NEET(UG)–2025 EXAMINATION

(Held On Sunday 4th May, 2025)

BIOLOGY

(Question Paper with Answer & Solution)

Paper Code : 47 **Test Date : 04.05.2025**

91. Which of the following is the unit of productivity of an Ecosystem ?

(1) (KCal m^{-2}) y (2) gm^{-2} (3) KCal m^{-2} (4) KCal m^{-3}

Ans. (1). **(KCal m^{-2}) y**

92. The First menstruation is called :

(1) Ovulation (2) Menopause (3) Menarche (4) Diapause

Ans. (3) **Menarche**

93. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A) : All vertebrates are chorates but all chorates are not vertebrate.

Reason (R) : The members of subphylum vertebrata possess notochord during the embryonic period, the notochord is replaced by a cartilaginous or bony vertebral column in adults.

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

(1) A is false but R is true

(2) Both A and R are true and R is the correct explanation of A

(3) Both A and R are true but R is not the correct explanation of A

(4) A is true but R is false

Ans. (2) **Both A and R are true and R is the correct explanation of A**

94. Genes R and Y follow independent assortment. If RRYY produce round yellow seeds and rryy produce wrinkled green seeds, what will be the phenotypic ratio of the F2 generation?

(1) Phenotypic ratio - 9 : 7 (2) Phenotypic ratio - 1 : 2 : 1

(3) Phenotypic ratio - 3 : 1 (4) Phenotypfc ratio - 9 : 3 : 3 : 1

Ans. (4) **Phenotypfc ratio - 9 : 3 : 3 : 1**

95. Given below are two statements :

Statement I : The DNA fragments extracted from gel electrophoresis can be used in construction of recombinant DNA.

Statement II: Smaller size DNA fragments are observed near hnbde while larger fragments are found near the wells in an agarose gel.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is incorrect but statement II is correct

(2) Both statement I and statement II are correct

(3) Both statement I and statement II are incorrect

(4) Statement is correct but statement II is incorrect

Ans. (2) **Both statement I and statement II are correct**

Sol. $A(g) \rightleftharpoons 2B(g)$ $\quad \Delta ng = +1$

$K_b = 2500\ K_F$ $\quad K_p = K_c (RT)^{\Delta ng}$

$$K_c = \frac{K_f}{K_b}$$

$$K_c = \frac{K_f}{2500K_f} \qquad K_P = 4 \times 10^{-4} (.0831 \times 1000)^1$$

$K_c = 4 \times 10^{-4}$ $\quad K_p = .033$

90. 5 moles of liquid X and 10 moles of liquid Y make a solution having a vapour pressures of pure X and Y are 63 torr and 78 torr respectively. Whic of the following is true regarding the described solution :

(1) The solution has volume greater than the sum of individual volumes.

(2) The solution shows positive deviation

(3) The solution shows negative deviation

(4) The solution is ideal

Ans. **(3) The solution shows negative deviation**

Sol. $P_S = P_A + P_B \rightarrow$ Rault's law

$P_S = P_X + P_Y$

$$P_x = X_x P_x^0 \qquad P_x = \frac{5}{15} \times 63 \qquad P_x = 21$$

$$P_y = X_y P_y^0 \qquad P_y = \frac{10}{15} \times 78 \qquad P_y = 52$$

$P_s = 21 + 52$

$P_s = 73$

$\boxed{P_{Practical} < P_{Theortical}}$

$\rightarrow$ Show Negative deviation

87. Identify the correct orders against the property mentioned

A. $H_2O > NH_3 > CHCl_3$ – dipole moment

B. $XeF_4 > XeO_3 > XeF_2$ – number of lone pairs on central atom

C. O–H > C–H > N–O – bond length

D. $N_2 > O_2 > H_2$ – bond enthalpy

Choose the **correct** answer from the options given below :

(1) B, C only (2) A, D only (3) B, D only (4) A, C only

Ans. **(2) A, D only**

Sol. (A) $H_2O > NH_3 > CHCl_3$ – dipole moment

(B) $\underset{3\ell.p.}{XeF_2} > \underset{2\ell.p.}{XeF_4} > \underset{1\ell.p.}{XeO_3}$ – number of lone pairs on central atom

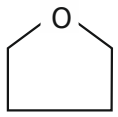
(D) $\underset{(N\equiv N)}{N_2} > \underset{(O=O)}{O_2} > \underset{(H-H)}{H_2}$ – bond enthalpy

88. Total number of possible isomers (both structural as well as stereoisomers) of cyclic ethers of molecular formula C_4H_8O is :

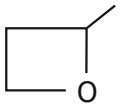
(1) 11 (2) 6 (3) 8 (4) 10

Ans. **(4) 10**

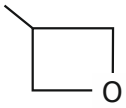
Sol. MF $\xrightarrow{C_4H_8O}$ cyclic ether isomers.



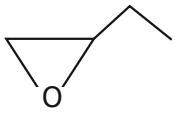
(A)



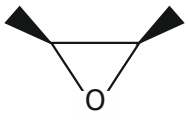
(B)



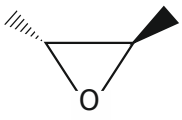
(C)



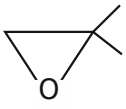
(D)



(E)



(F)



(G)

structure (B), (D), (F) are optically active so mirror images also included in stereoisomerism. so total stereoisomers are.

89. For the reaction A (g) $\rightleftharpoons$ 2B(g), the backward reaction rate constant is higher than the forward reaction rate constant by a factor of 2500, at 1000 K.

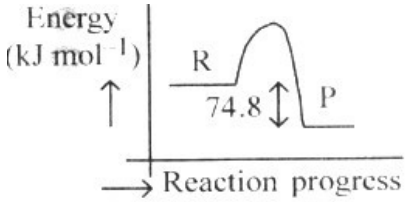
[Given : R = 0.0831 L atm mol^{-1} K^{-1}]

K_P for the reaction at 1000 K is :

(1) 0.021 (2) 83.1 (3) 2.077×10^5 (4) 0.033

Ans. **(4) 0.033**

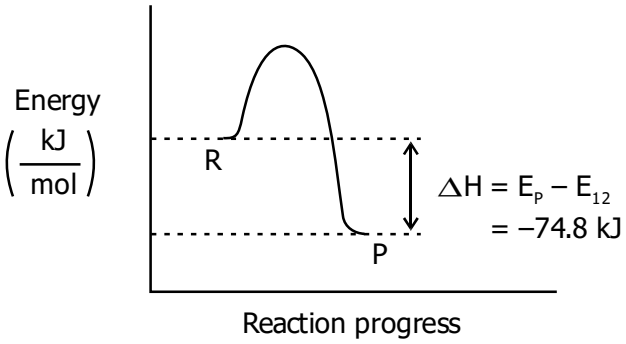
Ans. **(2)**



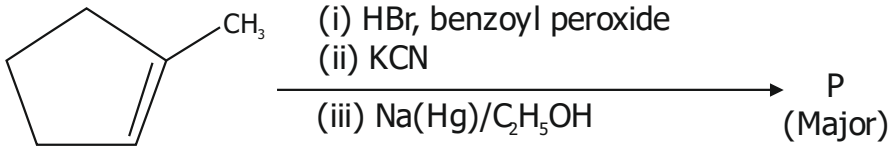
Sol. $C_{(s)} + 2H_{2(g)} \rightarrow CH_{4(g)}$ $\Delta H = -74.8$ kJ/mol

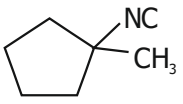
$\rightarrow$ Exothermic reaction

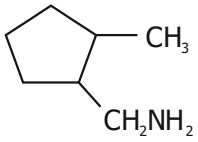
$E_P < E_R$

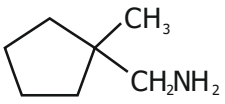


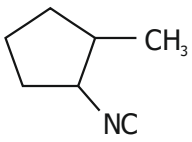
86. Predict the major product 'P' in the following sequence of reactions –

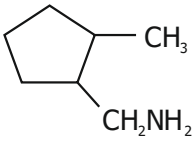


(1) 

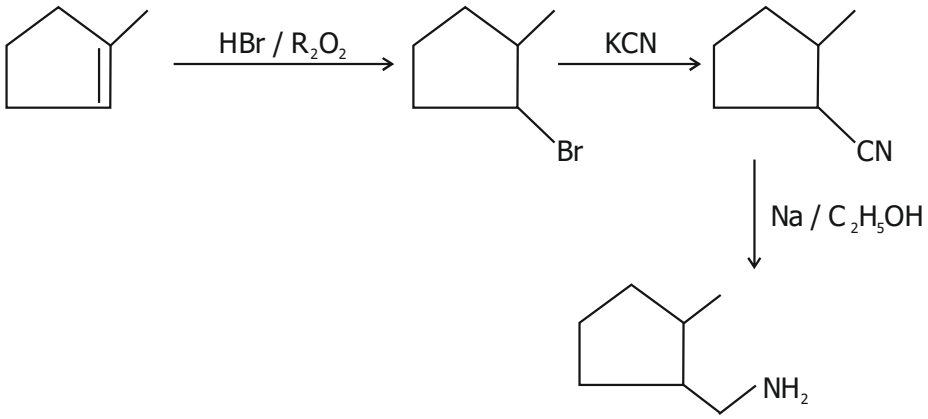
(2) 

(3) 

(4) 

Ans. **(2)** 

Sol.



$= .264\ S\ A^0$ $\quad E_{He^+} = -8.72 \times 10^{-18}\ S$

$= 26.4\ PM$

$n = 1$

$r_{Li^{+2}} = .529 \times \frac{1}{3} A^0$ $\quad E_{Li^{+2}} = -2.18 \times 10^{-18} \times \frac{(3)^2}{(1)^2}$

$= 17.6\ pm$ $\quad E_{Li^{+2}} = -19.62 \times 10^{-18}\ J$

84. Which among the following electronic configurations belong to main group elements :

A. $[Ne]3s^1$ B. $[Ar]3d^34s^2$ C. $[Kr]4d^{10}5s^25p^5$

D. $[Ar]3d^{10}4s^1$ E. $[Rn]5f^0\ 6d^27s^2$

Choose the **correct** answer form the option given below :

(1) A, C and D only (2) B and E only (3) A and C only (4) D and E only

Ans. **(3) A and C only**

Sol. s & p block element are main group element

(A) $[Ne]3s^1 \rightarrow$ s-block element

(B) $[Ar]3d^34s^2 \rightarrow$ d-block element

(C) $[Kr]4d^{10}5s^25p^5 \rightarrow$ p-block element

(D) $[Ar]3d^{10}4s^1 \rightarrow$ d-block element

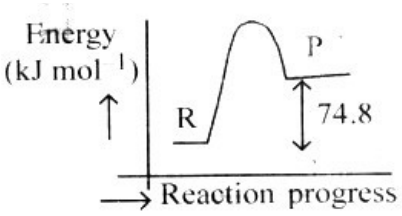
(E) $[Rn]5f^0\ 6d^27s^2 \rightarrow$ f-block element

85. $C(s) + 2H_2(g) \rightarrow CH_4(g);\ \Delta H = -74.8\ kJ\ mol^{-1}$

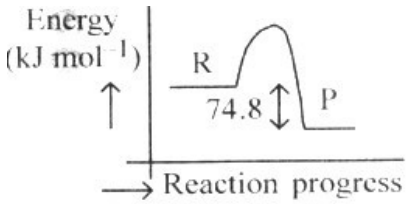
Which of the following diagrams gives an accurate representation of the above reaction ?

[R → reactants; P → prducts]

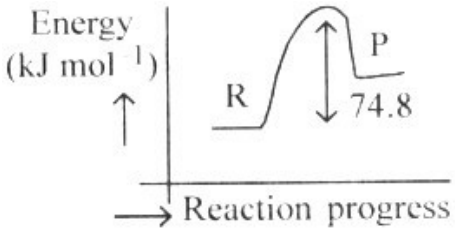
(1)



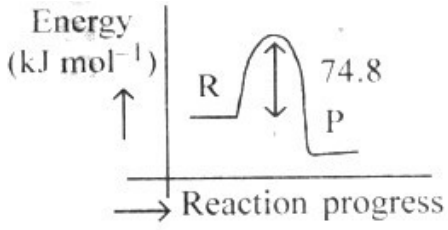
(2)



(3)



(4)



Choose the **correct** answer from the options given below :

(1) A-III, B-II, C-I, D-IV (2) A-II, B-IV, C-I, D-III

(3) A-II, B-I, C-IV, D-III (4) A-III, B-I, C-IV, D-II

Ans. **(3) A-II, B-I, C-IV, D-III**

Sol. Humidity – Liquid in gas

Alloys – Solid in solid

Amalgams – Liquid in solid

Smoke – Solid in gas

83. Enery and radius of first Bohr orbit of He^+ and Li^{2+} are

[Given $R_H = 2.18 \times 10^{-18}$ J, $a_0 = 52.9$ pm]

(1) $E_n\ (Li^{2+}) = -8.72 \times 10^{-16}$ J;

$r_n\ (Li^{2+}) = 17.6$ pm

$E_n\ (He^+) = -19.62 \times 10^{-16}$ J;

$r_n\ (He^+) = 17.6$ pm

(2) $E_n\ (Li^{2+}) = -19.62 \times 10^{-18}$ J;

$r_n\ (Li^{2+}) = 17.6$ pm

$E_n\ (He^+) = -8.72 \times 10^{-18}$ J;

$r_n\ (He^+) = 26.4$ pm

(3) $E_n\ (Li^{2+}) = -8.72 \times 10^{-18}$ J;

$r_n\ (Li^{2+}) = 26.4$ pm

$E_n\ (He^+) = -19.62 \times 10^{-18}$ J;

$r_n\ (He^+) = 17.6$ pm

(4) $E_n\ (Li^{2+}) = -19.62 \times 10^{-16}$ J;

$r_n\ (Li^{2+}) = 17.6$ pm

$E_n\ (He^+) = -8.72 \times 10^{-16}$ J;

$r_n\ (He^+) = 26.4$ pm

Ans. **(2) $E_n\ (Li^{2+}) = -19.62 \times 10^{-18}$ J;**

$r_n\ (Li^{2+}) = 17.6$ pm

$E_n\ (He^+) = -8.72 \times 10^{-18}$ J;

$r_n\ (He^+) = 26.4$ pm

Sol. $r = .529 \times \frac{n^2}{Z}\ A^0 \qquad E = -2.18 \times 10^{-18} \times \frac{z^2}{n^2}$ Joule

$n = 1$

$E_{He^+} = .529 \times \frac{1}{2}\ A^0 \qquad E_{He^+} = -2.18 \times 10^{-18} \times \frac{(2)^2}{(1)^2}$

80. Higher yield of NO in

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ can be obtained at

[ΔH of the reaction = + 180.7 kJ mol^{-1}]

A. higher temperaturg

B. lower temperature

C. higher concentration of N_2

D. higher concentration of O_2

Choose the **correct** answer from the options given below :

(1) A, C, D only (2) A, D only (3) B, C only (4) B, C, D only

Ans. **(1) A, C, D only**

Sol. $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ ΔH = +180.7 KJ mol

$\rightarrow$ endothermic reaction

(1) Higher temperaturg

(2) Higher concentration of N_2

(3) Higher concentration of O_2

81. Match List-I with List-II

List-I	**List-II**
A. XeO_3	I. sp^3d; linear
B. XeF_2	II. sp^3; pyramidal
C. $XeOF_4$	III. sp^3d^3; distorted octahedral
D. XeF_6	IV. sp^3d^2; square pyramidal

Choose the **correct** answer from the options given below :

(1) A-IV, B-II, C-I, D-III (2) A-II B-I, C-IV, D-III

(3) A-II B-I, C-III, D-IV (4) A-IV, B-II, C-III, D-I

Ans. **(2) A-II B-I, C-IV, D-III**

Sol. $XeO_3 \rightarrow sp^3d$ lenear [36 + 1 LP)

$XeF_2 \rightarrow sp^3d$ lenear [26 + 3 LP)

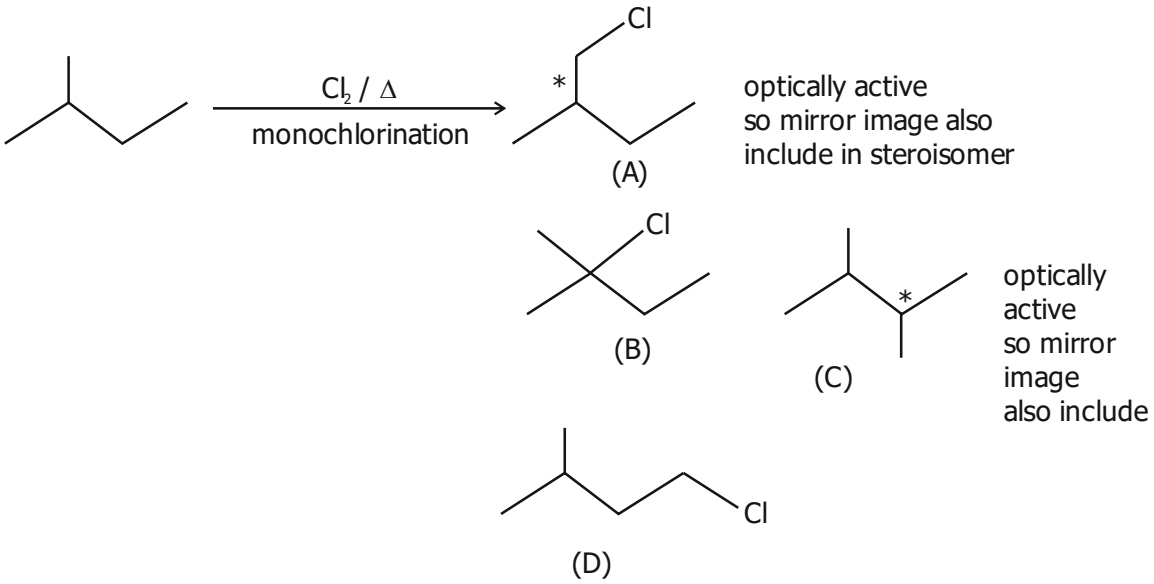
$XeOF_4 \rightarrow sp^3d^2$ – square pyramidal [5 + 1 LP)

$XeF_6 \rightarrow sp^3d^3$ – Distorted octahedral

82. Match List - I with List - II

List-I (Example)	**List-II (Type of solution)**
A. Humidity	I. Solid in solid
B. Alloys	II. Liquids in gas
C. Amalgams	III. Solid in gas
D. Smoke	III. Liquid in solid

Sol.



Total 6 isomers obtain including stereoisomerism.

78. Sugar 'X'

A. is found in honey.

B. is a keto sugar.

C. exists in α and β - anomeric forms.

D. is laevorotatory.

'X' is :

(1) Sucrose (2) D-Glucose (3) D-Fructose (4) Maltose

Ans. **(3) D-Fructose**

Sol. Sugar (x)

is fructose

→ present in Honey

→ Keto sugar

→ present in α & β form

→ Laevorotatory

79. Dalton's Atomic theory could not explain which of the following?

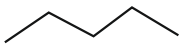
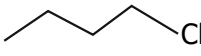
(1) Law of gaseous volume (2) Law of conservation of mass

(3) Law of constant proportion (4) Law of multiple proportion

Ans. **(1) Law of gaseous volume**

Sol. Dalton's atomic theory not explain law of gaseous volume.

74. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) :  I undergoes S_N2 reaction faster than  Cl.

Reason (R) : Iodine is a better leaving group because of its large size.

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

(1) A is false but R is true

(2) Both A and R are true and R is the correct explanation of A

(3) Both A and R are true but R is not the correct explanation of A

(4) A is true but R is false

Ans. **(2) Both A and R are true and R is the correct explanation of A**

Sol. Both statements are correct

75. The correct order of decreasing acidity of the following aliphatic acids is :

(1) HCOOH > $(CH_3)_3$ CCOOH > $(CH_3)_2$ CHCOOH > CH_3COOH

(2) $(CH_3)_3$ CCOOH > $(CH_3)_2$ CHCOOH > CH_3COOH > HCOOH

(3) CH_3COOH > $(CH_3)_2$ CHCOOH > $(CH_3)_3$ CCOOH > HCOOH

(4) HCOOH > CH_3COOH > $(CH_3)_2CHCOOH$ > $(CH_3)_3$ CCOOH

Ans. **(4) HCOOH > CH_3COOH > $(CH_3)_2CHCOOH$ > $(CH_3)_3$ CCOOH**

Sol. Acidic strength order

HCOOH > CH_3COOH > $(CH_3)_2$ CHCOOH > $(CH_3)_3$ CCOOH

76. Which one of the following reactions does **NOT** belong to "Lassaigne's test" ?

(1) $2CuO + \xrightarrow[\Delta]{} 2Cu + CO_2$

(2) $Na + C + N \xrightarrow[\Delta]{} NaCN$

(3) $2Na + S \xrightarrow[\Delta]{} Na_2S$

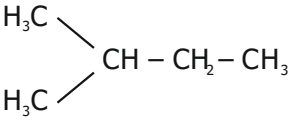
(4) $Na + X \xrightarrow[\Delta]{} + NaX$

Ans. **(1) $2CuO + \xrightarrow[\Delta]{} 2Cu + CO_2$**

Sol. $2CuO + C \xrightarrow[\Delta]{} 2Cu + CO_2$

This reaction is not related with lassaingne test.

77. How many products (including stereoisomers) are expected from monochlorination of the following compound ?



(1) 6 (2) 2 (3) 3 (4) 5

Ans. **(1) 6**

71. Which of the following aqueous solution will exhibit highest boiling point?

(1) 0.015 M $C_6H_{12}O_6$ (2) 0.01 M Urea (3) 0.01 M KNO_3 (4) 0.01 M Na_2SO_4

Ans. **(4) 0.01 M Na_2SO_4**

Sol. No. of particals (im) $\propto$ colligative properties

(im) $\propto$ boiling point

0.015 M ($C_6H_{12}O_6$) im = 0.015

0.01 M (Urea) im = 0.01

0.01 M (KNO_3) im = 0.02

0.01 M (Na_2SO_4) im = 0.03

So 0.01 M (Na_2SO_4) has highest bailing point

72. Give below are two statement :

Statement I : Benzenediazonium salt is prepared by the reaction of aniline with nitrous acid at 273 - 278 K. It decomposes easily in the dry state.

Statement II : Insertion of iodine into the benzene ring is difficult and hence iodobenzene is prepared through the reaction of benzenediazonium salt with KI.

In the light of the above statement, choose the most appropriate answer from the options given below :

(1) Statement I is incorrect but Statement II is correct

(2) Both Statement I and Statement II are correct

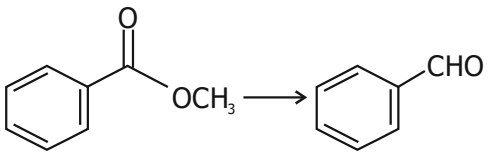
(3) Both Statement I and Statement II are incorrect

(4) Statement I is correct but Statement II is incorrect

Ans. **(2) Both Statement I and Statement II are correct**

Sol. Statement I & II Both are correct

73. Identify the suitable reagent for the following conversion.



(1) H_2 / Pd-$BaSO_4$

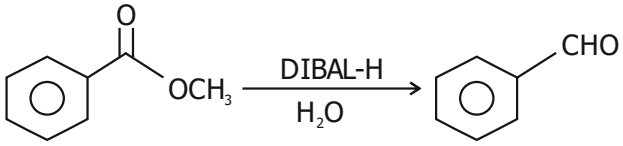
(2) (i) $LiAlH_4$, (ii) H^+/H_2O

(3) (i) $AlH(iBu)_2$, (ii) H_2O

(4) (i) $NaBH_4$, (ii) H^+/H_2O

Ans. **(3) (i) $AlH(iBu)_2$, (ii) H_2O**

Sol.



Sol. Polyprotic weak acid

$H_3PO_4 \rightleftharpoons H^+ + H_2PO_4^-$ K_{a_1}

$H_2PO_4^- \rightleftharpoons H^+ + HPO_4^{-2}$ K_{a_2}

$H_2PO_4^{-2} \rightleftharpoons H^+ + PO_4^{-3}$ K_{a_3}

$H_3PO_4 \rightleftharpoons H^+ + PO_4^{-3}$ $K = K_{a_1} \times K_{a_2} \times K_{a_3}$

$\log K = \log K_{a_1} + \log K_{a_2} + \log K_{a_3}$

$K_{a_1} > K_{a_2} > K_{a_3}$

69. Which of the following statements are true?

A. Unlike Ga that has a very high melting point, Cs has a very low melting point.

B. On Pauling scale, the electronegativity values of N and Cl are not the same.

C. Ar, K^+, Cl^-, Ca^{2+}, and S^{2-} are all isoelectronic species

D. The correct order of the first ionization enthalpies of Na, Mg, Al, and Si is Si > Al > Mg > Na.

E. The atomic radius of Cs is greater than that of Li and Rb

Choose the correct answer from the options given below :

(1) A, C and E only (2) A, B and E only (3) C and E only (4) C and D only

Ans. **(3) C and E only**

Sol. Ga has low melting point

E.N of Cl is graterthan nitrogen

Ar, K^+, Cl^-, Ca^{2+}, S^{2-} all have 18 electrons

Order of first ionization enthalpies

Si > Mg > Al > Na

Order of atomic radius

Cs > Rb > Li

70. Given below are two statements :

Statement I : Like nitrogen that can form ammonia, arsenic can form arsine.

Statement II: Antimony cannot form antimony pentoxide.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is incorrect but Statement II is correct

(2) Both Statement 1 and Statement II are correct

(3) Both Statement 1 and Statement II are incorrect

(4) Statement I is correct but Statement II is incorrect

Ans. **(4) Statement I is correct but Statement II is incorrect**

66. The correct order of decreasing basic strength of the given amines is :

(1) benzenamine > ethanamine > N-methylaniline > N-ethylethanamine

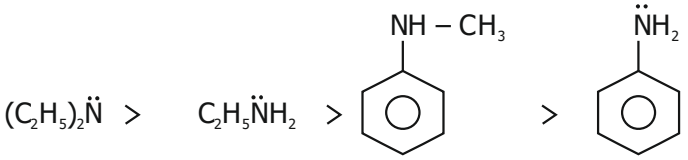
(2) N-methylaniline > benzenamine > ethanamine > N-ethylethanamine

(3) N-ethylethanamine > ethanamine > benzenamine > N-methylaniline

(4) N-ethylethanamine > ethanamine > N-methylaniline > benzenamine

Ans. **(3) N-ethylethanamine > ethanamine > benzenamine > N-methylaniline**

Sol. Basic strength order



67. Match List I with List II

List–I	**List-II**
(Ion)	**(Group number in Cation Anylysis)**
A. CO^{2+}	I. Group–I
B. Mg^{2+}	II. Group–III
C. Pb^{2+}	III. Group–IV
D. Al^{3+}	IV. Group–VI

Choose the **correct** answer from the options given below :

(1) A-III, B-II, C-I; D-IV (2) A-III, B-IV, C-II, D-I

(3) A-III, B-IV, C-I, D-II (4) A-III, B-II, C-IV, D-I

Ans. **(3) A-III, B-IV, C-I, D-II**

68. Phosphoric acid ionizes in three steps with their ionization constant values

K_{a_1}, K_{a_2} and K_{a_3} respectively,

while K is the overall ionization constant. Which of the following statements are true?

A. $\log K = \log K_{a_1} + \log K_{a_2} + \log K_{a_3}$

B. H_3PO_4 is stronger acid than $H_2PO_4^-$ and HPO_4^{2-}.

C. $K_{a_1} > K_{a_2} > K_{a_3}$

D. $K_{a_1} = \frac{K_{a_2} + K_{a_2}}{2}$

Choose the **correct** answer from the options given below:

(1) A, B and C only (2) A and B only (3) A and C only (4) B, C and D only

Ans. **(1) A, B and C only**

Choose the correct answer from the options given below :

(1) A-IV, B–III, C–II, D–I (2) A-I, B–III, C–II, D–IV

(3) A-IV, B–III, C–I, D–II (4) A–II, B–III, C–I, D–IV

Ans. **(3) A-IV, B–III, C–I, D–II**

Sol.

(Name of Vitamin)	**(Deficiency disease)**
A. Vitamin B_{12}	I. Pernicious anaemia
B. Vitamin D	II. Rickets
C. Vitamin B_2	III. Cheilosis
D. Vitamin B_6	IV. Convulsions

64. Given below are two statements :

Statement I : Ferromagnetism is considered as an extreme form of paramagnetism.

Statement II : The number of unpaired electrons in a Cr^{2+} ion (Z = 24) is the same as that of a Nd^{3+} ion (Z = 60)

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

(1) Statement I is false but Statement II is true

(2) Both Statement I and Statement II are true

(3) Both Statement I and Statement II are false

(4) Statement I it true but Statement II is false

Ans. **(4) Statement I it true but Statement II is false**

Sol. Ferromagnetism is cosidered as an extreme from of paramagnetism.

Cr^{+3} = [Ar]$3d^4 4s^0$ (4 unpaired electron)

Nd^{+3} = [Xe] $4f^3 6s^0$ (3 unpaired electron)

65. If the half-life ($t_{1/2}$ for a first order reaction is 1 minute, then the time required for 99.9% completion of the reaction is closest to :

(1) 10 minutes (2) 2 minutes (3) 4 minutes (4) 5 minutes

Ans. **(1) 10 minutes**

$$t_{1/2} = 1\,\text{min}$$

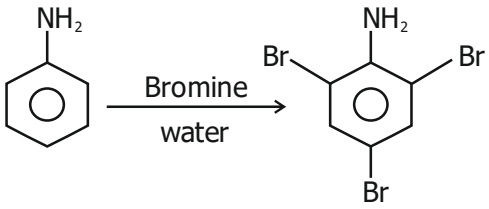
$$K = \frac{0.693}{t_{1/2}} = 0.693\,\text{min}^{-1}$$

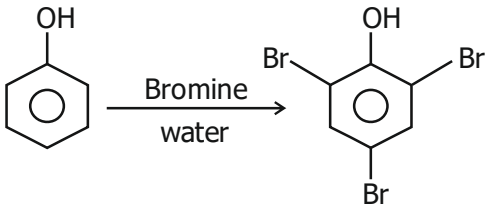
$$t = \frac{2.303}{K}\log\left(\frac{[R]_0}{[R]_t}\right)$$

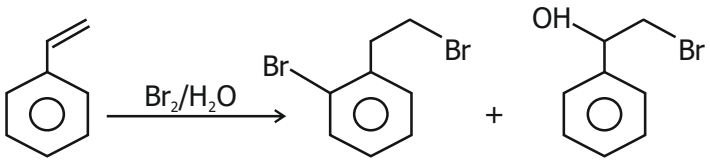
$$t_{(99.9\%)} = \frac{2.303}{0.693}\log\left(\frac{100}{0.1}\right)$$

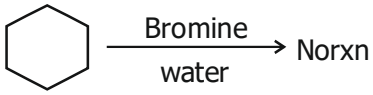
$$t_{(99.9\%)} = 10\ \text{min}$$

Sol.









62. Match List - I with List - II

List–I	**List–II**
A. Haber process	I. Fe catalyst
B. Wacker oxidation	II. $PdCl_2$
C. Wilkinson catalyst	III. $[PPh_3)_3RHCl]$
D. Ziegler catayst	IV. $TiCl_4$ with $Al(CH_3)_3$

Choose the **correct** answer from the options given below :

(1) A-I, B-IV, C-III, D-II (2) A-I, B-II, C-IV, D-III

(3) A-II, B-III, C-I, D-IV (4) A-I, B-II, C-III, D-IV

Ans. **(4) A-I, B-II, C-III, D-IV**

63. Match List-I with List-II

List-I (Name of Vitamin)	**List-II (Deficiency disease)**
A. Vitamin B_{12}	I. Cheilosis
B. Vitamin D	II. Convulsions
C. Vitamin B_2	III. Rickets
D. Vitamin B_6	IV. Pernicious anaemia

Ans. **(4) A and D only**

Sol. A. $[NiCl_4]^{2-}$

Oxidation state of Ni is +2

tetrahedral complex

Electronic configuration $e^4\, t_2^4$

unpaired electrons – 2 soparamagnetic

B. $Ni(CO)_4$

Oxidation state of Ni is O

tetrahedral complex

electronic configuration $e^4t_2^6$

unpaired electrons → O so diamagnetic

C. $[Ni(CN)_4]^{2-}$

Oxidation state of NI is +2

Square planar

Electronic configuration (d^8)

unpaired electrons → O so diamagnetic

D. $[Ni(H_2O)_6]^{2+}$

Oxidation state of NI is +2

Oxtahedral

Electronic configuration $t_{2g}^6\, e_g^2$

unpaired electrons → 2 so paramagnetic

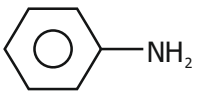
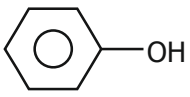
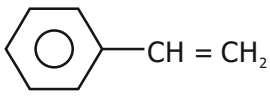
E. $[(PPh_3)_4]$

Oxidation state of NI is O

tetrahedral Electronic configuration d^{10}

unpaired electrons → O so diamagnetic

61. Which one of the following compounds **<u>does not</u>** decolourize bromine water ?

(1)  (2)  (3)  (4) 

Ans. **(2)** 

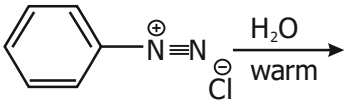
x = +6

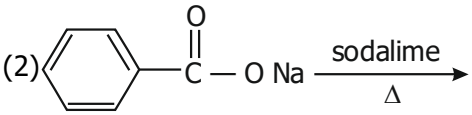
58. Out of the following cofnplex compounds, which of the compound will be having the minimum conductance in solution?

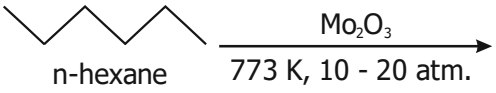
(1) $[Co(NH_3)_5Cl]Cl$ (2) $[Co(NH_3)_3Cl_3]$ (3) $[Co(NH_3)_4Cl_2]$ (4) $[Co(NH_3)_6Cl]Cl_3$

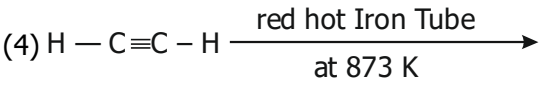
Ans. **(2) $[Co(NH_3)_3Cl_3]$, (3) $[Co(NH_3)_4Cl_2]$**

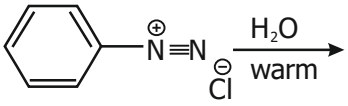
59. Which one of the following reactions does NOT give benzene as the product ?

(1) 

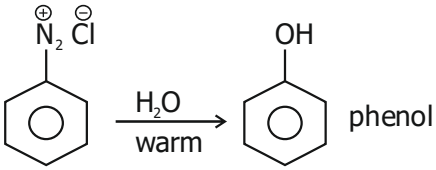
(2) 

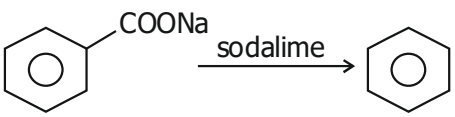
(3) 

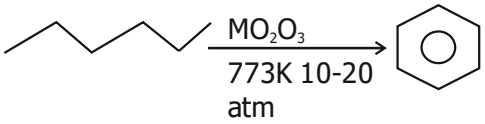
(4) 

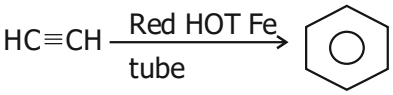
Ans. **(1)** 

Sol.









60. Which of the following are paramagnetic ?

A. $[NiCl_4]^{2-}$ B. $Ni(CO)_4$ C. $[Ni(CN)_4]^{2-}$

D. $[Ni(H_2O)_6]^{2+}$ E. $Ni(PPh_3)_4$

Choose the correct ans|ver from the options given below:

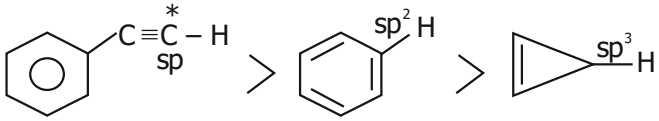
(1) A, D and E only (2) A and C only (3) B and E only (4) A and D only

Ans. **(2) II > I > III**

Sol. C – H Bond energy α overlapping between orbitals

C_{sp} – H > Csp^2 – H > Csp^3 – H

Bond energy



56. The standard heat of formation, in kcal/ mol of Ba^{2+} is :

[Given : standard heat of formation of SO_4^{2-} ion (aq) = – 216 kcal/mol,

$BaSO_4(s)$ = –4.5 kcal/mol, standard heat of formation of $BaSO_4(s)$ =–349 kcal/mol]

(1) + 220.5 (2) –128.5 (3) –133.0 (4) +133.0

Ans. **(2) –128.5**

Sol. Crystallisation of $BaSO_{4(s)}$

$Ba^{+2}_{(aq)} + SO^{-2}_{4(aq)} \longrightarrow BaSO_{4(s)}$

$\Delta_r H$ = –4.5 kcal /mol

$\Delta_r H = (\Delta_f H)_P - (\Delta_f H)_R$

$-4.5 = -349 - (\Delta_f H_{(Ba^{+2})} + (-216))$

$-4.5 = -349 - \Delta_f H_{(Ba^{+2})} + (-216)$

$\Delta_f H_{(Ba^{+2})} = -349 + 216 + 4.5 = -128.5$ kcal/mol

57. Consider the following compounds :

$\underline{K}O_2$, $H_2\underline{O}_2$ and $H_2\underline{S}O_4$

The oxidation states of the underlined elements in them are, respectively,

(1) +4, -4, and +6 (2) +1,-1, and +6 (3) +2,-2; and +6 (4) +1,-2, and +4

Ans. **(2) +1,-1, and +6**

Sol. KO_2 (Super oxide)

Alkali metal show only one oxidation state which is +1

O.S. of K is +1

H_2O_2 (Peroxide)

(2x + 1) + 2x = 0

2x = –2

x = –1

O.S. of O is –1

$H_2\underline{S}O_4$

(2x + 1) + x + (4x – 2) = 0

+2 + x – 8 = 0

54. Among the following, choose the ones with equal number of atoms .

A. 212 g of Na_2CO_3 (s) [molar mass = 106 g]

B. 248 g of Na_2O (s) [molar mass = 62 g]

C. 240 g of NaOH (s) [molar mass = 40 g]

D. 12 g of H_2 (g) [molar mass = 2 g]

E. 220 g of CO_2 (g) [molar mass = 44 g]

Choose the correct answer from the options given below :

(1) B, D and E only (2) A, B and C only (3) A, B and D only (4) B, C and D only

Ans. **(3) A, B and D only**

Sol. Option A 212 g Na_2CO_3

$$n = \frac{m}{Mw} = \frac{212}{106} = 2$$

no. of atoms = 2 × 6 = 12 N_A

Option B 248 g Na_2O

$$n = \frac{248}{62} = 4$$

no. of atoms = 4 × 3 = 12 N_A

option C 240 g NaOH

$$n = \frac{240}{40} = 6$$

no. of atoms = 6×3 = 18 N_A

Option D 12 g H_2

$$n = \frac{12}{2} = 6$$

no. of atoms = 6 × 2 = 12 N_A

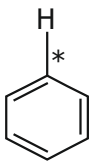
Option E 220 g CO_2

$$n = \frac{220}{44} = 5$$

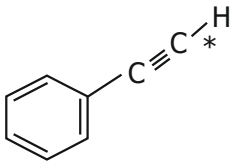
no. of atoms = 5 × 3 = 15 N_A

A, B and D have same no. of atoms.

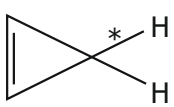
55. Among the given compounds I-III, the correct order of bond dissociation energy of C–H bond marked with * is :



I

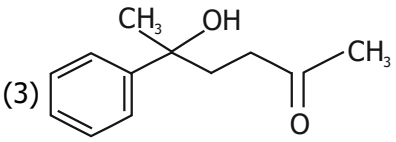


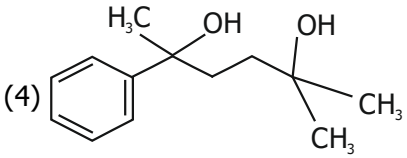
II

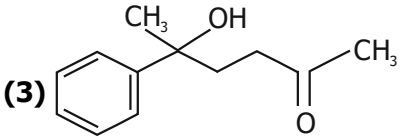


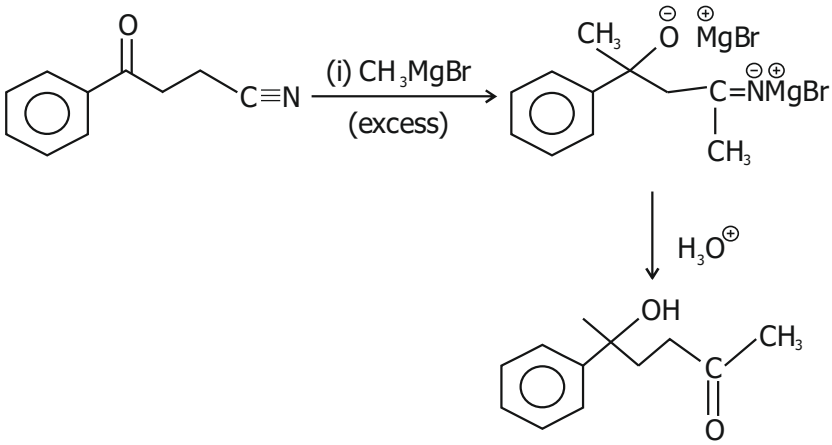
III

(1) II > III > I (2) II > I > III (3) I > II > III (4) III > II > I

(3) 

(4) 

Ans. **(3)** 

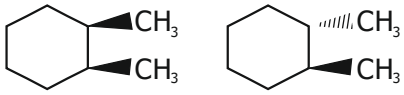
Sol. 

53. Which one of the following compounds can exist as cis-trans isomers ?

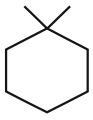
(1) 1,2-Dimethylcyclohexane (2) Pent-1-ene

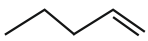
(3) 2-Methylhex-2-ene (4) 1, 1-Dimethylcyclopropane

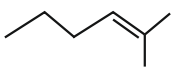
Ans. **(1) 1,2-Dimethylcyclohexane**

Sol. 

cis trans

 No G.I.

 No G.I.

 No G.I.

$$t = \frac{2.303}{K}\log\frac{[R]_0}{[R]_t}$$

$$t = \frac{2.303}{0.03}\log\left(\frac{7.2}{0.9}\right)$$

$$t = \frac{2.303}{0.03}\log(8)$$

$$t = \frac{2.303}{0.03}\log(2)^3$$

$$t = \frac{2.303}{0.03} \times 3 \times \log 2 = 69.3 \text{ sec}$$

51. Match List I with List II

List-I **(Mixture)**	**List-II** **(Method of Separation)**
A. $CHCl_3 + C_6H_5NH_2$	I. Distillation under reduced
B. Crude oil in petroleum industry	II. Steam distillation
C. Glycerol from spent-lye	III. Fractional distillation
D. Aniline - water	IV. Simple distillation

Choose the correct answer from the options given below :

(1) A–III, B–IV, C–II, D–I (2) A–IV, B–III, C–I, D–II

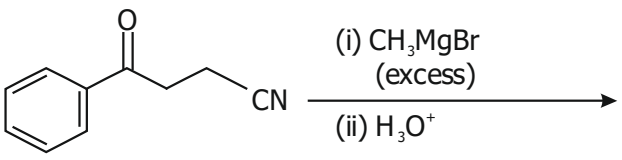
(3) A–IV, B–III, C–II, D–I (4) A–III, B–IV, C–I, D–II

Ans. **(2) A–IV, B–III, C–I, D–II**

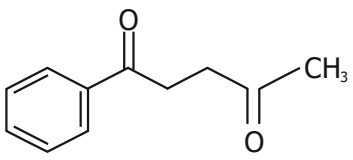
Sol.

Mixture	**Method of Separation**
A. $CHCl_3 + C_6H_5NH_2$	I. Simple distillation
B. Crude oil in petroleum industry	II. By Fractional distillation
C. Glycerol from spent-lye	III. Distillation under reduced
D. Aniline - water	IV. Steam distillation

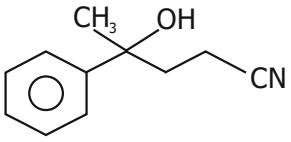
52. The major product of the following reaction is :



(1)



(2)



Sol. Wavelength during transmition of electron

$$\lambda = \frac{1}{R_H Z^2}\left(\frac{n_1^2 n_2^2}{n_1^2 - n_1^2}\right)$$

$$(\lambda_1)_{2-3} = \frac{1}{R_H}\left(\frac{4\times 9}{9-4}\right)$$

$$(\lambda_2)_{4-6} = \frac{1}{R_H}\left(\frac{16\times 36}{36-16}\right)$$

$$\frac{(\lambda_1)_{2-3}}{(\lambda_2)_{4-6}} = \frac{36}{5}\times\frac{20}{16\times 36} = \frac{1}{4}$$

49. The correct order of wavelength of light absorbed by the following complexes is :

A. $\left[Co(NH_3)_6\right]^{3+}$ B. $\left[Co(CN)_6\right]^{3-}$ C. $\left[Cu(H_2O)_4\right]^{2+}$ D. $\left[Ti(H_2O)_6\right]^{3+}$

Choose the correct answer from the options given belwo :

(1) C < A < D < B (2) B < D < A < C (3) B < A < D < C (4) C < D < A < B

Ans. **(3) B < A < D < C**

Sol. A stronger ligand will cause a greater splitting of the d-orbitals.

Increasing order of of strength of ligand

$H_2O < NH_3 < CN$

Octahderal (C.N = 6) splitting of d-orbitals is more as compared to zetrohedral (C.N. = 4) $\left(\Delta_0 = \frac{9}{4}\Delta_t\right)$

then increasing order of splitting energy

C < D < A < B

increasing order of wavelength of light absorbed $\left(\lambda \propto \frac{1}{E}\right)$

B < A < D < C

50. If the rate constant of a reaction is 0.03 s^{-1}, how much time does it take for 7.2 mol L^{-1} concentration of the reactant to get reduced to 0.9 mol L^{-1} ?

(Given : log 2 = 0.301)

(1) 21.0 s (2) 69.3 s (3) 23.1 s (4) 210 s

Ans. **(2) 69.3 s**

Sol. $K = 0.03\ S^{-1}$

$[R]_0 = 7.2$ mol/L

$[R]_t = 0.9$ mol/L

for first order

46. If the molar conductivity (Λ_m) of a 0.050 mol L^{-1} solution of a monobasic weak acid is 90 S cm^2 mol^{-1}, its extent (degree) of dissociation will be :

[Assume $\Lambda^0_+ = 349.6$ S cm^2 mol^{-1} and $\Lambda^0_- = 50.4$ S cm^2 mol^{-1})

(1) 0.215 (2) 0.115 (3) 0.125 (4) 0.225

Ans. **(4) 0.225**

Sol. $\Lambda_m = 90$ S Cm^2 mol^{-1}

$\Lambda^0_m = \Lambda^0 + \Lambda^0_-$ (According Kohlrausch law)

$\Lambda^0_m = 349.6 + 50.4 = 400$ S cm^2 mol^{-1}

Degree of dissociation $(\alpha) = \frac{\Lambda_m}{\Lambda_m} = \frac{90}{400} = 0.225$

47. Given below are two statement :

Statement I : A hypothetical diatomic molecule with bond order zero is quite stable.

Statement II : As bond order increases, the bond length increases.

In the light of the above statement, choose the most appropriate answer from the options given below:

(1) Statement I is false but Statement II is true

(2) Both Statement I and Statement II are true

(3) Both Statement I and Statement II are false

(4) Statement I is ture but Statement II is false

Ans. **(3) Both Statement I and Statement II are false**

Sol. If the bond order between two atoms in zero it means the molecule will not form and it is unstable. So statement–I is false.

B. L $\propto \frac{1}{\text{B.O.}}$ (Bond order inversly proportional to bond length)

So statement–II is also false.

48. The ratio of the wavelengths of the light absorbed by a Hydrogen atom when it undergoes n = 2 $\rightarrow$ n=3 and n = 4 $\rightarrow$ n = 6 transition, respectively, is

(1) $\frac{1}{4}$ (2) $\frac{1}{36}$ (3) $\frac{1}{16}$ (4) $\frac{1}{9}$

Ans. **(1)** $\frac{1}{4}$

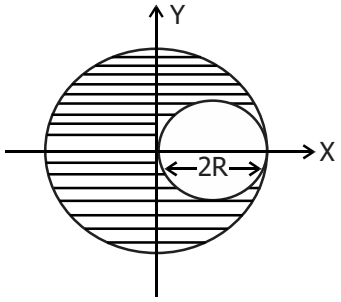
$100 = F_A \cdot 1000$ .... (1)

$225 = F_B \cdot 1500$ ... (2)

$$\frac{100}{225} = \frac{F_A}{F_B} \times \frac{2}{3}$$

$$\frac{F_A}{F_B} = \frac{2}{3}$$

45. A sphere of radius R is cut from a larger solid sphere of radius 2R as shown in the figure. The ratio of the moment of inertia of the smaller sphere to that of the rest part of the sphere about the Y-axis is :



(1) $\frac{7}{64}$ (2) $\frac{7}{8}$ (3) $\frac{7}{40}$ (4) $\frac{7}{57}$

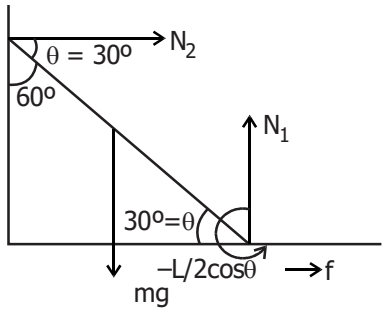
Ans. **(4)** $\frac{7}{57}$

Sol. $$M_{cut\,part} = \frac{M}{\frac{4}{3}\pi(2R)^3} \times \frac{4}{3}\pi R^3 = \frac{M}{8}$$

$$I_{small} = \frac{7}{5} \times \frac{M}{8} \times R^2 = \frac{7}{40}MR^2 .....(1)$$

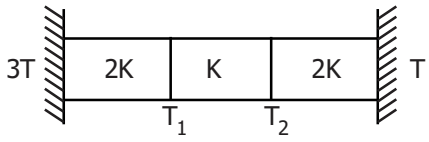
$$I_{remain} = \frac{2}{5}M \times 4R^2 - \frac{7}{40}MR^2$$

$$\frac{I_{small}}{I_{remain}} = \frac{7/40}{\left(\frac{8}{5} - \frac{7}{40}\right)} = \frac{7/40}{\frac{64-7}{40}} = \frac{7}{57}$$



$$N_2 = \frac{mg}{\cot 60} L_2 = 200 \times \frac{1}{2} \times \sqrt{3}$$

43. Three identical heat conducting rods are connected in series as shown in the figure. The rods on the sides have thermal conductivity 2K while that in the middle has thermal conductivity K. The left end of the combination is maintained at temperature 3T and the right end at T. The rods are thermally insulated from outside. In steady state, temperature at the left junction is T_1 and that at the right-junction is T_2. The ratio T_1/T_2 is :

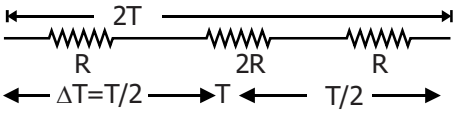


(1) $\frac{5}{4}$ (2) $\frac{3}{2}$ (3) $\frac{4}{3}$ (4) $\frac{5}{3}$

Ans. **(4)** $\frac{5}{3}$

Sol. Consider resistance

$\Delta T_1 : \Delta T_2 : \Delta T_3$
$1 : 2 : 1$



$\Delta T_1 : \Delta T_2 : \Delta T_3$
$1 : 2 : 1$

$$T_A = 3T - T/2 = 5T/2 \ldots\ldots (1)$$

$$T_B = \frac{5T}{2} - T = \frac{3T}{2}$$

$$\frac{T_A}{T_B} = \frac{5}{3}$$

44. The kinetic energies of two similar cars A and B are 100 J and 225 J respectively. On applying breaks, car A stops after 1000 m and car B stops after 1500 m. If F_A and F_B are the forces applied by the breaks on cars A and B, respectively, then the ratio F_A/F_B is :

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

Ans. **(3)** $\frac{2}{3}$

Sol. Work done by F = ΔK

40. A photon and an electron (mass m) have the same energy E. The ratio ($\lambda_{photon}/\lambda_{electron}$) of their de Broglie wavelengths is : (c is the speed of light)

(1) $\frac{1}{c}\sqrt{E/2m}$ (2) $\sqrt{E/2m}$ (3) $c\sqrt{2mE}$ (4) $c\sqrt{\frac{2m}{E}}$

Ans. **(4)** $c\sqrt{\frac{2m}{E}}$

Sol. $\lambda_{photon} = \frac{hc}{E}$, $\lambda_{electron} \frac{h}{\sqrt{2mE}}$

$$\frac{\lambda_{electron}}{\lambda_{electron}} \frac{hc\sqrt{2mE}}{E \cdot h} = C \cdot \sqrt{\frac{2m}{E}}$$

41. An unpolarized light beam travelling in air is incident on a medium of refractive index 1.73 at Brewster's angle. Then :

(1) transmitted light is completely polarized with angle of refraction close to 30°

(2) reflected light is completely polarized and the angle of reflection is close to 60°

(3) reflected light is partially polarized and the angle of reflection is close to 30°

(4) both reflected and transmitted light are perfectly polarized with angles of reflection and refraction close to 60° and 30°, respectively

Ans. **(2) reflected light is completely polarized and the angle of reflection is close to 60°.**

Sol. μ = 1.75 so By Brewester law.

$\mu = \tan \theta_p$

$\sqrt{3} = \tan\theta_p$

$\theta_p = 60°$

Reflected Ray will prefectly polarized.

$\frac{\sin i}{\sin r} = \mu$

$\frac{\sin 60°}{\sin r} = \sqrt{3}$ $\sin r = \frac{1}{2}$ $\boxed{r = 30°}$

42. An uniform rod of mass 20 kg and length 5 m leans against a smooth vertical wall making an angle of 60° with it. The other end rests on a rough horizontal floor. The friction force that the floor exerts on the rod is : (take g = 10 m/s^2)

(1) $200\sqrt{3}$ N (2) 100 N (3) $100\sqrt{3}$ N (4) 200 N

Ans. **(3)** $100\sqrt{3}$ N

Sol. Torque Balancing

$mg \times \frac{L}{2}\cos\theta = N_2 \times L\sin\theta$

Sol. radius of curvatre $r = \dfrac{d^2y/dx^2}{\left(1+\dfrac{d^2y}{dx^2}\right)^{3/2}}$

By Using Laplace equation

$\rho gy = r.s$

$$\frac{\rho g \cdot y}{S} = \frac{d^2y}{dx^2}$$

II-method :

F = force due to surface tension

$F = S \times Z$ ....(1)

this force is balanced by weight of liq.

$W = mg$

$\boxed{W = \rho \times xyz \times g}$ .... (2)

$\Delta \sin\theta = \rho xyz \times g$

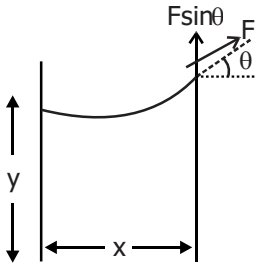
$\boxed{\sin\theta = \tan\theta}$

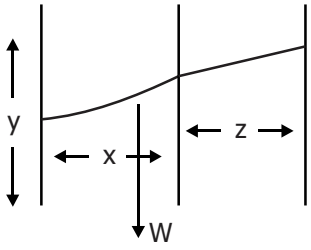
$\delta \times \tan\theta = \rho xyg$

$$\delta \times \frac{dy}{dx} = \rho xyg$$

$$\frac{dy}{dx} = \frac{\rho xyg}{s}$$

$$\frac{d^2y}{dx^2} = \frac{\rho g}{\delta} y$$





39. The intensity of transmitted light when a polaroid sheet, placed between two crossed polaroids at 22.5° from the polarization axis of one of the Polaroid, is :

(I_0 is the intensity of polarised light after passing through the first polaroid)

(1) $\frac{I_0}{16}$ (2) $\frac{I_0}{2}$ (3) $\frac{I_0}{4}$ (4) $\frac{I_0}{8}$

Ans. **(4)** $\frac{I_0}{8}$

Sol. I from 1st polaroid is I_0

I from 2 polaroid = $I_0\cos^2.22.5^o$

I from 3 polaroid = $I_0 \cos^2 (90^o - 22.5^o)$

$I = I_0\sin^2 22.5^o \cdot \cos^2 22.5^o$

$$= I_0 \frac{4}{4}\sin^2 22.5^o \cos^2 22.5^o$$

$$= \frac{I_0}{4} \times \sin^2 45^o = \frac{I_0}{8}$$

Sol. $B \cdot \pi r^2 = \frac{h}{e}\{n = 1\}$

$r = \sqrt{\frac{h}{eB\pi}}$ ..... (1)

$e \times B = \frac{mv}{r} \quad v = \frac{eBr}{m}$

$\mu = \frac{eVr}{2} = \frac{e}{2} \cdot \frac{eB}{m} \cdot r^2$

$e^2 \frac{B}{m} \cdot \frac{h}{eB\pi} = \frac{he}{2\pi m}$

37. A body weighs 48 N on the surface of the earth. The gravitational force experienced by the body due to the earth at a height equal to one-third the radius of the earth from its surface is :

(1) 36 N (2) 16 N (3) 27 N (4) 32 N

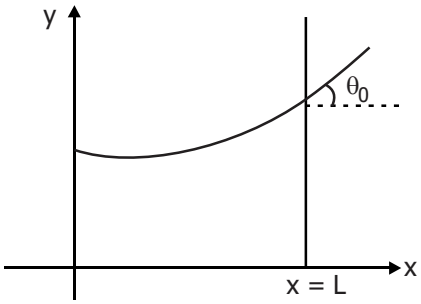
Ans. **(3) 27 N**

Sol. $mg = 48 \Rightarrow m = \frac{48}{g}$

$w = \frac{48}{g} \times g_h = \frac{48}{g} \times \frac{gR^2}{(R+h)^2}$

$= 48 \times \frac{R^2}{\left(R^2 + \frac{R}{3}\right)^2} = 48 \times \frac{R^2 \times g}{16R^2} = 3 \times 9 = 27N$

38. Consider a waiter tank shown in the figure. It has one wall at x = L and can be taken to be very wide in the z direction. When filled with a liquid of surface tension S and density ρ, the liquid surface makes angle $\theta_0 (\theta_0 << 1)$ with the x-axis at x = L. If y(x) is the height of the surface then the equation for y(x) is :

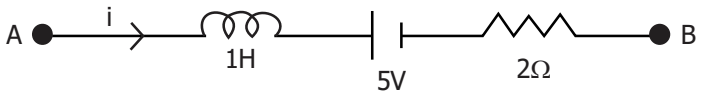


(take $\theta(x) = \sin\theta(x) = \tan\theta(x) = \frac{dy}{dx}$, g is the acceleration die to gravity)

(1) $\frac{dy}{dx} = \sqrt{\frac{\rho g}{S}}x$ (2) $\frac{d^2y}{dx^2} = \frac{\rho g}{S}x$ (3) $\frac{d^2y}{dx^2} = \frac{\rho g}{S}y$ (4) $\frac{d^2y}{dx^2} = \sqrt{\frac{\rho g}{S}}$

Ans. **(3)** $\frac{d^2y}{dx^2} = \frac{\rho g}{S}y$

34. AB is a part of an electrical circuit (see figure). The potential difference "$V_A - V_B$", at the instant when current i = 2A and is increasing at a rate of 1 amp/second is :



(1) 10 volt (2) 5 volt (3) 6 volt (4) 9 volt

Ans. **(1) 10 volt**

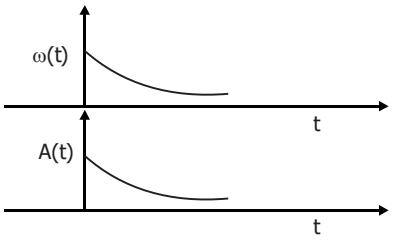
Sol. $V_A - L\times\frac{di}{dt} - 5 - ir - V_B = 0$

$V_A - 1 - 5 - 4 - V_B = 0$

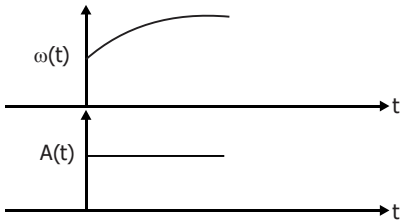
$V_A - V_B = 10$ volt

35. In an oscillating spring mass system, a spring is connected to a box filled with sand. As the box oscillates, sand leaks slowly out of the box vertically so that the average frequency $\omega(t)$ and average amplitude A(t) of the system change with time t. Which one of the following options schematically depicts these changes correctly :

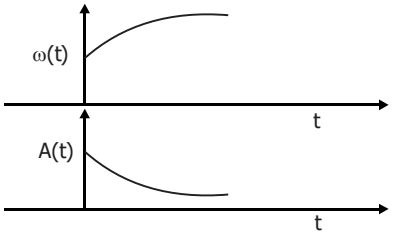
(1)



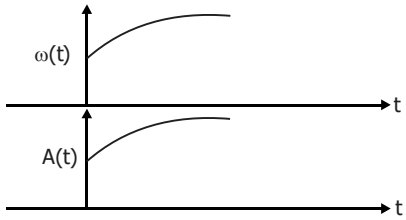
(2)



(3)



(4)



Ans. **(2)**

Sol. amp do not depends on mass.

$$w = \sqrt{\frac{K}{m}}$$

36. A model for quantized motion of an electron in a uniform magnetic field B states that the flux passing through the orbit of the electron is n(h/e) where n is an integer, h is Planck 's constant and e is the magnitude of electron's charge. According to the model, the magnetic moment of an electron in its lowest energy state will be : (m is the mass of the electron)

(1) $\frac{heB}{2\pi m}$ (2) $\frac{he}{\pi m}$ (3) $\frac{he}{2\pi m}$ (4) $\frac{heB}{\pi m}$

Ans. **(3)** $\frac{he}{2\pi m}$

32. Two cities X and Y are connected by a regular bus service with a bus leaving in either direction every T min. A girl is driving scooty with a speed of 60 km/h in the direction X to Y notices that a bus goes past her every 30 minutes in the direction of her motion, and every 10 minutes in the opposite period T of the bus service and the speed (assumed constant) of the buses :

(1) 15 min, 120 km/h (2) 9 min, 40 km/h (3) 25 min, 100 km/\ (4) 10 min, 90 km/h

Ans. **(1) 15 min, 120 km/h**

Sol. Distance between two buses

$$v_{girl} = \frac{60\,km}{60\,min}$$

= 1 km/min

$$30 = \frac{VT}{1-V} \quad \text{..... (1)}$$

$$10 = \frac{VT}{1+V} \quad \text{..... (2)}$$

30 – 3V = 10 + 10 V

20 = 40 V

V = 2 km/min or 120 km/h

$$30 = \frac{2T}{1-V}$$

$$10 = \frac{2T}{3}$$

T = 15 min

33. An oxygen cylinder of volume 30 litre has 18.20 moles of oxygen. After some oxygen is withdrawn from the cylinder, its gauge pressure drops to 11 atmospheric pressure at temperature 27°C. The mass of the oxygen withdrawn from the cylinder is nearly equal to :

[Given, $R = \frac{100}{12}\,Jmol^{-1}K^{-1}$, and molecular mass of O_2 = 32, 1 atm pressure = 1.01×10^5 N/m]

(1) 0.156 kg (2) 0.125 kg (3) 0.144 kg (4) 0.116 kg

Ans. **(4) 0.116 kg**

Sol. Mass in container

m_1 = 18.20 mole × 32 gm = 582.4 gm

$$PV = \frac{m'}{M_0}RT$$

$$12\times1.01\times10^5\times30\times10^{-3} = \frac{m'}{32}\times\frac{100}{12}\times300$$

$$m' = 465.4gm$$

$$\Delta m = m_2 - m_1 = 582.4 - 465.4 = 116\ gm = .116\ kg.$$

29. A physical quantity P is related to four observations a, b, c and d as follows : $P = a^3b^2 / c\sqrt{d}$

The percentage errors of measurement in a, b, c and d are 1%, 3%, 2% and 4% respectively. The percentage error in the quantity P is :

(1) 15% (2) 10% (3) 2% (4) 13%

Ans. **(4) 13%**

Sol. $$\frac{\Delta P}{P} = 3\frac{\Delta a}{a} + 2\frac{\Delta b}{b} + \frac{\Delta c}{c} + \frac{1}{2}\times\frac{\Delta d}{d}$$

$$= 3\times1\% + 2\times3\% + 0\times2\% + \frac{1}{2}\times4\%$$

$$3 + 6 + 2 + 2 = 13\%$$

30. The plates of a parallel plate capacitor are separated by d. Two slabs of different dielectric constant K_1 and K_2 with thickness $\frac{3}{8}d$ and $\frac{d}{2}$, respectively are inserted in the capacitor. Due to this, the capacitance becomes two times larger than when there is nothing between the plates. If $K_1 = 1.25\ K_2$, the value of K_1 is :

(1) 1.33 (2) 2.66 (3) 2.33 (4) 1.60

Ans. **(2) 2.66**

Sol. $C' = 2C_0$

$$\frac{A\varepsilon_0}{d-\left(\frac{3d}{8}+\frac{d}{2}\right)+\left(\frac{3d}{8K_1}+\frac{d\times5}{2\times4K_1}\right)} = \frac{2A\varepsilon_0}{d}$$

$$\frac{1}{1-\frac{7}{8}+\frac{1}{K_1}} = 2$$

$$\frac{1}{\frac{1}{8}-\frac{1}{K_1}} = 2 \Rightarrow 1 = \frac{1}{4} - \frac{2}{K_1}$$

$$K_1 = \frac{8}{3} = 2.66$$

31. A ball of mass 0.5 kg is dropped from a height of 40 m. The ball hits the ground and rises to a height of 10 m. The impulse imparted to the ball during its collision with the ground is : (Take g = 9.8 m/s^2)

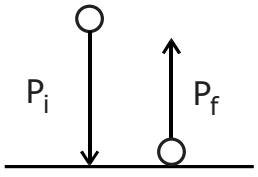
(1) 84 NS (2) 21 NS (3) 7 NS (4) 0

Ans. **(2) 21 NS**

Sol. Impulse $\Delta P = m\left[\sqrt{2gh_2} + \sqrt{2gh_1}\right]$

$$= \frac{1}{2}\left[\sqrt{800} + \sqrt{2\times10\times10}\right]$$

$$= \frac{10}{2}\left[\sqrt{8} + \sqrt{2}\right] = 21\,\text{NS}$$



25. An electric dipole with dipole moment 5×10^{-6} Cm is aligned with the direction of a uniform electric field of magnitude 4×10^5 N/C. The dipole is then rotated through an angle of 60° with respect to the electric field. The change in the potential energy of the dipole is :

(1) 1.5 J (2) 0.8 J (3) 1.0 J (4) 1.2 J

Ans. **(3) 1.0 J**

Sol. $\Delta U = PE(\cos\theta_1 - \cos\theta_2)$

$$= 5\times10^{-6}\times4\times10^5(1-\frac{1}{2})$$

$$= 5\times10^{-6}\times4\times\frac{1}{2}\times10^5$$

= 1 Joule

26. There are two inclined surfaces of equal length (L) and same angle of inclination 45º with the horizontal. One of them is rough and the other is perfectly smooth. A given body takes 2 times as much time to slide down on rough surface than on the smooth surface. The coefficient of kinetic friction (μ_k) between the object and rough surface is close to :

(1) 0.75 (2) 0.25 (3) 0.40 (4) 0.5

Ans. **(1) 0.75**

Sol. $t_1 = \sqrt{\frac{2h}{g\sin\theta}}$ $\quad t_2 = \sqrt{\frac{2h}{(g\sin\theta - \mu g\cos\theta)}}$

$t_2 = 2t_1$

$$\frac{1}{(\sin\theta - \mu\cos\theta)} = \frac{4}{\sin\theta}$$

$$\frac{1}{1-\mu} = 4 \qquad 1-\mu = \frac{1}{4}$$

27. De-Broglie wavelength of an electron orbiting in the n = 2 state of hydrogen atom is close to :

(Given Bohr radius = 0.052 nm)

(1) 2.67 nm (2) 0.067 nm (3) 0.67 nm (4) 1.67 nm

Ans. **(3) 0.67 nm**

Sol. $2\pi r = n\lambda$

$2\pi r = 2\lambda$

$\lambda = \pi \times .052 \times 2^2 = .67$ nm.

28. The Sun rotates around its centre once in 27 days. What will be the period of revolution if the Sun were to expand to twice its present radius without any external influence. Assume the Sun to be a sphere of uniform density :

(1) 108 days (2) 100 days (3) 105 days (4) 115 days

Ans. **(1) 108 days**

Sol. $L = I\omega$ = constant

$$MR^2\frac{2\pi}{T_1} = M.4R^2\frac{2\pi}{T_2}$$

$T_2 = 4T_1 = 4 \times 27 = 108$ days

23. Two identical point masses P and Q, suspended from two separate massless springs of spring constants k_1 and k_2, respectively, oscillate vertically. If their maximum speeds are the same, the ratio (A_Q/A_P) of the amplitude of A_Q of mass Q to the amplitude A_P of mass P is :

(1) $\sqrt{\frac{k_1}{k_2}}$ (2) $\frac{k_2}{k_1}$ (3) $\frac{k_1}{k_2}$ (4) $\sqrt{\frac{k_2}{k_1}}$

Ans. **(1)** $\sqrt{\frac{k_1}{k_2}}$

Sol. $\sqrt{\frac{k_1}{k_2}}$

$V_P = V_Q$

$A\omega = \text{constant}$ $\quad A \alpha \frac{1}{\omega} \alpha \sqrt{\frac{m}{k}}$

$$\frac{A_Q}{A_P} = \sqrt{\frac{k_1}{k_2}}$$

24. A parallel plate capacitor made of circular plates is being charged such that the surface charge density on its plates is increasing at a constant rate with time. The magnetic field arising due to displacement current is :

(1) zero between the plates and non-zero outside

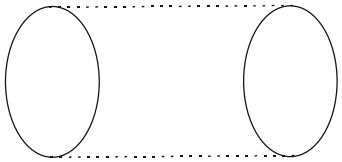
(2) zero at all places

(3) constant between the plates and zero outside the plates

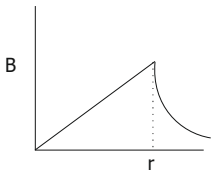
(4) non-zero everywhere with maximum at the imaginary cylindrical surface connecting peripheries of the plates

Ans. **(4) non-zero everywhere with maximum at the imaginary cylindrical surface connecting peripheries of the plates**

Sol. $i = \varepsilon_o \frac{d\sigma}{\varepsilon_o dt} A$ $\quad$ i constant

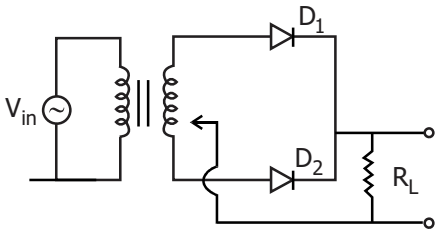


i is constant But will be in cylindrical



so hypothetical cylindrical surface B is maximum

20. A full wave rectifier circuit with diodes (D_1) and (D_2) is shown in the figure. If input supply voltage V_{in} = 220sin (100 πt) volt, then at t = 15 msec :



(1) D_1 and D_2 both are reverse biased (2) D_1 is forward biased, D_2 is reverse biased

(3) D_1 is reverse biased, D_2 is forward biased (4) D_1 and D_2 both are forward biased

Ans. **(3) D_1 is reverse biased, D_2 is forward biased**

Sol. at t = 15 ms

$V = 220 \sin(100\pi \times 1.5 \times 10^{-3})$ (–ve)

So diode D_1 will be reverse and will be forward.

21. A balloon is made of a material of surface tension S and its inflation outlet (from where gas is filled in it) has small area A. It is filled with a gas of density ρ and takes a spherical shape of radius R. When the gas is allowed to flow freely out of it, its radius r changes from R to 0 (zero) in time T. If the speed v(r) of gas coming out of the balloon depends on r as r^a and $T \propto S^{\alpha}A^{\beta}\rho^{\gamma}R^{\delta}$ then :

(1) $a=\frac{1}{2},\alpha=\frac{1}{2},\beta=-\frac{1}{2},\gamma=\frac{1}{2},\delta=\frac{7}{2}$ (2) $a=\frac{1}{2},\alpha=\frac{1}{2},\beta=-1,\gamma=1,\delta=\frac{3}{2}$

(3) $a=-\frac{1}{2},\alpha=-\frac{1}{2},\beta=-1,\gamma=-\frac{1}{2},\delta=\frac{5}{2}$ (4) $a=-\frac{1}{2},\alpha=-\frac{1}{2},\beta=-1,\gamma=\frac{1}{2},\delta=\frac{7}{2}$

Ans. **(4)** $a=-\frac{1}{2},\alpha=-\frac{1}{2},\beta=-1,\gamma=\frac{1}{2},\delta=\frac{7}{2}$

Sol. T a S α A^{β} $\rho\alpha$ R^{δ}

$(m^{o}L^{o}T^{1}) \alpha (M^{1} L^{o} T^{-2})^{\alpha}(L2)^{\beta}(M'L^{-3})^{r}(L^{1})^{s}$

$\alpha + r = 0$ $2\alpha = 1$

$r = 1/2$ $\alpha = -1/2$

matches with only 4 option

22. A microscope has an objective of focal length 2 cm, eyepiece of focal length 4 cm and the tube length of 40 cm. If the distance of distinct vision of eye is 25 cm, the magnification in the microscope is :

(1) 250 (2) 100 (3) 125 (4) 150

Ans. **(3) 125**

Sol. $m = \frac{V_0}{u_0} \times \frac{D}{f_e}$

$= \frac{L}{f_0} \times \frac{D}{f_e} = \frac{40}{2} \times \frac{24}{4} = 125$

18. A particle of mass m is moving around the origin with a constant force F pulling it towards the origin. If Bohr model is used to describe its motion, the radius r of the n^{th} orbit and the particle's speed v in the orbit depend on n as :

(1) $r \propto n^{4/3}$; $v \propto n^{-1/3}$ (2) $r \propto n^{1/3}$; $v \propto n^{1/3}$ (3) $r \propto n^{1/3}$; $v \propto n^{2/3}$ (4) $r \propto n^{2/3}$; $v \propto n^{1/3}$

Ans. **(4) $r \propto n^{2/3}$; $v \propto n^{1/3}$**

Sol. $F = \frac{mv^2}{r}$; $mvr = \frac{nh}{2\pi}$

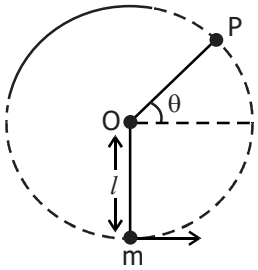
$v^2 \propto r$ ..... (1)

$vr \propto n$

$v \propto \frac{n}{r}$; $\frac{n^2}{r^2} \propto r$

$r^3 \propto n^2$; $r \propto n^{2/3}$; $v \propto n^{1/3}$

19. A bob of heavy mass m is suspended by a light string of length l. The bob is given a horizontal velocity v_0 as shown in figure. If the string gets slack at some point P making an angle θ from the horizontal, the ratio of the speed v of the bob at point P to its initial speed v_0 is :



(1) $\left(\frac{\sin\theta}{2+3\sin\theta}\right)^{1/2}$ (2) $(\sin\theta)^{1/2}$ (3) $\left(\frac{1}{2+3\sin\theta}\right)^{1/2}$ (4) $\left(\frac{\cos\theta}{2+3\sin\theta}\right)^{1/2}$

Ans. **(1)** $\left(\frac{\sin\theta}{2+3\sin\theta}\right)^{1/2}$

Sol. $\frac{mv^2}{l} = mg\sin\theta$

$v^2 = lg\sin\theta$

Now By energy conservation

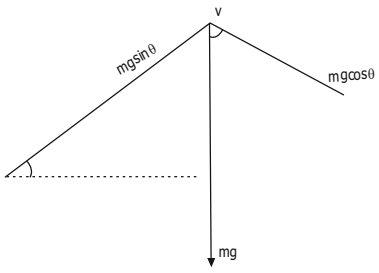
$K_i + U_i = K_f + U_f$

$\frac{1}{2}mv_0^2 = \frac{1}{2}ml\,g\sin\theta + mg(l + l\sin\theta)$

$V_0^2 = lg\sin\theta + 2gl + 2gl\sin\theta$

$V_0^2 = 2gl + 3gl\sin\theta$

$\frac{V}{V_0} = \left(\frac{\text{Sin}\theta}{2+3\text{Sin}\theta}\right)^{1/2}$



16. In some appropriate units, time (t) and position (x) relation of a moving particle is given by $t = x^2 + x$. The acceleration of the particle is :

(1) $+\frac{2}{2x+1}$ (2) $-\frac{2}{(x+2)^3}$ (3) $-\frac{2}{(2x+1)^3}$ (4) $+\frac{2}{(x+1)^3}$

Ans. **(3)** $-\frac{2}{(2x+1)^3}$

Sol. $t = x^2 + x$

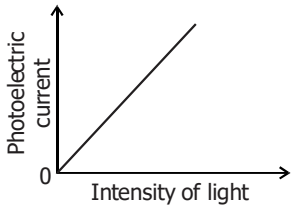
$$\frac{dt}{dx} = (2x+1)$$

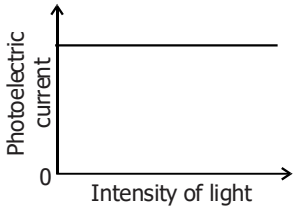
$$\frac{dx}{dt} = v = (2x+1)^{-1}$$

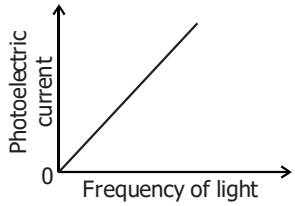
$$\frac{dv}{dx} = -1(2x+1)^{-2} \times 2$$

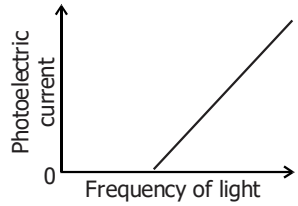
$$a = v.\frac{dv}{dx} = -(2x+1)_2^{-1}(2x+1)^{-2} = \frac{-2}{(2x+1)^3}$$

17. Which of the following options represent the variation of photoelectric current with property of light shown on the x-axis :

A. 

B. 

C. 

D. 

(1) B and D (2) A only (3) A and C (4) A and D

Ans. **(2) A only**

Sol. Photocurrent $\propto$ Intensity