JEE-Main Exam April, 2019 / 8-4-19 / Morning session

Physics

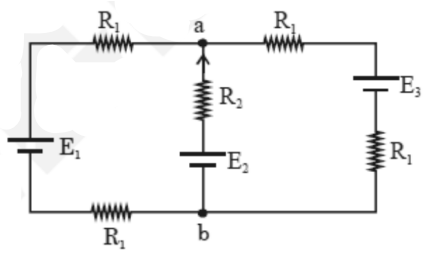
1. The bob of a simple pendulum has mass 2g and a charge of 5.0 μC. It is at rest in a uniform horizontal electric field of intensity 2000 V/m. At equilibrium, the angle that the pendulum makes with the vertical is: (take g = 10 m/s^2)

   (a) $\tan^{-1}(5.0)$ (b) $\tan^{-1}(2.0)$ (c) $\tan^{-1}(0.5)$ (d) $\tan^{-1}(0.2)$

2. Water from a pipe is coming at a rate of 100 litres per minute. If the radius of the pipe is 5 cm, the Reynolds number for the flow is of the order of : (density of water = 1000 kg/m^3, coefficient of viscosity of water = 1mPas)

   (a) 10^6 (b) 10^3 (c) 10^4 (d) 10^2

3. For the circuit shown, with $R_1 = 1.0\Omega$, $R_2 = 2.0\Omega$, $E_1 = 2$ V and $E_2 = E_3 = 4$ V, the potential difference between the points 'a' and 'b' is approximately (in V) :



   (a) 2.7 (b) 3.3 (c) 2.3 (d) 3.7

4. A 200Ω resistor has a certain color code. If one replaces the red color by green in the code, the new resistance will be :

   (a) 100Ω (b) 400Ω (c) 500Ω (d) 300Ω

5. A boy's catapult is made of rubber cord which is 42 cm long, with 6 mm diameter of cross-section and of negligible mass. The boy keeps a stone weighing 0.02kg on it and stretches the cord by 20 cm by applying a constant force. When released, the stone flies off with a velocity of 20 ms^{-1}. Neglect the change in the area of cross-section of the cord while stretched. The Young's modulus of rubber is closest to:

   (a) 10^4 Nm^{-2} (b) 10^8 Nm^{-2} (c) 10^6 Nm^{-2} (d) 10^3 Nm^{-2}

6. Two identical breakers A and B contain equal volumes of two different liquids at 60°C each and left to cool down. Liquid in A has density of 8×10^2 kg/m^3 and specific heat of 2000 J kg^{-1} K^{-1} while liquid in B has density of 10^3 kg m^{-3} and specific heat of 4000 J kg^{-1} K^{-1}. Which of the following best describes their temperature versus time graph schematically? (assume the emissivity of both the beakers to be the same)

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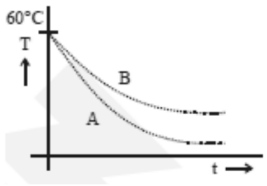

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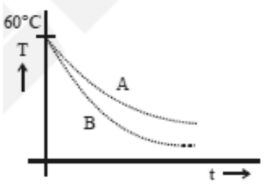

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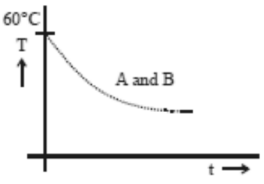

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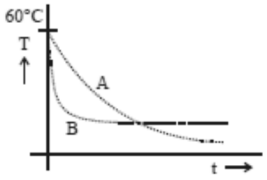
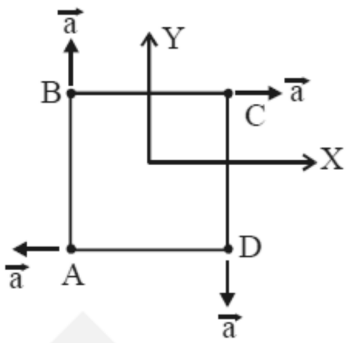


7. Four particles A, B, C and D with masses $m_A = m$, $m_B = 2m$, $m_C = 3m$ and $m_D = 4m$ are at the corners of a square. They have accelerations of equal magnitude with directions as shown. The acceleration of the centre of mass of the particles is :



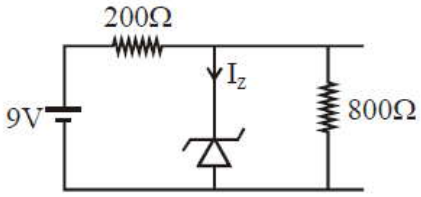
(a) $\frac{a}{5}(\hat{i}-\hat{j})$ (b) $\frac{a}{5}(\hat{i}+\hat{j})$ (c) zero (d) $a(\hat{i}+\hat{j})$

8. A circular coil having N turns and radius r carries a current I. It is held in the XZ plane in a magnetic field $B\hat{i}$. The torque on the coil due to the magnetic field is :

(a) $B\pi r^2 IN$ (b) $\frac{Br^2 I}{\pi N}$ (c) zero (d) $\frac{B\pi r^2 I}{N}$

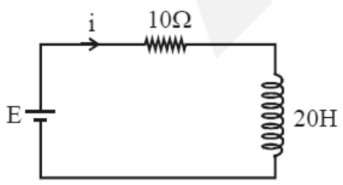
9. Voltage rating of a parallel plate capacitor is 500V. Its dielectric can withstand a maximum electric field of 10^6 V/m. The plate area is 10^{-4} m^2. What is the dielectric constant is the capacitance is 15 pF?
(given $\in_0 = 8.86 \times 10^{-12}$ C^2/Nm^2)
(a) 3.8 (b) 4.5 (c) 6.2 (d) 8.5

10. The reverse breakdown voltage of a Zener diode is 5.6 V in the given circuit.



The current I_z through the Zener is :
(a) 7 mA (b) 17 mA (c) 10 mA (d) 15mA

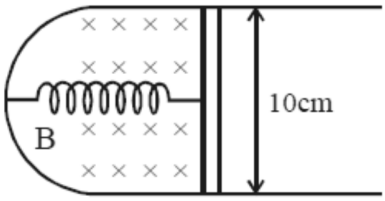
11. A 20 Henry inductor coil is connected to a 10 ohm resistance in series as shown in figure. The time at which rate of dissipation of energy (joule's heat) across resistance is equal to the rate at which magnetic energy is stored in the inductor is :



(a) $\frac{2}{\ell n2}$ (b) $\ell n2$ (c) $2\ell n2$ (d) $\frac{1}{2}\ell n2$

12. An upright object is placed at a distance of 40 cm in front of a convergent lens of focal length 20 cm. A convergent mirror of focal length 10 cm is placed at a distance of 60 cm on the other side of the lens. The position and size of the final image will be :
    (a) 40 cm from the convergent mirror, same size as the object
    (b) 20 cm from the convergent mirror, same size as the object
    (c) 20 cm from the convergent mirror, twice the size of the object
    (d) 40 cm from the convergent lens, twice the size of the object

13. A thin strip 10 cm long is on a U shaped wire of negligible resistance and it is connected to a spring of spring constant 0.5 Nm^{-1} (see figure). The assembly is kept in a uniform magnetic field of 0.1 T. If the strip is pulled from its equilibrium position and released, the number of oscillation it performs before its amplitude decreases by a factor of e is N. If the mass of the strip is 50 grams, its resistance $10\,\Omega$ and air drag negligible, N will be close to :



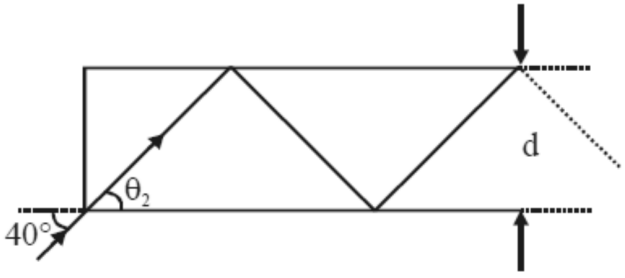
    (a) 50000 (b) 5000 (c) 10000 (d) 1000

14. A thin circular plate of mass M and radius R has its density varying as $\rho(r) = \rho_0 r$ with ρ_0 as constant and r is the distance from its centre. The moment of Inertia of the circular plate about an axis perpendicular to the plate and passing through its edge is $I = aMR^2$. The value of the coefficient a is :
    (a) $\frac{3}{2}$ (b) $\frac{1}{2}$ (c) $\frac{3}{5}$ (d) $\frac{8}{5}$

15. Ship A is sailing towards north-east with velocity $\vec{v} = 30\hat{i} + 50\hat{j}$ km/hr where $\hat{i}$ points east and $\hat{j}$, north. Ship B is at a distance of 80 km east and 150 km north of Ship A and is sailing towards west at 10 km/hr. A will be at minimum distance from B in :
    (a) 4.2 hrs. (b) 2.2 hrs. (c) 3.2 hrs. (d) 2.6 hrs.

16. A steel wire having a radius of 2.0 mm, carrying a load of 4 kg, is hanging from a ceiling. Given that $g = 3.1\,\pi\,ms^{-2}$, what will be the tensile stress that would be developed in the wire?
    (a) $4.8 \times 10^6\ Nm^{-2}$ (b) $5.2 \times 10^6\ Nm^{-2}$ (c) $6.2 \times 10^6\ Nm^{-2}$ (d) $3.1 \times 10^6\ Nm^{-2}$

17. In figure, the optical fiber is $\ell = 2m$ long and has a diameter of d = 20 μm. If a ray of light is incident on one end of the fiber at angle $\theta_1 = 40°$, the number of reflection it makes before emerging from the other end is close to: (refractive index of fibre is 1.31 and sin 40° = 0.64)

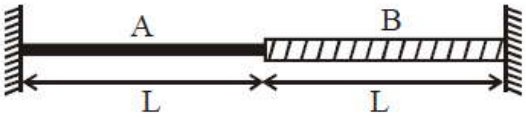


    (a) 55000 (b) 57000 (c) 66000 (d) 45000

18. A solid conducting sphere, having a charge Q, is surrounded by an uncharged conducting hollow spherical shell. Let the potential difference between the surface of the solid sphere and that of the outer surface of the hollow shell be V. If the shell is now given a charge of –4 Q, the new potential difference between the same two surfaces is :

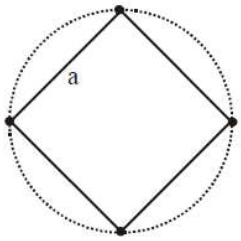
(a) V (b) 2V (c) –2V (d) 4V

19. A wire of length 2L, is made by joining two wires A and B of same length but different radii r and 2r and made of the same material. It is vibrating at a frequency such that the joint of the two wires forms a node. If the number of antinodes in wire A is p and that in B is q then the ratio p : q is :



(a) 4 : 9 (b) 3 : 5 (c) 1 : 4 (d) 1 : 2

20. Four identical particles of mass M are located at the corners of a square of side 'a'. What should be their speed if each of them revolves under the influence of other's gravitational field in a circular orbit circumscribing the square?



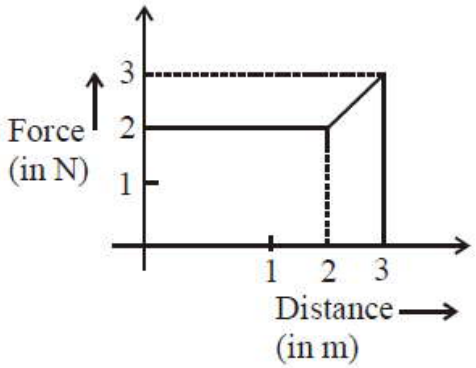
(a) $1.21\sqrt{\frac{GM}{a}}$ (b) $1.41\sqrt{\frac{GM}{a}}$ (c) $1.16\sqrt{\frac{GM}{a}}$ (d) $1.35\sqrt{\frac{GM}{a}}$

21. A plane electromagnetic wave travels in free space along the x-direction. The electric field component of the wave at a particular point of space and time is E = 6V m^{-1} along y-direction. Its corresponding magnetic field component, B would be :

(a) 6×10^{-8} T along z-direction (b) 6×10^{-8} T along x-direction

(c) 2×10^{-8} T along z-direction (d) 2×10^{-8} T along y-direction

22. A particle moves in one dimension from rest under the influence of a force that varies with the distance travelled by the particle as shown in the figure. The kinetic energy of the particle after it has travelled 3m is :



(a) 6.5 J (b) 2.5 J (c) 4 J (d) 5 J

23. In SI units, the dimesions of $\sqrt{\frac{\epsilon_0}{\mu_0}}$ is:

(a) A^{-1} TML^3 (b) $A^2T^3M^{-1}L^{-2}$ (c) $AT^2M^{-1}L^{-1}$ (d) $AT^{-3}ML^{3/2}$

24. Radiation coming from transitions n = 2 to n = 1 of hydrogen atoms fall on He^+ ions in n = 1 and n = 2 states. The possible transition of helium ions as they absorb energy from the radiation is :

(a) $n = 1 \rightarrow n = 4$ (b) $n = 2 \rightarrow n = 4$ (c) $n = 2 \rightarrow n = 5$ (d) $n = 2 \rightarrow n = 3$

25. Two particles move at right angle to each other. Their de-Broglie wavelengths are λ_1 and λ_2 respectively. The particles suffer perfectly inelastic collision. The de-Broglie wavelength λ, of the final particle, is given by :

(a) $\lambda = \frac{\lambda_1 + \lambda_2}{2}$ (b) $\frac{2}{\lambda} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$ (c) $\lambda = \sqrt{\lambda_1\lambda_2}$ (d) $\frac{1}{\lambda^2} = \frac{1}{\lambda_1^2} + \frac{1}{\lambda_2^2}$

26. A thermally insulated vessel contains 150g of water at 0°C. Then the air from the vessel is pumped out adiabatically. A fraction of water turns into ice and the rest evaporates at 0°C itself. The mass of evaporated water will be closest to : (Latent heat of vaporization of water = 2.10×10^6 J kg^{-1} and Latent heat of Fusion of water = 3.36 × 105 J kg^{-1})

(a) 130 g (b) 35 g (c) 20 g (d) 150 g

27. An alternating voltage $v(t) = 220 \sin 100 \pi t$ volt is applied to a purely resistance load of 50 Ω. The time taken for the current to rise from half of the peak value to the peak value is :

(a) 2.2 ms (b) 5 ms (c) 3.3 ms (d) 7.2 ms

28. The wavelength of the carrier waves in a modern optical fiber communication network is close to:

(a) 600 nm (b) 900 nm (c) 2400 nm (d) 1500 nm

29. In an interference experiment the ratio of amplitudes of coherent waves is $\frac{a_1}{a_2} = \frac{1}{3}$. The ratio of maximum and minimum intensities of fringes will be :

(a) 4 (b) 2 (c) 9 (d) 18

30. If 10^{22} gas molecules each of mass 10^{-26} kg collide with a surface (perpendicular to it) elastically per second over an area 1 m^2 with a speed 10^4 m/s, the pressure exerted by the gas molecules will be of the order of :

(a) 10^8 N/m^2 (b) 10^4 N/m^2 (c) 10^3 N/m^2 (d) 10^{16} N/m^2

Chemistry

31. The vapour pressures of pure liquids A and B are 400 and 600 mmHg, respectively at 298K. On mixing the two liquids, the sum of their initial volumes is equal to the volume of the final mixture. The mole fraction of liquid B is 0.5 in the mixture. The vapour pressure of the final solution, the mole fraction of components A and B in vapour phase, respectively are-

(a) 500 mmHg, 0.5, 0.5 (b) 450 mmHg, 0.4, 0.6
(c) 450 mmHg, 0.5, 0.5 (d) 500 mmHg, 0.4, 0.6

32. If solubility product of $Zr_3(PO_4)_4$ is denoted by K_{sp} and its molar solubility is denoted by S, then which of the following relation between S and K_{sp} is correct

(a) $S = \left(\frac{K_{sp}}{929}\right)^{1/9}$ (b) $S = \left(\frac{K_{sp}}{216}\right)^{1/7}$ (c) $S = \left(\frac{K_{sp}}{144}\right)^{1/6}$ (d) $S = \left(\frac{K_{sp}}{6912}\right)^{1/7}$

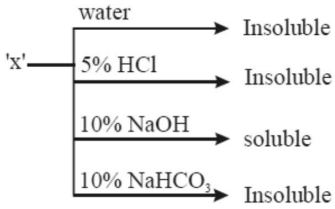
33. In order to oxidise a mixture one mole of each of FeC_2O_4, $Fe_2(C_2O_4)_3$, $FeSO_4$ and $Fe_2(SO_4)_3$ in acidic medium, the number of moles of $KMnO_4$ required is -

(a) 3 (b) 2 (c) 1 (d) 1.5

34. In the following compounds, the decreasing order of basic strength will be -
(a) $(C_2H_5)_2NH > C_2H_5NH_2 > NH_3$ (b) $(C_2H_5)_2NH > NH_3 > C_2H_5NH_2$
(c) $NH_3 > C_2H_5NH_2 > (C_2H_5)_2NH$ (d) $C_2H_5NH_2 > NH_3 > (C_2H_5)_2NH$

35. Diborane (B_2H_6) reacts independently with O_2 and H_2O to produce, respectively
(a) HBO_2 and H_3BO_3 (b) H_3BO_3 and B_2O_3 (c) B_2O_3 and H_3BO_3 (d) B_2O_3 and $[BH_4]^-$

36. An organic compound 'X' showing the following solubility profile is –
(a) m-Cresol (b) Oleic acid
(c) o-Toluidine (d) Benzamide



37. Coupling of benzene diazonium chloride with 1-napthol in alkaline medium will give

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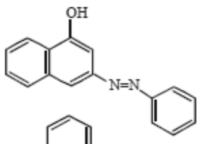

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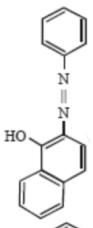

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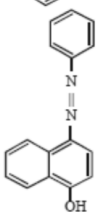

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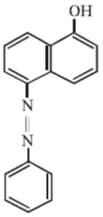
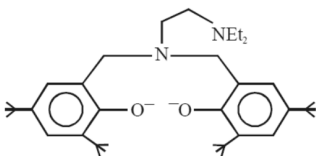


38. Which one of the following equations does not correctly represent the first law of thermodynamics for the given processes involving an ideal gas ? (Assume non-expansion work is zero)
(a) Cyclic process : $q = -w$ (b) Isothermal process : $q = -w$
(c) Adiabatic process : $\Delta U = -w$ (d) Isochoric process : $\Delta U = q$

39. The lanthanide ion that would show colour is-
(a) Sm^{3+} (b) La^{3+} (c) Lu^{3+} (d) Gd^{3+}

40. With respect to an ore, Ellingham diagram helps to predict the feasibility of its -
(a) Vapour phase refining (b) Zone refining
(c) Electrolysis (d) Thermal reduction

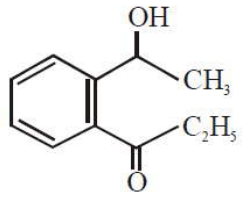
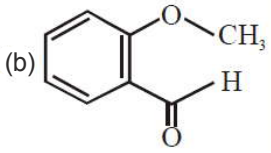
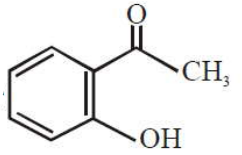
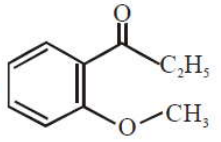
41. The following ligand is



(a) Bidentate (b) Hexadentate (c) Tetradentate (d) Tridentate

42. The correct order of hydration enthalpies of alkali metal ions is -
(a) $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$ (b) $Li^+ > Na^+ > K^+ > Cs^+ > Rb^+$
(c) $Na^+ > Li^+ > K^+ > Rb^+ > Cs^+$ (d) $Na^+ > Li^+ > K^+ > Cs^+ > Rb^+$

43. An organic compound neither reacts with neutral ferric chloride solution nor with Fehling solution, It however, reacts with Grignard reagent and gives positive iodoform test. The compound is –

(a) 
(b) 
(c) 
(d) 

44. The quantum number of four electrons are given below -
I. $n = 4, l = 2, m_l = -2, m_s = -\frac{1}{2}$
II. $n = 3, l = 2, m_l = 1, m_s = +\frac{1}{2}$
III. $n = 4, l = 1, m_l = 0, m_s = +\frac{1}{2}$
IV. $n = 3, l = 1, m_l = 1, m_s = -\frac{1}{2}$
The correct order of their increasing energies will be -
(a) IV < III < II < I (b) IV < II < III < I (c) I < II < III < IV (d) I < III < II < IV

45. **Assertion :** Ozone is destroyed by CFCs in the upper stratosphere
Reason : Ozone holes increase the amount of UV radiation reaching the earth.
(a) Assertion and reason are correct, but the reason is not the explanation for the assertion
(b) Assertion is false, but the reason is correct
(c) Assertion and reason are incorrect, Assertion and reason are both correct
(d) And the reason is the correct explanation for the assertion

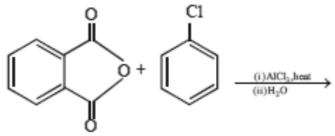
46. The size of the iso-electronic species Cl^-, Ar and Ca^{2+} is affected by -
(a) Principal quantum number of valence shell
(b) Nuclear charge
(c) Azimuthal qunatum number of valence shell
(d) Electron-electron interaction in the outer orbitals

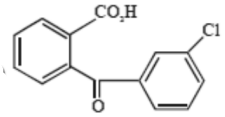
47. Given that : $E^0_{O_2/H_2O} = +1.23$ V,
$E^0_{S_2O_8^{2-}/SO_4^{2-}} = +2.05$ V
$E^0_{Br_2/Br^-} = +1.09$ V
$E^0_{Au^{3+}/Au} = +1.4$ V
The strongest oxidizing agent is -
(a) O_2 (b) Br_2 (c) $S_2O_8^{2-}$ (d) Au^{3+}

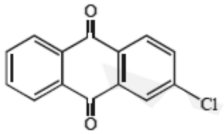
48. For silver, $C_p(JK^{-1}mol^{-1}) = 23 + 0.01T$. If the temperature (T) of 3 moles of silver is raised from 300K to 1000 K at 1 atm pressure, the value of ΔH will be close to
(a) 21 kJ (b) 16 kJ (c) 13 kJ (d) 62 kJ

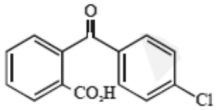
49. Which of the following amines can be prepared by Gabriel phthalimide reaction?
(a) Neo-pentylamine (b)n-butylamine (c) triethylamine (d) t-butylamine

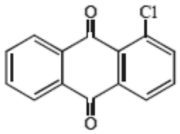
50. Which is wrong with respect to our responsibility as a human being to protect our environment?
    (a) Avoiding the use of floodlighted facilities
    (b) Restricting the use of vehicles
    (c) Using plastic bags
    (d) Setting up compost tin in gardens
51. Maltose on treatment with dilute HCl gives :
    (a) D-Galactose
    (b) D-Glucose
    (c) D-Glucose and D-Fructose
    (d) D-Fructose
52. The major product of the following reaction is:



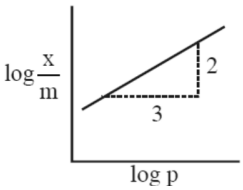
(a) 

(b) 

(c) 

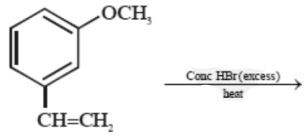
(d) 

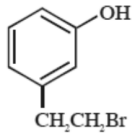
53. The correct order of the spin-only magnetic moment of metal ions in the following low spin complexes, $[V(CN)_6]^{4-}$, $[Fe(CN)_6]^{4-}$, $[Ru(NH_3)_6]^{3+}$, and $[Cr(NH_3)_6]^{2+}$, is :
    (a) $V^{2+} > Cr^{2+} > Ru^{3+} > Fe^{2+}$
    (b) $V^{2+} > Ru^{3+} > Cr^{2+} > Fe^{2+}$
    (c) $Cr^{2+} > V^{2+} > Ru^{3+} > Fe^{2+}$
    (d) $Cr^{2+} > Ru^{3+} > Fe^{2+} > V^{2+}$
54. 100 mL of a water sample contains 0.81 g of calcium bicarbonate and 0.73 of magnesium bicarbonate. The hardness of this water sample expressed in terms of equivalents of $CaCO_3$ is: (molar mass of calcium bicarbonate is 162 g mol^{-1} and magnesium bicarbonate is 146 $gmol^{-1}$)
    (a) 1,000 ppm (b) 10,000 ppm (c) 100 ppm (d) 5,000 ppm
55. Adsorption of a gas follows Freundlich adsorption isotherm x is the mass of the gas adsorbed on mass m of the adsorbent. The plot of $\log \frac{x}{m}$ versus log p is shown in the given graph. $\frac{x}{m}$ is proportional to :

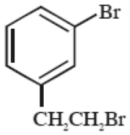


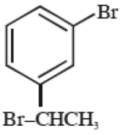
    (a) $p^{3/2}$ (b) p^3 (c) $p^{2/3}$ (d) p^2

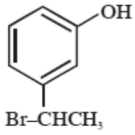
56. The major product of the following reactions:



(a) 

(b) 

(c) 

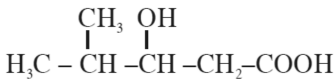
(d) 

57. For the reaction 2A + B $\rightarrow$ C, the values of initial rate at different reactant concentrations are given in the table below. The rate law for the reaction is :

[A] (mol L^{-1})	[B] (mol L^{-1})	Initial Rate (mol $L^{-1}s^{-1}$)
0.05	0.05	0.045
0.10	0.05	0.090
0.20	0.10	0.72

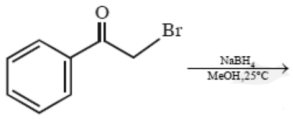
(a) Rate = k [A][B] (b) Rate = k $[A]^2[B]^2$ (c) Rate = k $[A][B]^2$ (d) Rate = k $[A]^2[B]$

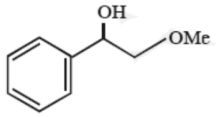
58. The IUPAC name of the following compound is :

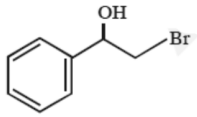


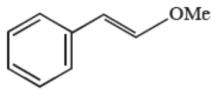
(a) 2-Methyl-3Hydroxypentan-5-oic acid (b) 4,4-Dimethyl-3-hydroxy butanoic acid
(c) 3-Hydroxy-4 -methylpentanoic acid (d) 4-Methyl-3-hydroxypentanoic acid

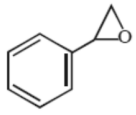
59. The major product of the following reaction is:



(a) 

(b) 

(c) 

(d) 

60. Element 'B' forms ccp structure and 'A' occupies half of the octahedral voids, while oxygen atoms occupy all the tetrahedral voids. The structure of bimetallic oxide is :

(a) A_2BO_4 (b) A_2B_2O (c) A_4B_2O (d) AB_2O_4

Mathematics

61. The shortest distance between the line $y = x$ and the curve $y^2 = x - 2$ is:

(a) $\frac{7}{4\sqrt{2}}$ (b) $\frac{7}{8}$ (c) $\frac{11}{4\sqrt{2}}$ (d) 2

62. Let $y = y(x)$ be the solution of the differential equation, $\left(x^2+1\right)^2 \frac{dy}{dx} + 2x\,(x^2+1)\,y = 1$ such that $y(0) = 0$. If $\sqrt{a}y(1) = \frac{\pi}{32}$, then the value of 'a' is :

(a) $\frac{1}{2}$ (b) $\frac{1}{16}$ (c) $\frac{1}{4}$ (d) 1

63. A point on the straight line, $3x + 5y = 15$ which equidistant from the coordinate axes will lie only in :

(a) 1^{st} and 2^{nd} quadrants (b) 4^{th} quadrant
(c) 1^{st}, 2^{nd} and 4^{th} quadrant (d) 1^{st} quadrant

64. If α and β be the roots of the equation $x^2 - 2x + 2 = 0$, then the least value of n for which $\left(\frac{\alpha}{\beta}\right)^n = 1$ is:

(a) 2 (b) 3 (c) 4 (d) 5

65. $\lim\limits_{x\to\infty} \frac{\sin^2 x}{\sqrt{2} - \sqrt{1+\cos x}}$ equals:

(a) $2\sqrt{2}$ (b) $4\sqrt{2}$ (c) $\sqrt{2}$ (d) 4

66. The length of the perpendicular from the point (2, –1, 4) on the straight line, $\frac{x+3}{10} = \frac{y-2}{-7} = \frac{z}{1}$ is:

(a) less than 2 (b) greater than 3 bus less than 4
(c) greater than 4 (d) greater than 2 but less than 3

67. The magnitude of the projection of the vector $2\hat{i} + 3\hat{j} + \hat{k}$ on the vector perpendicular to the plane containing the vectors $\hat{i} + \hat{j} + \hat{k}$ and $\hat{i} + 2\hat{j} + 3\hat{k}$ is:

(a) $\frac{\sqrt{3}}{2}$ (b) $\sqrt{\frac{3}{2}}$ (c) $\sqrt{6}$ (d) $3\sqrt{6}$

68. The contrapositive of the statement "If you are born in India, then you are a citizen of India", is:

(a) If you are born in India, then you are not a citizen of India.
(b) If you are not a citizen of India, then you are not born in India.
(c) If you are a citizen of India, then you are born in India.
(d) If you are not born in India, then you are not a citizen of India.

69. The mean and variance of seven observations are and 16, respectively. If 5 of the observations are 2, 4, 10, 12, 14, then the product of the remaining two observations is :

(a) 40 (b) 49 (c) 48 (d) 45

70. If $f(x) = \frac{2 - x\cos x}{2 + x\cos x}$ and $g(x) = \log_e x, (x > 0)$ then the value of integral $\int\limits_{-\frac{\pi}{4}}^{\frac{\pi}{4}} g(f(x))\,dx$ is :

(a) $\log_e 3$ (b) $\log_e 2$ (c) $\log_e e$ (d) $\log_e 1$

71. If the tangents on the ellipse $4x^2 + y^2 = 8$ at the points (1, 2) and (a, b) are perpendicular to each other, then a^2 is equal to:

(a) $\frac{64}{17}$ (b) $\frac{2}{17}$ (c) $\frac{128}{17}$ (d) $\frac{4}{17}$

72. If $\alpha = \cos^{-1}\left(\frac{3}{5}\right), \beta = \tan^{-1}\left(\frac{1}{3}\right)$, where $0 < \alpha, \beta < \frac{\pi}{2}$, then $\alpha - \beta$ is equal to :

(a) $\sin^{-1}\left(\frac{9}{5\sqrt{10}}\right)$ (b) $\tan^{-1}\left(\frac{9}{14}\right)$ (c) $\cos^{-1}\left(\frac{9}{5\sqrt{10}}\right)$ (d) $\tan^{-1}\left(\frac{9}{5\sqrt{10}}\right)$

73. If S_1 and S_2 are respectively the sets of local minimum and local maximum points of the function, $f(x) = 9x^4 + 12x^3 - 36x^2 + 25$, $x \in R$, then:

(a) $S_1 = \{-2, 1\}; S_2 = \{0\}$ (b) $S_1 = \{-2, 0\}; S_2 = \{1\}$
(c) $S_1 = \{-2\}; S_2 = \{0, 1\}$ (d) $S_1 = \{-1\}; S_2 = \{0, 2\}$

74. Let O(0, 0) and A(0, 1) be two fixed points. Then the locus of a point P such that the perimeter of ΔAOP is 4, is:

(a) $8x^2 - 9y^2 + 9y = 18$ (b) $9x^2 + 8y^2 - 8y = 16$
(c) $8x^2 + 9y^2 - 9y = 18$ (d) $9x^2 - 8y^2 + 8y = 16$

75. Let $A\begin{pmatrix}\cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha\end{pmatrix}, (\alpha \in R)$ such that $A^{32} = \begin{pmatrix}0 & -1 \\ 1 & 0\end{pmatrix}$. Then a value of α is

(a) $\frac{\pi}{16}$ (b) 0 (c) $\frac{\pi}{32}$ (d) $\frac{\pi}{64}$

76. If $f(x) = \log_e\left(\frac{1-x}{1+x}\right), |x| < 1$, then $f\left(\frac{2x}{1+x^2}\right)$ is equal to:

(a) $2f(x)$ (b) $2f(x^2)$ (c) $(f(x))^2$ (d) $-2f(x)$

77. The equation of a plane containing the line of intersection of the planes $2x - y - 4 = 0$ and $y + 2z - 4 = 0$ and passing through the point (1, 1, 0) is :

(a) $x + 3y + z = 4$ (b) $x - y - z = 0$ (c) $x - 3y - 2z = -2$ (d) $2x - z = 2$

78. The sum of all natural numbers 'n' such that $100 < n < 200$ and H.C.F $(91, n) > 1$ is:

(a) 3221 (b) 3121 (c) 3203 (d) 3303

79. The sum of the series
$2.^{20}C_0 + 5.^{20}C_1 + 8.^{20}C_2 + 11.^{20}C_3 + \ldots + 62.^{20}C_{20}$ is equal to:

(a) 2^{24} (b) 2^{25} (c) 2^{26} (d) 2^{23}

80. The sum of the solutions of the equation $|\sqrt{x} - 2| + \sqrt{x}(\sqrt{x} - 4) + 2 = 0, (x > 0)$ is equal to :

(a) 4 (b) 9 (c) 10 (d) 12

81. Let A and B be two non-null events such that $A \subset B$. Then, which of the following statements is always correct?

(a) $P(A|B) = 1$ (b) $P(A|B) = P(B) - P(A)$
(c) $P(A|B) \leq P(A)$ (d) $P(A|B) \geq P(A)$

82. The sum of the co-efficients of all even degree terms in x in the expansion of $(x + \sqrt{x^3 - 1})^6 + \left(x - \sqrt{x^3 - 1}\right)^6, (x > 1)$ is equal to :

(a) 32 (b) 26 (c) 29 (d) 24

83. The area (in sq. units) of the region $A = \{x, y\} \in R \times R | 0 \leq x \leq 3, 0 \leq y \leq 4, y \leq x^2 + 3x\}$ is :

(a) $\frac{53}{6}$ (b) $\frac{59}{6}$ (c) 8 (d) $\frac{26}{3}$

84. Let $f : [0, 2] \to R$ be a twice differentiable function such that $f''(x) > 0$, for all $x \in (0, 2)$. If $\phi(x) = f(x) + f(2 - x)$, then ϕ is :

(a) decreasing on (0, 2) (b) decreasing on (0, 1) and increasing on (1, 2)
(c) increasing on (0, 2) (d) increasing on (0, 1) and decreasing on (1, 2)

85. The sum of the squares of the lengths of the chords intercepted on the circle, $x^2 + y^2 = 16$, by the lines, $x + y = n$, $n \in N$, where N is the set of all natural numbers, is :
(a) 320 (b) 160 (c) 105 (d) 210

86. All possible numbers are formed using he digits 1, 1, 2, 2, 2, 2, 3, 4, 4 taken all at a time. The number of such numbers in which the odd digits occupy even places is:
(a) 175 (b) 162 (c) 160 (d) 180

87. $\int \frac{\sin\frac{5x}{2}}{\sin\frac{x}{2}}dx$ is equal to :
(where c is a constant of integration)
(a) $2x + \sin x + 2\sin 2x + c$ (b) $x + 2\sin x + 2\sin 2x + c$
(c) $x + 2\sin x + \sin 2x + c$ (d) $2x + \sin x + \sin 2x + c$

88. If $2y = \left(\cot^{-1}\left(\frac{\sqrt{3}\cos x + \sin x}{\cos x - \sqrt{3}\sin x}\right)\right)^2$, $x \in \left(0, \frac{\pi}{2}\right)$, then $\frac{dy}{dx}$ is equal to:
(a) $2x - \frac{\pi}{3}$ (b) $\frac{\pi}{3} - x$ (c) $\frac{\pi}{6} - x$ (d) $x - \frac{\pi}{6}$

89. The greatest value of $c \in R$ for which the system of linear equations
$x - cy - cz = 0$
$cx - y + cz = 0$
$cx + cy - z = 0$
has a non-trivial solution, is :
(a) $\frac{1}{2}$ (b) -1 (c) 0 (d) 2

90. If $\cos(\alpha + \beta) = \frac{3}{5}$, $\sin(\alpha - \beta) = \frac{5}{13}$ and $0, < \alpha, \beta < \frac{\pi}{4}$, then $\tan(2\alpha)$ is equal to:
(a) $\frac{21}{16}$ (b) $\frac{63}{52}$ (c) $\frac{33}{52}$ (d) $\frac{63}{16}$

PCM Answers

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