Deeksha

ABHYAS KCET 2024

FREE TEST SERIES

MOCK TEST 1 PDF

SOLUTION

Deeksha - CET

Subject	Topic	
C + M + P	Complete Syllabus	

Max. Marks: 180 **Duration:** 3 Hours

1. **This paper consists of 180 questions with 3 parts of Chemistry, Mathematics and Physics**

   - **Chemistry:** *(Q. No. 1 to 60) Multiple Choice Questions with one correct answer. A correct answer carries 1 Mark. No Negative marks.*
   - **Mathematics:** *(Q. No. 61 to 120) Multiple Choice Questions with one correct answer. A correct answer carries 1 Mark. No Negative marks.*
   - **Physics:** *(Q. No. 121 to 180) Multiple Choice Questions with one correct answer. A correct answer carries 1 Mark. No Negative marks.*

2. **The OMR sheet for 200 questions is to be used**

3. **Use of calculators and log tables is prohibited**

4. **Darken the appropriate bubble using a pen in the OMR sheet provided to you. Once entered, the answer cannot be changed. Any corrections or modifications will automatically draw a penalty of 1 mark**

5. **No clarification will be entertained during the examination. Doubts in the paper can be reported to the coordinator after the exam**

6. **If the details in the OMR Sheet are not filled, If the OMR sheet is mutilated, torn, white Ink used, the circles filled and scratched, then the OMR sheet will not be graded**

   All the best!!

Useful Data

At. Wt.:

$N=14;\ O=16;\ H=1;\ S=32;\ Cl=35.5;\ Mn=55;\ Na=23;\ C=12;\ Ag=108;\ K=39;\ Fe=56;\ Pb=207$

Physical Constants:

$h=6.626\times10^{-34}\,\text{Js},\ N_a=6.022\times10^{23}\,\text{mol}^{-1},\ c=2.998\times10^{8}\,\text{m s}^{-1},\ m_e=9.1\times10^{-31}\,\text{kg},\ R=8.314\ \text{J mol}^{-1}\ \text{K}^{-1}$

Chemistry

Multiple Choice Questions with one correct answer. A correct answer carries 1 mark. No negative mark. **60 x 1 = 60**

1. If one atom of an element A weighs $6.644\times10^{-23}g$, then the molar mass in g mol^{-1} of the element is

   (a) 50 (b) 40 (c) 100 (d) 20

   Sol: Atomic weight of A = weight of one atom $\times$ Avogadro's constant

   $= 6.644\times10^{-23}\times6.023\times10^{23} = 40g$

   Ans: (b)

2. The uncertainity in the momentum of an electron is $1.0\times10^{-5}\text{kg ms}^{-1}$. The uncertainty in its position will be (given $\frac{h}{4\pi}\approx5.25\times10^{-35}$)

   (a) $1.05\times10^{-28}m$ (b) $1.05\times10^{-26}m$ (c) $5.27\times10^{-30}m$ (d) $5.25\times10^{-28}m$

   Sol: We know, $\Delta x\cdot\Delta p=\frac{h}{4\pi}\approx5.25\times10^{-35}$

   $\Delta x=\frac{5.25\times10^{-35}}{1.0\times10^{-5}}=5.25\times10^{-30}m$

   Ans: (c)

3. The order of first ionisation energies of the elements $Li,\ Be,\ B,\ Na$ is

   (a) $Li>Be>B>Na$ (b) $Be>B>Li>Na$ (c) $Na>Li>B>Be$ (d) $Be>Li>B>Na$

   Sol: Ionisation energy increases from left to right $(Li\rightarrow B)$ and decreases from top to bottom in periodic table. But Be $(1s^2 2s^2)$ has higher ionisation energy than $B(1s^2 2s^2 2p^1)$ due to fully filled $s-$ orbital electronic configuration.

   Ans: (b)

4. Arrange the following in the increasing order of their bond order: O_2, O_2^+, O_2^- & O_2^{2-}

   (a) $O_2^{-2}, O_2^-, O_2, O_2^+$ (b) $O_2^{2-}, O_2^-, O_2^+, O_2$ (c) $O_2^+, O_2, O_2^-, O_2^{-2}$ (d) $O_2, O_2^+, O_2^-, O_2^{-2}$

   Sol:

   Increasing order of bond order is $\underset{(1.0)}{O_2^{-2}} < \underset{(1.5)}{O_2^-} < \underset{(2.0)}{O_2} < \underset{(2.5)}{O_2^+}$

   Ans: (a)

5. H_2O is dipolar, whereas BeF_2 is not. It is because

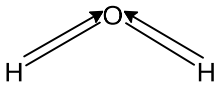
   (a) H_2O is angular and BeF_2 is linear

   (b) The electronegativity of F is greater than that of O

   (c) H_2O involves hydrogen bonding whereas BeF_2 is a discrete molecule

   (d) H_2O is linear and BeF_2 is angular

Sol:



$\mu \neq 0$
(Angular)

$\mu = 0$
(Angular)

Ans: (a)

6. Equal masses of methane and hydrogen are mixed in an empty container at $25°C$. The fraction of the total pressure exerted by hydrogen is

(a) 1/2 (b) 8/9 (c) 1/9 (d) 16/17

Sol: Let wg of each methane (CH_4, molecular weight 16) and hydrogen (H_2, mol. Weight 2) are mixed

Mole fraction of $H_2\left(x_{H_2}\right) = \dfrac{n_{H_2}}{n_{CH_4}+n_{H_2}} = \dfrac{\frac{w}{2}}{\frac{w}{16}+\frac{w}{2}} = \dfrac{w}{2}\times\dfrac{16}{9w} = \dfrac{8}{9}$

Partial pressure $\propto$ mole fraction

$\therefore \frac{8}{9}$ fraction of total pressure is exerted by hydrogen

Ans: (b)

7. Standard enthalpy and standard entropy changes for the oxidation of ammonia at $298K$ are $-382.0\,\text{kJ mol}^{-1}$ and $-145.0\ \text{JK}^{-1}\ \text{mol}^{-1}$ respectively. Standard Gibb's energy change for the same reaction at $300\ K$ is

(a) -523.2 kJ mol (b) -221.1 kJ mol (c) -338.5 kJ mol (d) -439.3 kJ mol

Sol: Applying $\Delta G = \Delta H - T\Delta S$

$\Delta H = -382.0\ \text{kJ mol}^{-1},\ T = 300\ K,$

$\Delta S = -145.0\ \text{JK}^{-1}\text{mol}^{-1} = -0.145\ \text{kJ K}^{-1}\text{mol}^{-1}$

$\Delta G = -382.0 - 300\times(-0.145) = -338.5\ \text{kJ mol}^{-1}$

Ans: (c)

8. Heat of neutralization of a strong acid by a strong base is a constant value because

(a) Salt formed does not hydrolyse

(b) Only H^+ and OH^- ions react in every case

(c) The strong base and strong acid react completely

(d) The strong base and strong acid react in aqueous solution

Sol: For example: $Na^+ + OH^- + H^+ + Cl^- \rightarrow Na^+ + Cl^- + H_2O$

i.e., $H^+ + OH^- \rightarrow H_2O$

Thus heat of neutralization of a strong acid with strong base is constant.

Ans: (b)

9. $NH_4COONH_{2(s)} \rightleftharpoons 2NH_{3(g)} + CO_{2(g)}$. If equilibrium pressure is 3 atm for the above reaction, K_p for the reaction is

(a) 4 (b) $\frac{4}{27}$ (c) $\frac{1}{27}$ (d) 27

Sol:

$$NH_4COONH_{2(s)} \rightleftharpoons 2NH_{3(g)} + CO_{2(g)}$$

Pressure at equilibrium $\quad 2p \quad p$

It is given that $2p + p = 3$ atm $\quad \therefore p = 1$ atm

$K_p = P_{NH_3}^2 \times P_{CO_2} = (2)^2 \times 1 = 4$

Ans: (a)

10. Why only As^{3+} gets precipitated as As_2S_3 and not Zn^{2+} as ZnS when H_2S is passed through an acidic solution containing As^{3+} and Zn^{2+}?

(a) Solubility product of As_2S_3 is less than that of ZnS

(b) Enough As^{3+} are present in acidic medium

(c) Zinc salt does not ionise in acidic medium

(d) Solubility product changes in presence of an acid

Sol: K_{sp} of $As_2S_3 < ZnS$ in acidic solution.

Ans: (a)

11. Which of the following species do not show disproportionation reaction?

(a) ClO^- (b) ClO_2^- (c) ClO_3^- (d) ClO_4^-

Sol: ClO_4^- does not disproportionate because in this oxoanion chlorine is present in its highest oxidation state that is, $+7$. The disproportionation reactions for the other three oxoanions of chlorine are as follows

$$3\overset{+1}{Cl}O^- \longrightarrow 2\overset{-1}{Cl^-} + \overset{+5}{Cl}O_3^-$$

$$3\overset{+3}{Cl}O_2^- \xrightarrow{hv} 2\overset{+5}{Cl}O_3^- + \overset{-1}{Cl^-}$$

$$4\overset{+5}{Cl}O_3^- \longrightarrow \overset{-1}{Cl^-} + 3\overset{+7}{Cl}O_4^-$$

Ans: (d)

12. The increasing order of ionic character of $CsF, LiI, NaBr$ & KCl is

(a) $NaBr < KCl < LiI < CsF$ (b) $CsF < KCl < NaBr < LiI$

(c) $LiI < NaBr < KCl < CsF$ (d) $LiI < KCl < CsF < NaBr$

Sol: Higher electronegativity difference means higher ionic character.

Ans: (c)

13. Variable valency is exhibited by

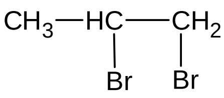
(a) F (b) Na (c) Fe (d) Ne

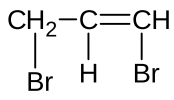
Sol: Variable valency is a characteristic of transition metals.

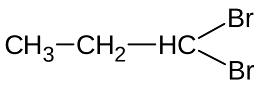
Ans: (c)

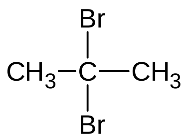
14. What is X in the following reaction?

$CH_3-C\equiv CH \xrightarrow{2HBr} X$

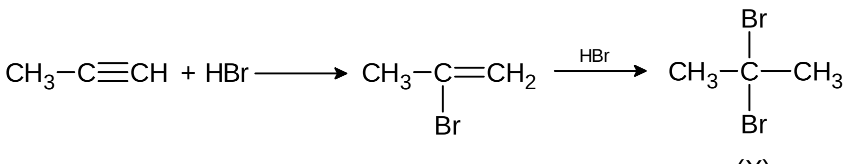
(a) 

(b) 

(c) 

(d) 

Sol:



(X)

Ans: (d)

15. Which of the following is least stable?

(a) $CH_3-CH_2\overset{+}{C}H_2$

(b) $CH_3-\overset{+}{C}H-CH_2-CH_3$

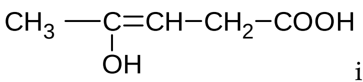
(c) $CH_3-\overset{+}{C}(CH_3)-CH_3$

(d) $CH_3-C(CH_3)_2-\overset{+}{C}H-C_6H_5$

Sol: $1°$ carbocation is least stable because of less $+I$ effect

Ans: (a)

16. The IUPAC name of the compound,



is

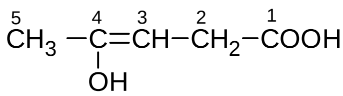
(a) Hydroxypentenoic acid

(b) 4-Hydroxypent-3-enoic acid

(c) 2-Hydroxypent-4-enoic acid

(d) 4-Hydroxy-4-methylpent-3-eonic acid

Sol:



4-Hydroxypent-3-enoic acid

Ans: (b)

17. The order of reactivity of halogens in the substitution reaction of aliphatic hydrocarbons is

(a) $Br_2 > Cl_2 > F_2$

(b) $Cl_2 > Br_2 > F_2$

(c) $F_2 > Cl_2 > Br_2$

(d) $F_2 > Br_2 > Cl_2$

Sol: Order of reactivity of halogenation of aliphatic hydrocarbons is $F_2 > Cl_2 > Br_2$.

Ans: (c)

18. The time required for 100 percent completion of a zero order reaction is

(a) $\frac{2k}{a}$ (b) $\frac{a}{2k}$ (c) $\frac{a}{k}$ (d) ak

Sol: For zero order reaction, $K = \frac{[A]_0 - [A]}{t}$

For 100 percent completion $[A] = \text{zero}$

$k = \frac{[A]_0}{t}; \quad t = \frac{[A]_0}{k}$

or $t = \frac{a}{k}$ where a is $[A]_0$ = initial concentration.

Ans: (c)

19. The charge required for the oxidation of 1 mol of FeO to Fe_2O_3 is

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

Sol: $\overset{+2}{Fe}O \longrightarrow \frac{1}{2}\overset{+3}{Fe_2}O_3$

$Fe^{2+} \longrightarrow Fe^{3+} + 1e^-$

1 mol 1 F

1 F is required for the oxidation of 1 mole of FeO.

Ans: (a)

20. The relative lowering in vapour pressure is

(a) $\alpha(x)^2_{\text{solute}}$ (b) $\alpha.\frac{1}{x_{\text{solute}}}$ (c) αx_{solute} (d) αm

Sol: $\frac{p^\circ - p_s}{p^\circ} = x_{\text{solute}}$ (Rault's law)

Ans: (c)

21. A mixture of two completely miscible non-ideal liquids which distils as such without change in its composition at a constant temperature like a pure liquid. This mixture is known as

(a) Binary liquid mixture (b) Azeotropic mixture

(c) Eutectic mixture (d) Ideal mixture

Sol: Azeotropes have a definite composition and boil like a pure liquid.

Ans: (b)

22. The osmotic pressure of 6.84% (mass/volume) solution of cane sugar at $300\,K$ (molecular weight of sugar $= 342$) is

(a) 4 atm (b) 4.926 atm (c) 3.55 atm (d) 2.45 atm

Sol: 5% (mass-volume) solution means $5g$ of sugar dissolved in $100\,\text{mL}$ water.

$$\pi = \frac{n}{V}RT = \frac{6.84}{342} \times \frac{1000}{100} \times 0.0821 \times 300 = 4.926\,\text{atm}$$

Ans: (b)

23. The boiling point of benzene is $353.3\,K$. When $1.80\,g$ of a non-volume solute was dissolved in $90\,g$ of benzene, the boiling point is raised to $354.1\,K$ given that K_b for benzene is $2.52\text{ K kg mol}^{-1}$, the molar mass of the solute is

(a) 15 g mol^{-1} (b) 20 g mol^{-1} (c) 25 g mol^{-1} (d) 63 g mol^{-1}

Sol: $M_2 = \dfrac{1000\times w_2 \times K_b}{\Delta T_b \times w_1} = \dfrac{1000\times 1.8\times 2.52}{0.8\times 90}$

$\left[\because \Delta T_b = 354.11\,K - 353.23K = 0.88K\right] = 63\text{ g mol}^{-1}$

Ans: (d)

24. $Cu_{(s)} + 2Ag^{+}_{(aq)} \rightarrow Cu^{2+}_{(aq)} + 2Ag_{(s)}$ $E^{\circ}_{\text{cell}} = 0.46\text{ V}$. The equilibrium constant of above reaction is

(a) $K_c = 4.92\times 10^{25}$ (b) $K_c = 2.5\times 10^{18}$ (c) $K_c = 3.98\times 10^{15}$ (d) $K_c = 7.5\times 10^{12}$

Sol: $E^{\circ}_{(\text{cell})} = \dfrac{0.059V}{2}\log K_c = 0.46V$ or

$\log K_c = \dfrac{0.46V\times 2}{0.059V} = 15.6$

$K_c = 3.98\times 10^{15}$

Ans: (c)

25. Λ°_m for $NaCl$, HCl and sodium acetate are 126.4, 425.9 and 91.0 $S\text{ cm}^2\text{ mol}^{-1}$ respectively. Λ°_m for acetic acid is

(a) $285\,S\text{ cm}^{-2}\text{ mol}^{-1}$ (b) $400\,S\text{ cm}^{-2}\text{ mol}^{-1}$ (c) $390.5\,S\text{ cm}^{-2}\text{ mol}^{-1}$ (d) $125\,S\text{ cm}^{-2}\text{ mol}^{-1}$

Sol: $\Lambda^{\circ}_{m(HAc)} = \lambda^{\circ}_{H^+} + \lambda^{\circ}_{Ac^-} = \lambda^{\circ}_{H^+} + \lambda^{\circ}_{Cl^-} + \lambda^{\circ}_{AC^-} + \lambda^{\circ}_{Na^+} - \lambda^{\circ}_{Cl^-} - \lambda^{\circ}_{Na^+}$

$= \Lambda^{\circ}_{m(HCl)} + \Lambda^{\circ}_{m(NaAC)} - \Lambda^{\circ}_{m(NaCl)} = (425.9 + 91.0 - 126.4)\,S\text{ cm mol}^{-1}$

$= 390.5\,S\text{ cm}^2\text{ mol}^{-1}$

Ans: (c)

26. Which of the following will not displace hydrogen?

(a) Pb (b) Sn (c) Ba (d) Hg

Sol: Mercury lies below hydrogen in the electrochemical series so it will not displace hydrogen from acids.

Ans: (d)

27. What is the order of a reaction which has a rate expression, rate $= K[A]^{3/2}[B]^{-1}$?

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

Sol:

Order: $\dfrac{3}{2} + (-1) = \dfrac{1}{2}$

Ans: (d)

28. The following data were obtained during the first order thermal decomposition of $A_{(g)}$ at constant volume:

$A_{(g)} \rightarrow B_{(g)} + C_{(g)}$

S. No.	Time/s	Total pressure/(atm)
1.	0	0.5
2.	100	0.512

The rate constant is

(a) $2.3\times10^{-4}s^{-1}$ (b) $4.8\times10^{-4}s^{-1}$ (c) $3\times10^{-4}s^{-1}$ (d) $8\times10^{-4}s^{-1}$

Sol: $k = \frac{2.303}{100}\log\frac{P_i}{2P_i - P_t} = \frac{2.303}{100}\log\frac{0.5}{2\times0.5-0.512}$

$= \frac{2.303}{100}\log 1.024 = \frac{2.303}{100}\times10^{-2} = 2.3\times10^{-4}$

Ans: (a)

29. Time required to decompose SO_2Cl_2 to half of its initial amount is 60 minutes. If the decomposition is a first order reaction, the rate constant of the reaction is

(a) $1.92\times10^{-4}s^{-1}$ (b) $3\times10^{-2}s^{-1}$ (c) $5\times10^{-3}s^{-1}$ (d) $4.75\times10^{-4}s^{-1}$

Sol: For a first order reaction, $k = \frac{0.693}{t_{1/2}} = \frac{0.693}{60} = 1.155\times10^{-2}\,\text{min}^{-1}$

Or $k = \frac{0.693}{60\times60} = 1.925\times10^{-4}s^{-1}$

Ans: (a)

30. Which of the following pairs of ions have the same electronic configuration?

(a) Ni^{2+}, Co^{3+} (b) Fe^{3+}, Mn^{2+} (c) Fe^{2+}, Mn^{2+} (d) Sc^{3+}, Ti^{3+}

Sol: ${}_{26}Fe^{3+} : [Ar]3d^5$

${}_{25}Mn^{2+} : [Ar]3d^5$

Ans: (b)

31. The elements in which electrons are progressively filled in $4f$ orbital are called

(a) Actinoids (b) Lanthanoids (c) Transition elements (d) Halogens

Sol: Lanthanoids involves filling in $4f$ – subshell.

Ans: (b)

32. The co-ordination number and oxidation number of X in $\left[X\left(SO_4\right)\left(NH_3\right)_5\right]Cl$ is

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

Sol: Co-ordination number is 6

O.N of $X = x - 2 - 1 = 0$

$x = +3$

Ans: (c)

33. Ammonia will not form complex ions with

(a) Ag^{+} (b) Cd^{2+} (c) Cu^{2+} (d) Pb^{2+}

Sol: Transition metals have ability to form complexes Pb^{2+} is not a transition metal.

Ans: (d)

34. If liquids A & B form an ideal solution

(a) the enthalpy of mixing is zero

(b) the entropy of mixing is zero

(c) the free energy of mixing is zero

(d) the free energy as well as the entropy of mixing are each zero

Sol: For ideal solution $\Delta H_{\text{mix}} = 0$

Ans: (a)

35. Which of the following concentration factor is affected by change in temperature?

(a) molarity (b) molality (c) mole fraction (d) weight fraction

Sol: Molarity involves volume so it changes with change in temperature.

Ans: (a)

36. What is the oxidation number of sulphur in $Na_2S_4O_6$?

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

Sol: $2(+1)+4x+6(-2)=0 \quad 4x=10 \quad x=\frac{5}{2}$

Ans: (d)

37. $C_2H_5Br \xrightarrow{AgCN} X \xrightarrow[Zn-Hg/HCl]{\text{Reduction}} Y$.

Here Y is

(a) n-propyl amine (b) Ethylamine (c) Isopropylamine (d) Ethylmethylamine

Sol: $C_2H_5Br \xrightarrow[AgBr]{AgCN} C_2H_5-CN \xrightarrow[Zn-Hg/HCl]{\text{Reduction}} \underset{n-\text{propylamine}}{\underset{(Y)}{C_2H_5-CH_2-NH_2}}$

Ans: (a)

38. $R-CH_2OH \xrightarrow{\Delta} RCHO + H_2$

The catalyst used in this reaction is

(a) Ni (b) Pd (c) Cu (d) $SoCl_2$

Sol: The catalyst used in the dehydrogenation reaction is red hot copper.

Ans: (c)

39. Which of the following will be colourless in aqueous solution?

I. Ti^{3+} II. V^{3+} III. Cu^{+}

IV. Mn^{2+} V. Co^{2+} VI. Sc^{3+}

(a) (I), (II), (IV) (b) (III) and (V) (c) (II), (IV) and (VI) (d) (III) and (VI)

Sol: $Ti^{3+} - 3d^1 4s^0$ 1 unpaired electrons

$V^{3+} - 3d^2 4s^0$ 2 unpaired electrons

$Cu^{+} - 3d^{10} 4s^0$ No unpaired electrons

$Mn^{2+} - 3d^5 4s^0$ 5 unpaired electrons

$Co^{3+} - 3d^7 4s^0$ 3 unpaired electrons

$Sc^{3+} - 3d^0 4s^0$ No unpaired electrons

Ans: (d)

40. Magnetic moment of Cr^{2+} is nearest to

(a) Fe^{2+} (b) Mn^{2+} (c) Co^{2+} (d) Ni^{2+}

Sol:

$Cr^{2+} = 3d^4$, No of unpaired electrons $(n) = 4$

Magnetic moment $= \sqrt{n(n+2)}BM = \sqrt{4(4+2)} = \sqrt{24} = 4.89\ BM$

$Fe^{2+} = 3d^6$, No of unpaired electrons $(n) = 4$

Magnetic moment $= \sqrt{4(4+2)}BM = \sqrt{24} = 4.89\ BM$

$Mn^{2+} = 3d$, No of unpaired electrons $(n) = 5$

Magnetic moment $= \sqrt{5(5+2)}BM = \sqrt{35} = 5.91$ BM

$Co^{2+} = 3d^7$, No of unpaired electrons $(n) = 3$

Magnetic moment $= \sqrt{3(3+2)}BM = \sqrt{15} = 3.87\ BM$

$Ni^{2+} = 3d^8$, No of unpaired electrons $(n) = 2$

Magnetic moment $= \sqrt{2(2+2)}BM = \sqrt{8} = 2.82\ BM$

Ans: (a)

41. The lanthanide contraction is responsible for the fact that

(a) Zr and Y have about the same radius (b) Zr and Hf have about the same radius

(c) Zr and Nb have similar oxidation state (d) cannot be predicted

Sol: Due to lanthanide contraction, the elements of second and third i.e. Zr and Hf transition series resemble more with each other than the elements of first and second transition series

Ans: (b)

42. The oxidation state of Co in $\left[Co(H_2O)(CN)(en)_2\right]^{2+}$ is

(a) $+2$ (b) $+3$ (c) -3 (d) -2

Sol: $x + (-1) = +2$

$x = +3$

Ans: (b)

43. Amongst the following the most stable complex is

(a) $\left[Fe(H_2O)_6\right]^{3+}$ (b) $\left[Fe(NH_3)_6\right]^{3+}$ (c) $\left[Fe(C_2O_4)_3\right]^{3-}$ (d) $\left[FeCl_6\right]^{3-}$

Sol: Since $C_2O_4^{2-}$ is a bidentate ligand, it forms the most stable complex.

Ans: (c)

44. The IUPAC name of $K_2\left[Ni(CN)_4\right]$ is

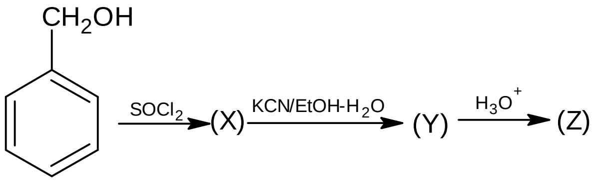
(a) Potassium tetracyanidonickelate(II) (b) Potassium tetracyanidonickelate(III)

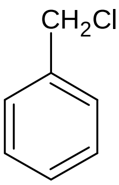
(c) Potassium tetracyanidonickle(II) (d) Potassium tetracyanidonickle(III)

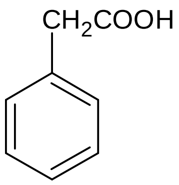
Sol: Potassium tetracyanidonickelate(II)

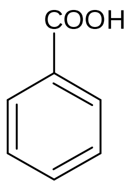
Ans: (a)

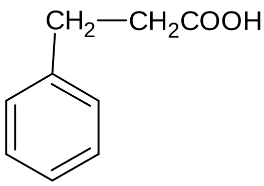
45. Identify Z in the following sequence of reactions.



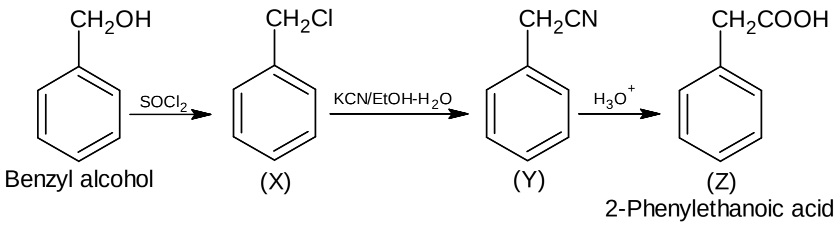
(a) 

(b) 

(c) 

(d) 

Sol:



Ans: (b)

46. Which of the following represents the correct order of increasing boiling points?

(a) 1-Chloropropane<1-Chlorobutane< 2-Chloropropane

(b) 2- Chloropropane <1-Chloropropane<1-Chlorobutane

(c) 2-Chloropropane <1-Chlorobutane<1-Chloropropane

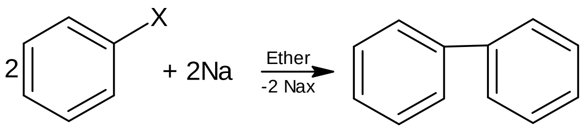
(d) 1-Chlorobutane< 2- Chloropropane<1-Chloroporpane

Sol:

Amongst molecules with same mass, it is the size of the molecule that determines the boiling point. Branched compounds are more compact and therefore have less surface area as compared to their straight chain counterparts and thus have lower boiling point. The correct order of increasing boiling point is 2- Chloropropane <1-Chloropropane<1-Chlorobutane.

Ans: (b)

47. The following reaction is called



(a) Wurtz Fitting reaction
(b) Fittig reaction
(c) Wurtz reaction
(d) Friedel-Crafts reaction

Sol: Fittig reaction

Ans: (b)

48. Arrange the following compounds in increasing order of solubility in water

(I). Pentan-1-ol (II) $n-$Butane (III) Pentanal (IV) Ethoxyethane

(a) (III)<(IV)<(I)<(II) (b) (IV)<(II)<(III)<(I) (c) (II)<(IV)<(III)<(I) (d) (II)<(III)<(IV)<(I)

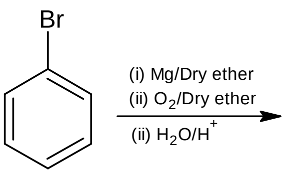
Sol:

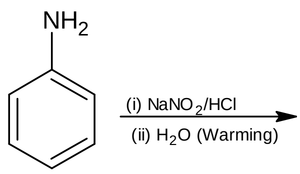
Carboxylic acids are more soluble in H_2O than corresponding alcohols, aldehydes and hydrocarbons.

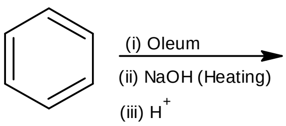
$$\underset{\text{II}}{n-\text{butane}} < \underset{\text{IV}}{\text{ethoxyethane}} < \underset{\text{III}}{\text{pentanal}} < \underset{\text{I}}{\text{pentan-1-ol}}$$

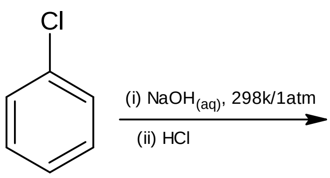
Ans: (c)

49. Which of the following reactions will not yield phenol?

(a)


(b)


(c)


(d)


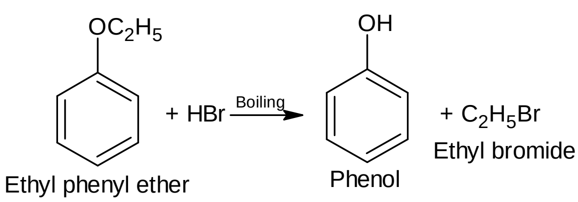
Sol: Chlorobenzene does not undergo hydrolysis on treatment with aq. $NaOH$ at $298\ K$.

Ans: (d)

50. On boiling with concentrated HBr, ethyl phenyl ether will give

(a) Phenol and ethyl bromide
(b) Bromobenzene and ethanol
(c) Phenol and ethane
(d) Bromobenzene and ethane

Sol:



Ans: (a)

51. Which is the most suitable reagent for the following conversion?

$$CH_2 = CHCH_2 - OH \longrightarrow CH_2 = CH - CHO$$

(a) $K_2Cr_2O_7$ in acidic medium (b) DIBAL-H

(c) PCC (d) $O_3/H_2O - Zn$ dust

Sol: $\underset{\text{Allyl alcohol}}{CH_2 = CHCH_2 - OH} \xrightarrow[CH_2Cl_2]{C_5H_5\overset{+}{N}HCrO_3Cl^-(PCC)} \underset{\text{Prop-2-enal}}{CH_2 = CH - CHO}$

Ans: (c)

52. Arrange the following compounds in the increasing order of ease of hydrogen bond formation

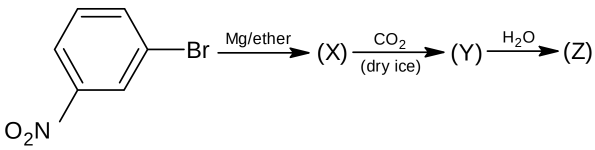
I. $CH_2CH_2CH_2CHO$ II. $CH_3CH_2CH_2CH_2OH$ III. $C_2H_5 - O - C_2H_5$ IV. $CH_3CH_2CH_2COOH$

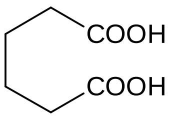
(a) I<III<II<IV (b) III<I<II<IV (c) III<II<IV<I (d) IV<III<II<I

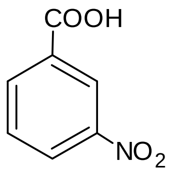
Sol: The overall increasing order of ease of hydrogen bond formation is III<I<II<IV.

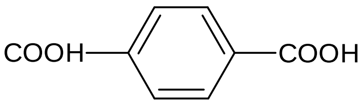
Ans: (b)

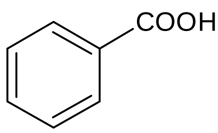
53. What is Z in the following sequence of reactions?



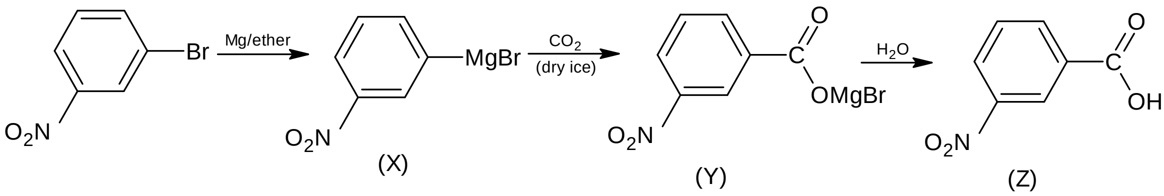
(a) 

(b) 

(c) 

(d) 

Sol:



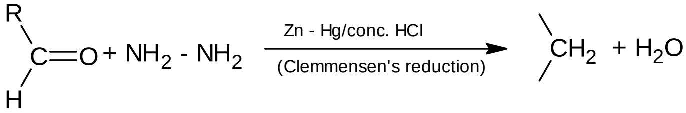
Ans: (b)

54. In Clemmensen's reduction carbonyl compound is treated with

(a) Zinc amalgam + HCl (b) Sodium amalgam + HCl

(c) Zinc amalgam + nitric acid (d) Sodium amalgam + HNO_3

Sol:



Ans: (a)

55. What is the decreasing order of basicity of primary, secondary and tertiary ethyl amines and NH_3 ?

(a) $NH_3 > C_2H_5NH_2 > (C_2H_5)_2 NH > (C_2H_5)_3 N$

(b) $(C_2H_5)_3 N > (C_2H_5)_2 NH > C_2H_5NH_2 > NH_3$

(c) $(C_2H_5)_2 NH > C_2H_5NH_2 > (C_2H_5)_3 N > NH_3$

(d) $(C_2H_5)_2 NH > (C_2H_5)_3 N > C_2H_5NH_2 > NH_3$

Sol: In case of ethyl amines, the combined effect of inductive effect, steric effect and solvation effect gives the order of basic strength as:

$$\underset{(2°)}{(C_2H_5)_2 NH} > \underset{(3°)}{(C_2H_5)_3 N} > \underset{(1°)}{C_2H_5NH_2} > NH_3$$

Ans: (d)

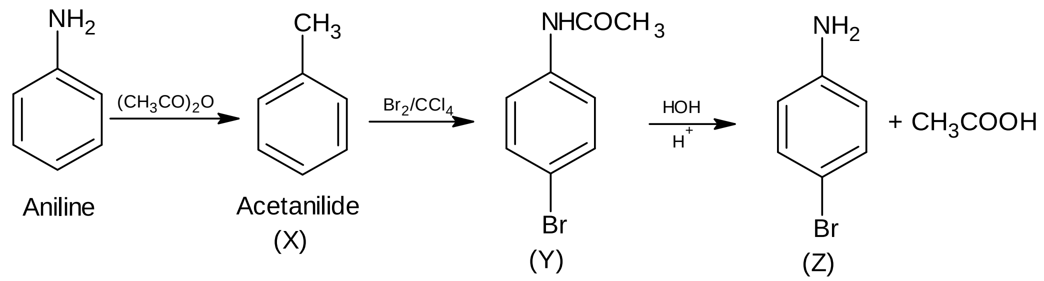
56. What is Z in the following sequence of reactions?

$$C_6H_5NH_2 \xrightarrow{(CH_3CO)_2O} X \xrightarrow{Br_2/CCl_4} Y \xrightarrow[H^+]{HOH} Z$$

(a) $p-$Bromoaniline (b) Bromoacetophenone

(c) $p-$Bromoacetanilide (d) $o-$Bromoacetanilide

Sol:

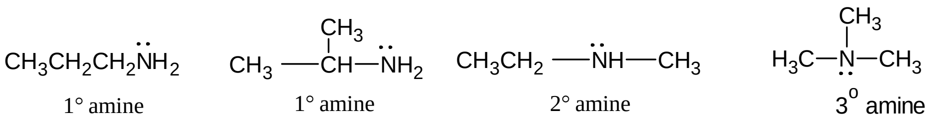


Ans: (a)

57. C_3H_9N represent

(a) Primary amine (b) Secondary amine (c) Tertiary amine (d) All of these

Sol:



Ans: (d)

58. The rapid inter conversion of $\alpha-D-$glucose and $\beta-D-$glucose in solution is known as

(a) Racemization (b) Specific rotation (c) Inversion (d) Mutarotation

Sol: Spontaneous rapid inter conversion of $\alpha-D-$glucose in solution is known as mutarotation.

Ans: (d)

59. The pH value of the solution at which a particular amino acid does not migrate under the influence of an electric field is called the

(a) Eutectic point (b) Yielding point (c) Neutralisation point (d) Isoelectric point

Sol: Isoelectric point is the pH of a solution at which a particular amino acid does not migrate under the influence of electric field.

Ans: (d)

60. Which of the following statements is not correct regarding the DNA?

(a) It has single stranded $\beta-$helix structure (b) It controls the synthesis of proteins

(c) It has the unique property of replication (d) It chiefly occurs in the nucleus of cell

Sol: DNA has double stranded α -helix structure.

Ans: (a)

Mathematics

Multiple Choice Questions with one correct answer. A correct answer carries 1 mark. No negative mark. 60 x 1 = 60

61. $2^{3n}-7n-1$ is divisible by

Options:

(a) 36 (b) 64 (c) 49 (d) 25

Sol: For $n=1, n=2$

$2^{3n}-7n-1$ is divisible by 49 (but not by 36, 64)

$\therefore$ (c) is true.

Ans: (c)

62. If the product of the roots of the equation $mx^2+6x+(2m-1)=0$ is -1, then the value of m is

Options:

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

Sol: Product of the roots $\frac{2m-1}{m}=-1$

$\Rightarrow 2m-1=-m \Rightarrow 3m=1 \Rightarrow m=\frac{1}{3}$

Ans: (c)

63. The smallest set A such that $A\cup\{1, 2\}=\{1, 2, 3, 5, 9\}$ is

Options:

(a) $\{2, 3, 5\}$ (b) $\{3, 5, 9\}$ (c) $\{1, 2, 5, 9\}$ (d) None of these

Sol: Since $A\cup\{1, 2\}=\{1, 2, 3, 5, 9\}$ $\therefore$ Smallest value of A

$=\{1, 2, 3, 5, 9\}-\{1, 2\}=\{3, 5, 9\}$

Ans: (b)

64. Domain of $\sqrt{4x-x^2}$ is

Options:

(a) $[0, 4]$ (b) $(0, 4)$ (c) $(0,1)\cup(1,\infty)$ (d) $R-[0, 4]$

Sol: For domain $4x - x^2 \geq 0$

$\Rightarrow x^2 - 4x \leq 0 \Rightarrow (x-2)^2 \leq 4 \;\Rightarrow |x-2| \leq 2 \Rightarrow 2-2 \leq x \leq 2+2$

$\Rightarrow 0 \leq x \leq 4.$

Ans: (a)

65. The range of the function $f(x) = |x-1|$ is

Options:

(a) $(-\infty, \infty)$ (b) $(0, \infty)$ (c) $[0, \infty)$ (d) $(-\infty, 0)$

Sol: Range $= [0, \infty) \left[\because |x-1| \geq 0 \; \forall \; x \in R\right]$

Ans: (c)

66. If $1+2x$ is a function having $(-\infty, \infty)$ as domain and $(-\infty, \infty)$ as codomain, then it is

Options:

(a) onto but not one-one (b) one-one but not onto

(c) one-one and onto (d) neither one-one nor onto

Sol: f is one-one onto

$\because f(x_1) = f(x_2) \Rightarrow 1+2x_1 = 1+2x_2 \;\Rightarrow x_1 = x_2$

And to each $y \in R_f, \exists \frac{y-1}{2}$ such that $f\left(\frac{y-1}{2}\right)$

$= 1 + 2\left(\frac{y-1}{2}\right) = y \;\therefore f$ is onto.

Ans: (c)

67. Let $f\left(x + \frac{1}{x}\right) = x^2 + \frac{1}{x^2}, x \neq 0,$ then $f(x) =$

Options:

(a) x^2 (b) $x^2 - 1$ (c) $x^2 - 2$ (d) $x^2 + 1$

Sol: $f\left(x + \frac{1}{x}\right) = x^2 + \frac{1}{x^2} = \left(x + \frac{1}{x}\right)^2 - 2$

$\therefore f(z) = z^2 - 2$ where $z = x + \frac{1}{x}. \quad \Rightarrow f(x) = x^2 - 2$

Ans: (c)

68. The value of $\sin 28^\circ \cos 17^\circ + \cos 28^\circ \sin 17^\circ$ is

Options:

(a) $\frac{1}{\sqrt{2}}$ (b) 1 (c) $-\frac{1}{\sqrt{2}}$ (d) 0

Sol: The given value $= \sin(28^\circ + 17^\circ)$

$= \sin 45^\circ = \frac{1}{\sqrt{2}}.$

Ans: (a)

69. If $\cos 20° = k$ and $\cos x = 2k^2 - 1$, then the possible values of x between $0°$ and $360°$ are

Options:

(a) $140°$ (b) $40°$ and $140°$ (c) $50°$ and $130°$ (d) $40°$ and $320°$

Sol: $\cos x = 2k^2 - 1 = 2\cos^2 20° - 1 = \cos 40°$

$\left[\because \cos 2\theta = 2\cos^2\theta - 1\right]$

$= \cos(360° - 40°) = \cos 320°$

$\therefore x = 40°$ and $320°$

Ans: (d)

70. $\sin 200° + \cos 200°$ is

Options:

(a) Negative (b) Positive (c) Zero (d) Zero or positive

Sol: Since $200°$ lies in III^{rd} quadrant

$\therefore \sin 200°, \cos 200°$ are both $-ve$

$\therefore$ Their sum is $-ve$.

Ans: (a)

71. Two points $(a, 0)$ and $(0, b)$ are joined by a straight line. Another point on this line is

Options:

(a) $(3a, -2b)$ (b) (a^2, ab) (c) $(-3a, 2b)$ (d) (a, b)

Sol: Equation of the line is $\frac{x}{a} + \frac{y}{b} = 1$

$(3a, -2b)$ lies on it.

Ans: (a)

72. The line passing through $(0, 1)$ and perpendicular to the line $x - 2y + 11 = 0$ is

Options:

(a) $2x - y + 1 = 0$ (b) $2x - y + 3 = 0$ (c) $2x + y - 1 = 0$ (d) $2x + y - 2 = 0$

Sol: The line $\perp$ to $x - 2y + 1 = 0$ is

$2x + y + K = 0$

It passes through $(0, 1)$ $\therefore 0 + 1 + K = 0 \quad \Rightarrow K = -1$

$\therefore$ Line is $2x + y - 1 = 0$

Ans: (c)

73. $\lim\limits_{x \to 0} \frac{1 - \cos 2x}{\cos 2x - \cos 8x} =$

Options:

(a) $\frac{1}{5}$ (b) $\frac{1}{3}$ (c) $\frac{1}{15}$ (d) 1

Sol: $\lim\limits_{x\to 0}\dfrac{1-\cos 2x}{\cos 2x-\cos 8x}=\lim\limits_{x\to 0}\dfrac{2\sin^2 x}{2\sin 5x.\sin 3x}$

$=\lim\limits_{x\to 0}\dfrac{\left(\dfrac{\sin x}{x}\right)^2}{\dfrac{\sin 5x}{x}.\dfrac{\sin 3x}{x}}\quad =\lim\limits_{x\to 0}\dfrac{\left(\dfrac{\sin x}{x}\right)^2}{5.\dfrac{\sin 5x}{5x}.\dfrac{\sin 3x}{3x}.3}\quad =\dfrac{(1)^2}{5.1.1.3}=\dfrac{1}{15}$

$\therefore$ (c) is the correct answer.

Ans: (c)

74. $\lim\limits_{x\to 3^+}\dfrac{|x-3|}{x-3}$

Options:

(a) 1 (b) -1 (c) 0 (d) does not exist

Sol: $\lim\limits_{x\to 3^+}\dfrac{|x-3|}{x-3}=\lim\limits_{x\to 3}\dfrac{x-3}{x-3}=1$

Ans: (a)

75. If $f(x)=x+2$ when $x\le 1$ and $f(x)=4x-1$ when $x>1$, then

Options:

(a) $f(x)$ is continuous at $x=1$ (b) $\lim\limits_{x\to 1}f(x)=4$

(c) $f(x)$ is discontinuous at $x=0$ (d) none of these

Sol: $\lim\limits_{x\to 1^-}f(x)=\lim\limits_{x\to 1}(x+2)=1+2=3$

$\lim\limits_{x\to 1^+}f(x)=\lim\limits_{x\to 1}(4x-1)=4-1=3$

$\therefore \lim\limits_{x\to 1}f(x)=3=f(1)$

$\therefore f(x)$ is continuous at $x=1$.

Ans: (a)

76. If $A=\begin{bmatrix}4 & 2\\ -1 & 1\end{bmatrix}$, then $(A-2I)(A-3I)=$

Options:

(a) A (b) I

(c) O, where O is null matrix (d) $5I$

Sol: $(A-2I)(A-3I)$

$=\begin{bmatrix}2 & 2\\ -1 & -1\end{bmatrix}\begin{bmatrix}1 & 2\\ -1 & -2\end{bmatrix}$

$=\begin{bmatrix}2-2 & 4-4\\ -1+1 & -2+2\end{bmatrix}=\begin{bmatrix}O & O\\ O & O\end{bmatrix}=0$

Hence (c) is the correct answer.

Ans: (c)

77. If $A=\begin{bmatrix}1 & 3\\ 2 & 1\end{bmatrix}$, then determinant of A^2-2A is

Options:

(a) 5 (b) 25 (c) –5 (d) –25

Sol: $A=\begin{bmatrix}1 & 3\\ 2 & 1\end{bmatrix}$

$\therefore A^2=\begin{bmatrix}1 & 3\\ 2 & 1\end{bmatrix}\begin{bmatrix}1 & 3\\ 2 & 1\end{bmatrix}=\begin{bmatrix}1+6 & 3+3\\ 2+2 & 6+1\end{bmatrix}=\begin{bmatrix}7 & 6\\ 4 & 7\end{bmatrix}$

$A^2-2A=\begin{bmatrix}7 & 6\\ 4 & 7\end{bmatrix}-2\begin{bmatrix}1 & 3\\ 2 & 1\end{bmatrix}=\begin{bmatrix}7 & 7\\ 4 & 7\end{bmatrix}-\begin{bmatrix}2 & 6\\ 4 & 2\end{bmatrix}=\begin{bmatrix}5 & 0\\ 0 & 5\end{bmatrix}$

$\det.\left(A^2-2A\right)=\begin{vmatrix}5 & 0\\ 0 & 5\end{vmatrix}=25$

Ans: (b)

78. Let $\begin{vmatrix}6i & -3i & 1\\ 4 & 3i & -1\\ 20 & 3 & i\end{vmatrix}=x+iy$, then (x, y) is equal to

Options:

(a) $(0,1)$ (b) $(0,0)$ (c) $(1,0)$ (d) $(1,1)$

Sol: By the given condition, $6i(-3+3)+3i(4i+20)+1(12-60i)=x+iy$

$\Rightarrow 12i^2+60i+12-60i=x+iy$

$\Rightarrow -12+12=x+iy$

$\Rightarrow 0=x+iy \quad \therefore x=0,\ y=0$

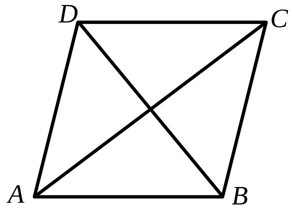
Ans: (b)

79. $ABCD$ is a parallelogram with AC, BD as diagonals. Then $\overrightarrow{AC}-\overrightarrow{BD}=$

Options:

(a) $4\,\overrightarrow{AB}$ (b) $3\,\overrightarrow{AB}$ (c) $2\,\overrightarrow{AB}$ (d) $\overrightarrow{AB}$

Sol: In the parallelogram $ABCD$,



$\overrightarrow{AC}=\overrightarrow{AB}+\overrightarrow{BC};\ \overrightarrow{BD}=\overrightarrow{BA}+\overrightarrow{AD};\quad \overrightarrow{AC}-\overrightarrow{BD}=\left(\overrightarrow{AB}+\overrightarrow{BC}\right)-\left(\overrightarrow{BA}+\overrightarrow{AD}\right)$

$=\overrightarrow{AB}+\overrightarrow{BC}-\overrightarrow{BA}-\overrightarrow{AD}\quad=\overrightarrow{AB}-\overrightarrow{BA}\quad\left[\because \overrightarrow{BC}=\overrightarrow{AD}\right]\quad=\overrightarrow{AB}+\overrightarrow{AB}=2\overrightarrow{AB}$

Hence (c) is the correct answer.

Ans: (c)

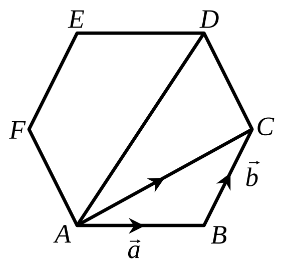
80. $ABCDEF$ is a regular hexagon. If $\overrightarrow{AB}=\vec{a}$ and $\overrightarrow{BC}=\vec{b}$, the $\overrightarrow{CD}=$

Options:

(a) $\vec{a}+\vec{b}$ (b) $\vec{b}-\vec{a}$ (c) $\vec{a}-\vec{b}$ (d) none of these

Sol: $\overrightarrow{AC}=\overrightarrow{AB}+\overrightarrow{BC}$

$=\vec{a}+\vec{b}$



$\overrightarrow{AD}=2\,\overrightarrow{BC}=2\vec{b}$

$(\because AD \parallel BC \text{ and } AD=2BC)$

Also $\overrightarrow{AD}=\overrightarrow{AC}+\overrightarrow{CD}$

$\therefore \overrightarrow{CD}=\overrightarrow{AD}-\overrightarrow{AC}$

$=2\vec{b}-(\vec{a}+\vec{b})=\vec{b}-\vec{a}$

$\therefore$ (b) is the correct answer.

Ans: (b)

81. The position vectors of A, B, C are $\vec{i}+\vec{j}+\vec{k}$, $4\vec{i}+5\vec{j}+\vec{k}$, $5\vec{i}-2\vec{j}+\vec{k}$. Then the area of ΔABC is

Options:

(a) 5 square units (b) $\frac{25}{2}$ square units (c) 25 square units (d) 50 square units

Sol: $\overrightarrow{AB}=(4\vec{i}+5\vec{j}+\vec{k})-(\vec{i}+\vec{j}+\vec{k}) \quad =3\vec{i}+4\vec{j}$

$\overrightarrow{AC}=5\vec{i}-2\vec{j}+\vec{k}-\vec{i}-\vec{j}-\vec{k} \quad =4\vec{i}-3\vec{j}$

Required area $=\frac{1}{2}\left|\overrightarrow{AB}\times\overrightarrow{AC}\right|$

$=\frac{1}{2}\left|(3\vec{i}+4\vec{j})\times(4\vec{i}-3\vec{j})\right| \quad =\frac{1}{2}\left|-9\vec{k}-16\vec{k}\right|=\frac{1}{2}\left|-25\vec{k}\right|$

$=\frac{25}{2}$ square units $\therefore$ (b) is the correct answer.

Ans: (b)

82. Let $\vec{a}=pi+qj$ and $\vec{b}=5i+j$, then $\vec{a}$ & $\vec{b}$ are parallel if

Options:

(a) $p+q=5$ (b) $pq=5$ (c) $p=5\,q$ (d) $q=5\,p$

Sol: $\vec{a}=\lambda\vec{b} \to pi+qj=\lambda(5i+j) \;\Rightarrow \frac{p}{5}=\frac{q}{1}\Rightarrow p=5q$

Ans: (c)

83. If n is any integer, then i^n is

Options:

(a) $1, -1, i, -i$ (b) $i, -i$ (c) $1, -1$ (d) i

Sol: Since $i^1=i$

$i^2=-1$

$i^3 = -i$; $i^4 = 1$

$i^5 = i$ and so on.

$\therefore i^n = 1, -1, i, -i$

Hence (a) is the correct answer.

Ans: (a)

84. The value of $\tan\left(\frac{1}{2}\cos^{-1}\frac{\sqrt{5}}{3}\right)$ is

Options:

(a) $\frac{3-\sqrt{5}}{2}$ (b) $\frac{3+\sqrt{5}}{2}$ (c) $\frac{\sqrt{5}-3}{2}$ (d) none of these

Sol: Put $\frac{1}{2}\cos^{-1}\frac{\sqrt{5}}{3} = \theta \Rightarrow \cos 2\theta = \frac{\sqrt{5}}{3}$ and $0 \le 2\theta \le \pi$

$\Rightarrow \frac{1-\tan^2\theta}{1+\tan^2\theta} = \frac{\sqrt{5}}{3} \quad \Rightarrow \frac{1+\tan^2\theta}{1-\tan^2\theta} = \frac{3}{\sqrt{5}}$

$\Rightarrow \frac{2\tan^2\theta}{2} = \frac{3-\sqrt{5}}{3+\sqrt{5}} = \frac{3-\sqrt{5}}{3+\sqrt{5}}.\frac{3-\sqrt{5}}{3-\sqrt{5}}$

$\Rightarrow \tan^2\theta = \frac{\left(3-\sqrt{5}\right)^2}{9-5} = \frac{\left(3-\sqrt{5}\right)^2}{4} \quad \Rightarrow \tan\theta = \pm\left(\frac{3-\sqrt{5}}{2}\right)$

But $0 \le 2\theta \le \pi \ \therefore 0 \le \theta \le \frac{\pi}{2} \ \Rightarrow \theta$ lies in the first quadrant.

Hence (a) is the correct answer.

Ans: (a)

85. If $y = x\sin^{-1}x + \sqrt{1-x^2}$, then $\frac{dy}{dx} =$

Options:

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

Sol: $\frac{dy}{dx} = 1.\sin^{-1}x + \frac{x}{\sqrt{1-x^2}} + \frac{1}{2}\frac{(-2x)}{\sqrt{1-x^2}}$

$= \sin^{-1}x + \frac{x}{\sqrt{1-x^2}} - \frac{x}{\sqrt{1-x^2}} \quad = \sin^{-1}x \quad \therefore$

(d) is the correct answer.

Ans: (d)

86. If $y = \sqrt{x\log_e x}$, then $\frac{dy}{dx}$ at $x = e$ is

Options:

(a) $\frac{1}{e}$ (b) $\frac{1}{\sqrt{e}}$ (c) $\sqrt{e}$ (d) none of these

Sol: $y=(x\log_e x)^{1/2}$

$\therefore \log y=\frac{1}{2}[\log x+\log(\log x)]$

$\Rightarrow \frac{1}{y}\frac{dy}{dx}=\frac{1}{2}\left(\frac{1}{x}+\frac{1}{\log x}.\frac{1}{x}\right)$

$\frac{1}{\sqrt{x\log x}}\frac{dy}{dx}=\frac{1}{2x}\left(1+\frac{1}{\log x}\right)$

At $x=e$, we have $\frac{1}{\sqrt{e\log e}}\frac{dy}{dx}=\frac{1}{2e}\left(1+\frac{1}{\log e}\right)$

$\Rightarrow \frac{dy}{dx}=\frac{\sqrt{e}}{2e}(1+1)=\frac{1}{\sqrt{e}}$

Hence (b) is the correct answer.

Ans: (b)

87. Let $f(x)=e^x g(x)$, $g(0)=4$, $g'(0)=2$, then $f'(0)$ is

Options:

(a) 1 (b) 3 (c) 2 (d) 6

Sol: $f'(x)=e^x g'(x)+e^x g(x)$

$\Rightarrow f'(0)=g'(0)+g(0)=4+2=6$

Ans: (d)

88. If $y=(\sin x)^{(\sin x)^{(\sin x)\ldots\infty}}$, then $\frac{dy}{dx}=$

Options:

(a) $\frac{y^2}{\sin x(1-\log y)}$ (b) $\frac{y^2\sin x}{1-\log y}$ (c) $\frac{y^2\cot x}{1-\log y}$ (d) $\frac{y^2\tan x}{1-\log y}$

Sol: $y=(\sin x)^y \Rightarrow \log y = y\log\sin x$

$\Rightarrow \frac{1}{y}\frac{dy}{dx}=\frac{dy}{dx}\log(\sin x)+y\frac{1}{\sin x}.\cos x$

$\Rightarrow \frac{dy}{dx}\left(\frac{1}{y}-\log\sin x\right)=y\cot x$

$\Rightarrow \frac{dy}{dx}=\frac{y^2\cot x}{1-y\log\sin x}=\frac{y^2\cot x}{1-\log y}$ $[\because \log y = y\log\sin x]$

Ans: (c)

89. Derivative of $\tan^{-1}\left(\frac{t}{1+z}\right)$ w.r.t. $\tan^{-1}\left(\frac{z}{1+t}\right)$, where $t=\sin x$, $z=\cos x$ is

Options:

(a) -1 (b) 0 (c) 1 (d) 2

Sol: Put $u=\tan^{-1}\frac{t}{1+z}=\tan^{-1}\frac{\sin x}{1+\cos x}=\tan^{-1}\tan\frac{x}{2}=\frac{x}{2}\quad\therefore\frac{du}{dx}=\frac{1}{2}$

Let $v=\tan^{-1}\frac{z}{1+t}=\tan^{-1}\frac{\cos x}{1+\sin x}$

$=\tan^{-1}\frac{\cos^2\frac{x}{2}-\sin^2\frac{x}{2}}{\left(\cos\frac{x}{2}+\sin\frac{x}{2}\right)^2}\quad=\tan^{-1}\frac{\cos\frac{x}{2}-\sin\frac{x}{2}}{\cos\frac{x}{2}+\sin\frac{x}{2}}$

$=\tan^{-1}\frac{1-\tan\frac{x}{2}}{1+\tan\frac{x}{2}}=\tan^{-1}\tan\left(\frac{\pi}{4}-\frac{x}{2}\right)\quad=\frac{\pi}{4}-\frac{x}{2}\quad\therefore\frac{dv}{dx}=-\frac{1}{2}\quad\therefore\frac{du}{dv}=\frac{du/dx}{dv/dx}=\frac{\frac{1}{2}}{-\frac{1}{2}}=-1$

Ans: (a)

90. $\sin x+\sqrt{3}\cos x$ is maximum when

Options:

(a) $x=60°$ (b) $x=45°$ (c) $x=30°$ (d) $x=0°$

Sol: Let $y=\sin x+\sqrt{3}\cos x\quad\therefore\frac{dy}{dx}=\cos x-\sqrt{3}\sin x$

$\frac{d^2y}{dx^2}=-\sin x-\sqrt{3}\cos x$

For max or min. $\frac{dy}{dx}=0.\quad\therefore\cos x=\sqrt{3}\sin x$

$\Rightarrow\tan x=\frac{1}{\sqrt{3}}\Rightarrow x=30°$ Since $\frac{d^2y}{dx^2}<0$ for $x=30°$.

$\therefore$ (c) is the correct answer.

Ans: (c)

91. A man is walking at the rate of 8 kmph towards the foot of a tower 60 metres high. The rate at which he is approaching the top when he is 80 metres from the foot of the tower is

Options:

(a) $6\cdot 4$ kmph (b) $\frac{32}{3}$ kmph (c) 6 kmph (d) none of these

Sol:

Let $x=$ distance between foot of the lower and the man and $y=$ distance between top of the tower and the man. Then $x^2+60^2=y^2$

$\Rightarrow 2x\frac{dx}{dt}+0=2y\frac{dy}{dt}\quad\Rightarrow\frac{dx}{dt}=\frac{x}{y}\frac{dx}{dt}$

$=\frac{80}{\sqrt{80^2+60^2}}\times 8=6\cdot 4$

Ans: (a)

92. $\int \frac{x^3}{1+x^8} dx$

Options:

(a) $\tan^{-1}\left(x^4\right)+C$ (b) $\frac{1}{4}\tan^{-1}\left(x^4\right)+C$ (c) $\tan^{-1}\left(x^8\right)+C$ (d) None of these

Sol: $\int \frac{x^3}{1+x^8} dx = \frac{1}{4}\int \frac{4x^3}{1+\left(x^4\right)^2} dx$

Put $x^4 = t$ $= \frac{1}{4}\int \frac{dt}{1+t^2} = \frac{1}{4}\tan^{-1}(t)+c$

$= \frac{1}{4}\tan^{-1}\left(x^4\right)+c$

Ans: (b)

93. $\int e^{3x}\left(x^2+\frac{2x}{3}\right)dx$

Options:

(a) $\frac{1}{3}x^2e^{3x}+C$ (b) $x^2e^{3x}+C$ (c) $\frac{1}{9}x^2e^{3x}+C$ (d) None of these

Sol: Let $I = \int e^{3x}\left(x^2+\frac{2x}{3}\right)dx$

Put $3x = y,\ dx = \frac{dy}{3}\ x = \frac{y}{3}$ $\therefore I = \frac{1}{3}\int e^y\left[\frac{y^2}{9}+\frac{2}{9}y\right]dy = \frac{1}{27}\int e^y\left(y^2+2y\right)dy$

$= \frac{1}{27}e^y y^2 + C = \frac{1}{27}e^{3x}\left(9x^2\right)+C$

$= \frac{1}{3}x^2e^{3x}+C$

Ans: (a)

94. If $\int \frac{2^{\frac{1}{x}}}{x^2} dx = K.2^{\frac{1}{x}}$, then K is

Options:

(a) -1 (b) $-\log 2$ (c) $-\frac{1}{\log 2}$ (d) $\frac{1}{2}$

Sol: By the given condition $\frac{d}{dx}\left(K2^{\frac{1}{x}}\right) = \frac{2^{\frac{1}{x}}}{x^2}$

$\Rightarrow K.2^{\frac{1}{x}}\left(-\frac{1}{x^2}\right)\log 2 = \frac{2^{\frac{1}{x}}}{x^2} \Rightarrow K = -\frac{1}{\log 2}$ $\therefore$ (c) is the correct answer.

Ans: (c)

95. $\int \frac{x}{x-\sqrt{x^2-1}}dx =$

Options:

(a) $\frac{x^2}{2}+\sqrt{x^2-1}+c$ (b) $\frac{x^2}{2}-\sqrt{x^2-1}+c$ (c) $\frac{x^3}{3}+\frac{1}{3}\left(x^2-1\right)^{3/2}+c$ (d) $\frac{x^3}{3}+\left(x^2-1\right)^{3/2}+c$

Sol: $\int \frac{x}{x-\sqrt{x^2-1}}dx$

$= \int \frac{x\left(x+\sqrt{x^2-1}\right)}{x^2-\left(x^2-1\right)}dx \quad = \int x^2 dx + \frac{1}{2}\int \sqrt{x^2-1}.2x\,dx$

$= \frac{x^3}{3}+\frac{1}{2}.\frac{\left(x^2-1\right)^{3/2}}{3/2}+c \quad = \frac{x^3}{3}+\frac{1}{3}\left(x^2-1\right)^{3/2}+c$

$\therefore$ (c) is the correct answer.

Ans: (c)

96. $\int \frac{dx}{\sqrt{e^{2x}-1}} =$

Options:

(a) $\sin^{-1}\left(e^x\right)+c$ (b) $\cos^{-1}\left(e^x\right)+c$ (c) $\tan^{-1}\left(e^x\right)+c$ (d) $\sec^{-1}\left(e^x\right)+c$

Sol: $I = \int \frac{dx}{\sqrt{e^{2x}-1}}$

Put $e^x = z \quad \therefore e^x dx = dz$

$\Rightarrow dx = \frac{dz}{e^x} = \frac{dz}{z} = \int \frac{dz}{z\sqrt{z^2-1}}$

$= \sec^{-1}(z)+c = \sec^{-1}\left(e^x\right)+c \quad \therefore$ (d) is the correct answer.

Ans: (d)

97. $\int_0^1 x\,e^{x^2}dx =$

Options:

(a) $\frac{e+1}{2}$ (b) $\frac{e-1}{2}$ (c) $\frac{e}{2}$ (d) $\frac{1}{2}$

Sol: $\int_0^1 x\,e^{x^2}dx = \frac{1}{2}\int_0^1 2x.e^{x^2}dx$

$= \frac{1}{2}.\left|e^{x^2}\right|_0^1 \quad = \frac{1}{2}\left(e^1-e^0\right) = \frac{e-1}{2}$

$\therefore$ (b) is the correct answer.

Ans: (b)

98. $\int_{0}^{\pi/2} \frac{\sin x \cos x}{1+\sin^4 x} dx =$

Options:

(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{8}$ (d) $\frac{\pi}{6}$

Sol: Put $\sin^2 x = z \quad \therefore 2\sin x \cos x \, dx = dz$

When $x = 0, z = 0; x = \frac{\pi}{2}, z = 1$

$\therefore$ Given integral $= \int_0^1 \frac{dz}{2(1+z^2)} = \frac{1}{2}\left|\tan^{-1} z\right|_0^1 = \frac{1}{2}\left[\tan^{-1} 1 - \tan^{-1} 0\right]$

$= \frac{1}{2} \cdot \frac{\pi}{4} = \frac{\pi}{8} \quad \therefore$ (c) is the correct answer.

Ans: (c)

99. $\int_{-5}^{5} |x+2| dx =$

Options:

(a) 15 (b) 40 (c) 29 (d) 10

Sol: $\int_{-5}^{5} |x+2| = \int_{-5}^{-2} |x+2| dx + \int_{-2}^{5} |x+2| dx = \int_{-5}^{-2} -(x+2) dx + \int_{-2}^{5} (x+2) dx$

$= -\left|\frac{x^2}{2} + 2x\right|_{-5}^{-2} + \left|\frac{x^2}{2} + 2x\right|_{-2}^{5} = -\left((2-4) - \left(\frac{25}{2} - 10\right)\right) + \left(\frac{25}{2} + 10\right) - \left(\frac{4}{2} - 4\right)$

$= -\left(-2 - \frac{5}{2}\right) + \frac{45}{2} + 2 = 29 \therefore$ (c) is the correct answer.

Ans: (c)

100. The area enclosed by the curve $y = \sin 2x$, $x -$ axis and the lines $x = \frac{\pi}{4}$ and $x = \frac{3\pi}{4}$ is

Options:

(a) $\frac{1}{2}$ square unit (b) 1 square unit (c) 2 square unit (d) none of these

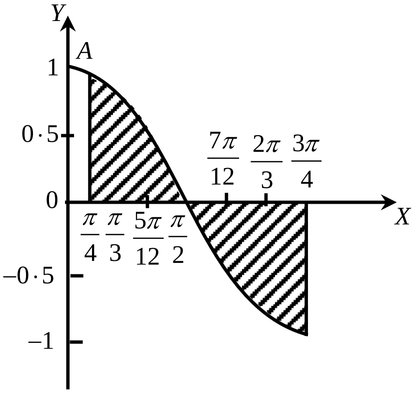
Sol: We have $y = \sin 2x$

$\frac{\pi}{4} \leq x < \frac{3\pi}{4} \Rightarrow \frac{\pi}{2} \leq 2x < \frac{3\pi}{2}$.

Table of values

x	$\pi/4$	$\pi/3$	$5\pi/12$	$\pi/2$	$7\pi/12$	$2\pi/3$	$3\pi/4$
$2x$	$\pi/2$	$2\pi/3$	$5\pi/6$	π	$7\pi/6$	$4\pi/3$	$3\pi/2$
$y = \sin 2x$	1	0·87	0.50	0	–0·50	–0·87	–1

$\therefore$ Required area (shown shaded)



$$= \int_{\pi/4}^{\pi/2} y\,dx + \int_{\pi/2}^{3\pi/2} (-y)\,dx$$

$$= \int_{\pi/4}^{\pi/2} \sin 2x\,dx - \int_{\pi/2}^{3\pi/4} \sin 2x\,dx$$

$$= \frac{-\cos 2x}{2}\Bigg|_{\pi/4}^{\pi/2} - \left(-\cos\frac{2x}{2}\right)\Bigg|_{\pi/2}^{3\pi/4}$$

$$= -\frac{1}{2}\left[\cos\pi - \cos\frac{\pi}{2}\right] + \frac{1}{2}\left[\cos\frac{3\pi}{2} - \cos\pi\right]$$

$$= -\frac{1}{2}[-1-0] + \frac{1}{2}[0-(-1)] \;= \frac{1}{2}+\frac{1}{2} = 1 \text{ square unit.}$$

$\therefore$ (b) is the correct answer.

Ans: (b)

101. The complete solution of differential equation $\frac{dy}{dx} = 2x+5$ is

Options:

(a) $y = x^2 + 5x$

(b) $y = x^2 + 5x + 1$

(c) $y = x^2 + 5x + 2$

(d) $y = x^2 + 5x + c$ where c is an arbitrary constant

Sol: G.S. is $y = x^2 + 5x + c.$ $\left[\because \text{G.S. is } y = \int (2x+5)\,dx + c\right]$

Ans: (d)

102. The equation of the curve, whose slope at any point different from origin is $y + \frac{y}{x}$, is

Options:

(a) $y = c\,xe^x, c \neq 0$ (b) $y = xe^x$ (c) $xy = e^x$ (d) $y + xe^x = c$

Sol: By the given condition $\frac{dy}{dx} = y + \frac{y}{x} \Rightarrow \frac{dy}{dx} = y\left(1+\frac{1}{x}\right)$

$\Rightarrow \frac{dy}{y} = \left(1+\frac{1}{x}\right)dx \quad \Rightarrow \log y = x + \log x + \log c \quad \Rightarrow \log y - \log cx = x \quad \Rightarrow \log\left(\frac{y}{cx}\right) = x \quad \Rightarrow y = cx\,e^x.$

Ans: (a)

103. Equation of line passing through $(1, 0, 2)$ intersecting the line $\frac{x+1}{3} = \frac{y-2}{-2} = \frac{z+1}{-1}$ at right angles is:

Options:

(a) $\frac{x-1}{3} = \frac{y}{2} = \frac{z-2}{1}$ (b) $\frac{x+1}{3} = \frac{y}{2} = \frac{z+1}{-1}$ (c) $\frac{x-1}{1} = \frac{y}{-2} = \frac{z-2}{7}$ (d) $\frac{x+1}{2} = \frac{y-1}{3} = \frac{z-1}{4}$

Sol: Let the required line meet $\frac{x+1}{3}=\frac{y-2}{-2}=\frac{z+1}{-1}$ at

$=(3r-1,-2r+2,-r-1)\ P(1, 0, 2)$

Since $PQ \perp$ the given line

$\therefore 3(3r-2)-2(-2r+2)-1(-r-3)=0$

$\Rightarrow r=\frac{1}{2} \therefore$ Direction ratio y required line: $-\frac{1}{2}, 1, -\frac{7}{2}$ or $1, -2, 7$

$\therefore$ Required equation $\frac{x-1}{1}=\frac{y}{-2}=\frac{z-2}{7}$

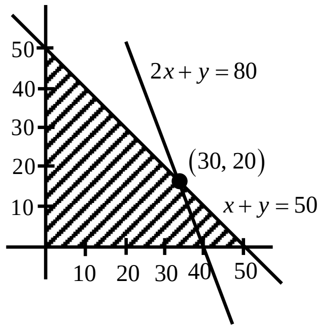
Ans: (c)

104.The maximum value of $z=10x+9y$ subject to the conditions $x+y\le 50; 2x+y\le 80; x\ge 0, y\ge 0$ is

Options:

(a) 500 (b) 450 (c) 480 (d) None of these

Sol:



$z=10x+9y$

$\therefore$ Corner points are $(0, 0), (0, 50), (40, 0), (30, 20)$

$\therefore z(0, 0)=0 \quad z(40, 0)=400$

$z(0, 50)=450 \quad z(30, 20)=300+180=480$

Ans: (c)

105.A card from a pack of 52 cards is lost. From the remaining cards a card is drawn and found to be spade. The probability that the card lost in spade:

Options:

(a) $\frac{12}{52}$ (b) $\frac{13}{51}$ (c) $\frac{12}{51}$ (d) None of these

Sol: Let S be the event that card drawn is spade.

Let E_1 : the card lost is spade

E_2 : the card lost is not spade

$\therefore P(E_1)=\frac{1}{4} \quad P(E_2)=\frac{3}{4}$

$P(S/E_1)=\frac{12}{51} \quad P(S/E_2)=\frac{13}{51}$

$$P(E_1/S)=\frac{P(E_1)P(S/E_1)}{P(E_1)P(S/E_1)+P(E_2)P(S/E_2)}$$

$$=\frac{\frac{1}{4}\times\frac{12}{51}}{\frac{1}{4}\times\frac{12}{51}+\frac{3}{4}\times\frac{13}{51}}=\frac{12}{12+39}=\frac{12}{51}$$

Ans: (c)

106. A die is thrown 3 times. The probability of getting different number is:

Options:

(a) $\frac{5}{36}$ (b) $\frac{5}{9}$ (c) $\frac{13}{36}$ (d) None of these

Sol: Total no of outcomes $=n(5)=6\times6\times6=6^3$

The ways of getting different nos $=6\times5\times4$

$\therefore$ Required probability $=\frac{6\times5\times4}{6\times6\times6}=\frac{5}{9}$

Ans: (b)

107. Integrating factor of $x\frac{dy}{dx}-y=x^4-3x$ is

Options:

(a) $\frac{1}{x}$ (b) x (c) $-x$ (d) $\log x$

Sol: $\frac{dy}{dx}-\frac{1}{x}y=\frac{x^4-3x}{x}$. I.F $=e^{-\int\frac{1}{x}dx=e^{-\log x}=\frac{1}{x}}$

Ans: (a)

108. The value of $\int\frac{e^{6\log x}-e^{5\log x}}{e^{4\log x}-e^{3\log x}}dx$ is equal to

Options:

(a) $\frac{3}{x^3}$ (b) 0 (c) $\frac{1}{x}$ (d) $\frac{x^3}{3}$

Sol: $I=\int\frac{x^6-x^5}{x^4-x^3}dx\Rightarrow\int\frac{x^5(x-1)}{x^3(x-1)}dx=\int x^2dx=\frac{x^3}{3}+c$ $\quad(\because\log_a a^x=x)$

Ans: (d)

109. If the straight lines $2x+3y-3=0$ and $x+ky+7=0$ are perpendicular, then the value of k is

Options:

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

Sol:

$m_1\cdot m_2=\left(-\frac{2}{3}\right)\left(-\frac{1}{k}\right)=-1\Rightarrow k=-\frac{2}{3}$

Ans: (a)

110. If A is any square matric of order 3×3 then $|3A|$ is equal to

Options:

(a) $27|A|$ (b) $3|A|$ (c) $9|A|$ (d) $\frac{1}{3}|A|$

Sol: $|3A| = 3^3|A| \Rightarrow |3A| = 27|A|$

Ans: (a)

111. The solution for the differential equation $\frac{dy}{y}+\frac{dx}{x}=0$ is

Options:

(a) $xy=c$ (b) $\frac{1}{y}+\frac{1}{x}=c$ (c) $x+y=c$ (d) $\log x\cdot\log y=c$

Sol: $\int\frac{dy}{y}+\int\frac{dx}{x}=\log c \Rightarrow \log y+\log x=\log c \Rightarrow xy=c$

Ans: (a)

112. The value of $\int\frac{e^x(1+x)dx}{\cos^2(e^x\cdot x)}$ is equal to

Options:

(a) $\tan(e^x)+c$ (b) $-\cot(e\cdot x^x)+c$ (c) $\cot(e^x)+c$ (d) $\tan(e^x\cdot x)+c$

Sol: $\frac{d}{dx}(e^x x)=e^x(1+x).I=\int\sec^2(e^x x)\cdot\frac{d}{dx}(e^x x)dx=\tan(xe^x)+c$

Ans: (d)

113. The set A has 4 elements and the set B has 5 elements then the number of injective mappings that can be defined from A to B is

Options:

(a) 60 (b) 144 (c) 120 (d) 72

Sol: Number of injective functions $= {}^nP_m=\frac{n!}{(n-m)!}, n(A)=m, n(B)=n(n>m)$.

Here, required number $=\frac{5!}{(5-4)!}=5!=120$

Ans: (c)

114. The value of $\int_2^8\frac{\sqrt{10-x}}{\sqrt{x}+\sqrt{10-x}}dx$ is

Options:

(a) 8 (b) 10 (c) 3 (d) 0

Sol: $\int_a^b\frac{\sqrt{(a+b)-x}}{\sqrt{x}+\sqrt{(a+b)-x}}dx=\frac{b-a}{2}$. Here $\frac{8-2}{2}=3$

Ans: (c)

115. $\int_0^{\pi/2} \frac{\sin^{1000} x\, dx}{\sin^{1000} x + \cos^{1000} x}$ is equal to

Options:

(a) $\frac{\pi}{2}$ (b) 1000 (c) $\frac{\pi}{4}$ (d) 1

Sol: $\int_0^{\pi/2} \frac{\sin^n x}{\sin^n x + \cos^n x} dx = \frac{\pi}{4}$

Ans: (c)

116. The distance of the point $(-2, 4, -5)$ from the line $\frac{x+3}{3} = \frac{y-4}{5} = \frac{z+8}{6}$ is

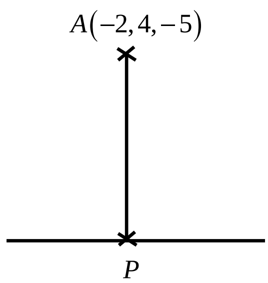
Options:

(a) $\frac{\sqrt{37}}{10}$ (b) $\sqrt{\frac{37}{10}}$ (c) $\frac{37}{\sqrt{10}}$ (d) $\frac{37}{10}$

Sol: $A = (-2, 4, -5); \frac{x+3}{3} = \frac{y-4}{5} = \frac{z+8}{6} = \lambda$

Let, $P = (3\lambda - 3, 5\lambda + 4, 6\lambda - 8)$ be the foot of the perpendicular drawn from A onto the line.

D.r's of A.P: $3\lambda - 1, 5\lambda, 6\lambda - 3$. AP is perpendicular to the line



$\Rightarrow 3(3\lambda - 1) + 5(5\lambda) + 6(6\lambda - 3) = 0 \Rightarrow \lambda = \frac{3}{10}$.

D.r's of AP are, $-\frac{1}{10}, \frac{3}{2}, -\frac{6}{5} \Rightarrow \vec{AP} = \left(-\frac{1}{10}, \frac{3}{2}, -\frac{6}{5}\right)$

Required length $= |\vec{AP}| = \sqrt{\frac{1}{100} + \frac{9}{4} + \frac{36}{25}} = \sqrt{\frac{1 + 225 + 144}{100}} = \sqrt{\frac{370}{100}} = \sqrt{\frac{37}{10}}$

Ans: (b)

117. Two events A and B will be independent if

Options:

(a) A and B are mutually exclusive

(b) $P(A' \cap B') = (1 - P(A))(1 - P(B))$

(c) $P(A) = P(B)$

(d) $P(A) + P(B) = 1$

Sol: A and B are independent $\Rightarrow A'$ and B' are also independent.

Thus, $P(A' \cap B') = P(A') \cdot P(B') \Rightarrow P(A' \cap B') = [1 - P(A)][1 - P(B)]$

Ans: (b)

118. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, then the value of $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$ is equal to

Options:

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

Sol: Standard problem; Ans is $-\frac{3}{2}$

OR $\left|\vec{a}+\vec{b}+\vec{c}\right|^2 = \left|\vec{a}\right|^2 + \left|\vec{b}\right|^2 + \left|\vec{c}\right|^2 + 2\left(\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{b}+\vec{c}\cdot\vec{a}\right)$

$\Rightarrow\ 0 = 3+2\left(\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{b}+\vec{c}\cdot\vec{a}\right) \Rightarrow \vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{b}+\vec{c}\cdot\vec{a} = -\frac{3}{2}$

Ans: (c)

119.The range of the function $f(x)=\sqrt{9-x^2}$ is

Options:

(a) $(0,3)$ (b) $[0,3]$ (c) $(0,3]$ (d) $[0,3)$

Sol: Let, $y=\sqrt{9-x^2} \Rightarrow y^2 = 9-x^2 \Rightarrow x=\sqrt{9-y^2}$

Now, $9-y^2 \geq 0 \Rightarrow 9 \geq y^2 \Rightarrow -3 \leq y \leq 3$

But, $y \geq 0$ .Thus the range is $0 \leq y \leq 3$, i.e., $y \in [0,3]$

Ans: (b)

120.The eccentricity of the ellipse $\frac{x^2}{36}+\frac{y^2}{16}=1$ is

Options:

(a) $\frac{2\sqrt{5}}{6}$ (b) $\frac{2\sqrt{5}}{4}$ (c) $\frac{2\sqrt{13}}{6}$ (d) $\frac{2\sqrt{13}}{4}$

Sol: $l=\sqrt{\frac{a^2-b^2}{a^2}}=\sqrt{\frac{36-16}{36}}=\frac{2\sqrt{5}}{6}$

Ans: (a)

Physics

Multiple Choice Questions with one correct answer. A correct answer carries 1 mark. No negative mark. 60 x 1 = 60

121. The potential energy of a satellite, having mass m and rotating at a height of 6.4×10^6 m from the earth surface, is

(a) $-mgR_e$ (b) $-0.67\,mgR_e$ (c) $-0.5\,mgR_e$ (d) $-0.33\,mgR_e$

Sol: Mass of the satellite $=m$ and height of satellite from earth $(h)=6.4\times10^6$ m .

We know that gravitational potential energy of the satellite at height

$$h=-\frac{GM_e m}{(R_e+h)}=-\frac{gR_e^2 m}{2R_e}=-\frac{gR_e m}{2}=-0.5\,mgR_e \text{ (where, } GM_e=gR_e^2 \text{ and } h=R_e\text{)}$$

Ans: (c)

122. Which of the following statements is correct regarding Poisson's ratio?

(a) It is the ratio of the longitudinal strain to the lateral strain

(b) Its value is independent of the nature of the material

(c) It is unitless and dimensionless quantity

(d) The practical value of Poisson's ratio lies between 0 and 1

Sol: The ratio of the lateral strain to longitudinal strain is called Poisson's ratio.

Ans: (c)

123. The wheel of a car is rotating at the rate of 1200 revolutions per minute. On pressing the accelerator for 10 seconds. It starts rotating at 4500 revolutions per minute. The angular acceleration of the wheel is

(a) 30 radians/second^2 (b) 1880 degree/second^2 (c) 40 radians/second^2 (d) 1980 degree/second^2

$$\text{Sol: } \alpha=\frac{2\pi(n_2-n_1)}{t}=\frac{2\pi\left(\frac{4500-1200}{60}\right)}{10}\text{ rad s}^{-2}$$

$$=\frac{2\pi\frac{3300}{60}}{10}\times\frac{360}{2\pi}\frac{\text{degree}}{s^2}=1980\text{ degree/s}^2$$

Ans: (d)

124. The cylindrical tube of a spray pump has a cross-section of $8\,\text{cm}^2$, one end of which has 40 fine holes each of area 10^{-8} m^2. If the liquid flows inside the tube with a speed of $0.15\,\text{m min}^{-1}$, the speed with which the liquid is ejected through the hole is

(a) 50 ms^{-1} (b) 5 ms^{-1} (c) 0.05 ms^{-1} (d) 0.5 ms^{-1}

Sol: According to equation n to continuity, $(\text{area } a)\times(\text{velocity } v)=\text{constant}$

$\therefore$ For tube, $\left(8\times10^{-4}\right)\times\left(\frac{0.15}{60}\right)=a_1v_1$

For holes, $\left(40\times10^{-8}\right)\times v=a_2v_2$

$\because\ a_2v_2=a_1v_1$

$\therefore\ 40\times10^{8}\times v$

$= \dfrac{8\times10^{-4}\times0.15}{60}$

$\Rightarrow\ v=\dfrac{8\times10^{-4}\times0.15}{40\times10^{-8}\times60}=\dfrac{8\times15}{4\times6}=5\ \text{ms}^{-1}$

Ans: (b)

125. A beaker is completely filled with water at 4°C . It will overflow, if

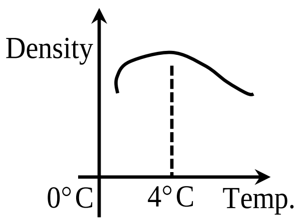
(a) heated above 4°C

(b) cooled below 4°C

(c) both heated and cooled above and below 4°C respectively

(d) none of these

Sol: Water has maximum density at 4°C , so if the water is heated above 4°C or cooled below 4°C density decreases, i.e., volume increases.



In other words, it expands so it overflows in both the cases.

Ans: (c)

126. A graph is plotted with PV/T on $y-$axis and mass of the gas along $x-$axis for different gases. The graph is

(a) a straight line parallel to $x-$axis for all the gases

(b) a straight line passing through origin with a slope having a constant value for all the gases

(c) a straight line passing through origin with a slope having different values for different gases

(d) a straight line parallel to $y-$axis for all the gases

Sol: $\dfrac{PV}{T}=nR=\left(\dfrac{m}{M}\right)R$

or $\dfrac{PV}{T}=\left(\dfrac{R}{M}\right)m$

i.e. $\dfrac{PV}{T}$ versus m graph is straight line passing through origin with slope R/M , i.e. the slope depends on molecular mass of the gas M and is different for different gases.

Ans: (c)

127. A perfect gas contained in a cylinder is kept in vacuum. If the cylinder suddenly bursts, then the temperature of the gas

(a) remains constant (b) becomes zero (c) increases (d) decreases

Sol: During free expansion of a perfect gas no work is done and also no heat is supplied from outside. Therefore, no change in internal energy. Hence, temperature remains constant.

Ans: (a)

128.If the length of a simple pendulum is increased by 2%, then the time period

(a) increases by 2% (b) decreases by 2% (c) increases by 1% (d) decreases by 1%

Sol: We know that

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$\frac{\Delta T}{T}\times 100 = \frac{1}{2}\frac{\Delta l}{l}\times 100$$

If length is increased by 2%,

time period increases by 1%.

Ans: (c)

129.A 5.5 metre long string has a mass of $0.035\,\text{kg}$. If the tension in the string is $77\ \text{N}$, the speed of a wave on the string is

(a) $110\ \text{ms}^{-1}$ (b) $165\ \text{ms}^{-1}$ (c) $77\ \text{ms}^{-1}$ (d) $102\ \text{ms}^{-1}$

Sol: $m = \frac{0.035}{5.5}\,\text{kg}\,\text{m}^{-1}, T = 77\ \text{N}$

$$v = \sqrt{\frac{T}{m}} = \sqrt{\frac{77\times 5.5}{0.035}} = 110\,\text{ms}^{-1}$$

Ans: (a)

130.One metallic sphere A is given positive charge whereas another identical metallic sphere B of exactly same mass as of A is given equal amount of negative charge. Then

(a) mass of A and mass of B still remain equal

(b) mass of A increases

(c) mass of B decreases

(d) mass of B increases

Sol: Negative charge means excess of electron which increases the mass of sphere B.

Ans: (d)

131.If the electric field is given by $\left(5\hat{i}+4\hat{j}+9\hat{k}\right)$. The electric flux through a surface of area 20 units lying in the $Y-Z$ plane will be

(a) 100 units (b) 80 units (c) 180 units (d) 20 units

Sol: Here, E must be perpendicular to $Y-Z$ plane, i.e., area must be parallel to X – plane,

so $d\vec{s} = 20\hat{i}$ units

$\therefore$ electric flux

$$= \vec{E}\cdot d\vec{s} = \left(5\hat{i}+4\hat{j}+9\hat{k}\right)\cdot\left(20\hat{i}\right) = 100 \text{ units}$$

Ans: (a)

132.Three concentric metal shells A, B and C of respective radii a, b and $c(a<b<c)$ have surface charge densities $+\sigma, -\sigma$ and $+\sigma$ respectively. The potential of shell B is

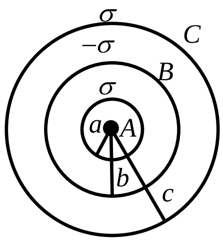
(a) $\frac{\sigma}{\varepsilon_0}\left[\frac{a^2-b^2}{a}+c\right]$ (b) $\frac{\sigma}{\varepsilon_0}\left[\frac{a^2-b^2}{b}+c\right]$ (c) $\frac{\sigma}{\varepsilon_0}\left[\frac{b^2-c^2}{b}+a\right]$ (d) $\frac{\sigma}{\varepsilon_0}\left[\frac{b^2-c^2}{c}+a\right]$

Sol: Potential outside the shell,

$$V_{\text{outside}}=\frac{KQ}{r}$$

where r is distance of point from the centre of shell Potential inside the shell,

$$V_{\text{inside}}=\frac{KQ}{R}$$



where 'R"is radius of the shell

$$V_B=\frac{Kq_A}{r_b}+\frac{Kq_B}{r_b}+\frac{Kq_C}{r_c}$$

$$V_B=\frac{1}{4\pi\varepsilon_0}\left[\frac{\sigma 4\pi a^2}{b}-\frac{\sigma 4\pi b^2}{b}+\frac{\sigma 4\pi c^2}{c}\right]$$

$$V_B=\frac{\sigma}{\varepsilon_0}\left[\frac{a^2-b^2}{b}+c\right]$$

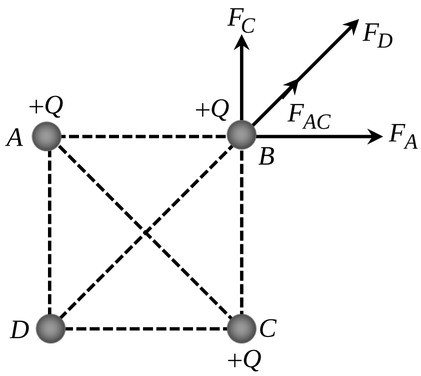
Ans: (b)

133.Equal charges q are placed at the four corners A, B, C, D of a square of length a. The magnitude of the force on the charge at B will be

(a) $\frac{3q^2}{4\pi\varepsilon_0 a^2}$ (b) $\frac{4q^2}{4\pi\varepsilon_0 a^2}$ (c) $\left(\frac{1+2\sqrt{2}}{2}\right)\frac{q^2}{4\pi\varepsilon_0 a^2}$ (d) $\left(2+\frac{1}{\sqrt{2}}\right)\frac{q^2}{4\pi\varepsilon_0 a^2}$

Sol: $F_{\text{net}}=F_{AC}+F_D=\sqrt{F_A^2+F_C^2}+F_D$

Since, $F_A=F_C=\frac{kq^2}{a^2}$ and $F_D=\frac{kq^2}{\left(a\sqrt{2}\right)^2}$



$$F_{\text{net}}=\frac{\sqrt{2}kq^2}{a^2}+\frac{kq^2}{2a^2}$$

$$=\frac{kq^2}{a^2}\left(\sqrt{2}+\frac{1}{2}\right)$$

$$=\frac{q^2}{4\pi\varepsilon_0 a^2}\left(\frac{1+2\sqrt{2}}{2}\right)$$

Ans: (c)

134.Two points P and Q are maintained at the potentials of $10\,\text{V}$ and $-4\,\text{V}$, respectively. The work done in moving 100 electrons from P and Q is

(a) 9.60×10^{-7} J (b) -2.24×10^{-16} J (c) 2.24×10^{-16} J (d) -9.60×10^{-17} J

Sol: $\dfrac{W_{PQ}}{q} = -(V_Q - V_P)$

$W_{PQ} = q(V_Q - V_P) = (-100 \times 1.6 \times 10^{-19})(-4-10) = 2.24 \times 10^{-16}$ J

Ans: (c)

135. A parallel plate capacitor with air between the plates has a capacitance of $9\,\text{pF}$. The separation between its plates is $'d'$. The space between the plates is now filled with two dielectrics. One of the dielectrics has dielectric constant $k_1 = 3$ and thickness $d/3$ while the other one has dielectric constant $k_2 = 6$ and thickness $2d/3$. Capacitance of the capacitor is now

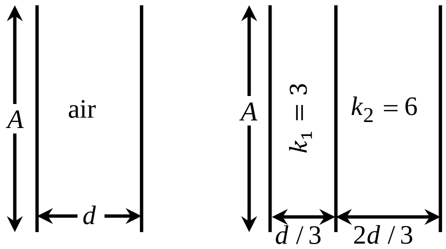
(a) 45 pF (b) 40.5 pF (c) 20.25 pF (d) 1.8 pF

Sol: $C_{\text{air}} = \dfrac{\varepsilon_0}{d} = 9$

$\dfrac{1}{C_{med}} = \dfrac{1}{C_1} + \dfrac{1}{C_2} = \dfrac{d_1}{k_1\varepsilon_0 A} + \dfrac{d_2}{k_2\varepsilon_0 A}$

$\Rightarrow \dfrac{1}{C_{med}} = \dfrac{k_1k_2\varepsilon_0 A}{k_1d_2 + k_1d_1}$

$= \dfrac{3\times 6\times \varepsilon_0 A}{3\times 2d/3 + 6\times d/3} = \dfrac{18}{4}\times 9 = 40.5$ pF



Ans: (b)

136. An oil drop of radius r and density ρ is held stationary in a uniform vertically upwards electric field $'E'$. If $\rho_0\,(<\rho)$ is the density of air and e is charge on electron, then the drop has -

(a) $\dfrac{4\pi r^3(\rho-\rho_0)g}{3eE}$ excess electrons

(b) $\dfrac{4\pi r^2(\rho-\rho_0)g}{3eE}$ excess electrons

(c) deficiency of $\dfrac{4\pi r^3(\rho-\rho_0)g}{3eE}$ electrons

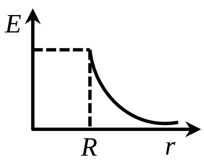
(d) deficiency of $\dfrac{4\pi r^2(\rho-\rho_0)g}{eE}$ electrons

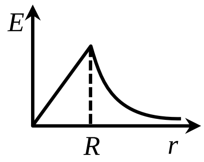
Sol: Net downward force on the drop $= \dfrac{4}{3}\pi r^3(\rho-\rho_0)g$. For equilibrium, electric force must be upwards

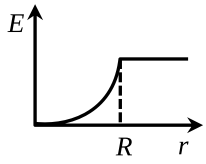
i.e. charge on the drop is positive: $neE = \dfrac{4}{3}\pi r^3(\rho-\rho_0)g$ i.e., $n = \dfrac{4\pi r^3(\rho-\rho_0)g}{3eE}$

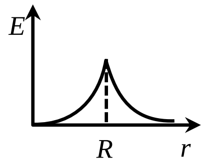
Ans: (c)

137. Which of the following graphs shows the variation of electric field E due to a hollow spherical conductor of radius R as a function of distance from the centre of the spherical conductor?

(a) 

(b) 

(c) 

(d) 

Sol: Electric field due to a hollow spherical conductor is governed by following equation,

$E = 0$, for $r < R$ … (i)

and $E=\frac{Q}{4\pi\varepsilon_0 r^2}$ for $r\geq R$

i.e. inside the conductor field will be zero and outside the conductor will vary according to $E\propto\frac{1}{r^2}$

Ans: (a)

138. In the equation $AB=C$, A is the current density, C is the electric field, then B is

(a) Resistivity (b) Conductivity (c) Potential difference (d) Resistance

Sol: $J=\sigma E\Rightarrow J\rho=E$

J is current density, E is electric field

So $B=\rho=$ resistivity.

Ans: (a)

139. If negligibly small current is passed through a wire of length $15\,\text{m}$ and of resistance 5Ω having uniform cross-section of $6\times10^{-7}\ \text{m}^2$, then coefficient of resistivity of material, is

(a) $1\times10^{-7}\ \Omega-\text{m}$ (b) $2\times10^{-7}\ \Omega-\text{m}$ (c) $3\times10^{-7}\ \Omega-\text{m}$ (d) $4\times10^{-7}\ \Omega-\text{m}$

Sol: Given: Length of wire $(l)=15\ \text{m}$

Area $(A)=6\times10^{-7}\ \text{m}^2$

Resistance $(R)=5\Omega$

We know that resistance of the wire material

$R=\rho\frac{l}{A}\ \Rightarrow$

$5=\rho\times\frac{15}{6\times10^{-7}}$

$\Rightarrow\ \rho=2\times10^{-7}\ \Omega-\text{m}$

[where $\rho=$ coefficient of resistivity]

Ans: (b)

140. A current of 1mA flows through a copper wire. How many electrons will pass through a given point of wire in each second?

(a) 6.25×10^{8} (b) 6.25×10^{31} (c) 6.25×10^{15} (d) 6.25×10^{19}

Sol: Current, $I=\frac{\text{Charge}}{\text{Time}}$

as a charge $q=n\times1.6\times10^{-19}$

$10^{-3}\,\text{A}=\frac{n\times1.6\times10^{-19}}{1\text{s}}$

$n=6.25\times10^{15}$

Ans: (c)

141. The number of free electrons per $100\,\text{mm}$ of ordinary copper wire is 2×10^{21}. Average drift speed of electrons is 0.25 mm s^{-1}. The current flowing is

(a) $5\,\text{A}$ (b) $80\,\text{A}$ (c) $8\,\text{A}$ (d) $0.8\,\text{A}$

Sol: $I = neAv_d = 2\times10^{21}\times1.6\times10^{-19}\times10\times0.25\times10^{-3}$

$= 2\times1.6\times0.25 = \frac{8}{10} = 0.8\text{ A}$

Ans: (d)

142. We are able to obtain fairly large currents in a conductor because

(a) The electron drift speed is usually very large

(b) The number density of free electrons is very high and this can compensate for the low values of the electron drift speed and the very small magnitude of the electron charge

(c) The number density of free electrons as well as the electron drift speeds are very large and these compensate for the very small magnitude of the electron charge

(d) The very small magnitude of the electrons charge has to be divided by the still smaller product of the number density and drift speed to get the electric current

Sol: The number density of free electrons is very high and this can compensate for the low values of the electron drift speed and the very small magnitude of the electron charge

Ans: (b)

143. The resistance of a wire at room temperature $30°\text{C}$ is found to be 10Ω. Now to increase the resistance by 10%, the temperature of the wire must be [The temperature coefficient of resistance of the material of the wire is 0.002 per $°\text{C}$]

(a) $36°\text{C}$ (b) $83°\text{C}$ (c) $63°\text{C}$ (d) $33°\text{C}$

Sol: $R_t = R_0(1+\alpha t)$

Initially, $R_0(1+30\alpha) = 10\Omega$

Finally, $R_0(1+\alpha t) = 11\Omega$

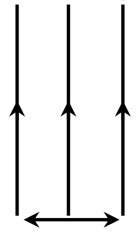
$\therefore \frac{11}{10} = \frac{1+\alpha t}{1+30\alpha}$

Or, $10+(10\times0.002\times t) = 11+330\times0.002$

Or, $0.02t = 1+0.66 = 1.066$ or $t = \frac{1.66}{0.02} = 83°\text{C}$

Ans: (b)

144.In the adjoining figure, two very long parallel wires A and B carry currents of 10 ampere and 20 ampere respectively, and are at a distance $20\,\text{cm}$ apart. If a third wire C (length $15\,\text{cm}$) having a current of 10 ampere is placed midway between them, then how much force will act on C. The direction of current in all the three wires is same.



(a) 3×10^{-5} N (left) (b) 3×10^{-5} N (right) (c) 6×10^{-5} N (left) (d) 6×10^{-5} N (right)

Sol: The wires A and C carry current in same direction, therefore they attract each other. The force on C due to A is towards the wire A and is given by.

$$F_{CA} = \frac{\mu_0}{4\pi}\cdot\frac{2i_Ai_C}{r_{AC}}l = \frac{10^{-7}\times2\times10\times10}{0.10}0.15$$

or $F_{CA} = 3\times10^{-5}$ N (towards left)

Similarly, the wires B and C attract each other as they also the current sin the same direction, the force on C due to current in B is towards right hand side. Therefore, the force on C due to B is given by

$$F_{BC} = \frac{\mu_0}{4\pi}\cdot\frac{2i_Bi_C}{r_{BC}}l = \frac{10^{-7}\times2\times20\times10\times0.15}{0.10} \quad \text{or} \quad F_{BC} = 6\times10^{-5}\,\text{N (towards right)}$$

Therefore, the net force on C is $F = \left(6\times10^{-5} - 3\times10^{-5}\right) = 3\times10^{-5}$ N (towards right)

Ans: (b)

145.In a moving coil galvanometer, the deflection of the coil θ is related to the electrical current i by the relation

(a) $i \propto \tan\theta$ (b) $i \propto \theta$ (c) $i \propto \theta^2$ (d) $i \propto \sqrt{\theta}$

Sol: $i = \frac{C\theta}{NAB} \Rightarrow i \propto \theta$

Ans: (b)

146.A beam of electrons is moving with constant velocity in a region having simultaneous perpendicular electric and magnetic fields of strength $20\,\text{Vm}^{-1}$ and $0.5\,\text{T}$ respectively at right angles to the direction of motion of the electrons. Then the velocity of electrons must be

(a) 8 ms^{-1} (b) 20 ms^{-1} (c) 40 ms^{-1} (d) $\frac{1}{40}$ ms^{-1}

Sol: As electron move with constant velocity without deflection. Hence, force due to magnetic field is equal and opposite to force due to electric field.

$qvB = qE \Rightarrow v = \frac{E}{B} = \frac{20}{0.5} = 40 \text{ ms}^{-1}$

Ans: (c)

147. At what distance from a long straight wire carrying a current of $12\,\text{A}$ will the magnetic field be equal to 3×10^{-5} Wb m^{-2}?

(a) 8×10^{-2} m (b) 12×10^{-2} m (c) 18×10^{-2} m (d) 24×10^{-2} m

Sol: Current $(I) = 12\,\text{A}$ and magnetic field $(B) = 3\times10^{-5}$ Wb m^{-2}

Consider magnetic field $\vec{B}$ at distance r

Magnetic field, $B = \frac{\mu_0 I}{2\pi r}$ $\Rightarrow r = \frac{\mu_0 I}{2\pi B} = \frac{(4\pi\times10^{-7})\times12}{2\times\pi\times(3\times10^{-5})} = 8\times10^{-2}$ m

Ans: (a)

148. A coil in the shape of an equilateral triangle of side $0.02\,\text{m}$ is suspended from its vertex such that it is hanging in a vertical plane between the pole pieces of permanent magnet producing a uniform field of 5×10^{-2} T. If a current of $0.1\,\text{A}$ is passed through the coil, what is the couple acting?

(a) $5\sqrt{3}\times10^{-7}$ N – m (b) $5\sqrt{3}\times10^{-10}$ N – m (c) $\frac{\sqrt{3}}{5}\times10^{-7}$ N – m (d) none of these

Sol: Torque $\tau = iAB\sin\theta,\ i = 0.1\text{A}, \theta = 90°$

$A = \frac{1}{2}\times\text{base}\times\text{height}$

or $A = \frac{1}{2}a\times\frac{a\sqrt{3}}{2} = \frac{\sqrt{3}a^2}{4} = \frac{\sqrt{3}\times(0.02)^2}{4} = \sqrt{3}\times10^{-4}\text{ m}^2,\ \theta = 90°$

$\tau = 0.1\times\sqrt{3}\times10^{-4}\times5\times10^{-2}\sin90° = 5\sqrt{3}\times10^{-7}$ N – m

Ans: (a)

149. The distance at which the magnetic field on axis as compared to the magnetic field at the center of the coil carrying current I and radius R is $\frac{1}{8}$, would be

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

Sol: $\frac{B_A}{B_C} = \left(\frac{R^2}{x^2+R^2}\right)^{3/2}$

$\frac{1}{8} = \left(\frac{R^2}{x^2+R^2}\right)^{3/2} \Rightarrow \frac{1}{4} = \frac{R^2}{x^2+R^2}$

$\Rightarrow x^2 + R^2 = 4R^2$

$\Rightarrow x = \sqrt{3}R$

Ans: (d)

150.Magnetic permeability is maximum for

(a) diamagnetic substance
(b) paramagnetic substance
(c) ferromagnetic substance
(d) All of the above

Sol: ferromagnetic substance

Ans: (c)

151.A magnetic field of 2×10^{-2} T acts at right angles to a coil of area $100\,cm^2$, with 50 turns. The average e.m.f. induced in the coil is 0.1 V, when it is removed from the field in t s. The value of t is

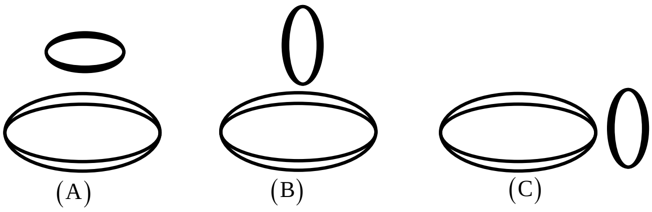
(a) 10 s
(b) 0.1 s
(c) 0.01 s
(d) 1 s

Sol: $e = \frac{-(\phi_2 - \phi_1)}{t} = \frac{-(0 - NBA)}{t} = \frac{NBA}{t}$

$t = \frac{NBA}{e} = \frac{50\times2\times10^{-2}\times10^{-2}}{0.1} = 0.1\,s$

Ans: (b)

152.Two circular coils can be arranged in any of the three situations shown in the figure. Their mutual inductance will be



(a) maximum in situation (A)
(b) maximum in situation (B)
(c) maximum in situation (C)
(d) the same in all situation

Sol: The mutual inductance between two coils depends on their degree of flux linkage, i.e., the fraction of flux linked with one coil which is also linked to the other coil. Here, the two coils in arrangement (a) are placed with their planes parallel. This will allow maximum flux linkage.

Ans: (a)

153.In an A.C. circuit with voltage V and current I the power dissipated is

(a) $\frac{1}{\sqrt{2}}VI$
(b) $\frac{1}{2}VI$
(c) VI
(d) dependent on the phase between V and I

Sol: Power dissipated $E_{rms}\cdot I_{rms} = (E_{rms})(I_{rms})\cos\theta$

Hence, power dissipated depends upon phase difference.

Ans: (d)

154.A $100\,\mu F$ capacitor in series with a $40\,\Omega$ resistance is connected to a 100 V, 60 Hz supply. What is the maximum current in the circuit?

(a) 3.24 A
(b) 4.25 A
(c) 2.25 A
(d) 5.20 A

Sol: Here, $C = 100\,\mu F = 100\times10^{-6}\,F$, $R = 40\,\Omega$, $V_{rms} = 100\,V$, $f = 60\,Hz$

Peak voltage, $V_0 = \sqrt{2}\cdot V_{rms} = 100\sqrt{2} = 155.54\,V$

Circuit impedance,

$$Z=\sqrt{R^2+\frac{1}{\omega^2C^2}}=\sqrt{40^2+\frac{1}{\left(2\times\pi\times60\times100\times10^{-6}\right)^2}}=\sqrt{1600+703.60}=\sqrt{2303.60}=48\,\Omega$$

Hence, maximum current in coil, $I_0=\frac{V_0}{Z}=\frac{155.54}{48}=3.24\,\text{A}$

Ans: (a)

155. An alternating current in a circuit is given by $I=20\sin\left(100\pi t+0.05\pi\right)\text{A}$. The r.m.s. value and the frequency of current respectively are

(a) $10\,\text{A}$ and $100\,\text{Hz}$ (b) $10\,\text{A}$ and $50\,\text{Hz}$ (c) $10\sqrt{2}\,\text{A}$ and $50\,\text{Hz}$ (d) $10\sqrt{2}\,\text{A}$ and $100\,\text{Hz}$

Sol: $I=20\sin\left(100\pi t+0.05\pi\right)$

$$\therefore\ I_{\text{rms}}=\frac{20}{\sqrt{2}}=10\sqrt{2}\ \text{A}$$

$\omega=100\pi\ \Rightarrow\ f=50\,\text{Hz}$

Ans: (c)

156. The decreasing order of wavelength of infrared, microwave, ultraviolet and gamma rays is

(a) Microwave, infrared, ultraviolet, gamma rays

(b) Infrared, microwave, ultraviolet, gamma rays

(c) Gama rays, ultraviolet, infrared, microwaves

(d) Microwaves, gamma rays, infrared, ultraviolet

Sol: Microwave, infrared, ultraviolet, gamma rays

Ans: (a)

157. Two lenses of power $+12$ and -2 diopters are placed in contact. The combined focal length of the combination will be

(a) 8.33 cm (b) 16.6 cm (c) 12.5 cm (d) 10 cm

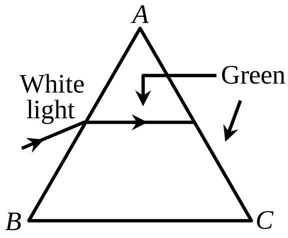
Sol: The combined power of lenses placed in contact,

$P=P_1+P_2,\ P=12-2=10$ dioptres

$$F=\frac{1}{10}\text{m}=10\,\text{cm}$$

Ans: (d)

158. White light is incident on face AB of a glass prism. The path of the green component is shown in the figure. If the green light is just totally internally reflected at face AC as shown, the light emerging from face AC will contain



(a) yellow, orange and red colours (b) violet, indigo and blue colours
(c) all colours (d) all colours except green

Sol: Wavelength (λ) increases in the sequence of VIBGYOR. According to Cauchy's formula, (μ) decreases as wavelength increases. Therefore, μ decreases in the sequence VIBGYOR.

As $C = \sin^{-1}\left(\frac{1}{\mu}\right)$, therefore, critical angle C increases in the sequence VIBGYOR. For green colour, $\angle i = C$. For yellow, orange and red, critical angle is greater. Therefore, $\angle i$ is less than critical angle for YOR. These colours will not suffer total internal reflection. They will emerge from glass-air interface.

Ans: (a)

159. A 2.0 cm tall object is placed 15 cm in front of a concave mirror of focal length 10 cm. What is the size and nature of the image?

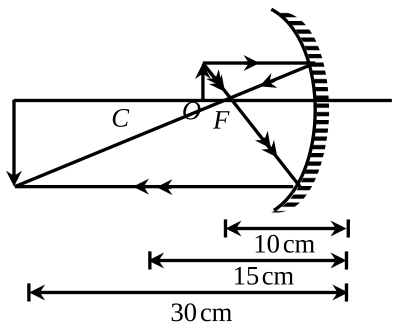
(a) 4 cm, real (b) 4 cm, virtual (c) 1.0 cm, real (d) none of these

Sol: According to New Cartesian sign convention,

Object distance $u = -15$ cm

Focal length of a concave lens, $f = -10\,\text{cm}$

Height of the object $h_0 = 2.0\,\text{cm}$



According to mirror formula,

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$$

$$= \frac{1}{-10} - \frac{1}{-15} \Rightarrow v = -30\,\text{cm}$$

This image is formed $30\,\text{cm}$ from the mirror on the same side of the object. It is real image.

Magnification of the mirror,

$$m = \frac{-v}{u} = \frac{h_1}{h_0} \qquad \Rightarrow \frac{-(-30)}{-15} = \frac{h_1}{2} \quad \Rightarrow h_1 = -4\,\text{cm}$$

Negative sign shows that image is inverted.

The image is real, inverted, of size $4\,cm$ at a distance $30\,cm$ in front of the mirror.

Ans: (a)

160. A vessel of depth $2d$ cm is half filled with a liquid of refractive index μ_1 and the upper half with a liquid of refractive index μ_2. The apparent depth of the vessel seen perpendicularly is

(a) $d\left(\frac{\mu_1\mu_2}{\mu_1+\mu_2}\right)$ (b) $d\left(\frac{1}{\mu_1}+\frac{1}{\mu_2}\right)$ (c) $2d\left(\frac{1}{\mu_1}+\frac{1}{\mu_2}\right)$ (d) $2d\left(\frac{1}{\mu_1\mu_2}\right)$

Sol: $h'=\frac{d_1}{\mu_1}+\frac{d_2}{\mu_2}=d\left(\frac{1}{\mu_1}+\frac{1}{\mu_2}\right)$

Ans: (b)

161. Two sources of light are said to be coherent, when they give light waves of same

(a) Amplitude and phase
(b) Wavelength and constant phase difference
(c) Intensity and wavelength
(d) Phase and speed

Sol: For coherent sources λ is same and phase is also same or phase diff. is constant.

Ans: (b)

162. Raito of intensities of two waves are given by $4:1$. Then the ratio of the amplitudes of the two waves is

(a) $2:1$ (b) $1:2$ (c) $4:1$ (d) $1:4$

Sol: $\frac{I_1}{I_2}=\frac{a_1^2}{a_2^2}=\frac{4}{1}$

$\therefore \frac{a_1}{a_2}=\frac{2}{1}$

Ans: (a)

163. If the momentum of electron is changed by P, then the de-Broglie wavelength associated with it changes by 0.5%. The initial momentum of electron will be

(a) $200\,P$ (b) $400\,P$ (c) $\frac{P}{200}$ (d) $100\,P$

Sol: The de-Broglie's wavelength associated with the moving electron, $\lambda=\frac{h}{P}$

Now, according to problem

$\frac{d\lambda}{\lambda}=-\frac{dp}{P}$

$\frac{0.5}{100}=\frac{P}{P'}$

$P'=200\,P$

Ans: (a)

164. When a metal surface is illuminated by light of wavelengths $400\,nm$ and $250\,nm$, the maximum velocities of the photoelectrons ejected are υ and 2υ respectively. The work function of the metal is ($h=$ Planck's constant, $c=$ velocity of light in air)

(a) $2hc\times10^6$ J (b) $1.5hc\times10^6$ J (c) $hc\times10^6$ J (d) $0.5hc\times10^6$ J

Sol: By using, $\frac{hc}{\lambda} = W_0 + \frac{1}{2}m\upsilon^2$

$\Rightarrow \frac{hc}{400\times10^{-9}} = W_0 + \frac{1}{2}m\upsilon^2$ … (i)

and, $\frac{hc}{250\times10^{-9}} = W_0 + \frac{1}{2}m(2\upsilon)^2$ … (ii)

on solving (i) and (ii)

$\frac{1}{2}m\upsilon^2 = \frac{hc}{3}\left[\frac{1}{250\times10^{-9}} - \frac{1}{400\times10^{-9}}\right]$ … (iii)

From equation (i), (ii) and (iii),

$W_0 = 2hc\times10^6$ J

Ans: (a)

165. As the quantum number increases, the difference of energy between consecutive energy levels

(a) remain the same

(b) increases

(c) decreases

(d) sometimes increases and sometimes decreases

Sol: The energy of an electron revolving in an orbit is: $E = -\frac{me^4}{8n^2h^2\varepsilon_0^2}$ where variables have their usual meanings.

$\Rightarrow E_n \propto \frac{1}{n^2}$

$\Delta E_{n,n-1} = E_n - E_{n-1} = -\frac{1}{(n-1)^2} + \frac{1}{n^2} = \frac{2n-1}{n^2-n}$

This can be approximated to $\frac{2}{n}$ when n is very large. Thus, energy difference consecutive levels as n increases.

Ans: (c)

166. According to the Bohr theory of H-atom, the speed of the electron, its energy and the radius of its orbit varies with the principal quantum number n, respectively, as

(a) $\frac{1}{n}, n^2 \frac{1}{n^2}$ (b) $n, \frac{1}{n^2}, n^2$ (c) $n, \frac{1}{n^2}, \frac{1}{n^2}$ (d) $\frac{1}{n}, \frac{1}{n^2}, n^2$

Sol: $v \propto \frac{1}{n}, E \propto \frac{1}{n^2}$ and $r \propto n^2$

Ans: (d)

167. The electron in a hydrogen atom makes a transition $n_1 \to n_2$, where n_1 and n_2 are the principal quantum numbers of the two states. Assume the Bohr model to be valid. The time period of the electron in the initial state is eight times that in the final state. The possible values of n_1 and n_2 are

(a) $n_1 = 4, n_2 = 2$ (b) $n_1 = 8, n_2 = 2$ (c) $n_1 = 8, n_2 = 1$ (d) $n_1 = 6, n_2 = 3$

Sol: $T \propto n^3$. Given $T_{n_1} = 8T_{n_2}$, hence $n_1 = 2n_2$

Ans: (a)

168. When the number of nucleons in nuclei increases, the binding energy per nucleon

(a) Increases continuously with mass number

(b) Decreases continuously with mass number

(c) Remains constant with mass number

(d) First increases and then decreases with increases of mass number

Sol: Average BE / nucleon increases first, and then decreases, as is clear from BE curve

Ans: (d)

169. A nuclei having same number of neutron but different number of protons/atomic number are called

(a) Isobars (b) Isomers (c) Isotones (d) Isotopes

Sol: Isotones

Ans: (c)

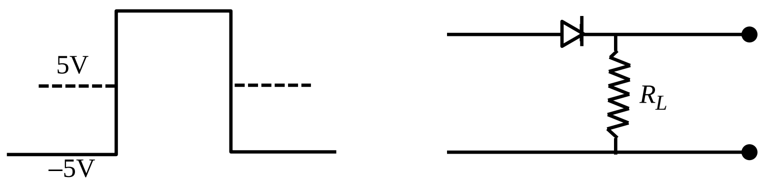
170. If $220\,\text{MeV}$ energy is released in the fission of a single U^{235} nucleus, the number of fissions required per second to produce 1 kilowatt power shall be (Given $1\text{eV} = 1.6\times10^{-19}\,\text{J}$)

(a) 3.125×10^{13} (b) 3.125×10^{14} (c) 3.125×10^{15} (d) 3.125×10^{16}

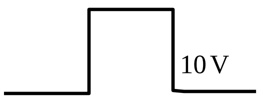
Sol: $P = n\left(\frac{E}{t}\right)$ $\Rightarrow 1000 = \frac{n\times200\times10^{6}\times1.6\times10^{-19}}{t}$ $\Rightarrow \frac{n}{t} = 3.125\times10^{3}$

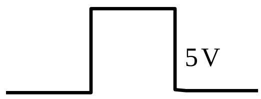
Ans: (a)

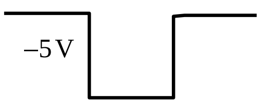
171. In a $p-n$ junction diode, a square input signal of $10\,\text{V}$ is applied as shown in fig.

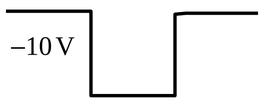


The output signal across R_L will be

(a) 

(b) 

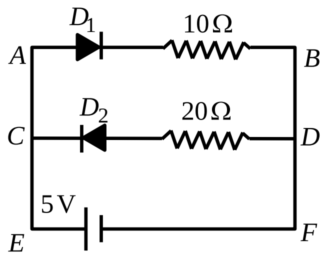
(c) 

(d) 

Sol: The $p-n$ junction diode is a half wave rectifier which produces output in forward biased mode only. Thus, there will be no output corresponding to $-5\,\text{V}$ input. Hence, output will be obtained corresponding to $+5\,\text{V}$ only.

Ans: (b)

172. Two ideal diodes are connected to a battery as shown in the circuit. The current supplied by the battery is



(a) $0.75\,\text{A}$ (b) zero (c) $0.25\,\text{A}$ (d) $0.5\,\text{A}$

Sol: Here D_1 is in forward bias and D_2 is in reverse bias so, D_1 will conduct and D_2 will not conduct. Thus, no current with flow through DC.

$$I = \frac{V}{R} = \frac{5}{10} = \frac{1}{2}\ \text{A}$$

Ans: (d)

173. A p-type semiconductor is

(a) Positively charged

(b) Negative charged

(c) Uncharged

(d) Uncharged at $0\,\text{K}$ but charged at height temperatures

Sol: By doping, the band gap reduce from $1\,\text{eV}$ to 0.3 to $0.7\,\text{eV}$ & electron can achieve this energy $(0.3\ \text{eV to}\ 0.7\ \text{eV})$ at room temperature & reach in C.B (conduction band).

Ans: (c)

174. A charged particle of charge q and mass m enters perpendicularly in a magnetic field $\vec{B}$. Kinetic energy of the particle is E; then frequency of rotation is

(a) $\frac{qB}{m\pi}$ (b) $\frac{qB}{2\pi m}$ (c) $\frac{qBE}{2\pi m}$ (d) $\frac{qB}{2\pi E}$

Sol: For circular path in magnetic field,

$$mr\omega^2 = qvB$$

$$\Rightarrow\ \omega^2 = \frac{qvB}{mr}$$

As $v = r\omega$

$$\therefore\ \omega^2 = \frac{q(r\omega)B}{mr} \quad \Rightarrow \omega = \frac{qB}{m}$$

$\therefore$ If v is frequency of rotation, then

$$v = \frac{\omega}{2\pi} \quad \Rightarrow \quad v = \frac{qB}{2\pi m}$$

Ans: (b)

175. Which of the following is the most precise instrument for measuring length?

(a) Metre rod of least count 0.1 cm (b) Vernier callipers of least count 0.01 cm

(c) Screw gauge of least count 0.001 cm (d) None of these

Sol: Screw gauge has minimum least count of 0.001 cm . Hence, is most precise instrument.

Ans: (c)

176. The water drops fall at regular intervals from a tap 5 m above the ground. The third drop is leaving the tap at an instant when the first drop touches the ground. How far above the ground is the second drop at that instant? (Take $g = 10\ \text{ms}^{-2}$)

(a) 1.25 m (b) 2.50 m (c) 3.75 m (d) 5.00 m

Sol: Height of tap $= 5\,\text{m}$ and $(g) = 10\,\text{m}\,\text{s}^{-2}$

For the first drop,

$$5 = ut + \frac{1}{2}gt^2 = (0 \times t) + \frac{1}{2} \times 10t^2 = 5t^2 \text{ or } t^2 = 1 \text{ or } t = 1$$

It means that the third drop leaves after one second of the first drop. Or, each drop leaves after every 0.5 s . distance covered by the second drop in 0.5 s .

$$= ut + \frac{1}{2}gt^2 = (0 \times 0.5) + \frac{1}{2} \times 10 = (0.5)^2 = 1.25 \text{ m}$$

Therefore, distance of the second drop above the ground $= 5 - 1.25 = 3.75$ m .

Ans: (c)

177. A particle starts from origin at $t = 0$ with velocity $5\hat{i}\ \text{ms}^{-1}$ and moves in $x - y$ plane under the action of a force which produces a constant acceleration of $3\hat{i} + 2\hat{j}\ \text{ms}^{-2}$. The $y -$ coordinate of the particle at the instant when its $x -$coordinate is 84 m , is

(a) 12 m (b) 24 m (c) 36 m (d) 48 m

Sol: The position of the particle is given by

$$\vec{r} = \vec{r}_0 + \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$$

where, $\vec{r}_0$ is the position vector at $t = 0$ and $\vec{v}_0$ is the velocity at $t = 0$

Here, $\vec{r}_0 = 0,\ \vec{v}_0 = 5\hat{i}\ \text{ms}^{-1},\ \vec{a} = (3\hat{i} + 2\hat{j})\ \text{ms}^{-2}$

$$\therefore\ \vec{r} = 5t\hat{i} + \frac{1}{2}(3\hat{i} + 2\hat{j})t^2 = (5t + 1.5t^2)\hat{i} + 1t^2\hat{j} \qquad \ldots \text{(i)}$$

Compare it with $\vec{r} = x\hat{i} + y\hat{j}$, we get $x = 5t + 1.5t^2,\ y = 1t^2$

$\therefore\ x = 84$ m $\quad \because\ 84 = 5t + 1.5t^2$

On solving, we get $t = 6\,\text{s}$

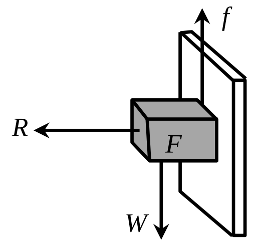
At $t = 6\,\text{s},\ y = (1)(6)^2 = 36$ m

Ans: (c)

178. A block weighs W is held against a vertical wall by applying a horizontal force F. The minimum value of F needed to hold the block is

(a) Less than W
(b) Equal to W
(c) Greater than W
(d) Data is insufficient

Sol: Here applied horizontal force F acts as normal reaction.



For holding the block

Force of friction = Weight of block

$F = W \Rightarrow \quad \mu R = W \quad \Rightarrow \mu F = W$

$\Rightarrow \quad F = \dfrac{W}{\mu}$

As $\mu < 1 \qquad \therefore \quad F > W$

Ans: (c)

179. A running man has half the kinetic energy of that of a boy of half of his mass. The man speeds up by 1ms^{-1} so as to have same K.E. as that of the boy. The original speed of the man will be

(a) $\sqrt{2}\ \text{ms}^{-1}$
(b) $\left(\sqrt{2}-1\right)\ \text{ms}^{-1}$
(c) $\dfrac{1}{\left(\sqrt{2}-1\right)}\text{ms}^{-1}$
(d) $\dfrac{1}{\sqrt{2}}\text{ms}^{-1}$

Sol: Let $m =$ mass of boy, $M =$ mass of man $v =$ velocity of boy, $V =$ velocity of man

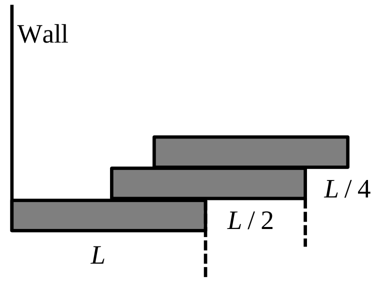
$$\frac{1}{2}MV^2 = \frac{1}{2}\left[\frac{1}{2}mv^2\right] \qquad \ldots\text{(i)}$$

$$\frac{1}{2}M\left(V+1\right)^2 = 1\left[\frac{1}{2}mv^2\right] \qquad \ldots\text{(ii)}$$

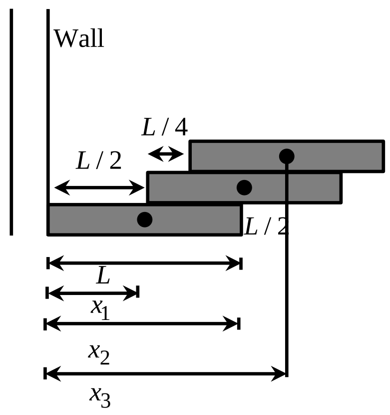
Putting $m = \dfrac{M}{2}$ and solving $V = \dfrac{1}{\sqrt{2}-1}$

Ans: (c)

180. Three bricks each of length L and mass M arranged as shown from the wall. The distance of the centre of mass of the system from the wall is



(a) $\dfrac{L}{4}$
(b) $\dfrac{L}{2}$
(c) $\left(\dfrac{3}{2}\right)L$
(d) $\left(\dfrac{11}{12}\right)L$



Sol: From figure, $x_1 = \frac{L}{2}$, $x_2 = \frac{L}{2} + \frac{L}{2} = L$

$x_3 = \frac{L}{2} + \frac{L}{4} + \frac{L}{2} = \frac{5L}{4}$

$\therefore \; X_{CM} = \frac{m_1 x_1 + m_2 x_2 + m_3 x_3}{m_1 + m_2 + m_3}$

$= \frac{M \times \frac{L}{2} + M \times L + 6M \times \frac{5L}{4}}{M + M + M} = \frac{\frac{11}{4} ML}{3M} = \frac{11L}{12}$

Ans: (d)

Key Answers:

1. b	2. c	3. b	4. a	5. a	6. b	7. c	8. b	9. a	10. a
11. d	12. c	13. c	14. d	15. a	16. b	17. c	18. c	19. a	20. c
21. b	22. b	23. d	24. c	25. c	26. d	27. d	28. a	29. a	30. b
31. b	32. c	33. d	34. a	35. a	36. d	37. a	38. c	39. d	40. a
41. b	42. b	43. c	44. a	45. b	46. b	47. b	48. c	49. d	50. a
51. c	52. b	53. b	54. a	55. d	56. a	57. d	58. d	59. d	60. a
61. c	62. c	63. b	64. a	65. c	66. c	67. c	68. a	69. d	70. a
71. a	72. c	73. c	74. a	75. a	76. c	77. b	78. b	79. c	80. b
81. b	82. c	83. a	84. a	85. d	86. b	87. d	88. c	89. a	90. c
91. a	92. b	93. a	94. c	95. c	96. d	97. b	98. c	99. c	100.b
101.d	102.a	103.c	104.c	105.c	106.b	107.a	108.d	109.a	110.a
111.a	112.d	113.c	114.c	115.c	116.b	117.b	118.c	119.b	120.a
121.c	122.c	123.d	124.b	125.c	126.c	127.a	128.c	129.a	130.d
131.a	132.b	133.c	134.c	135.b	136.c	137.a	138.a	139.b	140.c
141.d	142.b	143.b	144.b	145.b	146.c	147.a	148.a	149.d	150.c
151.b	152.a	153.d	154.a	155.c	156.a	157.d	158.a	159.a	160.b
161.b	162.a	163.a	164.a	165.c	166.d	167.a	168.d	169.c	170.a
171.b	172.d	173.c	174.b	175.c	176.c	177.c	178.c	179.c	180.d