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JEE

(Main)

PAPER-1 (B.E./B. TECH.)

2022

COMPUTER BASED TEST (CBT) Questions & Solutions

Date: 29 July, 2022 (SHIFT-1) | TIME : (9.00 a.m. to 12.00 p.m)

Duration: 3 Hours | Max. Marks: 300






SUBJECT: CHEMISTRY

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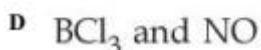
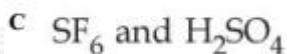
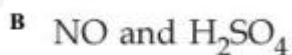
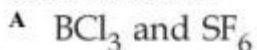
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PART : CHEMISTRY

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



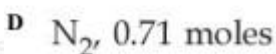
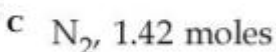
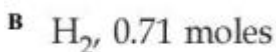
Ans. (B)

- Sol. (A) BCl_3 - Even electron molecules
 SF_6 - Expanded octet molecules
 (B) NO - Odd electron molecules
 H_2SO_4 - Expanded octet
 (C) SF_6 - Even electron molecules
 H_2SO_4 - Expanded octet
 (D) BCl_3 - Even electron molecules
 NO - odd electron molecules

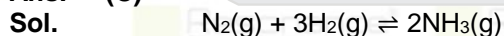


20 g 5 g

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



Ans. (C)



$w_2 = \frac{20}{28} \quad \frac{5}{2}$

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

Stoichiometric amount

$\text{N}_2 = \frac{20/80}{1} = \frac{20}{28} \quad \text{H}_2 = \frac{5/2}{3} = \frac{5}{6}$

$\therefore \text{N}_2$ is the limiting reagent

$\therefore n(\text{NH}_3) = 2 \times n(\text{N}_2) = 2 \times \frac{20}{28} = 1.42$

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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 :
- Lyophilic sol
 - Lyophobic sol
 - Emulsion
 - Precipitate

Ans. (A)

Sol. Given in Lab manual

This is process of Lyophilic sol formation.

4. The first ionization enthalpy of Na, Mg and Si, respectively, are : 496, 737 and 786 kJ mol⁻¹. The first ionization enthalpy (kJ mol⁻¹) of Al is :
- 487
 - 768
 - 577
 - 856

Ans. (C)

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

∴ 496 < I.E. (Al) < 737

Option (C), matches the condition

i.e. I.E. (Al) = 577 kJ mol⁻¹

5. In metallurgy the term "gangue" is used for :
- Contamination of undesired earthy materials.
 - Contamination of metals, other than desired metal.
 - Minerals which are naturally occurring in pure form
 - Magnetic impurities in an ore.

Ans. (A)

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

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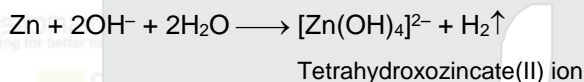
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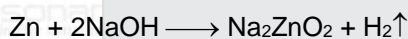
6. The reaction of zinc with excess of aqueous alkali, evolves hydrogen gas and gives :
- A $Zn(OH)_2$
- B ZnO
- C $[Zn(OH)_4]^{2-}$
- D $[ZnO_2]^{2-}$

Ans. NTA answer D, Resonance answer C & D.

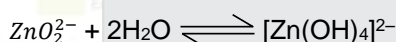
Sol. Zinc dissolves in excess of aqueous alkali.



However, this reaction in NCERT is given as



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



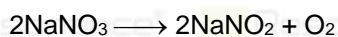
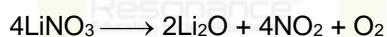
So in aqueous medium best answer of this question is $[Zn(OH)_4]^{2-}$.

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

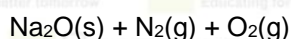
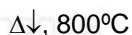
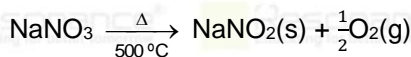
Ans. (C)

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.



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



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

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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

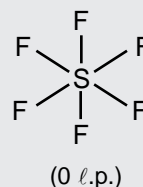
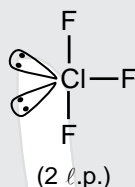
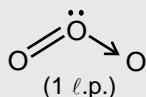
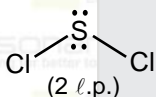
B 2, 1, 2 and 0

C 1, 2, 2 and 0

D 2, 1, 0 and 2

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+}

Ans. (A)

Sol.

(A) Sc^{3+} , Zn^{2+}
 $3d^0$, $3d^{10}$

(B) Ti^{4+} , Cu^{2+}
 $3d^0$, $3d^9$

(C) V^{2+} , Ti^{3+}
 $3d^3$, $3d^1$

(D) Zn^{2+} , Mn^{2+}
 $3d^{10}$, $3d^5$

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

Ans. (D)

Sol.



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

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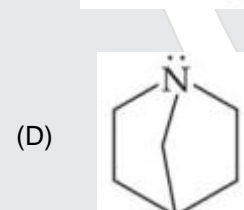
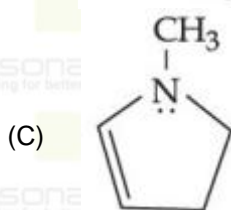
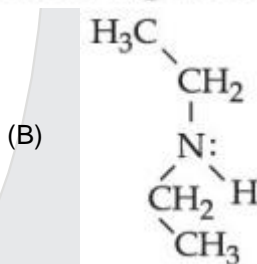
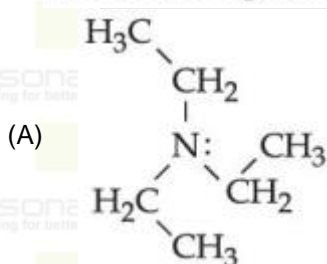
11. Which among the following pairs has only herbicides ?

- A Aldrin and Dieldrin
- B Sodium chlorate and Aldrin
- C Sodium arsenate and Dieldrin
- D Sodium chlorate and sodium arsenite.

Ans. (D)

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

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



Ans. (NTA answer D; Reso Answer B)

Sol. pK_a of conjugate acid of  = 11

pK_a of conjugate acid of  = 10.98

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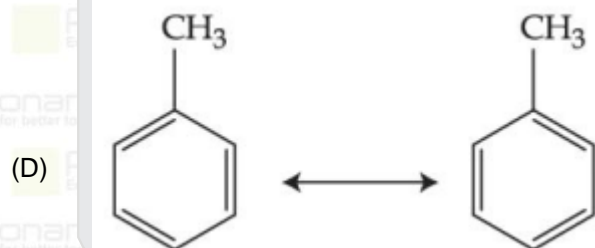
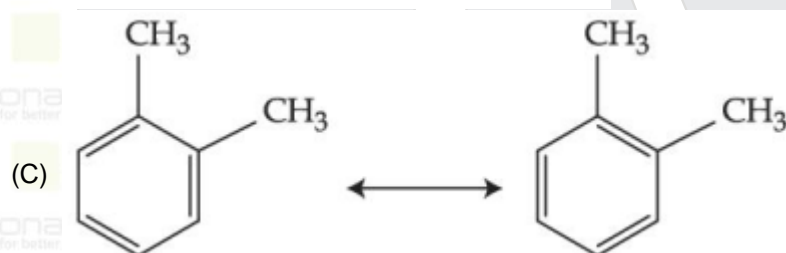
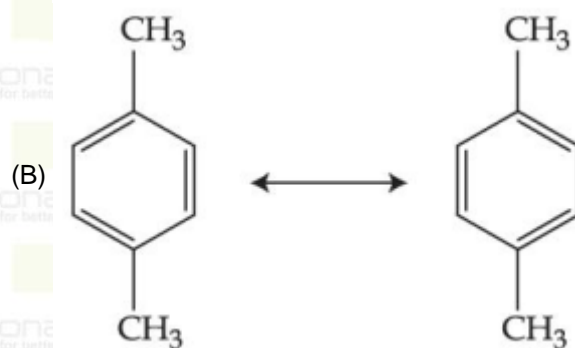
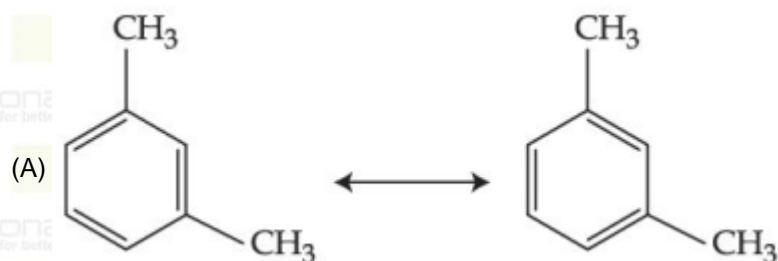
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13. Which among the following pairs of the structures will give different products on ozonolysis ? (Consider the double bonds in the structures are rigid and not delocalized.)



Ans. (C)

Sol. O-xylene has different resonating structures which will produce different ozonolysis products. m-xylene, p-xylene and toluene have identical resonating structures which will give identical ozonolysis products.

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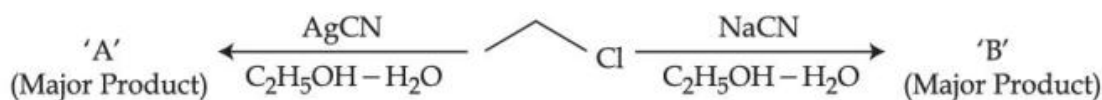
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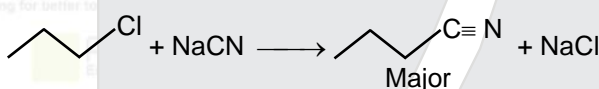
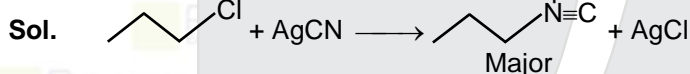
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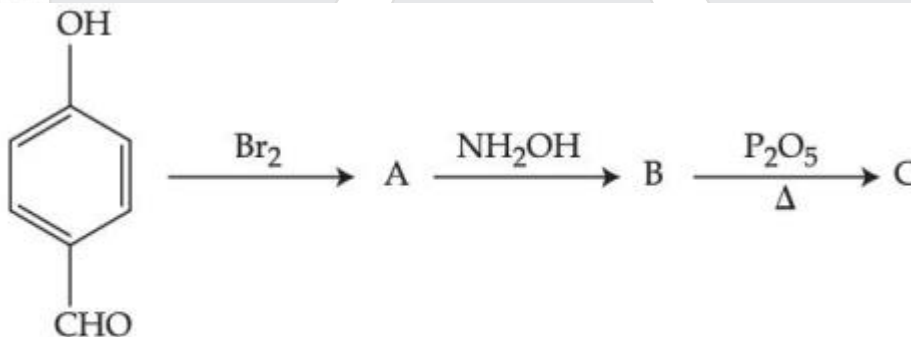
Considering the above reactions, the compound 'A' and compound 'B' respectively are :



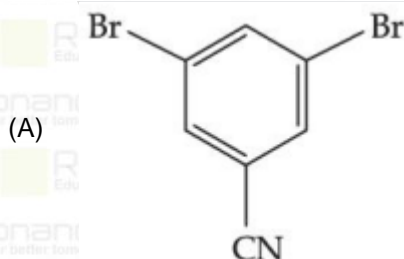
Ans. (C)



15.



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



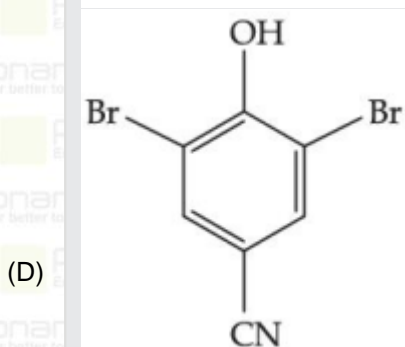
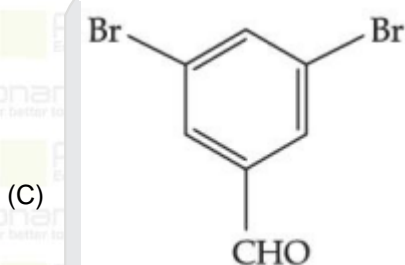
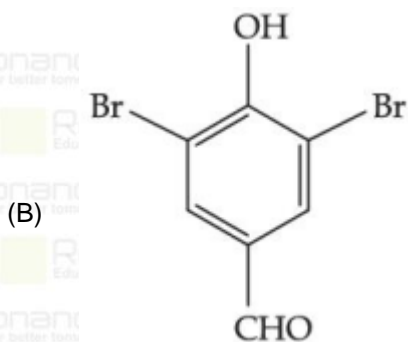
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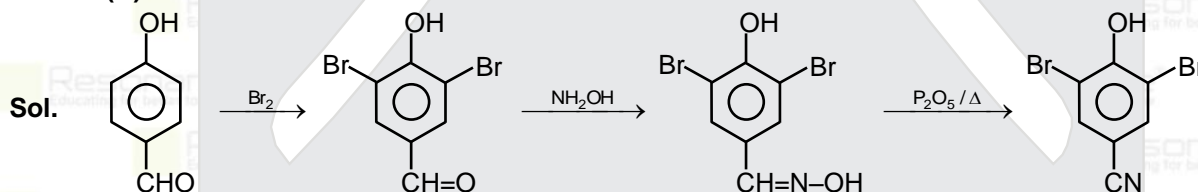
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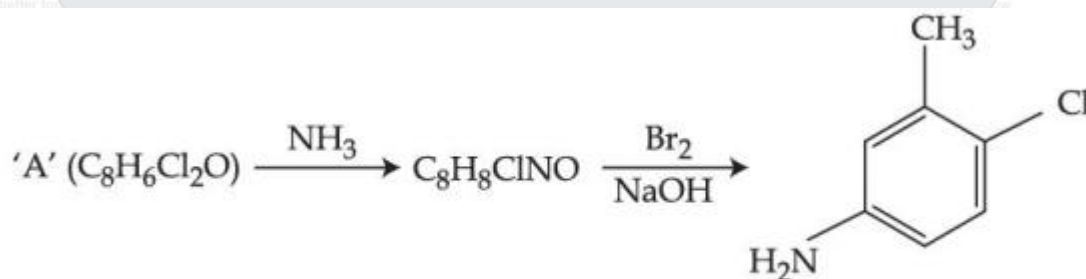
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Ans. (D)



16.



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

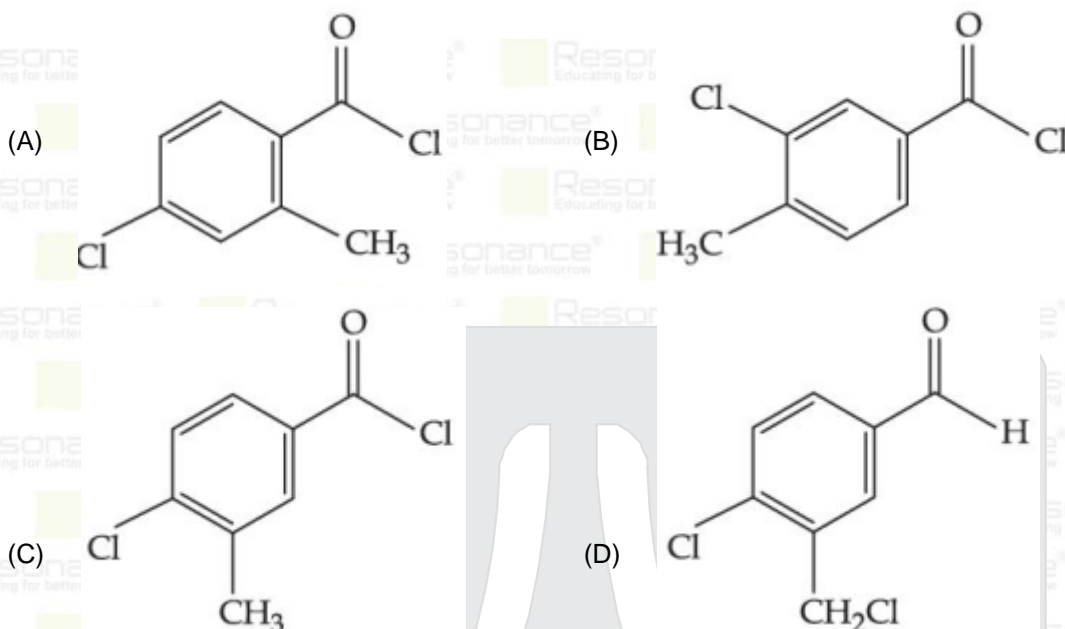
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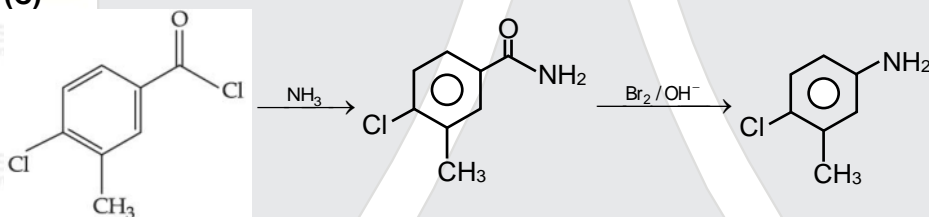
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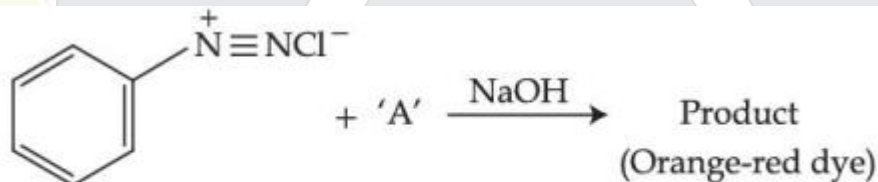


Ans. (C)

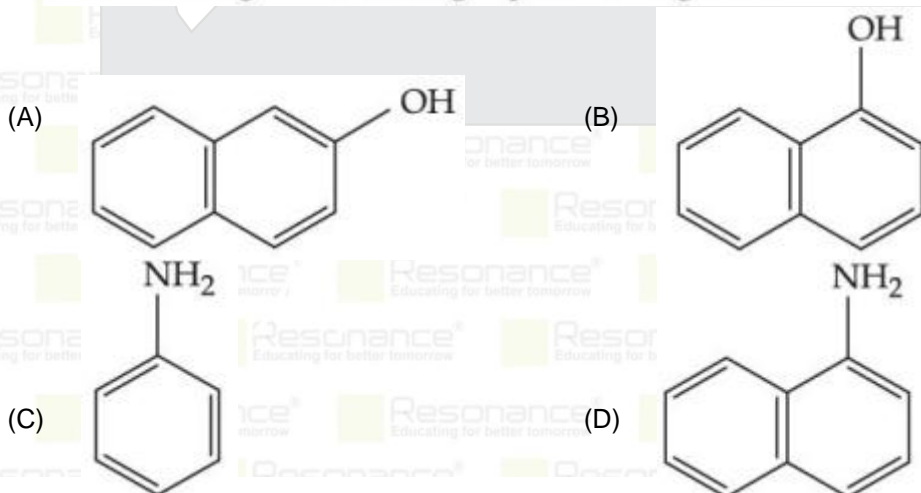
Sol.



17.



Which among the following represent reagent 'A' ?



Ans. (A)

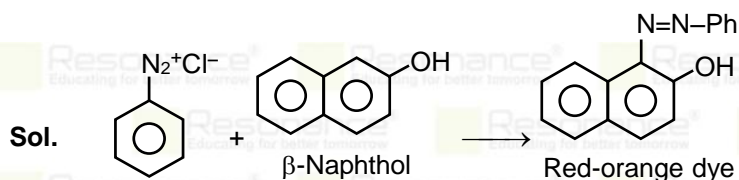
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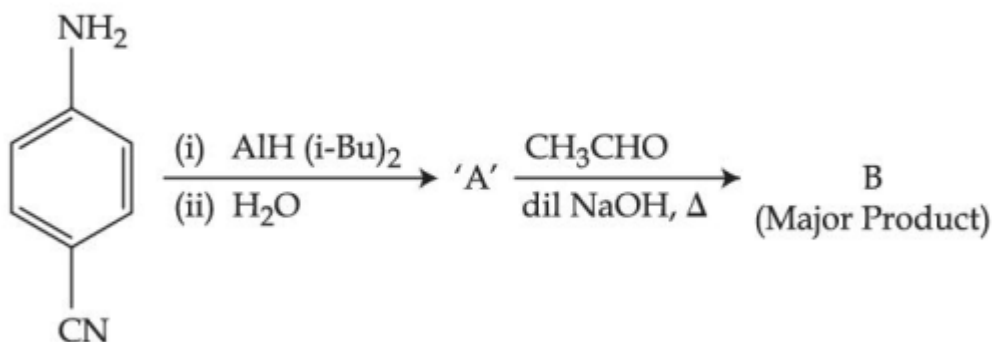
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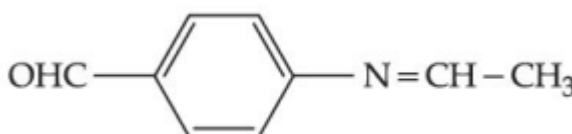
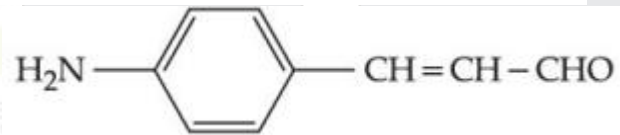
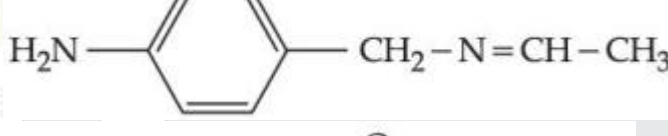
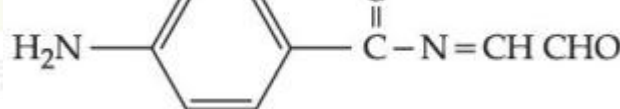
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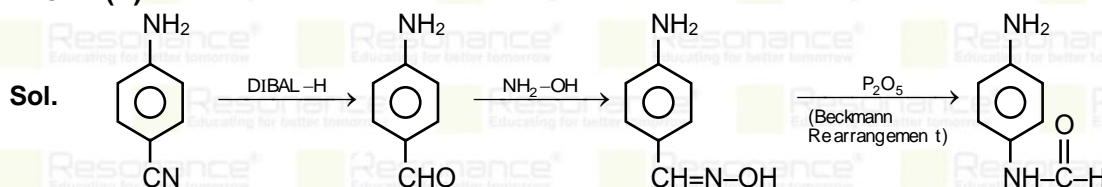
18. Consider the following reaction sequence :



The product 'B' is :

- (A)  O=Cc1ccc(N=CC)cc1
- (B)  Nc1ccc(C=CC=O)cc1
- (C)  Nc1ccc(C=CC(=O)N)cc1
- (D)  Nc1ccc(C=CC=O)cc1

Ans. (B)








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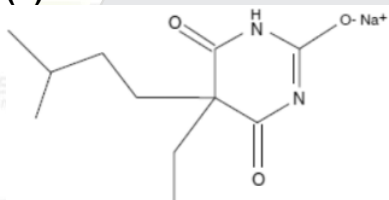
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19. Which of the following compounds is an example of hypnotic drug ?

- A Seldane
B Amytal
C Aspartame
D Prontosil

Ans. (B)

Sol.

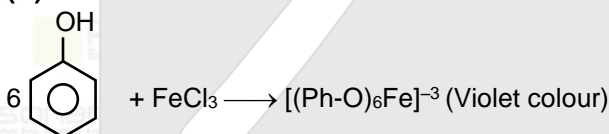


20. A compound 'X' is acidic and it is soluble in NaOH solution, but insoluble in NaHCO₃ solution. Compound 'X' also gives violet colour with neutral FeCl₃ solution. The compound 'X' is :

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

Ans. (B)

Sol.



21. 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. $\frac{\Lambda_1}{\Lambda_2} = x \times 10^{-3}$. The value of x is _____. (Nearest integer)

Given, molar mass of KCl is 74.5 g mol⁻¹.

Ans. (1000)

Sol.

$$\frac{l}{A} = 129 \text{ m}^{-1}$$

KCl solution 1 ⇒ 74.5 ppm, R₁ = 100 Ω

KCl solution 2 ⇒ 149 ppm, R₂ = 50 Ω

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$$\text{Here, } \frac{ppm_1}{ppm_2} = \frac{M_1}{M_2} = \left(\frac{w_1/M_0}{V} \times \frac{V}{w_2/M_0} \right)$$

$$\frac{\Lambda_1}{\Lambda_2} = \frac{k_1 \times \frac{1000}{M_1}}{k_2 \times \frac{1000}{M_2}}$$

$$= \frac{k_1}{k_2} \times \frac{M_1}{M_2}$$

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

$$= \frac{\Lambda_1}{\Lambda_2} = 1000 \times 10^{-3}$$

$$= 1000 \text{ Ans.}$$

22. 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)

Ans. (NTA answer 512, Resonance answer 566)

Sol. $a = 2(r_+ + r_-)$
 $a = 2(102 + 181)$
 $a = 2(283)$
 $a = 566 \text{ pm}$

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

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

Ans. (548)

Sol. Heisenberg's uncertainty principle

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

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

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

$$= 6.63 \times 10^{-34}$$

$$4 \times 3.14 \times 2 \times 52.9 \times 10^{-12} \times 9.1 \times 10^{-31}$$

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

$$= 548.273 \text{ kms}^{-1}$$

$$= 548 \text{ kms}^{-1}$$

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

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

(Neglect heat capacity of flask)

Ans. (54)

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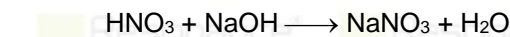
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Sol. HNO_3 NaOH
600 ml \times 0.2 M 400 ml \times 0.1 M
= 120 m mol = 40 m mol



Bef. 120 40
aft. 80 0 40 m mol

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

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

$$= 2280 \text{ J}$$

$$m\Delta T = 2280$$

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

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

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

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

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

$$\Delta T = 54.286 \times 10^{-20} \text{ C}$$

Ans. 54.286 \approx 54

25. 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 $\text{O}_2 = 0.920$ bar)

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

Ans. (1)

Sol. $P = K_H \times X$

$$0.920 \text{ bar} = 46.82 \times 10^3 \text{ bar} \times \frac{\text{mol of } \text{O}_2}{\text{mol of } \text{H}_2\text{O}}$$

$$0.920 = 46.82 \times 10^3 \times \frac{\text{mol of } \text{O}_2}{1000/18}$$

$$0.920 = 46.82 \times n_{\text{O}_2}$$

$$P = \frac{0.920}{46.82 \times 18} = n_{\text{O}_2}$$

$$\Rightarrow 1.09 \times 10^{-3} n_{\text{O}_2}$$

$$\Rightarrow m \text{ mol of } \text{O}_2 = 1$$

26. 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 : $\sqrt{2} = 1.41$]

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

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

Experiment	[X] mol L ⁻¹	[Y] mol L ⁻¹	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 × 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 Integer)

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

28. In a linear tetrapeptide (Constituted with different amino acids), (number of amino acids) – (number of peptide bonds) is _____.

Ans. (1)

Sol. In tetrapeptide

No. of amino acids = 4

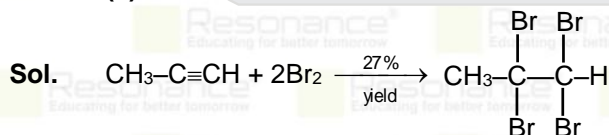
No. of peptide bonds = 3

Hence, (1)

29. 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 _____ × 10⁻¹ g. (Nearest integer)

(Molar Mass : Bromine = 80 g/mol)

Ans. (3)



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

$$= 0.30375$$

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

Ans. 3

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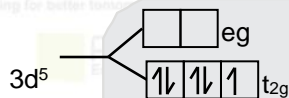
30. $[\text{Fe}(\text{CN})_6]^{3-}$ should be an inner orbital complex. Ignoring the pairing energy, the value of crystal field stabilization energy for this complex is $(-)$ _____ Δ_0 .
(Nearest integer)

Ans. (1)

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

CN^- is strong field ligand

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



$$\text{CFSE} = 5 (-0.4\Delta_0)$$

$$= -2.0 \Delta_0$$

Ans. (2)

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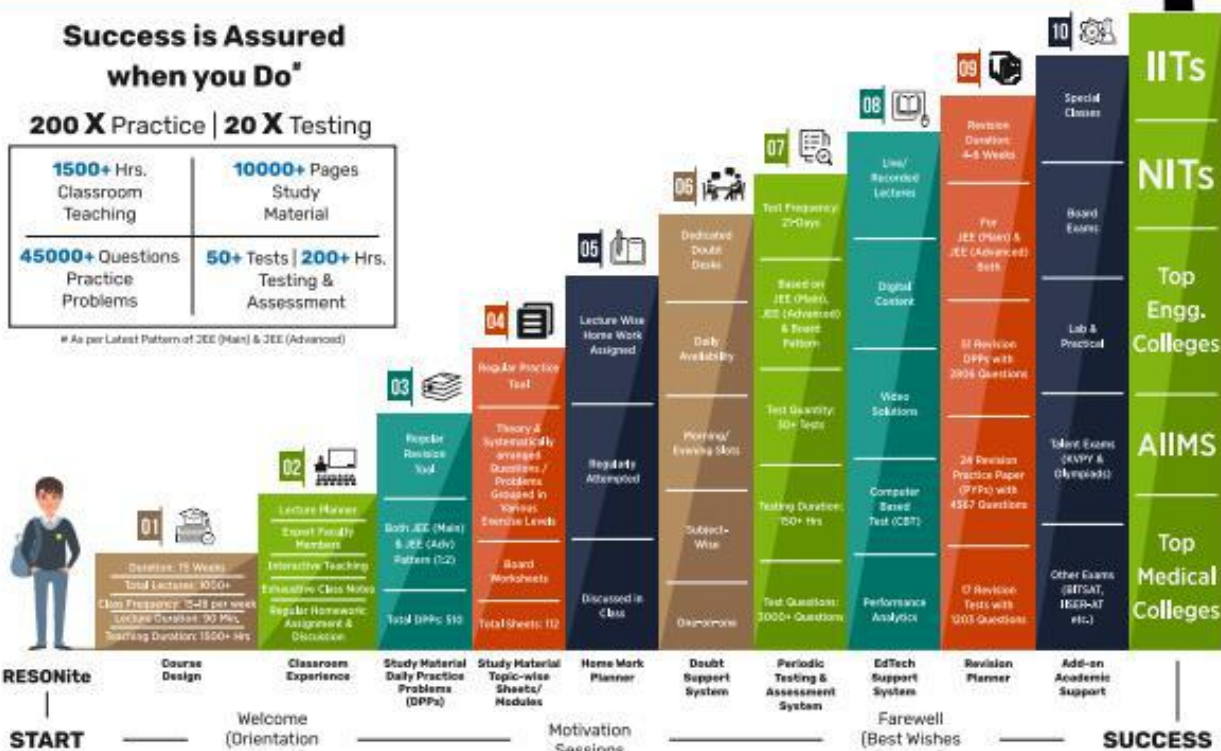
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