

AIEEE 2007 Chemistry

Q. 1. The energies of activation for forward and reverse reactions for $A_2 + B_2 \leftrightarrow 2 AB$ are 180 kJ mol^{-1} and 200 kJ mol^{-1} respectively. The presence of a catalyst lowers the activation energy of both (forward and reverse) reactions by 100 kJ mol^{-1} . The enthalpy change of the reaction $A_2 + B_2 \rightarrow 2 AB$ in the presence of catalyst will be (in kJ mol^{-1})

- a. 300
- b. 120
- c. 280
- d. 20

Ans. D

Q. 2. The cell, $Zn | Zn^{2+} (1 M) || Cu^{2+} (1 M) | Cu$ ($E_{cell}^0 = 1.10 V$), was allowed to be completely discharged at 298 K. The relative concentration of Znocelle

$$Zn^{2+} \text{ to } Cu^{2+} \left(\frac{[Zn^{2+}]}{[Cu^{2+}]} \right) \text{ is}$$

- a. antilog (24.08)
- b. 37.3
- c. 10^{373}
- d. 9.65×10^4

Ans. C

Q. 3. The pK_a of a weak acid (HA) is 4.5. The pOH of an aqueous buffered solution of HA in which 50% of the acid is ionized is

- a. 4.5
- b. 2.5
- c. 9.5
- d. 7.0

Ans. C

Q. 4. Consider the reaction, $2 A + B \rightarrow \text{products}$ When concentration of B alone was doubled, the half-life did not change. When the concentration of A alone was doubled, the rate increased by two times. The unit of rate constant for this reaction is

- a. $L \text{ mol}^{-1} \text{ s}^{-1}$
- b. no unit
- c. $\text{mol L}^{-1} \text{ s}^{-1}$
- d. s^{-1}

Ans. A

Q. 5. Identify the incorrect statement among the following:

- d-Block elements show irregular and erratic chemical properties among themselves.
- La and Lu have partially filled d orbitals and no other partially filled orbitals.
- The chemistry of various lanthanoids is very similar.
- 4f and 5f orbitals are equally shielded.

Ans. D

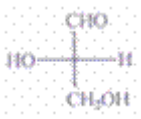
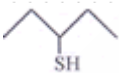

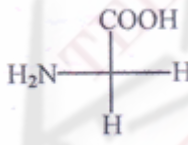
Q. 6. Which one of the following has a square planar geometry?

- $[CoCl_4]^{2-}$
- $[FeCl_4]^{2-}$
- $[NiCl_4]^{2-}$
- $[PtCl_4]^{2-}$

(Atomic numbers: Co = 27, Ni = 28, Fe = 26, Pt = 78)

Ans. 4

Q. 7. Which of the following molecules is expected to rotate the plane of plane – polarised light?

- 
- 
- 
- 

Ans. A

Q. 8. The secondary structure of protein refers to:

- α – helical backbone.
- hydrophobic interactions.
- sequence of α – amino acids.
- fixed configuration of the polypeptide backbone.

Ans. D

Q. 9. Which of the following reactions will yield 2,2-dibromopropane?

- $CH_3 - C \equiv CH + 2HBr \rightarrow$
- $CH_3 - CH = CHBr + HBr \rightarrow$

- c. $CH_3 \equiv CH + 2HBr \rightarrow$
 d. $CH_3 - CH \equiv CH_2 + HBr \rightarrow$

Ans. A

Q. 10. In the chemical reaction, $CH_3CH_2NH_2 + CHCl_3 + 3KOH \rightarrow (A) + (B) + 3H_2O$ the compounds (A) and (B) are respectively:

- a. CH_3CH_2CN and $3KCl$
 b. $CH_3CH_2CONH_2$ and $3KCl$
 c. C_2H_5NC and K_2CO_3
 d. C_2H_5NC and $3KCl$

Ans. D

Q. 11. The reaction of toluene with Cl_2 in presence of $FeCl_3$ gives predominantly:

- a. benzoyl chloride
 b. benzyl chloride
 c. o- and p-chlorotoluene
 d. m-chlorotoluene

Ans. C

Q. 12. Presence of a nitro group in a benzene ring

- a. activates the ring towards electrophilic substitution.
 b. renders the ring basic.
 c. deactivates the ring towards nucleophilic substitution.
 d. deactivates the ring towards electrophilic substitution.

Ans. D

Q. 13. In which of the following ionization processes, the bond order has increased and the magnetic behaviour has changed?

- a. $C_2 \rightarrow C_2^+$
 b. $NO \rightarrow NO^+$
 c. $O_2 \rightarrow O_2^+$
 d. $N_2 \rightarrow N_2^+$

Ans. B

Q 14. The actinoids exhibit more number of oxidation states in general than the lanthanoids. This is because

- a. the 5f orbitals are more buried than the 4f orbitals.
 b. there is a similarity between 4f and 5f orbitals in their angular part of the wave function.
 c. the actinoids are more reactive than the lanthanoids.
 d. the 5f orbitals extend further from the nucleus than the 4f orbitals.

Ans. D

Q. 15. Equal masses of methane and oxygen are mixed in an empty container at 25°C . The fraction of the total pressure exerted by oxygen is

- a. $\frac{2}{3}$
 b. $\frac{1}{3} \times \frac{273}{298}$
 c. $\frac{1}{3}$
 d. $\frac{1}{2}$

Ans. C

Q. 16. A 5.25% solution of a substance is isotonic with a 1.5% solution of urea (molar mass = 60 g mol^{-1}) in the same solvent. If the densities of both the solutions are assumed to be equal to 1.0 g cm^{-3} , molar mass of the substance will be

- a. 90.0 g mol^{-1}
 b. 115.0 g mol^{-1}
 c. 105.0 g mol^{-1}
 d. 210.0 g mol^{-1}

Ans. D

Q. 17. Assuming that water vapour is an ideal gas, the internal energy change ΔU when 1 mol of water is vapourised at 1 bar pressure and 100°C , (Given: Molar enthalpy of vapourisation of water at 1 bar and 373 K = 41 kJ mol^{-1} and $R = 8.3\text{ J mol}^{-1}\text{K}^{-1}$) will be:

- a. 4.100 kJ mol^{-1}
 b. $3.7904\text{ kJ mol}^{-1}$
 c. $37.904\text{ kJ mol}^{-1}$
 d. 41.00 kJ mol^{-1}

Ans. C

Q. 18. In a saturated solution of the sparingly soluble strong electrolyte AgIO_3 (Molecular mass = 283) the equilibrium which sets in is $\text{AgIO}_3(s) \leftrightarrow \text{Ag}^+(aq) + \text{IO}_3^-(aq)$. If the solubility product constant K_{sp} of AgIO_3 at a given temperature is, what is the mass of AgIO_3 contained in 100 ml of its saturated solution?

- a. $28.3 \times 10^{-2}\text{ g}$
 b. $2.83 \times 10^{-3}\text{ g}$
 c. $1.0 \times 10^{-7}\text{ g}$
 d. $1.0 \times 10^{-4}\text{ g}$

Ans. B

Q. 19. A radioactive element gets spilled over the floor of a room. Its half-life period is 30 days. If the initial activity is ten times the permissible value, after how many days will it be safe to enter the room?

- a. 1000 days
- b. 300 days
- c. 10 days
- d. 100 days

Ans. D

Q. 20. Which one of the following conformations of cyclohexane is chiral?

- a. Twist boat
- b. Rigid
- c. Chair
- d. Boat

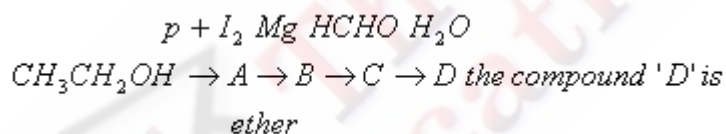
Ans. A

21. Which of the following is the correct order of decreasing S_N2 reactivity?

- a. $RCH_2X > R_3CX > R_2CHX$
- b. $RCH_2X > R_2CHX > R_3CX$
- c. $R_3CX > R_2CHX > RCH_2X$
- d. $R_2CHX > R_3CX > RCH_2X$
(X = a halogen)

Ans. B

Q. 22. In a following sequence of reactions,



- a. butanal
- b. n-butyl alcohol
- c. n-propyl alcohol
- d. propanal

Ans. C

Q. 23. Which of the following sets of quantum numbers represents the highest energy of an atom?

- a. $n = 3, l = 1, m = 1, s = +\frac{1}{2}$
- b. $n = 3, l = 2, m = 1, s = +\frac{1}{2}$
- c. $n = 4, l = 0, m = 0, s = +\frac{1}{2}$
- d. $n = 3, l = 0, m = 0, s = +\frac{1}{2}$

Ans. B

Q. 24. Which of the following hydrogen bonds is the strongest?

- O—H...N
- F—H...F
- O—H...O
- O—H...F

Ans. B

Q. 25. In the reaction, $2Al(s) + 6HCl(aq) \rightarrow 2Al^{3+}(aq) + 6Cl^{-}(aq) + 3H_2(g)$

- 6 L HCl(aq) is consumed for every 3 L H₂(g) produced.
- 33.6 L H₂(g) is produced regardless of temperature and pressure for every mole Al that reacts.
- 67.2 L H₂(g) at STP is produced for every mole Al that reacts.
- 11.2 L H₂(g) at STP is produced for every mole HCl(aq) consumed.

Ans. D

Q. 26. Regular use of which of the following fertilizers increases the acidity of soil?

- Potassium nitrate
- Urea
- Superphosphate of lime
- Ammonium sulphate

Ans. D

Q. 27. Identify the correct statement regarding a spontaneous process:

- For a spontaneous process in an isolated system, the change in entropy is positive.
- Endothermic processes are never spontaneous.
- Exothermic processes are always spontaneous.
- Lowering of energy in the reaction process is the only criterion for spontaneity.

Ans. A

Q. 28. Which of the following nuclear reactions will generate an isotope?

- neutron particle emission
- positron emission
- α^{-} particle emission
- β^{-} particle emission

Ans. A

Q. 29. The equivalent conductances of two strong electrolytes at infinite dilution in H₂O (where ions move freely through a solution) at 25°C are given below:

$$\Lambda^{\circ} CH_3COONa = 91.08 \text{ cm}^2 / \text{equiv}; \Lambda^{\circ} C_{HCl} = 426.2 \text{ S cm}^2 / \text{equiv}$$

What additional information/quantity one needs to calculate of an aqueous solution of acetic acid?

- Λ° of NaCl
- Λ° of CH₃COOK
- (C) The limiting equivalent conducted of H^+ ($\lambda_{H^+}^{\circ}$)

d. Λ^0 of chloroacetic acid (ClCH_2COOH)

Ans. A

Q. 30. Which one of the following is the strongest base in aqueous solution?

- Trimethylamine
- Aniline
- Dimethylamine
- Methylamine

Ans. C

Q. 31. The compound formed as a result of oxidation of ethyl benzene by KMnO_4 is

- benzophenone
- acetophenone
- benzoic acid
- benzyl alcohol

Ans. C

Q. 32. The IUPAC name of  is

- 1,1-diethyl-2,2-dimethylpentane
- 4,4-dimethyl-5,5-diethylpentane
- 5,5-diethyl-4,4-dimethylpentane
- 3-ethyl-4,4-dimethylheptane

Ans. D

Q. 33. Which of the following species exhibits the diamagnetic behaviour?

- O_2^{2-}
- O_2^+
- O_2
- NO

Ans. A

Q. 34. The stability of dihalides of Si, Ge, Sn and Pb increases steadily in the sequence

- $\text{GeX}_2 \ll \text{SiX}_2 \ll \text{SnX}_2 \ll \text{PbX}_2$
- $\text{SiX}_2 \ll \text{GeX}_2 \ll \text{PbX}_2 \ll \text{SnX}_2$
- $\text{SiX}_2 \ll \text{GeX}_2 \ll \text{SnX}_2 \ll \text{PbX}_2$
- $\text{PbX}_2 \ll \text{SnX}_2 \ll \text{GeX}_2 \ll \text{SiX}_2$

Ans. C

Q. 35. Identify the incorrect statement among the following:

- Ozone reacts with SO_2 to give SO_3 .
- Silicon reacts with $\text{NaOH}(\text{aq})$ in the presence of air to give Na_2SiO_3 and H_2O .
- Cl_2 reacts with excess of NH_3 to give N_2 and HCl .
- Br_2 reacts with hot and strong NaOH solution to give NaBr , NaBrO_4 and H_2O .

Ans. D

Q. 36. The charge/size ratio of a cation determines its polarizing power. Which one of the following sequences represents the increasing order of the polarizing power of the cationic species, K^+ , Ca^{2+} , Mg^{2+} , Be^{2+} ?

- $\text{Mg}^{2+} < \text{Be}^{2+} < \text{K}^+ < \text{Ca}^{2+}$
- $\text{Mg}^{2+} < \text{Be}^{2+} < \text{K}^+ < \text{Ca}^{2+}$
- $\text{Be}^{2+} < \text{K}^+ < \text{Ca}^{2+} < \text{Mg}^{2+}$
- $\text{K}^+ < \text{Ca}^{2+} < \text{Mg}^{2+} < \text{Be}^{2+}$
- $\text{K}^+ < \text{Ca}^{2+} < \text{Mg}^{2+} < \text{Be}^{2+}$

Ans. C

Q. 37. The density (in g mL^{-1}) of a 3.60 M sulphuric acid solution that is 29%. H_2SO_4 (Molar mass = 98 g mol^{-1}) by mass will be

- .64
- 1.88
- 1.22
- 1.45

Ans. C

Q. 38. The first and second dissociation constants of an acid H_2A are 1.0×10^{-5} and 5.0×10^{-10} respectively. The overall dissociation constant of the acid will be

- 5.0×10^{-5}
- 5.0×10^{15}
- 5.0×10^{-15}
- 0.2×10^5

Ans. C

Q. 39. A mixture of ethyl alcohol and propyl alcohol as vapour pressure of 290 mm at 300 K. The vapour pressure of propyl alcohol is 200 mm. If the mole fraction of ethyl alcohol is 0.6, its vapour pressure (in mm) at the same temperature will be

- 350
- 300
- 700
- 360

Ans. A

Q. 40. In conversion of lime-stone to lime, $\text{CaCO}_3 (s) \rightarrow \text{CaO} (s) + \text{CO}_2 (g)$

The values of ΔH° and ΔS° are $+179.1 \text{ kJ mol}^{-1}$ and 160.2 J/K respectively at 298 K and 1 bar. Assuming that

ΔH^0 and ΔS^0 do not change with temperature, temperature above which conversion of limestone to lime will be spontaneous is

- a. 1008 K
- b. 1200 K
- c. 845 K
- d. 1118 K

Ans. D

 **The
Education Era**

Solutions

- Q 1. Enthalpy change of a reaction is not affected by the presence of a catalyst as it lowers the activation energy of the forward and reverse reaction by the same amount

$$\Delta H = E_{a,f} - E_{a,r} = 180 - 200 = -20 \text{ KJ mol}^{-1}$$

. None of the options given is correct but option (4) can be treated as correct in terms of magnitude. Correct choice: (4)

$$-nFE_{cell}^0 = -2.303 RT \log \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

$$2 \times 96500 \times 1.10 = 2.303 \times 8.314 \times 298 \log \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

$$\log \frac{[Zn^{2+}]}{[Cu^{2+}]} = 37.3; \frac{[Zn^{2+}]}{[Cu^{2+}]} = 10^{37.3}$$

Q 2.

Correct choice: (3)

- Q 3. If the given weak acid is 50% ionized, then its conjugate base will have the concentration same as that of weak acid.

$$\therefore pH = pK_a + \log \frac{[Conjugate\ base]}{[Acid]} = 4.5 + \log \frac{0.5c}{0.5c}$$

$$pH = 4.5$$

$$\therefore pOH = 14 - pH = 14 - 4.5 = 9.5$$

Correct choice: (3)

- Q 4. The reaction would be first order with respect to A and first order with respect to B. The overall order of the reaction is 2.

$$Rate = K [A][B]$$

$$\frac{\text{mole}}{\text{litre.s}} = K \left[\frac{\text{mole}}{\text{litre}} \right]^2; K = \text{mole}^{-1} \text{ litre s}^{-1}$$

Correct choice: (1)

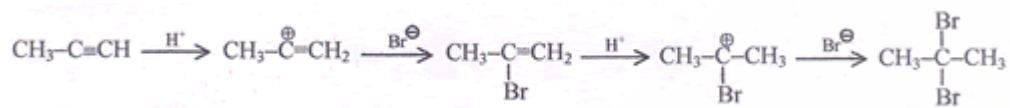
- Q 5. 4f orbital electrons are shielded more than 5f orbital electrons.
Correct choice: (4)

- Q 6. Platinum(+II) only forms square planar complex. Correct choice: (4)

- Q 7. Compound (1) does not have any plane of symmetry as well as centre of symmetry so it rotates the plane of plane-polarised light. Compound (2), (3) and (4) have a plane of symmetry, so they all are optically inactive.
Correct choice: (1)

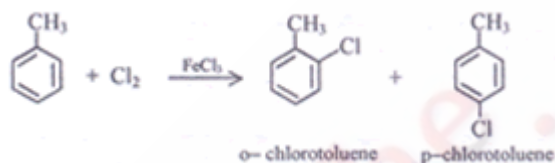
- Q 8. Secondary structure of a protein refers to the fixed configuration of the polypeptide skeleton. α -helix structure results only when intramolecular H-bonds are formed between $C=O$ of one amino acid residue and N-H of fourth amino acid residue in polypeptide chain. β -pleated structure is formed when intermolecular H-bond is formed between $C=O$ of one polypeptide chain with N-H of the other chain. Correct choice: (4)

Q9.



Correct choice: (1)

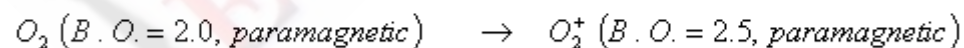
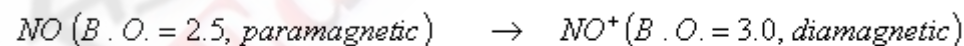
- Q10. $CH_3CH_2-NH_2 + CHCl_3 + 3KOH \rightarrow C_2H_5-N \equiv C + 3KCl + 3H_2O$ This is carbylamine reaction. Correct choice: (4)



Q 11.

The reaction proceeds by electrophilic substitution mechanism. Correct choice: (3)

- Q 12. NO_2 group in benzene ring shows -I and -R effect, which deactivates the ring towards electrophilic substitution but activates it towards nucleophilic substitution. Correct choice: (4)



- Q 13. $N_2 (B.O. = 3.0, \text{diamagnetic}) \rightarrow C_2^+ (B.O. = 2.5, \text{paramagnetic})$

Correct choice: (2)

- Q 14. The actinoids exhibit more number of oxidation states than lanthanoids because they can lose more number of electrons as the 5f orbital electrons are held less strongly than the 4f orbital electrons. Correct choice: (4)

- Q 15. Let the mass of methane and oxygen be x g each.

$$\therefore \text{Total moles of gaseous mixture} = \text{Moles of } CH_4 + \text{Moles of } O_2 = \frac{x}{4} + \frac{x}{32} = \frac{3x}{32}$$

$$P_{O_2} = p_T \times X_{O_2}; \quad \frac{P_{O_2}}{p_T} = X_{O_2} = \frac{x / 32}{3x / 32} = \frac{1}{3}$$

Correct choice: (3)

Q 16. Since the two solutions are isotonic, their concentrations will be same.

$$\therefore C_1 = C_2; \quad \frac{5.25}{M} = \frac{1.5}{60}; \quad M = 210 \text{ mol}^{-1}$$

Correct choice: (4)

Given that, $H_2O(l) \rightarrow H_2O(g)$; $\Delta H = 41 \text{ KJ mol}^{-1}$

The change in internal energy (ΔU) for the above process is given by

$$\Delta U = \Delta H - \Delta n_g RT = \Delta H - RT \left[\ominus \Delta n_g = 1 \right]$$

$$= 41 - \frac{8.3 \times 373}{1000} = 37.904 \text{ KJ mol}^{-1}$$

Q.17.

Correct choice: (3)

Given that, $AgClO_2(s) \leftrightarrow Ag^+(aq) + ClO_2^-(aq)$

Q 18.

If 's' is the solubility of $AgClO_2$ in a saturated solution, then

Correct choice: (2)

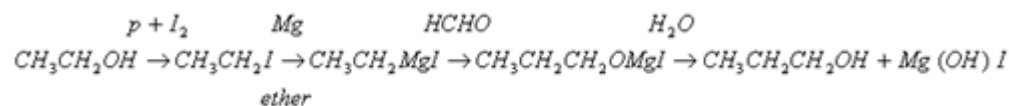
Q 19. Let the permissible activity limit of the radioactive element be x, then the initial activity would be 10 x.

$$t = \frac{2.303}{\lambda} \log \frac{[A]}{[A]_t} = \frac{2.303 \times 30}{0.693} \log \frac{10x}{x} \approx 100 \text{ days}$$

Correct choice: (4)

Q 20. Twist boat conformation of cyclohexane is chiral because it has neither plane of symmetry nor centre of symmetry. Correct choice: (1)

Q 21. The reactivity of a compound towards SN_2 reaction decreases as the crowding at the C-atom containing leaving group increases. Correct choice: (2)



Q 22.

(A) (B) (C) (D)

Correct choice: (3)

Q 23. An orbital having higher value of $(n + l)$ has higher energy. Out of the four options given, the value of $(n + l)$ is highest if $n = 3$ and $l = 2$. Correct choice: (2)

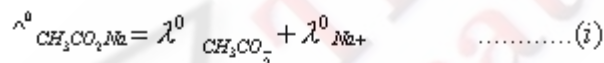
Q 24. Greater the difference in electronegativity of H-atom and the other electronegative atom with which H is covalently bonded, stronger is the hydrogen bond. Highest electronegativity difference exists in HF molecule. Correct choice: (2)

Q 25. Given that, $2Al(s) + 6HCl(aq) \rightarrow 2Al^{3+}(aq) + 6Cl^{-}(aq) + 3H_2(g)$
 For each mole of Al reacted, 1.5 mol of H_2 is formed; and for each mole of $HCl(aq)$ consumed, 0.5 mol or 11.2 L of H_2 at STP is formed. Correct choice: (4)

Q 26. Ammonium sulphate is a salt of weak base and strong acid. Its aqueous solution is acidic due to hydrolysis of ammonium ion. It will increase the acidity of soil. Correct choice: (4)

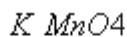
Q 27. For a process to be spontaneous in an isolated system, the change in entropy is positive. Correct choice: (1)

Q 28. In a nuclear reaction, an isotope cannot be generated by the emission of positron α^{-} , particle or β^{-} particle because it will change the atomic number of the parent nuclei. An isotope can be generated when the nuclei of an element are bombarded with slow neutrons e.g., ${}_{27}Co^{59} + {}_0n^1 \rightarrow {}_{27}Co^{60}$. Formation of isotope by neutron particle emission is a hypothetical process. Correct choice: (1)

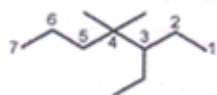


Q 29. ${}^0CH_3CO_2H = {}^0CH_3CO_2^{-} + {}^0Mn^{2+} \dots\dots\dots (iv)$ Correct choice: (1)

Q 30. Aliphatic amines are more basic than aromatic amines and among aliphatic amines, the order of basicity in aqueous solution is $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N$ Correct choice: (3)



Q 31. $Ph - Et \rightarrow Ph - CO_2H$ Correct choice: (3)



Q 32. IUPAC name of the given compound is: 3-ethyl-4,4-dimethyl heptane. Correct choice: (4)

Q 33. O_2 , O_2^+ , and NO are paramagnetic due to the presence of 2, 1 and 1 unpaired electrons respectively. O_2^{2-} will have no unpaired electron and is diamagnetic in nature. Correct choice: (1)

Q 34. The stability of the lower oxidation state increases down the group in group 14. $SiX_2 \ll GeX_2 \ll SnX_2 \ll PbX_2$ Correct choice: (3)

Q 35. $O_3 + SO_2 \rightarrow SO_3 + O_2$
 $Si + 2NaOH + O_2 \rightarrow Na_2SiO_3 + H_2O$
 $3Cl_2 + 2NH_3 \rightarrow N_2 + 6HCl$
 $3Br_2 + 6NaOH \rightarrow 5NaBr + NaBrO_3 + 3H_2O$ Correct choice: (4)

Q 36. Greater the charge/size ratio of a cation, size but charge of all those ions is same. Thus, polarising power of these ions is in the order: $K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$ K^+ has a 1 unit charge less than that of Ca^{2+} and its size is larger than that of Ca^{2+} , thus polarising power of K^+ is less than that of Ca^{2+} . So, the correct order is $K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$
 Correct choice: (3)

Q 37. Let the mass of solution be x g.

$$3.6 \times 98 = x \times \frac{29}{100}; x = 1216.5g$$

$$\text{Density of solution} = \frac{\text{mass of solution}}{\text{Volume of solution}} = \frac{1216.5g}{1000 ml} = 1.216 g ml^{-1}$$

Correct choice: (3)

Q 38. $K_{overall} = K_{a1} \times K_{a2} = 1 \times 10^{-5} \times 5 \times 10^{-10} = 5 \times 10^{-15}$

Correct choice: (3)

$$P_T = P_B^0 X_B + P_P^0 X_P$$

$$290 = (P_B^0 \times 0.6) + (200 \times 0.4)$$

$$\therefore (P_B^0 \times 0.6) = 290 - 80 = 210$$

Q 39. $P_B^0 = \frac{210}{0.6} = 350 mm Hg$ Correct choice: (1)

Q 40. $\Delta G^0 = \Delta H^0 - T\Delta S^0$ The decomposition of $CaCO_3$ to CaO and CO_2 would become spontaneous when ΔG^0 would be -ve. But limiting condition can be arrived at when ΔG^0 would become zero.
 $\therefore \Delta G^0 = 0 = \Delta H^0 - T\Delta S^0; \Delta H^0 = T\Delta S^0$

$$T = \frac{\Delta H^0}{\Delta S^0} = \frac{179.1 KJ}{160.2 J / K}$$

$$T = \frac{179.1 \times 10^3 J}{160.2 J / K} \cong 1118 K$$

zero.

Correct choice: (4)