JEE (Main) Model Paper

Mathamatics

Max Marks - 30x4 =120

Instructions : Question 1 to 30 carries FOUR (4) marks each for correct response , 1/4th marks will be deducted for indicating incorrect response of each question.

1. It is known that $\sum_{r=1}^{\infty}\frac{1}{(2r-1)^2}=\frac{\pi^2}{8}$. Then $\sum_{r=1}^{\infty}\frac{1}{r^2}$ is equal to

1. $\frac{\pi^2}{24}$ 2. $\frac{\pi^2}{3}$ 3. $\frac{\pi^2}{6}$ 4. None

2.For a real number $x, [x]$ denotes the integral part of x. The value of

$\left[\frac{1}{2}\right]+\left[\frac{1}{2}+\frac{1}{100}\right]+\left[\frac{1}{2}+\frac{2}{100}\right]+....+\left[\frac{1}{2}+\frac{99}{100}\right]$ is

(1)49 (2)50 (3)48 (4)51

3. If the sum of squares of roots of equation $x^2-(\sin\alpha-2)x-(1+\sin\alpha)=0$ is least then α =

1) 90° 2) 70° 3) 20° 4) 60°

4.) The function $f(x)=\sum_{k=1}^{5}(x-K)^2$ assumes the minimum value of x given by

1. 5 **2.** $\frac{5}{2}$ **3.** 3 **4.** 2

5. Let three matrices $A=\begin{bmatrix}2 & 1\\ 4 & 1\end{bmatrix}, B=\begin{bmatrix}3 & 4\\ 2 & 3\end{bmatrix}$ and $C=\begin{bmatrix}3 & -4\\ -2 & 3\end{bmatrix}$ then

$tr(A)+tr\left(\frac{A(BC)}{2}\right)+tr\left(\frac{A(BC)^2}{4}\right)+tr\left(\frac{A(BC)^3}{8}\right)+.....\infty$ is equal to

1) 6 2) 14 3) 24 4) 18

6.. The weighted mean of first n natural numbers whose weights are equal to the number of selections out of n natural numbers of corresponding numbers respectively is

1. $\frac{n.2^{n-1}}{2^n-1}$ 2. $\frac{3n(n+1)}{2(2n+1)}$ 3. $\frac{(n+1)(2n+1)}{6}$ 4. $\frac{n(n+1)}{2}$.

7. The distance between the line $\bar{r}=2i-2j+3k+\lambda(i-j+4k)$ and the plane $r.(i+5j+k)=5$

1) $\frac{10}{3\sqrt{3}}$ 2) $\frac{10}{9}$ 3) $\frac{10}{3}$ 4) $\frac{3}{10}$

8. Find the equation of the curve passing through (1, 2) whose differential equation is $y(x+y^3)dx=x(y^3-x)dy$

1) $xy=1$ 2) $x^2-y^2=1$ 3) $y^3+2x=5x^2y$ 4) $x^2-y+3=0$

9. If x, y, z are real numbers satisfying the equation $25(9x^2+y^2)+9z^2-15(5xy+yz+3zx)=0$ then x, y, z are in

1) A.P 2) G.P 3) H.P 4) A.G.P

10. α, β, γ are the angles made by a line with x, y, z axes in positive direction then the range of $\cos\alpha\cos\beta+\cos\beta\cos\gamma+\cos\gamma\cos\alpha$ is

1) $\left[\frac{-1}{2},1\right]$ 2) $\left[\frac{-1}{2},\alpha\right]$ 3) $(1,\alpha)$ 4) $(1,2]$

11.Let (a-1)(b-1)(c-1) $\neq 0$. If the points $\left(\frac{a^3}{a-1},\frac{a^2-3}{a-1}\right),\left(\frac{b^3}{b-1},\frac{b^2-3}{b-1}\right),\left(\frac{c^3}{c-1},\frac{c^2-3}{c-1}\right)$ are collinear , then $abc-(ab+bc+ca)=\lambda(a+b+c)$ where λ is

1. 1 **2.** -1 **3.** 2 **4.** -3

12.. The sum of two positive integers is 200 then chance that their product is greater than 3/4 times their greatest product probability is

1) $\frac{51}{99}$ 2) $\frac{99}{199}$ 3) $\frac{1}{2}$ 4) $\frac{1}{3}$

13..If $\int \frac{(2x^2+1)\,dx}{(x^2-4)(x^2-1)} = \log\left[\left(\frac{x+1}{x-1}\right)^a \left(\frac{x-2}{x+2}\right)^b\right] + C,$ then the values of *a* and *b* are respectively

(1)1/2, ¾ (2)–1, 3/2 (3)1, 3/2 (4) –1/2, 3/

14) The no. of points of discontinuity of f(x)

$$f(x)=[x]+\left[x+\frac{1}{4}\right]+\left[x+\frac{1}{2}\right]+\left[x+\frac{3}{4}\right]$$

in (0,1] where ([.] denotes Greatest integer function)

(1) 4 2)2 (3)0 (4) 8

15. If a+b+c=0, then the equation $3ax^2+2bx+c=0$ has, in the interval (0,1)

1. at least one root **2.** At most one root **3.** No root **4.** Exactly one root

16. For all complex numbers z_1, z_2 satisfying $|z_1|=12$ and $|z_2-3-4i|=5$, the minimum value of $|z_1-z_2|$ is

1) 0 2) 2 3) 7 4) 17

17. A tangent is drawn to the circle $2\left(x^2+y^2\right)-3x+4y=0$ and it touches the circle at point 'A'. The tangent passes through the point $P(2,1)$. Then PA =

1) 4 2) 2 3) $2\sqrt{2}$ 4) 8

18. Range of values K of for which the point $(k,-1)$ is exterior to both the parabolas $y^2=|x|$ is

1) $(-1,0)$ 2) $(-1,1)$ 3) $(0,1)$ 4) $(0,-1)$

19.If $x^2+y^2+z^2=r^2$, then $Tan^{-1}\left(\frac{xy}{zr}\right)+Tan^{-1}\left(\frac{yz}{xr}\right)+Tan^{-1}\left(\frac{xz}{yr}\right)=$

1) $\frac{\pi}{6}$ 2) $\frac{\pi}{3}$ 3) $\pm\frac{\pi}{4}$ 4) $\frac{\pi}{2}$

20. If normal to hyperbola $xy=c^2$ at $\left(ct_1,\frac{c}{t_1}\right)$ meet the curve again at $\left(ct_2,\frac{c}{t_2}\right)$, then:

1) $t_1t_2=-1$ 2) $t_2=-t_1-\frac{2}{t_1}$ 3) $t_1t_1^3=-1$ 4) $t_1^3t_2=-1$

21. If f is a real-valued differentiable function satisfying $|f(x)-f(y)|\le(x-y)^2, x,y\in R$ and $f(0)=0$, then $f(1)=$

1. 2 **2.** 0 **3** -1 **4.** 5

22. The area of the region bounded by the curves $y=9x^2$ and $y=5x^2+4$ (in square units) is

1) $\frac{16}{3}$ 2) $\frac{64}{3}$ 3) $\frac{32}{3}$ 4) 64

23. $\int_0^{\pi/2}\frac{\sin^2 9x}{\sin x}dx=$

1) $1+\frac{1}{2}+\frac{1}{3}+.....+\frac{1}{9}$ 2) $\frac{1}{2}+\frac{1}{4}+.....+\frac{1}{18}$

3) $1+\frac{1}{3}+\frac{1}{5}+\frac{1}{7}+.....+\frac{1}{19}$ 4) $1+\frac{1}{3}+\frac{1}{5}+.....+\frac{1}{17}$

24. The distance of the point (2,1,-2) from the line $\frac{x-1}{2}=\frac{y+1}{1}=\frac{z-3}{-3}$ measured parallel to the plane $x+2y+z=4$ is

1. $\sqrt{10}$ 2. $\sqrt{20}$ 3. $\sqrt{5}$ 4. $\sqrt{30}$

25) Function $f(x)=\frac{\lambda\sin x+6\sin x}{2\sin x+3\cos x}$ is monotonically increasing if :

1) $\lambda>1$ 2) $\lambda>4$ 3) $\lambda<1$ 4) $\lambda<4$

26 The equation of the tangent, to the curve $y=e^{-|x|}$ at the point where the curve cuts the line x = 1, is

1) x + y = e 2) e(x + y) = 1 2) y + ex = 1 4) x - ey = 0

27.Let p be the statement : "x is an irrational number"

q be the statement : "y is a transcendental number"

r be the statement : x is rational off y is a transcendental number

Statement – 1 : r is equivalent to either q or p

Statement – 2 : r is equivalent to $\sim(p\leftrightarrow\sim q)$

1) Statement – 1 is false, statement – 2 is true

2) Statement – 1 is true, statement – 2 is true

Statement – 2 is correct explanation for statement – 1

3) Statement – 1 is true, statement – 2 is true

Statement – 2 is not correct explanation for statement – 1

4) Statement – 1 is true, statement – 2 is false

28. If $A=\{a_1,a_2,a_3,a_4,a_5\}$, $B=\{b_1,b_2,b_3,b_4,b_5\}$ and the number of one-one functions from A to B such that $f(a_i)$ not equal to b_i for $i=1,2,3,4,5$ are

1) 11 2) 14 3) 24 4) 18

29. If $|z_1|=2$, $|z_2|=3$, $|z_3|=4$ and $|z_1+z_2+z_3|=5$ then $|4z_2z_3+9z_3z_1+16z_1z_2|$ =

1) 120 b)24 3) 48 4) 20

30.Let p and q be the roots of equation $x^2 - 2x + A = 0$ and let 'r' and 's' be the roots of the equation $x^2 - 18 + B = 0$ if $p < q < r < s$ are in A.P, then value of 'A', 'B' are ___

1) A = 3, B = 77

2) A = 3, B = 7

3) A = - 3, B = 77

4) A = 3, B = - 7

KEY

1) 3	2) 2	3) 1	4) 3	5) 1	6) 1	7) 1	8) 3	9) 1	10) 1
11) 4	12) 3	13) 1	14) 4	15) 1	16) 2	17) 2	18) 2	19) 4	20) 4
21) 2	22) 1	23) 4	24) 4	25) 2	26) 4	27) 4	28) 1	29) 1	30) 2

CHEMISTRY

31. Which one of the following statements is not correct

1) Energy of an electron in hydrogen atom depends only on principal quantum number

2) With increase in principal quantum number of an orbital energy of an electron in that orbital increases

3) Energy of an electron in 2s orbital of hydrogen atom is same as the energy of 2s orbital electron in Lithium atom.

4) In multi electron atoms energy of different subshells of a particular shell is different

32. $P \xrightarrow[2)H_3O^+]{1)CH_3MgBr} R \xrightarrow[2)\Delta]{1)dil.NaOH}$ **4-methylpent-3-en-2-one. In this reaction What is P?**

1) ethanamine 2) ethanal 3) propanone 4) ethanenitrile

33. In which one of the following reactions Kharasch effect can be observed

1) $CH_3CH_2CH=CH_2 + HCl \xrightarrow{peroxide}$ 2) $CH_3CH_2-CH=CH_2 + HBr \xrightarrow{peroxide}$

3) $CH_3CH=CH-CH_3 + HBr \xrightarrow{peroxide}$ 4) $CH_3CH=CH-CH_3 + HCl \xrightarrow{peroxide}$

34. The first ionisation enthalpy values of Na, Mg and silicon are 496, 737 and 786 kJ/mole respectively. The first ionisation enthalpy of aluminium is nearly (in kJ / mole)

1) 825 2) 575 3) 496 4) 786

35. A complex is represented as $CoCl_3.xNH_3$. Its 0.1 m solution in aqueous solution shows ΔT_f = 0.558° and assume 100% ionization and co–ordination number of Co(III) is six . What is the complex [$K_f(H_2O)$ = 1.86 mol^{-1} K] ?

1) $CoCl_3.\ 6NH_3$ 2) $CoCl_3.\ 5NH_3$ 3) $CoCl_3.\ 4NH_3$ 4) $CoCl_3.\ 3NH_3$

36. What is not true about N_2O_5?

1) It is anhydride of HNO_3

2) In solid state it exists as NO_2^+ NO_3^-

3) It is structurally similar to P_2O_5

4) It can be prepared by heating HNO_3 over P_2O_5

37. One of the necessary food additives butylated hydroxy anisole acts as

1) Flavouring agent
2) Emulsifier
3) Antioxidant
4) Colouring agent

38. The statement that is NOT correct is

1) Wrought iron is the purest form of commercial iron

2) Copper from its low grade ores is extracted by hydrometallurgy

3) NaCN can be used as a depressant in froth floatation technique

4) Collectors enhance the wettability of mineral particles during froth flotation

39. Match list I with list II and select the correct answer:

List I	**List II**
(A) Coagulation	(p) Scattering of light
(B) Dialysis	(q) Preparation of colloid
(C) Peptization	(r) Purification of colloids
(D) Tyndall effect	(s) Electrolyte

1) (A) → (p) ; (B) → (q) ; (C) → (r) ; (D) → (s)

2) (A) → (p) ; (B) → (p) ; (C) → (q) ; (D) → (s)

3) (A) → (s) ; (B) → (r) ; (C) → (q) ; (D) → (p)

4) (A) → (r) ; (B) → (s) ; (C) → (p) ; (D) → (q)

40. Identify Z in the sequence

$$C_6H_5NH_2 \xrightarrow[0^\circ C]{NaNO_2+HCl} X \xrightarrow{Cu_2(CN)_2/KCN} Y \xrightarrow{H_2O/H^+} Z$$

1) C_6H_5CHO 2) C_6H_5COOH 3) C_6H_5OH 4) $C_6H_5CH_2COOH$

41. Which one of the following monomers take part in anionic polymerization mechanism during polymerization?

1) isobutylene 2) vinyl chloride 3) acryolonitrile 4) Both (2) and (3)

42. Which one of the following compounds is stable

1) MnO_3F 2) MnF_7 3) $VOCl_3$ 4) Both 1 and 3

43. The rate constant, activation energy and the Arrhenius parameter of a chemical reaction at 25°C are , $3\times10^{-4}\,sec^{-1}, 104.4\ KJ\ mol^{-1}$ *and* $6.0\times10^{14}\,sec^{-1}$ **respectively. The value of the rate constants as** $T \to \infty$ **is**

1) $2\times10^{18}\,sec^{-1}$ 2) $6\times10^{14}\,sec^{-1}$ 3) Infinity 4) $3.6\times10^{30}\,sec^{-1}$

44. $MnO_2 + HCl \xrightarrow{\Delta} A_{(g)}$ **;** $A(g) + F_2(excess) \xrightarrow{573K} B_{(g)}$ **;** $B(l) + U(s) \to C(g) + D(g)$

The gases A, B, C and D are respectively

1) Cl_2, ClF_3, UF_6, ClF 2) O_2, O_2F_2, U_2O_3, OF_2

3) Cl_2, ClF, UF_6, ClF_3 4) O_2, OF_2, U_2O_3, O_2F_2

45. For $Cr_2O_{7\,(aq)}^{2-} + 14H^+_{(aq)} + 6e^- \to 2Cr^{3+}_{(aq)} + 7H_2O_{(l)}$ **E° = 1.33 V. At [$Cr_2O_7^{2-}$] = 4.5 millimolar, [Cr^{3+}] = 15 millimolar, E is 1.067 V. The pH of the solution is nearly equal to (given log15 = 1.176 ; log 4.5=0.653)**

1) 3 2) 4 3) 2 4) 5

46. Which of the following is an example of autocatalysis

1) $N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)}$

2) $2SO_{2(g)} + O_{2(g)} \longrightarrow 2SO_{3(g)}$

3) $2KMnO_4 + 3H_2SO_4 + 5H_2C_2O_4 \to 2MnSO_4 + K_2SO_4 + 10CO_2 + 8H_2O$

4) $C_{12}H_{22}O_{11(aq)} + H_2O_{(\ell)} \longrightarrow C_6H_{12}O_{6_{(aq)}} + C_6H_{12}O_{6_{(aq)}}$

47. The correct sequence of reactions to be performed to convert benzene into m-bromoaniline is

1) bromination, nitration, reduction 2) reduction, nitration, bromination

3) nitration, reduction, bromination 4) nitration, bromination, reduction

48. Which one of the following substances cause more hardness when dissolved in equal amount of substances in 1 litre water

1) $CaCl_2$ 2) $CaCO_3$ 3) $Ca(HCO_3)_2$ 4) $CaSO_4$

49. Pernicious anemia is due to the deficiency of

1) B_6 2) B_1 3) B_2 4) B_{12}

50. Neglecting the Vander Waals constant (b) value for four gases A, B, C and D having their critical temperatures in the order $T_B > T_D > T_A > T_C$ then the order of their liquefaction pressure at a temperature T ($T < T_C$) will be:

1) $P_A < P_B < P_C < P_D$ 2) $P_B < P_D < P_A < P_C$ 3) $P_C < P_A < P_D < P_B$ 4) $P_D < P_C < P_A < P_B$

51. If 50% of CO_2 converts to CO at the following equilibrium $C_{(s)} + CO_2(g) \rightleftharpoons 2CO_{(g)}$ and the equilibrium pressure is 12 atm, calculate Kp.

1) 16 2) 8 3) 12 4) 4

52. Which of the following is true about the complex $[PtCl_2(NH_3)(H_2O)]$;[Atomic no. of Pt = 78]

i) It will have two geometrical isomeric forms

ii) The hybridisation state of Pt(II) is sp^3

iii) It is a square planar complex

iv) It is a diamagnetic complex

v) It can show hydrate isomerism

vi) It is a tetrahedral complex

1) (i), (iii),(iv) 2) (ii), (iv), (v) 3) (ii), (v), (vi) 4) (i), (v), (vi)

53. 1.216 g of an organic compound was reacted under kjeldhal's method and the ammonia evolved was absorbed in 100ml of 1N H_2SO_4. The remaining acid solution was made up to 500ml by addition of water. 20 ml of this dilute solution required 32 ml of N/10 caustic soda solution for complete neutralization. Calculate the % of nitrogen in the compound.

1) 56% 2) 23% 3) 66% 4) 43%

54. In a crystalline solid AB_3, atoms of element B form ccp arrangement where atoms of element A occupies

1) 33% of tetrahedral voids 2) 33% of octahedral voids

3) 66% of tetrahedral voids 4) 66% of octahedral voids

55. $C_2H_6 \xrightarrow[h\nu]{\text{one mole } Cl_2} A \xrightarrow{Na/\text{dry ether}} B \xrightarrow{\text{anhydrous } AlCl_3/HCl} C;B \,\&\, C$ **are**

1) tautomer's 2) Positional isomers

3) Geometrical isomers 4) chain isomers

56. Depression of freezing point of which of the following solutions does represent the cryoscopy constant of water?

1) 6% by mass of urea is aqueous solution

2) 100g of aqueous solution containing 18 g of glucose

3) 59 g of aqueous solution containing 9 g of glucose

4) 1M KCl solution in water.

57. The weight of H_2O_2 present in 80mL of 10V H_2O_2 solution is

1)3.2g 2)4.2g 3)2.4g 4)3.6g

58. Which one of the following statements is false

1) Plaster of paris is a hemihydrate of calcium sulphate obtained by heating the gypsum above 393K.

2) Sodium carbonate is used in water softening.

3) For a good quality cement, the ratio of silica to alumina should be between 2.5 to 4 and the ratio of lime to the total of the oxides of silicon aluminium and iron should be as close as possible to 2

4) $CaCO_3$ is used as mild abrasive in tooth paste

59. The incorrect statement from the following is

1) ΔS_{total} in isothermal reversible process is zero

2) ΔS_{total} in adiabatic reversible process is zero

3) ΔS_{total} in isothermal irreversible process is zero

4) For a spontaneous process ΔG is negative

60. Hybridization of 'Xe' in XeF_2, XeF_4 and XeF_6 are respectively

1) sp^3d, sp^3d^2, sp^3d^3 2) sp^3d^2, sp^3d^3, sp^3d 3) sp^3d^3, sp^3d^2, sp^3d 4) sp^3, sp^3d, sp^3d^3

Chemistry --Key

31) 3	32) 4	33) 2	34) 2	35) 2	36) 3	37) 3	38) 4	39) 3	40) 2
41) 3	42) 4	43) 2	44) 1	45) 3	46) 3	47) 4	48) 1	49) 4	50) 2
51) 1	52) 1	53) 2	54) 2	55) 4	56) 3	57) 3	58) 1	59) 3	60) 1

Chemistry-Solutions

31. Energy electron in same shell for different atoms is different due to difference in effective nuclear charge

32. $\underset{\text{Ethanenitrile 'P'}}{H_3C-C\equiv N} \xrightarrow[H_3O^+]{CH_3MgBr} \underset{\text{Acetone(2 moles)}}{CH_3COCH_3}$

$$\xrightarrow[\text{(Aldol condensation)}]{\text{1)dil.NaOH}} \underset{\text{Diacetone alcohol (Aldol)}}{(CH_3)_2-\overset{\overset{OH}{|}}{C}-CH_2COCH_3}$$

$$\xrightarrow[-2H_2O]{\text{2)Heat},H^+} \underset{\substack{\text{4-Methylpent-3-ene-2-one}\\ \text{(Mesityl oxide)}}}{(CH_3)_2C=CHCOCH_3}$$

33. Peroxide effect is observed only with HBr

34. $I.P_1 : Na < Al < Mg < Si$

35. $\Delta T_f = i K_f m ; 0.558 = i \times 1.86 \times 0.1$; i=3 $\alpha = \frac{i-1}{n-1}$ α=1 as i = n=3

40. x= benzene diazonim chloride; y= cyanobenzene; z = benzoic acid

43. $K = A.e^{-\frac{Ea}{RT}}$ as $T = \infty K = A$

44. $MnO_2 + 4HCl \xrightarrow{\Delta} \underset{(A)}{Cl_2(g)} + MnCl_2 + 2H_2O$

$$\underset{(A)}{Cl_2(g)} + 3F_{2(excess)} \xrightarrow{573K} \underset{(B)}{2ClF_3(g)}$$

$$\underset{(B)}{3ClF_3(l)} + U_{(s)} \xrightarrow{\Delta} \underset{(C)}{UF_{6(g)}} + \underset{(D)}{3ClF_{(g)}}$$

45. $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$

$$E = E^\circ - \frac{2.303RT}{nF} \log \frac{[Products]}{[Reactants]}$$

$$1.067 = 1.33 - \frac{0.0591}{6} \log \frac{[Cr^{3+}]^2[H_2O]^7}{[Cr_2O_7^{2-}][H^+]^{14}}$$

$$1.067 = 1.33 - 9.85\times10^{-3} \log \frac{[15\times10^{-3}]^2[1]^2}{[4.5\times10^{-3}][H^+]^{14}}$$

$$\frac{-0.263}{-9.85\times10^{-3}} = 2\log[15\times10^{-3}] - \log[4.5\times10^{-3}] - 14\log[H^+]$$

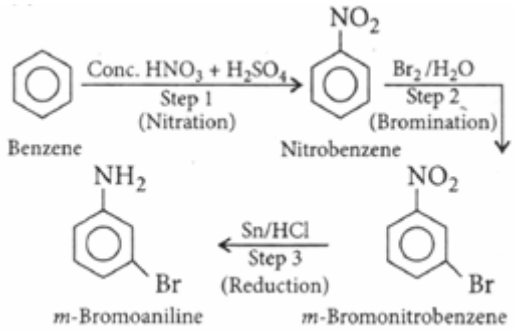
$$26.7 = 2\times -1.8x + 2.34 + 14pH$$

$$26.7 = -3.64 + 2.34 + 14pH$$

$$14pH = 26.7 + 3.64 - 2.34$$

$$pH = \frac{28}{14} = 2$$

47.



48. $\text{Degree of Hardness} = \frac{W_B}{M_B} X \frac{10^6 X100}{W_A}$

Where W_B= weight of salt causing hardness

M_B = molar mass of salt

W_A= weight of water

50. easily liquefiable gases have high critical temperature

51. $C_{(s)} + O_2 \rightleftharpoons 2CO_{(g)}$ $Kp = \frac{P_{CO}^2}{P_{O_2}}$

$$C_{(s)} + O_{2(g)} \rightarrow 2CO_{(g)}$$
$$1 \qquad 0$$
$$1-x \qquad 2x$$

Total moles = 1+0.5 =1.5 as x= 0.5

Partial pressure = Molefraction X total pressure

52. Platinum in co-ordination number 4 forms squreplanar complex with dsp^2 hybridization

53. $\%N = \frac{1.4xNx(V - V_b)}{\text{wt of org.compound}}$

54. ratio of spheres and Octahedral voids $= 1:1$ for three B atoms only one A

55. A= chloroethane; B= Butane ;C= isobutene

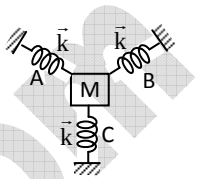
57. $\frac{\text{weight of } H_2O_2}{68} = \frac{\text{volume of Oxygen}}{22400}$

PHYSICS

61. Vernier scale of Vernier calipers has 50 divisions which coincide with 49 main scale divisions. Find the Vernier constant. Given : there are 20 main scale divisions cm^{-1}.

1) 100 μm 2) 1000 μm 3) 10 μm 4) 1 μm

62. A block of mass m is connected to three springs, each of spring constant k as shown in figure. The block is pulled by x in the direction of C. Find resultant spring constant.

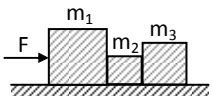


1) k 2) 2k 3) 3k 4) 3k/2

63. A particle moves according to the law a = –ky. Find the velocity as a function of distance y, v_0 is initial velocity.

1) $v^2 = v_0^2 - ky^2$ 2) $v^2 = v_0^2 - 2ky$ 3) $v^2 = v_0^2 - 2ky^2$ 4) $v^2 = v_0 - ky$

64. Three blocks of mass m_1, m_2 and m_3 are lying in contact with each other on a horizontal frictionless plane as shown in the figure. If a horizontal force F is applied on m_1 then the force at the constant plane of m_1 and m_2 will be



1) $\frac{F(m_2+m_3)}{(m_1+m_2+m_3)}$ 2) $\frac{m_1+F}{(m_1+m_2+m_3)}$ 3) m_1F 4) $\frac{F(m_1+m_2)}{(m_1+m_2+m_3)}$

65. A particle is projected upwards. The times corresponding to height h while ascending and while descending are t_1 and t_2 respectively. The velocity of projection will be

1) gt_1 2) gt_2 3) $gt(t_1 + t_2)$ 4) $\frac{g(t_1+t_2)}{2}$

66. A car is moving on a circular track of radius R. The road is banked at θ. μ is the coefficient of friction. Find the maximum speed the car can have

1) $\left[\frac{Rg(\sin\theta+\mu\cos\theta)}{\cos\theta+\mu\sin\theta}\right]^{1/2}$ 2) $\left[\frac{Rg(\cos\theta+\mu\sin\theta)}{\cos\theta-\mu\sin\theta}\right]^{1/2}$ 3) $\left[\frac{Rg(\sin\theta+\mu\cos\theta)}{\cos\theta-\mu\sin\theta}\right]^{1/2}$ 4) $\left[\frac{Rg(\cos\theta+\mu\sin\theta)}{\cos\theta-\mu\sin\theta}\right]^{2}$

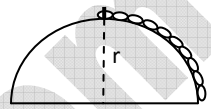
67. A small object slides without friction from the height H = 50 cm and then loops the vertical loop of radius r = 20 cm from which a symmetrical section of angle 2α has been removed. Find angle α such that after losing contact at A and flying through air, the object will reach point B.

1) 30° 2) 45° 3) 60° 4) 90°

68. The upper half of an inclined plane with inclination □ is perfectly smooth, while the lower half is rough. A body starting from rest at the top will again come to rest at the bottom, if the coefficient of friction for the lower half is given by

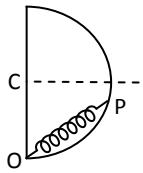
1) 2 sin ϕ 2) 2 cosϕ 3) tan ϕ 4) 2 tan ϕ

69. A chain of length l is placed on a smooth spherical surface of radius r with one of its ends fixed at the top of the surface. Length of chain is assumed to be $l < \pi r/2$. Acceleration of each element of chain when upper end is released is



1) $\frac{lg}{r}\left(1-\cos\frac{r}{l}\right)$ 2) $\frac{rg}{l}\left(1-\cos\frac{l}{r}\right)$ 3) $\frac{lg}{r}\left(1-\sin\frac{l}{r}\right)$ 4) $\frac{rg}{l}\left(1-\sin\frac{l}{r}\right)$

70. A smooth semicircular wire track of radius R is fixed in a vertical plane. One end of a massless spring of natural length 3R/4 is attached to the lowest point O of the wire track. A small ring of mass m which can slide on the track is attached to the other end of the spring. The ring is held stationary at point P such that the spring makes an angle 60° with the vertical. Spring constant K = mg/R. The spring force is

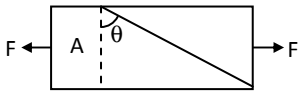


1) $\frac{mg}{3}$ 2) mg 3) $\frac{mg}{2}$ 4) $\frac{mg}{4}$

71. Find the work done to take a particle of mass m from surface of the earth to a height equal to 2R

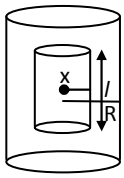
1) 2 mg R 2) $\frac{mgR}{2}$ 3) 3 mg R 4) $\frac{2mgR}{3}$

72. A bar of cross-section A is subjected to equal and opposite tensile forces F at its ends. Consider a plane through the bar making an angle θ with a plane at right angles to the bar. Then shearing stress will be maximum if θ



1) 0° 2) 30° 3) 45° 4) 90°

73. Uniformly charged long cylinder has volume charge density ρ. Find the electric field at a distance x < R from the axis of the cylinder

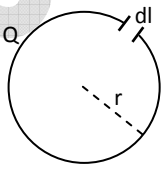


1) $\frac{\rho x}{\varepsilon_0}$ 2) $\frac{\rho x}{2\varepsilon_0}$ 3) $\frac{\rho x}{3\varepsilon_0}$ 4) $\frac{\rho x}{4\varepsilon_0}$

74. $E = 20\hat{i} + 30\hat{j}$ exists in space. If the potential at the origin is taken to be zero, find the potential at P(3, 2).

1) –150 V 2) –100 V 3) +150 V 4) –120 V

75. A ring of radius R has charge Q. It is cut by dl. Find the electric field at the centre.

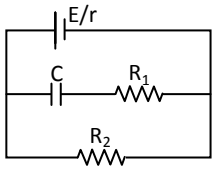


1) zero 2) $\frac{Qdl}{2\pi r^2\varepsilon_0}$ 3) $\frac{Qdl}{2\pi r^3\varepsilon_0}$ 4) $\frac{Qdl}{8\pi^2\varepsilon_0 r^3}$

76. The electric field strength due to a ring of radius R at a distance x from its centre on the axis of ring carrying charge Q is given by $E = \frac{1}{4\pi\varepsilon_0}\frac{Qx}{(R^2+x^2)^{3/2}}$. At what distance from the centre will the electric field be maximum?

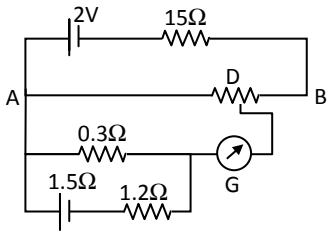
1) x = R 2) x = R/2 3) $x = R/\sqrt{2}$ 4) $x = \sqrt{R/2}$

77. A circuit network is shown in figure. The charge on capacitor will be



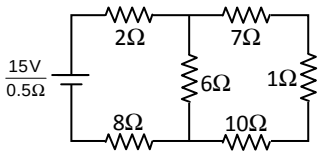
1) $\frac{ER_2}{(r+R_1)}$ 2) $\frac{ER_2}{(r+R_2+R_1)}$ 3) $\frac{ER_2}{(r+R_2)}$ 4) $\frac{ER_1}{(R_2+R_1)}$

78. In the following circuit the resistance of wire AB is 10 Ω and its length is 1 m. Rest of the quantities are given in the diagram. The potential gradient on the wire will be



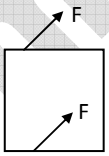
1) 0.08 V/m 2) 0.008 V/m 3) 0.8 V/m 4) 8.0 V/m

79. The power consumed by 6 Ω resistor in the given circuit of figure is



1) 4.611 W 2) 3.375 W 3) 1.125 V 4) 2.635 W

80. A square coil of edge l having n turns carries a current i. It is placed on a smooth horizontal plate A magnetic field B parallel to one edge is applied. The total mass of the coil is M. The minimum value of B for which the coil will tip over is



1) $\frac{Mg}{lin}$ 2) $\frac{Mg}{2lin}$ 3) $\frac{2Mg}{lin}$ 4) $\frac{Mgi}{ln}$

81. A thin disc (or dielectric) having radius r and charge q distributed uniformly over the disc is rotated n rotations per second about its axis. Find the magnetic field at the centre of the disc.

1) $\frac{\mu_0 qn}{a}$ 2) $\frac{\mu_0 qn}{2a}$ 3) $\frac{\mu_0 qn}{4a}$ 4) $\frac{3\mu_0 qn}{4a}$

82. The coercive force for a certain permanent magnet is 4×10^4 Am^{-1}. This magnet is placed in a long solenoid having 20 turns per cm. What current be passed to completely demagnetize it?

1) 10A 2) 20A 3) 40A 4) 25 A

83. A long wire carries a current 5 A. The energy stored in the magnetic field inside a volume 1 mm^3 at a distance 10 cm from the wire is

1) $\frac{\pi}{4}\times10^{-13}$ J 2) $\frac{\pi}{2}\times10^{-13}$ J 3) $\pi\times10^{-13}$ J 4) $\frac{\pi}{8}\times10^{-13}$ J

84. Magnetic flux during time interval τ varies through a stationary loop of resistance R as $\phi_B = at(\tau - t)$. Find the amount of heat generated during that time. Neglect the inductance of the loop.

1) $\frac{a^2\tau^3}{R}$ 2) $\frac{a^2\tau^2}{2R}$ 3) $\frac{a^2\tau^3}{3R}$ 4) $\frac{a^2\tau^3}{4R}$

85. An alternating current is given by $i = i_1 \cos \omega t + i_2 \sin \omega t$. The rms current is given by

1) $\frac{i_1 + i_2}{\sqrt{2}}$ 2) $\frac{|i_1 + i_2|}{\sqrt{2}}$ 3) $\sqrt{\frac{i_1^2 + i_2^2}{2}}$ 4) $\sqrt{\frac{i_1^2 + i_2^2}{\sqrt{2}}}$

86. Maxwell's four equations are written as

i) $\oint \vec{E} \cdot \vec{ds} = \frac{q_0}{\varepsilon_0}$ ii) $\oint \vec{B} \cdot \vec{ds} = 0$ iii) $\oint \vec{B} \cdot \vec{dl} = \frac{d}{dt} \oint \vec{B} \cdot \vec{ds}$ iv) $\oint \vec{B} \cdot \vec{ds} = \mu_0 \varepsilon_0 \frac{d}{dt} \oint \vec{E} \cdot \vec{ds}$

The equations which have sources of field are

1) i, iii, iii 2) i, ii 3) i and iii only 4) i and iv only

87. A flood light is covered with a filter that transmits red light. The electric field of the emerging beam is represented by a sinusoidal plane wave $E_x = 36 \sin (1.20 \times 10^7 z + 6 \times 10^{15} t)$ V/m. The average intensity of the beam will be

1) 0.86 W/m^2 2) 1.72 W/m^2 3) 3.44 W/m^2 4) 6.88 W/m^2

88. A cube is placed with one vertex at origin. The side of cube is 'a', the electric field is $E = 600\sqrt{x}\,\hat{i}$. The electric flux through the cube is

1) $600a^2\sqrt{x}$ 2) $-600\ a^{5/2}$ 3) $600\ a^{5/2}$ 4) zero

89. Find the minimum wavelength of X-ray produced if 10 kV potential difference is applied across the anode and cathode of the tube.

1) 12.4 Å 2) 12.4 nm 3) 1.24 nm 4) 1.24 Å

90. NAND gate is the combination of

1) AND gate and NOT gate 2) AND gate and OR gate

3) NOT gate and OR gate 4) NOT gate and NOT gate

Key :

61) 3	62) 3	63) 1	64) 1	65) 4	66) 3	67) 3	68) 4	69) 2	70) 4
71) 4	72) 3	73) 2	74) 4	75) 4	76) 3	77) 3	78) 3	79) 2	80) 2
81) 1	82) 2	83) 4	84) 3	85) 3	86) 4	87) 2	88) 3	89) 4	90) 1