$. Its maximum acceleration is:

(A) $A\omega$

(B) $A\omega^2$

(C) A/ω^2

(D) $A^2\omega$

Q.85. The first law of thermodynamics is a statement of conservation of:

(A) Mass

(B) Momentum

(C) Energy

(D) Charge

Q.86. A resistor and inductor are connected in series to an AC source. The current in the circuit lags behind the voltage by:

(A) $\tan^{-1}\left(\frac{R}{\omega L}\right)$

(B) $\tan^{-1}\left(\frac{\omega L}{R}\right)$

(C) $\cos^{-1}\left(\frac{\omega L}{R}\right)$

(D) $\sin^{-1}\left(\frac{R}{\omega L}\right)$

Q.87. In photo-electric effect, the stopping potential is independent of:

(A) Frequency of incident light

(B) Intensity of incident light

(C) Work function of metal

(D) Nature of the metal surface

Q.88. The magnetic field at the centre of a circular loop of radius R carrying current I is:

(A) $\frac{\mu_0 I}{2\pi R}$

(B) $\frac{\mu_0 I}{R}$

(C) $\frac{\mu_0 I}{2R}$

(D) $\frac{\mu_0 I}{4R}$

Q.89. According to Heisenberg's uncertainty principle:

(A) $\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$

(B) $\Delta x \cdot \Delta p \geq h$

(C) $\Delta x \cdot \Delta p \leq \frac{h}{4\pi}$

(D) $\Delta x \cdot \Delta p = 0$

Q.90. The phenomenon of diffraction is most prominent when the obstacle size is:

(A) Much larger than wavelength

(B) Much smaller than wavelength

(C) Comparable to wavelength

(D) Exactly equal to frequency

Q.91. Compton effect proves the:

(A) Wave nature of light

(B) Particle nature of electrons

(C) Particle nature of photons

(D) Dual nature of X-rays

Q.92. When a body is at rest on a rough inclined plane, the static friction acts:

(A) Perpendicular to the incline, pointing upward

(B) Along the incline, pointing upward

(C) Along the incline, pointing downward

(D) Horizontally outward

Q.93. A solenoid of n turns per unit length carrying current I has magnetic field inside equal to:

(A) $\dfrac{\mu_0 n I}{2}$

(B) $\mu_0 n I$

(C) $2\mu_0 n I$

(D) $\dfrac{\mu_0 I}{n}$

Q.94. The dimension of Planck's constant is the same as that of:

(A) Energy

(B) Linear momentum

(C) Angular momentum

(D) Power

Q.95. In a nuclear reactor, heavy water is used as a:

(A) Fuel

(B) Moderator

(C) Coolant only

(D) Reflector

Q.96. The minimum energy needed to remove an electron from the surface of a metal is called:

(A) Ionisation potential

(B) Binding energy

(C) Work function

(D) Threshold energy

Q.97. An electric dipole of moment p placed in a uniform electric field E at angle θ experiences a torque:

(A) $pE\cos\theta$

(B) $pE\sin\theta$

(C) $\dfrac{pE}{\sin\theta}$

(D) $p^2 E\sin\theta$

Q.98. The value of ε_0 (permittivity of free space) is approximately:

(A) 8.85×10^{-10} C^2 N^{-1} m^{-2}

(B) 8.85×10^{-12} C^2 N^{-1} m^{-2}

(C) 9×10^{9} C^2 N^{-1} m^{-2}

(D) $4\pi \times 10^{-7}$ C^2 N^{-1} m^{-2}

Q.99. Huygen's principle is used to explain:

(A) Photoelectric effect

(B) Wave propagation and refraction of light

(C) Nuclear fission

(D) Compton scattering

Q.100. A body is thrown vertically upward with velocity 20 m/s. The time to reach maximum height is ($g = 10$ m/s^2):

(A) 1 s

(B) 2 s

(C) 4 s

(D) 5 s

2 Chemistry

2.1 Chemical Bonding and Molecular Structure

Q.101. The VSEPR shape of NH_3 is:

(A) Tetrahedral

(B) Trigonal planar

(C) Trigonal pyramidal

(D) Linear

Q.102. In $BeCl_2$, the hybridisation of Be is:

(A) sp^3

(B) sp^2

(C) sp

(D) sp^3d

Q.103. The bond angle in water (H_2O) is approximately:

(A) 120°

(B) 109.5°

(C) 104.5°

(D) 90°

Q.104. Which of the following has the maximum bond order?

(A) N_2

(B) O_2

(C) F_2

(D) H_2

Q.105. Hydrogen bonding is strongest in:

(A) HCl

(B) HF

(C) H_2S

(D) NH_3

2.2 States of Matter and Solutions

Q.106. Van der Waals equation for one mole of a real gas is:

(A) $\left(P + \frac{a}{V}\right)(V - b) = RT$

(B) $\left(P + \frac{a}{V^2}\right)(V - b) = RT$

(C) $PV = RT$

(D) $P(V - b) = RT$

Q.107. Raoult's law states that the partial vapour pressure of a solvent is:

(A) Proportional to mole fraction of solute

(B) Proportional to mole fraction of solvent times P^0

(C) Independent of concentration

(D) Equal to osmotic pressure

Q.108. The elevation of boiling point is a colligative property. The formula $\Delta T_b = K_b m$ gives rise to the determination of:

(A) Density of solute

(B) Molar mass of solute

(C) Viscosity of solution

(D) Surface tension

Q.109. Henry's law states that the solubility of a gas in liquid is:

(A) Inversely proportional to partial pressure

(B) Directly proportional to partial pressure

(C) Independent of pressure

(D) Proportional to temperature

2.3 Thermodynamics and Chemical Equilibrium

Q.110. Gibbs free energy change for a spontaneous process at constant T and P satisfies:

(A) $\Delta G > 0$

(B) $\Delta G = 0$

(C) $\Delta G < 0$

(D) $\Delta G = \Delta H$

Q.111. For the reaction $\mathrm{N_2 + 3\,H_2 \rightleftharpoons 2\,NH_3}$, the equilibrium constant K_p and K_c are related by:

(A) $K_p = K_c(RT)^2$

(B) $K_p = K_c(RT)^{-2}$

(C) $K_p = K_c$

(D) $K_p = K_c(RT)^3$

Q.112. Le Chatelier's principle predicts that increasing pressure on the equilibrium $\mathrm{N_2 + 3\,H_2 \rightleftharpoons 2\,NH_3}$ will:

(A) Shift equilibrium left

(B) Shift equilibrium right

(C) Have no effect

(D) Decrease temperature

Q.113. Hess's law is based on the principle of conservation of:

(A) Mass

(B) Momentum

(C) Energy

(D) Charge

Q.114. The standard enthalpy of formation of an element in its standard state is:

(A) +1 kJ/mol

(B) −1 kJ/mol

(C) Zero

(D) Depends on the element

2.4 Chemical Kinetics

Q.115. For a first-order reaction, the half-life is:

(A) Dependent on initial concentration

(B) $\frac{1}{k}$

(C) $\frac{0.693}{k}$

(D) $\frac{k}{0.693}$

Q.116. The Arrhenius equation is $k = Ae^{-E_a/RT}$. Increasing temperature:

(A) Decreases k

(B) Increases k

(C) Does not affect k

(D) First decreases then increases k

Q.117. For a zero-order reaction, the rate of reaction:

(A) Depends on concentration

(B) Is independent of concentration

(C) Decreases exponentially

(D) Increases with time

Q.118. A catalyst increases the rate of reaction by:

(A) Increasing the activation energy

(B) Decreasing the activation energy

(C) Increasing temperature

(D) Changing the equilibrium constant

2.5 Electrochemistry

Q.119. Faraday's first law states that the mass of substance deposited at an electrode is proportional to:

(A) Voltage applied

(B) Quantity of charge passed

(C) Resistance of electrolyte

(D) Temperature

Q.120. The EMF of the standard hydrogen electrode (SHE) is taken as:

(A) +1.0 V

(B) −1.0 V

(C) Zero

(D) Depends on acid concentration

Q.121. The Nernst equation for an electrode reaction at temperature T is:

(A) $E = E^\circ - \dfrac{RT}{nF} \ln Q$

(B) $E = E^\circ + \dfrac{nF}{RT} \ln Q$

(C) $E = E^\circ \times RT$

(D) $E = E^\circ + \dfrac{RT}{nF}$

Q.122. Which cell uses hydrogen and oxygen to produce electricity?

(A) Daniel cell

(B) Leclanche cell

(C) Fuel cell

(D) Lead storage battery

2.6 p-Block Elements

Q.123. The shape of SF_6 is:

(A) Trigonal bipyramidal

(B) Octahedral

(C) Square planar

(D) Tetrahedral

Q.124. Which of the following is the strongest reducing agent among halogens?

(A) F_2

(B) Cl_2

(C) Br_2

(D) I_2

Q.125. The oxide of nitrogen that is used as an anaesthetic is:

(A) NO
(B) NO_2
(C) N_2O
(D) N_2O_5

Q.126. Ozone reacts with KI solution to liberate:

(A) I_2
(B) KIO_3
(C) HI
(D) K_2O

Q.127. The acidic nature of oxoacids of chlorine increases in the order:

(A) $HClO < HClO_2 < HClO_3 < HClO_4$
(B) $HClO_4 < HClO_3 < HClO_2 < HClO$
(C) All are equally acidic
(D) $HClO_2 < HClO < HClO_4 < HClO_3$

2.7 d-Block and Coordination Compounds

Q.128. The IUPAC name of $[Cu(NH_3)_4]^{2+}$ is:

(A) Copper(II) tetraammine
(B) Tetraamminecopper(II) ion
(C) Tetraaminecupric ion
(D) Copper tetraammine(II) ion

Q.129. The coordination number of Fe in $[Fe(CN)_6]^{3-}$ is:

(A) 3
(B) 4
(C) 5
(D) 6

Q.130. Which of the following coordination compounds exhibits geometrical isomerism?

(A) $[Co(NH_3)_6]^{3+}$
(B) $[Pt(NH_3)_2Cl_2]$
(C) $[PtCl_4]^{2-}$
(D) $[Ni(CO)_4]$

Q.131. According to crystal field theory, the *d*-orbitals that are directed towards the ligands in an octahedral field are:

(A) d_{xy}, d_{yz}, d_{xz}

(B) d_{z^2}, $d_{x^2-y^2}$

(C) d_{xy}, d_{z^2}

(D) All five d-orbitals equally

2.8 Organic Chemistry – Basic Principles

Q.132. The IUPAC name of $CH_3-CH(OH)-COOH$ is:

(A) 2-hydroxyethanoic acid

(B) 2-hydroxypropanoic acid

(C) 3-hydroxypropanoic acid

(D) Propan-1-ol-2-carboxylic acid

Q.133. A carbocation is most stable when it is:

(A) Primary

(B) Secondary

(C) Tertiary

(D) Methyl carbocation

Q.134. In SN2 mechanism, the attacking nucleophile approaches the carbon from:

(A) Same side as the leaving group

(B) Opposite side to the leaving group

(C) Perpendicular to the carbon–leaving group axis

(D) Any direction with equal probability

Q.135. Markovnikov's rule predicts the major product in the addition of HBr to:

(A) Alkynes only

(B) Unsymmetrical alkenes

(C) Symmetrical alkenes

(D) Arenes

Q.136. The reaction of benzene with Cl_2 in the presence of $AlCl_3$ is an example of:

(A) Nucleophilic substitution

(B) Electrophilic addition

(C) Electrophilic substitution

(D) Free radical substitution

2.9 Hydrocarbons

Q.137. Baeyer's reagent (alkaline $KMnO_4$) converts an alkene into a:

(A) Diol (glycol)
(B) Monoalcohol
(C) Alkane
(D) Carboxylic acid

Q.138. The product of ozonolysis of 2-butene followed by reductive workup is:

(A) Two molecules of ethanal
(B) One molecule of butanal
(C) Two molecules of formaldehyde
(D) Acetic acid

Q.139. The strongest acid among the following hydrocarbons is:

(A) Ethane
(B) Ethene
(C) Ethyne
(D) Propane

2.10 Haloalkanes and Organic Functional Groups

Q.140. The reaction of an alcohol with HBr involves:

(A) Free radical mechanism
(B) Nucleophilic substitution
(C) Electrophilic addition
(D) Elimination

Q.141. Reimer–Tiemann reaction introduces a functional group at which position of phenol?

(A) Para position only
(B) Ortho position
(C) Meta position
(D) None of the above

Q.142. Aldol condensation is possible for aldehydes and ketones containing:

(A) No α-hydrogen
(B) At least one α-hydrogen
(C) A β-carbonyl group
(D) An aromatic ring

Q.143. The primary amines react with HNO_2 at low temperature to give:

(A) Amide

(B) Diazonium salt

(C) Nitrile

(D) Secondary amine

Q.144. Carboxylic acids are more acidic than alcohols because:

(A) They have higher boiling points

(B) The carboxylate ion is stabilised by resonance

(C) They contain oxygen

(D) They have a double bond

Q.145. Fehling's solution is used to distinguish between:

(A) Primary and secondary alcohols

(B) Aldehydes and ketones

(C) Carboxylic acids and esters

(D) Alkenes and alkynes

2.11 Biomolecules and Polymers

Q.146. The monomer units of proteins are:

(A) Monosaccharides

(B) Nucleotides

(C) Amino acids

(D) Fatty acids

Q.147. The secondary structure of protein refers to:

(A) Sequence of amino acids

(B) α-helix or β-pleated sheet formed by hydrogen bonds

(C) 3D folding of polypeptide chain

(D) Quaternary aggregation

Q.148. DNA stores genetic information by the sequence of:

(A) Phosphate groups

(B) Sugar units

(C) Nitrogenous bases

(D) Fatty acids

Q.149. Nylon-6,6 is a:

(A) Addition polymer

(B) Condensation polymer

(C) Natural polymer

(D) Copolymer of two identical monomers

Q.150. The repeating unit of natural rubber is:

(A) Isoprene (2-methylbuta-1,3-diene)

(B) Styrene

(C) Ethylene

(D) Chloroprene

2.12 s-Block and Hydrogen

Q.151. The compound formed when Na_2O_2 reacts with H_2O is:

(A) NaOH + O_2

(B) NaOH + H_2O_2

(C) Na_2O + H_2O_2

(D) NaH + O_2

Q.152. The atomic number of the element with the largest ionic radius in Group 1 is:

(A) Li (3)

(B) Na (11)

(C) K (19)

(D) Cs (55)

Q.153. Which of the following is an ortho acid of phosphorus?

(A) H_3PO_2

(B) H_3PO_3

(C) H_3PO_4

(D) HPO_3

2.13 Atomic Structure and Periodic Table

Q.154. The wavelength of the spectral line in the Balmer series is given by:

(A) $\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{n^2}\right)$

(B) $\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$

(C) $\frac{1}{\lambda} = R\left(\frac{1}{3^2} - \frac{1}{n^2}\right)$

(D) $\frac{1}{\lambda} = R\left(\frac{1}{4^2} - \frac{1}{n^2}\right)$

Q.155. The quantum number that describes the orientation of an orbital in space is:

(A) Principal quantum number (n)

(B) Azimuthal quantum number (l)

(C) Magnetic quantum number (m_l)

(D) Spin quantum number (m_s)

Q.156. The electron affinity is highest for:

(A) Fluorine

(B) Chlorine

(C) Bromine

(D) Iodine

Q.157. Ionisation enthalpy generally increases across a period from left to right because:

(A) Atomic radius increases

(B) Nuclear charge increases and atomic radius decreases

(C) Electrons are added in the same shell

(D) Shielding effect increases

2.14 Solid State and Surface Chemistry

Q.158. In a face-centred cubic (fcc) unit cell, the number of atoms per unit cell is:

(A) 1

(B) 2

(C) 4

(D) 6

Q.159. The packing efficiency of body-centred cubic (bcc) structure is approximately:

(A) 52.4%

(B) 68.0%

(C) 74.0%

(D) 90.0%

Q.160. Adsorption of a gas on a solid surface in which the gas molecules form multi-layers is described by:

(A) Freundlich isotherm

(B) BET isotherm

(C) Langmuir isotherm

(D) Henry's isotherm

Q.161. The Schottky defect in ionic crystals leads to:

(A) Increased density

(B) Decreased density

(C) Increased conductivity only

(D) No change in density

2.15 Additional Chemistry Questions

Q.162. Borax bead test gives a characteristic colour due to:

(A) Formation of metal borate

(B) Formation of metal carbonate

(C) Reduction of metal oxide

(D) Dissolution of metal in acid

Q.163. The reaction between Na_2SO_4 and $BaCl_2$ solutions is a:

(A) Oxidation-reduction reaction

(B) Double displacement reaction

(C) Combination reaction

(D) Decomposition reaction

Q.164. The standard electrode potential of Zn^{2+}/Zn is -0.76 V. That of Cu^{2+}/Cu is $+0.34$ V. The EMF of Daniell cell is:

(A) -0.42 V

(B) 0.42 V

(C) 1.10 V

(D) 0.76 V

Q.165. In the extraction of copper from its ore, the final step involves:

(A) Roasting

(B) Electrolytic refining

(C) Smelting

(D) Zone refining

Q.166. The geometry of $[Ni(CO)_4]$ is:

(A) Square planar

(B) Octahedral

(C) Tetrahedral

(D) Trigonal bipyramidal

Q.167. Which of the following is paramagnetic?

(A) N_2

(B) O_2

(C) F_2

(D) Ne

Q.168. The correct order of boiling points of hydrogen halides is:

(A) HF > HI > HBr > HCl

(B) HI > HBr > HCl > HF

(C) HF > HI > HCl > HBr

(D) HCl < HBr < HI < HF

Q.169. Glycine is the simplest amino acid. Its zwitterion form exists at the:

(A) Isoelectric point

(B) Strongly acidic pH

(C) Strongly basic pH

(D) Any pH

Q.170. Which of the following is an example of a lyophilic colloid?

(A) Gold sol

(B) As_2S_3 sol

(C) Starch in water

(D) Sulphur sol

Q.171. The Cannizzaro reaction occurs in aldehydes that have:

(A) At least one α-hydrogen

(B) No α-hydrogen

(C) A hydroxyl group

(D) An aromatic ring

Q.172. Identify the product when CH_3COCl reacts with dry ammonia:

(A) CH_3CONH_2

(B) CH_3OH

(C) CH_3COOH

(D) CH_3NH_2

Q.173. The colour of $CuSO_4$ solution is due to:

(A) $SO_4{}^{2-}$ ion

(B) Cu^{2+} ion

(C) H_2O molecules in crystal

(D) Absorbed infrared light

Q.174. Which of the following has the highest lattice enthalpy?

(A) NaCl

(B) KCl

(C) LiF

(D) CsI

Q.175. The number of moles of NaOH required to precipitate $Al(OH)_3$ from 1 mol of $AlCl_3$ is:

(A) 1

(B) 2

(C) 3

(D) 4

Q.176. The product of nucleophilic addition of HCN to acetaldehyde (CH_3CHO) is:

(A) Acetonitrile

(B) Lactic acid (after hydrolysis)

(C) Acetic acid

(D) Propionitrile

Q.177. Which polymer is used to make bullet-proof vests?

(A) Nylon-6,6

(B) Kevlar

(C) Teflon

(D) Polystyrene

Q.178. The enzyme that catalyses the hydrolysis of starch to maltose is:

(A) Zymase

(B) Amylase

(C) Invertase

(D) Lipase

Q.179. The oxidation state of Cr in $K_2Cr_2O_7$ is:

(A) +3

(B) +4

(C) +5

(D) +6

Q.180. Which of the following is a false statement about benzene?

(A) All carbon–carbon bonds are of equal length

(B) It undergoes electrophilic aromatic substitution readily

(C) It readily undergoes addition reactions

(D) It has 6 π electrons

Q.181. The term "polymer" was coined by:

(A) Staudinger

(B) Berzelius

(C) Kekule

(D) Wohler

Q.182. The isomerism exhibited by $[Co(NH_3)_5Cl]Cl_2$ and $[Co(NH_3)_4Cl_2]Cl$ is:

(A) Geometrical isomerism

(B) Optical isomerism

(C) Ionisation isomerism

(D) Linkage isomerism

Q.183. The hybridisation of carbon in benzene is:

(A) sp^3

(B) sp^2

(C) sp

(D) sp^3d

Q.184. Which of the following is used as an antibiotic?

(A) Chloramphenicol

(B) Morphine

(C) Chloroquine

(D) Salol

Q.185. Vapour pressure of a solution is always:

(A) Greater than the pure solvent

(B) Less than the pure solvent

(C) Equal to the pure solvent

(D) Depends on solute only

Q.186. The reaction in which two or more molecules combine to form a polymer without the loss of any small molecule is called:

(A) Condensation polymerisation

(B) Addition polymerisation

(C) Co-polymerisation

(D) Hydrolysis

Q.187. Which type of isomerism is shown by hexane and 2-methylpentane?

(A) Position isomerism

(B) Functional group isomerism

(C) Chain isomerism

(D) Metamerism

Q.188. The IUPAC name of $CHCl_3$ is:

(A) Chloroform

(B) Trichloromethane

(C) Dichloromethane

(D) Tetrachloromethane

Q.189. Tollen's reagent is used to detect:

(A) Ketones
(B) Aldehydes
(C) Carboxylic acids
(D) Alcohols

Q.190. The number of σ and π bonds in $CH_2{=}CH{-}C{\equiv}CH$ are:

(A) 5σ, 2π
(B) 6σ, 3π
(C) 6σ, 2π
(D) 5σ, 3π

Q.191. Which of the following has the lowest melting point?

(A) NaF
(B) NaCl
(C) NaBr
(D) NaI

Q.192. The unit of rate constant for a second-order reaction is:

(A) mol L^{-1} s^{-1}
(B) L mol^{-1} s^{-1}
(C) s^{-1}
(D) mol^2 L^{-2} s^{-1}

Q.193. The van't Hoff factor i for Na_2SO_4 in dilute solution is:

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

Q.194. Copper sulphate is blue because:

(A) It absorbs blue light
(B) It reflects blue light
(C) It absorbs red light (transmits blue)
(D) It absorbs all visible light

Q.195. The process by which a colloidal sol is converted into a gel by cooling is called:

(A) Coagulation
(B) Peptisation
(C) Dialysis
(D) Gelation

Q.196. In electrolysis of acidified water, at cathode the reaction is:

(A) Oxidation of water

(B) Reduction of H^+ to H_2

(C) Reduction of O_2^-

(D) Oxidation of H_2

Q.197. Which of the following is a primary standard?

(A) NaOH

(B) HCl

(C) $K_2Cr_2O_7$

(D) $KMnO_4$

Q.198. A substance that speeds up a reaction but is not consumed is called:

(A) Inhibitor

(B) Catalyst

(C) Reactant

(D) Intermediate

Q.199. The boiling point of water increases when:

(A) A volatile solute is added

(B) An involatile solute is added

(C) Pressure is decreased

(D) Temperature is decreased

Q.200. The correct formula of the compound formed by Al^{3+} and O^{2-} ions is:

(A) AlO

(B) AlO_2

(C) Al_2O_3

(D) Al_3O_2

3 Mathematics

3.1 Algebra

Q.201. The roots of $x^2 - 5x + 6 = 0$ are:

(A) 2, 3

(B) 1, 6

(C) $-2, -3$

(D) 2, -3

Q.202. If ω is a cube root of unity, then $1 + \omega + \omega^2$ equals:

(A) 1

(B) ω

(C) 0

(D) -1

Q.203. The number of terms in the expansion of $(x + y)^{10}$ is:

(A) 10

(B) 11

(C) 9

(D) 12

Q.204. If $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$, then $|A|$ is:

(A) 2

(B) -2

(C) 4

(D) 10

Q.205. The sum of the first n terms of an arithmetic progression with first term a and common difference d is:

(A) $\frac{n}{2}(2a + (n-1)d)$

(B) $n(a + d)$

(C) $\frac{n}{2}(a + d)$

(D) $a + (n-1)d$

Q.206. If ${}^nC_r = 15$ and ${}^nC_{r-1} = 6$, then n is:

(A) 5

(B) 6

(C) 7

(D) 8

Q.207. The modulus of the complex number $z = 3 + 4i$ is:

(A) 3
(B) 4
(C) 5
(D) 7

Q.208. If $f(x) = 2^x$, then $f(3) - f(2)$ is:

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

Q.209. The general term T_{r+1} in the binomial expansion of $(x + a)^n$ is:

(A) ${}^nC_r\, x^r\, a^{n-r}$
(B) ${}^nC_r\, x^{n-r}\, a^r$
(C) ${}^nC_r\, x^n\, a^r$
(D) ${}^nC_r\, x^{n+r}\, a^r$

Q.210. For a 2×2 matrix A with $|A| = 5$, the value of $|3A|$ is:

(A) 15
(B) 25
(C) 45
(D) 9

3.2 Coordinate Geometry

Q.211. The slope of a line passing through $(2, 3)$ and $(5, 9)$ is:

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

Q.212. The equation of a circle with centre (h, k) and radius r is:

(A) $(x - h)^2 + (y - k)^2 = r$
(B) $(x - h)^2 + (y - k)^2 = r^2$
(C) $(x + h)^2 + (y + k)^2 = r^2$
(D) $x^2 + y^2 = r^2$

Q.213. The eccentricity of an ellipse $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} = 1$ where $a > b$ is:

(A) $\sqrt{1 + b^2/a^2}$

(B) $\sqrt{1 - b^2/a^2}$

(C) b/a

(D) a/b

Q.214. The distance of the point $(3, -4)$ from the line $3x + 4y - 5 = 0$ is:

(A) 3

(B) 4

(C) 5

(D) 7

Q.215. The vertex of the parabola $y^2 = 4ax$ is at:

(A) $(a, 0)$

(B) $(0, a)$

(C) $(0, 0)$

(D) (a, a)

Q.216. The angle between the lines $y = m_1x + c_1$ and $y = m_2x + c_2$ is:

(A) $\tan^{-1}\left(\dfrac{m_1 - m_2}{1 + m_1m_2}\right)$

(B) $\tan^{-1}(m_1 - m_2)$

(C) $\tan^{-1}\left(\dfrac{m_1 + m_2}{1 - m_1m_2}\right)$

(D) $\tan^{-1}(m_1m_2)$

Q.217. A hyperbola has equation $\dfrac{x^2}{9} - \dfrac{y^2}{4} = 1$. Its eccentricity is:

(A) $\dfrac{\sqrt{13}}{3}$

(B) $\dfrac{\sqrt{13}}{4}$

(C) $\dfrac{5}{3}$

(D) $\dfrac{4}{3}$

3.3 Trigonometry

Q.218. The value of $\sin 75^\circ$ is:

(A) $\dfrac{\sqrt{3} - 1}{2\sqrt{2}}$

(B) $\dfrac{\sqrt{3} + 1}{2\sqrt{2}}$

(C) $\dfrac{\sqrt{3}}{2}$

(D) $\dfrac{1}{\sqrt{2}}$

Q.219. In a triangle ABC, the cosine rule states:

(A) $a^2 = b^2 + c^2 - 2bc\cos A$

(B) $a^2 = b^2 + c^2 + 2bc\cos A$

(C) $a = b + c - 2bc\cos A$

(D) $a^2 = b^2 - c^2 + 2bc\cos A$

Q.220. The general solution of $\sin\theta = \dfrac{1}{2}$ is:

(A) $\theta = n\pi + (-1)^n \dfrac{\pi}{6}$

(B) $\theta = 2n\pi \pm \dfrac{\pi}{6}$

(C) $\theta = n\pi + \dfrac{\pi}{6}$

(D) $\theta = n\pi - \dfrac{\pi}{6}$

Q.221. The principal value of $\sin^{-1}\left(-\dfrac{1}{2}\right)$ is:

(A) $-\dfrac{\pi}{3}$

(B) $-\dfrac{\pi}{6}$

(C) $\dfrac{\pi}{6}$

(D) $\dfrac{5\pi}{6}$

Q.222. $\tan^{-1} x + \cot^{-1} x$ equals:

(A) π

(B) $\dfrac{\pi}{4}$

(C) $\dfrac{\pi}{2}$

(D) 0

Q.223. The expression $2\sin^2\theta + 2\cos^2\theta$ simplifies to:

(A) 0

(B) 1

(C) 2

(D) 4

3.4 Differential Calculus

Q.224. The derivative of $\sin(\ln x)$ with respect to x is:

(A) $\cos(\ln x)$

(B) $\dfrac{\cos(\ln x)}{x}$

(C) $x\cos(\ln x)$

(D) $-\dfrac{\cos(\ln x)}{x}$

Q.225. $\lim_{x\to 0} \dfrac{\sin x}{x}$ equals:

(A) 0

(B) ∞

(C) 1

(D) -1

Q.226. If $y = x^x$, then $\dfrac{dy}{dx}$ is:

(A) x^x

(B) $x^x(1 + \ln x)$

(C) $x^x \ln x$

(D) $x \cdot x^{x-1}$

Q.227. For a function $f(x)$, the condition $f'(x) = 0$ at $x = c$ and $f''(c) > 0$ implies $x = c$ is a:

(A) Point of inflection

(B) Local maximum

(C) Local minimum

(D) Absolute maximum

Q.228. The derivative of $\tan^{-1} x$ is:

(A) $\dfrac{1}{\sqrt{1-x^2}}$

(B) $\dfrac{1}{1+x^2}$

(C) $\dfrac{-1}{1+x^2}$

(D) $\sqrt{1+x^2}$

Q.229. $\lim_{x\to\infty} \left(1 + \dfrac{1}{x}\right)^x$ equals:

(A) 1

(B) π

(C) e

(D) ∞

Q.230. By Rolle's theorem, if f is continuous on $[a, b]$, differentiable on (a, b), and $f(a) = f(b)$, then there exists $c \in (a, b)$ such that:

(A) $f(c) = 0$

(B) $f'(c) = 0$

(C) $f''(c) = 0$

(D) $f(c) = f(a)$

3.5 Integral Calculus

Q.231. $\int e^x(\sin x + \cos x)\, dx$ equals:

(A) $e^x \cos x + C$

(B) $e^x \sin x + C$

(C) $e^x(\sin x - \cos x) + C$

(D) $e^x(\cos x - \sin x) + C$

Q.232. $\int_0^{\pi/2} \sin x\, dx$ equals:

(A) 0

(B) -1

(C) 1

(D) $\pi/2$

Q.233. The area enclosed by $y = x^2$ and $y = x$ (between their intersections) is:

(A) $\dfrac{1}{6}$

(B) $\dfrac{1}{3}$

(C) $\dfrac{1}{2}$

(D) $\dfrac{1}{4}$

Q.234. $\displaystyle\int \frac{dx}{\sqrt{1 - x^2}}$ equals:

(A) $\tan^{-1} x + C$

(B) $\sin^{-1} x + C$

(C) $\cos^{-1} x + C$

(D) $\sec^{-1} x + C$

Q.235. The order of the differential equation $\dfrac{d^2y}{dx^2} + x\dfrac{dy}{dx} + y = 0$ is:

(A) 1

(B) 2

(C) 3

(D) 0

Q.236. $\int xe^x\,dx$ equals:

(A) $xe^x + C$

(B) $e^x(x-1) + C$

(C) $e^x(x+1) + C$

(D) $x^2e^x/2 + C$

Q.237. The solution of the differential equation $\dfrac{dy}{dx} = ky$ (where k is a constant) is:

(A) $y = Ce^{kx}$

(B) $y = C + kx$

(C) $y = Ck^x$

(D) $y = Ce^{-kx}$

Q.238. $\displaystyle\int_{-1}^{1} x^3\,dx$ equals:

(A) $\dfrac{1}{2}$

(B) 2

(C) 0

(D) $-\dfrac{1}{4}$

3.6 Vectors and 3D Geometry

Q.239. The dot product $\vec{a} \cdot \vec{b} = 0$ implies that:

(A) $\vec{a}$ and $\vec{b}$ are parallel

(B) $\vec{a}$ and $\vec{b}$ are perpendicular

(C) $|\vec{a}| = |\vec{b}|$

(D) $\vec{a} = \vec{b}$

Q.240. The magnitude of the cross product $|\vec{a} \times \vec{b}|$ equals:

(A) $|\vec{a}||\vec{b}|\cos\theta$

(B) $|\vec{a}||\vec{b}|\sin\theta$

(C) $|\vec{a}||\vec{b}|\tan\theta$

(D) $|\vec{a}| + |\vec{b}|$

Q.241. The direction cosines of a vector satisfy:

(A) $l + m + n = 1$

(B) $l^2 + m^2 + n^2 = 1$

(C) $l^2 + m^2 + n^2 = 0$

(D) $lmn = 1$

Q.242. The equation of a line through (x_1, y_1, z_1) with direction ratios (a, b, c) is:

(A) $\dfrac{x - x_1}{a} = \dfrac{y - y_1}{b} = \dfrac{z - z_1}{c}$

(B) $(x - a) = (y - b) = (z - c)$

(C) $ax + by + cz = 0$

(D) $ax_1 + by_1 + cz_1 = 0$

Q.243. The scalar triple product $[\vec{a}, \vec{b}, \vec{c}] = \vec{a} \cdot (\vec{b} \times \vec{c})$ gives the:

(A) Area of parallelogram

(B) Volume of parallelepiped

(C) Length of diagonal

(D) Surface area of prism

3.7 Probability and Statistics

Q.244. If $P(A) = 0.4$, $P(B) = 0.3$, and A and B are independent events, then $P(A \cap B)$ is:

(A) 0.12

(B) 0.7

(C) 0.1

(D) 0.58

Q.245. Bayes' theorem computes:

(A) Joint probability

(B) Marginal probability

(C) Posterior probability given prior information

(D) Conditional probability of cause given effect

Q.246. The mean of the numbers 3, 7, 5, 13, 20, 23, 39, 23, 40, 23, 14, 12, 56, 23, 29 is:

(A) 21

(B) 20

(C) 23

(D) 22

Q.247. In a binomial distribution with parameters n and p, the mean is:

(A) np

(B) npq

(C) $\sqrt{npq}$

(D) n/p

3.8 Sets, Relations and Functions

Q.248. If $A = \{1, 2, 3\}$ and $B = \{3, 4, 5\}$, then $A \cap B$ is:

(A) $\{1, 2, 3, 4, 5\}$

(B) $\{3\}$

(C) $\{1, 2\}$

(D) $\{4, 5\}$

Q.249. A function $f : A \to B$ is bijective if it is:

(A) One-one only

(B) Onto only

(C) Both one-one and onto

(D) Neither one-one nor onto

Q.250. The domain of $f(x) = \sqrt{4 - x^2}$ is:

(A) $[-2, 2]$

(B) $(-2, 2)$

(C) $[0, 4]$

(D) $\mathbb{R}$

3.9 Additional Mathematics Questions

Q.251. The value of $\sum_{r=0}^{n} {}^{n}C_r$ is:

(A) n

(B) $2n$

(C) 2^n

(D) $n!$

Q.252. If A is a square matrix, then $A + A^T$ is always:

(A) Skew-symmetric

(B) Symmetric

(C) Identity matrix

(D) Null matrix

Q.253. The number of ways to arrange 5 different books on a shelf is:

(A) 20

(B) 60

(C) 120

(D) 25

Q.254. Cramer's rule is used to solve:

(A) Differential equations

(B) Systems of linear equations

(C) Trigonometric equations

(D) Integral equations

Q.255. The value of $\lim_{x \to 0} \dfrac{1 - \cos x}{x^2}$ is:

(A) 0

(B) $\dfrac{1}{2}$

(C) 1

(D) ∞

Q.256. If $f(x) = x^3 - 3x$, then f is decreasing on:

(A) $(-\infty, -1)$

(B) $(-1, 1)$

(C) $(1, \infty)$

(D) $(0, \infty)$

Q.257. The equation $|x - 2| = 3$ has the solutions:

(A) $x = 1$ or $x = 5$

(B) $x = -1$ or $x = 5$

(C) $x = 1$ or $x = -5$

(D) $x = 2$ or $x = -3$

Q.258. The number of solutions of $\sin x = x$ in $[0, 2\pi]$ is:

(A) 0

(B) 1

(C) 2

(D) Infinite

Q.259. The value of ${}^{10}P_2$ is:

(A) 20

(B) 45

(C) 90

(D) 100

Q.260. For any two events A and B, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$. This is known as:

(A) Total probability theorem

(B) Bayes' theorem

(C) Addition theorem

(D) Multiplication theorem

Q.261. The number of complex cube roots of unity is:

(A) 1

(B) 2

(C) 3

(D) 6

Q.262. If $|\vec{a}| = 3$, $|\vec{b}| = 4$, and $\vec{a} \cdot \vec{b} = 6$, then the angle between them is:

(A) 30°

(B) 45°

(C) 60°

(D) 90°

Q.263. The general solution of $\cos\theta = 0$ is:

(A) $\theta = n\pi$

(B) $\theta = (2n+1)\dfrac{\pi}{2}$

(C) $\theta = 2n\pi$

(D) $\theta = n\pi \pm \dfrac{\pi}{4}$

Q.264. If a matrix A has rank 2, then the number of linearly independent rows is:

(A) 0

(B) 1

(C) 2

(D) 3

Q.265. The Maclaurin series expansion of e^x is:

(A) $1 + x + \dfrac{x^2}{2!} + \dfrac{x^3}{3!} + \ldots$

(B) $1 - x + \dfrac{x^2}{2!} - \dfrac{x^3}{3!} + \ldots$

(C) $x + \dfrac{x^3}{3!} + \dfrac{x^5}{5!} + \ldots$

(D) $1 + x^2 + x^4 + \ldots$

Q.266. The centre of the circle $x^2 + y^2 - 6x + 4y - 12 = 0$ is:

(A) $(3, -2)$

(B) $(-3, 2)$

(C) $(6, -4)$

(D) $(3, 2)$

Q.267. The value of $\displaystyle\int_0^1 x(1-x)^n\,dx$ is:

(A) $\dfrac{1}{n+2}$

(B) $\dfrac{1}{(n+1)(n+2)}$

(C) $\dfrac{n}{(n+1)(n+2)}$

(D) $\dfrac{1}{n+1}$

Q.268. The equation of the tangent to the parabola $y^2 = 4ax$ at the point $(at^2, 2at)$ is:

(A) $ty = x + at^2$

(B) $ty = x - at^2$

(C) $y = tx - at^2$

(D) $ty = x$

Q.269. The sum of all natural numbers from 1 to 100 is:

(A) 4950

(B) 5000

(C) 5050

(D) 5100

Q.270. The principal argument of $z = -1 - i$ is:

(A) $\dfrac{3\pi}{4}$

(B) $-\dfrac{3\pi}{4}$

(C) $\dfrac{\pi}{4}$

(D) $-\dfrac{\pi}{4}$

Q.271. The inverse of the matrix $A = \begin{pmatrix} 2 & 1 \\ 1 & 1 \end{pmatrix}$ is:

(A) $\begin{pmatrix} 1 & -1 \\ -1 & 2 \end{pmatrix}$

(B) $\begin{pmatrix} 1 & 1 \\ -1 & 2 \end{pmatrix}$

(C) $\begin{pmatrix} -1 & 1 \\ 1 & -2 \end{pmatrix}$

(D) $\begin{pmatrix} 2 & -1 \\ -1 & 1 \end{pmatrix}$

Q.272. The function $f(x) = \sin x$ is continuous on $\mathbb{R}$ and its range is:

(A) $[0, 1]$

(B) $[-1, 1]$

(C) $(0, \pi)$

(D) $[-\pi, \pi]$

Q.273. If the events A and B are mutually exclusive, then $P(A \cup B)$ is:

(A) $P(A) \cdot P(B)$

(B) $P(A) + P(B) - P(A \cap B)$

(C) $P(A) + P(B)$

(D) 0

Q.274. $\displaystyle\int \frac{1}{x \ln x}\, dx$ equals:

(A) $\ln(\ln x) + C$

(B) $\dfrac{1}{(\ln x)^2} + C$

(C) $\dfrac{\ln x}{x} + C$

(D) $e^{\ln x} + C$

Q.275. The angle bisectors of two perpendicular lines divide the plane into how many regions?

(A) 2

(B) 3

(C) 4

(D) 8

Q.276. The standard deviation of the data set $\{2, 4, 4, 4, 5, 5, 7, 9\}$ is:

(A) 1

(B) 2

(C) 3

(D) 4

Q.277. If f is differentiable and $f(1) = f(2)$, by Rolle's theorem there exists $c \in (1, 2)$ such that:

(A) $f(c) = 0$

(B) $f'(c) = 0$

(C) $f''(c) > 0$

(D) $f(c) > 0$

Q.278. The number of different 4-digit numbers formed using digits 1, 2, 3, 4 without repetition is:

(A) 16

(B) 24

(C) 64

(D) 256

Q.279. If A and B are 3×3 matrices with $|A| = 2$ and $|B| = 3$, then $|AB|$ is:

(A) 5

(B) 6

(C) 9

(D) 12

Q.280. The mid-point of the line segment joining $(3, 4)$ and $(7, 2)$ is:

(A) $(5, 3)$

(B) $(4, 3)$

(C) $(5, 4)$

(D) $(10, 6)$

Q.281. The focus of the parabola $y^2 = 8x$ is at:

(A) $(2, 0)$

(B) $(0, 2)$

(C) $(4, 0)$

(D) $(0, 4)$

Q.282. The area of a triangle with vertices $(0, 0)$, $(3, 0)$, and $(0, 4)$ is:

(A) 6

(B) 7

(C) 12

(D) 3.5

Q.283. The series $1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \ldots$ is a geometric series with sum:

(A) 1

(B) 1.5

(C) 2

(D) 3

Q.284. The maximum value of $\sin x + \cos x$ is:

(A) 1

(B) $\sqrt{2}$

(C) 2

(D) $\sqrt{3}$

Q.285. The number of elements in the power set of $\{a, b, c\}$ is:

(A) 3

(B) 6

(C) 8

(D) 9

Q.286. If $f(x) = \dfrac{x^2 - 1}{x - 1}$ for $x \neq 1$, the removable discontinuity at $x = 1$ can be removed by defining $f(1)$ as:

(A) 0

(B) 1

(C) 2

(D) Undefined

Q.287. For two non-zero vectors $\vec{a}$ and $\vec{b}$, $\vec{a} \times \vec{b} = \vec{0}$ implies:

(A) They are perpendicular

(B) They are parallel (or anti-parallel)

(C) $|\vec{a}| = |\vec{b}|$

(D) $\vec{a} = \vec{b}$

Q.288. The derivative of $\sec x$ is:

(A) $\csc x \cot x$

(B) $\sec x \tan x$

(C) $-\csc x \cot x$

(D) $-\sec x \tan x$

Q.289. The value of $\cos 0 + \cos \dfrac{\pi}{3} + \cos \dfrac{2\pi}{3} + \cos \pi$ equals:

(A) 0

(B) 1

(C) -1

(D) 2

Q.290. The differential equation $\dfrac{dy}{dx} = \dfrac{x + y}{x - y}$ is:

(A) Linear

(B) Homogeneous

(C) Separable

(D) Exact

Q.291. If $P(A|B) = P(A)$, then:

(A) A and B are mutually exclusive

(B) A and B are independent

(C) $A \subset B$

(D) $P(B) = 0$

Q.292. The geometric mean of 2 and 8 is:

(A) 4

(B) 5

(C) 6

(D) 8

Q.293. $\int \tan x \, dx$ equals:

(A) $\ln|\sec x| + C$

(B) $\ln|\cos x| + C$

(C) $\sec^2 x + C$

(D) $-\ln|\cos x| + C$ (same as A)

Q.294. The number of diagonals in a polygon with n sides is:

(A) $\dfrac{n(n-3)}{2}$

(B) $\dfrac{n(n-1)}{2}$

(C) $n(n-3)$

(D) $n-3$

Q.295. Two dice are rolled. The probability of getting a sum of 7 is:

(A) $\dfrac{1}{6}$

(B) $\dfrac{5}{36}$

(C) $\dfrac{7}{36}$

(D) $\dfrac{1}{12}$

Q.296. The cofactor expansion of a 3×3 determinant along the first row gives:

(A) Sum of elements multiplied by their cofactors

(B) Product of diagonal elements

(C) Sum of all elements

(D) Trace of the matrix

Q.297. The set of all integers forms a group under:

(A) Multiplication

(B) Division

(C) Addition

(D) Exponentiation

Q.298. The value of ${}^{20}C_{18}$ is:

(A) 20

(B) 180

(C) 190

(D) 380

Q.299. The graph of $y = |x|$ has a:

(A) Minimum at $(0, 0)$

(B) Maximum at $(0, 0)$

(C) Inflection point at $(0, 0)$

(D) No critical point

Q.300. The length of the latus rectum of the ellipse $\dfrac{x^2}{16} + \dfrac{y^2}{9} = 1$ is:

(A) $\dfrac{9}{2}$

(B) $\dfrac{9}{4}$

(C) $\dfrac{9}{8}$

(D) $\dfrac{9}{16}$

Answer Key

Q. No.	Answer	Brief Answer
1	B	Time of flight = 2u sin(theta)/g
2	C	Both fall under same gravitational acceleration
3	B	a = dv/dt = 6t - 2; at t=2, a = 10 m/s2
4	B	Range is maximum at 45 degrees
5	C	f = mu*mg = 0.4*2*10 = 8 N
6	A	a = (m2-m1)g/(m1+m2) = 2*10/8 = 2.5 m/s2
7	C	v = sqrt(a*r) = sqrt(2*200) = 20 m/s
8	B	Conservation of momentum: v = 10*5/15 = 3.33 m/s
9	B	Elastic potential energy = (1/2)kx2
10	B	W = mgh = 2*10*5 = 100 J
11	A	Power = Force x velocity (P = F.v)
12	C	KE lost = (1/2)*(m1*m2/(m1+m2))*(u1-u2)2 = 891 J
13	A	I = (2/5)MR2 for solid sphere about diameter
14	B	Escape velocity from Earth = 11.2 km/s
15	C	Kepler third law: T2 proportional to r3
16	B	alpha = tau/I = 10/2 = 5 rad/s2
17	B	Orbital velocity v = sqrt(gR) = 7.9 km/s
18	C	Bulk modulus = -dP/(dV/V)
19	C	Bernoulli principle: conservation of energy
20	B	Terminal velocity proportional to r2 (Stokes law)
21	B	Adiabatic: PV(gamma) = constant
22	B	Carnot efficiency = 1 - T2/T1
23	B	v(rms) = sqrt(3RT/M)
24	C	Isothermal: temperature constant
25	A	Cv = (3/2)R for monoatomic ideal gas
26	C	Heat absorbed at melting = latent heat of fusion
27	B	T = 2*pi*sqrt(l/g)
28	B	Transverse waves: displacement perpendicular to propagation
29	B	Speed of sound in air at 0 C = 332 m/s
30	B	Source approaches observer: observed frequency increases
31	B	Fundamental frequency in open pipe = v/(2L)
32	B	Coulomb law: F = q1q2/(4*pi*eps0*r2)
33	C	Electric field inside hollow conductor = zero
34	B	C = eps0*A/d for parallel plate capacitor
35	C	Electric potential = work per unit positive charge
36	B	Gauss law: flux = Q(enc)/eps0
37	B	Energy decreases when dielectric inserted in isolated capacitor
38	B	Ohm law: V proportional to I at constant T
39	B	Ideal voltage source has zero internal resistance

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Table – continued from previous page

Q. No.	Answer	Brief Answer
40	C	Balanced Wheatstone bridge: galvanometer reads zero
41	B	Alpha is temperature coefficient of resistance
42	A	1/Req = 1/2 + 1/3 + 1/6 = 1; Req = 1 Ohm
43	B	B = mu0*I/(2*pi*r) for long straight wire
44	B	Lorentz force = q*(v x B)
45	B	Galvanometer: torque on current loop in magnetic field
46	B	Magnetic moment m = I*A
47	A	Cyclotron frequency = qB/(2*pi*m)
48	C	Faraday: EMF = -d(phi)/dt
49	C	At resonance LCR: impedance = R only
50	B	I(rms) = I0/sqrt(2)
51	C	Unit of self-inductance is Henry
52	C	Power factor = cos(phi)
53	B	Mirror formula: 1/v + 1/u = 1/f
54	B	TIR: denser to rarer medium beyond critical angle
55	A	Fringe width = lambda*D/d
56	B	Lens formula: 1/v - 1/u = 1/f; v = 60 cm
57	A	Brewster law: tan(theta) = n
58	C	Resolving power increases with larger aperture
59	B	Photoelectric: KE(max) = h*nu - phi
60	B	de Broglie: lambda = h/p
61	B	Bohr model: radius proportional to n2
62	C	Photon energy = h*nu
63	B	T(1/2) = ln2/lambda
64	A	Mass defect converts to KE of fission products
65	D	Below threshold frequency no photoelectric effect
66	B	Forward bias reduces barrier potential
67	B	NAND output 0 only when both inputs are 1
68	B	n-type semiconductor majority carriers: electrons
69	B	Zener diode used as voltage regulator
70	C	Common emitter: 180 degree phase difference
71	B	AM bandwidth = 2 * signal frequency
72	B	Ground waves suitable below 2 MHz
73	A	Viscosity dimension: ML-1T-1
74	B	6.020 x 10 to 23 has 4 significant figures
75	A	Mass = [FV-1A]
76	C	Critical angle: sin(c) = 1/n = 2/3
77	B	Iron (Fe-56) has highest binding energy per nucleon
78	B	v = c/n = 3e8/1.5 = 2e8 m/s
79	B	SHM at mean position: kinetic energy is maximum
80	D	Stefan law: power proportional to T4

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Table – continued from previous page

Q. No.	Answer	Brief Answer
81	B	Series: C = C1*C2/(C1+C2) = 24/10 = 2.4 uF
82	A	N2/N1 = V2/V1 = 2200/220 = 10; N2 = 1000
83	D	Gamma rays have highest frequency
84	B	Maximum acceleration in SHM = A*omega2
85	C	First law of thermodynamics: conservation of energy
86	B	Phase lag = arctan(omega*L/R) for RL circuit
87	B	Stopping potential independent of intensity
88	C	B at centre of loop = mu0*I/(2R)
89	A	Heisenberg: delta(x)*delta(p) >= h/(4*pi)
90	C	Diffraction prominent when obstacle size comparable to wavelength
91	C	Compton effect: proves particle nature of photons
92	B	Friction on incline acts along incline pointing upward
93	B	Solenoid interior field = mu0*n*I
94	C	Planck constant has dimension of angular momentum
95	B	Heavy water in nuclear reactor used as moderator
96	C	Minimum energy to remove electron = work function
97	B	Torque on dipole = p*E*sin(theta)
98	B	eps0 = 8.85 x 10-12 C2 N-1 m-2
99	B	Huygens principle explains wave propagation and refraction
100	B	t = u/g = 20/10 = 2 s
101	C	NH3: trigonal pyramidal (one lone pair on N)
102	C	BeCl2: sp hybridisation (linear geometry)
103	C	H2O bond angle is 104.5 degrees
104	A	N2 has triple bond; bond order = 3
105	B	HF forms strongest hydrogen bonds
106	B	Van der Waals: (P + a/V2)(V - b) = RT
107	B	Raoult law: P = x(solvent) * P0
108	B	Boiling point elevation used to find molar mass
109	B	Henry law: solubility directly proportional to pressure
110	C	Spontaneous process: delta G < 0
111	B	Kp = Kc times (RT) to power delta n; delta n = -2
112	B	Higher pressure favours fewer moles side (right)
113	C	Hess law: conservation of energy
114	C	Standard enthalpy of formation of element = zero
115	C	First-order half-life = 0.693/k

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Q. No.	Answer	Brief Answer
116	B	Higher temperature increases rate constant k
117	B	Zero-order rate independent of concentration
118	B	Catalyst lowers activation energy
119	B	Faraday first law: mass proportional to charge
120	C	SHE has zero standard electrode potential
121	A	Nernst: E = E(std) - (RT/nF)*ln Q
122	C	Fuel cell uses H2 and O2 to produce electricity
123	B	SF6 geometry is octahedral
124	D	I2 is the strongest reducing agent among halogens
125	C	N2O (nitrous oxide) used as anaesthetic
126	A	Ozone oxidises KI to liberate I2
127	A	Acidity of oxoacids of Cl increases with oxidation state
128	B	Tetraamminecopper(II) ion
129	D	Coordination number of Fe in [Fe(CN)6]3- = 6
130	B	[Pt(NH3)2Cl2] shows geometrical isomerism
131	B	In octahedral field dz2 and dx2-y2 point towards ligands
132	B	CH3-CH(OH)-COOH = 2-hydroxypropanoic acid
133	C	Tertiary carbocation is most stable
134	B	SN2: nucleophile attacks from backside
135	B	Markovnikov rule applies to unsymmetrical alkenes
136	C	Benzene + Cl2/AlCl3: electrophilic aromatic substitution
137	A	Baeyer reagent converts alkene to diol
138	A	Ozonolysis of 2-butene gives two ethanal molecules
139	C	Ethyne (terminal alkyne) is strongest acid among hydrocarbons
140	B	Alcohol + HBr: nucleophilic substitution
141	B	Reimer-Tiemann introduces CHO at ortho position
142	B	Aldol needs at least one alpha-hydrogen
143	B	Primary amine + HNO2 at low T gives diazonium salt
144	B	Carboxylate ion stabilised by resonance
145	B	Fehling solution distinguishes aldehydes from ketones
146	C	Protein monomers are amino acids
147	B	Secondary structure: alpha-helix or beta-sheet
148	C	DNA stores information via nitrogenous base sequence
149	B	Nylon-6,6 is a condensation polymer
150	A	Natural rubber monomer: isoprene (2-methylbuta-1,3-diene)

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Table – continued from previous page

Q. No.	Answer	Brief Answer
151	B	Na2O2 + H2O gives NaOH + H2O2
152	D	Cs+ has largest ionic radius in Group 1
153	C	H3PO4 is the ortho acid of phosphorus
154	B	Balmer series: 1/lambda = R(1/22 - 1/n2)
155	C	Magnetic quantum number describes orbital orientation
156	B	Chlorine has highest electron affinity
157	B	IE increases because nuclear charge increases, radius decreases
158	C	FCC unit cell contains 4 atoms
159	B	BCC packing efficiency = 68 percent
160	B	BET isotherm describes multilayer adsorption
161	B	Schottky defect: ion vacancies decrease density
162	A	Borax bead: formation of coloured metal borate
163	B	Na2SO4 + BaCl2: double displacement (precipitation)
164	C	EMF = E(cathode) - E(anode) = 0.34 - (-0.76) = 1.10 V
165	B	Copper final extraction step: electrolytic refining
166	C	[Ni(CO)4] geometry is tetrahedral
167	B	O2 is paramagnetic (two unpaired electrons)
168	A	Boiling points: HF > HI > HBr > HCl (H-bonding in HF)
169	A	Zwitterion exists at isoelectric point
170	C	Starch in water is a lyophilic colloid
171	B	Cannizzaro reaction for aldehydes with no alpha-hydrogen
172	A	CH3COCl + NH3 gives CH3CONH2 (acetamide)
173	B	Blue colour of CuSO4 due to Cu2+ ion
174	C	LiF has highest lattice enthalpy (small ions, high charge)
175	C	3 moles NaOH needed to precipitate Al(OH)3 from AlCl3
176	B	HCN addition to CH3CHO gives lactic acid on hydrolysis
177	B	Kevlar used to make bullet-proof vests
178	B	Amylase catalyses starch hydrolysis to maltose
179	D	Cr oxidation state in K2Cr2O7 = +6
180	C	False: benzene does not readily undergo addition reactions
181	B	Term polymer coined by Berzelius
182	C	[Co(NH3)5Cl]Cl2 and [Co(NH3)4Cl2]Cl: ionisation isomerism
183	B	Carbon in benzene: sp2 hybridisation
184	A	Chloramphenicol is an antibiotic
185	B	Vapour pressure of solution less than pure solvent

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Table – continued from previous page

Q. No.	Answer	Brief Answer
186	B	Addition polymerisation: no small molecule lost
187	C	Hexane and 2-methylpentane: chain isomerism
188	B	CHCl3 IUPAC name: trichloromethane
189	B	Tollen reagent detects aldehydes
190	B	CH2=CH-C triple bond CH: 6 sigma, 3 pi bonds
191	D	NaI has lowest melting point (largest ions, lowest lattice energy)
192	B	Second-order rate constant unit: L mol-1 s-1
193	C	Na2SO4 gives 2Na+ + SO42-; van't Hoff factor i = 3
194	C	CuSO4 absorbs red light, transmits blue light
195	D	Conversion of sol to gel by cooling is gelation
196	B	At cathode: reduction of H+ ions to H2 gas
197	C	K2Cr2O7 is a primary standard
198	B	Substance not consumed but speeds reaction: catalyst
199	B	Involatile solute raises boiling point (elevation)
200	C	Al2O3: Al3+ and O2- combine in 2:3 ratio
201	A	x2 - 5x + 6 = 0: roots are 2 and 3
202	C	1 + omega + omega2 = 0 (property of cube roots of unity)
203	B	Binomial expansion of (x+y)10 has 10+1 = 11 terms
204	B	det([[1,2],[3,4]]) = 4 - 6 = -2
205	A	S(n) = n/2 * (2a + (n-1)d)
206	B	Using nCr/nC(r-1) = (n-r+1)/r = 15/6; n = 6
207	C	|z| = sqrt(9 + 16) = sqrt(25) = 5
208	B	f(3) - f(2) = 8 - 4 = 4
209	B	General term T(r+1) = nCr times x to (n-r) times a to r
210	C	det(3A) = 3 squared times det(A) = 9 times 5 = 45
211	B	Slope = (9-3)/(5-2) = 6/3 = 2
212	B	Circle equation: (x-h)2 + (y-k)2 = r2
213	B	Eccentricity = sqrt(1 - b2/a2)
214	A	Distance = |3*3 + 4*(-4) - 5|/sqrt(9+16) = |9-16-5|/5 = 12/5
215	C	Parabola y2 = 4ax has vertex at (0,0)
216	A	Angle = arctan((m1-m2)/(1+m1*m2))
217	A	e = sqrt(1 + 4/9) = sqrt(13)/3
218	B	sin75 = sin(45+30) = (sqrt(3)+1)/(2*sqrt(2))
219	A	Cosine rule: a2 = b2 + c2 - 2bc*cos A
220	A	General solution sin(theta)=1/2: theta = n*pi + alternating sign times pi/6 – use plain description
221	B	Principal value of arcsin(-1/2) = -pi/6

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Q. No.	Answer	Brief Answer
222	C	arctan(x) + arccot(x) = pi/2
223	C	2sin2(theta) + 2cos2(theta) = 2*(sin2+cos2) = 2
224	B	d/dx[sin(ln x)] = cos(ln x)/x
225	C	lim(sin x/x) as x->0 = 1
226	B	y = x to x; dy/dx = x to x times (1 + ln x)
227	C	f'(c)=0 and f"(c)>0: local minimum
228	B	d/dx[arctan x] = 1/(1+x2)
229	C	limit of (1+1/x) to x as x to inf equals e
230	B	Rolle theorem: f'(c) = 0 for some c in (a,b)
231	B	Integral of e to x times (sin x + cos x) = e to x times sin x + C
232	C	Integral of sin x from 0 to pi/2 = [-cos x] = 0-(-1) = 1
233	A	Area between y=x2 and y=x = 1/6
234	B	Integral of 1/sqrt(1-x2) = arcsin x + C
235	B	Order of ODE = order of highest derivative = 2
236	B	Integral of x times e to x = e to x times (x-1) + C by parts
237	A	dy/dx = ky gives y = C times e to (kx)
238	C	Integral of x3 from -1 to 1 = 0 (odd function)
239	B	Dot product zero implies vectors are perpendicular
240	B	|a x b| = |a|*|b|*sin(theta)
241	B	Direction cosines: l2 + m2 + n2 = 1
242	A	Symmetric form of line: (x-x1)/a = (y-y1)/b = (z-z1)/c
243	B	Scalar triple product = volume of parallelepiped
244	A	P(A and B) = P(A)*P(B) = 0.4*0.3 = 0.12
245	D	Bayes theorem: posterior probability of cause given effect
246	A	Mean = 315/15 = 21
247	A	Binomial mean = np
248	B	A intersect B = 3
249	C	Bijective = one-one and onto
250	A	Domain of sqrt(4-x2): x in [-2, 2]
251	C	Sum of nCr for r=0 to n equals 2 to the power n
252	B	A plus A-transpose is always symmetric
253	C	5! = 120 ways to arrange 5 books
254	B	Cramer rule solves systems of linear equations
255	B	lim(1-cos x)/x2 as x->0 = 1/2
256	B	f'(x) = 3x2 - 3 < 0 for x in (-1,1)
257	B	|x-2| = 3 gives x = 5 or x = -1
258	B	sin x = x has only one solution: x = 0
259	C	10P2 = 10!/(10-2)! = 10*9 = 90
260	C	P(A union B) = P(A)+P(B)-P(A int B): addition theorem

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Q. No.	Answer	Brief Answer
261	B	Complex cube roots of unity: omega and omega2 (2 values)
262	C	cos(theta) = 6/(3*4) = 0.5; theta = 60 degrees
263	B	cos(theta)=0: theta = (2n+1)*pi/2
264	C	Rank 2 means 2 linearly independent rows
265	A	Maclaurin series of e to x: sum of x to n over n factorial
266	A	Circle x2+y2-6x+4y-12=0: centre at (3,-2)
267	B	Integral = 1/((n+1)(n+2))
268	A	Tangent to y2=4ax at (at2,2at): ty = x + at2
269	C	Sum 1 to 100 = 100*101/2 = 5050
270	B	arg(-1-i) = -3*pi/4 (third quadrant)
271	A	Inverse of [[2,1],[1,1]] = [[1,-1],[-1,2]]
272	B	Range of sin x is [-1, 1]
273	C	Mutually exclusive: P(A union B) = P(A) + P(B)
274	A	Integral of 1/(x*ln x) = ln(ln x) + C
275	D	Two perpendicular lines: angle bisectors make 8 regions
276	B	Standard deviation of the given data set = 2
277	B	Rolle theorem conclusion: f'(c) = 0
278	B	4P4 = 4! = 24 four-digit numbers
279	B	|AB| = |A|*|B| = 2*3 = 6
280	A	Midpoint = ((3+7)/2, (4+2)/2) = (5, 3)
281	A	y2 = 8x = 4*2*x; focus at (2, 0)
282	A	Area = (1/2)*3*4 = 6 square units
283	C	Sum of infinite GP with a=1, r=1/2: S = 1/(1-1/2) = 2
284	B	Max of sin x + cos x = sqrt(2)
285	C	Power set of 3-element set has 2 cubed = 8 elements
286	C	f(1) = lim(x2-1)/(x-1) = lim(x+1) = 2
287	B	a x b = 0 implies a and b are parallel
288	B	d/dx(sec x) = sec x * tan x
289	A	cos0 + cos(pi/3) + cos(2pi/3) + cos(pi) = 1+0.5-0.5-1 = 0
290	B	dy/dx = (x+y)/(x-y) is a homogeneous ODE
291	B	P(A|B) = P(A) implies A and B are independent
292	A	Geometric mean of 2 and 8 = sqrt(2*8) = sqrt(16) = 4
293	A	Integral of tan x = ln|sec x| + C
294	A	Number of diagonals = n*(n-3)/2
295	A	P(sum=7) = 6/36 = 1/6
296	A	Cofactor expansion: sum of elements times cofactors
297	C	Integers form group under addition

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Q. No.	Answer	Brief Answer
298	C	20C18 = 20C2 = 20*19/2 = 190
299	A	y = |x| has minimum at (0,0)
300	A	Latus rectum = 2b2/a = 2*9/4 = 9/2