INDIAN ASSOCIATION OF CHEMISTRY TEACHERS

NATIONAL STANDARD EXAMINATION IN CHEMISTRY (NSEC) 2018-19

Examination Date : 25-11-2018 **Time: 2 Hrs.** **Max. Marks : 240**

Q. PAPER CODE : 321 HBCSE Olympiad (STAGE - 1)

Write the question paper code mentioned above on YOUR answer sheet (in the space provided), otherwise your answer sheet will NOT be assessed. Note that the same Q. P. Code appears on each page of the question paper.

INSTRUCTION TO CANDIDATES

1. Use of mobile phones, smart phones, ipads during examination is STRICTLY PROHIBITED.
2. In addition to this question paper, you are given answer sheet along with Candidate's copy.
3. On the answer sheet, fill up all the entries carefully in the space provided, **ONLY In BLOCK CAPITALS**. Use only **BLUE or BACK BALL PEN** for making entries and marking answer.

   Incomplete / incorrect / carelessly filled information may disqualify your candidature.
4. On the answer sheet, use only BLUE or BLACK BALL POINT PEN for making entries and filling the bubbles.
5. The question paper contain 80 multiple-choice question. Each question has 4 options, out of which only one is correct. Choose the correct alternative and fill the appropriate bubble, as shown

   Q. No. 22 (a) ● (c) (d)
6. A correct answer carries 3 marks and 1 mark will be deducted for each wrong answer.
7. Any rough work should be done only in the space provided.
8. Periodic Table is provided at the end of the question paper.
9. Use of a nonprogrammable calculator is allowed.
10. No candidate should leave the examination hall before the completion of the examination.
11. After submitting your answer paper, take away the Candidate's copy for your reference.

    Please DO NOT make any mar other than filling the appropriate bubbles properly in the space provided on the answer sheet. Answer sheet are evaluated using machine, hence CHANGE OF ENTRY IS NOT ALLOWED.

    Scratching or overwriting may result in wrong score.

    DO NOT WRITE ANYTHING ON THE BACK OF ANSWER SHEET.

Read the following instructions after submitting the answer sheet.

12. Comments regarding this question paper, if any, may be filled in Google forms only at https://google/forms/Lxb1|8Bqov3C|9FQ2 till 27th November, 2018.
13. The answers/solutions to this question paper will be available on our website — www.iapt.org.in by 2nd December, 2018.
14. **Certificates & Awards**

    Following certificates are awarded by the IAPT to students successful in NSEs

    (i) Certificates to "Centre Top" 10% students

    (ii) Merit certificates to "State wise Top" 1% students.

    (iii) Merit certificate and a prize in term to "National wise" Top 1% students.
15. Result sheets can be downloaded from our website in the month of February. The "Centre Top 10%" certificates will be dispatched to the Prof-in-charge of the centre by February, 2019**.**
16. List of students (with centre number and roll number only) having score above MAS will be displayed on our website (www.iapt.org.in) by 22nd December, 2018. See the Eligibility Clause in the Student's brochure on our website.
17. Students eligible for the INO Examination on the basis of selection criteria mentioned in Student's brochure will be informed accordingly.
18. Students qualified for OCSC (Chemistry) - 2019 will be awarded gold medals.

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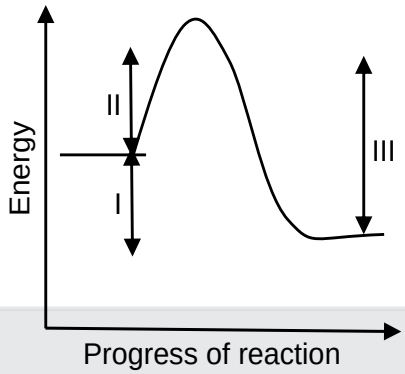
1. Which of the energy values marked as I, II and III in the following diagram, will change by the addition of a suitable catalyst?

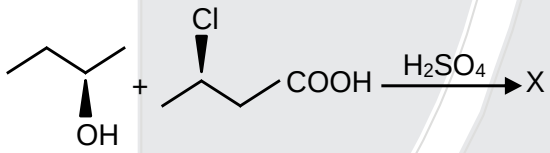


(A) II only (B) I and II (C) II and III (D) III only

Ans. **(C)**

Sol. In presence of suitable catalyst both Ea_f & Ea_b decreases.

2. The product 'X' in the following reaction is

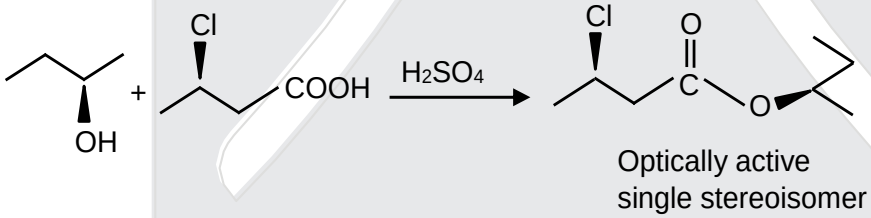


(A) a racemic mixture of ester (B) an optically inactive ester

(C) an optically active ester (D) a meso ester

Ans. **(C)**

Sol.



Optically active
single stereoisomer

3. At 298 K, change in internal energy for the complete combustion of fullerene, $C_{60}(s)$, an allotrope of carbon, and the enthalpy of formation of $CO_2(g)$ are –25970 kJ mol^{-1} and –393 kJ mol^{-1} respectively. The enthalpy of formation of $C_{60}(s)$ at 298 K is

(A) –2390 kJ (B) 4.95×10^4 kJ (C) 2.60×10^4kJ (D) 2390 kJ

Ans. **(D)**

Sol. $C_{60}(s) + 60\ O_2(g) \longrightarrow 60\ CO_2(g)\ \Delta U = -25970$ kJ/mole.

$$\Delta H = \Delta U + \Delta n_g RT$$
$$= -25970 \text{ kJ/mole}$$

$\Delta H_{rxn} = 60\Delta H_f(CO_2, g) - \Delta H_f(C_{60,S}) - 60\Delta H_f(O_2, g)$

$-25970 = 60\ (-393) - \Delta H_f(C_{60})$

$\Delta H_f(C_{60}) = 60(-393) + 25970$

$= 2390$ kJ

4. Which of the following is not paramagnetic?

(A) S^{2-} (B) N^{2-} (C) O^{2-} (D) NO

Ans. **(A or C)**

Sol. $S^{2-} = 1s^2 2s^2 2p^6 3s^2 3p^6$ Diamagnetic

$N^{2-} = 1s^2 2s^2 2p^5$ Paramagnetic

$O^{2-} = 1s^2 2s^2 2p^6$ Diamagnetic

NO = odd e^- molecular Paramagnetic

5. Solubility product of AgCl is 1.8×10^{-10}. The minimum volume (in L) of water required to dissolve 1 mg of Ag Cl is close to

(A) 0.5 (B) 7.5 (C) 50 (D) 0.75

Ans. **(A)**

Sol. $K_{sp}(AgCl) = 1.8 \times 10^{-10}$

$= (s)^2 = 1.8 \times 10^{-10}$

$s = \sqrt{1.8} \times 10^{-5}$ mole/lit.

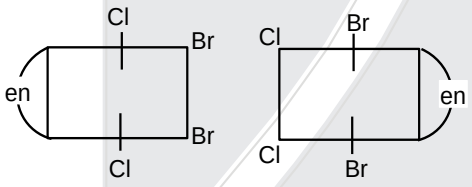
$= \sqrt{1.8} \times 10^{-5} \times 143$ gram/lit.

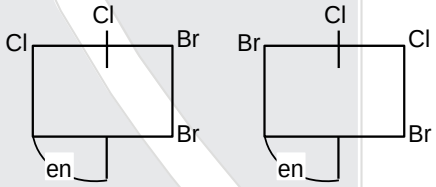
$= \sqrt{1.8} \times 143 \times 10^{-2}$ milligram/lit.

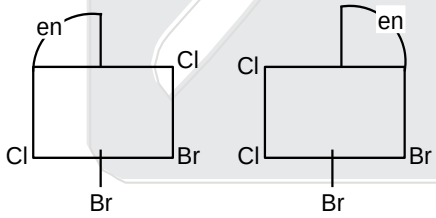
$= 191.85 \times 10^{-2}$ milligram/lit

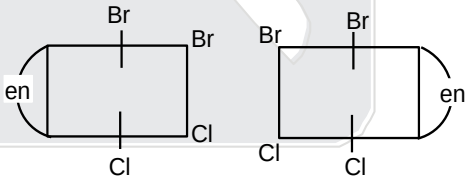
= 0.5 lit/milligram.

6. The complex $[M(en)Br)_2(Cl)_2]$ has two optical isomers. Their configurations can be represented as

(A) 

(B) 

(C) 

(D) 

Ans. **(D)**

Sol. Option (A), (B) & (C) have plane of symmetry so show no optical isomerism. In option (D), given structures are non super-imposable mirror image.

7. A sample of water from a river was analyzed for the presence of metal ions and the observations were recorded as given below

The water sample is likely to contain

Reagent added	Observation
dil. HCl	No change
aq. Na_2CO_3	White precipitate
aq, Na_2SO_4	No change

(A) Ba^{2+} (B) Cu^{2+} (C) Li^+ (D) Mg^{2+}

Ans. **(D)**

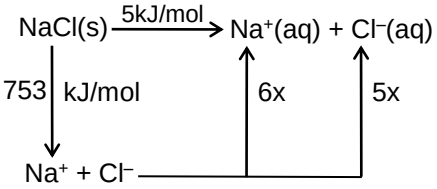
Sol. Only Mg^{2+} gives ppt. with Na_2CO_3.

8. The lattice enthalpy and enthalpy of solution in water for solid NaCl are 753 kJ mol^{-1} and 5 kJ mol^{-1} respectively (Fig. above). If the solution enthalpies of Na^+ and Cl^- are in the ratio 6 : 5, the enthalpy of hydration of Na^+ ion is

(A) 408 kJ mol^{-1} (B) –412 kJ mol^{-1} (C) –408 kJ mol^{-1} (D) –412 kJ mol^{-1}

Ans. **(C)**

Sol.



$753 + 6x + 5x = 5$

$x = -68$ kJ/mol.

$\therefore$ enthalpy of hydration of $Na^+ = 6x = -408$ kJ/mol.

9. The gaseous product obtained on reaction of BF_3 with LiH is

(A) HF (B) H_2 (C) B_2H_6 (D) F_2

Ans. **(C)**

Sol. $8BF_3 + 6LiH \xrightarrow{\text{ether}} B_2H_6(g) + 6LiBF_4$

10. The equilibrium constant K for the reversible reaction A=B is 2×10^3 at 350 K. The rate constants of the forward reaction in the presence and absence of a suitable catalyst at the same temperature are 5×10^4 s^{-1} and 4×10^{-6} s^{-1} respectively. The rate constant of the reverse reaction in the absence of the catalyst is

(A) 2×10^{-3} s^{-1} (B) 2.5×10^{-3} s^{-1} (C) 1.6×10^{-7} s^{-1} (D) 1.25×10^{-2} s^{-1}

Ans. **(All options are incorrect)**

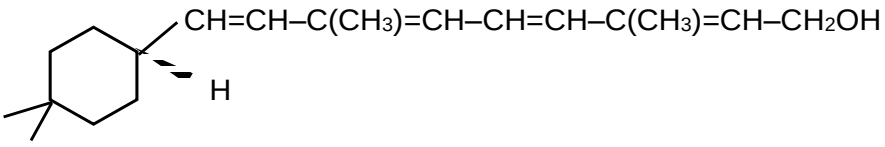
Sol. $A \underset{k_b}{\overset{k_f}{\rightleftharpoons}} B \qquad K_{eq.} = 2 \times 10^3$

$K_{eq} = \dfrac{k_f}{k_b}$ in absence of catalyst

$2 \times 10^3 = \dfrac{4 \times 10^{-6}}{k_b}$

$K_b = \dfrac{4 \times 10^{-6}}{2 \times 10^3} = 2 \times 10^{-9}$ sec^{-1}

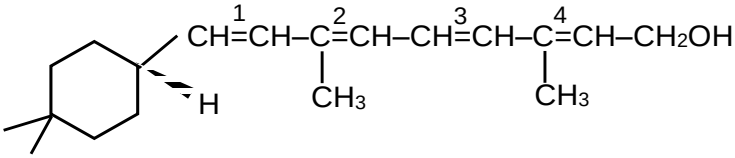
11. The number of stereoisomers possible for the following compound



(A) 4 (B) 2 (C) 16 (D) 32

Ans. **(C)**

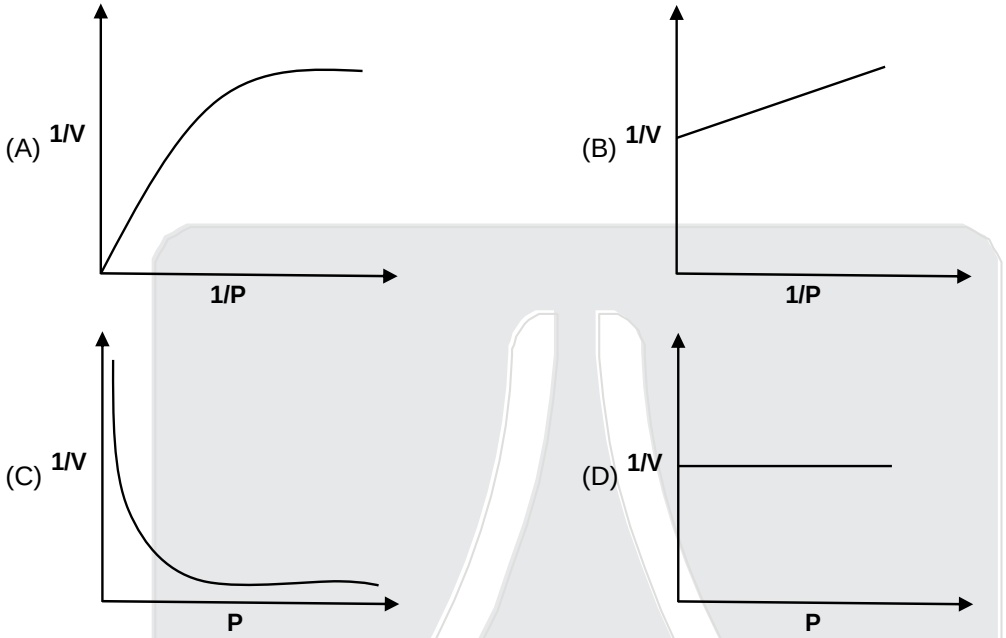
Sol.



Number of stereo unit = 4

Total stereoisomers = $2^4 = 16$

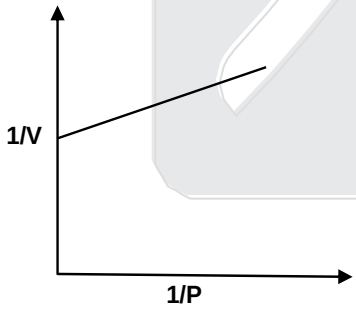
12. An adsorption isotherm equation proposed by Langmuir is of the form $V = \frac{V_0 bPO}{(1+bP)}$ where V is the volume of gas adsorbed at pressure P. For a given adsorbate/adsorbent system, V_0 and b are constants. The dependence of V on P can be depicted as



Ans. **(B)**

Sol. $\frac{1+bP}{V_0 bP} = \frac{1}{V}$

$\frac{1}{V} = \left(\frac{1}{V_0 P}\right)\frac{1}{P} + \frac{1}{V_0}$



13. For the reaction $4NO_2(g) + O_2(g) \rightarrow 2N_2O_5(g)$, $\Delta H_{reaction} = -112$ kJ. If the N_2O_5 is assumed to be formed in the reaction as a solid, $\Delta H_{reaction}$ will be ($\Delta H_{sublimation}$ of N_2O_5 is 54 kJ mol^{-1})

(A) – 220 kJ (B) – 4 kJ (C) – 166 kJ (D) – 332 kJ

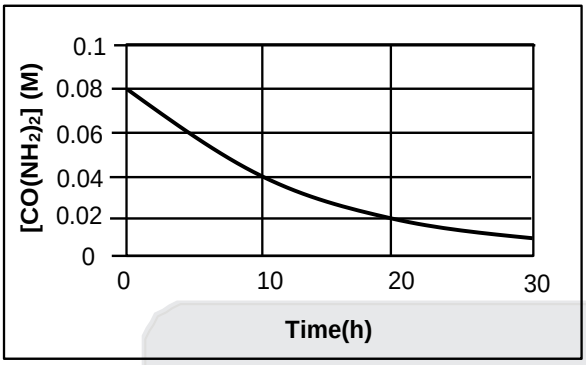
Ans. **(A)**

Sol. $4NO_2(g) + O_2(g) \xrightarrow{-112\ kJ} 2N_2O_5(g) \xrightarrow{2(-54)} 2N_2O_5(s)$

$\Delta H_{reaction}$

$\Delta H_{reaction} = -112 - 108 = -220$ kJ

14. Urea, $CO(NH_2)_2$, decomposes at 90ºC as $CO(NH_2)_2(aq) \rightarrow NH_4^+(aq) + OCN^-(aq)$ Experimental data obtained for the reaction is given in the following plot



From the graph it can be inferred that

(A) Average rate of the reaction is the same for successive time intervals of 10 h

(B) unit of rate constant of the reaction is h^{-1}

(C) rate constant of the reaction is the lowest at 30 h

(D) the reaction is of zero order

Ans. **(B)**

Sol. As $t_{½}$ as independent of initial concentration so, it is first order reaction.

15. If for an aqueous solution of a weak acid, pH = pK_a + 2 at 25ºC, the approximate fraction of the acid in the dissociated form is

(A) 1.1 % (B) 0.99 % (C) 99.0 % (D) 9.9 %

Ans. **(C)**

Sol. pH = pK_a +2

$$\log \frac{[\text{Ionised}]}{[\text{Unionised}]} = 2 \; ; \quad \frac{[\text{Ionised}]}{[\text{Unionised}]} = \frac{100}{1}$$

$$\frac{[\text{Ionised}]}{[\text{Ionised}]+[\text{Unionised}]} = \frac{100}{101}$$

Approximate % fraction of the acid in the dissociated form is = $\frac{100}{101} \times 100 = 99\%$

16. 2.0 L of N_2 gas kept at 25ºC and 5 atm pressure were expanded isothermally against a constant pressure of 1 atm until the pressure of the gas reaches 1 atm. Assuming ideal behavior, reversible work of expanstion in this process (in J) is close to

(A) 810 J (B) –194 kJ (C) – 810 kJ (D) 3390 kJ

Ans. **(A)**

Sol. $w = -nRT \ln\left(\frac{P_1}{P_2}\right)$

$= -(2 \times 5) \times 2.303 \log\left(\frac{5}{1}\right)$

$= -16.121$ lt atm

$= -16.121 \times 101.3 = -1633$ J

$w = -P_{ext}(V_2 - V_1)$

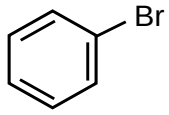
$= -1\left(\frac{nRT}{1} - \frac{nRT}{5}\right)$

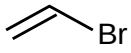
$= -nRT\left(1-\frac{1}{5}\right) = -2 \times 5 \times \frac{4}{5}$ L atm

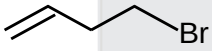
$= -810$ J

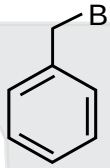
Note : As per given information process is irreverisible isothermal, but in question reversible isothermal work of expanstion is asked.

17. The compound which would undergo a reaction with ammonia by S_N1 mechanism is

(A) 

(B) 

(C) 

(D) 

Ans. **(D)**

Sol. Among the given, carbocation is most stable at benzylic position.

18. The daily energy requirement of a teenager is 7800 kJ. As calculated from the data given in the table below, the amount of glucose he has to consume (g) per day assuming that the entire energy he requires comes from the combustion of glucose is

Molecule	ΔH_f (kJ mol^{-1})
$C_6H_{12}O_6$	– 1273
$CO_2(g)$	– 394
H_2O	– 286

(A) 262 (B) 500 (C) 131 (D) 250

Ans. **(B)**

Sol. $C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$

$\Delta H_{Comb} = 6(-394) + 6(-286) - (-1273)$

$= -2358 - 1716 + 1273$

$= -2801$ kJ/mol

Amount of glucose required per day = $\frac{7800}{2801} \times 180 = 501$ gm

19. The pressure inside two gas cylinders of volume 25 m^3 and 50 m^3 are 10 kPa and 20 kPa respectively. The cylinders are kept at the same temperature and separated by a valve. What is the pressure in the combined system when the vale is opened?

(A) 30 kPa (B) 15 kPa (C) 16.7 kPa (D) 2.5 kPa

Ans. **(C)**

Sol. $n_T = n_1 + n_2$

$$\frac{P \times (25+50)}{RT} = \frac{10 \times 25}{RT} + \frac{50 \times 20}{RT}$$

$P \times 75 = 250 + 1000 = 1250$

$P = 16.7$ kPa

20. Aluminium and copper are extracted from their oxide and sulphide ores respectively. Which of the following is correct?

I. Copper is extracted by the auto reduction of copper oxide by copper sulphide

II. Aluminium cannot be obtained by chemical reduction due to its strong affinity for oxygen,

III. In electrometallurgy of Al, graphite is used as cathode to avoid reoxidation of Al into Al_2O_3 by preventing formation of O_2.

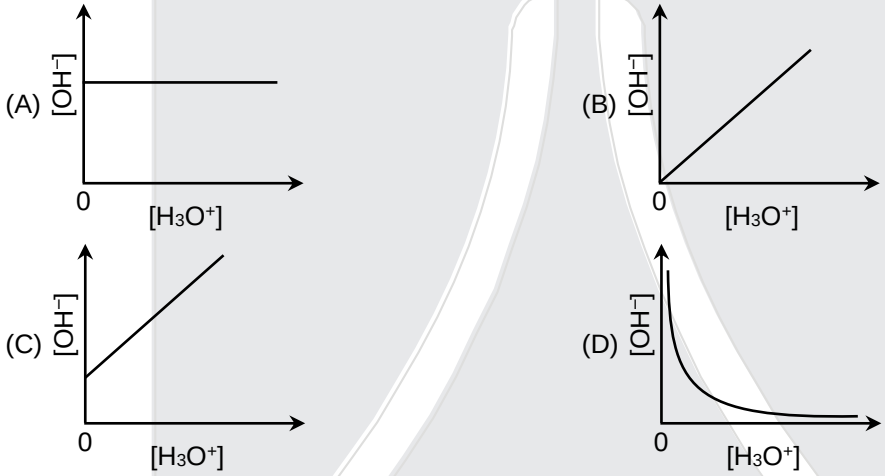
IV. Sulphide ores of copper are difficult to be reduced than the oxide ores

(A) I, II, IV (B) II and III (C) II and III (D) II and IV

Ans. **(A)**

Sol. It is facts.

21. Which of the following graph describes the relationship between $[H_3O^+]$ and $[OH^-]$ in an aqueous solution at a constant temperature ?



Ans. **(D)**

Sol. $[H_3O^+] \times [OH^-] = K_w$ constant at given constant temperature.

22. From the given standard electrode potentials

$Sn^{4+}(aq) + 2e^- \rightarrow Sn^{2+}(aq)$ $E^o = 0.15V$

$Br_2(l) + 2e^- \rightarrow 2Br^-(aq)$ $E^o = 1.07V$

The approximate free energy change of the process.

$2Br^-(aq) + Sn^{4+}(aq) \rightarrow Br_2(l) + Sn^{2+}(aq)$ is

(A) 117.6 kJ (B) 355 kJ (C) –177.6 kJ (D) –355 kJ

Ans. **(A)**

Sol. $E^\circ_{Cell} = 0.15 - (1.07) = -0.92$ V

$\Delta G^\circ = -nF\,E^\circ_{cell} = -2 \times 96500\,(-0.92) = 177.6$ kJ

23. Number of moles of $KClO_3$ that have to be heated to produce 1.0 L of O_2 (g) at STP can be expressed as

(A) 1/3 (1/22.4) (B) ½(1/22.4) (C) 2/3 (1/22.4) (D) 3/2 (22.4)

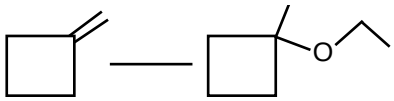
Ans. **(C)**

Sol. $2KClO_3 \longrightarrow 2KCl + 3O_2$

mole of O_2 produced = $\frac{1}{22.4}$

$\therefore$ moles of $KClO_3$ required = $\frac{1}{22.4} \times \frac{2}{3}$

24. The sequence of reagents required for the following conversion is

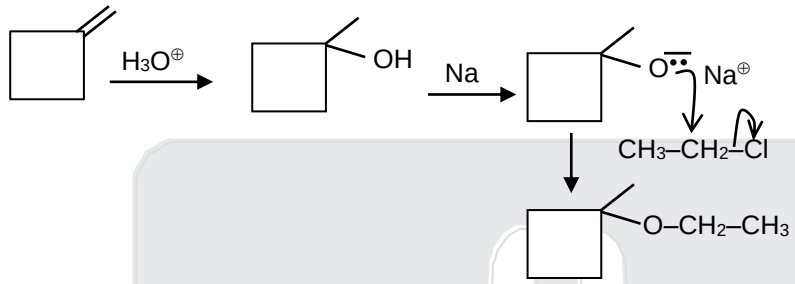


(A) (i) $B_2H_6/H_2O_2/ OH^-$ (ii) Na (iii) C_2H_5I (B) (i) HCl (ii) C_2H_5ONa

(C) (i) H_3O^+ (ii) Na (iii) C_2H_5OH (D) (i) H_3O^+ (ii) Na (iii) C_2H_5Cl

Ans. **(D)**

Sol.



25. Among the following, number of oxygen atoms present in the maximum in

(A) 1.0 g of O_2 molecules (B) 4.0 g of O atoms

(C) 1.0 g of O_3 (D) 1.7 g of H_2O

Ans. **(B)**

Sol.

	Given species	Number of oxygen atoms
(A)	1.0 g of O_2 molecules	$\frac{1}{32}\times 2\times N_A = \frac{1}{16}\times N_A$
(B)	4.0 g of O atoms	$\frac{4}{16}\times N_A = \frac{1}{4}N_A$
(C)	1.0 g of O_3	$\frac{1}{48}\times 3\times N_A = \frac{1}{16}N_A$
(D)	1.7 g of H_2O	$\frac{1.7}{18}\times 1\times N_A = \frac{1}{10.58}N_A$

26. Which of the following elements will exhibit photoelectric effect with light of the longest wavelength?

(A) K (B) Rb (C) Mg (D) Ca

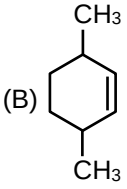
Ans. **(B)**

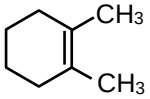
Sol. Among these to exhibit photoelectric effect Rb needed light of minimum energy or longest wavelength.

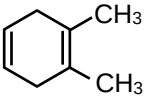
27. Compound 'X' in the following reaction is

$$X \xrightarrow[\text{(iii) } Cl_2/NaOH]{\text{(i) } O_3 \text{ (ii) } Zn/H_2O \text{ (iv) } H_3O^+} \underset{\text{Adipic Acid}}{HOOC{-}(CH_2)_4{-}COOH}$$

(A) 

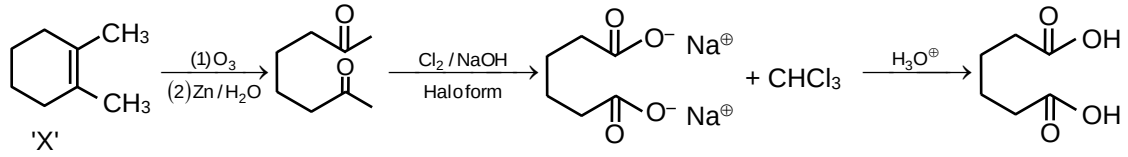
(B) 

(C) 

(D) 

Ans. **(C)**

Sol.



28. The standard molar entropies of $H_2(g)$, $N_2(g)$ and $NH_3(g)$ are 130. 190 and 193 J $mol^{-1}.K^{-1}$ respectively, For the reaction ½ $N_2(g)$ + 3/2 H_2 (g) $\rightleftharpoons$ $NH_3(g)$ ($\Delta H_{reaction}$= –45 kJ) to be in equilibrium, the temperature must be equal to

(A) 464 K (B) 928 K (C) 737 K (D) 354 K

Ans. **(A)**

Sol. $\frac{1}{2}N_2(g) + \frac{3}{2}H_2 \rightleftharpoons NH_3(g)$

$\Delta H° = -45$ kJ/mol

$\Delta S° = 193 - \left[\left(\frac{1}{2}\times 90\right)+\left(\frac{3}{2}\times 130\right)\right] = 193 - [95 + 195] = -97$ J/mol^{-k}.

$\Delta G = \Delta H - T\Delta S° = 0$

$T_{eq} = \frac{\Delta H°}{\Delta S°} = \frac{-45000}{-97} = 464$ K

29. Density of CO_2 gas at 0ºC and 2.00 atm pressure can be expressed as

(A) 2 g m^{-3} (B) 4 g m^{-3} (C) 4 × 10^3 kg m^{-3} (D) 8 g L^{-1}

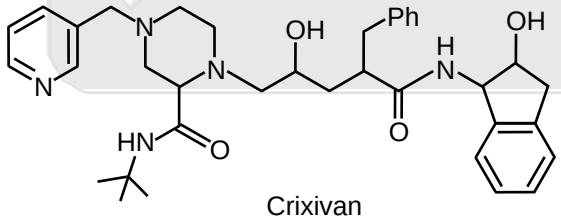
Ans. **(All options are incorrect)**

Sol. PM = dRT

$\therefore \quad d = \frac{2\times 44}{0.082\times 273} = 3.93$ gm/lt.

$= \frac{3.93\times 10^{-3}\text{kg}}{10^{-3}\text{m}^3} \approx 4$ kg/m^3

30. The maximum number of moles of CH_3I consumed by one mole of crixivan, a drug against AIDS is

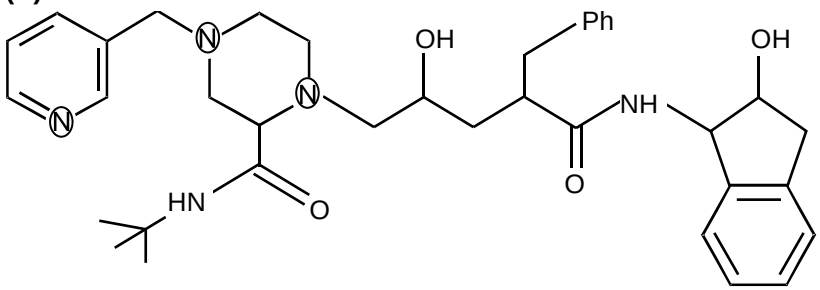


Crixivan

(A) 2 (B) 3 (C) 5 (D) 7

Ans. **(B)**

Sol.



Encircled nitrogen are the sites which reacts with CH_3I

31. Concentration of K^+ ions inside a biological cell was found to be 25 times higher than that outside. The magnitude of the potential difference between the two sides of the cell is close to (2.303 RT/F- can be taken as 59 mV; difference in concentrations of other ions can be taken as negligible)

(A) 4.2 mV (B) 195 mV (C) 82 mV (D) –82 mV

Ans. **(C)**

Sol. Anode : $K(s) \longrightarrow K^+(aq) + e^-$

Cathode : $K^+(aq) + e^- \longrightarrow K(s)$

$K^+(aq)|_c \rightleftharpoons K^+(aq)|_a$

$$E_{cell} = E°_{cell} - \frac{0.0591}{1} \log \frac{[K^+(aq)]_a}{[K^+(aq)]_c}$$

$$= 0 - \frac{0.0591}{1} \log \left\{\frac{1}{25}\right\}$$

$$= 82 \text{ mV}$$

32. The standard redox potential for the reaction $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$ is –1.23V. If the same reaction is carried out at 25ºC and at pH = 7, the potential will be

(A) –0.82 V (B) –3.28V (C) 0.82V (D) –1.18V

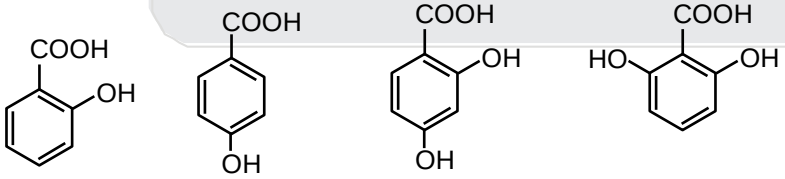
Ans. **(A)**

Sol. $E = E° - \frac{0.059}{4} \log [H^+]^4$

$$= -1.23 - \frac{0.059}{4} \log (10^{-7})^4$$

$$= -1.23 + \frac{0.059 \times 4 \times 7}{4} = -0.82 \text{ V}$$

33. The order of pK_a values of the following acids is

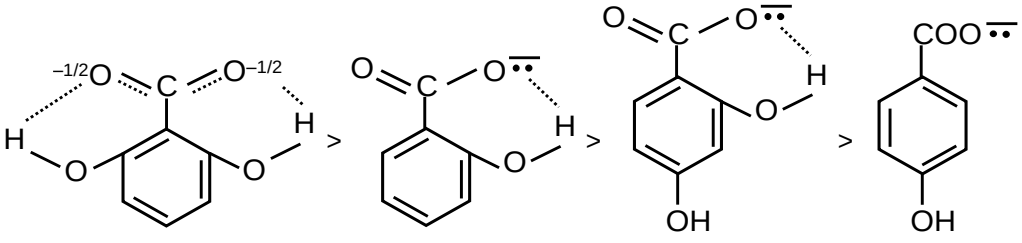


(I) (II) (III) (IV)

(A) IV > I > III > II (B) III > IV > I > II (C) II > I > III > IV (D) II > III > I > IV

Ans. **(D)**

Sol. After loosing $H^{\oplus}$ order of stability of conjugate base.



(IV) (I) (III) (II)

34. If the radius of the hydrogen atom is 53 pm, the radius of the He^+ ion is close to

(A) 75 pm (B) 38 pm (C) 106 pm (D) 27 pm

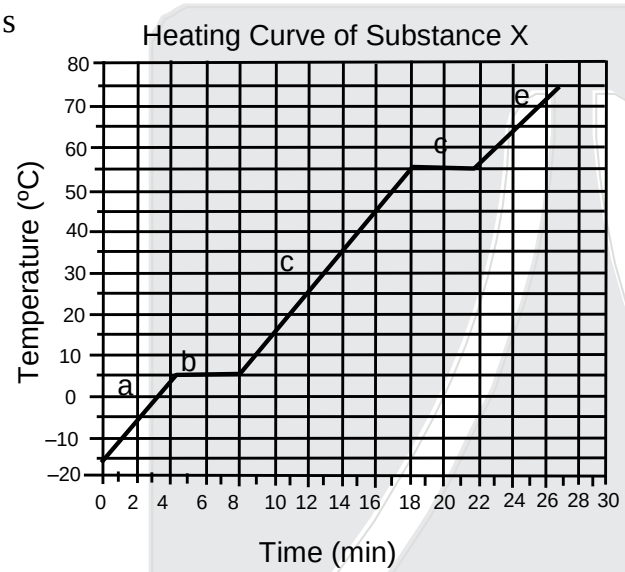
Ans. **(D)**

Sol. $r = r_0 \times \frac{n^2}{z}$

$= 53 \times \frac{1}{2} = 26.5$

35. A substance X was heated at constant pressure and the temperature observed at various times of heating was plotted as given below

S



Which of the following is/are correct ?

I. Melting point of X is –5°C

II. Solid and liquid forms of X coexist in the region b

III. Boiling point of X is 55°C

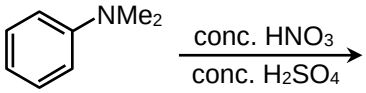
IV. Solid and liquid forms of X coexist in the region d

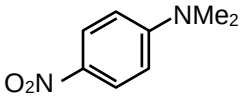
(A) I and IV (B) II and III (C) III only (D) I, II and III

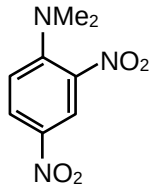
Ans. **(B)**

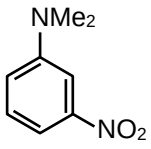
Sol. From the graph (B) option is correct.

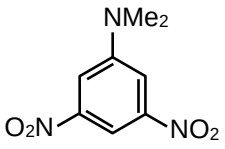
36. The major product of the following reaction is



(A) 

(B) 

(C) 

(D) 

Ans. **(C)**

Sol. In acidic medium $-N(Me)_2$ group form $-\overset{\oplus}{N}(Me)_2H$ group, which is strong deactivating group and decreases e– density at O & P position and meta product is favoured.

37. In which of the following, all the bond lengths are not the same ?

I. IF_4^+ II. BF_4^- III. SF_4 IV. $TeCl_4$

(A) I, II, IV (B) II, III, IV (C) I, III, IV (D) I, II, III

Ans. **(C)**

Sol. In (I), (III) & (IV) hybridization is sp^3d and shape is sea-saw. So all bond length are not the same.

In BF_4^- all the bond lengths are same.

38. Among the following, the reaction/s that can be classified as oxidation-reduction is/are.

I. $Cr_2O_7^{2-}(aq) + 2OH^-(aq) \rightarrow 2CrO_4^{2-} + H_2O(l)$

II. $SiCl_4(l) + 2Mg(s) \rightarrow 2MgCl_2(l) + Si(s)$

III. $6Cl_2(l) + 12KOH(l) \rightarrow 2KClO_3(g) + 10\ KCl + 6H_2O(l)$

IV. $2H_2O_2 \rightarrow 2H_2O(l) + O_2(g)$

(A) I and IV (B) I, II and III (C) II, III and IV (D) IV only

Ans. **(C)**

Sol. (I) reaction is non-redox reaction.

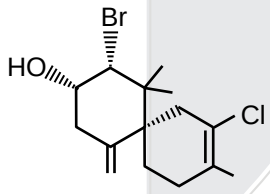
39. Among the following pairs, the one in which both the compounds as pure liquids can show significant auto ionization is

(A) H_2O and H_2S (B) BrF_3 and ICl_3 (C) PF_5 and PCl_5 (D) HF and HCl

Ans. **(B)**

Sol. $2BrF_3$ (liquid) $\rightarrow BrF_2^+ + BrF_4^-$; $2ICl_3$ (liquid) $\rightarrow ICl_2^+ + ICl_4^-$

40. The number of quaternary and chiral carbon atoms present in elatol, isolated from an algae are respectively

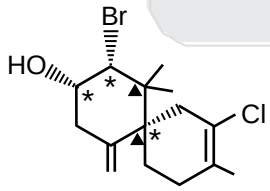


Elatol

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

Ans. **(A)**

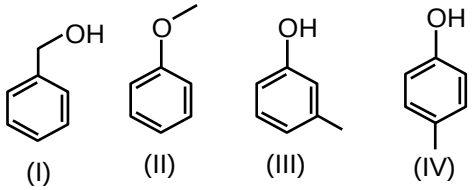
Sol.



▲= Quaternary carbon

* = Chiral carbon

41. Compounds X (pK_a ~ 15) and Y (pK_a ~ 10), both produce H_2 on treatment with sodium metal and both yield a mixture of isomers on mononitration. X and Y respectively are



(I) (II) (III) (IV)

(A) IV, I (B) III, II (C) III, I (D) I, III

Ans. **(D)**

Sol. Both X and Y producing H_2 gas with Na indicates presence of acidic H. Only I, II and III gives a mixture of product on mononitration. Therefore I and III are the X and Y respectively

42. A crystal of KCl containing a small amount of $CaCl_2$ will have
(A) vacant Cl^- sites
(B) vacant K^+ sites and a higher density as compared to pure KCl
(C) vacant K^+ sites and a lower density as compared to pure KCl
(D) K^+ ions in the interstitial sites

Ans. **(C)**

Sol. In the crystallization, some K^+ ions will get replaced by as many half of Cd^{2+} ions. Thus the cation vacancies will be the same as the number of Cd^{2+} is ions incorporated. So crystal have vacant K^+ sites and a lower density as compared to pure KCl.

43. In the following reaction, the values of a, b and c, respectively are

$a\ F_2(g) + b\ OH^-(aq) \longrightarrow c\ F^-(aq) + d\ OF_2(g) + e\ H_2O(l)$

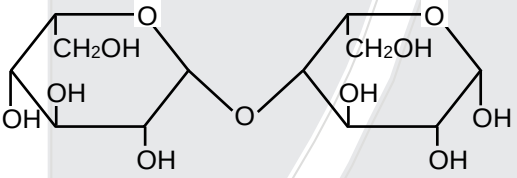
(A) 3, 2, 4 (B) 3, 4, 2 (C) 2, 2, 4 (D) 2, 2, 2

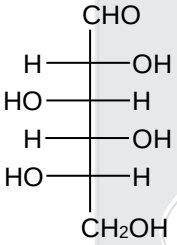
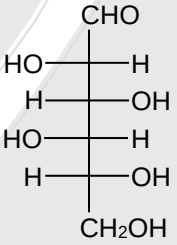
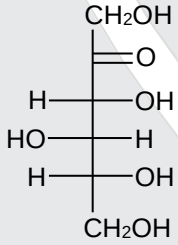
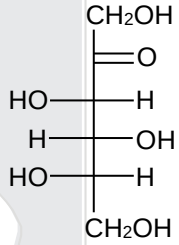
Ans. **(D)**

Sol. $2F_2 + 2OH^- \longrightarrow 2F^- + OF_2 + H_2O$

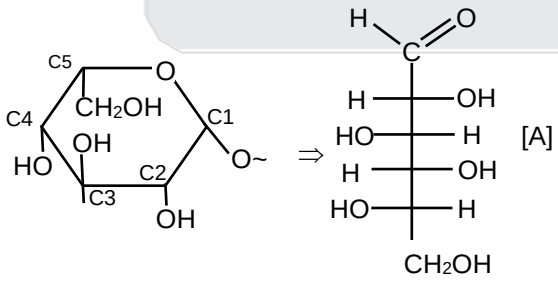
a = 2, b = 2, c = 2

44. The monosaccharide present in the following disaccharide is



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

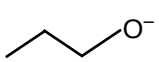
Ans. **(A)**

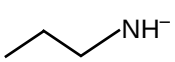
Sol. 

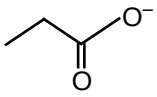
45. The IUPAC name of the complex $[Pt(en)(NH_3)(Cl)_2(ONO)][Ag(CN)_2]$ is
(A) monoamminedichlorido(ethane-1,2-diammine)nitritioplatinum(IV)dicyanoargentate(I)
(B) monoaminebischlorido(ethane-1,2-diamine)nitritioplatinate(IV)dicyanoanosilver(I)
(C) monoaminebischlorido(ethane-1,2-diammine)nitritioplatinate(IV)dicyanoargentate(I)
(D) monoamminebischlorido(ethane-1,2-diammine)nitritioplatinum(IV)dicyanoargentate(I)

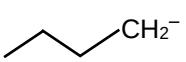
Ans. **(D)**

46. The correct order of basicity of the following is


I


II

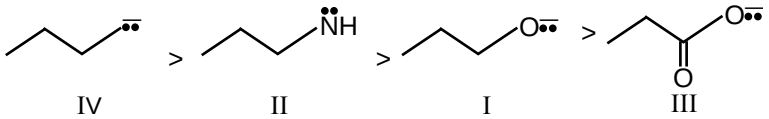

III


IV

(A) III < IV < II < I (B) III < I < II < IV (C) III < II < I < IV (D) IV < I < II < III

Ans. **(B)**

Sol.


IV > II > I > III

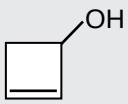
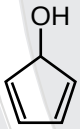
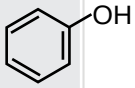
47. Which among the following is nonlinear ?

(A) N_3^- (B) ClF_2^- (C) Br_3^- (D) $BrCl_2^+$

Ans. **(D)**

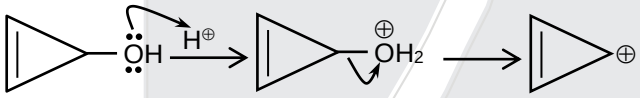
Sol. $BrCl_2^+$, sp^3 hybridisation, angular shape.

48. The compound most likely to lose water on protonation is

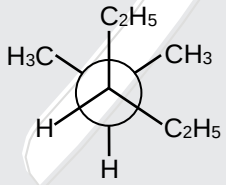
(A)  (B)  (C)  (D) 

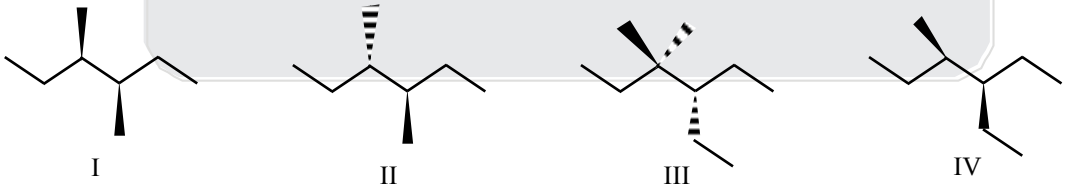
Ans. **(A)**

Sol.


Aromatic

49. The Newman projection shown is the same as

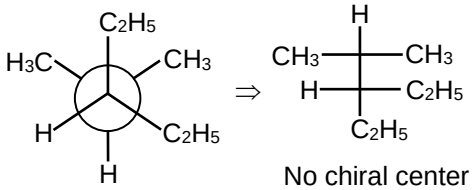


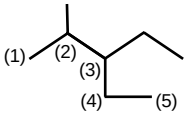

I II III IV

(A) I and IV (B) II and III (C) III and IV (D) I and II

Ans. **(C)**

Sol.


No chiral center


3-Ethyl-2-methyl pentane

Which resembles with III and IV only Ans. (C).

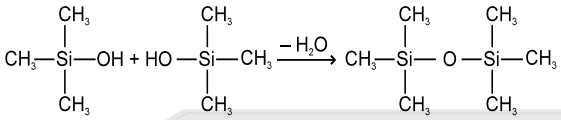
50. Which one of the following is not used as a monomer for the synthesis of a high molecular weight silicone polymer ?

(A) $MeSiCl_3$ (B) Me_2SiCl_2 (C) Me_3SiCl (D) $PbSiCl_3$

Ans. **(C or D)**

Sol. From the hydrolysis of $(CH_3)_3SiCl$ only dimer is formed

$$(CH_3)_3SiCl \xrightarrow{H_2O} (CH_3)_3Si(OH)$$



While in $MeSiCl_3$, Me_2SiCl_2 & $PbSiCl_3$ polymer is formed.

Note : There is a typing error in this question.

"Pb" mentioned in (D) option suggests the metal "Lead". There is no compound like $PbSiCl_3$, since it can be rejected on the basis of valancies.

Actually, it should be $PBSiCl_3$. Note that "PB" here is represents polybutadiene polymer derivative.

Interestingly, this question is repeated from as NEET-2013. In that paper correct printing was done.

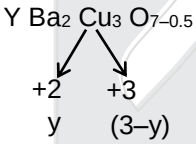
51. In $YBa_2Cu_3O_{7-x}$, a superconducting oxide that got George Bednorz and Karl Muller the Noble prize in 1986, Cu can exist in both +2 and +3 oxidation states and their proportion depends on the value of 'x'. In $YBa_2Cu_3O_{7-0.5}$

(A) 0.5 moles of Cu are in +3 oxidation state (B) 5% of Cu is in +3 oxidation sate

(C) All the Cu is in +3 oxidation state (D) All Cu is in +2 oxidation state

Ans. **(D)**

Sol. In



Charge balance

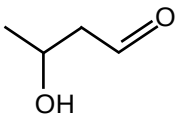
$+3 + 4 + 2y + 3(3 - y) + 2(-6.5) = 0$

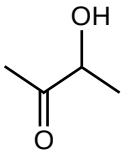
$\Rightarrow + 7 + 2y + 9 - 3y - 13 = 0$

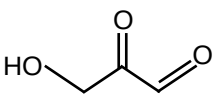
$y = 3$

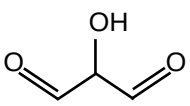
$\therefore$ all Cu is in +2 oxidation state

52. Compound 'Y' (molar mass = 88.12 g mol^{-1}) containing 54.52% carbon, 9.17% hydrogen and 36.31% oxygen gives a reddish-brown precipitate in Fehling's test. 'Y' is

(A) 

(B) 

(C) 

(D) 

Ans. **(A)**

Sol. Assume 100 g of the compound is present

C	⇒	54.52 g	⇒	4.5 moles
H	⇒	9.17 g	⇒	9.17 moles
O	⇒	36.31 g	⇒	2.2 moles

So, empirical formula = C_2H_4O

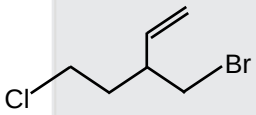
Only α-Hydroxy ketones gives fehling solution test.

So, $CH_3–\underset{\underset{O}{\|}}{C}–\underset{\underset{OH}{|}}{CH}–CH_3$ is correct answer .

($M.F. = C_4H_8O_2$)

Note : (B) is possible, but (A) is a better answer.

53. The IUPAC name of the following compound is

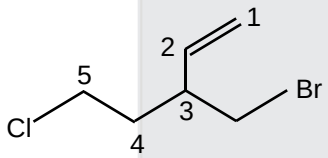


(A) 1-Bromo-4-chloro-3-ethenylbutane (B) 4-Bromo-1-chloro-3-ethenylbutane

(C) 3-(Bromomethyl)-5-chloropent-1-ene (D) 3-(Bromomethyl)-1-chloropent-4-ene

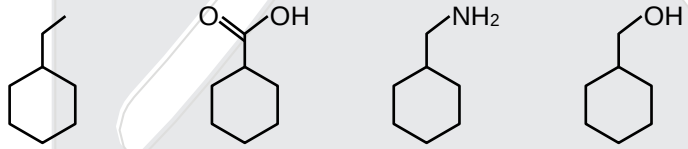
Ans. **(C)**

Sol.



3-(Bromomethyl)-5-chloropent-1-ene.

54. The correct order of boiling points of the following compound is

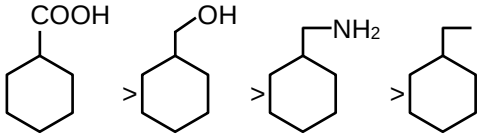


(I) (II) (III) (IV)

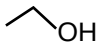
(A) III < IV < II < I (B) I < III < IV < II (C) I < II < III < IV (D) IV < III < I < II

Ans. **(B)**

Sol. Correct order or boiling point



The alkyl group is same in all, but extent of hydrogen bond is in the sequence

–COOH >  > $–NH_2$ > 

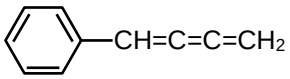
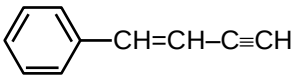
55. Which of the following is a strong oxidizing agent ?

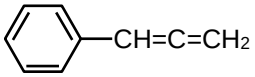
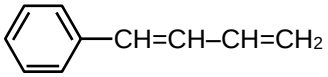
(A) $AlCl_3$ (B) $TlCl_3$ (C) NF_3 (D) PCl_3

Ans. **(B)**

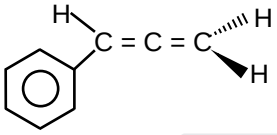
Sol. Due to inert pair effect. Stability order $TlCl_3$ < TlCl.

56. The molecule in which all atoms are not coplanar is

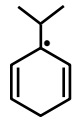
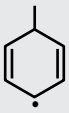
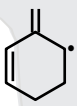
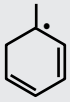
(A)  (B) 

(C)  (D) 

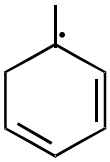
Ans. **(C)**

Sol. 

57. The most stable radical among the following is

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

Ans. **(D)**

Sol.  is most stable because of it is 3º and conjugated.

58. During World War II, soldiers posted at high altitudes experienced crumbling of the tin buttons of their uniforms into a grey powder. This can be attributed to

(A) oxidation of tin

(B) interaction with nitrogen in the air at low pressure

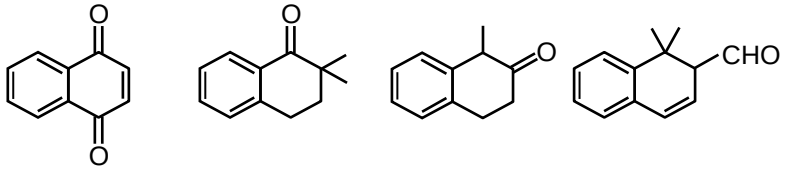
(C) change in the crystal structure of tin

(D) reaction of tin with water vapour in the air

Ans. **(C)**

Sol. White metallic tin i.e. (β-Sn) changes to another allotrope, grey (α-Sn) at low temperature ($T < 13.2^oC$).

59. The molecules that can exhibit tautomerism are

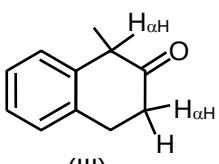
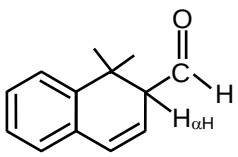


(I) (II) (III) (IV)

(A) I, IV (B) II, III (C) III, IV (D) I, II

Ans. **(C)**

Sol. Only III and IV can exhibit tautomerism as

 and  has α-hydrogen

(III) (IV)

60. A scientist attempts to replace a few carbon atoms in 1.0 g of diamond with boron atoms or nitrogen atoms in separate experiments. Which of the following is correct ?

(A) The resulting material with B doping will be an n-type semiconductor

(B) The resulting material with B doping will be an p-type semiconductor

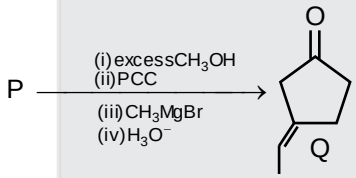
(C) B doping is NOT possible as B cannot from multiple bonds

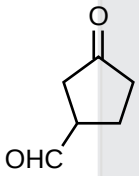
(D) The resulting material with N doping will be a p-type semiconductor

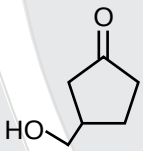
Ans. **(B)**

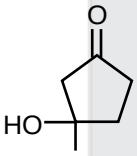
Ans. Carbon doped with boron forms p-type of semiconductor. Boron contains one less electron than carbon which create a hole which is responsible for semiconductor properties.

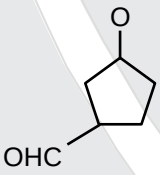
61. Compound 'P' that undergoes the sequence of reactions given below to give the product Q is



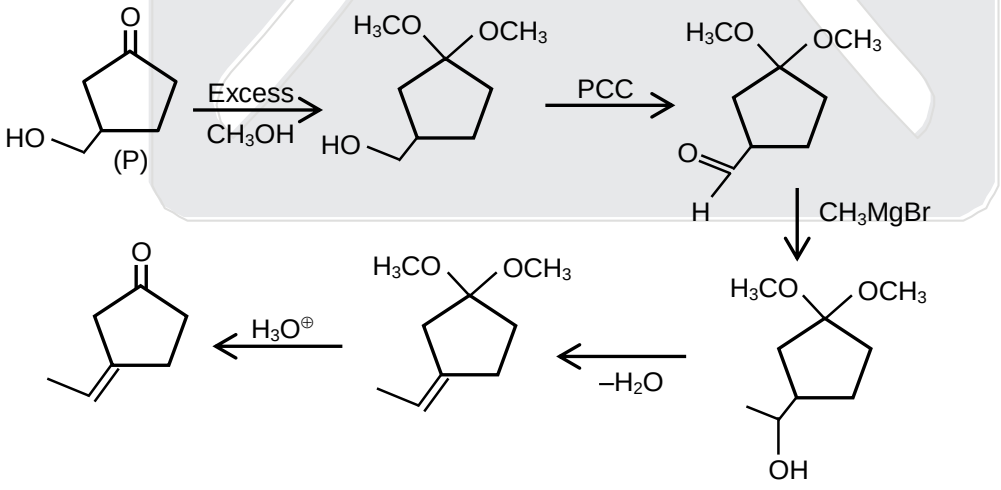
(A) 

(B) 

(C) 

(D) 

Ans. **(B)**

Sol. 

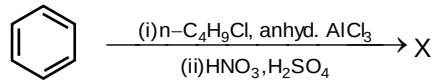
62. The most stable Lewis structure of N_2O is

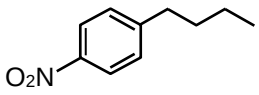
(A) $:\ddot{O}=\ddot{N}=\ddot{N}:$ (B) $:N=O=\ddot{N}:$ (C) $:\ddot{\underset{\cdot\cdot}{N}}-\ddot{N}\equiv O:$ (D) $:\ddot{\underset{\cdot\cdot}{O}}-\ddot{N}\equiv N:$

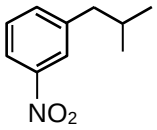
Ans. **(D)**

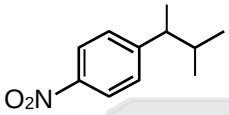
Sol. Most stable Lewis structure of N_2O is $:\ddot{\underset{\cdot\cdot}{O}}-\ddot{N}\equiv N:$.

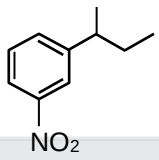
63. The major product 'X' formed in the following reaction is



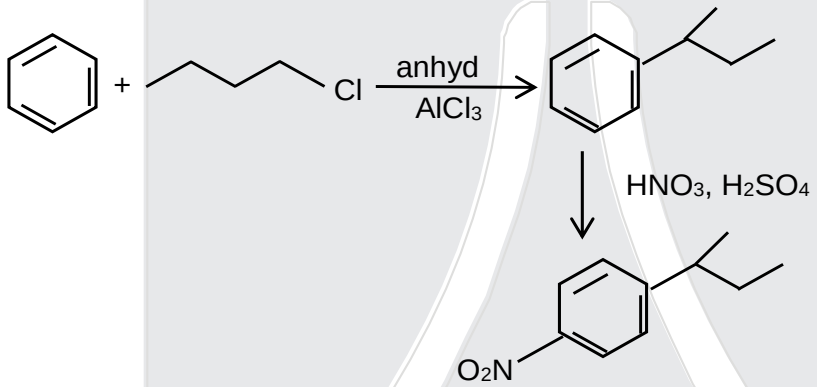
(A) 

(B) 

(C) 

(D) 

Ans. **(C)**

Sol. 

64. Which of the following accounts best for the fact that F^- is smaller than O^{2-} ?

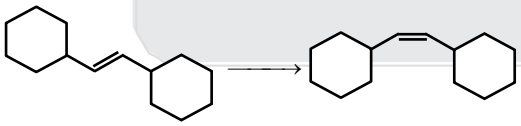
(A) F^- has a larger nuclear mass than O^{2-} (B) F^- has a larger nuclear charge than O^{2-}

(C) F^- is more polarizable than O^{2-} (D) F is more electronegative than O

Ans. **(B)**

Sol. Size $F^- < O^{2-}$: $Z_{eff.}$ of $F^- > Z_{eff.}$ of O^{2-}

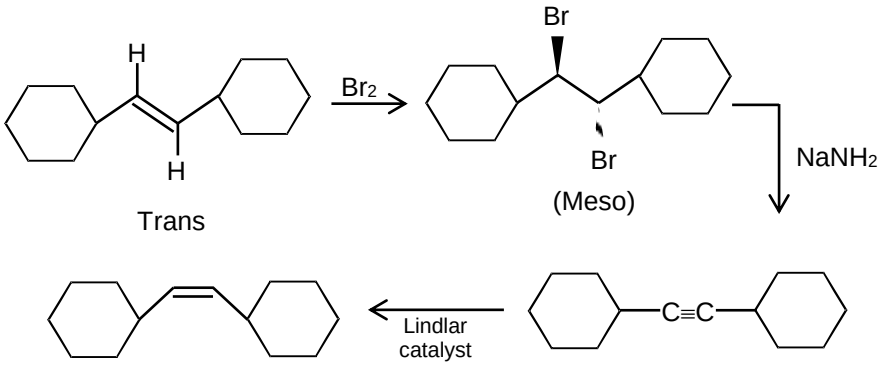
65. The correct sequence of reagents from those listed below for the following conversion is



I. $NaNH_2$ II. Br_2 III. H_2/Pd-C, quinoline IV. H_3O^+

(A) IV – I – III (B) III – IV – I (C) II – I – III (D) I – II – III

Ans. **(C)**

Sol. 

66. An orbital among the following that has two radial nodes and two angular nodes is

(A) 3d (B) 4p (C) 4f (D) 5d

Ans. **(D)**

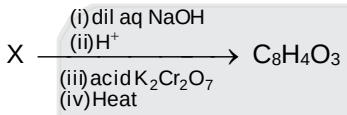
Sol. Radial node = n – ℓ – 1

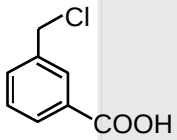
Angular node = ℓ

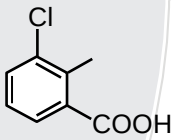
For 5d Radial node = (5 – 2 – 1) = 2

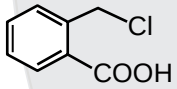
Angular node = 2

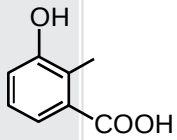
67. The compound 'X' undergoing the following reaction is



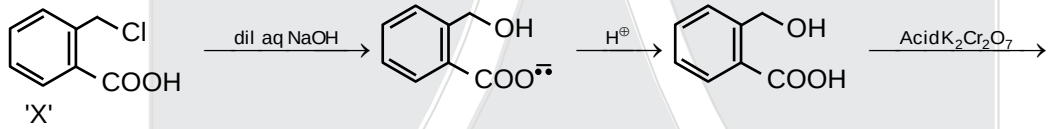
(A) 

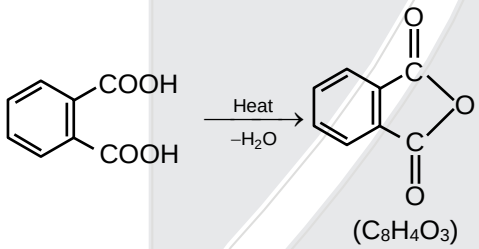
(B) 

(C) 

(D) 

Ans. **(C)**

Sol. 



68. A dilute solution of an alkali metal in liquid ammonia is

I. blue in colour II. conducts electricity III. paramagnetic IV. an oxidizing agent

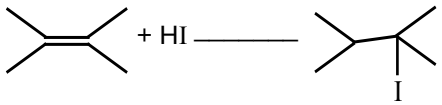
(A) I and III (B) II and IV (C) I, II and III (D) I and III

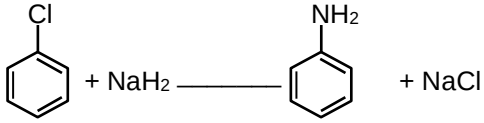
Ans. **(C)**

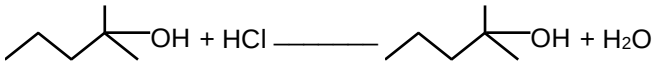
Sol. (I), (II) & (III) are correct.

A dilute solution of an alkali metal in liquid ammonia is reducing agent due to presence of ammoniated free electron.

69. The reactions from those given below that involve a carbocation intermediate are

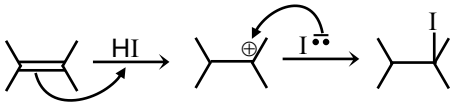
(i) 

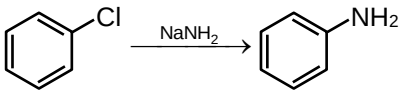
(ii) 

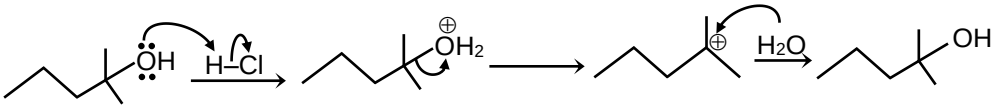
(iii) 

(A) i, ii and iii (B) i and ii (C) i and iii (D) ii and iii

Ans. **(C)**

Sol. (i)  (Electrophilic addition)

(ii)  (Benzyne mechanism)

(iii) 

70. The C–O bond length is the shortest in

(A) $[Cr(CO)_6]$ (B) $[Mo(CO)_6]$ (C) $[Mn(CO)_6]^+$ (D) $[V(CO)_6]^-$

Ans. **(C)**

Sol. In metal carbonyl, due to positive charge on metal formation of synergic bond is weak so that C–O bond length decrease less in positively charge metal carbonyl.

71. The rate of the reaction between two reactants X and Y can be expressed as $R = k[X]^2[Y]$. In an experiment, the initial rate of the reaction was found to be R_1 when the initial concentrations of X and Y are $[X_0]$ and $[Y_0]$. Another experiment was performed in which $[X_0]$ was taken as ½ $[X_0]$. What should be $[Y_0]$ in this experiment to get the initial rate as 0.5 R_1 ?

(A) 4 $[Y_0]$ (B) 1/2 $[Y_0]$ (C) 2 $[Y_0]$ (D) $[Y_0]$

Ans. **(C)**

Sol. $R = k[X]^2[Y]$

$R_1 = k[X_0]^2[Y_0]$ ……(1)

$$R_2 = K\left[\frac{X_0}{2}\right]^2[Y] \quad \text{……(2)}$$

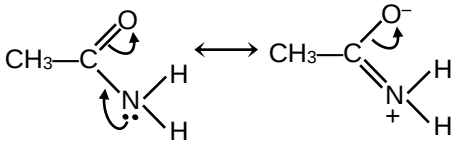
$$\frac{R_2}{R_1} = \frac{\left(\frac{1}{2}\right)^2[Y]}{[Y_0]} = \frac{0.5R_1}{R_1}$$

$[Y] = 2[Y_0]$

72. Among the following, the compound that has the highest dipole moment is

(A) CH_3COOCH_3 (B) CH_3CONH_2 (C) $CH_3COC_2H_5$ (D) CH_3COCl

Ans. **(B)**

Sol. 

Due to ionic resonating form of amide its has highest dipole moment.

73. A common method to clean spills is to use to Na_2CO_3(Molar mass 106 g.) If 50.0 mL of 0.75 M HCl is split on a wooden surface, the amount of Na_2CO_3 required is

(A) 3.75 g (B) 7.5 g (C) 2.0 g (D) 4.0 g

Ans. **(C)**

Sol. $Na_2CO_3 + 2HCl \longrightarrow 2NaCl + CO_2 + H_2O$

Mole of HCl = $\frac{50 \times 0.75}{1000} = 37.5 \times 10^{-3}$

Mole of Na_2CO_3 required = $\frac{37.5 \times 10^{-3}}{2}$

Mass of Na_2CO_3 required = $\frac{37.5 \times 10^{-3}}{2} \times 106 \approx 2gm$

74. The spin-only magnetic moments of $[Fe(NH_3)_6]^{3+}$ and $[FeF_6]^{3-}$ (in units of BM) respectively are

(A) 1.73 and 1.73 (B) 5.92 and 1.73 (C) 1.73 and 5.92 (D) 5.92 and 5.92

Ans. **(C)**

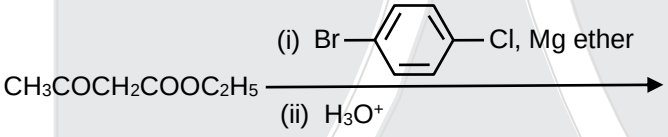
Sol. $\mu = \sqrt{n(n+2)}BM$ n = number of unpaired electron

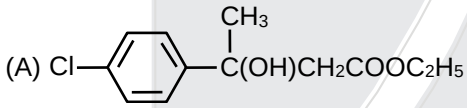
In $[Fe(NH_3)_6]^{3+}$, NH_3 is SFL so $t_{2g}^{2,2,1}\ eg^{0,0}$ μ = 1.73 B.M.

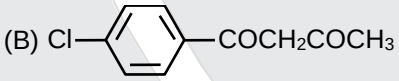
In $[FeF_6]^{3-}$, F^- is WFL so $t_{2g}^{1,1,1}\ eg^{1,1}$ μ = 5.92 B.M.

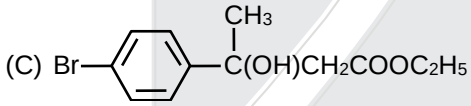
Note : $[Fe(NH_3)_6]^{3+}$ does not exist.

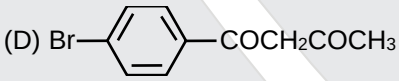
75. The major product of the following reaction is



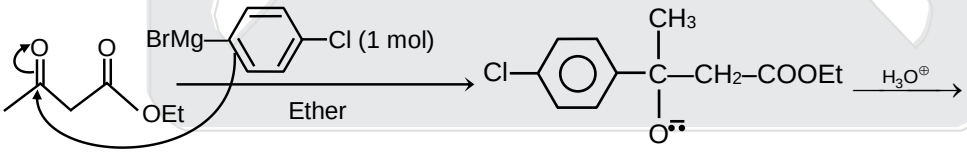
(A) 

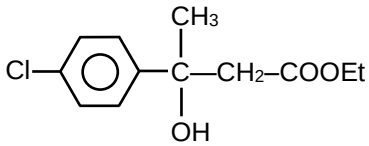
(B) 

(C) 

(D) 

Ans. **(A)**

Sol. 



Ketone is more reactive than ester towards Grignard reagent.

76. The standard electrode potential (E°) of the Daniel cell is 1.1 V and the overall cell reaction can be represented as $Zn(s) + Cu^{2+}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s)$. Under which of the following conditions will the cell potential be higher than 1.1 V ?

(A) 1.0 M Zn^{2+}, 1.0 M Cu^{2+} (B) 1.2 M Zn^{2+}, 1.2 M Cu^{2+}

(C) 0.1 M Zn^{2+}, 1.0 M Cu^{2+} (D) 1.0 M Zn^{2+}, 0.01 M Cu^{2+}

Ans. **(C)**

Sol. $E = E° - \frac{0.059}{2}\log\frac{[Zn^{2+}]}{[Cu^{2+}]}$

$E = 1.1 - \frac{0.059}{2}\log\frac{[Zn^{2+}]}{[Cu^{2+}]}$

For $E > 1.1$

$\therefore \quad [Zn^{2+}] < [Cu^{2+}]$

77. Penicillamine is used in the treatment of arthritis. One molecule of penicillamine contains a single sulphur atom and the weight percentage of sulphur in penicillamine is 21.49%. Molecular weight of penicillamine in g mol^{-1} is

(A) 85.40 (B) 68.76 (C) 125.2 (D) 149.2

Ans. (D)

Sol. % of $S = \frac{32 \times 1 \times 100}{\text{Molecular mass}} = 21.49$

Molecular mass $= \frac{3200}{21.49} = 149$ g/mol.

78. An ion exchange resin, RH_2 can replace Ca^{2+} in hard water as $RH_2 + Ca^{2+} \longrightarrow RCa^{2+} + 2H^+$. When a 1.0 L hard water sample was passed through the resin, all H^+ ions were replaced by Ca^{2+} ions and the pH of eluted water was found to be 2.0. The hardness of water (as ppm of Ca^{2+}) in the sample of water treated is

(A) 50 (B) 100 (C) 125 (D) 200

Ans. (D)

Sol. $RH_2 + Ca^{2+} \longrightarrow RCa + 2H^+$

$pH = 2 \Rightarrow [H^+] = 10^{-2}$ mol/lt.

$\therefore$ Mole of H^+ in 1 lt. $= 10^{-2}$

$\therefore$ Mole of Ca^{2+} 1 lt. water $= \frac{10^{-2}}{2}$

Mass of Ca^{2+} in 1 lt. $= \frac{10^{-2}}{2} \times 40 = 0.2$ g

$\therefore$ Hardness (in terms of Ca^{2+} ppm) $= 0.2 \times 1000 = 200$ ppm

79. The analysis of three different binary oxides of bromine (Br) and oxygen (O) gives the following results :

Compound	Mass of O combined with 1.0 g of Br
X	0.101 g
Y	0.303 g
Z	0.503 g

Which of the following statements is not correct ?

I Compound Y is Br_2O_3 II Compound Z is Br_2O_5

III Compound Z is Br_2O_7 IV Compound Y is Br_2O_5

(A) I and III (B) II and IV (C) III and IV (D) I and II

Ans. (C)

Sol. For same mass of Br

Mass of O in X, Y & Z are

= 0.101 g, 0.303 g, 0.503 g

= 1 : 3 : 5

$\therefore$ Molar ratio of O is X, Y & Z are

= 1 : 3 : 5

$\therefore$ X can be $\rightarrow Br_2O$

Y can be $\rightarrow Br_2O_3$

Z can be $\rightarrow Br_2O_5$

80. Which of the following statements is/are correct ?

I. Number of significant figure in 2345.100 is three

II. 0.00787 rounded to two significant figures is written as 0.787×10^{-2}

III. 340 rounded to two significant figures is written as 0.34×10^{3}

IV. The number of significant figures in 0.020 is two

(A) II and III (B) III and IV (C) I, II and IV (D) III only

Ans. **(B)**

Sol. It is fact.