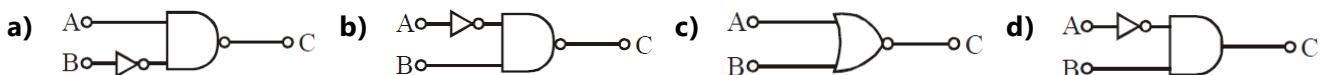# Rankers Academy JEE

Competishun

52/6, Opposite Metro Mas Hospital, Shipra Path, Mansarovar

Date: 15/01/2024

Time: 3 hours

Max. Marks: 300

MFST-13 (23-24) & UT-2_MT-6

Physics

### Single Choice Question

Q1

The logic circuit shown above is equivalent to :

a)
b)
c)
d)

Q2 Consider the diffraction pattern obtained from the sunlight incident on a pinhole of diameter 0.1μm. If the diameter of the pinhole is slightly increased, it will affect the diffraction pattern such that :

a) its size decreases, and intensity decreases

b) its size increases, and intensity increases

c) its size increases, but intensity decreases

d) its size decreases, but intensity increases

Q3 The current (i) at time t = 0 and t = ∞ respectively for the given circuit is :
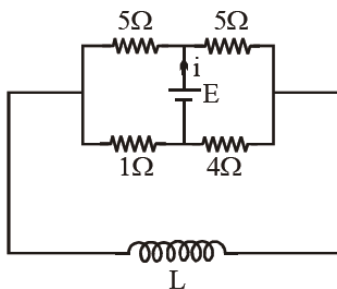

a) $\dfrac{18E}{55}, \dfrac{5E}{18}$

b) $\dfrac{10E}{33}, \dfrac{5E}{18}$

c) $\dfrac{5E}{18}, \dfrac{18E}{55}$

d) $\dfrac{5E}{18}, \dfrac{10E}{33}$

Q4 Two coherent light sources having intensity in the ratio 2x produce an interference pattern.

The ratio $\dfrac{I_{max}-I_{min}}{I_{max}+I_{min}}$ will be:

a) $\dfrac{2\sqrt{2x}}{x+1}$

b) $\dfrac{\sqrt{2x}}{2x+1}$

c) $\dfrac{\sqrt{2x}}{x+1}$

d) $\dfrac{2\sqrt{2x}}{2x+1}$

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Q5 A string is wound around a hollow cylinder of mass 5 kg and radius 0.5 m. If the string is now pulled with a horizontal force of 40 N, and the cylinder is rolling without slipping on a horizontal surface (see figure), then the angular acceleration of the cylinder will be (Neglect the mass and thickness of the string)
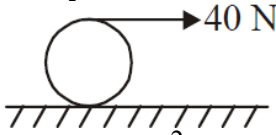

a) 20 rad/s^2
b) 16 rad/s^2
c) 12 rad/s^2
d) 10 rad/s^2

Q6 The figure shows a conducting loop abcda placed in plane perpendicular to a constant magnetic field B. The two parts acb and adb are circular arcs of radius a. The separation between the points a and b is l. The point a and b are connected to a battery which sends a current i. The magnetic force on the loop due to the field B is :
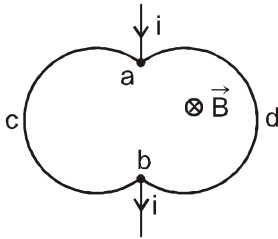

a) $i\ell B$
b) $2i\ell B$
c) zero
d) $2ia\ B$

Q7 When a wave travel in a medium, the particle displacement is given by the equation y = a sing 2π (bt-cx) where a, b and c are constants. The maximum particle velocity will be twice the wave velocity if

a) $c = \dfrac{1}{\pi a}$
b) $c = \pi a$
c) $b = ac$
d) $b = \dfrac{1}{ac}$

Q8 Light is incident from a medium into air at two possible angles of incidence (A) 20° and (B) 40°.
In the medium light travels 3.0 cm in 0.2 ns. The ray will :
a) suffer total internal reflection in both cases (A) and (B)

b) suffer total internal reflection in case (B) only

c) have partial reflection and partial transmission in case (B)

d) have 100% transmission in case (A)

Q9 A hydrogen atom is initially at rest and free to move is in the second excited state. It comes to ground state by emitting a photon, then the momentum of hydrogen atom will be approximately : (in kg–m/s)
a) 12.1×0^{-27}
b) 6.45×10^{-27}
c) 3×10^{-27}
d) 1.5×0^{-27}

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Q10 In an experimental observation of the photoelectric effect, the stopping potential was plotted versus the light frequency, as shown in the figure below. The best straight line was fitted to the experimental points. Which of the following gives the slope of the line? (Work function of the metal is ϕ and symbols have their usual meaning.)
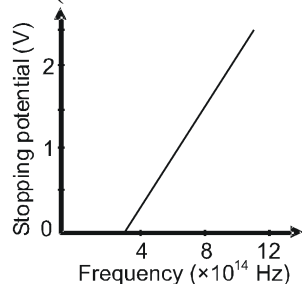

a) $\dfrac{h}{\phi}$ b) $\dfrac{h}{e}$ c) $\dfrac{e}{h}$ d) $\dfrac{\phi}{e}$

Q11 The potential difference in volts, across the resistance R_2 in the circuit given is:
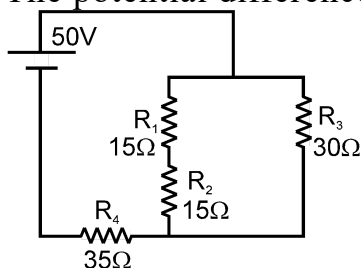
a)   5   b)   7.5   c)   10   d)   15

Q12 A thin disc of radius b = 2a has a concentric hole of radius 'a' in it (see figure). It carries uniform surface charge 'σ' on it. If the electric field on its axis at height 'h' (h << a) from its centre is given as 'Ch' then value of 'C' is :
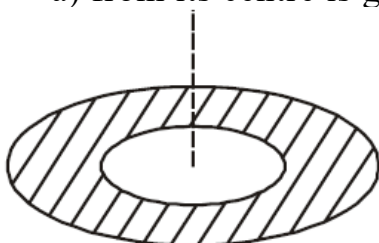
a) $\dfrac{\sigma}{4a\,\epsilon_0}$ b) $\dfrac{\sigma}{8a\,\epsilon_0}$ c) $\dfrac{\sigma}{a\,\epsilon_0}$ d) $\dfrac{\sigma}{2a\,\epsilon_0}$

Q13 An incompressible liquid flows through a horizontal tube as shown in the figure. Then the velocity ' v ' of the fluid is :
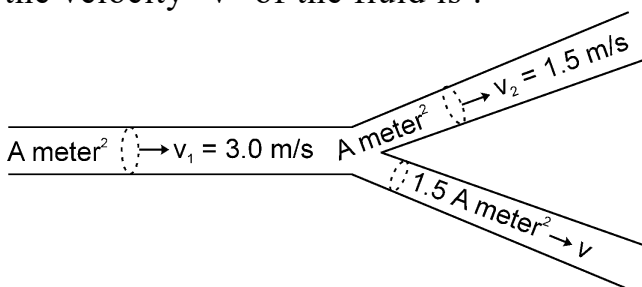

a)   3.0 m/s   b)   1.5 m/s   c)   1.0 m/s   d)   2.25 m/s

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Q14 In a process the density of a gas remains constant. If the temperature is doubled, then the change in the pressure will be:

a) 100 % b) 200 % c) 50 % d) 25 %

Q15 A uniform thin, rod AB of length L and mass m is undergoing fixed axis rotation about end A, such that end A remains stationary as shown. The kinetic energy of section AP of rod is equal to kinetic energy of section BP of rod at an instant. Then the ratio of length AP and length AB, that is, $\frac{AP}{AB}$ is equal to
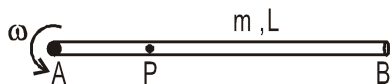

a) $\frac{1}{2}$ b) $\frac{1}{2^{1/3}}$ c) $\frac{1}{\sqrt{2}}$ d) $\frac{1}{2\sqrt{2}}$

Q16 A wheel of centroidal radius of gyration 'k' is rolling on a horizontal surface with constant velocity. It comes across an obstruction of height 'h' Because of its rolling speed, it just overcomes the obstruction. To determinate v, one should use the principle(s) of conservation of :
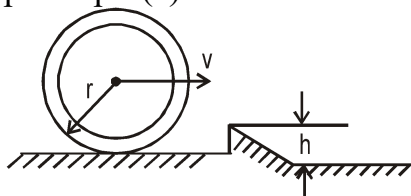

a) Energy b) linear momentum c) energy and linear momentum

d) energy and angular momentum

Q17 A horizontal spring–block system of mass 2kg executes S.H.M. When the block is passing through its equilibrium position, an object of mass 1kg is put gently on it and the two move together. The new amplitude of vibration is (A being its initial amplitude) :

a) $\sqrt{\frac{2}{3}}A$ b) $\sqrt{\frac{3}{2}}A$ c) $\sqrt{2}A$ d) $\frac{A}{\sqrt{2}}$

Q18 Three capacitors C_1, C_2 and C_3 are connected to a battery as shown. With symbols having their
usual meanings, the correct conditions are
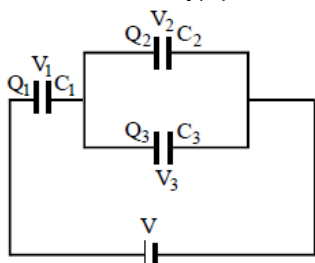
a) $Q_1 = Q_2 = Q_3$ and $V_1 = V_2 = V$ b) $V_1 = V_2 = V_3 = V$ c) $Q_1 = Q_2 + Q_3$ and $V = V_1 + V_2$

d) $Q_2 = Q_3$ and $V = V_2 + V_3$

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Q19 A block of mass ' M ' area of cross-section 'A' & length 'ℓ' is placed on smooth horizontal floor. A force ' F ' is applied on the block as shown. If ' y ' is young's modulus of material, then total extension in the block will be:
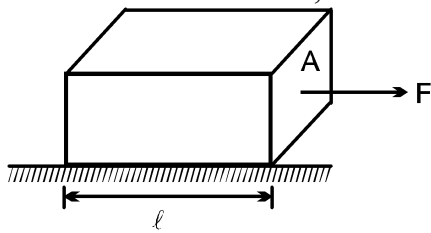

a) $\dfrac{F\ell}{Ay}$

b) $\dfrac{F\ell}{2Ay}$

c) $\dfrac{F\ell}{3Ay}$

d) cannot extend

Q20 A man is moving with 10 m/s towards west on a horizontal ground. He observed that the rainfall is falling vertically down wards. Now he increases his speed to 15 m/s and find that now the rainfall is falling at an angle of 45° towards him. The speed of the rain with respect to ground is :

a) $10\sqrt{5}m/s$

b) 10 m/s

c) $5\sqrt{5}m/s$

d) None of these

Numerical

Q21 In connection with the circuit drawn below, the value of current flowing through 2 k Ω resistor is _____ $\times 10^{-4}$ A.
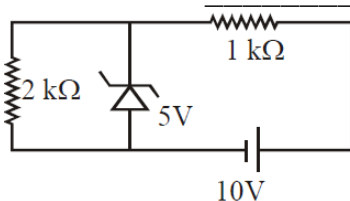
Q22 A solid conducting sphere of radius a is surrounded by a thin uncharged concentric conducting shell of radius 2a. A point charge q is placed at a distance 4a from common centre of conducting sphere and shell. The inner sphere is then grounded.

The charge on solid sphere is $\dfrac{q}{x}$. Find the value of x.
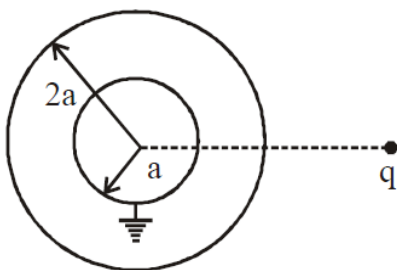
Q23 The initial velocity v_i required to project a body vertically upward from the surface of the earth to reach a height of 10R, where R is the radius of the earth, may be described in terms of escape velocity v_e such that $v_i = \sqrt{\dfrac{x}{y}} \times v_e$. The value of x will be _____.

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Q24 A small bob tied at one end of a thin string of length 1m is describing a vertical circle so that the maximum and minimum tension in the string are in the ratio 5 : 1. The velocity of the bob at the highest position is _____ m/s. (Take g = 10 m/s^2)

Q25 A copper wire is stretched to make it 0.5% longer. The percentage change in its electrical resistance if its volume remains unchanged is:

Q26 An LCR series circuit with 100Ω resistance is connected to an AC source of 200 V and angular
frequency 300 rad/s. When only the capacitance is removed, the current lags behind the voltage
by 60°. When only the inductance is removed, the current leads the voltage by 60°. Calculate
the current (in ampere) in the LCR circuit.

Q27 The emissivity of tungsten is approximately 0.35. A tungsten sphere 1 cm in radius is suspended within a large evacuated enclosure whose walls are at 300 K. What power input is required to maintain the sphere at a temperature of 3000 K if heat conduction along the supports is neglected ? Express your answer in kW after rounding off the integer. Take $\sigma = \dfrac{17}{3} \times 10^{-8}$ S.I. units and $\pi = \dfrac{213}{68}$

Q28 The magnetic field of a plane electromagnetic wave is given by:

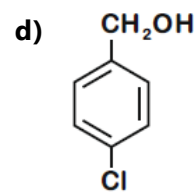$$\vec{B} = B_0 \hat{i} [\cos(kz - \omega t)] + B_1 \hat{j} \cos(kz + \omega t)$$

Where $B_0 = 3 \times 10^{-5}$ T and $B_1 = 2 \times 10^{-6}$ T .
The rms value of the force (in newton) experienced by a stationary charge $Q = 10^{-4}$ C
at $z = 0$ is $\dfrac{x}{\sqrt{2}} \times 10^{-1}$, find value of x:

Q29 A particle starts from point A, moves along a straight line path with an acceleration given by a = 2 (4 – x) where x is distance from point A. The particle stops at point B for a moment. Find the distance AB (in m). (All values are in S.I. units)

Q30 A particle is projected up with 15 m/s perpendicular to the incline. (see fig.). If the particle hits the incline at a distance R (in meter) from the point of projection then find the value of $\dfrac{R}{5}$? (g = 10 m/s^2)

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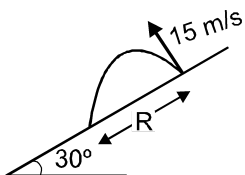
Chemistry

Single Choice Question

Q31 The major product of the following reaction is:

$$\xrightarrow{\substack{(1)Cl_2 \text{ Excess}+h\nu \\ (2)H_2O,\Delta}}$$

a) $CHCl_2$ (on benzene ring with Cl)

b) CO_2H (on benzene ring with Cl)

c) CHO (on benzene ring with Cl)

d) CH_2OH (on benzene ring with Cl)
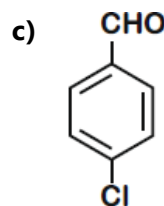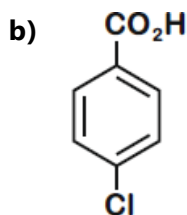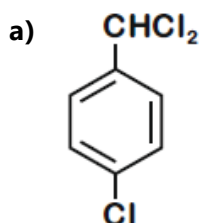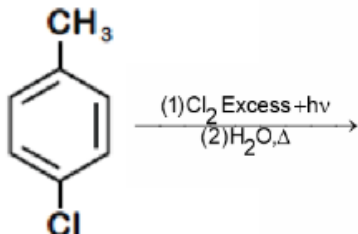
Q32 For the solution of the gases w, x, y and z in water at 298 K, the Henrys law constants (K_H) are 0.5, 2, 35 and 40 kbar, respectively. The correct plot for the given data is :

a)

b)

c)

d)
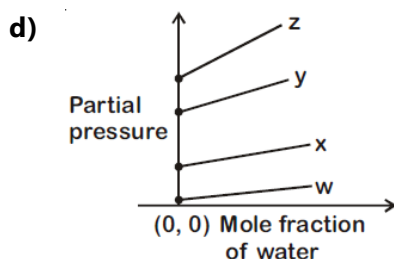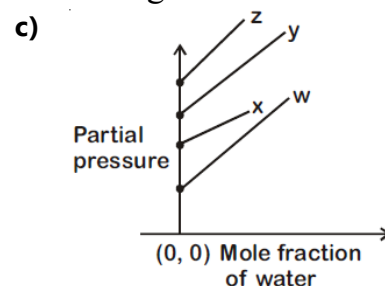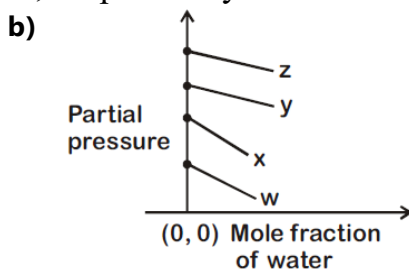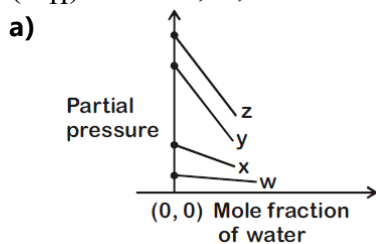
Q33 For a reaction scheme $A \xrightarrow{k_1} B \xrightarrow{k_2}$, if the rate of formation of B is set to be zero then the concentration of B is given by :

a) $k_1 k_2 [A]$

b) $(k_1 - k_2) [A]$

c) $\left(\frac{k_1}{k_2}\right) [A]$

d) $(k_1 + k_2) [A]$

Q34 Which one of the following equations does not correctly represent the first law of thermodynamics for the given processes involving an ideal gas? (Assume non-expansion work is zero)

a) Isothermal process : $q = -w$

b) Cyclic process : $q = -w$

c) Isochoric process : $\Delta U = q$

d) Adiabatic process : $\Delta U = -w$

Q35 A 100 ml solution of 0.1 n HCl was titrated with 0.2 N NaOH solution. The titration was discontinued after adding 30 ml of NaOH solution. The remaining titration was completed by adding 0.25 N KOH solution. The volume of KOH required for completing the titration is

a) 70 ml　　　　b) 32 ml　　　　c) 35 ml　　　　d) 16 ml

Q36 N_2 and H_2 are taken in 1 : 3 molar ratio in a closed vessel to attained the following equilibrium

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$. Find K_p for reaction at total pressure of 2P if at equilibrium is $\dfrac{P}{3}$

a) $\dfrac{1}{3P^2}$　　　　b) $\dfrac{4}{3P^2}$　　　　c) $\dfrac{4P^2}{3}$　　　　d) None

Q37 The complex that can show fac-and merisomers is

a) $[CoCl_2(en)_2]$　　b) $[Co(NH_3)_3(NO_2)_3]$　　c) $[Pt(NH_3)_2Cl_2]$　　d) $[Co(NH_3)_4Cl_2]^+$

Q38 The de Broglie wavelength of an electron in the 4th Bohr orbit is

a) $4\pi a_0$　　　　b) $6\pi a_0$　　　　c) $8\pi a_0$　　　　d) $2\pi a_0$
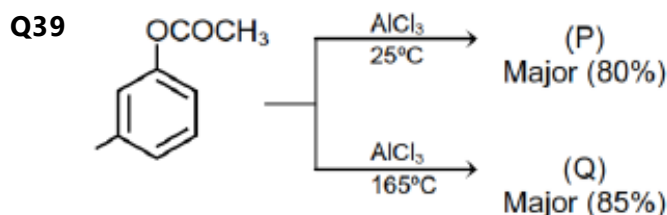
Q39

P and Q are respectively –

Q40
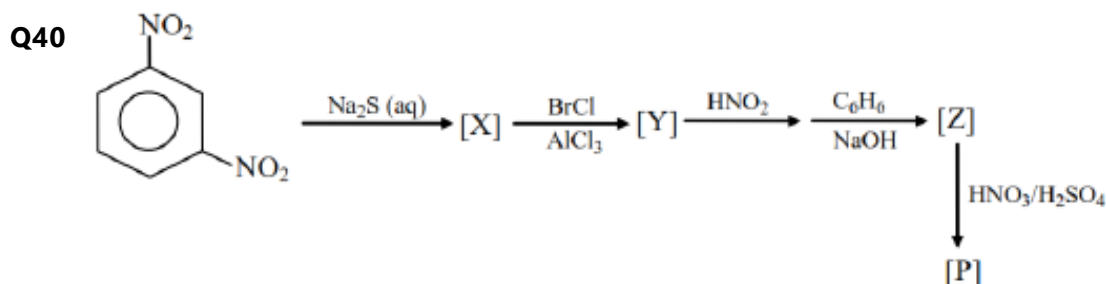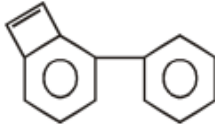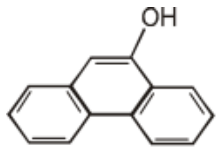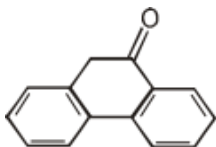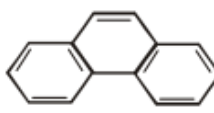
The correct statement is :

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Q41 The final product in the following reaction is

$$\xrightarrow{H^{\oplus}} \xrightarrow[\Delta]{H_2SO_4}$$
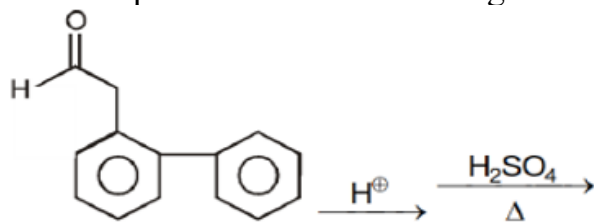
a)   b)   c)   d)

Q42 In the given reaction, [X] will be:

$$C_6H_5 - \underset{\underset{O}{\|}}{\overset{\overset{C}{\|}}{}} - H \xrightarrow{NH_2OH/H^{\oplus}} [X]$$
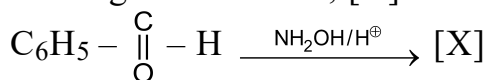
a) only syn oxime   b) only and oxime   c) mixture of syn and anti oxime

d) secondary amide

Q43 A nucleoside is :

a) base + sugar   b) base + phosphate   c) sugar + phosphate

d) base + sugar + phosphate

Q44 Correct IUPAC name of the compound
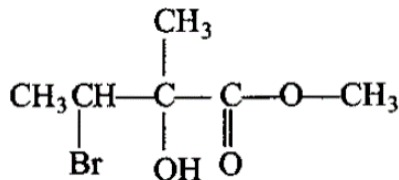
a) Methyl-3-brorno-2-hydroxy-2-methylbutanoate

b) Methyl-2-brorno-3-hydroxy-3-methylbutanoate

c) Methyl-2-brorno-1-hydroxybutanoate

d) Methyl-3-brorno-2-hydroxy-2-methylbutylester

Q45 Which of the indicated H in the following is most acidic?

a) X   b) Y   c) Z   d) p

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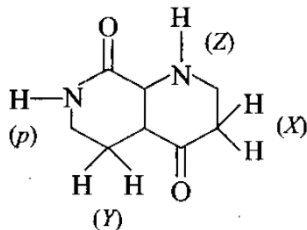
Q46 Which of the following statement is correct.
  a) Nucleophiles have an unshared electron pair and can make use of this to react with an electron rich species.

  b) $AgNO_3$ increases the rate of solvolysis in S_N^1 reaction of alkyl halide.

  c) Inversion of configuration occurs at the carbon undergoing S_N^1 reaction.

  d) Aryl halides are more reactive towards nucleophilc substitution reaction as compared to alkyl halide.

Q47 Greater reactivity of F_2 is due to
(I) Low energy of F–F bond
(II) Small size
(III) High heat of hydration
(IV) High energy of F–F bond
  a) I, II, III   **b)** I, III, IV   **c)** I, II   **d)** I, II, III, IV

Q48 The standard electrode potential of a metal-metal ion $(Ag \,|\, Ag^+)$ and metal-sparingly soluble salt anion $(Ag \,|\, AgCl \,|\, Cl^-)$ are related as :
  a)
  $$E°_{Ag^+|Ag} = E°_{Cl^-|AgCl||Ag} + \frac{RT}{F}\ln K_{sp}$$

  b)
  $$E°_{Cl^-|AgCl||Ag} = E°_{Ag^+|Ag} + \frac{RT}{F}\ln K_{sp}$$

  c)
  $$E°_{Cl^-|AgCl||Ag} = E°_{Ag^+|Ag} - \frac{RT}{F}\ln \frac{[Cl^-]}{K_{sp}}$$

  d)
  $$E°_{Cl^-|AgCl||Ag} = E°_{Ag^+|Ag} - \frac{RT}{F}\ln \frac{K_{sp}}{[Cl^-]}$$

Q49 CrO_3 dissolves in aqueous NaOH to give :
  a) $Cr_2O_7^{2-}$ **b)** CrO_4^{2-} **c)** $Cr(OH)_3$ **d)** $Cr(OH)_2$

Q50 10 litre of a non linear polyatomic ideal gas at 127°C and 2 atm pressure is suddenly released to 1 atm pressure and the gas expanded adiabatically against constant external pressure, the final temperature and volume of the gas respectively are :
  a) T = 350K; V = 17.5 L   **b)** T = 300K; V = 15L   **c)** T = 250 K; V =12.5 L
  d) None of these

Numerical

Q51 In order to oxidise a mixture of one mole of each of FeC_2O_4, $Fe_2(C_2O_4)_3$, $FeSO_4$ and $Fe_2(SO_4)_3$ in acidic medium, the number of moles of $KMnO_4$ required is

Q52 If the activation energy of a reaction is 80.9 kJ mol^{-1}, the fraction of molecules at 700 K, having enough energy to react to form products is e^{-x}. The value of x is _____.
(Rounded off to the nearest integer)
[Use R = 8.31 J K^{-1} mol^{-1}]

Q53 The pH of ammonium phosphate solution, if pk_a of phosphoric acid and pk_b of ammonium hydroxide are 5.23 and 4.75 respectively, is _____. (Rounded off to the nearest integer)

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Q54 40 mL gaseous mixtures of CO, CH_4 and Ne was exploded with 10 mL of oxygen. On cooling the gases occupied 36.5 mL. After treatment with KOH the volume reduced by 9 mL and again on treatment with alkaline pyrogallol, the volume further reduced. Percentage of CH_4 in the original mixture is :

Q55 A 250 mL sample of a 0.20 M Cr^{3+} is electrolyzed with a current of 96.5 A. If the remaining $[Cr^{3+}]$ is 0.1 M the duration of process (in sec.) is :

Q56 The electron gain enthalpy of a hypothetical element 'A' is –3 eV per atom. How much energy in kCal is released when 10 g of 'A' are completely converted to A^- ions in gaseous state?
(Take : 1 eV per atom = 23 kCal mol^{-1}, Molar mass of A = 30 g)

Q57 0.092g of a compound with molecular formula $C_3H_8O_3$ on reaction with an excess of CH_3MgI give 67.00 mL of CH_4 at STP. The number of active hydrogen atoms present in a molecule of the compound is :

Q58 Consider the following compounds
IF_5; ICl_4^-; XeO_2F_2; NH_2^-; $AsCl_4^+$
$B(OH)_3$; NO_2^-; ClO_2^+; $[SbF_5]^{2-}$; $[PCl_4]^+$, $[PCl_6]^-$
What is total number of compounds in (above compounds) which central atom used their all 3 p- orbitals in hybridisation.

Q59 How many of the following species are paramagnetic :
NO, $[Cr(NH_3)_6]^{3+}$, $Ni(CO)_4$,
NO_2 $[Cu(Cl_4)]^{2-}$, $[Cu(NH_3)_4]^{2+}$, $[CO(NH_3)_6]^{3+}$,
ClO_2 $[Fe(CN)_6]^{4-}$, $Fe(CO)_5$, KO_2,

Q60 What is the total number of stereoisomers of pent-3-en-2-ol ?

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Mathematics

Single Choice Question

Q61 If $y = \dfrac{x}{\sqrt{a^2-1}} - \dfrac{2}{\sqrt{a^2-1}}\tan^{-1}\left(\dfrac{\sin x}{a+\sqrt{a^2-1}+\cos x}\right)$ where $a \in (-\infty, -1) \cup (1, \infty)$ then $y'\left(\dfrac{\pi}{2}\right)$ equals

a) $\dfrac{1}{a}$
b) $\dfrac{2}{a}$
c) $\dfrac{1}{2a}$
d) a

Q62 The number of ordered quadruples (a_1, a_2, a_3, a_4) of positive odd integers that satisfy $a_1 + a_2 + a_3 + a_4 = 32$ is equal to

a) 286
b) 4495
c) 680
d) 4040

Q63 The coefficient of t^8 in the expansion of $(1 + 2t^2 - t^3)^9$, is

a) 1680
b) 2140
c) 2520
d) 2730

Q64 Let two non-collinear vectors $\vec{a}$ and $\vec{b}$ inclined at an angle $\dfrac{2\pi}{3}$ be such that $|\vec{a}| = 3$ and $|\vec{b}| = 2$. A point P moves so that at any time t the position vector $\overrightarrow{OP}$ (where O is the origin) is given as $\overrightarrow{OP} = (e^t + e^{-t})\vec{a} + (e^t - e^{-t})\vec{b}$. Then the least distance of P from origin is

a) $\sqrt{10 + 2\sqrt{133}}$
b) $\sqrt{10 + \sqrt{133}}$
c) $\sqrt{5 + \sqrt{133}}$
d) $\sqrt{5 + 2\sqrt{133}}$

Q65 Water is dropped at the rate of $2m^3$/sec. into a cone of semi-vertical angle 45°. The rate at which periphery of water surface changes when height of the water in the cone is 2 meter, is

a) 1 m/sec.
b) 2 m/sec.
c) 3m/sec.
d) 4 m/sec.

Q66 The base of a triangle passes through a fixed point (f, g) and its sides are bisected at right angles by the lines $y^2 - 8xy - 9x^2 = 0$. The locus of vertex of triangle is

a) straight line
b) circle
c) parabola
d) ellipse

Q67 Equation of chord AB of circle $x^2 + y^2 = 2$ passing through the point P(2, 2) such that $\dfrac{PB}{PA} = 3$ is

a) $x = 3y$
b) $x = y$
c) $y - 2 = \sqrt{3}(x - 2)$
d) None of these

Q68 Let α, β, γ are the real roots of the equation $x^3 + ax^2 + bx + c = 0$ (a, b, c ∈ R and a ≠ 0). If the system of equations (in u, v and w) given by
αu + βv + γw = 0
βu + γv + αw = 0
γu + αv + βw = 0
has non-trivial solutions, then a^2 equals

a) b
b) 2b
c) 3b
d) 4b

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Q69 Consider two sets A = {1, 2, 3, 4, 5} and B = {1, 2, 3, ..., 9, 10}.
If Tina randomly selects two distinct numbers from set A and Reena randomly selects one number from set B, the probability that Reena's number is greater than the sum of the two number chosen by Tina, is

a) 2/5   b) 1/2   c) 3/5   d) 1/5

Q70 Suppose a parabola $y = x^2 - ax - 1$ intersects the coordinate axes at three points A, B and C respectively. The circumcircle of $\triangle ABC$ intersects the y-axis again at the point D(0, t). Find the value of t.

a) 4   b) 1   c) 3   d) 2

Q71 If $\dfrac{dy}{dx} = \left(e^y - x\right)^{-1}$ where y (0) = 0, then y is expressed explicitly as

a) $\dfrac{1}{2}\ln\left(1+x^2\right)$ b) $\ln\left(1+x^2\right)$ c) $\ln\left(x+\sqrt{1+x^2}\right)$ d) $\ln\left(x+\sqrt{1-x^2}\right)$

Q72 The point on the curve $4x^2 + a^2y^2 = 4a^2$, $a^2 \in (4, 8)$. Which is farthest from P(0, –2) is

a) (0, 2)   b) (a, 0)   c) (–4, 0)   d) None of these

Q73 If $U_n = \int_0^{\pi/2} x^n \sin x \, dx$ then the value $U_{10} + 90U_8$ is

a) $10(\pi/2)^9$ b) $9(\pi/2)^9$ c) $9(\pi/2)^8 + (\pi/2)^9$ d) None of these

Q74 If $0 < \theta \le \pi$ and $\sin\dfrac{\theta}{2} = \sqrt{1+\sin\theta} - \sqrt{1-\sin\theta}$, then possible values of $\tan\theta$, is

a) $\dfrac{4}{3}$ b) 0   c) $\dfrac{-3}{4}$ d) $\dfrac{-4}{3}$

Q75 Let A = $[a_{ij}]_{3\times3}$ be a matrix such that $AA^T = 4I$ and $a_{ij} + 2c_{ij} = 0$ where c_{ij} is the cofactor of a_{ij} $\forall$ i and j and I is the unit matrix of order 3.

If $\begin{vmatrix} a_{11}+4 & a_{12} & a_{13} \\ a_{21} & a_{22}+4 & a_{23} \\ a_{31} & a_{32} & a_{33}+4 \end{vmatrix} + 5\lambda \begin{vmatrix} a_{11}+1 & a_{12} & a_{13} \\ a_{21} & a_{22}+1 & a_{23} \\ a_{31} & a_{32} & a_{33}+1 \end{vmatrix} = 0$, then find the value of 100 λ.

a) 40   b) 50   c) 54   d) 44

Q76 If f(x) = f(a – x), g(x) = g(a – x) and 3h(x) – 4h(a – x) = 5 and $\int_0^a f(x)g(x)h(x)dx = k\int_0^a f(x)g(x)dx$ then the value of k is

a) 5   b) –5   c) 4   d) –4

Q77 If a point R(4, y, z) lies on the line segment joining the points P(2, –3, 4) and Q(8, 0, 10), then the distance of R from the origin is

a) $\sqrt{53}$ b) $2\sqrt{21}$ c) 6   d) $2\sqrt{14}$

Q78 If mean and standard deviation of 5 observations x_1, x_2, x_3, x_4, x_5 are 10 and 3, respectively, then the variance of 6 observations $x_1, x_2, ..., x_5$ and –50 is equal to :

a) 586.5   b) 582.5   c) 509.5   d) 507.5

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Q79 Let $\vec{a} = 3\hat{i} + 2\hat{j} + 2\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} - 2\hat{k}$ be two vectors. If a vector perpendicular to both the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ has the magnitude 12 then one such vector is :

a) $4\left(-2\hat{i} - 2\hat{j} + \hat{k}\right)$
b) $4\left(2\hat{i} + 2\hat{j} - \hat{k}\right)$
c) $4\left(2\hat{i} + 2\hat{j} + \hat{k}\right)$
d) $4\left(2\hat{i} - 2\hat{j} - \hat{k}\right)$

Q80 The solution set of inequality $(\cot^{-1}x)(\tan^{-1}x) + \left(2 - \dfrac{\pi}{2}\right)\cot^{-1}x - 3\tan^{-1}x - 3\left(2 - \dfrac{\pi}{2}\right) > 0$, is

a) $x \in (\tan 2, \tan 3)$
b) $x \in (\cot 3, \cot 2)$
c) $x \in (-\infty, \tan 2) \cup (\tan 3, \infty)$
d) $x \in (-\infty, \cot 3) \cup (\cot 2, \infty)$

Numerical

Q81 $f(x) = \log_4\left(\dfrac{2x^2 - 3x + a}{2x^2 + 3x + 3}\right)$ has range $[\alpha, \beta]$ such that $\alpha + \beta = 0$, then find 'a'.

Q82 Let α and β be roots of $x^2 - 6(t^2 - 2t + 2)x - 2 = 0$ with $\alpha > \beta$. If $a_n = \alpha^n - \beta^n$ for $n \geq 1$, then find the minimum value of $\dfrac{a_{100} - 2a_{98}}{a_{99}}$ (where $t \in R$)

Q83 Let S denote the sum of the series $\dfrac{3}{2^3} + \dfrac{4}{2^4 \cdot 3} + \dfrac{5}{2^6 \cdot 3} + \dfrac{6}{2^7 \cdot 5} + \dfrac{7}{2^7 \cdot 15} + \ldots\ldots\infty$, then the value of S^{-1} is

Q84 If the value $\lim\limits_{x \to \infty} x\{(x^2 + 2x)^{1/2} - (x^3 + 3x^2 + x)^{1/3}\} = L$; then $6L =$

Q85 If $y = f(x)$ is continuous and $f(3) = 0$ and $f'(3) = 6$ then $\lim\limits_{x \to 0} \dfrac{f(3+3x) + f(3+5x)}{x}$ is

Q86 Let $P(x) = \dfrac{5}{3} - 6x - 9x^2$ and $Q(y) = -4y^2 + 4y + \dfrac{13}{2}$. If there exist unique pair of real numbers (x, y) such that $P(x)\,Q(y) = 20$, then find the value of $(6x + 10y)$.

Q87 If $\displaystyle\int \dfrac{(x-1)(x-2)(x-3)}{(x-4)(x-5)(x-6)}dx$
$= a_1 x + a_2 \log|x-4| + a_3 \log|x-5| + a_4 \log|x-6| + C$
then $a_1 + a_2 + a_3 + a_4 =$
(where C is a constant of integration)

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Q88 The area enclosed by the curve $y \le \sqrt{4-x^2}, y \ge \sqrt{2}\sin\left(\dfrac{\pi x}{2\sqrt{2}}\right)$ and the x-axis is divided by y–axis in the ratio $\dfrac{a\pi^2}{2\pi + b\pi^2 - 8}$, then a + b is

Q89 The sum of first four terms of a geometric progression (G.P.) is $\dfrac{65}{12}$ and the sum of their respective reciprocals is $\dfrac{65}{18}$. If the product of first three terms of the G.P. is 1, and the third term is α, then 2α is ___ .

Q90 If the expression $(1 + ir)^3$ is of the form of s(1 + i) for some real 's' where 'r' is also real and $i = \sqrt{-1}$, then sum of the values of 'r' is

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Answer Key

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

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