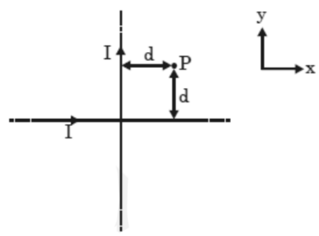
JEE-Main Exam April, 2019 / 8-4-19/ Evening session
Physics

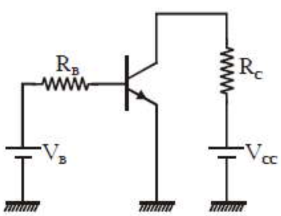
1. A circuit connected to an ac source of emf $e = e_0\sin(100t)$ with t in second, gives a phase difference of $\frac{\pi}{4}$ between the emf e and current i. Which of the following circuits will exhibit this?
   (a) RC circuit with $R = 1\ k\Omega$ and $C = 1\ \mu F$
   (b) RL circuit with $R = 1 k\Omega$ and $L = 1$ mH
   (c) RL circuit with $R = 1 k\Omega$ and $L = 10$ mH
   (d) RC circuit with $R = 1 k\Omega$ and $C = 10\ \mu F$

2. Two very long, straight, and insulated wires are kept at 90° angle from each other in xy-plane as shown in the figure. These wires carry currents of equal magnitude I, whose directions are shown in the figure. The net magnetic field at point P will be :



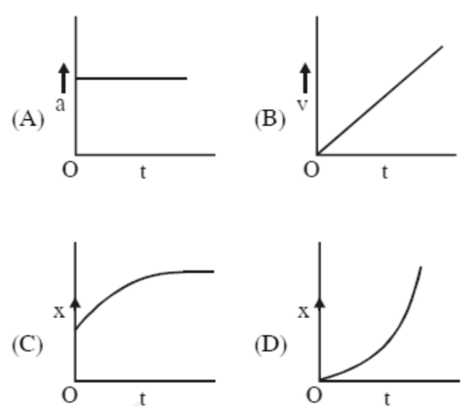
   (a) zero (b) $\frac{+\mu_0 I}{\pi d}(\hat{z})$ (c) $-\frac{\mu_0 I}{2\pi d}(\hat{x}+\hat{y})$ (d) $\frac{\mu_0 I}{2\pi d}(\hat{x}+\hat{y})$

3. A common emitter amplifier circuit, built using an npn transistor, is shown in the figure. Its dc current gain is 250, $R_C = 1k\Omega$ and $V_{cc} = 10$ V. What is the minimum base current for V_{CE} to reach saturation?



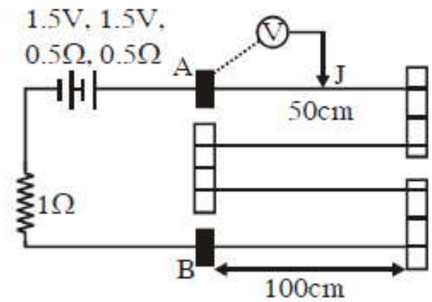
   (a) $100\ \mu A$ (b) $7\ \mu A$ (c) $40\ \mu A$ (d) $10\ \mu A$

4. A particle starts from origin O from rest and moves with a uniform acceleration along the positive x-axis. Identify all figures that correctly represent the motion qualitatively. (a = acceleration, v = velocity, x = displacement, t = time)



   (a) (A), (B), (C) (b) (A) (c) (A), (B), (D) (d) (B), (C)

5. In the circuit shown, a four-wire potentiometer is made of a 400 cm long wire, which extends between A and B. The resistance per unit length of the potentiometer wire is $r = 0.01\ \Omega/\text{cm}$. If an ideal voltmeter is connected as shown with jockey J at 50 cm from end A, the expected reading of the voltmeter will be :-



(a) 0.20 V (b) 0.25 V (c) 0.75 V (d) 0.50V

6. A cell of internal resistance r drives current through an external resistance R. The power delivered by the cell to the external resistance will be maximum when :-

(a) $R = 1000\ r$ (b) $R = 0.001\ r$ (c) $R = 2r$ (d) $R = r$

7. An electric dipole is formed by two equal and opposite charges q with separation d. The charges have same mass m. It is kept in a uniform electric field E. If it is slightly rotated from its equilibrium orientation, then its angular frequency ω is:-

(a) $\sqrt{\frac{qE}{2md}}$ (b) $2\sqrt{\frac{qE}{md}}$ (c) $\sqrt{\frac{2qE}{md}}$ (d) $\sqrt{\frac{qE}{md}}$

8. In a line of sight radio communication, a distance of about 50 km is kept between the transmitting and receiving antennas. If the height of the receiving antenna is 70m, then the minimum height of the transmitting antenna should be : (Radius of the Earth $= 6.4 \times 10^6$ m).

(a) 40 m (b) 51 m (c) 32 m (d) 20 m

9. The ratio of mass densities of nuclei of ^{40}Ca and ^{16}O is close to :-

(a) 1 (b) 2 (c) 0.1 (d) 5

10. Calculate the limit of resolution of a telescope objective having a diameter of 200 cm, if it has to detect light of wavelength 500 nm coming from a star :-

(a) 305×10^{-9} radian (b) 152.5×10^{-9} radian
(c) 610×10^{-9} radian (d) 457.5×10^{-9} radian

11 The magnetic field of an electromagnetic wave is given by :-

$$\vec{B} = 1.6 \times 10^{-6} \cos(2 \times 10^7 z + 6 \times 10^{15} t)\ (2\hat{i} + \hat{j}) \frac{wb}{m^2}$$

The associated electric field will be :-

(a) $\vec{E} = 4.8 \times 10^2 \cos(2 \times 10^7 z + 6 \times 10^{15} t)\ (\hat{i} - 2\hat{j}) \frac{V}{m}$

(b) $\vec{E} = 4.8 \times 10^2 \cos(2 \times 10^7 z - 6 \times 10^{15} t)\ (2\hat{i} + \hat{j}) \frac{V}{m}$

(c) $\vec{E} = 4.8 \times 10^2 \cos(2 \times 10^7 z - 6 \times 10^{15} t)\ (-2\hat{j} + \hat{i}) \frac{V}{m}$

(d) $\vec{E} = 4.8 \times 10^2 \cos(2 \times 10^7 z + 6 \times 10^{15} t)\ (-\hat{i} + 2\hat{i}) \frac{V}{m}$

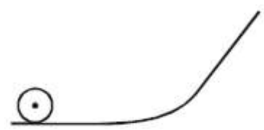
12. Young's moduli of two wires A and B are in the ratio 7 : 4. Wire A is 2 m long and has radius R. Wire B is 1.5 m long and has radius 2 mm. If the two wires stretch by the same length for a given load, then the value of R is close to :-

(a) 1.9 mm (b) 1.7 mm (c) 1.5 mm (d) 1.3 mm

13. A rocket has to be launched from earth in such a way that it never returns. If E is the minimum energy delivered by the rocket launcher, what should be the minimum energy that the launcher should have if the same rocket is to be launched from the surface of the moon? Assume that the density of the earth and the moon are equal and that the earth's volume is 64 times the volume of the moon:-

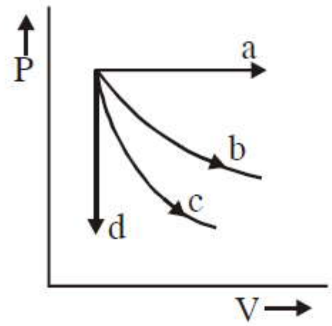
(a) $\frac{E}{4}$ (b) $\frac{E}{16}$ (c) $\frac{E}{32}$ (d) $\frac{E}{64}$

14. A solid sphere and solid cylinder of identical radii approach an incline with the same linear velocity (see figure). Both roll without slipping all throughout. The two climb maximum heights h_{sph} and h_{cyl} on the incline. The ratio $\frac{h_{sph}}{h_{cyl}}$ is given by:-



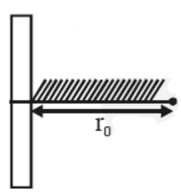
(a) $\frac{14}{15}$ (b) $\frac{4}{5}$ (c) 1 (d) $\frac{2}{\sqrt{5}}$

15. The given diagram shows four processes i.e., isochoric, isobaric, isothermal and adiabatic. The correct assignment of the processes, in the same order is given by :-



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

16. A positive point charge is released from rest at a distance r_0 from a positive line charge with uniform density. The speed (v) of the point charge, as a function of instantaneous distance r from line charge, is proportional to:-



(a) $v \propto e^{+r/r_0}$ (b) $v \propto \ell n\left(\frac{r}{r_0}\right)$ (c) $v \propto \left(\frac{r}{r_0}\right)$ (d) $v \propto \sqrt{\ell n\left(\frac{r}{r_0}\right)}$

17. A damped harmonic oscillator has a frequency of 5 oscillations per second. The amplitude drops to half its value for every 10 oscillations. The time it will take to drop to $\frac{1}{1000}$ of the original amplitude is close to :-

(a) 100 s (b) 20 s (c) 10 s (d) 50 s

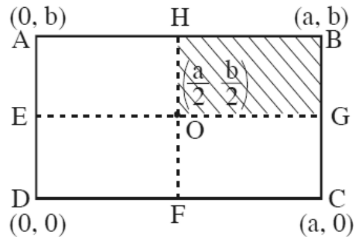
18. The electric field in a region is given by $\vec{E} = (Ax + B)\hat{i}$, where E is in NC^{-1} and x is in metres. The values of constants are A = 20 SI unit and B = 10 SI unit. If the potential at x = 1 is V_1 and that at x = –5 is V_2, then $V_1 - V_2$ is :-

(a) –48 V (b) –520 V (c) 180 V (d) 320 V

19. A parallel plate capacitor has $1\,\mu F$ capacitance. One of its two plates is given $+2\,\mu C$ charge and the other plate, $+4\,\mu C$ charge. The potential difference developed across the capacitor is ;-
(a) 5 V (b) 2 V (c) 3 V (d) 1 V

20. In a simple pendulum experiment for determination of acceleration due to gravity (g), time taken for 20 oscillations is measured by using a watch of 1 second least count. The mean value of time taken comes out to be 30 s. The length of pendulum is measured by using a meter scale of least count 1 mm and the value obtained is 55.0 cm. The percentage error in the determination of g is close to ;-
(a) 0.7% (b) 0.2% (c) 3.5% (d) 6.8%

21. A uniform rectangular thin sheet ABCD of mass M has length a and breadth b, as shown in the figure. If the shaded portion HBGO is cut-off, the coordinates of the centre of mass of the remaining portion will be:-

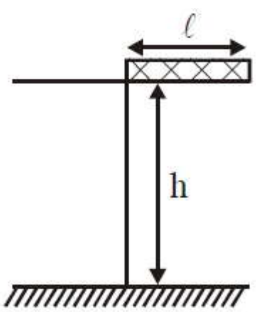


(a) $\left(\frac{2a}{3}, \frac{2b}{3}\right)$ (b) $\left(\frac{5a}{3}, \frac{5b}{3}\right)$ (c) $\left(\frac{3a}{4}, \frac{3b}{4}\right)$ (d) $\left(\frac{5a}{12}, \frac{5b}{12}\right)$

22. The temperature, at which the root mean square velocity of hydrogen molecules equals their escape velocity from the earth, is closest to : [Boltzmann Constant $k_B = 1.38 \times 10^{-23}$ J/K Avogadro Number $N_A = 6.02 \times 10^{26}$/kg Radius of Earth : 6.4×10^6 m
Gravitational acceleration on Earth = 10 ms^{-2}]
(a) 650 K (b) 3×10^5 K (c) 10^4 K (d) 800 K

23. A convex lens (of focal length 20 cm) and a concave mirror, having their principal axes along the same lines, are kept 80 cm apart from each other. The concave mirror is to the right of the convex lens. When an object is kept at a distance of 30 cm to the left of the convex lens, its image remains at the same position even if the concave mirror is removed. The maximum distance of the object for which this concave mirror, by itself would produce a virtual image would be:-
(a) 20 cm (b) 10 cm (c) 25 cm (d) 30 cm

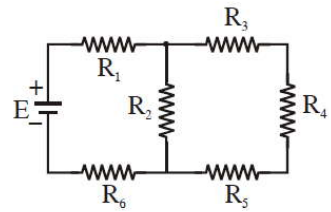
24. A rectangular solid box of length 0.3 m is held horizontally, with one of its sides on the edge of a platform of height 5 m. When released, it slips off the table in a very short time $\tau = 0.01$s, remaining essentially horizontal. The angle by which it would rotate when it hits the ground will be (in radians) close:-



(a) 0.02 (b) 0.28 (c) 0.5 (d) 0.3

25. If surface tension (S), Moment of inertia (I) and Planck's constant (h), were to be taken as the fundamental units, the dimensional formula for linear momentum would be:-
(a) $S^{3/2}I^{1/2}h^0$ (b) $S^{1/2}I^{1/2}h^0$ (c) $S^{1/2}I^{1/2}h^{-1}$ (d) $S^{1/2}I^{3/2}h^{-1}$

26. In the figure shown, what is the current (in Ampere) drawn from the battery? Your are given:
$R_1 = 15\,\Omega$ $R_2 = 10\ \Omega$, $R_3 = 20\ \Omega$, $R_4 = 5\,\Omega$, $R_5 = 25\,\Omega$, $R_6 = 30\ \Omega$, $E = 15$ V



(a) 7/18 (b) 13/24 (c) 9/32 (d) 20/3

27. A nucleus a, with a finite de-broglie wavelength λ_A, undergoes spontaneous fission into two nuclei B and c of equal mass. B lies in the same direction as that of A, while C flies in the opposite direction with a velocity equal to half of that of B. The Broglie wavelengths λ_B and λ_C of B and C are respectively;-

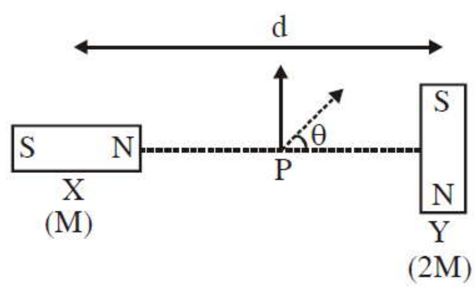
(a) $2\lambda_A, \lambda_A$ (b) $\lambda_A, 2\lambda_A$ (c) $\lambda_A, \frac{\lambda_A}{2}$ (d) $\frac{\lambda_A}{2}, \lambda_A$

28. A body of mass m_1 moving with an unknown velocity of $v_1\hat{i}$, undergoes a collinear collision with a body of mass m_2 moving with a velocity $v_2\hat{i}$. After collision, m_1 and m_2 move with velocities of $v_3\hat{i}$ and $v_4\hat{i}$ respectively. If $m_2 = 0.5\ m_1$ and $v_3 = 0.5\ v_1$, then v_1 is ;-

(a) $v_4 - \frac{v_2}{4}$ (b) $v_4 - \frac{v_2}{2}$ (c) $v_4 - v_2$ (d) $v_4 + v_2$

29. Let $|\vec{A}_1| = 3, |\vec{A}_2| = 5$ and $|\vec{A}_1 + \vec{A}_2| = 5$ The value of $(2\vec{A}_1 + 3\vec{A}_2).(3\vec{A}_1 - 2\vec{A}_2)$ is :-
(a) −1125 (b) −106.5 (c) −118.5 (d) −99.5

30. Two magnetic dipoles X and y are placed at a separation d, with heir axes perpendicular to each other. The dipole moment of Y is twice that to X. A particle of charge q is passing, through their midpoint P, at angle $\theta = 45°$ with the horizontal line, as shown in figure. What would be the magnitude of force on the particle at that instant? (d is much larger than the dimensions of the dipole)



(a) $\sqrt{2}\left(\frac{\mu_0}{4\pi}\right)\frac{M}{(d/2)^3} \times qv$ (b) $\left(\frac{\mu_0}{4\pi}\right)\frac{2M}{(d/2)^3} \times qv$

(c) $\left(\frac{\mu_0}{4\pi}\right)\frac{M}{(d/2)^3} \times qv$ (d) 0

Chemistry

31. Calculate the standard cell potential in(V) of the cell in which following reaction takes place : $Fe^{2+}(aq) + Ag^{+}(aq) \rightarrow Fe^{3+}(aq) + Ag(s)$ Given that

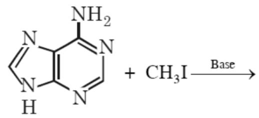
$E^{\circ}_{Ag^+/Ag} = xV$

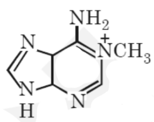
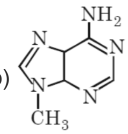
$E^{\circ}_{Fe^{2+}/Fe} = yV$

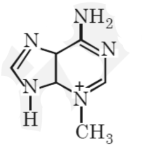
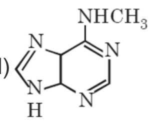
$E^{\circ}_{Fe^{3+}/Fe} = zV$

(a) x + 2y − 3z (b) x − z (c) x − y (d) x + y − z

32. The major product in the following reaction is :



(a)  (b) 

(c)  (d) 

33. For the following reactions, equilibrium constants are given :

$S(s) + O_2(g) \rightleftharpoons SO_2(g); K_1 = 10^{52}$

$2S(s) + 3O_2(g) \rightleftharpoons 2SO_3(g); K_2 = 10^{129}$

The equilibrium constant for the reaction,

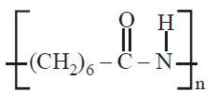
$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ is :

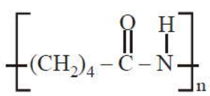
(a) 10^{181} (b) 10^{154} (c) 10^{25} (d) 10^{77}

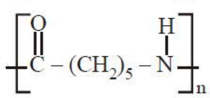
34. The ion that has sp^3d^2 hybridization for the central atom, is :

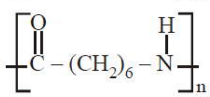
(a) $[ICl_2]^-$ (b) $[IF_6]^-$ (c) $[ICl_4]^-$ (d) $[BrF_2]^-$

35. The structure of Nylon-6 is :

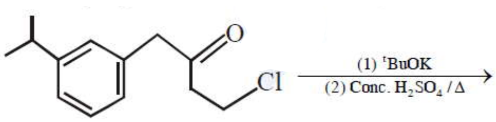
(a) 

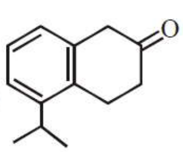
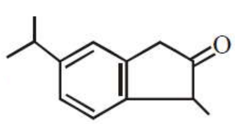
(b) 

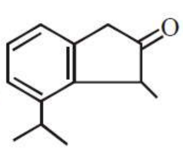
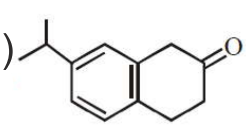
(c) 

(d) 

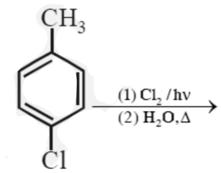
36. The major product of the following reaction is:



(a)  (b) 

(c)  (d) 

37. The major product of the following reaction is:



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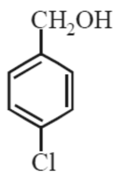

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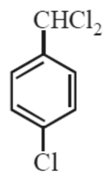

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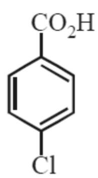

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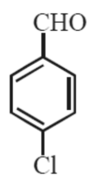


38. The percentage composition of carbon by mole in methane is :

(a) 80% (b) 25% (c) 75% (d) 20%

39. The IUPAC symbol for the element with atomic number 119 would be :

(a) unh (b) uun (c) une (d) uue

40. The compound that inhibits the growth of tumors is :

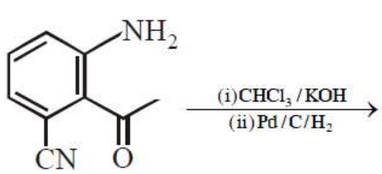
(a) cis-$[Pd(Cl)_2(NH_3)_2]$ (b) cis-$[Pt(Cl)_2(NH_3)_2]$

(c) trans-$[Pt(Cl)_2(NH_3)_2]$ (d) trans-$[Pd(Cl)_2(NH_3)_2]$

41. The covalent alkaline earth metal halide (X = Cl, Br, I) is :

(a) CaX_2 (b) SrX_2 (c) BeX_2 (d) MgX_2

42. The major product obtained in the following reaction is :



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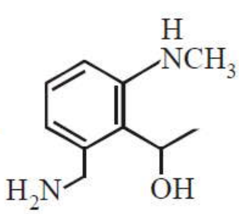

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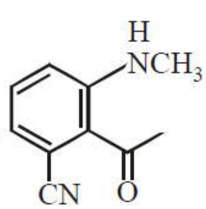

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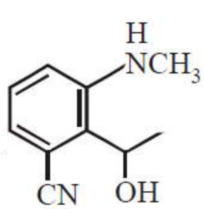

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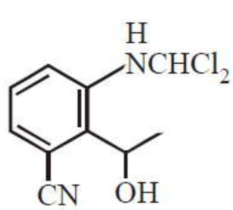
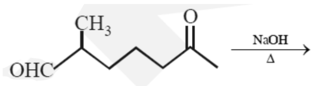
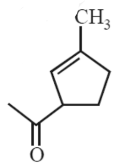


43. The statement that is **INCORRECT** about the interstitial compounds is :
    (a) They have high melting points
    (b) They are chemically reactive
    (c) They have metallic conductivity
    (d) They are very hard
44. The maximum prescribed concentration of copper in drinking water is:
    (a) 5 ppm (b) 0.5 ppm (c) 0.05 ppm (d) 3 ppm
45. The calculated spin-only magnetic moments (BM) of the anionic and cationic species of $[Fe(H_2O)_6]_2$ and $[Fe(CN)_6]$, respectively, are :
    (a) 4.9 and 0 (b) 2.84 and 5.92 (c) 0 and 4.9 (d) 0 and 5.92
46. 0.27 g of a long chain fatty acid was dissolved in 100 cm^3 of hexane. 10 mL of this solution was added dropwise to the surface of water in a round watch glass. Hexane evaporates and a monolayer is formed. The distance from edge to centre of the watch glass is 10 cm. What is the height of the monolayer? [Density of fatty acid = 0.9 g cm^{-3}, $\pi = 3$]
    (a) 10^{-8} m (b) 10^{-6} m (c) 10^{-4} m (d) 10^{-2} m
47. Among the following molecules / ions, $C_2^{2-}, N_2^{2-}, O_2^{2-}, O_2$ which one is diamagnetic and has the shortest bond length?
    (a) C_2^{2-} (b) N_2^{2-} (c) O_2 (d) O_2^{2-}
48. 5 moles of an ideal gas at 100 K are allowed to undergo reversible compression till its temperature becomes 200 K. If $C_V = 28\ JK^{-1}mol^{-1}$, calculate ΔU and ΔpV for this process. ($R = 8.0\ JK^{-1}\ mol^{-1}$)
    (a) $\Delta U = 14$ kJ; $\Delta(pV) = 4$ kJ (b) $\Delta U = 14$ kJ; $\Delta(pV) = 18$ kJ
    (c) $\Delta U = 2.8$ kJ; $\Delta(pV) = 0.8$ kJ (d) $\Delta U = 14$ kJ; $\Delta(pV) = 0.8$ kJ
49. Which one of the following alkenes when treated with HCl yields majorly an anti Markovnikov product?
    (a) $F_3C - CH = CH_2$ (b) $Cl - CH = CH_2$
    (c) $CH_3O - CH = CH_2$ (d) $H_2N - CH = CH_2$
50. For a reaction scheme $A \xrightarrow{k_1} B \xrightarrow{k_2} C$, if the rate of formation of B is set to be zero then the concentration of B is given by :
    (a) $\left(\frac{k_1}{k_2}\right)[A]$ (b) $(k_1 + k_2)[A]$ (c) $k_1k_2[A]$ (d) $(k_1 - k_2)[A]$
51. Which of the following compounds will show the maximum enol content?
    (a) $CH_3COCH_2COCH_3$ (b) CH_3COCH_3
    (c) $CH_3COCH_2CONH_2$ (d) $CH_3COCH_2COOC_2H_5$
52. The correct statement about ICl_5 and ICl_4^- is
    (a) ICl_5 is trigonal bipyramidal and ICl_4^- is tetrahedral.
    (b) ICl_5 is square pyramidal and ICl_4^- is tetrahedral.
    (c) ICl_5 is square pyramidal and ICl_4^- is square planar.
    (d) Both are isostructural.

53. The major product obtained in the following reaction is



(a)


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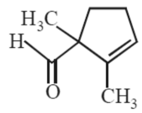
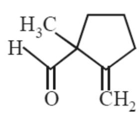
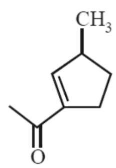


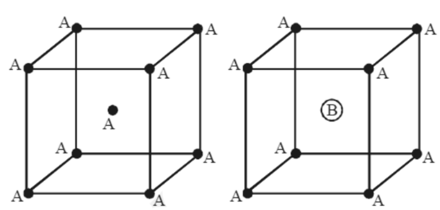
(c)


(d)


54. Fructose and glucose can be distinguished by :
   (a) Fehling's test (b) Barfoed's test (c) Benedict's test (d) Seliwanoff's test

55. If p is the momentum of the fastest electron ejected from a metal surface after the irradiation of light having wavelength λ, then for 1.5 p momentum of the photoelectron, the wavelength of the light should be:
   (Assume kinetic energy of ejected photoelectron to be very high in comparison to work function)
   (a) $\frac{1}{2}\lambda$ (b) $\frac{3}{4}\lambda$ (c) $\frac{2}{3}\lambda$ (d) $\frac{4}{9}\lambda$

56. Consider the bcc unit cells of the solids 1 and 2 with the position of atoms as shown below. The radius of atom B is twice that of atom A. The unit cell edge length is 50% more in solid 2 than in 1. What is the approximate packing efficiency in solid 2?



Solid 1 Solid 2

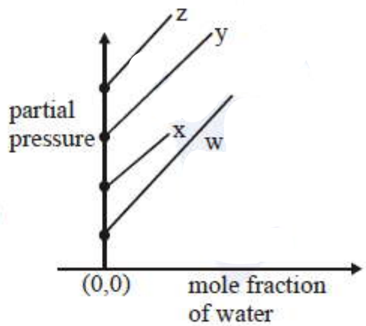
   (a) 45% (b) 65% (c) 90% (d) 75%

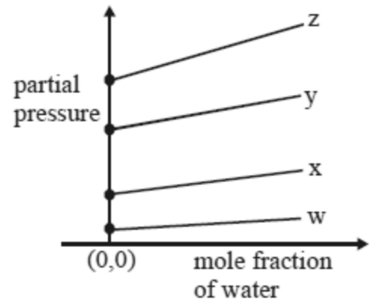
57. Polysubstitution is a major drawback in:
   (a) Reimer Tiemann reaction (b) Friedel Craft's acylation
   (c) Friedel Craft's alkylation (d) Acetylation of aniline

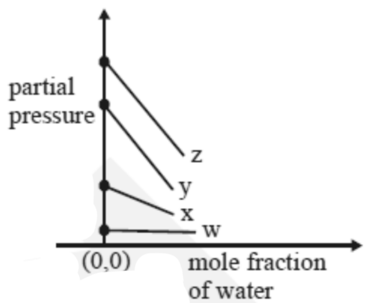
58. The Mond process is used for the
   (a) extraction of Mo
   (b) Purification of Ni
   (c) Purification of Zr and Ti
   (d) Extraction of Zn

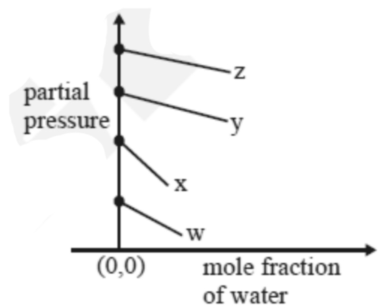
59. The strength of 11.2 volume solution of H_2O_2 is : [Given that molar mass of H = 1 g mol^{-1} and O = 16 g mol^{-1}]
   (a) 13.6% (b) 3.4% (c) 34% (d) 1.7%

60. For the solution of the gases w, x, y and z in water at 298K, 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)


Mathematics

61. The minimum number of times one has to toss a fair coin so that the probability of observing at least one head is at least 90% is :

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

62. A student scores the following marks in five tests: 45, 54, 41, 57, 43. His score is not known for the sixth test. If the mean score is 48 in the six tests, then the standard deviation of the marks in six tests is

(a) $\frac{10}{\sqrt{3}}$ (b) $\frac{100}{\sqrt{3}}$ (c) $\frac{100}{3}$ (d) $\frac{10}{3}$

63. The sum $\sum_{k=1}^{20} k\frac{1}{2^k}$ is equal to-

(a) $2-\frac{3}{2^{17}}$ (b) $2-\frac{11}{2^{19}}$ (c) $1-\frac{11}{2^{20}}$ (d) $2-\frac{21}{2^{20}}$

64. Let $\vec{a} = 3\hat{i} + 2\hat{j} + x\hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$, for some real x. Then $|\vec{a} \times \vec{b}| = r$ is possible if :

(a) $3\sqrt{\frac{3}{2}} < r < 5\sqrt{\frac{3}{2}}$ (b) $0 < r \le \sqrt{\frac{3}{2}}$ (c) $\sqrt{\frac{3}{2}} < r \le 3\sqrt{\frac{3}{2}}$ (d) $r \ge 5\sqrt{\frac{3}{2}}$

65. If the system of linear equations

$x - 2y + kz = 1$

$2x + y + z = 2$

$3x - y - kz = 3$

has a solution (x, y, z), $z \neq 0$, then (x, y) lies on the straight line whose equation is :

(a) $3x - 4y - 1 = 0$ (b) $3x - 4y - 4 = 0$

(c) $4x - 3y - 4 = 0$ (d) $4x - 3y - 1 = 0$

66. If the eccentricity of the standard hyperbola passing through the point (4, 6) is 2, then the equation of the tangent to the hyperbola at (4, 6) is-
(a) $2x - y - 2 = 0$ (b) $3x - 2y = 0$
(c) $2x - 3y + 10 = 0$ (d) $x - 2y + 8 = 0$

67. If the lengths of the sides of a triangle are in A.P. and the greatest angle is double the smallest, then a ratio of lengths of the sides of this triangle is :
(a) 5 : 9 : 13 (b) 5 : 6 : 7 (c) 4 : 5 : 6 (d) 3 : 4 : 5

68. Let $f(x) = a^x$ $(a > 0)$ be written as $f(x) = f_1(x) + f_2(x)$, where $f_1(x)$ is an even function of $f_2(x)$ is an odd function. Then $f_1(x + y) + f_1(x - y)$ equals
(a) $2f_1(x)f_1(y)$ (b) $2f_1(x)f_2(y)$
(c) $2f_1(x + y)f_2(x - y)$ (d) $2f_1(x + y)f_1(x - y)$

69. If the fourth term in the binomial expansion of $\left(\sqrt{\frac{1}{x^{1+\log_{10} x}}} + x^{\frac{1}{12}}\right)^6$ is equal to 200, and $x > 1$, then the value of x is :
(a) 10^3 (b) 100 (c) 10^4 (d) 10

70. Let $S(\alpha) = \{(x, y) : y^2 \le x, 0 \le x \le \alpha\}$ and $A(\alpha)$ is area of the region $S(\alpha)$. If for a λ, $0 < \lambda < 4$, $A(\lambda)$: $A(4) = 2 : 5$, then λ equals
(a) $2\left(\frac{4}{25}\right)^{\frac{1}{3}}$ (b) $4\left(\frac{4}{25}\right)^{\frac{1}{3}}$ (c) $2\left(\frac{2}{5}\right)^{\frac{1}{3}}$ (d) $4\left(\frac{2}{5}\right)^{\frac{1}{3}}$

71. Given that the slope of the tangent to a curve $y = y(x)$ at any point (x, y) is $\frac{2y}{x^2}$. If the curve passes through the centre of the circle $x^2 + y^2 - 2x - 2y = 0$, then its equation is :
(a) $x \log_e|y| = 2(x - 1)$ (b) $x \log_e|y| = x - 1$
(c) $x^2 \log_e|y| = -2(x - 1)$ (d) $x \log_e|y| = -2(x - 1)$

72. The vector equation of the plane through the line of intersection of the planes $x + y + z = 1$ and $2x + 3y + 4z = 5$ which is perpendicular to the plane $x - y + z = 0$ is :
(a) $\vec{r} \times (\hat{i} + \hat{k}) + 2 = 0$ (b) $\vec{r} \cdot (\hat{i} - \hat{k}) - 2 = 0$ (c) $\vec{r} \cdot (\hat{i} - \hat{k}) + 2 = 0$ (d) $\vec{r} \times (\hat{i} - \hat{k}) + 2 = 0$

73. Which one of the following statements is not a tautology?
(a) $(P \wedge q) \to p$ (b) $(p \wedge q) \to (\sim p) \vee q$
(c) $p \to (p \vee q)$ (d) $(p \vee q) \to (p \vee (\sim q))$

74. Let $f : R \to R$ be a differentiable function satisfying $f'(3) + f'(2) = 0$. Then $\lim_{x\to\infty}\left(\frac{1 + f(3 + x) f(3)}{1 + f(2 - x) - f(2)}\right)^{\frac{1}{x}}$ is equal to
(a) e^2 (b) e (c) e^{-1} (d) 1

75. The tangent to the parabola $y^2 = 4x$ at the point where it intersects the circle $x^2 + y^2 = 5$ in the first quadrant, passes through the point :
(a) $\left(-\frac{1}{3}, \frac{4}{3}\right)$ (b) $\left(-\frac{1}{4}, \frac{1}{2}\right)$ (c) $\left(\frac{3}{4}, \frac{7}{4}\right)$ (d) $\left(\frac{1}{4}, \frac{3}{4}\right)$

76. Let the number 2, b, c be in an A.P. and $A = \begin{bmatrix} 1 & 1 & 1 \\ 2 & b & c \\ 4 & b^2 & c^2 \end{bmatrix}$. If det (A) $\in$ [2, 16], then c lies in the interval :
(a) [2, 3) (b) $(2 + 2^{3/4}, 4)$ (c) $[3, 2 + 2^{3/4}]$ (d) [4, 6]

77. If three distinct numbers a, b, c are in G.P. and the equations $ax^2 + 2bx + c = 0$ and $dx^2 + 2ex + f = 0$ have a common root, then which one of the following statements is correct?

(a) d, e, f are in A.P.
(b) $\frac{d}{a}, \frac{e}{b}, \frac{f}{c}$ are in G.P.
(c) $\frac{d}{a}, \frac{e}{b}, \frac{f}{c}$ are in A.P.
(d) d, e, f are in G.P.

78. The number of integral values of m for which the equation $(1 + m^2)x^2 - 2(1 + 3m)x + (1 + 8m) = 0$ has no real root is :

(a) infinitely many (b) 2 (c) 3 (d) 1

79. 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) $2\sqrt{14}$ (b) 6 (c) $\sqrt{53}$ (d) $2\sqrt{21}$

80. If $z = \frac{\sqrt{3}}{2} + \frac{i}{2} (i = \sqrt{-1})$, then $(1 + iz + z^5 + iz^8)^9$ is equal to

(a) –1 (b) 1 (c) 0 (d) $(-1 + 2i)^9$

81. Let $f(x) = \int_0^x g(t)dt$, where g is a non-zero even function. If $f(x + 5) = g(x)$, then $\int_0^x f(t)dt$ equals-

(a) $\int_{x+5}^{5} g(t)dt$ (b) $5\int_{x+5}^{5} g(t)dt$ (c) $\int_{5}^{x+5} g(t)dt$ (d) $2\int_{5}^{x+5} g(t)dt$

82. The tangent and the normal lines at the point $(\sqrt{3}, 1)$ to the circle $x^2 + y^2 = 4$ and the x-axis form a triangle. The area of this triangle (in square units) is :

(a) $\frac{1}{3}$ (b) $\frac{4}{\sqrt{3}}$ (c) $\frac{1}{\sqrt{3}}$ (d) $\frac{2}{\sqrt{3}}$

83. In an ellipse, with centre at the origin, if the difference of the lengths of major axis and minor axis is 10 and one of the foci is at $(0, 5\sqrt{3})$, then the length of its latus rectum is:

(a) 10 (b) 8 (c) 5 (d) 6

84. If $f(1) = 1, f'(1) = 3$, then the derivative of $f(f(f(x))) + (f(x))^2$ at x = 1 is :

(a) 12 (b) 33 (c) 9 (d) 15

85. If $\int \frac{dx}{x^3(1+x^6)^{2/3}} = xf(x)(1+x^6)^{\frac{1}{3}} + C$ where C is a constant of integration, then the function f(x) is equal to-

(a) $-\frac{1}{6x^3}$ (b) $\frac{3}{x^2}$ (c) $-\frac{1}{2x^2}$ (d) $-\frac{1}{2x^3}$

86. Suppose that the points (h, k), (1, 2) and (–3, 4) lie on the line L_1. If a line L_2 passing through the points (h, k) and (4, 3) is perpendicular to L_1, then $\frac{k}{h}$ equals :

(a) 3 (b) $-\frac{1}{7}$ (c) $\frac{1}{3}$ (d) 0

87. Let $f : [-1, 3] \rightarrow R$ be defined as

$$f(x) = \begin{cases} |x| + [x] & , \; -1 \le x < 1 \\ x + |x| & , \; 1 \le x < 2 \\ x + [x] & , \; 2 \le x \le 3 \end{cases},$$

where [t] denotes the greatest integer less than or equal to t. Then, f is discontinuous at:

(a) four or more points (b) only one point
(c) only two points (d) only three points

88. Two vertical poles of heights, 20m and 80m stand a part on a horizontal plane. The height (in meters) of the point of intersection of the lines joining the top of each pole to the foot of the other, from this horizontal plane is :

(a) 12 (b) 15 (c) 16 (d) 18

89. The number of four-digit numbers strictly greater than 4321 that can be formed using the digits 0, 1, 2, 3, 4, 5 (repetition of digits is allowed) is :

(a) 288 (b) 306 (c) 360 (d) 310

90. The height of a right circular cylinder of maximum volume inscribed in a sphere of radius 3 is

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

PCM Answers

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