FINAL JEE–MAIN EXAMINATION – JULY, 2022

(Held On Friday 29th July, 2022) **TIME : 9 : 00 AM to 12 : 00 NOON**

CHEMISTRY | TEST PAPER WITH SOLUTION

SECTION-A

1. Which of the following pair of molecules contain odd electron molecule and an expanded octet molecule?

(A) BCl_3 and SF_6 (B) NO and H_2SO_4

(C) SF_6 and H_2SO_4 (D) BCl_3 and NO

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. (A) $BCl_3 \rightarrow$ Even Electron molecule

$SF_6 \rightarrow$ Expanded octet molecule

(B) NO $\rightarrow$ Odd Electron molecule

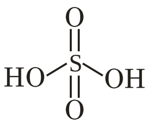
$H_2SO_4 \rightarrow$ Expanded octet.

(C) $SF_6 \rightarrow$ Even Electron molecule

$H_2SO_4 \rightarrow$ Expanded octet.

(D) $BCl_3 \rightarrow$ Even Electron molecule

NO $\rightarrow$ Odd Electron molecule

$\bullet\ddot{N}=\ddot{O}:$ and 

S $\rightarrow$ 12e⁻ in outer orbit.

2. $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

20 g 5 g

Consider the above reaction, the limiting reagent of the reaction and number of moles of NH_3 formed respectively are:

(A) H_2, 1.42 moles (B) H_2, 0.71 moles

(C) N_2, 1.42 moles (D) N_2, 0.71 moles

Official Ans. by NTA (C)

Allen Ans. (C)

Sol.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

$$W_2 = 20g \qquad 5g.$$

$$n = \frac{20}{28} \qquad \frac{5}{2}$$

Stoichiometric Amount:

$$N_2 \rightarrow \frac{20/28}{1} = \frac{20}{28} \qquad H_2 \rightarrow \frac{5/2}{3} = \frac{5}{6}$$

$\therefore$ N_2 is the Limiting Reagent.

$$\therefore \quad n(NH_3) = 2 \times n(N_2) = 2 \times \frac{20}{28}$$

$$= 1.42$$

3. 100 mL of 5% (w/v) solution of NaCl in water was prepared in 250 mL beaker. Albumin from the egg was poured into NaCl solution and stirred well. This resulted in a/ an :

(A) Lyophilic sol (B) Lyophobic sol

(C) Emulsion (D) Precipitate

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. Standard method for the preparation of lyophilic sol. (Discussed in lab Manual)

4. The first ionization enthalpy of Na, Mg and Si, respectively, are: 496, 737 and 786 kJ mo1^{-1}. The first ionization enthalpy (kJ mol^{-1}) of Al is:

(A) 487 (B) 768

(C) 577 (D) 856

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. I. E : Na < Al < Mg < Si

$\therefore$ 496 < IE (Al) < 737

Option (C), matches the condition.

$$\text{i.e } IE(Al) = 577 \text{ kJmol}^{-1}$$

5. In metallurgy the term "gangue" is used for:

(A) Contamination of undesired earthy materials.

(B) Contamination of metals, other than desired metal

(C) Minerals which are naturally occuring in pure form

(D) Magnetic impurities in an ore.

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. Earthy and undesired materials present in the ore, other then the desired metal, is known as gangue.

6. The reaction of zinc with excess of aqueous alkali, evolves hydrogen gas and gives :

(A) $Zn(OH)_2$ (B) ZnO

(C) $[Zn(OH)_4]^{2-}$ (D) $[ZnO_2]^{2-}$

Official Ans. by NTA (D)

Allen Ans. (C or D)

Sol. Zinc dissolves in excess of aqueous alkali

$$Zn + 2OH^- + 2H_2O \rightarrow \underset{\text{Tetrahydroxozincate(II) ion}}{[Zn(OH)_4]^{2-}} + H_2 \uparrow$$

However, this reaction in NCERT is given as

$$Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2 \uparrow$$

ZnO_2^{2-} is anhydrous form of $[Zn(OH)_4]^{2-}$

So in aqueous medium best answer of this question is $[Zn(OH)_4]^{2-}$

7. Lithium nitrate and sodium nitrate, when heated separately, respectively, give :

(A) $LiNO_2$ and $NaNO_2$

(B) Li_2O and Na_2O

(C) Li_2O and $NaNO_2$

(D) $LiNO_2$ and Na_2O

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. Li_2O, $NaNO_2$

As per NCERT Lithium nitrate when heated gives lithium oxide, Li_2O, whereas other alkali metal nitrates decompose to give the corresponding nitrite.

$$4LiNO_3 \longrightarrow 2Li_2O + 4NO_2 + O_2$$

$$2NaNO_3 \longrightarrow 2NaNO_2 + O_2$$

However, the decomposition product of $NaNO_3$ are temperature dependent process as shown in the below reaction.

$$NaNO_3 \xrightarrow[500°C]{\Delta} NaNO_2(s) + \frac{1}{2}O_2(g)$$

$$\downarrow \Delta\ 800°C$$

$$Na_2O(s) + N_2(g) + O_2(g)$$

As temperature is not mentioned, we can go by **Ans. (C)**

8. Number of lone pairs of electrons in the central atom of SCl_2, O_3, ClF_3 and SF_6, respectively, are :

(A) 0, 1, 2 and 2

(B) 2, 1, 2 and 0

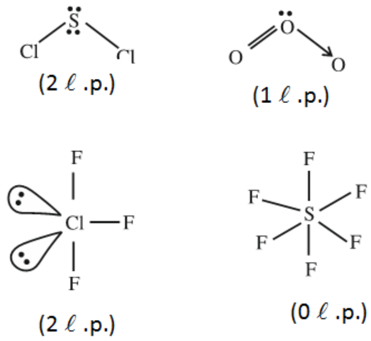
(C) 1, 2, 2 and 0

(D) 2, 1, 2 and 0

Official Ans. by NTA (B)

Allen Ans. (B)

Sol.



9. In following pairs, the one in which both transition metal ions are colourless is :

(A) Sc^{3+}, Zn^{2+}

(B) Ti^{4+}, Cu^{2+}

(C) V^{2+}, Ti^{3+}

(D) Zn^{2+}, Mn^{2+}

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. (A) Sc^{3+}, Zn^{2+} (B) Ti^{4+}, Cu^{2+}

$3d^0$ $3d^{10}$ $3d^0$ $3d^9$

(C) V^{2+}, Ti^{3+} (D) Zn^{2+}, Mn^{2+}

$3d^3$ $3d^1$ $3d^{10}$ $3d^5$

No d-d transitions in ions with d^o & d^{10} configuration. Therefore they are colourless.

10. In neutral or faintly alkaline medium, $KMnO_4$ being a powerful oxidant can oxidize, thiosulphate almost quantitatively, to sulphate. In this reaction overall change in oxidation state of manganese will be :

(A) 5 (B) 1 (C) 0 (D) 3

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. $$8\overset{+7}{Mn}O_4^- + 3S_2O_3^{2-} + H_2O \rightarrow 8\overset{+4}{Mn}O_2 + 6SO_4^{2-} + 2OH^-$$

Change in oxidation state of Mn is from +7 to +4 which is 3.

11. Which among the following pairs has only herbicides ?

(A) Aldrin and Dieldrin

(B) Sodium chlorate and Aldrin

(C) Sodium arsinate and Dieldrin

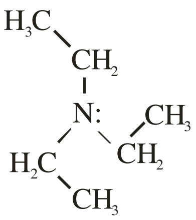
(D) Sodium chlorate and sodium arsinite.

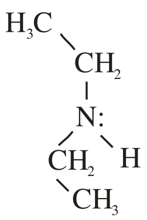
Official Ans. by NTA (D)

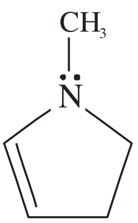
Allen Ans. (D)

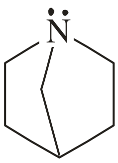
Sol. Both sodium chlorate and sodium arsenite behave as herbicide.

12. Which among the following is the strongest Bronsted base ?

(A) 

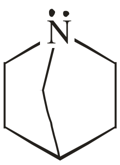
(B) 

(C) 

(D) 

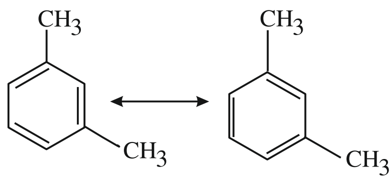
Official Ans. by NTA (D)

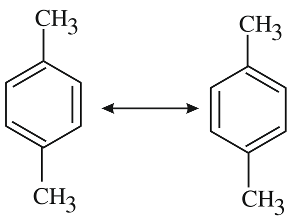
Allen Ans. (D)

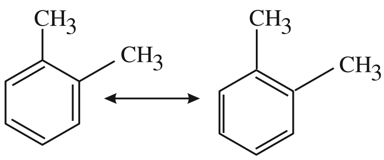
Sol. 

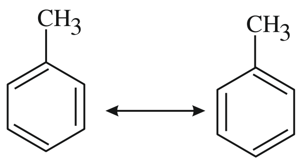
It is most basic because there is no amine inversion.

13. Which among the following pairs of the structures will give different products on ozonolysis? (Consider the double bonds in the structures are rigid and not delocalized.)

(A) 

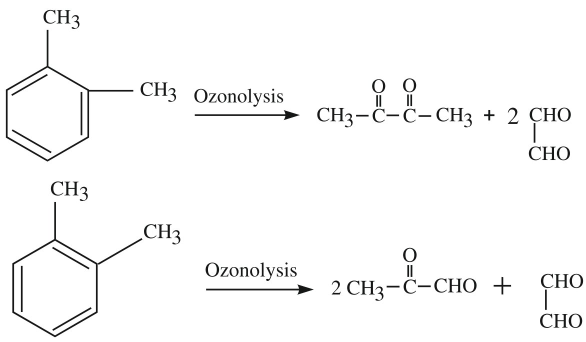
(B) 

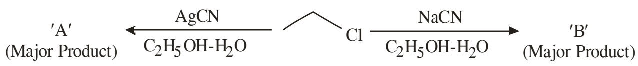
(C) 

(D) 

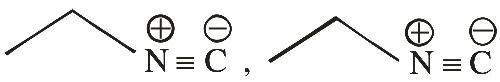
Official Ans. by NTA (C)

Allen Ans. (C)

Sol. 

14. 

Considering the above reactions, the compound 'A' and compound 'B' respectively are :

(A) 

(B) 

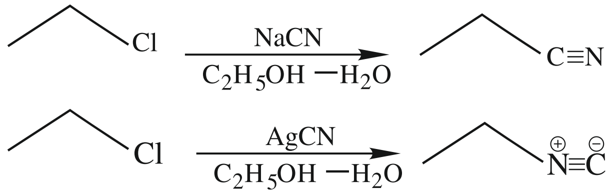
(C) 

(D) 

Official Ans. by NTA (C)

Allen Ans. (C)

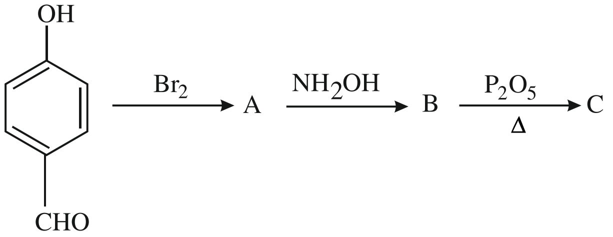
Sol.



In NaCN; carbon is more nucleophilic atom.

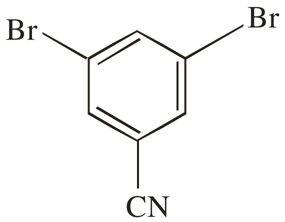
Whereas in AgCN; Ag – C has covalent bond.

15.

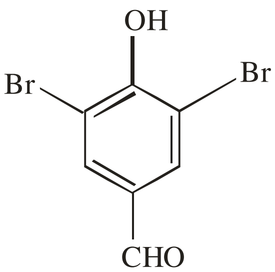


Consider the above reaction sequence, the Product 'C' is :

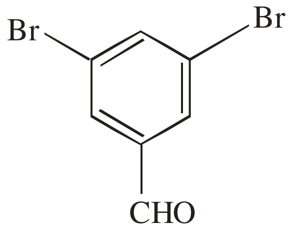
(A)



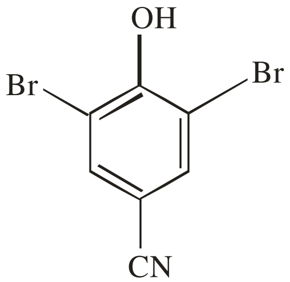
(B)



(C)

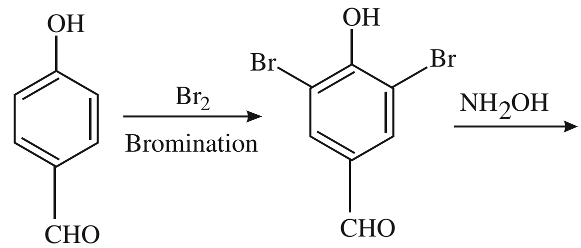


(D)

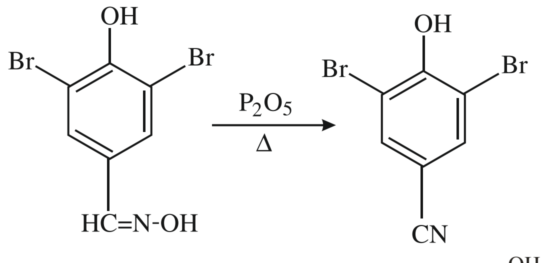


Official Ans. by NTA (D)
Allen Ans. (D)

Sol.

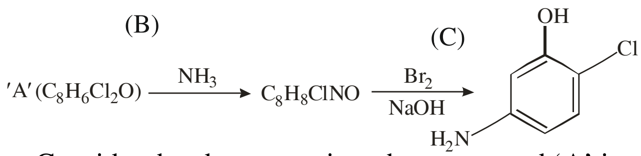


(A)



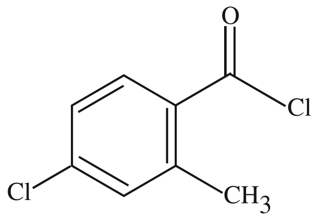
(B) (C)

16.

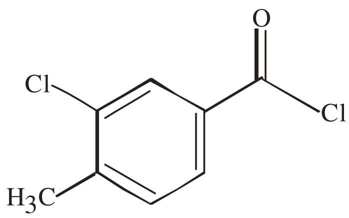


Consider the above reaction, the compound 'A' is :

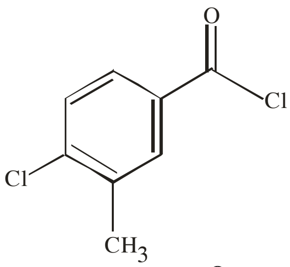
(A)



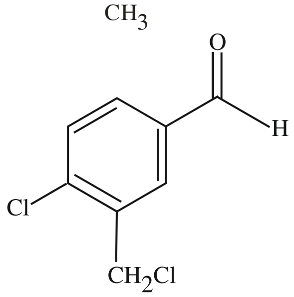
(B)



(C)

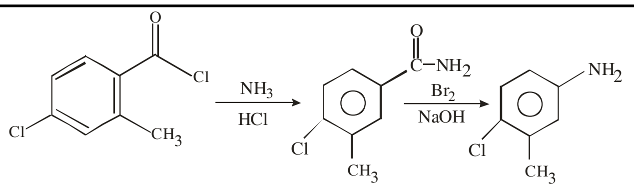


(D)

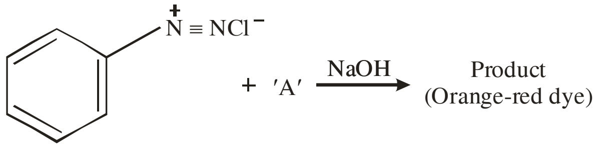


Official Ans. by NTA (C)
Allen Ans. (C)

Sol.

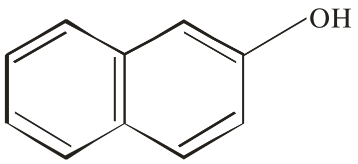


17.

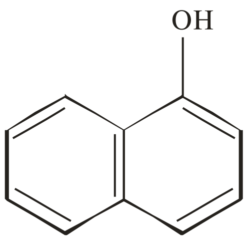


Which among the following represent reagent 'A'?

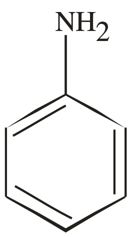
(A)



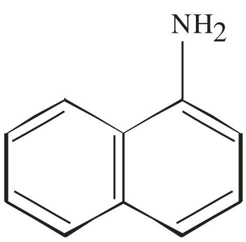
(B)



(C)



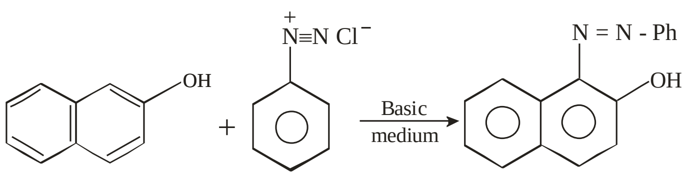
(D)



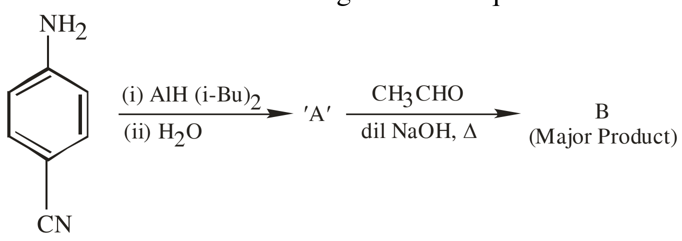
Official Ans. by NTA (A)

Allen Ans. (A)

Sol.

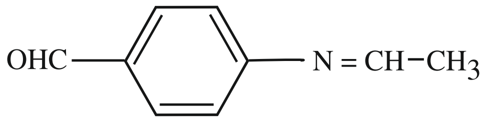


18. Consider the following reaction sequence :

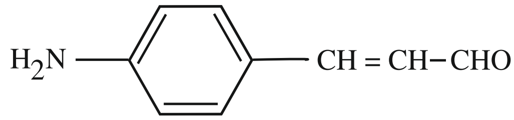


The product 'B' is :

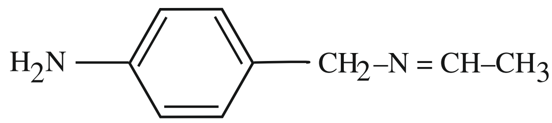
(A)



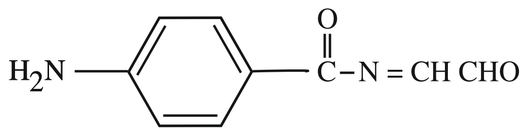
(B)



(C)



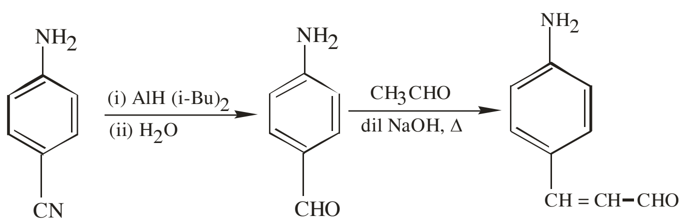
(D)



Official Ans. by NTA (B)

Allen Ans. (B)

Sol.



Cross aldol condensation

19. Which of the following compounds is an example of hypnotic drug ?

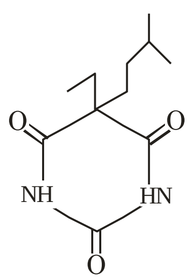
(A) Seldane (B) Amytal

(C) Aspartame (D) Prontosil

Official Ans. by NTA (B)

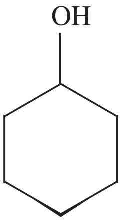
Allen Ans. (B)

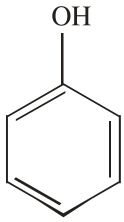
Sol. Amytal is hypnotic drug used to treat sleeping disorder.

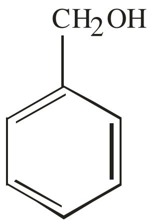


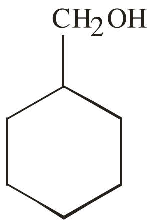
Amytal

20. A compound 'X' is acidic and it is soluble in NaOH solution, but insoluble in $NaHCO_3$ solution. Compound 'X' also gives violet colour with neutral $FeCl_3$ solution. The compound 'X' is :

(A) 

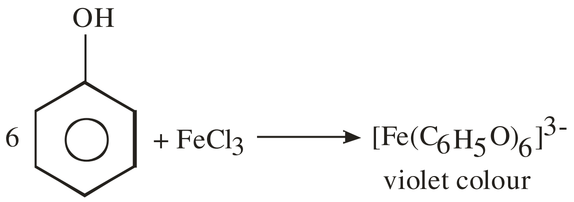
(B) 

(C) 

(D) 

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. 

SECTION-B

1. Resistance of a conductivity cell (cell constant 129 m^{-1}) filled with 74.5 ppm solution of KCl is 100 Ω (labelled as solution 1). When the same cell is filled with KCl solution of 149 ppm, the resistance is 50 Ω (labelled as solution 2). The ratio of molar conductivity of solution 1 and solution 2 is i.e. $\frac{\wedge_1}{\wedge_2} = x \times 10^{-3}$. The value of x is _____.

(Nearest integer)

Given, molar mass of KCl is 74.5 g mol^{-1}

Official Ans. by NTA (1000)

Allen Ans. (1000)

Sol. $\frac{\ell}{A} = 129 m^{-1}$

KCl solution 1 :

74.5 ppm, $R_1 = 100\,\Omega$

KCl solution 2 :

149 ppm, $R_2 = 50\,\Omega$

149 ppm, $R_2 = 50\,\Omega$

Here, $\frac{ppm_1}{ppm_2} = \frac{M_1}{M_2}\left(= \frac{W_1/M_0}{V} \times \frac{V}{W_2/M_0}\right)$

$$\frac{\wedge_1}{\wedge_2} = \frac{\kappa_1 \times \frac{1000}{M_1}}{\kappa_2 \times \frac{1000}{M_2}}$$

$$= \frac{\kappa_1}{\kappa_2} \times \frac{M_2}{M_1}$$

$$= \frac{50}{100} \times 2$$

$$= \frac{\wedge_1}{\wedge_2} = 1{,}000 \times 10^{-3}$$

Ans. 1,000

2. Ionic radii of cation A^+ and anion B^- are 102 and 181 pm respectively. These ions are allowed to crystallize into an ionic solid. This crystal has cubic close packing for B^-. A^+ is present in all octahedral voids. The edge length of the unit cell of the crystal AB is _____ pm. (Nearest Integer)

Official Ans. by NTA (512)

Allen Ans. (566)

Sol. $a = 2(r_+ + r_-)$

$a = 2\,(102 + 181)$

$a = 2(283)$

$a = 566$ pm

3. The minimum uncertainty in the speed of an electron in an one dimensional region of length $2a_O$ (Where a_0 = Bohr radius 52.9 pm) is _____km s^{-1}.

(Given : Mass of electron = 9.1×10^{-31} kg, Planck's constant h = 6.63×10^{-34} Js)

Official Ans. by NTA (548)

Allen Ans. (548)

Sol. Heisenberg's uncertainty principle

$$\Delta x \times \Delta p_x \geq \frac{h}{4\pi}$$

$$\Rightarrow 2a_0 \times m\Delta v_x = \frac{h}{4\pi}(\text{minimum})$$

$$\Rightarrow \Delta v_x = \frac{h}{4\pi} \times \frac{1}{2a_0} \times \frac{1}{m}$$

$$= \frac{6.63 \times 10^{-34}}{4 \times 3.14 \times 2 \times 52.9 \times 10^{-12} \times 9.1 \times 10^{-31}}$$

$= 548273 \text{ ms}^{-1}$

$= 548.273 \text{ km s}^{-1}$

$= \boxed{548} \text{ km s}^{-1}$

4. When 600 mL of 0.2 M HNO_3 is mixed with 400 mL of 0.1M NaOH solution in a flask, the rise in temperature of the flask is _______ $\times 10^{-2}$ ^{0}C.

(Enthalpy of neutralisation = 57 kJ $mo1^{-1}$ and Specific heat of water = 4.2 JK^{-1} g^{-1})

(Neglect heat capacity of flask)

Official Ans. by NTA (54)

Allen Ans. (54)

Sol.

HNO_3	NaOH
600 mL × 0.2 M	400 mL × 0.1 M
= 120 m mol	= 40 m mol

$HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$

Bef.	120	40		
Aft.	80	0		40 m mol

$$\Delta_r H = 40 \text{ m mol} \times (57 \times 10^3) \frac{J}{mol}$$

$$= 40 \times 10^{-3} \text{ mol} \times 57 \times 10^3 \frac{J}{mol}$$

= 2280 J

$m S\Delta T = 2280$

$$\Rightarrow 1000 \text{ mL} \times \frac{1gm}{mL} \times 4,2 \times \Delta T = 2280$$

$$\Delta T = \frac{2280}{4.2} \times 10^{-3}$$

$$= \frac{22800}{42} \times 10^{-3}$$

$= 542.86 \times 10^{-3}$

$\Delta T = 54.286 \times 10^{-2} K$

$\Delta T = 54.286 \times 10^{-2}\,^0C$

Ans. $\boxed{54.286}$

Answer mentioned as 54 (Closest integer)

5. If O_2 gas is bubbled through water at 303 K, the number of millimoles of O_2 gas that dissolve in 1 litre of water is_______. (Nearest Integer)

(Given : Henry's Law constant for O_2 at 303 K is 46.82 k bar and partial pressure of O_2 = 0.920 bar)

(Assume solubility of O_2 in water is too small, nearly negligible)

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. $p = K_H \times x$

$$\underset{bar}{0.920} = 46.82 \times 10^3 \text{ bar} \times \frac{\text{mol of } O_2}{\text{mol of } H_2O}$$

$$0.920 = 46.82 \times \cancel{10^3} \times \frac{\text{mol of } O_2}{\cancel{1000}/18}$$

$0.920 = 46.82 \times n_{O_2}$

$$p = \frac{0.920}{46.82 \times 18} = n_{O_2}$$

$\Rightarrow 1.09 \times 10^{-3} = n_{O_2}$

$\Rightarrow \text{m mol of } O_2 = 1$

6. If the solubility product of PbS is 8×10^{-28}, then the solubility of PbS in pure water at 298 K is $x \times 10^{-16}$ mol L^{-1}. The value of x is ________. (Nearest Integer)

[Given $\sqrt{2} = 1.41$]

Official Ans. by NTA (282)

Allen Ans. (282)

Sol. $K_{sp} = S^2$

$$S = \sqrt{K_{sp}} = \sqrt{8 \times 10^{-28}} = 2\sqrt{2} \times 10^{-14}$$

$$= 2.82 \times 10^{-14}$$

$$= 282 \times 10^{-16}$$

Ans. = 282

7. The reaction between X and Y is first order with respect to X and zero order with respect to Y.

Experiment	$\frac{[X]}{mol\,L^{-1}}$	$\frac{[Y]}{mol\,L^{-1}}$	$\frac{\text{Initial rate}}{mol\,L^{-1}\,min^{-1}}$
I.	0.1	0.1	2×10^{-3}
II.	L	0.2	4×10^{-3}
III.	0.4	0.4	$M \times 10^{-3}$
IV.	0.1	0.2	2×10^{-3}

Examine the data of table and calculate ratio of numerical values of M and L. (Nearest Inetger)

Official Ans. by NTA (40)

Allen Ans. (40)

Sol. $r = k\,[x]\,[y]^0 = k\,[x]$

Using I & II

$$\frac{4 \times 10^{-3}}{2 \times 10^{-3}} = \left(\frac{L}{0.1}\right) \Rightarrow L = 0.2$$

Using I & III

$$\frac{M \times 10^{-3}}{2 \times 10^{-3}} = \frac{0.4}{0.1} \Rightarrow M = 8$$

$$\frac{M}{L} = \frac{8}{0.2} = 40$$

Ans. 40

8. In a linear tetrapeptide (Constituted with different amino acids), (number of amino acids) - (number of peptide bonds) is______.

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. In Tetrapeptide,

No. of Amino Acids = 4

No. of Peptide bonds = 3

Hence

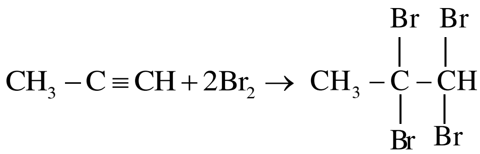
Ans. = 1

9. In bromination of Propyne, with Bromine 1, 1, 2, 2-tetrabromopropane is obtained in 27% yield. The amount of 1, 1, 2, 2 tetrabromopropane obtained from 1 g of Bromine in this reaction is ______ $\times$ 10^{-1} g. (Nearest integer)

(Molar Mass : Bromine = 80 g/mol)

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. 

$$= \frac{1}{160} \times \frac{1}{2} \times 360 \times 0.27$$

$$= 0.30375$$

$$= 3.0375 \times 10^{-1}$$

Ans. = 3

10. $[Fe(CN)_6]^{3-}$ should be an inner orbital complex. Ignoring the pairing energy, the value of crystal field stabilization energy for this complex is (–) _________ Δ_o. (Nearest integer)

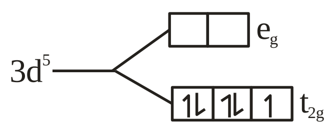
Official Ans. by NTA (2)

Allen Ans. (2)

Sol. $[Fe(CN)_6]^{3-}$

CN^- is strong field ligand

Fe^{+3} $3d^5$ (t_{2g}^5 e_g^0)



CFSE = 5 (–0.4 Δ_0) = –2.0 Δ_0

Ans. (2)