CHEMISTRY

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer:

1. The correct order of electron gain enthalpy (magnitude only) for group 16 elements is

(1) Te > Se > S > O

(2) S > Se > Te > O

(3) O > S > Se > Te

(4) S > O > Se > Te

Answer (2)

Sol.

	O	S	Se	Te
ΔH_{eg} (kJ/mol)	–141	–200	–195	–190

2. 100 g 98% by weight H_2SO_4 is mixed with 100 g 49% by weight H_2SO_4. Mole fraction of H_2SO_4 in the solution is

(1) 0.9 (2) 0.1

(3) 0.67 (4) 0.33

Answer (4)

Sol. (I) Mass of H_2SO_4 = 98 g

Mass of H_2O = 2 g

(II) Mass of H_2SO_4 = 49 g

Mass of H_2O = 51 g

Total mass of H_2SO_4 = 98 + 49 = 147 g

$n_{H_2SO_4} = 1.5$ mol

Mass of H_2O = 53 g

$n_{H_2O} \approx 3$ mol

$$X_{H_2SO_4} = \frac{1.5}{4.5} = \frac{1}{3}$$

3. Correct order of ionisation enthalpy is

(1) F > Cl > Cl^- > F^- (2) F^- > Cl^- > F > Cl

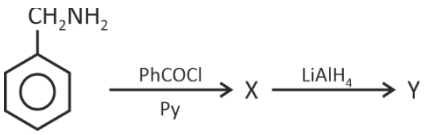
(3) Cl > F > Cl^- > F^- (4) F > Cl > F^- > Cl^-

Answer (1)

Sol.

				kJ/mol
Cl(17)	→	2, 8, 7	→	1256
F(9)	→	2, 7	→	1680
F^-(9 + 1)	→	2, 8	→	+328
Cl^-(17+1)	→	2, 8, 8	→	+349

4. Consider the following reaction.



The correct structure of Y is

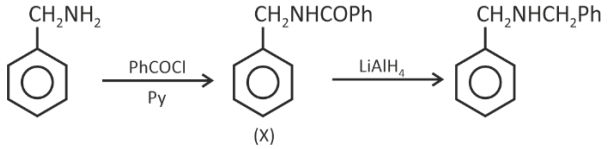
(1) $PhCH_2NHCOPh$

(2) $Ph–CH_2NHCH_2Ph$

(3) $PhNH_2CH_2Ph$

(4) $PhCH_3$

Answer (2)

Sol. 

5. Which of the following is a mixed oxide?

(1) Fe_2O_3 (2) PbO_2

(3) Pb_3O_4 (4) BaO_2

Answer (3)

Sol. Pb_3O_4 is a mixed oxide of PbO and PbO_2

6. Which of following is basic buffer?

(1) NaOH + CH_3COONa

(2) NaOH + Na_2SO_4

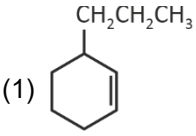
(3) K_2SO_4 + H_2SO_4

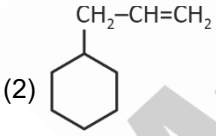
(4) NH_4OH + NH_4Cl

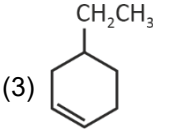
Answer (4)

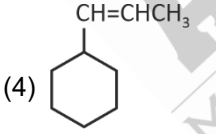
Sol. NH_4OH is weak base and NH_4Cl is its salt with strong base

7. An alkene on reductive ozonolysis gives methanal as one of the products. It's structure is

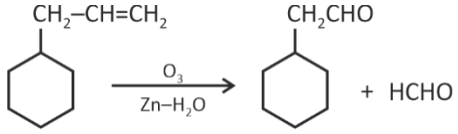
(1) 

(2) 

(3) 

(4) 

Answer (2)

Sol. 

To get HCHO as one of the product, alkene should contain $=CH_2$ as group.

8. Consider the following data :

$Na(s)+\frac{1}{2}Cl_2(g)\rightarrow NaCl(s)$ $\Delta H^o = -411$ kJ/mole

$Na(s)\rightarrow Na(g)$ $\Delta H^o = 107$ kJ/mole

$Cl_2(g)\rightarrow 2Cl(g)$ $\Delta H^o = 242$ kJ/mole

$Cl(g)+e^-\rightarrow Cl^-(g)$ $\Delta H^o = -355$ kJ/mole

$Na(g)\rightarrow Na^+(g)+e^-$ $\Delta H^o = 502$ kJ/mole^{-1}

Find out lattice energy of NaCl(s).

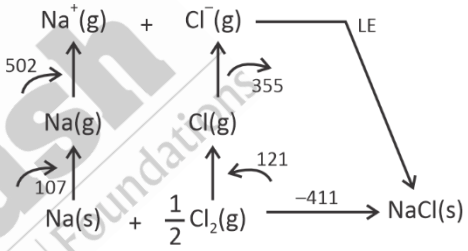
(1) –786 kJ mole^{-1}

(2) –628 kJ mol^{-1}

(3) –428 kJ mole^{-1}

(4) –393 kJ mole^{-1}

Answer (1)

Sol. 

–411 = 107 + 502 + 121 – 355 + LE

LE = –786 kJ mole^{-1}

9. Which of the following will behave as best reducing agent?

Given $Al^{3+} + 3e^- \rightarrow Al$ $E^\circ = -1.66$ V

$Co^{3+} + e^- \rightarrow Co^{2+}$ $E^\circ = 1.81$ V

$Fe^{3+} + e^- \rightarrow Fe^{2+}$ $E^\circ = 0.77$ V

$Cd^{2+} + 2e^- \rightarrow Cd$ $E^\circ = -0.4$ V

(1) Al (2) Co^{2+}

(3) Fe^{2+} (4) Cd

Answer (1)

Sol. Smaller the value of E°, lesser will be the tendency to reduce $Al^{3+} + e^- \rightarrow Al$ have smallest E°, so Al will have high tendency to oxidise.

10. $Br_2CH-CH_2-CH_2-CH_3 \xrightarrow[NaNH_2]{2\,Equivalent} X \xrightarrow[II.\,1\,Eq.\,CH_3CHBrCH_3]{I.\,1\,Eq.\,NaNH_2} Y$

(1) 2-Methylhex-3-yne

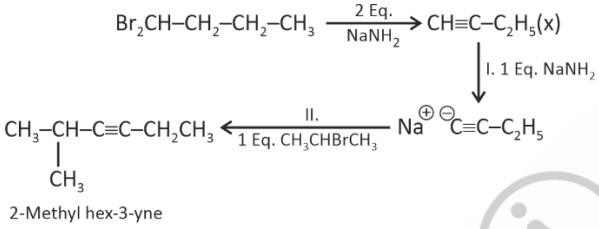
(2) 2-Methylhex-2-ene

(3) 2-Pentyne

(4) 3-Methylhex-2-yne

Answer (1)

Sol.



2-Methyl hex-3-yne

11. Given below are two statements.

Statement I : First ionisation enthalpy of Cr is greater than that of Mn.

Statement II : Second and third ionisation enthalpies of Cr are less than that of Mn.

In the light of above statements, choose the correct option.

(1) Both statement I and statement II are correct

(2) Both statement I and statement II are incorrect

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

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

Answer (2)

Sol.

	Cr	Mn
IE_1 (kJ/mol)	653	717
IE_2 (kJ/mol)	1592	1509
IE_3 (kJ/mol)	2990	3260

12. Which of the following is the correct IUPAC name of complex $[Ni(PPh_3)_3(H_2O)_3]Cl_2$?

(1) Triaquatris(triphenylphosphine)nickel(II) chloride

(2) Tris(triphenyphosphine)triaquanickel(II) chloride

(3) Triaquatris(triphenylphosphine)nickelate(II) chloride

(4) Triaquatris(triphenylphosphine)nickel(III) chloride

Answer (1)

Sol. Correct IUPAC name is triaquatris(triphenyl phosphine) nickel(II) chloride

13. Match the two columns : based on the reaction

Glucose + 'X' → 'P'

	List-I (Reagent-X)		**List-II (Product-P)**
A.	Br_2/water	(i)	Glucose oxime
B.	Acetic anhydride (excess)	(ii)	Saccharic acid

C.	Conc. HNO_3	(iii)	Glucose pentaacetate
D.	NH_2OH	(iv)	Gluconic acid

(1) A – iv, B – ii, C – iii, D – i

(2) A – ii, B – iv, C – iii, D – i

(3) A – ii, B – iii, C – iv, D – i

(4) A – iv, B – iii, C – ii, D – i

Answer (4)

Sol. (1) Glucose + Br_2-water $\rightarrow$ Gluconic acid

(2) Glucose + Acetic anhydride $\rightarrow$ Glucose pentaacetate

(3) Glucose + Conc. $HNO_3 \rightarrow$ Saccharic acid

(4) Glucose + $NH_2OH \rightarrow$ Glucose oxime

14. Consider two reactions having same pre-exponential factor (A) occuring at same temperature (T).

$A \xrightarrow{E_{a_1}} B$

$C \xrightarrow{E_{a_2}} D$

$E_{a_1} = 5E_{a_2}$

Find out the correct expression?

(1) $\frac{k_1}{k_2} = e^{-\frac{E_{a_2}}{RT}}$ (2) $\frac{k_1}{k_2} = e^{-\frac{4E_{a_1}}{RT}}$

(3) $\frac{k_1}{k_2} = e^{-\frac{4E_{a_1}}{5RT}}$ (4) $\frac{k_1}{k_2} = e^{-\frac{4E_{a_2}}{5RT}}$

Answer (3)

Sol. $k_1 = Ae^{-\frac{E_{a_1}}{RT}}$

$k_2 = Ae^{-\frac{E_{a_2}}{RT}}$

$\frac{k_1}{k_2} = e^{-\left(\frac{E_{a_1} - E_{a_2}}{RT}\right)}$

$= e^{-\frac{\left(5E_{a_2} - E_{a_2}\right)}{RT}}$

$= e^{-\frac{4E_{a_2}}{RT}}$

$= e^{-\frac{4E_{a_1}}{5RT}}$

Option (3) is correct

15. Consider the given species

H_2S, H_2O, NH_3, NF_3, $CHCl_3$

The number of lone pair on central atom which has lowest dipole moment.

(1) 0

(2) 1

(3) 2

(4) 3

Answer (2)

Sol.

Molecules		Dipole Moment (D)
NH_3	$\rightarrow$	1.47
NF_3	$\rightarrow$	0.23
H_2O	$\rightarrow$	1.85
H_2S	$\rightarrow$	0.95
$CHCl_3$	$\rightarrow$	1.04

16. Consider the statements below

Statement I: BCl_3 is covalent in nature

Statement II: BCl_3 undergoes hydrolysis to form $[B(OH)_4]^-$ and BH_2^+

In the light of above statements choose the correct option.

(1) Statement I and statement II both are correct

(2) Statement I and statement II both are incorrect

(3) Statement I correct statement II incorrect

(4) Statement I incorrect statement II correct

Answer (3)

Sol. BCl_3 is covalent in nature

$BCl_3 + H_2O \rightarrow H_3BO_3 + HCl$

17. Energy of first Balmer line of H-atom is x kJ

The energy of second Balmer line of H-atom is ___

(1) x

(2) 1.35 x

(3) 2x

(4) x/1.35

Answer (2)

Sol. $E_{Balmer\ 1^{st}} \propto 13.6 \times \left(\frac{1}{2^2} - \frac{1}{3^2}\right) \propto 13.6 \times \frac{5}{36} \propto x$ ...(i)

($n_1 = 2, n_2 = 3$)

$E_{Balmer\ 2^{nd}} \propto 13.6 \times \left(\frac{1}{2^2} - \frac{1}{4^2}\right) \propto 13.6 \times \frac{3}{16}$ ...(ii)

$(ii)/(i) \Rightarrow E_{Balmer\ 2^{nd}} = \frac{13.6 \times \frac{3}{16}}{13.6 \times \frac{5}{36}} \times x = x \times 1.35$

18. 36 g of A reacts with 54 g of B to form AB_2, if molar mass of A and B is respectively 60 and 80, then choose correct option from following.

(1) Limiting Reagent is A

(2) 90 g of AB_2 formed

(3) Limiting Reagent is B

(4) 50 g of AB_2 formed

Answer (3)

Sol. $n_A = \frac{36}{60} = 0.6,\ n_B = \frac{54}{80} = 0.675$

$$\underset{0.6\,mol}{1A} + \underset{0.675\,mol}{2B} \rightarrow 1AB_2$$

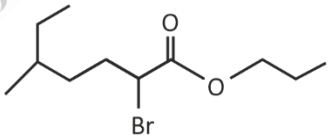
$$\frac{0.6}{1} = 0.6 \qquad \frac{0.675}{2} = 0.3375$$

So, limiting reagent is B

Mole of AB_2 formed = 0.3375

W of AB_2 = 0.3375 × 220 = 74.25 g

19. The correct IUPAC nomenclature of the following compound is



(1) Propyl-2-bromo-6-methyl heptanoate

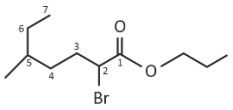
(2) 2-Bromo-5-methyl-1-propyl heptanoate

(3) Propyl-2-bromo-5-ethyl hexanoate

(4) Propyl-2-bromo-5-methyl heptanoate

Answer (4)

Sol. Ester is the principal functional group in this molecule.



→ Propyl-2-bromo-5-methyl heptanoate

20.

SECTION - B

Numerical Value Type Questions: This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

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21. Volume ratio of decimolar NH_4OH and decimolar HCl to give a solution of pH = 9.26 at 25°C is x : 1. Find x.

pK_b of NH_4OH = 4.74

Answer (2)

Sol. Assume $V_{NH_4OH} = xL$ and $V_{HCl} = 1L$

NH_4OH	+	HCl	→	NH_4Cl	+	H_2O
0.1x		0.1		–		–
0.1x – 0.1		0		0.1		

$$pOH = pK_b + \log\frac{[salt]}{[base]}$$

$$4.74 = 4.74 + \log\frac{(0.1x - 0.1)/V}{0.1/V}$$

0.1x – 0.1 = 0.1

x = 2

22. 5.8 g Aniline is converted into benzanilide with some reaction sequences.

Calculate mass of benzanilide formed, if percentage yield of reaction is 82%.

$$Ph - COCl + PhNH_2 \xrightarrow{Py} \text{Benzanilide}$$

Answer (10)

Sol. $Ph-\overset{\overset{O}{\|}}{C}-Cl + PhNH_2 \xrightarrow{Py} Ph-\overset{\overset{O}{\|}}{C}-NH-Ph$

Benzanilide

Mole of aniline

$$= \frac{5.8}{93}\text{ mol}$$

Mole of $Ph-\overset{\overset{O}{\|}}{C}-NH-Ph$ will be formed of yield is 100%

$$= \frac{5.8}{93}\text{ mol}$$

mole of $Ph-\overset{\overset{O}{\|}}{C}-NHPh = \frac{5.8}{93} \times 0.82 = 0.0511\text{ mol}$

mass = 10.07 ≈ 10 g

23. A cycloalkene (X) is treated with Br_2 and compound (Y) is formed with C : Br ratio 3 : 1. One mole of X required 1 mol of Br_2. Find composition of 'Br' in Y compound (percentage).

Answer (66)

Sol. Cycloalkene (X) $\Rightarrow C_nH_{2n-2}$

After reaction with Br_2 compound Y is formed

$\Rightarrow C_nH_{2n-2}Br_2$

If ration of C : Br = 3 : 1

MF of Y should be $C_6H_{10}Br_2$

$$\%\text{ of Br} = \frac{2\times 80}{242}\times 100 = 66.11\% \approx 66$$

24.

25.