JEE ADVANCED (Paper - 1)

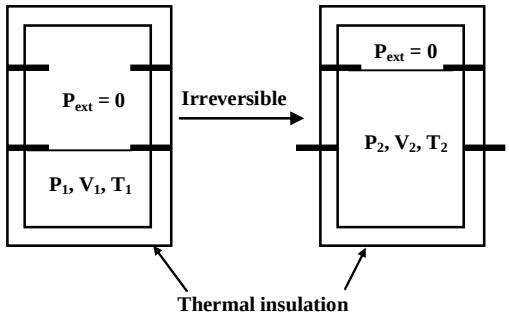
CHEMISTRY

SECTION – 1 (One or More Than One Options Correct Type)

This section contains **10 multiple choice type questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE** or **MORE THAN ONE** are correct.

*21. The correct combination of names for isomeric alcohols with molecular formula $C_4H_{10}O$ is/are
(A) tert-butanol and 2-methylpropan-2-ol
(B) tert-butanol and 1, 1-dimethylethan-1-ol
(C) n-butanol and butan-1-ol
(D) isobutyl alcohol and 2-methylpropan-1-ol

*22. An ideal gas in a thermally insulated vessel at internal pressure = P_1, volume = V_1 and absolute temperature = T_1 expands irreversibly against zero external pressure, as shown in the diagram. The final internal pressure, volume and absolute temperature of the gas are P_2, V_2 and T_2, respectively. For this expansion,



(A) $q = 0$
(B) $T_2 = T_1$
(C) $P_2V_2 = P_1V_1$
(D) $P_2V_2^{\gamma} = P_1V_1^{\gamma}$

*23. Hydrogen bonding plays a central role in the following phenomena:
(A) Ice floats in water.
(B) Higher Lewis basicity of primary amines than tertiary amines in aqueous solutions.
(C) Formic acid is more acidic than acetic acid.
(D) Dimerisation of acetic acid in benzene.

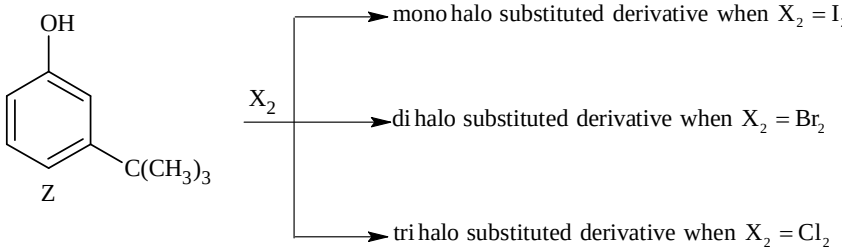
24. In a galvanic cell, the salt bridge
(A) does not participate chemically in the cell reaction.
(B) stops the diffusion of ions from one electrode to another.
(C) is necessary for the occurrence of the cell reaction.
(D) ensures mixing of the two electrolytic solutions.

*25. For the reaction:

$$I^- + ClO_3^- + H_2SO_4 \longrightarrow Cl^- + HSO_4^- + I_2$$

The correct statement(s) in the balanced equation is/are:
(A) Stoichiometric coefficient of HSO_4^- is 6.
(B) Iodide is oxidized.
(C) Sulphur is reduced.
(D) H_2O is one of the products.

*26. The reactivity of compound Z with different halogens under appropriate conditions is given below:



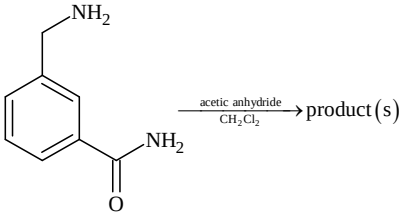
The observed pattern of electrophilic substitution can be explained by
(A) the steric effect of the halogen
(B) the steric effect of the tert-butyl group
(C) the electronic effect of the phenolic group
(D) the electronic effect of the tert-butyl group

*27. The correct statement(s) for orthoboric acid is/are
(A) It behaves as a weak acid in water due to self ionization.
(B) Acidity of its aqueous solution increases upon addition of ethylene glycol.
(C) It has a three dimensional structure due to hydrogen bonding.
(D) It is a weak electrolyte in water.

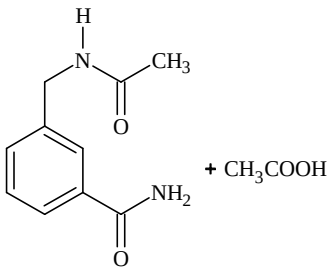
28. Upon heating with Cu_2S, the reagent(s) that give copper metal is/are
(A) $CuFeS_2$ (B) CuO
(C) Cu_2O (D) $CuSO_4$

*29. The pair(s) of reagents that yield paramagnetic species is/are
(A) Na and excess of NH_3 (B) K and excess of O_2
(C) Cu and dilute HNO_3 (D) O_2 and 2- ethylanthraquinol

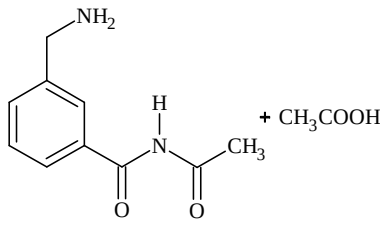
30. In the reaction shown below, the major product(s) formed is/are



(A)



(B)



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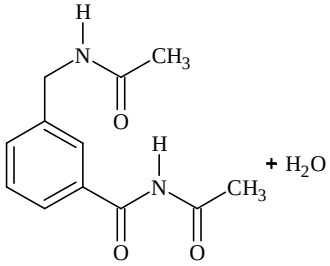
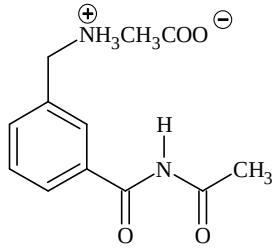


(D)

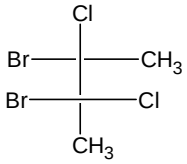


SECTION – 2: (Only Integer Value Correct Type)

This section contains **10 questions.** Each question, when worked out will result in one integer from 0 to 9 (both inclusive).

31. Among PbS, CuS, HgS, MnS, Ag_2S, NiS, CoS, Bi_2S_3 and SnS_2, the total number of BLACK coloured sulphides is

*32. The total number(s) of stable conformers with non-zero dipole moment for the following compound is(are)



33. Consider the following list of reagents:
Acidified $K_2Cr_2O_7$, alkaline $KMnO_4, CuSO_4, H_2O_2, Cl_2, O_3, FeCl_3, HNO_3$ and $Na_2S_2O_3$.
The total number of reagents that can oxidise aqueous iodide to iodine is

34. A list of species having the formula XZ_4 is given below.
$XeF_4, SF_4, SiF_4, BF_4^-, BrF_4^-, \left[Cu(NH_3)_4\right]^{2+}, \left[FeCl_4\right]^{2-}, \left[CoCl_4\right]^{2-}$ and $\left[PtCl_4\right]^{2-}$.
Defining shape on the basis of the location of X and Z atoms, the total number of species having a square planar shape is

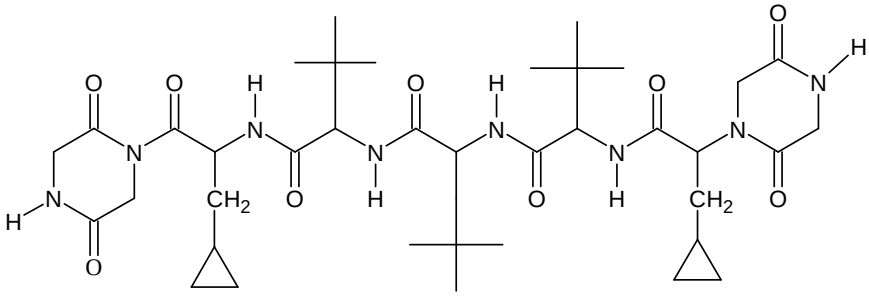
35. Consider all possible isomeric ketones, including stereoisomers of MW = 100. All these isomers are independently reacted with $NaBH_4$ **(NOTE:** stereoisomers are also reacted separately). The total number of ketones that give a racemic product(s) is/are

*36. In an atom, the total number of electrons having quantum numbers $n = 4$, $|m_l| = 1$ and $m_s = -1/2$ is

*37. If the value of Avogadro number is 6.023×10^{23} mol^{-1} and the value of Boltzmann constant is $1.380 \times 10^{-23} JK^{-1}$, then the number of significant digits in the calculated value of the universal gas constant is

38. MX_2 dissociates in M^{2+} and X^- ions in an aqueous solution, with a degree of dissociation (α) of 0.5. The ratio of the observed depression of freezing point of the aqueous solution to the value of the depression of freezing point in the absence of ionic dissociation is

39. The total number of ***distinct naturally occurring amino acids*** obtained by complete acidic hydrolysis of the peptide shown below is



*40. A compound H_2X with molar weight of 80g is dissolved in a solvent having density of 0.4 gml^{-1}. Assuming no change in volume upon dissolution, the molality of a 3.2 molar solution is

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ANSWERS

CHEMISTRY

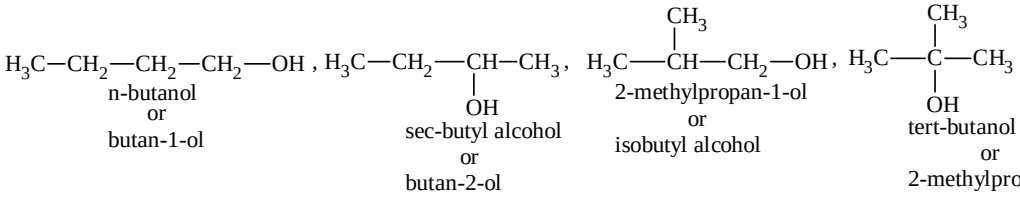
21.	**A, C, D**	22.	**A, B, C**	23.	**A, B, D**	24.	**A**
25.	**A, B, D**	26.	**A, B, C**	27.	**B, D**	28.	**B, C, D**
29.	**A, B, C**	30.	**A**	31.	**6**	32.	**3**
33.	**7**	34.	**4**	35.	**5**	36.	**6**
37.	**4**	38.	**2**	39.	**1**	40.	**8**

HINTS AND SOLUTIONS

CHEMISTRY

SECTION – 1:

21. Isomeric alcohols of $C_4H_{10}O$ are



22. Since container is thermally insulated. So, q = 0, and it is a case of free expansion therefore W = 0 and $\Delta E = 0$

So, $T_1 = T_2$

Also, $P_1V_1 = P_2V_2$

23. (A) Ice has cage-like structure in which each water molecule is surrounded by four other water molecules tetrahedrally through hydrogen boding, due to this density of ice is less than water and it floats in water.

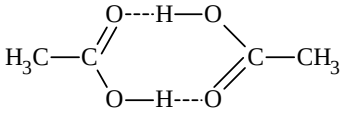
(B) $R-NH_2 + H-OH \rightleftharpoons R-\underset{(I)}{\overset{\oplus}{N}}H_3 + OH^-$

$(R)_3N + H-OH \rightleftharpoons (R)_3-\underset{(II)}{\overset{\oplus}{N}}H + OH^-$

The cation (I) more stabilized through hydrogen boding than cation (II). So, R–NH_2 is better base than $(R)_3N$ in aqueous solution.

(C) HCOOH is stronger acid than CH_3COOH due to inductive effect and not due to hydrogen bonding.

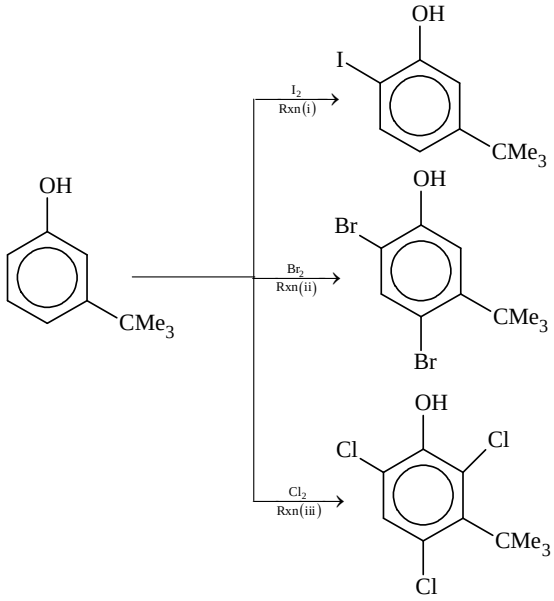
(D) Acetic acid dimerizes in benzene through intermolecular hydrogen bonding.



25. The balanced equation is,

$$ClO_3^- + 6I^- + 6H_2SO_4 \longrightarrow 3I_2 + Cl^- + 6HSO_4^- + 3H_2O$$

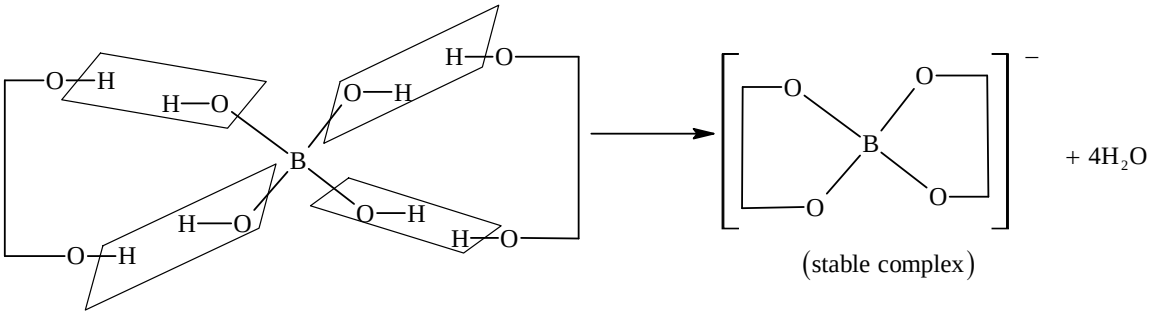
26.



27. (A) H_3BO_3 is a weak monobasic Lewis acid.

$$H_3BO_3 + H-OH \rightleftharpoons B(OH)_4^- + H^+ \quad \ldots (i)$$

(B) Equilibrium (i) is shifted in forward direction by the addition of syn-diols like ethylene glycol which forms a stable complex with $B(OH)_4^-$.



(stable complex)

(C) It has a planar sheet like structure due to hydrogen bonding.

(D) H_3BO_3 is a weak electrolyte in water.

28. (A) $2CuFeS_2 + O_2 \xrightarrow{\Delta} Cu_2S + 2FeS + SO_2$

(B) $4CuO \xrightarrow{1100^\circ C} 2Cu_2O + O_2$

$2Cu_2O + Cu_2S \xrightarrow{\Delta} 6Cu + SO_2$

(C) $Cu_2S + 2Cu_2O \xrightarrow{\Delta} 6Cu + SO_2$

(D) $CuSO_4 \xrightarrow{720^\circ C} CuO + SO_2 + \frac{1}{2}O_2$

$4CuO \xrightarrow{1100^\circ C} 2Cu_2O + O_2$

$2Cu_2O + Cu_2S \xrightarrow{\Delta} 6Cu + SO_2$

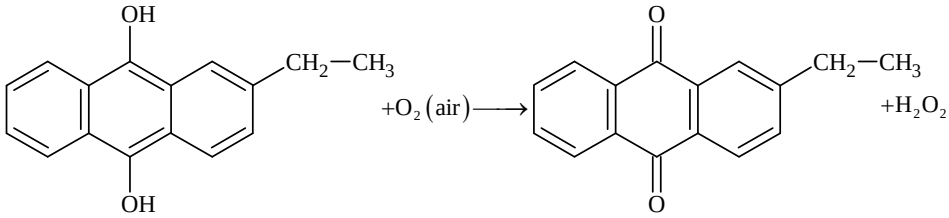
29. (A) sodium (Na) when dissolved in excess liquid ammonia, forms a blue coloured paramagnetic solution.

(B) $K + O_2 \longrightarrow \underset{\text{(potassium superoxide)}}{KO_2}$ and KO_2 is paramagnetic.

(C) $3Cu + \underset{\text{(dilute)}}{8HNO_3} \longrightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

Where "NO" is paramagnetic.

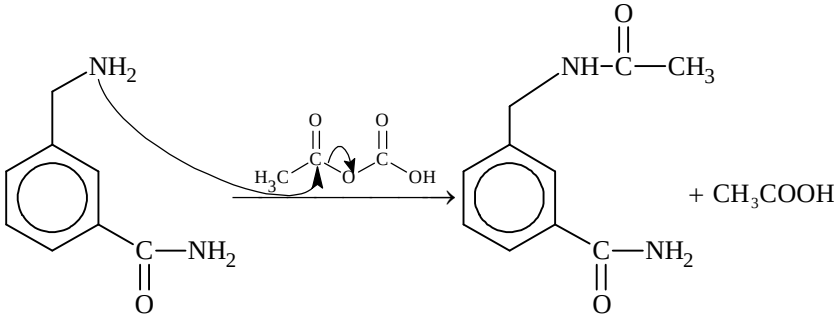
(D)



(2 – ethyl anthraquinol)

Where "H_2O_2" is diamagnetic.

30. Only amines undergo acetylation and not acid amides.

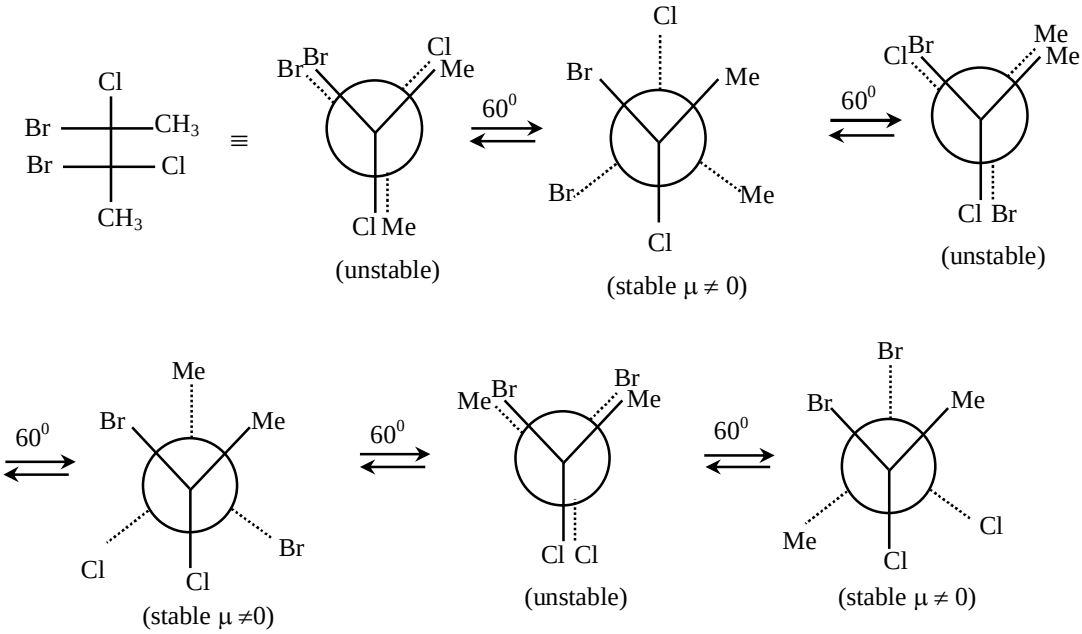


SECTION – 2:

31. Black coloured sulphides $\{PbS, CuS, HgS, Ag_2S, NiS, CoS\}$

*** Bi_2S_3 in its crystalline form is dark brown but Bi_2S_3 precipitate obtained is black in colour.**

32.



33. $K_2Cr_2O_7, CuSO_4, H_2O_2, Cl_2, O_3, FeCl_3, HNO_3$

$K_2Cr_2O_7 + 7H_2SO_4 + 6KI \longrightarrow 4K_2SO_4 + Cr_2(SO_4)_3 + 3I_2 + 7H_2O$

$2CuSO_4 + 4KI \longrightarrow Cu_2I_2 + I_2 + 2K_2SO_4$

$H_2O_2 + 2KI \longrightarrow I_2 + 2KOH$

$Cl_2 + 2KI \longrightarrow 2KCl + I_2$

$O_3 + 2KI + H_2O \longrightarrow 2KOH + I_2 + O_2$

$2FeCl_3 + 2KI \longrightarrow 2FeCl_2 + I_2 + 2KCl$

$8HNO_3 + 6KI \longrightarrow 6KNO_3 + 2NO + 4H_2O + 3I_2$

$2KMnO_4 + KI + H_2O \longrightarrow KIO_3 + 2MnO_2 + 2KOH$

34. $XeF_4 \rightarrow$ Square planar

$BrF_4^- \rightarrow$ Square planar

$\left[Cu(NH_3)_4\right]^{2+} \rightarrow$ Square planar

$\left[PtCl_4\right]^{2-} \rightarrow$ Square planar

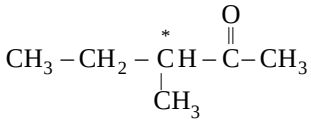
$SF_4 \rightarrow$ See – saw

$SiF_4 \rightarrow$ Tetrahedral

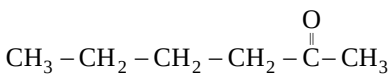
$BF_4^- \rightarrow$ Tetrahedral

$\left[FeCl_4\right]^{2-} \rightarrow$ Tetrahedral

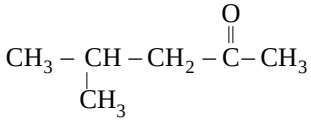
$\left[CoCl_4\right]^{2-} \rightarrow$ Tetrahedral

35. (1) 

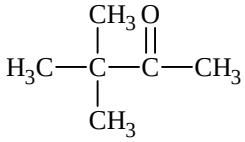
Will not give a racemic mixture on reduction with $NaBH_4$

(2) 

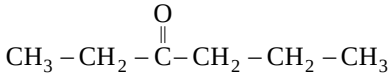
Will give a racemic mixture on reduction with $NaBH_4$

(3) 

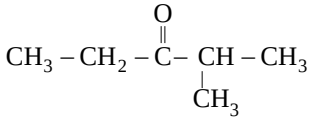
Will give a racemic mixture on reduction with $NaBH_4$

(4) 

Will give a racemic mixture on reduction with $NaBH_4$

(5) 

Will give a racemic mixture on reduction with $NaBH_4$

(6) 

Will give a racemic mixture on reduction with $NaBH_4$

36. $n = 4$

$\ell = 0,1,2,3$

$|m_\ell| = 1 \Rightarrow \pm 1$

$m_s = -\frac{1}{2}$

For $\ell = 0,\ m_\ell = 0$

$\ell = 1,\ m_\ell = -1,\ 0,\ +1$

$\ell = 2,\ m_\ell = -2, -1, 0, +1, +2$

$\ell = 3,\ m_\ell = -3, -2, -1, 0, +1, +2, +3$

So, six electrons can have $|m_\ell| = 1$ & $m_s = -\frac{1}{2}$ **37.** $k = \frac{R}{N_A}$

$R = kN_A$

$= 1.380 \times 10^{-23} \times 6.023 \times 10^{23}$

$= 8.31174$
≈ 8.312

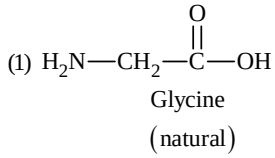
38. $MX_2 \rightleftharpoons M^{2+} + 2X^-$

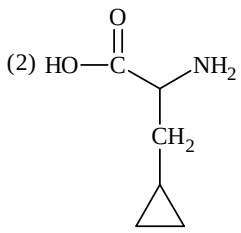
$1-\alpha \qquad \alpha \qquad 2\alpha$

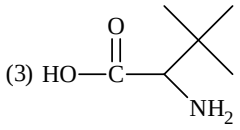
$i = 1 + 2\alpha \qquad \{\alpha = 0.5\}$

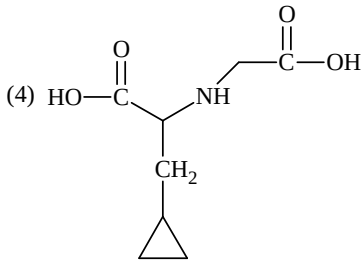
i = 2

39. This peptide on complete hydrolysis produced 4 distinct amino acids which are given below:









Only glycine is naturally occurring amino acid.

40. Here, $V_{solution} \approx V_{solvent}$

Since, in 1ℓ solution , 3.2 moles of solute are present,

So, 1ℓ solution $\approx$ 1ℓ solvent (d = 0.4g/ml) $\approx$ 0.4 kg

So, molality $(m) = \dfrac{\text{moles of solute}}{\text{mass of solvent (kg)}} = \dfrac{3.2}{0.4} = 8$