JEE MAIN 4th Attempt

CHEMISTRY

27th August 2021 [SHIFT – 1]

QUESTION WITH SOLUTION

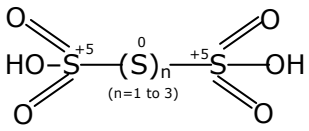
SECTION - A

Q.1 In polythionic acid, $H_2S_xO_6$ (x =3 to 5) the oxidation(s) of sulphur is /are:

(1) +3 and + 5 only (2) +5 only

(3) + 6 only (4) 0 and + 5 only

Sol. 4



Q.2 Match list – I with List-II:

List -I (Species)		List-II (No. of lone pairs of electrons on the central atom)	
(a)	XeF_2	(i)	0
(b)	XeO_2F_2	(ii)	1
(c)	XeO_3F_2	(iii)	2
(d)	XeF_4	(iv)	3

Choose the **most appropriate** answer from the options given below:

(1) (a) - (iv), (b) – (i), (c) – (ii), (d) – (iii)

(2) (a) - (iii), (b) – (iv), (c) – (ii), (d) – (i)

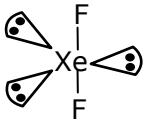
(3) (a) - (iii), (b) – (ii), (c) – (iv), (d) – (i)

(4) (a) - (iv), (b) – (ii), (c) – (i), (d) – (iii)

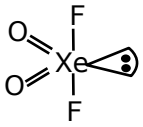
Sol. 4

Species (Number of Ione pairs of electrons on the central atom)

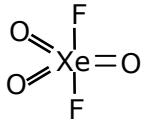
XeF_2 3



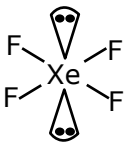
XeO_2F_2 1



XeO_3F_2 0



XeF_4 2



Q.3 Tyndall effect is more effectively shown by :

(1) lyophilic colloid (2) suspension (3) true solution (4) lyophobic colloid

Sol. 4

Tyndall effect is observed in lyophobic colloids

Q.4 Which of the following is not a correct statement for primary aliphatic amines ?

(1) Primary amines can be prepared by the Gabriel phthalimide syntheis.

(2) Primary amines on treating with nitrous acid solution form corresponding alcohols except methyl amine.

(3) Primary amines are less basic than the secondary amines.

(4) The intermolecular association in primary amines is less than the intermolecular association in secondary amines.

Sol. 4

The intermolecular association is more prominent in case of primary amines as compared to secondary, due to the availability of two hydrogen atom.

Q.5 Deuterium resembles hydrogen in properties but:

(1) reacts slower than hydrogen (2) emits β^+ particles

(3) reacts vigorously than hydrogen (4) react just as hydrogen

Sol. 1

The bond dissociation energy of D_2 is greater than H_2 and therefore D_2 reacts slower than H_2.

Q.6 In which one of the following molecules strongest back donation of an electron pair from halide to boron is expected ?

(1) BF_3 (2) BI_3 (3) BBr_3 (4) BCl_3

Sol. 1

Type of back bonding

BF_3 BCl_3 BBr_3 BI_3

$(2p\pi-2p\pi)(2p\pi-3p\pi)$ $(2p\pi-4p\pi)$ $(2p\pi-5p\pi)$

Therefore back bonding strength is as follows

$BF_3 > BCl_3 > BBr_3 > BI_3$

Q.7 Acidic ferric chloride solution on treatment with excess of potassium ferrocyanide give a Prussian blue coloured colloidal species, It is :

(1) $HFe[Fe(CN)_6]$ (2) $K_5Fe[Fe(CN)_6]_2$ (3) $Fe_4[Fe(CN)_6]_3$ (4) $KFe[Fe(CN)_6]$

Sol. 4

$$FeCl_3 + K_4[Fe(CN)_6](\text{excess}) \downarrow$$

$K\,Fe[Fe(CN)_6]$

Colloidal species

Q.8 Match items of List-I with those of list-II:

List -I (Property)		List-II (Example)	
(a)	Diamagnetism	(i)	MnO
(b)	Ferrimagnetism	(ii)	O_2
(c)	Paramagnetism	(iii)	NaCl
(d)	Antiferromagnetism	(iv)	Fe_3O_4

(1) (a) – (i), (b) – (iii), (c) – (iv), (d) – (ii)
(2) (a) – (iv), (b) – (ii), (c) – (i), (d) – (iii)
(3) (a) – (ii), (b) – (i), (c) – (iii), (d) – (iv)
(4) (a) – (iii), (b) – (iv), (c) – (ii), (d) – (i)

Sol. 4

Q.9 The number of water molecules in gypsum, dead burnt plaster and plaster of Paris respectively are :

(1) 2, 0 and 1 (2) 5, 0 and 0.5 (3) 0.5, 0 and 2 (4) 2, 0 and 0.5

Sol. 4

Gypsum $CaSO_4 . 2H2O$

Plaster of Paris $CaSO_4 . \frac{1}{2}H_2O$

Dead burnt plaster $CaSO_4$

Q.10 The gas 'A' is having very low reactivity reaches to stratosphere. It is non-toxic and non-flammable but dissociated by UV- radiations in stratosphere. The intermediates formed initially from the gas 'A' are :

(1) $\dot{C}l + \dot{C}F_2Cl$ (2) $\dot{C}H_3 + \dot{C}F_2Cl$ (3) $Cl\dot{O} + \dot{C}H_3$ (4) $Cl\dot{O} + \dot{C}F_2Cl$

Sol. 1

In stratosphere CFCs get broken down by powerful UV radiations releasing $Cl^{\bullet}$

$$CF_2Cl_2(g) \xrightarrow{U.V.} Cl^{\bullet}(g) + {}^{\bullet}CF_2Cl(g)$$

Q.11 Which refining process is generally used in the purification of low melting metals ?

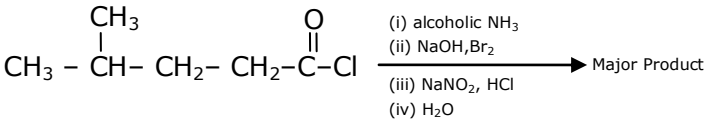
(1) Liquation (2) Electrolysis
(3) Chromatographic method (4) Zone refining

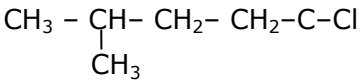
Sol. 1

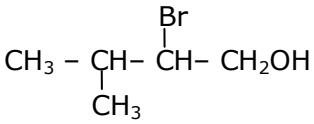
Liquation method is used to purify those impure metals which has lower melting point than the melting point of impurities associated.

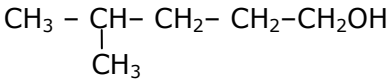
$\therefore$ This method is used for metal having low melting point

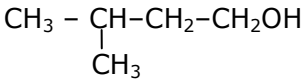
Q.12 The major product of the following reaction is :



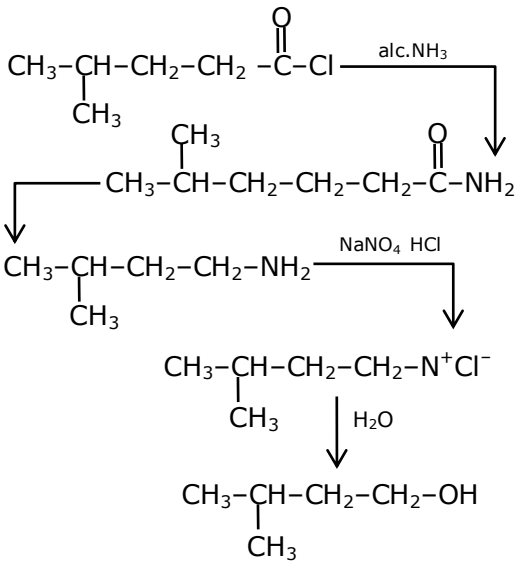
(1) 

(2) 

(3) 

(4) 

Sol. 4



Q.13 The nature of oxides V_2O_3 and CrO is indexed as 'X' and 'Y' type respectively. The correct set of X and Y is :

(1) X = amphoteric Y = basics (2) X = basic Y = basic

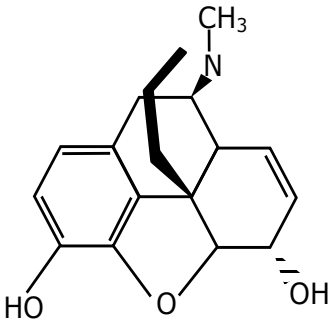
(3) X = acidic Y = acidic (4) X = basic Y= amphoteric

Sol. 2

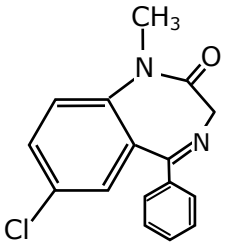
V_2O_3 basic

CrO basic

Q.14 (A)



(B)



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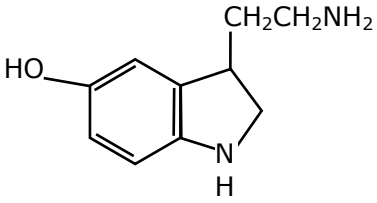
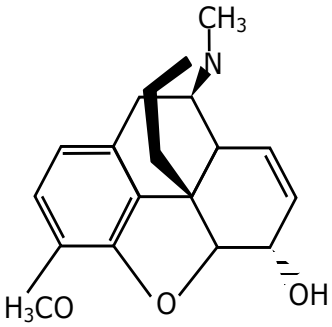


(D)



The correct statement about (A), (B), (C) and (d) is :

(1) (A) and (D) are tranquillizers

(2) (B), (C) and (D) are tranquillizers

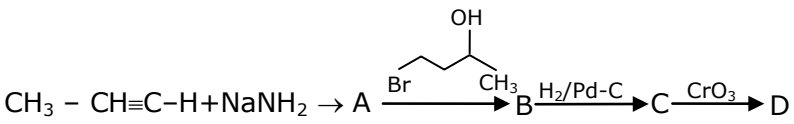
(3) (B) and (C) are tranquillizers

(4) (A), (B) and (C) are narcotic analgesics

Sol. 3

B and C are tranquilizers

Q.15 In the following sequence of reactions, the final product D is :



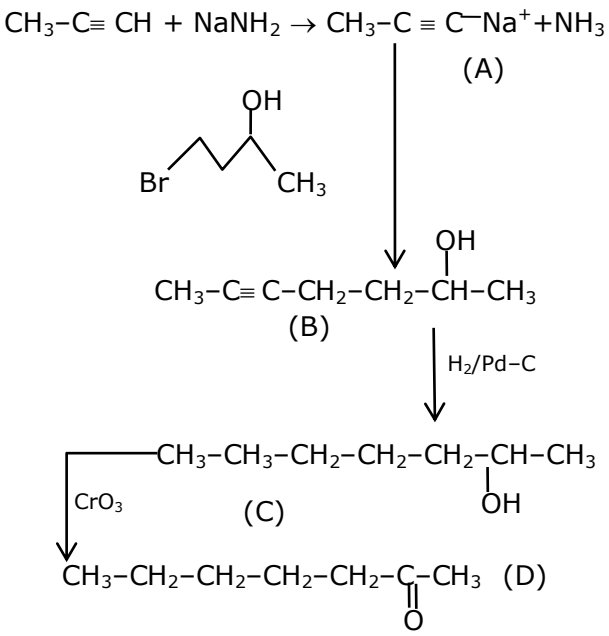
(1) $H_3C-CH_2-CH_2-CH_2-CH_2-\overset{\overset{O}{\|}}{C}-H$

(2) $CH_3-CH=CH-CH_2-CH_2-CH_2-COOH$

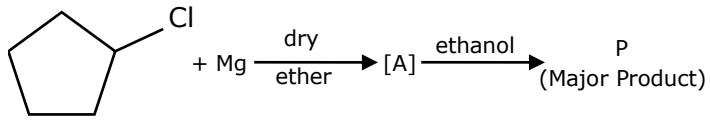
(3) $CH_3-CH_2-CH_2-CH_2-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$

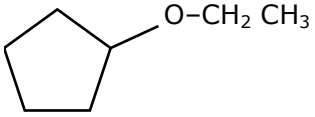
(4) $H_3C-CH=CH-CH(OH)-CH_2-CH_2-CH_3$

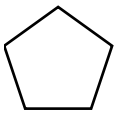
Sol. 3

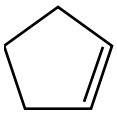


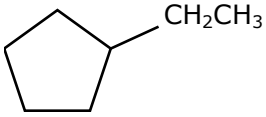
Q.16 In the following sequence of reaction the P is :



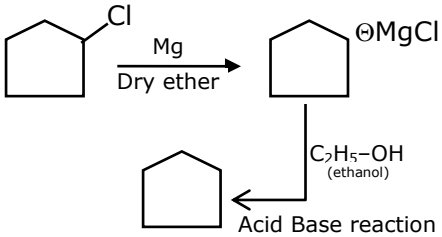
(1) 

(2) 

(3) 

(4) 

Sol. 2



Q.17 The unit of the van der Waals gas equation parameter 'a' in

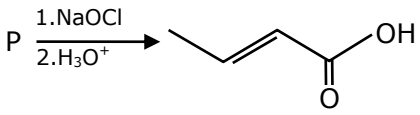
$\left(P+\frac{an^2}{V^2}\right)(V-nb)=nRT$ is :

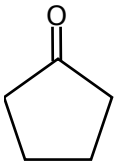
(1) kg ms^{-1} (2) dm^3 mol^{-1} (3) atm dm^6 mol^{-2} (4) kg m s^{-2}

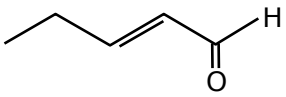
Sol. 3

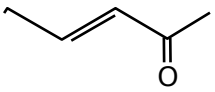
$$\frac{an^2}{V^2}=atm \Rightarrow a=atm\times\frac{dm^6}{mol^2}$$

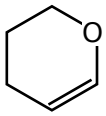
Q.18 The structure of the starting compound P used in the reaction given below is :



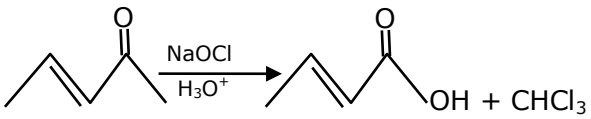
(1) 

(2) 

(3) 

(4) 

Sol. 3



NaOCl is used in haloform reaction as reagent

Q.19 Given below are two statements: one is labelled as Assertion (A) and the other is labelled as **Reason (R).**

Assertion (A). Synthesis of ethyl phenyl ether may be achieved by Williamson synthesis.

Reason (R): Reaction of bromobenzene with sodium ethoxide yields ethyl phenyl ether. In the light of the above statements, choose the most appropriate answer from the options given below:

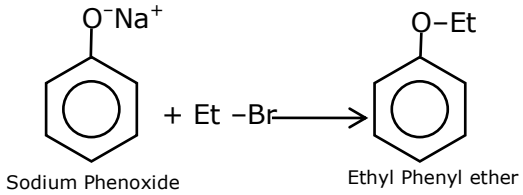
(1) Both (A) and (R) are correct and (R) is the correct explanation of (A)

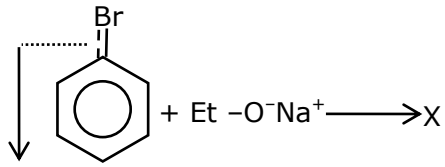
(2) Both (A) and (R) are correct but (R) is NOT the correct explanation of (A)

(3) (A) is correct but (R) is not correct

(4) (A) is not correct but (R) is correct

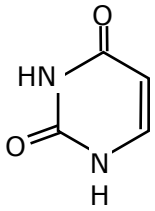
Sol. 3

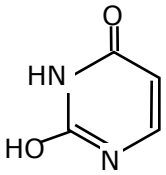


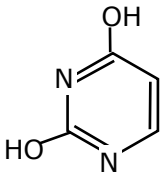


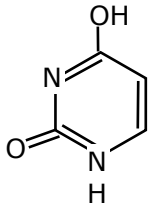
Partial double bond character

Q.20 Out of following isomeric forms of uracil, which one is present in RNA ?

(1) 

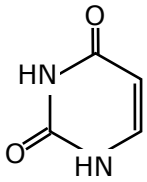
(2) 

(3) 

(4) 

Sol. 1

Isosmeric from of uracil present in RNA



Section B

Q.1 In Carius method for estimation of halogens, 0.2 g of an organic compound gave 0.188 g of AgBr. The percentage of bromine in the compound is ..... (Nearest integer) [Atomic mass : Ag = 108, Br = 80]

Sol. **40**

$n_{AgBr} = \frac{0.188g}{188g/mol} = 10^{-3}mol$

$\Rightarrow n_{Br} = n_{AgBr} = 0.001$ mol

$\Rightarrow mass_{Br} = (0.001 \times 80)$ gm $= 0.08$ gm

$\Rightarrow$ mass % $= \frac{0.08 \times 100}{0.2} = 40\%$

Q.2 The kinetic energy of an electron in the second Bohr orbit of a hydrogen atom is equal to $\frac{h^2}{xma_0^2}$.

The value of 10 x is _____. (a_0 is radius of Bohr's orbit)
(Nearest integer) (Given $\pi = 3.14$)

Sol. **3155**

$mvr = \frac{nh}{2\pi}$

$K.E. = \frac{n^2h^2}{8\pi^2mr^2} = \frac{4h^2}{8\pi^2m(4a_0)^2}$

$= \left(\frac{4}{8\pi^2 \times 16}\right)\frac{h^2}{ma_0^2}$

$\Rightarrow x = 315.507$

$\Rightarrow 10x = 3155$ (nearest integer)

Q.3 The number of f electrons in the ground state electron configuration of Np (z=93) is _____.
(Integer answer)

Sol. **NTA Sol. 4**
Motion Sol. 18

Np = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ \boxed{4f^{14}}\ 5d^{10}\ 6p^6\ 7s^2\ \boxed{5f^4}\ 6d^1$

Total no. of 'f' electron = $14\ e^- + 4e^- = 18$

Q.4 200 mL of 0.2M HCl is mixed with 300 mL of M NaOH. The molar heat of neutralization of this reaction is –57.1 kJ. The increase in temperature in °C of the system on mixing is $x \times 10^{-2}$. The value of x is ____. (Nearest integer)
[Given : Specific heat of water = 4.18 J g^{-1} K^{-1}]
Density of water = 1.00 g cm^{-3}] (Assume no volume change on mixing)

Sol. **82**

$\Rightarrow$ Millimoles of HCl = $200 \times 0.2 = 40$

$\Rightarrow$ Millimoles of NaOH = $300 \times 0.1 = 30$

$\Rightarrow$ Heat released $= \left(\frac{30}{1000} \times 57.1 \times 1000\right) = 1713J$

$\Rightarrow$ Mass of solution = 500 ml $\times$ 1 gm/ ml = 500 gm

$\Rightarrow \Delta T = \frac{q}{m \times C} = \frac{1713J}{500g \times 4.18\frac{J}{g-K}} = 0.8196K$

$= 81.96 \times 10^{-2}$ K

Q.5 The number of moles of CuO, that will be utilized in Dumas method for estimating nitrogen in a sample of 57.5 g of N, N-dimethylaminopentane is _____$\times 10^{-2}$. (Nearest integer)

Sol. **1125**

Moles of N in N,N – dimethylaminopentane

$= \left(\frac{57.5}{115}\right) = 0.5\text{mol}$

$\Rightarrow C_7H_{17}N + \frac{45}{2}CuO \rightarrow 7CO_2 + \frac{17}{2}H_2O + \frac{1}{2}N_2 + \frac{45}{2}Cu$

$\frac{n_{cuo}\text{reacted}}{\left(\frac{45}{2}\right)} = \frac{n_{c_7H_{17}N}\text{reacted}}{1} \Rightarrow n_{cuO}\text{ reacted} = \left(\frac{45}{2}\right)\times 0.5 = 11.25$

Q.6 When 10 mL of an aqueous solution of $KMnO_4$ was titrated in acidic medium, equal volume of 0.1 M of an aqueous solution of ferrous sulphate was required for complete discharge of colour. The strength of $KMnO_4$ in grams per litre is _____ $\times 10^{-2}$. (Nearest integer)
[Atomic mass of K = 39, Mn= 55, O = 16]

Sol. **316**

Let molarity of $KMnO_4$ = x

$KMnO_4 + FeSO_4 \rightarrow Fe_2(SO_4)_3 + Mn^{+2}$

n = 5 n= 1

(Equivalents of $KMnO_4$ reacted) = (Equivalents of $FeSO_4$ reacted)

$\Rightarrow$ (5× x × 10ml) = 1 × 0.1 × 10ml

Molar mass of $KMnO_4$ = 158 gm/mol

$\Rightarrow$ Strength = (x × 158) = 3.16 g/ℓ

Q.7 1 kg of 0.75 molal aqueous solution of sucrose can be cooled up to –4°C before freezing. The amount if ice (in g) that will be separated out is _____. (Nearest integer) [Given : K_f (H_2O)= 1.86 K kg mol^{-1}]

Sol. **518**

Let mass of water initially present = x gm

$\Rightarrow$ Mass of sucrose = (1000 –x) gm

$\Rightarrow$ moles of sucrose = $\left(\frac{1000-x}{342}\right)$

$\Rightarrow 0.75 = \frac{\left(\frac{1000-x}{342}\right)}{\left(\frac{x}{1000}\right)} \Rightarrow \frac{x}{1000} = \frac{1000-x}{342\times 0.75}$

$\Rightarrow 256.5\,x = 10^6 - 1000x$

$\Rightarrow$ x = 795.86 gm

New mass of H_2O = a kg

$\Rightarrow 4 = \frac{0.5969}{a}\times 1.86 \Rightarrow$ a = 0.2775 kg

$\Rightarrow$ ice separated = (795.86–277.5) = 518.3 gm

Q.8 The reaction that occurs in a breath analyser, a device used to determine the alcohol level in a person's blood stream is

$2K_2Cr_2O_7 + 8H_2SO_4 + 3C_2H_6O \rightarrow 2Cr_2(SO_4) + 3C_2H_4O_2 + 2K_2SO_4 + 11H_2O$

If the rate of appearance of $Cr_2(SO_4)_3$ is 2.67 mol min^{-1} at a particular time, the rate of disappearance of C_2H_6O at the same time is _____ mole min^{-1} (Nearest integer)

Sol. 4

$$\left(\frac{\text{Rate of disappearance of } C_2H_6O}{3}\right)$$

$$= \left(\frac{\text{Rate of disappearance of } Cr_2(SO_4)_3}{2}\right)$$

$$\Rightarrow \left(\frac{2.67\text{mol/min} \times 3}{2}\right) = \text{rate of disappearance of } C_2H_6O.$$

$\Rightarrow$ Rate of disappearance of C_2H_6O = 4.005 mol/min

Q.9 1 mole of an octahedral metal complex with formula MCl_3 2L on reaction with excess of $AgNO_3$ gives 1 mol of AgCl. The denticity of Ligand L is _____. (Integer answer)

Sol. 2

$MCl_3.2L$ octahedral

$$\underset{1\text{mole}}{MCl_3.2L} \xrightarrow{Ex\,AgNO_3} 1\text{mol of AgCl}$$

Its means that one Cl^- ion present in ionization sphere.

$\therefore$ formula = $[MCl_2L_2]Cl$

For octahedral complex coordination no. is 6

$\therefore$ L act as bidentate ligand

Q.10 The number of moles of NH_3, that must be added to 2 L of 0.80 M $AgNO_3$ in order to reduce the concentration of Ag^+ ions to 5.0×10^{-8} M ($K_{formation}$ for $[Ag(NH_3)_2]^+ = 1.0 \times 10^8$) is _____. (Nearest integer)

[Assume no volume change on adding NH_3]

Sol. 4

Let moles added = a

$$Ag^+_{(aq)} + 2NH_{3(aq.)} \rightleftharpoons Ag(NH_3)^+_{2(aq.)}$$

t = 0 0.8 $\left(\frac{a}{2}\right)$

t = ∞ 5×10^{-8} $\left(\frac{a}{2} - 1.6\right)$ 0.8

$$\frac{0.8}{(5\times10^{-8})\left(\frac{a}{2}-1.6\right)^2} = 10^8$$

$$\frac{a}{2} - 1.6 = 0.4 \Rightarrow a = 4$$