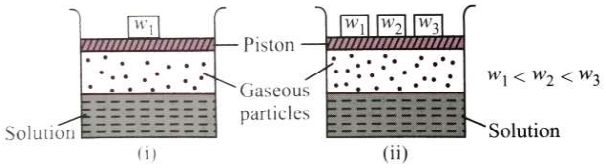
1. Consider the two figures given below.



Which of the following statements regarding the experiment is true**?**

a) The solubility of a gas in liquid in beaker (i) is greater than that in beaker (ii).

b) The solubility of a gas in beaker (i) is less than that in beaker (ii).

c) The solubility of a gas is equal in both beakers.

d) The solubility of a gas remains unaffected by change in weights.

2. The value of Henry's law constant for some gases at 293 K is given below. Arrange the gases in the increasing order of their solubility.

He: 144.97 kbar, H_2 : 69.16 kbar,

N_2 : 76.48 kbar, O_2 : 34.86 kbar

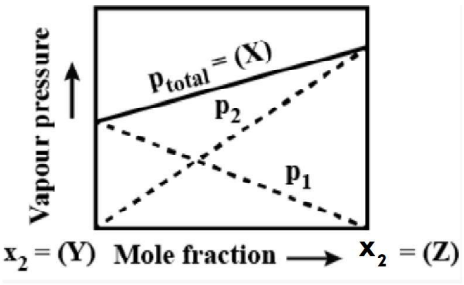
(a) He < N_2 < H_2 < O_2

(b) O_2 < H_2 < N_2 < He

(c) H_2 < N_2 < O_2 < He

(d) He < O_2 < N_2 < H_2

3.



X, Y and Z in the above graph are

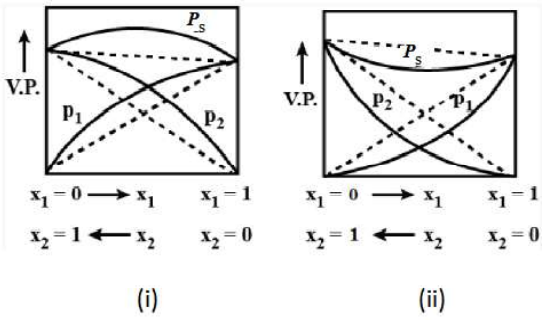
a) X = p_1 + p_2, Y = 1, Z = 0

b) X = p_1 + p_2, Y = 0, Z = 1

c) X = p_1 × p_2, Y = 0, Z = 1

d) X = p_1 – p_2, Y = 1, Z = 0

4. Study the figures given below and mark the correct statement.



a) (i) Nitric acid + Water,
(ii) Acetone + Ethyl alcohol

b) (i) Water + Ethyl alcohol,
(ii) Acetone + Benzene

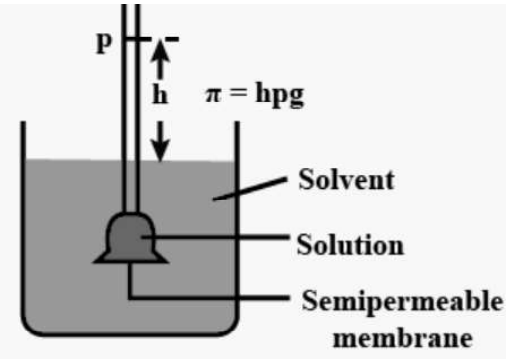
c) (i) Acetone + Ethyl alcohol,
(ii) Acetone + Chloroform

Rough Work

d) (i) Benzene + Chloroform,

(ii) Acetone + Chloroform

5. If semipermeable membrane is placed between the solvent and solution as shown in the given figure then



a) the solvent molecules will flow through the membrane from solution to pure solvent

b) the solvent molecules will flow continuously till the equilibrium is attained

c) the flow of the solvent from its side to solution side across a semipermeable membrane can be stopped if some extra pressure (called osmotic pressure) is applied on the solution.

d) both (b) and (c).

6. Why is the molecular mass determined by measuring colligative property in case of some solutes is abnormal?

a) Due to association or dissociation of solute molecules.

b) Due to insolubility of solute molecules.

c) Due to decomposition of solute molecules.

d) Due to large size of solute molecules.

7. If α is the degree of dissociation of Na_2SO_4, the van't Hoff's factor (i) used for calculating the molecular mass is

a) $1 + \alpha$

b) $1 - \alpha$

c) $1 + 2\alpha$

d) $1 - 2\alpha$

8. Elevation in the boiling point for 1 molal solution of glucose is 2 K. The depression in the freezing point for 2 molal solution of glucose in the same solvent is 2K. The relation between K_b and K_f is

a) $K_b = 1.5\ K_f$

b) $K_b = 0.5\ K_f$

c) $K_b = 2\ K_f$

d) $K_b = K_f$

9. Which of the following is the correct cell representation for the given cell reaction?

$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

(a) $Zn\ |Zn^{2+}\ ||H^+|H_2$

(b) $Zn\ |Zn^{2+}||H^+, H_2|Pt$

(c) $Zn|ZnSO_4\ ||H_2SO_4|\ Zn$

(d) $Zn|H_2SO_4||ZnSO_4\ |H_2$

Rough Work

10. The cell reaction of the galvanic cell :

$Cu(s)|Cu^{2+}_{(aq)}||Hg^{2+}_{(aq)}|Hg(l)$ is

a) $Hg + Cu^{2+} \rightarrow Hg^{2+} + Cu$

b) $Hg + Cu^{2+} \rightarrow Cu^{+} + Hg^{+}$

c) $Cu + Hg \rightarrow CuHg$

d) $Cu + Hg^{2+} \rightarrow Cu^{2+} + Hg$

11. The number of electrons delivered at the cathode during electrolysis by a current of 1 ampere in 60 seconds is

(charge on electron = 1.6×10^{-19})

a) 6×10^{23}

b) 6×10^{20}

c) 3.75×10^{20}

d) 7.48×10^{23}

12. The molar conductance of NaCl, HCl and CH_3CooNa at infinite dilution are 126.45, 426.16 and 91.0 S cm^2 mol^{-1} respectively. The molar conductance of CH_3COOH at Infinite dilution is. Choose the right option for your answer.

a) 540.48 S cm^2 Mol^{-1}

b) 201.28 S cm^2 Mol^{-1}

c) 390.71 S cm^2 Mol^{-1}

d) 698.28 S cm^2 Mol^{-1}

13. The standard electrode potential (E^0) for OCl^-/Cl^- and $Cl^-/\frac{1}{2}Cl_2$ respectively are 0.94 V and –1.36 V. The E^0 value for $OCl^-/\frac{1}{2}Cl_2$ will be

a) –0.42 V

b) –2.20 V

c) 0.52 V

d) 1.04 V

14. Which cell will measure standard electrode potential of copper electrode ?

a) $Pt_{(s)} | H_2(g,0.1bar)|H^+(aq,1M) || Cu^{2+}(aq,1M)|Cu$

b) $Pt_{(s)}|H_2(g,1bar)|H^+(aq,1M)|| Cu^{2+}(aq,2M)|Cu$

c) $Pt_{(s)}|H_2(g,1bar)|H^+(aq,1M)|| Cu^{2+}(aq,1M)|Cu$

d) $Pt_{(s)}|H_2(g,1bar)|H^+(aq, 0.1M)|| Cu^{2+}(aq,1M)|Cu$

15. For a cell reaction : $M^{n+}_{(aq)} + ne^- \rightarrow M_{(s)}$, the Nernst equation for electrode potential at any concentration measured with respect to standard hydrogen electrode is represented as

a) $E_{(M^{n+}/M)} = E^{\circ}_{(M^{n+}/M)} - \frac{RT}{nF} \ln \frac{1}{[M^{n+}]}$

Rough Work

b) $E_{(M/M^{n+})} = E^{\circ}_{(M/M^{n+})} - \frac{RT}{nF}\ln\frac{[M^{n+}]}{[M]}$

c) $E_{(M^{n+}/M)} = E^{\circ}_{(M^{n+}/M)} - \frac{RT}{nF}\log\frac{1}{[M]}$

d) $E_{(M^{n+}/M)} = E^{\circ}_{(M^{n+}/M)} - \frac{RT}{nF}\ln[m^{n+}]$

16. Molar conductivity 0.025 mol L^{-1} methanoic acid is 46.1 S cm^2 mol^{-1}, the degree of dissociation and dissociation constant will be

(Give $\lambda^{\circ}_{H^+} = 349.6\ S\,cm^2\,mol^{-1}$ and $\lambda^{\circ}_{HCOO^-} = 54.6\ S\,cm^2\,mol^{-1}$)

a) 11.4%, 3.67×10^{-4} mol L^{-1}

b) 22.8%, 1.83×10^{-4} mol L^{-1}

c) 52.2%, 4.25×10^{-4} mol L^{-1}

d) 1.14%, 3.67×10^{-6} mol L^{-1}

17. Match the rate law given in column I with the dimensions of rate constants given in column II and mark the appropriate choice

Column I	Column II
(A) Rate = $k[NH_3]^0$	(i) mol $L^{-1}s^{-1}$
(B) Rate = $k[H_2O_2][I^-]$	(ii) L $mol^{-1}s^{-1}$
(C) Rate = $k[CH_3CHO]^{3/2}$	(iii) s^{-1}
(D) Rate = $k[C_2H_5Cl]$	(iv) $L^{1/2}mol^{-1/2}s^{-1}$

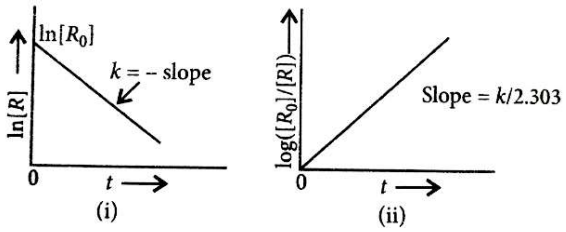
a) $(A) \rightarrow (iv), (B) \rightarrow (iii), (C) \rightarrow (ii), (D) \rightarrow (i)$

b) $(A) \rightarrow (i), (B) \rightarrow (ii), (C) \rightarrow (iii), (D) \rightarrow (iv)$

c) $(A) \rightarrow (ii), (B) \rightarrow (i), (C) \rightarrow (iv), (D) \rightarrow (iii)$

d) $(A) \rightarrow (i), (B) \rightarrow (ii), (C) \rightarrow (iv), (D) \rightarrow (iii)$

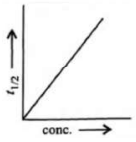
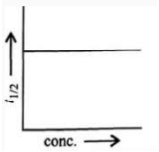
18. Observe the given graphs carefully.



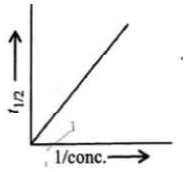
Which of the given orders are shown by the graphs respectively ?

	(i)	(ii)
a)	Zero order	First order
b)	First order	Zero order
c)	First order	First order
d)	Second order	Zero order

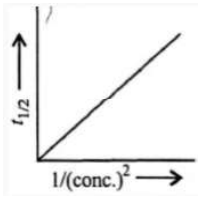
19. Match the plots in column I with their orders in column II and mark the appropriate choice.

column I		Column II
(A)		(i) Zero order
(B)		(ii) First order

Rough Work

(C) 

(ii) Second

(D) 

(iv) Third order

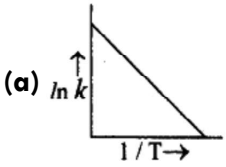
a) (*A*)→ (*iii*), (*B*)→ (*ii*), (C)→ (*i*), (*D*)→ (*iv*)

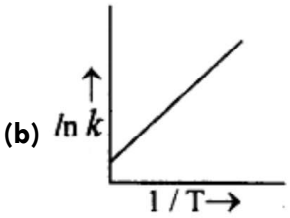
b) (*A*)→ (*i*), (*B*)→ (*ii*), (C)→ (*iii*), (*D*)→ (*iv*)

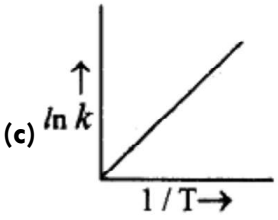
c) (*A*)→ (*iv*), (*B*)→ (*iii*), (C)→ (*ii*), (*D*)→ (*i*)

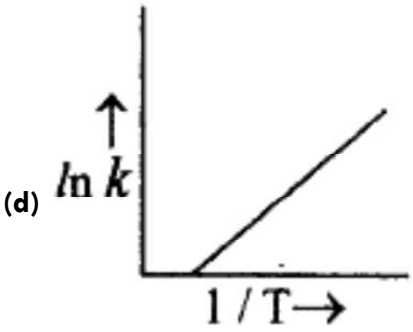
d) (*A*)→ (*ii*), (*B*)→ (*i*), (C)→ (*iii*), (*D*)→ (*iv*)

20. According to Arrhenius equation, rate constant k is equal to $Ae^{-E_a/RT}$. Which of the following options represents the graph of ln k $vs\frac{1}{T}$?

(a) 

(b) 

(c) 

(d) 

21. Which of the following statements is not correct for the catalyst ?

a) It catalyses the forward and backward reaction to the same extent.

b) It alters ΔG of the reaction.

c) It is a substance that does not change the equilibrium constant of a reaction

d) It provides an alternate mechanism by reducing activation energy between reactants and products.

22. Which option is valid for a zero order reaction ?

a) $t_{3/4} = \frac{3}{2}t_{1/2}$

Rough Work

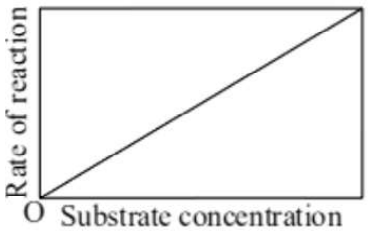
b) $t_{1/2} = \frac{4}{2} t_{3/4}$

c) $t_{1/2} = 2t_{3/4}$

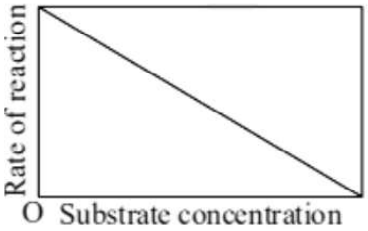
d) $t_{1/2} = 2t_{3/4}$

23. The variation of the rate of an enzyme catalyzed reaction with substrate concentration is correctly represented by graph

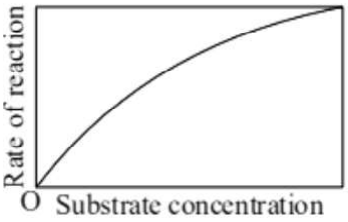
a)



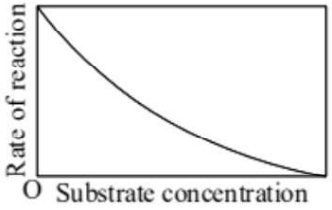
b)



c)



d)



24. Match the column I with column II and mark the appropriate choice.

Column I	Column II
(A) $FeSO_4 . 7H_2O$	(i) Green
(B) $NiCl_2 . 6H_2O$	(ii) Light pink
(C) $MnCl_2 . 4H_2O$	(iii) Pale green
(D) $CoCl_2 . 6H_2O$	(iv) Pink
(E) Cu_2Cl_2	(v) Colourless

(a) $(A) \rightarrow (iii), (B) \rightarrow (iv), (C) \rightarrow (i), (D) \rightarrow (ii), (D) \rightarrow (v)$

(b) $(A) \rightarrow (ii), (B) \rightarrow (iii), (C) \rightarrow (iv), (D) \rightarrow (i), (D) \rightarrow (v)$

(c) $(A) \rightarrow (v), (B) \rightarrow (ii), (C) \rightarrow (iii), (D) \rightarrow (iv), (D) \rightarrow (i)$

(d) $(A) \rightarrow (iii), (B) \rightarrow (i), (C) \rightarrow (ii), (D) \rightarrow (iv), (D) \rightarrow (v)$

25. Which of the following compounds is used as the starting material for the preparation of potassium dichromate ?

(a) $K_2SO_4 . Cr_2(SO_4)_3 . 24H_2O$ (Chrome alum)

(b) $PbCrO_4$ (Chromite yellow)

(c) $FeCr_2O_4$ (Chromite)

(c) $PbCrO_4 . PbO$ (Chrome red)

26. Which of the following reactions is not correct ?

(a) $MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$

(b) $2MnO_2 + 4KOH + O_2 \rightarrow 4KMnO_4 + 2H_2O$

(c) $2Na_2CrO_4 + 2H^+ \rightarrow Na_2Cr_2O_7 + 2Na^+ + H_2O$

(d) $K_2Cr_2O_7 + 7H_2SO_4 + 6KI \rightarrow$

$4K_2SO_4 + Cr_2(SO_4)_3 + 3I_2 + 7H_2O$

Rough Work

27. $A \xrightarrow{4KOH,\ O_2} \underset{(green)}{2B + 2H_2O}$

$3B \xrightarrow{4HCl} \underset{(purple)}{2C + MnO_2 + 2H_2O}$

$2C \xrightarrow{H_2O,\ KI} 2A + 2KOH + D$

In the above sequence of reactions, A and D, respeectively are

a) KI and $KMnO_4$

b) KIO_3 and MnO_2

c) KI and K_2MnO_4

d) MnO_2 and KIO_3

28. Given below are two statements.

Statement I : Iron (III) catalyst, acidified $K_2Cr_2O_7$ and neutral $KMnO_4$ have the ability to oxidise I^- **to I_2 independently.**

Statement II : Manganate ion is paaramagnetic in nature and involves $p\pi - p\pi$ bonding.

In the light of the above statements, choose the correct answer from the options given below

a) Both statement I and statement IIare true

b) Both statement I and statement II are fasle

c) Statement I is true but statement II is false

d) Statement I is false but statement II is true.

29. Highest oxidation state of manganese in flurides is +4 (MnF_4) **but highest oxidation state in oxides is +7 (Mn_2O_7) because**

a) fluorine is more electronegative than oxygen

b) fluorine doesnot possess d-orbitals

c) fluorine stabilises lower oxidation state

d) in covalent compounds, fluorine can form single bond only while oxygen forms double bond.

30. Strong reducing and oxidising agents among the following, respectively, are

a) Ce^{4+} and Eu^{2+}

b) Eu^{2+} and Ce^{4+}

c) Ce^{3+} and Ce^{4+}

d) Ce^{4+} and Tb^{4+}

31. The inverse of the function $y = \dfrac{10^x - 10^{-x}}{10^x + 10^{-x}}$ is :

a) $\log_{10}(2-x)$

b) $\dfrac{1}{2}\log_{10}\left(\dfrac{1+x}{1-x}\right)$

c) $\dfrac{1}{2}\log_{10}(2x-1)$

d) $\dfrac{1}{4}\log\left(\dfrac{2x}{2-x}\right)$

Rough Work

32. If $f(x)=\begin{cases}2+2x, & -1\le x<0\\ 1-\frac{x}{3}, & 0\le x\le 3\end{cases}$;

$g(x)=\begin{cases}-x, & -3\le x\le 0\\ x, & 0<x\le 1\end{cases}$ then range of (fog)(x) is :

a) [0, 1)

b) [0, 3)

c) (0, 1]

d) [0, 1]

33. If a and B are roots of the equation $x^2+5|x|-6=0$ then the value of $\left|\tan^{-1}\alpha-\tan^{-1}\beta\right|$ is

a) $\frac{\pi}{2}$

b) 0

c) π

d) $\frac{\pi}{4}$

34. If $\cot^{-1}\left(\sqrt{\cos\alpha}\right)-\tan^{-1}\left(\sqrt{\cos\alpha}\right)=x$, then sinx is equal to

a) $\tan^2\left(\frac{\alpha}{2}\right)$

b) $\cot^2\left(\frac{\alpha}{2}\right)$

c) $\tan\alpha$

d) $\cot\left(\frac{\alpha}{2}\right)$

35. Let $a_1=1$, a_2, a_3, a_4,... be consecutive natural numbers.

Then $\tan^{-1}\left(\frac{1}{1+a_1a_2}\right)+\tan^{-1}\left(\frac{1}{1+a_2a_3}\right)+.....$

$\tan^{-1}\left(\frac{1}{1+a_{2021}a_{2022}}\right)$ is equal to

a) $\cot^{-1}(2022)-\frac{\pi}{4}$

b) $\frac{\pi}{4}-\cot^{-1}(2022)$

c) $\tan^{-1}(2022)-\frac{\pi}{4}$

d) $\frac{\pi}{4}-\tan^{-1}(2022)$

36. Let P be a square matrix such that $P^2 = I - P$. For $\alpha,\beta,\gamma,\delta\in N$, If $p^\alpha+p^\beta=\gamma I-29P$ and $p^\alpha-p^\beta=\delta I-13P$, then $\alpha+\beta+\gamma-\delta$ is equal to

a) 40

b) 22

c) 18

d) 24

Rough Work

37. Let A=[a_{ij}] be a square matrix of order 3 such that $a_{ij} = 2^{j-i}$, for all i, j = 1, 2, 3. Then, the matrix $A^2 + A^3 + ... + A^{10}$ is equal to

a) $\left(\frac{3^{10}-3}{2}\right)A$

b) $\left(\frac{3^{10}-1}{2}\right)A$

c) $\left(\frac{3^{10}+1}{2}\right)A$

d) $\left(\frac{3^{10}+3}{2}\right)A$

38. If the equations x + y = 1, (c+2)x+(c+4)y–z = 6, $(c+2)^2 x + (c+4)^2 y + z = 36$ are consistent, then c ≠

a) 1

b) $\frac{-7}{2}$

c) 3

d) None of these

39. A non-trivial solution of the system of equations $x + \lambda y + 2z = 0$, $2x + \lambda z = 0$, $2\lambda x - 2y + 3z = 0$ is

a) 1 : 2 : –2

b) 1 : –2 : 2

c) 2 : 1 : 2

d) 2 : 1 : –2

40. Let A be 2×2 matrix with det(A) = –1 and det ((A+I) (Adj (A) + I)) = 4. Then the sum of the diagonal elements of A can be.

a) –1

b) 2

c) 1

d) $-\sqrt{2}$

41. Let A be a matrix of order 3×3 and det(A) = 2. Then det (det (A) . adj (5 adj (A^3))) is equal to _____

a) 512 ×10^6

b) 256 ×10^6

c) 1024 ×10^6

d) 256 ×10^{11}

42. The derivative of $\sin^{-1}\left(\frac{2x}{1+x^2}\right)$ with respect to $\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$ is :

a) –1

b) 1

c) 2

d) 4

Rough Work

43. If x = f(t) and y = g(t), then $\frac{d^2y}{dx^2}$ is equal to

a) $\frac{g''(t)}{f''(t)}$

b) $\frac{g''(t)f'(t)-g'(t)f''(t)}{(f'(t))^3}$

c) $\frac{g''(t)f'(t)-g'(t)f''(t)}{(f'(t))^2}$

d) None of these

44. In which of the following intervals, the function $y(x) = x^3 - 3x^2 - 9x + 5$ is always decreasing?

a) (–1, 3)

b) (–3, 3)

c) (–4, 4)

d) (–2, 2)

45. If $\int \sin 4x.e^{\tan^2 x}dx = a\cos^b x.e^{\tan^2 x} + c$, then the value of a^{2b} must be equal to _____.

a) –2

b) 64

c) 32

d) 256

46. If $\int \frac{x+1}{\sqrt{2x-1}}dx = f(x)\sqrt{2x-1} + C$, where C is a constant of integration, then f(x) is equal to

a) $\frac{1}{3}(x+1)$

b) $\frac{1}{3}(x+4)$

c) $\frac{2}{3}(x+2)$

d) $\frac{2}{3}(x-4)$

47. Area (in. sq. units) of the region bounded by the curve y = tanx, line $x = \frac{\pi}{4}$ and the x-axis is

a) log2

b) $\frac{1}{2}$log2

c) $\frac{1}{3}$log2

d) 5 log 2

48. The area enclosed by the curves $3x^2 + 5y = 32$ and y = |x–2| is

a) $\frac{13}{2}$ sq. units

b) $\frac{17}{2}$ sq. units

c) $\frac{23}{2}$ sq. units

d) $\frac{33}{2}$ sq. units

Rough Work

49. The area of the region bounded by the curve x = $2y + 3$ and the lines y = 1 and y = –1 is

a) 4 sq. units

b) $\frac{3}{2}$ sq. units

c) 6 sq. units

d) 8 sq. units

50. The order and degree of the differential equation $\frac{d^2y}{dx^2}+\left(\frac{dy}{dx}\right)^{\frac{1}{4}}+x^{\frac{1}{5}}=0$, respectively, are

a) 2 and not defined

b) 2 and 2

c) 2 and 3

d) 3 and 3

51. If $(2+\sin x)\frac{dy}{dx}+(y+1)\cos x=0$, y(0) = 1, then $y\left(\frac{\pi}{2}\right)$ is equal to

a) $-\frac{2}{3}$

b) $-\frac{1}{3}$

c) $\frac{4}{3}$

d) $\frac{1}{3}$

52. The distance of the point A(–2, 3, 1) from the line PQ through P(–3, 5, 2) which makes equal angles with the axes is

a) $\frac{2}{\sqrt{3}}$

b) $\sqrt{\frac{14}{3}}$

c) $\frac{16}{\sqrt{3}}$

d) $\frac{5}{\sqrt{3}}$

53. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectos, then $\left|\vec{a}-\vec{b}\right|^2+\left|\vec{b}-\vec{c}\right|^2+\left|\vec{c}-\vec{a}\right|^2$ does not exceed

a) 4

b) 9

c) 8

d) 6

54. If $\vec{a}=\hat{i}+2\hat{k}, \vec{b}=\hat{i}+\hat{j}+\hat{k}, \vec{c}=7\hat{i}-3\hat{j}+4\hat{k}$, $\vec{r}\times\vec{b}+\vec{b}\times\vec{c}=\vec{0}$ and $\vec{r}.\vec{a}=0$. Then $\vec{r}.\vec{c}$ is equal to

a) 34

b) 36

c) 32

d)30

Rough Work

55. If the angle between the lines, $\frac{x}{2}=\frac{y}{2}=\frac{z}{1}$ and $\frac{5-x}{-2}=\frac{7y-14}{p}=\frac{z-3}{4}$ is $\cos^{-1}\left(\frac{2}{3}\right)$, then p is equal to

a) $-\frac{4}{7}$

b) $\frac{7}{2}$

c) $-\frac{7}{4}$

d) $\frac{2}{7}$

56. Let S be the set of all values of λ, for which the shortest distance btween the lines $\frac{x-\lambda}{0}=\frac{y-3}{4}=\frac{z+6}{1}$ and $\frac{x+\lambda}{3}=\frac{y}{-4}=\frac{z-6}{0}$ is 13. Then $8\left|\sum_{\lambda\in S}\lambda\right|$ is equal to

a) 302

b) 306

c) 308

d) 304

57. Suppose that 6% of the people with blood group O are left handed and 10% of those with other blood groups are left handed, 30% of the people have blood group O. If a left handed person is selected at random, what is the probability that he/she will have blood group O?

a) $\frac{3}{44}$

b) $\frac{6}{44}$

c) $\frac{9}{44}$

d) $\frac{7}{44}$

58. If $P(B)=\frac{3}{5}, P(A\mid B)=\frac{1}{2}$ and $P(A\cup B)=\frac{4}{5}$, then $P(A\cup B)'+P(A'\cup B)=$

a) $\frac{1}{5}$

b) $\frac{4}{5}$

c) $\frac{1}{2}$

d) 1

59. Let E1 and E2 be two events such that the conditional probablities $P(E_1\mid E_2)=\frac{1}{2}, P(E_2\mid E_1)=\frac{3}{4}$ and $P(E_1\cap E_2)=\frac{1}{8}$. Then

a) $P(E_1\cap E_2)=P(E_1).P(E_2)$

b) $P(E'_1\cap E'_2)=P(E'_1).P(E_2)$

Rough Work

c) $P(E_1 \cap E'_2) = P(E_1).P(E_2)$

d) $P(E'_1 \cap E'_2) = P(E_1).P(E_2)$

60. Let two fair six-faced dice A and B be thrown simultaneously. If E_1 is the event that die A shows up four, E_2 is the event that die B shows up two and E_3 is the event that the sum of numbers on both dice is odd, then which of the following statements is not true?

a) E_1 and E_2 are independent

b) E_2 and E_3 are independent

c) E_1 and E_3 are independent

d) E_1, E_2 and E_3 are independent

61. In a certain code, "PLANET" is written as "OMZMDZ" and "ORBIT" is written as "NQSAZ". How is "SYSTEM" written in that code?

a) RXRSDX

b) RYRTDN

c) RXRRDZ

d) RZRTDZ

62. Pointing to a photograph, a man said, "I have no brothers and sisters, but the man's father in the photo is my father's son." How is the man in the photograph related to the speaker?

a) Son

b) Nephew

c) Cousin

d) Self

63. A man starts from point P and walks 5 km east, then takes a left turn and walks 8 km, then takes another left turn and walks 12 km. Finally, he takes a left turn and walks 8 km. How far is he from point P?

a) 2 km

b) 3 km

c) 4 km

d) 5 km

64. In a class of 45 students, A ranks 12th from the top, and B ranks 8th from the bottom. How many students are there between A and B?

a) 24

b) 25

c) 26

d) 27

65. A large cube is painted on two opposite faces and then cut into 216 smaller cubes of equal size. How many cubes have no faces painted?

a) 64

b) 100

c) 96

d) 120

66. If 1st January 2021 was a Friday, what day of the week was 1st January 2025?

a) Tuesday

b) Wednesday

c) Thursday

d) Friday

Rough Work

67. A rectangular grid is made by dividing a square into 5 rows and 5 columns of equal size, forming smaller squares. How many total squares (of all possible sizes) are there in this grid?

a) 25
b) 28
c) 30
d) 55

68. Some chairs are tables.

1. All tables are furniture.

Conclusions:

I. Some chairs are furniture.
II. All chairs are furniture.

a) Only conclusion I follows
b) Only conclusion II follows
c) Both conclusions I and II follow
d) Neither conclusion I nor II follows

69. Mountain : Valley :: Convex : ?

a) Circle
b) Concave
c) Plane
d) Line

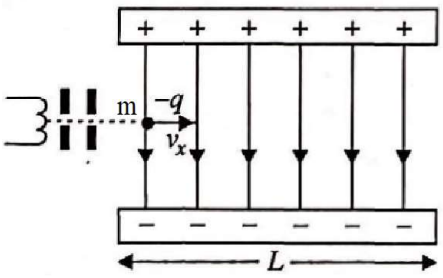
70. Choose the odd one out:

a) Pyramid
b) Cylinder
c) Sphere
d) Cone

71. A cup contains 250 g of water. Find the total positive charge present in the cup of water.

a) 1.34×10^{19} C
b) 1.34×10^{7}C
c) 2.43×10^{19}C
d) 2.43×10^{7}C

72. A particle of mass m and charge –q enters the region between the two charged plates initially moving along x-axis with speed v_x as shown in figure. The length of plate is L and a uniform electric field E is maintained between the plates. The vertical deflection of the particle at the far edge of the plate is

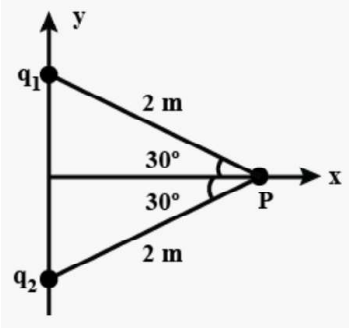


a) $\frac{qEL^2}{2mv_x^2}$
b) $\frac{qEL^2}{2mv_x}$
c) $\frac{2mv_x^2}{qEL^2}$
d) $\frac{2mv_x}{qE^2L}$

73. Two point carge $q_1 = -4\mu C$ and $q_2 = 8\mu C$ are lying on the y-axis. They are equidistant from the point P, which lies on the x-axis.

Rough Work

A small object of charge $q_0 = 8\mu C$ and mass m = 12 g is placed at P.
What it is released, what is its acceleration (in m s^{-2}) ? (Neglect the effect of gravity)



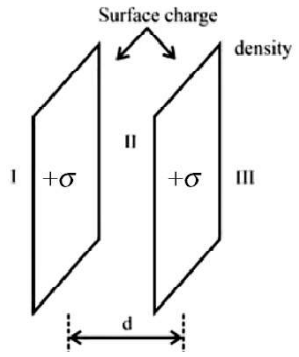
a) $3\sqrt{3}\hat{i} + 9\hat{j}$

b) $9\hat{i} + 3\sqrt{3}\ \hat{j}$

c) $3\hat{i} + 3\sqrt{3}\ \hat{j}$

d) $3\sqrt{3}\ \hat{i} + 3\hat{j}$

74. Let σ be the uniform surface charge density of two infinite thin plane sheets shown in figure. Then the electric field in three different region E_I, E_{II} and E_{III} are



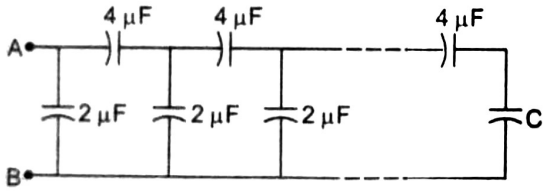
a) $\vec{E}_1 = 0,\ \vec{E}_{II} = \dfrac{\sigma}{\varepsilon_0}\hat{n},\ \vec{E}_{III} = 0$

b) $\vec{E}_1 = \dfrac{2\sigma}{\varepsilon_0}\hat{n},\ \vec{E}_{II} = 0,\ \vec{E}_{III} = \dfrac{2\sigma}{\varepsilon_0}\hat{n}$

c) $\vec{E}_1 = -\dfrac{\sigma}{\varepsilon_0}\hat{n},\ \vec{E}_{II} = 0,\ \vec{E}_{III} = \dfrac{\sigma}{\varepsilon_0}\hat{n}$

d) $\vec{E}_1 = \dfrac{\sigma}{2\varepsilon_0}\hat{n},\ \vec{E}_{II} = 0,\ \vec{E}_{III} = \dfrac{\sigma}{2\varepsilon_0}\hat{n}$

75. A finite ladder is contracted by connecting several setions of 2μ, $4\mu F$ capacitor combinations as shown in figure. It is terminated by a capacitor of capacitance C. The value that shold be chosen for C, such that the equivalent capacitance of the ladder between the points A and B becomes independent of the number of sections in between, is ..... μF.



a) $4\mu F$

b) $5\mu F$

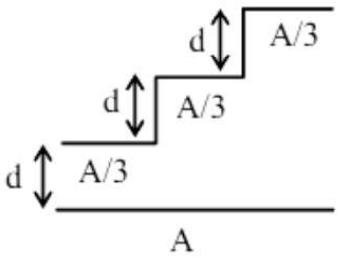
c) $6\mu F$

d) $7\ \mu F$

76. A capacitor is made of a flat plate of area. A and a second plate having s stair - like structure as shown in figure. If the area of each stair is $\dfrac{A}{3}$

Rough Work

and the height is d, the capacitance of the arrangement is



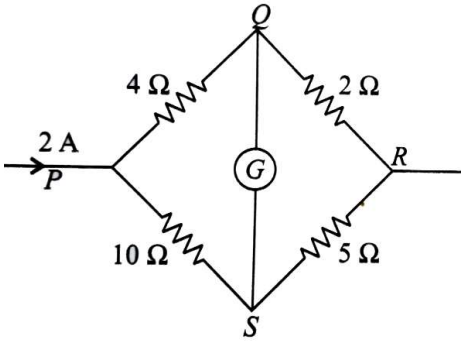
a) $\frac{11\varepsilon_0 A}{20d}$

b) $\frac{18\varepsilon_0 A}{11d}$

c) $\frac{11\varepsilon_0 A}{18d}$

d) $\frac{13\varepsilon_0 A}{17d}$

77. In the shown figure, bridge is balanced, the current flowing through 2Ω resistance is



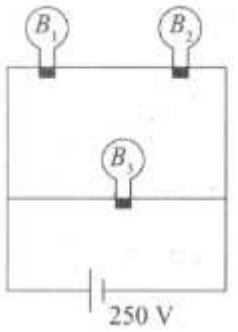
a) $\frac{10}{7}A$

b) $\frac{11}{7}A$

c) $\frac{13}{7}A$

d) $\frac{8}{7}A$

78. A 100 W bulb B_1 and two 60 W bulbs B_2 and B_3, are connected to a 250 V source, as shown in figure. Now W_1, W_2 and W_3 are the output powers of the bulbs B_1, B_2 and B_3, respectively. Then



a) $W_1 > W_2 = W_3$

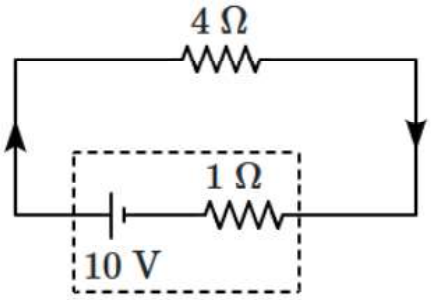
b) $W_1 > W_2 > W_3$

c) $W_1 < W_2 = W_3$

d) $W_1 < W_2 < W_3$

79. The terminal voltage of the battery, whose emf is 10 V and internal resistance 1Ω, when connected through an external resistance of $4\ \Omega$ as shown in the figure is

Rough Work



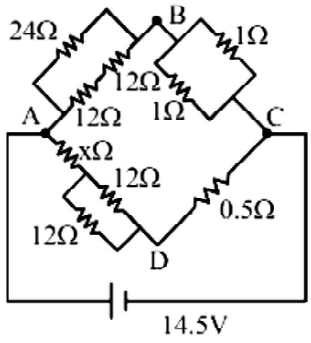
a) 4 V

b) 6 V

c) 8 V

d) 10 V

80. The value of unknown resistance (x) for which the potential difference between B and D will be zero in the arrangement shown, is



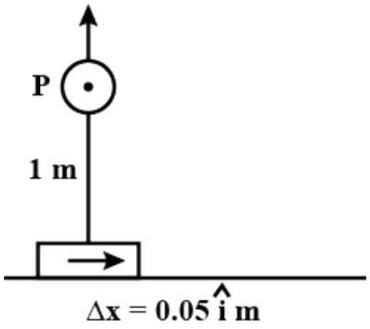
a) 42 Ω

b) 9 Ω

c) 6 Ω

d) 3 Ω

81. An element of $0.05\hat{i}$ m is placed at the origin as shown in figure which carries a large current of 10 A. The magnetic field at a distance of 1 m in perpendicular direction is



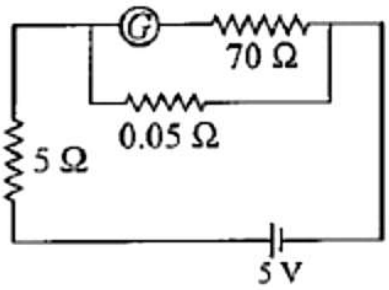
a) 4.5×10^{-8}T

b) 5.5×10^{-8}T

c) 5.0×10^{-8}T

d) 7.5×10^{-8}T

82. In the given circuit, a galvanometer with a resistance of 70Ω is converted to an ammeter by a shunt resistance of 0.05Ω, total current measurd by this device is



a) 0.88 A

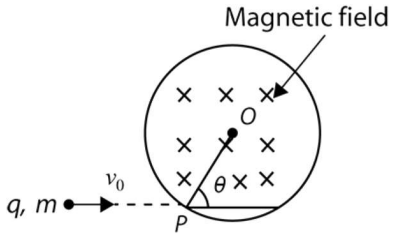
b) 0.77 A

c) 0.55 A

d) 0.99 A

Rough Work

83. A particle of charge q and mass m is projected with a velocity v_0 towards a circular region having uniform magnetic field B perpendicular and into the plane of paper, from point P as shown in figure. R is the radius and O is the centre of the circular region. If the line OP makes and angle θ with the direction of v_0 then the value of v_0 so that particle passes through O is



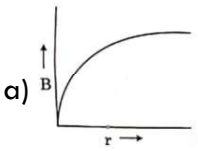
a) $\frac{qBR}{m\sin\theta}$

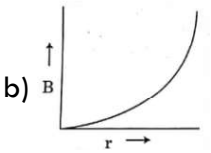
b) $\frac{qBR}{2m\sin\theta}$

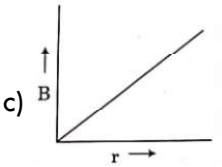
c) $\frac{2qBR}{m\sin\theta}$

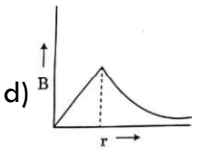
d) $\frac{3qBR}{2m\sin\theta}$

84. A thick current carrying cable of radius 'R' carries current 'I' uniformaly distributed across its cross-section. The variation of magnetic field B(r) due to the cable with the distance 'r' from the axis of the cable is represented by

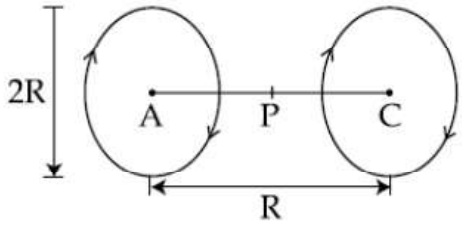
a) 

b) 

c) 

d) 

85. A helmholtz coil has a pair of loops, each with N turns and radius R. They are placed coaxially at distance R and the same current I flows through the loops in the same direction. The magnitude of magnetic field at P, midway between the centre s A and C, is given by



Rough Work

a) $\frac{4N\mu_0 I}{5^{1/2}R}$

b) $\frac{4N\mu_0 I}{5^{3/2}R}$

c) $\frac{8N\mu_0 I}{5^{3/2}R}$

d) $\frac{8N\mu_0 I}{5^{1/2}R}$

86. A short bar magent placed with its axis at 30^0 with a uniform external magnetic field of 0.35 T experiences a torque of magnitude equal to 4.5×10^{-2} N m. The magnitude of magnetic moment of the given magnet is

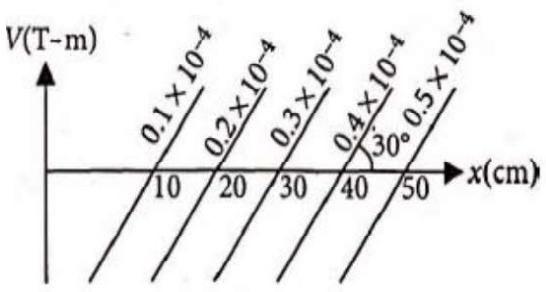
a) 26 J T^{-1}

b) 2.6 J T^{-1}

c) 0.26 J T^{-1}

d) 0.026 J T^{-1}

87. Some equipotential surfaces of the magnetic scalar potential are shown in figure. Magnetic field at a point in the region (in T) is



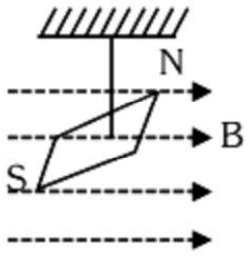
a) 10^{-4}

b) 0.5×10^{-4}

c) 2×10^{-4}

d) None

88. In a uniform magnetic field of 0.049 T, a magnetic needle performs 20 complete oscillations in 5 seconds as shown. The moment of inertia of a needle is 9.8×10^{-6} kg m^2. If the magnitude of magnetic moment of the needle is $x \times 10^{-5}$ Am^2; then the value of 'x' is



a) $5\pi^2$

b) $128\pi^2$

c) $50\pi^2$

d) $1280\pi^2$

89. A susceptibility of a certain magnetic material is 400. What is the class of the magnetic material ?

a) Ferromagnetic

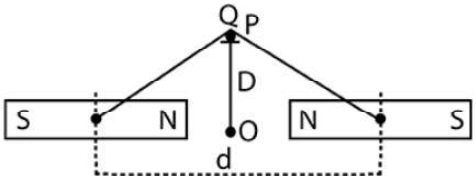
b) Diamagnetic

c) Ferroelectric

d) Paramagnetic

Rough Work

90. Two identical bar magnets are fixed with their centres at a distane d apart. a stationary charge Q is placed at P in between the gap of the two magnets at a distance D from the centre O as shown in the figure. The force on the charge Q is



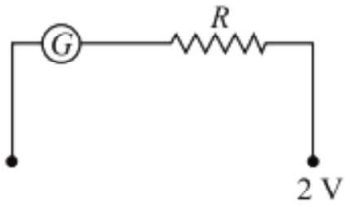
a) zero

b) directed along OP

c) directed along PO

d) directed perpendicular to the plane of paper

91. A voltmeter which can measure 2 V is constructed by using a galvanometer of resistance 12Ω and that produces maximum deflection for the current of 2mA, then the resistance R is



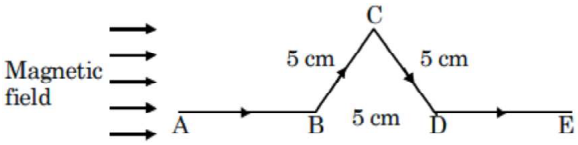
a) 888 Ω

b) 988 Ω

c) 898 Ω

d) 999 Ω

92. A triangular shaped wire carrying 10 A current is placed in a uniform magnetic field of 0.5 T, as shown in figure. The magnetic force on segment CD is
(Given BC = CD = BD = 5 cm.)



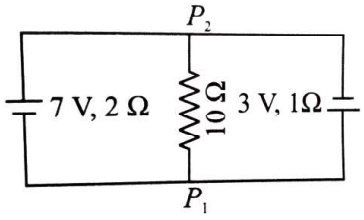
a) 0.126 N

b) 0.312 N

c) 0.216 N

d) 0.245 N

93. A 7 V battery with internal resistance 2 Ω **and a 3 V battery with internal resistance** 1 Ω **are connected to a** 10 Ω **resistor as shown in figure, the current in** 10 Ω **resistor is**



a) 0.27 A

b) 0.31 A

c) 0.031 A

d) 0.53 A

94. A silver wire has temperature coefficient of resistivity 4 × 10^{-3} °C^{-1} and its resistance at 20

Rough Work

°C is 10 Ω. Neglect any change in dimensions due to the change in temperature, its resistance at 40 °C is

a) 0.8 Ω

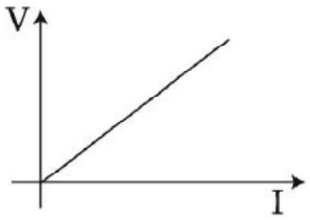
b) 1.8 Ω

c) 9.2 Ω

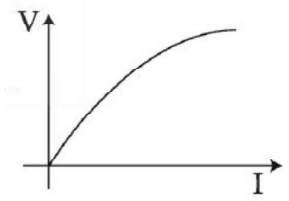
d) 10.8 Ω

95. Suppose the drift velocity v_d in a material varied with the applied electric field E as $v_d \propto \sqrt{E}$. Then V-I graph for a wire made of such a material is best given by

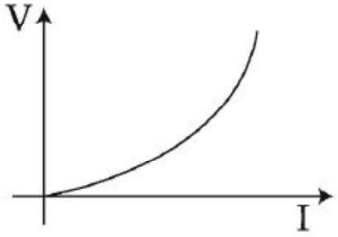
a)



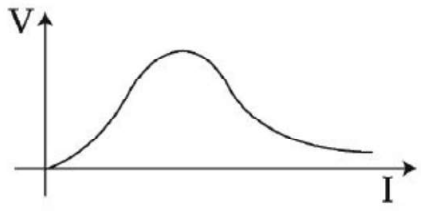
b)



c)



d)



96. In an atom electrons revolves around the nucleus along a path of radius 0.72 Å making 9.4×10^{18} revolution per second. The equivalent current is ($e = 1.6 \times 10^{-19}$ C)

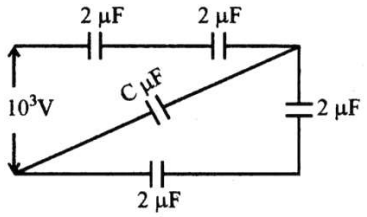
a) 1.2 A

b) 1.5 A

c) 1.4 A

d) 1.8 A

97. When a potential difference of 10^3 V is applied between A and B, a charge of 0.75 mC is stored in the system of capacitors as shown. The value of C is (in μF) and energy stored (in J) in the equivalent capacitor is



a) $\frac{1}{2}$, 2

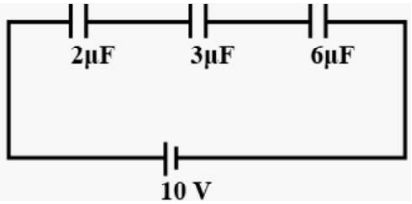
b) 2, 1

c) 2.5, 2

d) 3,1

Rough Work

98. The charge on $3\mu F$ capacitor shown in the figure is



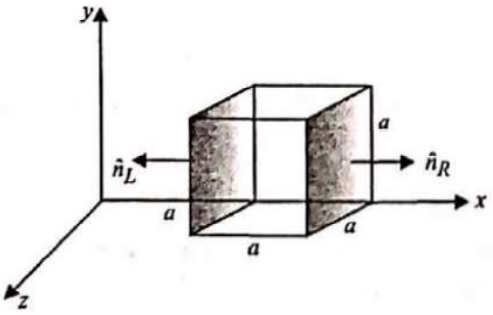
a) $2\mu C$

b) $10\mu C$

c) $6\mu C$

d) $8\mu C$

99. The electric field components in the given figure are $E_x = \alpha x^{1/2}$, $E_y = E_z = 0$ in which $\alpha = 800 N C^{-1} m^{-1/2}$. The charge within the cube if net flux in (in 10^{-12} C) through the cube is 1.05 N m^2 C^{-1}, is approx (assume a = 0.1 m)



a) 9.27

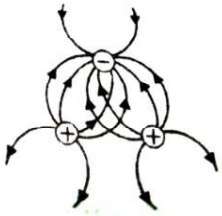
b) 8.27

c) 5.97

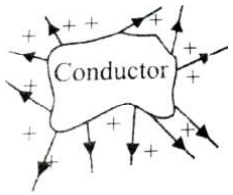
d) 4.97

100. Which of the following curves represent electric field lines correctly ?

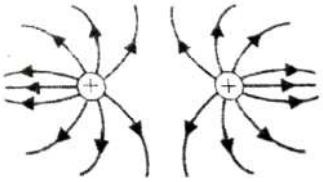
a)



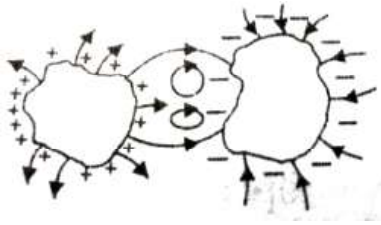
b)



c)



d)



Rough Work

ROUGH WORK

ROUGH WORK