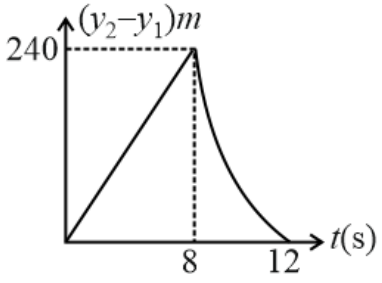
Q1. The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{\frac{l}{g}}$. Measured value of l is 20.0 cm, known to 1 mm accuracy and time for 100 oscillations of the pendulum is found to be 90 s using a wristwatch of 1 s resolution. The accuracy in the determination of g is

(1) 5% (2) 4%

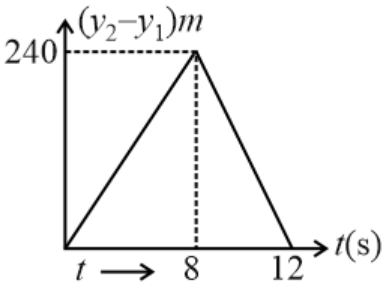
(3) 3% (4) 1%

Q2. Two stones are thrown up simultaneously from the edge of a cliff 240 m high with an initial speed of 10 m s^{-1} and 40 m s^{-1} respectively. Which of the following graph best represents the time variation of the relative position of the second stone with respect to the first? (Assume stones do not rebound after hitting the ground and neglect air resistance, take $g = 10$ ms^{-2})(the figure are schematic and not drawn to scale)

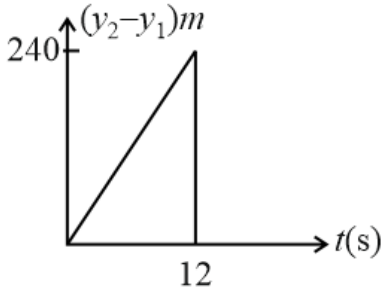
(1)



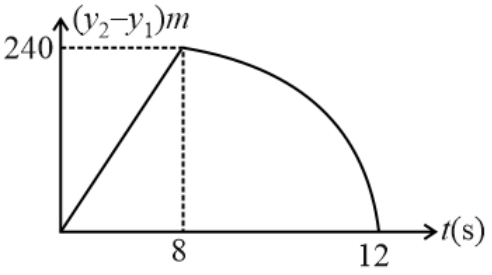
(2)



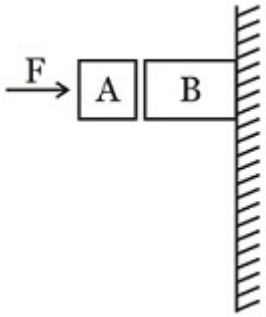
(3)



(4)



Q3.



Given in the figure are two blocks A and B of weight 20 N and 100 N, respectively. These are being pressed against a wall by a force F and kept in equilibrium as shown. If the coefficient of friction between the blocks is 0.1 and between block B and the wall is 0.15, the frictional force applied by the wall on block B is:

(1) 150 N (2) 100 N

(3) 80 N (4) 120 N

Q4. Distance of the centre of mass of a solid uniform cone from its vertex is z_0. If the radius of its base is R and its height is h then z_0 is equal to:

(1) $\frac{3h^2}{8R}$ (2) $\frac{h^2}{4R}$
(3) $\frac{3h}{4}$ (4) $\frac{5h}{8}$

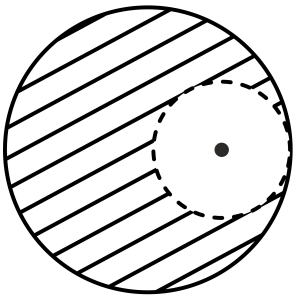
Q5. A particle of mass m moving in the x direction with speed $2v$ is hit by another particle of mass $2m$ moving in the y direction with speed v. If the collision is perfectly inelastic, the percentage loss in the energy during the collision is close to:

(1) 62% (2) 44%
(3) 50% (4) 56%

Q6. From a solid sphere of mass M and radius R, a cube of the maximum possible volume is cut. Moment of inertia of cube about an axis passing through its centre and perpendicular to one of its faces is:

(1) $\frac{4MR^2}{3\sqrt{3}\pi}$ (2) $\frac{MR^2}{32\sqrt{2}\pi}$
(3) $\frac{MR^2}{16\sqrt{2}\pi}$ (4) $\frac{4MR^2}{9\sqrt{3}\pi}$

Q7. From a solid sphere of mass M and radius R, a spherical portion of radius $\left(\frac{R}{2}\right)$ is removed as shown in the figure. Taking gravitational potential $V = 0$ at $r = \infty$, the potential at the centre of the cavity thus formed is (G =gravitational constant)



(1) $\frac{-2GM}{R}$ (2) $\frac{-GM}{2R}$
(3) $\frac{-GM}{R}$ (4) $\frac{-2GM}{3R}$

Q8. A pendulum made of a uniform wire of cross sectional area A has time period T. When an additional mass M is added to its bob, the time period changes to T_M . If the Young's modulus of the material of the wire is Y, then $\frac{1}{Y}$ is equal to:
(g =gravitational acceleration)

(1) $\left[1-\left(\frac{T}{T_M}\right)^2\right]\frac{A}{Mg}$ (2) $\left[\left(\frac{T_M}{T}\right)^2-1\right]\frac{A}{Mg}$
(3) $\left[\left(\frac{T_M}{T}\right)^2-1\right]\frac{Mg}{A}$ (4) $\left[1-\left(\frac{T_M}{T}\right)^2\right]\frac{A}{Mg}$

Q9. Consider an ideal gas confined in an isolated closed chamber. As the gas undergoes an adiabatic expansion, the average time of collision between molecules increases as V^{q} , where V is the volume of the gas. The value of q is:
$\left(\gamma=\frac{\mathrm{C}_P}{\mathrm{C}_v}\right)$

(1) $\frac{\gamma-1}{2}$ (2) $\frac{3\gamma+5}{6}$
(3) $\frac{3\gamma-5}{6}$ (4) $\frac{\gamma+1}{2}$

Q10. Consider a spherical shell of radius R at temperature T. The black body radiation inside it can be considered as an ideal gas of photons with internal energy per unit volume $u = \frac{U}{V} \propto T^4$ and pressure $p = \frac{1}{3}\left(\frac{U}{V}\right)$. If the shell now undergoes an adiabatic expansion the relation between T and R is:

(1) $T \propto \frac{1}{R^3}$ (2) $T \propto e^{-R}$

(3) $T \propto e^{-3R}$ (4) $T \propto \frac{1}{R}$

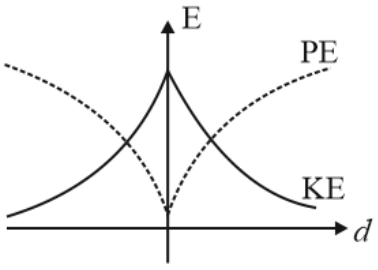
Q11. A solid body of constant heat capacity 1 J $(°C)^{-1}$ is being heated by keeping it in contact with reservoirs in two ways: (i) Sequentially keeping in contact with 2 reservoirs such that each reservoir supplies the same amount of heat. (ii) Sequentially keeping in contact with 8 reservoirs such that each reservoir supplies the same amount of heat. In both, cases the body is brought from initial temperature 100 K to final temperature 200 K. Entropy change of the body in the two cases respectively is: Note: This question was awarded as a bonus since temperatures were given in centigrade instead of in Kelvin. Proper corrections are made in the question to avoid it.

(1) $2\ln 2,\ 8\ln 2$ (2) $\ln 2,\ 4\ln 2$

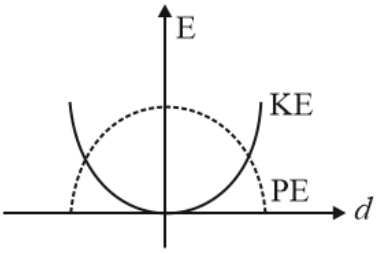
(3) $\ln 2,\ \ln 2$ (4) $\ln 2,\ 2\ln 2$

Q12. For a simple pendulum, a graph is plotted between its kinetic energy (K.E.) and potential energy (P.E.) against its displacement d. which one of the following represents these correctly? (graphs are schematic and not drawn to scale)

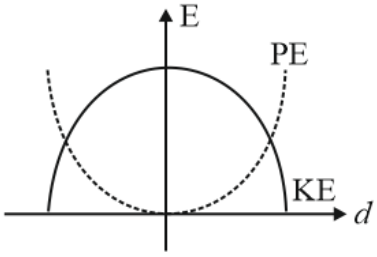
(1)



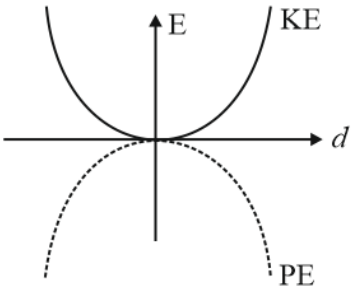
(2)



(3)



(4)

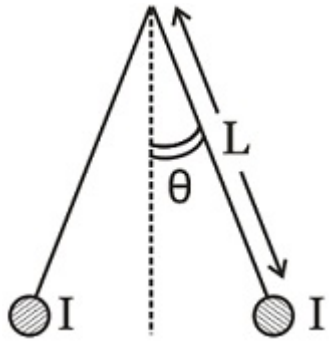


Q13. A train is moving on a straight track with speed 20 m s^{-1}. It is blowing its whistle at the frequency of 1000 Hz. The percentage change in the frequency heard by a person standing near the track as the train passes him is (speed of sound = 320 m s^{-1}) close to:

(1) 24% (2) 6%

(3) 12% (4) 18%

Q14.



Two long currents carrying thin wires, both with current I, are held by insulating threads of length L and are in equilibrium as shown in the figure, with threads making an angle ' θ ' with the vertical. If wires have a mass λ per unit length then the value of I is:

(g = gravitational acceleration)

(1) $\sqrt{\frac{\pi\lambda gL}{\mu_0}\tan\theta}$

(2) $\sin\theta\sqrt{\frac{\pi\lambda gL}{\mu_0\cos\theta}}$

(3) $2\sin\theta\sqrt{\frac{\pi\lambda gL}{\mu_0\cos\theta}}$

(4) $2\sqrt{\frac{\pi gL}{\mu_0}\tan\theta}$

Q15. A uniformly charged solid sphere of radius R has potential V_0 (measured with respect to ∞) on its surface. For this sphere the equipotential surfaces with potential $\frac{3V_0}{2}$, $\frac{5V_0}{4}$, $\frac{3V_0}{4}$ and $\frac{V_0}{4}$ have radius R_1 , R_2, R_3 and R_4 respectively. Then

Note : This question had two option correct at the time of examination. Proper corrections are made in the question to avoid it.

(1) $2R > R_4$

(2) $R_1 = 0$ and $R_2 > (R_4 - R_3)$

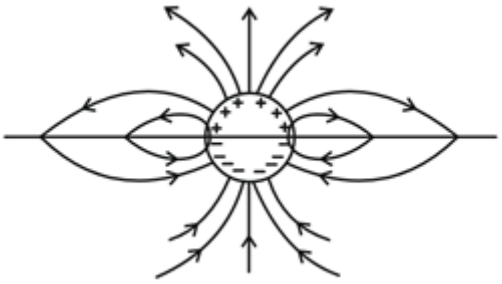
(3) $R_1 \neq 0$ and $(R_2 - R_1) > (R_4 - R_3)$

(4) $R_1 = 0$ and $R_2 < (R_4 - R_3)$

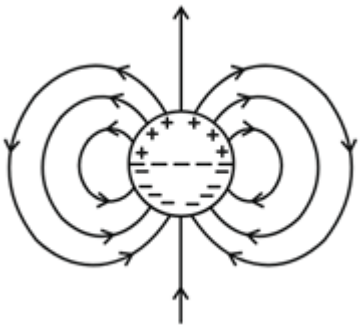
Q16. A long cylindrical shell carries positive surface charge σ in the upper half and negative surface charge $-\sigma$ in the lower half. The electric field lines around the cylinder will look like figure given in:

(figures are schematic and not drawn to scale)

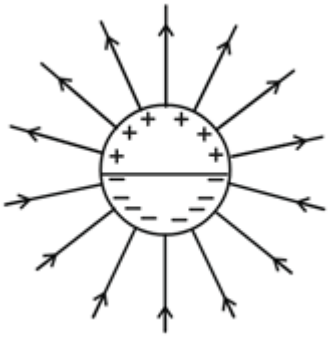
(1)



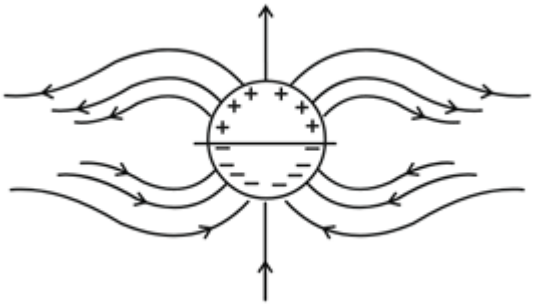
(2)



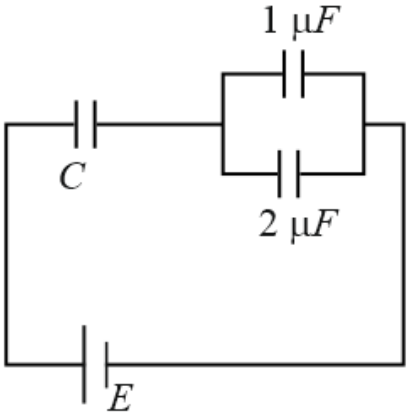
(3)



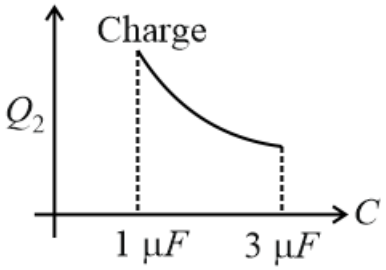
(4)



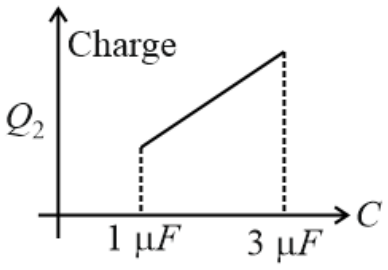
Q17. In the given circuit, charge Q_2 on the 2 μF capacitor changes as C is varied from 1 μF to 3 μF. Q_2 as a function of 'C' is given properly by: (figures are drawn schematically and are not to scale)



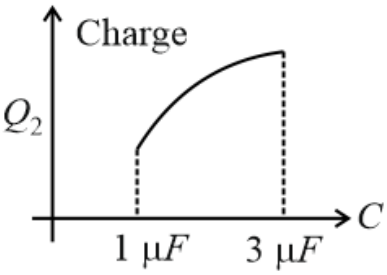
(1)



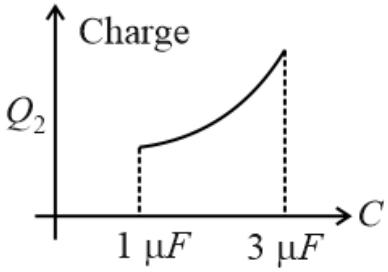
(2)



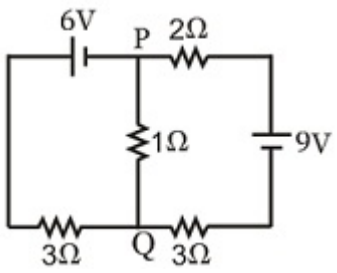
(3)



(4)



Q18.



In the circuit shown, the current in the 1 Ω resistor is:

(1) 0.13 A, from P to Q

(2) 1.3 A, from P to Q

(3) 1.3 A, from Q to P

(4) 0.13 A, from Q to P

Q19. When 5 V potential difference is applied across a wire of length 0.1 m, the drift speed of electrons is 2.5×10^{-4} m s^{-1} . If the electron density in the wire is 8×10^{28} m^{-3} , the resistivity of the material is close to:

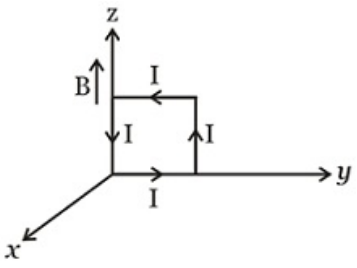
(1) 1.56×10^{-5} Ω m

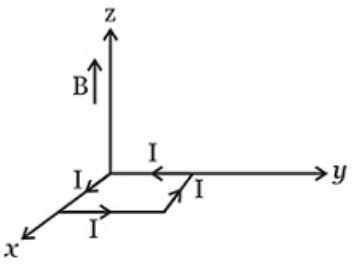
(2) 1.6×10^{-8} Ω m

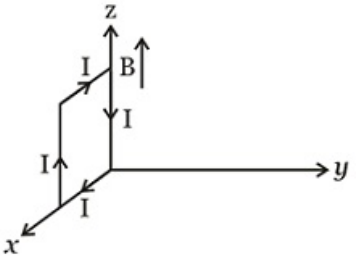
(3) 1.6×10^{-7} Ω m

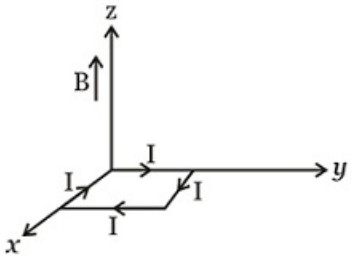
(4) 1.6×10^{-6} Ω m

Q20. A rectangular loop of sides 10 cm and 5 cm, carrying a current I of 12 A, is placed in different orientations as shown in the figure below.

(a) 

(b) 

(c) 

(d) 

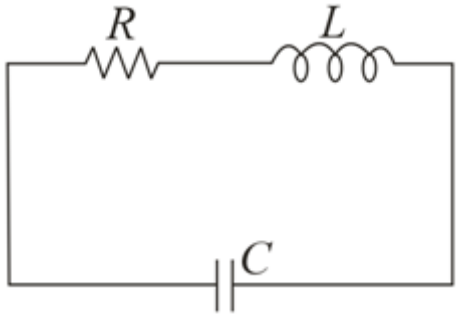
If there is a uniform magnetic field of $0.3\ \mathrm{T}$ in the positive z direction, in which orientations the loop would be in (i) stable equilibrium and (ii) unstable equilibrium?

(1) (b) and (c), respectively.
(2) (a) and (b), respectively.
(3) (a) and (c), respectively.
(4) (b) and (d), respectively.

Q21. Two coaxial solenoids of different radii carry current I in the same direction. Let $\overrightarrow{F_1}$ be the magnetic force on the inner solenoid due to the outer one and $\overrightarrow{F_2}$ be the magnetic force on the outer solenoid due to the inner one. Then:

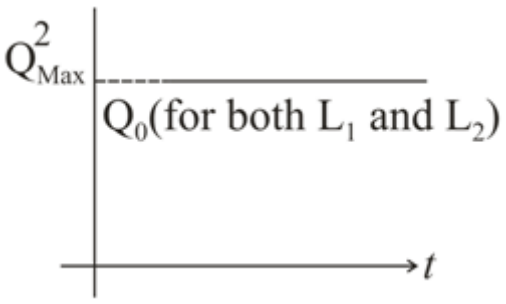
(1) $\overrightarrow{F_1}$ is radially outwards and $\overrightarrow{F_2} = 0$
(2) $\overrightarrow{F_1} = \overrightarrow{F_2} = 0$
(3) $\overrightarrow{F_1}$ is radially inwards and $\overrightarrow{F_2}$ is radially outwards
(4) $\overrightarrow{F_1}$ is radially inwards and $\overrightarrow{F_2} = 0$

Q22. An LCR circuit is equivalent to a damped pendulum. In an LCR circuit the capacitor is charged to Q_0 and then connected to the L and R as shown below:

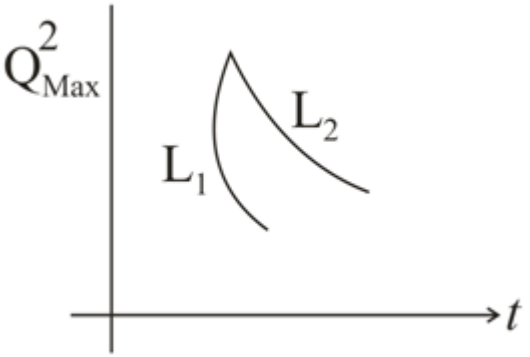


If a student plots graphs of the square of maximum charge $\left(Q_{Max}^2\right)$ on the capacitor with time (t) for two different values L_1 and $L_2 (L_1 > L_2)$ of L then which of the following represents this graph correctly? (plots are schematic and not drawn to scale)

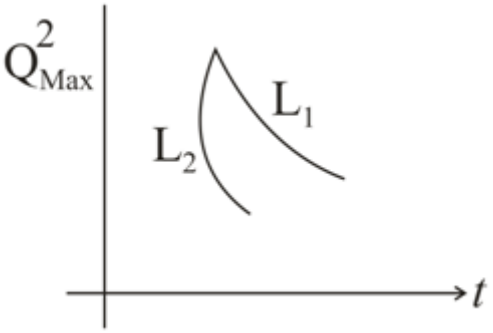
(1)



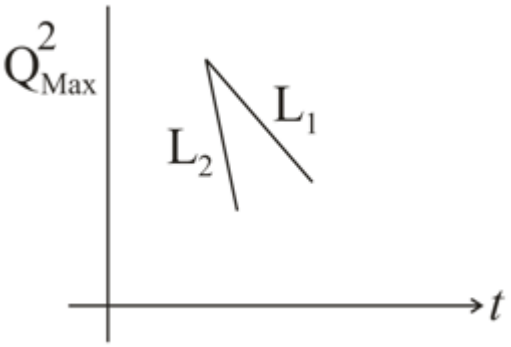
(2)



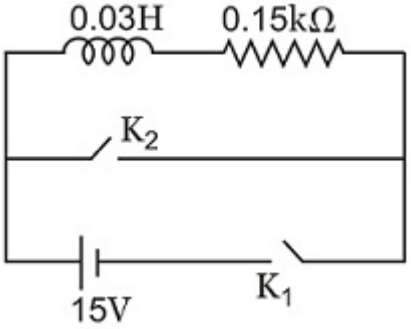
(3)



(4)



Q23. An inductor $(L = 0.03\,\mathrm{H})$ and a resistor $(R = 0.15\ \mathrm{k\Omega})$ are connected in series to a battery of 15 V E.M.F. in a circuit shown below. The key K_1 has been kept closed for a long time. Then at $t = 0$, K_1 is opened and key K_2 is closed simultaneously. At $t = 1\,\mathrm{ms}$, the current in the circuit will be : $(\mathrm{Take},\ e^5 \approx 150)$



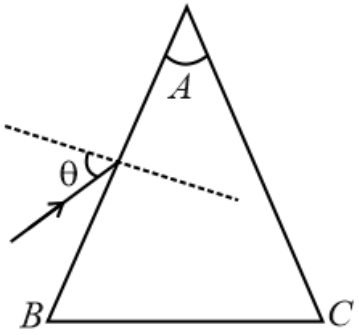
(1) $0.67\ \mathrm{mA}$
(2) $100\ \mathrm{mA}$
(3) $67\ \mathrm{mA}$
(4) $6.7\ \mathrm{mA}$

Q24. A red LED emits light at 0.1 watt uniformly around it. The amplitude of the electric field of the light at a distance of 1 m from the diode is:

(1) $7.75\ \mathrm{V\ m^{-1}}$
(2) $1.73\ \mathrm{V\ m^{-1}}$
(3) $2.45\ \mathrm{V\ m^{-1}}$
(4) $5.48\ \mathrm{V\ m^{-1}}$

Q25. Monochromatic light is incident on a glass prism of angle A. If the refractive index of the material of the prism is μ , a ray, incident at an angle θ , on the face AB would get transmitted through the face AC of the prism

provided:



(1) $\theta < \cos^{-1}\left[\mu \sin\left(\mathrm{A} + \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$ (2) $\theta > \sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

(3) $\theta < \sin^{-1}\left[\mu \sin\left(\mathrm{A} - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$ (4) $\theta > \cos^{-1}\left[\mu \sin\left(A + \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

Q26. On a hot summer night, the refractive index of air is the smallest near the ground and increases with a height from the ground. When a light beam is directed horizontally, the Huygens' principle leads us to conclude that as it travels, the light beam,

(1) bends upward. (2) becomes narrower.

(3) goes horizontally without any deflection. (4) bends downward.

Q27. Assuming that the human pupil has a radius of 0.25 cm and a comfortable viewing distance of 25 cm. The minimum separation between two point objects that the human eye can resolve for the light of wavelength 500 nm is

(1) 300 μm (2) 1 μm

(3) 30 μm (4) 100 μm

Q28. Match list-I (Fundamental Experiment) with List-II (its conclusion) and select the correct option from the choices given below the list:

List-I	**List-II**
A Franck-Hertz Experiment	**(i)** Particle nature of light
B Photo-electric experiment	**(ii)** Discrete energy levels of the atom
C Davison-Germer Experiment	**(iii)** Wave nature of electron
	(iv) Structure of atom

(1) $\mathrm{A} - (\mathrm{iv})\ ; \mathrm{B} - (\mathrm{iii}); \mathrm{C} - (\mathrm{ii})$ (2) $\mathrm{A} - (\mathrm{i})\ ; \mathrm{B} - (\mathrm{iv}); \mathrm{C} - (\mathrm{iii})$

(3) $\mathrm{A} - (\mathrm{ii})\ ; \mathrm{B} - (\mathrm{iv}); \mathrm{C} - (\mathrm{iii})$ (4) $\mathrm{A} - (\mathrm{ii})\ ; \mathrm{B} - (\mathrm{i}); \mathrm{C} - (\mathrm{iii})$

Q29. As an electron makes a transition from an excited state to the ground state of a hydrogen-like atom/ion

(1) kinetic energy and total energy decrease but potential energy increases (2) its kinetic energy increases but potential energy and total energy decrease

(3) kinetic energy, potential energy and total energy decrease (4) kinetic energy decreases, potential energy increases but total energy remains same

Q30. A signal of 5 kHz frequency is amplitude modulated on a carrier wave of frequency 2 MHz. The frequencies of the resultant signal is/are:

(1) 2000 kHz and 1995 kHz
(2) 2 MHz only
(3) 2005 kHz and 1995 kHz
(4) 2005 kHz, 2000 kHz and 1995 kHz

Q31. The molecular formula of a commercial resin used for exchanging ions in water softening is $C_8H_7SO_3Na$ (molecular weight = 206). What would be the maximum uptake of Ca^{2+} ions by the resin if expressed in mol per gm?
(1) $\frac{1}{412}$
(2) $\frac{1}{103}$
(3) $\frac{1}{206}$
(4) $\frac{2}{309}$

Q32. Which of the following is the energy of a possible excited state of hydrogen?
(1) +6.8 eV
(2) +13.6 eV
(3) −6.8 eV
(4) −3.4 eV

Q33. The ionic radii (in Å) of N^{3-}, O^{2-} and F^- are respectively:
(1) 1.71, 1.36 and 1.40
(2) 1.36, 1.40 and 1.71
(3) 1.36, 1.71 and 1.40
(4) 1.71, 1.40 and 1.36

Q34. The intermolecular interaction that is dependent on the inverse cube of distance between the molecules is:
(1) Hydrogen bond
(2) Ion-ion interaction
(3) Ion-dipole interaction
(4) London force

Q35. The following reaction is performed at 298 K.
$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$
The standard free energy of the formation of NO(g) is 86.6 kJ mol^{-1} at 298 K. What is the standard free energy of the formation of $NO_2(g)$ at 298 K? $(K_P = 1.6 \times 10^{12})$
(1) $0.5[2 \times 86{,}600 - R(298)\ln(1.6 \times 10^{12})]$
(2) $R(298)\ln(1.6 \times 10^{12}) - 86{,}600$
(3) $86{,}600 + R(298)\ln(1.6 \times 10^{12})$
(4) $86{,}600 - \frac{\ln(1.6\times10^{12})}{R(298)}$

Q36. The standard Gibbs energy change at 300 K for the reaction $2A \rightleftharpoons B + C$ is 2494.2 J. At a given time, the composition of the reaction mixture is $[A] = \frac{1}{2}$, $[B] = 2$ and $[C] = \frac{1}{2}$. The reaction proceeds in the:
$[R = 8.314\ J/K - mol,\ e = 2.718]$ {Given antilog (-0.44)=0.36}
(1) Reverse direction because $Q < K_C$
(2) Forward direction because $Q > K_C$
(3) Reverse direction because $Q > K_C$
(4) Forward direction because $Q < K_C$

Q37. From the following statements, choose the incorrect statement regarding H_2O_2.
(1) It has to be kept away from dust.
(2) It can act only as an oxidising agent.
(3) It decomposes on exposure to light.
(4) It has to be stored in plastic or wax-lined glass bottles in the dark.

Q38. Which one of the following alkaline earth metal sulphates has its hydration enthalpy greater than its lattice enthalpy?
(1) $SrSO_4$
(2) $CaSO_4$
(3) $BeSO_4$
(4) $BaSO_4$

Q39. In Carius method of estimation of halogens, 250 mg of an organic compound gave 141 mg AgBr. What is the percentage of bromine in the compound (atomic mass of Ag = 108 and atomic number of Br = 80)?

(1) 60 (2) 24

(3) 36 (4) 48

Q40. Which of the following compounds will exhibit geometrical isomerism?

(1) 1, 1 - Diphenyl - 1 - propane (2) 1 - Phenyl - 2 - butene

(3) 3 - Phenyl - 1 - butene (4) 2 - Phenyl - 1 - butene

Q41. **Assertion:** Nitrogen and Oxygen are the main components in the atmosphere but these do not react to form oxides of nitrogen.

Reason: The reaction between nitrogen and oxygen requires high temperature.

(1) Both the Assertion and Reason are incorrect. (2) Both Assertion and Reason are correct and the Reason is the correct explanation for the Assertion.

(3) Both Assertion and Reason are correct, but the Reason is not the correct explanation for the Assertion. (4) The Assertion is incorrect but the Reason is correct.

Q42. Sodium metal crystallizes in a body centred cubic lattice with a unit cell edge of 4.29 Å . The radius of sodium atom is approximately:

(1) 0.93 Å (2) 1.86 Å

(3) 3.22 Å (4) 5.72 Å

Q43. The vapour pressure of acetone at $20^{\circ}\mathrm{C}$ is 185 torr. When 1.2 g of a non-volatile substance was dissolved in 100 g of acetone at $20^{\circ}\mathrm{C}$, its vapour pressure was 183 torr. The molar mass $\left(\mathrm{g\ mol^{-1}}\right)$ of the substance is:

(1) 488 (2) 32

(3) 64 (4) 128

Q44. Two Faraday of electricity is passed through a solution of $\mathrm{CuSO_4}$. The mass of copper deposited at the cathode is: (Atomic mass of Cu = 63.5 amu)

(1) 127 g (2) 0 g

(3) 63.5 g (4) 2 g

Q45. Higher order (>3) reactions are rare due to:

(1) Loss of active species on collision. (2) Low probability of simultaneous collision of all the reacting species.

(3) Increase in entropy and activation energy as more molecules are involved. (4) Shifting of equilibrium towards reactants due to elastic collisions.

Q46. 3 g of activated charcoal was added to 50 mL of acetic acid solution (0.06 N) in a flask. After an hour, it was filtered and the strength of the filtrate was found to be 0.042 N. The amount of acetic acid adsorbed (per gram of charcoal) is:

(1) 54 mg (2) 18 mg

(3) 36 mg (4) 42 mg

Q47. In the context of the Hall-Heroult process for the extraction of Al, which of the following statements is false?

(1) Na_3AlF_6 serves as the electrolyte.
(2) CO and CO_2 are produced in this process.
(3) Al_2O_3 is mixed with CaF_2 which lowers the melting point of the mixture and brings conductivity.
(4) Al^{3+} is reduced at the cathode to form Al.

Q48. Which among the following is the most reactive?

(1) ICl
(2) Cl_2
(3) Br_2
(4) I_2

Q49. Which one has the highest boiling point?

(1) Xe
(2) He
(3) Ne
(4) Kr

Q50. Match the catalysts to the correct process.

	Catalyst		**Process**
A.	$TiCl_3$	**i.**	Wacker process
B.	$PdCl_2$	**ii.**	Ziegler – Natta polymerisation
C.	$CuCl_2$	**iii.**	Contact process`
D.	V_2O_5	**iv.**	Deacon's process

(1) A $\rightarrow$ iii , B $\rightarrow$ i , C $\rightarrow$ ii , D $\rightarrow$ iv
(2) A $\rightarrow$ iii , B $\rightarrow$ ii , C $\rightarrow$ iv , D $\rightarrow$ i
(3) A $\rightarrow$ ii , B $\rightarrow$ i , C $\rightarrow$ iv , D $\rightarrow$ iii
(4) A $\rightarrow$ ii , B $\rightarrow$ iii , C $\rightarrow$ iv , D $\rightarrow$ i

Q51. Which one of the following compounds is not a yellow colored compound ?

(1) $BaCrO_4$
(2) $Zn_2[Fe(CN)_6]$
(3) $K_3[Co(NO_2)_6]$
(4) $(NH_4)_3[As\ (Mo_3O_{10})_4]$

Q52. The colour of $KMnO_4$ is due to: [where M $\rightarrow$ metal, L $\rightarrow$ ligand]

(1) $\sigma - \sigma^*$ transition
(2) M $\rightarrow$ L charge transfer transition
(3) d $-$ d transition
(4) L $\rightarrow$ M charge transfer transition

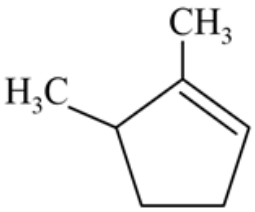
Q53. The number of geometric isomers that can exist for square planar $[Pt(Cl)(py)(NH_3)(NH_2OH)]^+$ is (py = pyridine):

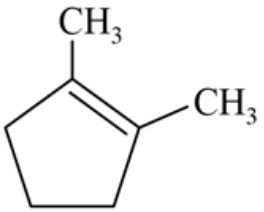
(1) 6
(2) 2
(3) 3
(4) 4

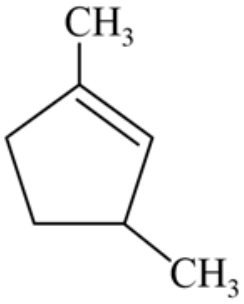
Q54. The synthesis of alkyl fluorides is best accomplished by:

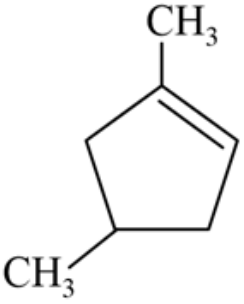
(1) Swarts reaction
(2) Free radical fluorination
(3) Sandmeyer's reaction
(4) Finkelstein reaction

Q55. Which compound would give $5-$keto$-2-$methyl hexanal upon ozonolysis?

(1) 

(2) 

(3) 

(4) 

Q56. In the following sequence of reactions:

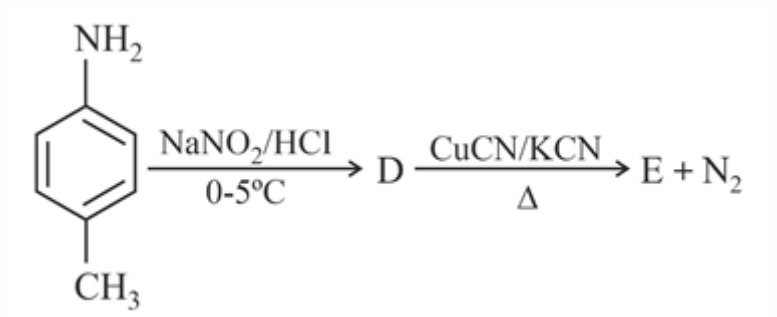
$$\text{Toluene} \xrightarrow{KMnO_4} A \xrightarrow{SOCl_2} B \xrightarrow[BaSO_4]{H_2/Pd} C$$

The Product C is:

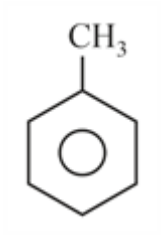
(1) C_6H_5CHO (2) C_6H_5COOH

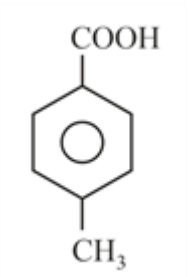
(3) $C_6H_5CH_3$ (4) $C_6H_5CH_2OH$

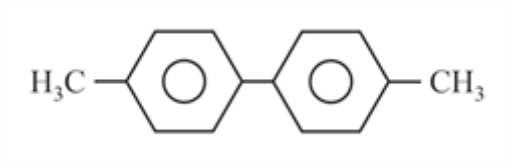
Q57. In the reaction,

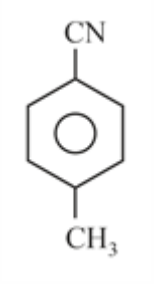


The product E is

(1) 

(2) 

(3) 

(4) 

Q58. Which polymer is used in the manufacture of paints and lacquers?

(1) Poly vinyl chloride (2) Bakelite

(3) Glyptal (4) Polypropene

Q59. Which of the following compounds is not an antacid?

(1) Ranitidine (2) Aluminium hydroxide

(3) Cimetidine (4) Phenelzine

Q60. Which of the vitamins given below is water soluble?

(1) Vitamin K (2) Vitamin C

(3) Vitamin D (4) Vitamin E

Q61. Let α and β be the roots of equation $x^2 - 6x - 2 = 0$. If $a_n = \alpha^n - \beta^n,\ \forall\ n \geq 1$, then the value of $\frac{a_{10} - 2a_8}{2a_9}$ is equal to

(1) -3 (2) 6

(3) -6 (4) 3

Q62. A complex number z is said to be unimodular if $|z| = 1$. Let z_1 and z_2 are complex numbers such that $\frac{z_1 - 2z_2}{2 - z_1\bar{z}_2}$ is unimodular and z_2 is not unimodular, then the point z_1 lies on a

(1) circle of radius $\sqrt{2}$ (2) straight line parallel to x-axis

(3) straight line parallel to y-axis (4) circle of radius 2

Q63. The number of integers greater than 6000 that can be formed, using the digits $3,\ 5,\ 6,\ 7$ and 8, without repetition is

(1) 72 (2) 216

(3) 192 (4) 120

Q64. The number of points, having both co-ordinates as integers, that lie in the interior of the triangle with vertices $(0,\ 0),\ (0,\ 41)$ and $(41,\ 0)$ is

(1) 780 (2) 901
(3) 861 (4) 820

Q65. Let A and B be two sets containing four and two elements respectively. Then the number of subsets of the set $A \times B$, each having at least three elements is
(1) 510 (2) 219
(3) 256 (4) 275

Q66. The sum of first 9 terms of the series $\frac{1^3}{1} + \frac{1^3+2^3}{1+3} + \frac{1^3+2^3+3^3}{1+3+5} + \ldots$ is
(1) 192 (2) 71
(3) 96 (4) 142

Q67. If m is the $A.M.$ of two distinct real numbers I and n $(I,\ n > 1)$ and $G_1,\ G_2$ and G_3 are three geometric means between I and n, then $G_1^4 + 2G_2^4 + G_3^4$ equals
(1) $4l^2m^2\,n^2$ (2) $4\,l^2mn$
(3) $4\,lm^2\,n$ (4) $4lmn^2$

Q68. The sum of coefficients of integral powers of x in the binomial expansion of $\left(1 - 2\sqrt{x}\right)^{50}$ is
(1) $\frac{1}{2}\left(2^{50} + 1\right)$ (2) $\frac{1}{2}\left(3^{50} + 1\right)$
(3) $\frac{1}{2}\left(3^{50}\right)$ (4) $\frac{1}{2}\left(3^{50} - 1\right)$

Q69. Locus of the image of the point $(2, 3)$ in the line $(2x - 3y + 4) + k(x - 2y + 3) = 0$, k∈R , is a
(1) Circle of radius $\sqrt{3}$ (2) Straight line parallel to x-axis.
(3) Straight line parallel to y-axis. (4) Circle of radius $\sqrt{2}$

Q70. The number of common tangents to the circles $x^2 + y^2 - 4x - 6y - 12 = 0$ and $x^2 + y^2 + 6x + 18y + 26 = 0$, is
(1) 4 (2) 1
(3) 2 (4) 3

Q71. Let O be the vertex and Q be any point on the parabola, $x^2 = 8y$. If the point P divides the line segment OQ internally in the ratio $1 : 3$, then the locus of P is
(1) $x^2 = 2y$ (2) $x^2 = y$
(3) $y^2 = x$ (4) $y^2 = 2x$

Q72. The area (in sq. units) of the quadrilateral formed by the tangents at the end points of the latus rectum to the ellipse $\frac{x^2}{9} + \frac{y^2}{5} = 1$, is
(1) 27 (2) $\frac{27}{4}$
(3) 18 (4) $\frac{27}{2}$

Q73. $\lim\limits_{x \to 0} \frac{(1-\cos 2x)(3+\cos x)}{x\tan 4x} =$
(1) $\frac{1}{2}$ (2) 4
(3) 3 (4) 2

Q74. The negation of $\sim s \vee (\sim r \wedge s)$ is equivalent to

(1) $s \wedge r$ (2) $s \wedge \sim r$
(3) $s \wedge (r \wedge \sim s)$ (4) $s \vee (r \vee \sim s)$

Q75. The mean of a data set comprising of 16 observations is 16. If one of the observation value 16 is deleted and three new observations valued 3 , 4 and 5 are added to the data, then the mean of the resultant data is
(1) 14 .0 (2) 16 .8
(3) 16 .0 (4) 15 .8

Q76. If the angles of elevation of the top of a tower from three collinear points $A,\ B$ and C on a line leading to the foot of the tower are $30^{\circ},\ 45^{\circ}$ and 60° respectively, then the ratio $AB : BC$, is
(1) $2 : 3$ (2) $\sqrt{3} : 1$
(3) $\sqrt{3} : \sqrt{2}$ (4) $1 : \sqrt{3}$

Q77. If $A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ a & 2 & b \end{bmatrix}$ is a matrix satisfying the equation $AA^T = 9I$, where I is 3×3 identity matrix, then the ordered pair $(a,\ b)$ is equal to
(1) $(-2,\ -1)$ (2) $(2,\ -1)$
(3) $(-2,\ 1)$ (4) $(2,\ 1)$

Q78. The set of all values of λ for which the system of linear equations:
$2x_1 - 2x_2 + x_3 = \lambda x_1$
$2x_1 - 3x_2 + 2x_3 = \lambda x_2$
$-x_1 + 2x_2 = \lambda x_3$
has a non-trivial solution,
(1) Contains more than two elements. (2) Is an empty set.
(3) Is a singleton. (4) Contains two elements.

Q79. Let $\tan^{-1}\ y = \tan^{-1}\ x + \tan^{-1}\left(\frac{2x}{1-x^2}\right)$, where $|x| < \frac{1}{\sqrt{3}}$,Then a value of y is
(1) $\frac{3x+x^3}{1+3x^2}$ (2) $\frac{3x-x^3}{1-3x^2}$
(3) $\frac{3x+x^3}{1-3x^2}$ (4) $\frac{3x-x^3}{1+3x^2}$

Q80. If the function g $(x) = \begin{cases} k\sqrt{x+1}\ , & 0 \le x \le 3 \\ mx+2\ , & 3 < x \le 5 \end{cases}$ is differentiable, then the value of $k+m$ is
(1) 4 (2) 2
(3) $\frac{16}{5}$ (4) $\frac{10}{3}$

Q81. The normal to the curve $x^2 + 2xy - 3y^2 = 0$, at $(1,\ 1)$
(1) Meets the curve again in the fourth quadrant (2) Does not meet the curve again
(3) Meets the curve again in the second quadrant (4) Meets the curve again in the third quadrant

Q82. Let $f(x)$ be a polynomial of degree four and having its extreme values at $x = 1$ and $x = 2$. If $\lim\limits_{x \to 0}\left[1 + \frac{f(x)}{x^2}\right] = 3$, then $f(2)$ is equal to
(1) 4 (2) -8
(3) -4 (4) 0

Q83. The integral $\int \frac{dx}{x^2\left(x^4+1\right)^{\frac{3}{4}}}$ equals to

(1) $-\left(\frac{x^4+1}{x^4}\right)^{\frac{1}{4}}+c$ (2) $\left(\frac{x^4+1}{x^4}\right)^{\frac{1}{4}}+c$

(3) $\left(x^4+1\right)^{\frac{1}{4}}+c$ (4) $-\left(x^4+1\right)^{\frac{1}{4}}+c$

Q84. The integral $\int\limits_2^4 \frac{\log x^2}{\log x^2+\log(6-x)^2} dx$ is equal to

(1) 6 (2) 2

(3) 4 (4) 1

Q85. The area (in sq. units) of the region described by $\left[(x, y): y^2 \leq 2x \text{ and } y \geq 4x-1\right]$ is

(1) $\frac{9}{32}$ sq. units (2) $\frac{7}{32}$ sq. units

(3) $\frac{5}{64}$ sq. units (4) $\frac{15}{64}$ sq. units

Q86. Let $y(x)$ be the solution of the differential equation $(x \log x)\frac{dy}{dx}+y=2x \log x,\ (x \geq 1)$. Then $y(e)$ is equal to

(1) $2e$ (2) e

(3) 0 (4) 2

Q87. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three non - zero vectors such that no two of them are collinear and $\left(\vec{a} \times \vec{b}\right) \times \vec{c}=\frac{1}{3}\left|\vec{b}\right|\left|\vec{c}\right|\vec{a}$. If θ is the angle between vectors $\vec{b}$ and $\vec{c}$, then a value of $\sin \theta$ is

(1) $\frac{-2\sqrt{3}}{3}$ (2) $\frac{2\sqrt{2}}{3}$

(3) $\frac{-\sqrt{2}}{3}$ (4) $\frac{2}{3}$

Q88. The distance of the point $(1,\ 0,\ 2)$ from the point of intersection of the line $\frac{x-2}{3}=\frac{y+1}{4}=\frac{z-2}{12}$ and the plane $x-y+z=16$, is

(1) 13 (2) $2\sqrt{14}$

(3) 8 (4) $3\sqrt{21}$

Q89. The equation of the plane containing the line of intersection of $2x-5y+z=3;\ x+y+4z=5$, and parallel to the plane, $x+3y+6z=1$, is

(1) $2x+6y+12z=-13$ (2) $2x+6y+12z=13$

(3) $x+3y+6z=-7$ (4) $x+3y+6z=7$

Q90. If 12 identical balls are to be placed in 3 identical boxes, then the probability that one of the boxes contains exactly 3 balls is

(1) $22\left(\frac{1}{3}\right)^{11}$ (2) $\frac{5}{19}$

(3) $55\left(\frac{2}{3}\right)^{10}$ (4) $220\left(\frac{1}{3}\right)^{12}$

ANSWER KEYS

1. (3)	**2.** (4)	**3.** (4)	**4.** (3)	**5.** (4)	**6.** (4)	**7.** (3)	**8.** (2)
9. (4)	**10.** (4)	**11.** (3)	**12.** (3)	**13.** (3)	**14.** (3)	**15.** (4)	**16.** (2)
17. (3)	**18.** (4)	**19.** (1)	**20.** (4)	**21.** (2)	**22.** (3)	**23.** (1)	**24.** (3)
25. (2)	**26.** (1)	**27.** (3)	**28.** (4)	**29.** (2)	**30.** (4)	**31.** (1)	**32.** (4)
33. (4)	**34.** (1)	**35.** (1)	**36.** (3)	**37.** (2)	**38.** (3)	**39.** (2)	**40.** (2)
41. (2)	**42.** (2)	**43.** (3)	**44.** (3)	**45.** (2)	**46.** (2)	**47.** (1)	**48.** (1)
49. (1)	**50.** (3)	**51.** (2)	**52.** (4)	**53.** (3)	**54.** (1)	**55.** (3)	**56.** (1)
57. (4)	**58.** (3)	**59.** (4)	**60.** (2)	**61.** (4)	**62.** (4)	**63.** (3)	**64.** (1)
65. (2)	**66.** (3)	**67.** (3)	**68.** (2)	**69.** (4)	**70.** (4)	**71.** (1)	**72.** (1)
73. (4)	**74.** (1)	**75.** (1)	**76.** (2)	**77.** (1)	**78.** (4)	**79.** (2)	**80.** (2)
81. (1)	**82.** (4)	**83.** (1)	**84.** (4)	**85.** (1)	**86.** (4)	**87.** (2)	**88.** (1)
89. (4)	**90.** (2)						