

CHEMISTRY
TEST PAPER WITH SOLUTION
SECTION-A

1. The number of radial and angular nodes in 4d orbital are, respectively

(A) 1 and 2 (B) 3 and 2
(C) 1 and 0 (D) 2 and 1

Official Ans. by NTA (A)

Ans. (A)

Sol. Radial node = $n - l - 1$
 $= 4 - 2 - 1$
 $= 1$

Angular node (l) = 2

2. Match List I with List II.

List I Enzyme	List II Conversion of
A. Invertase	I. Starch into maltose
B. Zymase	II. Maltose into glucose
C. Diastase	III. Glucose into ethanol
D. Maltase	IV. Cane sugar into glucose

Choose the most appropriate answer from the options given below :

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

Official Ans. by NTA (C)

Ans. (C)

Sol. Invertase : Cane sugar → Glucose and fructose

Zymase : Glucose → Ethanol and CO₂

Diastase : Starch → Maltose

Maltase : Maltose → Glucose

3. Which of the following elements is considered as a metalloid?

(A) Sc (B) Pb (C) Bi (D) Te

Official Ans. by NTA (D)

Ans. (D)

Sol. Sc, Pb, Bi are metals
 Te is a metalloid

4. The role of depressants in Froth Flotation method* is to

(A) selectively prevent one component of the ore from coming to the froth.
 (B) reduce the consumption of oil for froth formation.
 (C) stabilize the froth.
 (D) enhance non-wettability of the mineral particles.

Official Ans. by NTA (A)

Ans. (A)

- Sol.** Depressant prevent one component from coming to the froth.

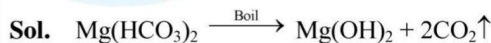
For eg., in Galena ore, the depressant (NaCN) prevents impurity (ZnS) from coming to the froth.

5. Boiling of hard water is helpful in removing the temporary hardness by converting calcium hydrogen carbonate and magnesium hydrogen carbonate to

(A) CaCO₃ and Mg(OH)₂
 (B) CaCO₃ and M₂CO₃
 (C) Ca(OH)₂ and MgCO₃
 (D) Ca(OH)₂ and Mg(OH)₂

Official Ans. by NTA (A)

Ans. (A)



6. s-block element which cannot be qualitatively confirmed by the flame test is

(A) Li (B) Na (C) Rb (D) Be

Official Ans. by NTA (D)

Ans. (D)

Sol. **Flame color**

Li Crimson Red

Na Yellow

Rb Red violet

Be No color

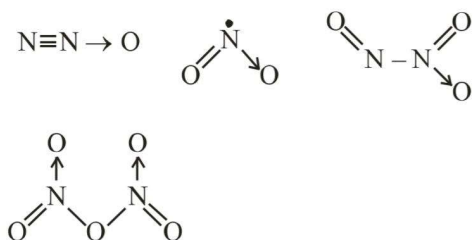
7. The oxide which contains an odd electron at the nitrogen atom is

- (A) N_2O (B) NO_2 (C) N_2O_3 (D) N_2O_5

Official Ans. by NTA (B)

Ans. (B)

Sol.



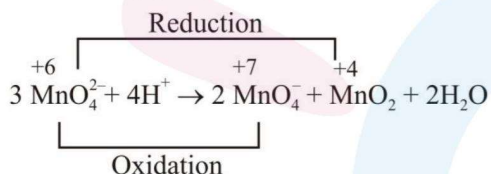
8. Which one of the following is an example of disproportionation reaction?

- (A) $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$
 (B) $MnO_4^{2-} + 4H^+ + 4e^- \rightarrow MnO_2 + 2H_2O$
 (C) $10I^- + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5I_2$
 (D) $8MnO_4^- + 3S_2O_3^{2-} + H_2O \rightarrow 8MnO_2 + 6SO_4^{2-} + 2OH^-$

Official Ans. by NTA (A)

Ans. (A)

Sol.



9. The most common oxidation state of Lanthanoid elements is +3. Which of the following is likely to deviate easily from +3 oxidation state?

- (A) Ce (At. No. 58) (B) La (At. No. 57)
 (C) Lu (At. No. 71) (D) Gd (At. No. 64)

Official Ans. by NTA (A)

Ans. (A)

Sol. $Ce = [Xe] 4f^1 5d^1 6s^2$

$Ce^{3+} = [Xe] 4f^1 5d^0$

$Ce^{+4} = [Xe] 4f^0 5d^0$ (Noble gas configuration)

10. The measured BOD values for four different water samples (A-D) are as follows:

A = 3 ppm; B = 18 ppm; C = 21 ppm; D = 4 ppm. The water samples which can be called as highly polluted with organic wastes, are

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

Official Ans. by NTA (C)

Ans. (C)

Sol. Clean water \rightarrow B.O.D. < 5 ppm

Highly polluted water \rightarrow B.O.D. > 17 ppm

11. The correct order of nucleophilicity is

- (A) $F^- > OH^-$ (B) $H_2\ddot{O} > OH^-$
 (C) $R\ddot{O}H > RO^-$ (D) $NH_2^- > NH_3$

Official Ans. by NTA (D)

Ans. (D)

Sol. Nucleophilicity \propto electro density on donor atom
 \propto size of donor atom (in gas)

$$\propto \frac{1}{EN \text{ of atom}} \quad (\text{for period})$$

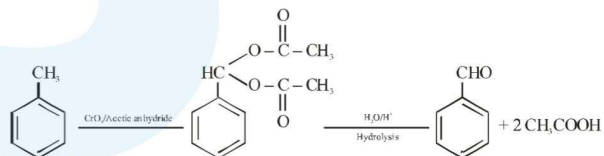
12. Oxidation of toluene to Benzaldehyde can be easily carried out with which of the following reagents?

- (A) CrO_3 /acetic acid, H_3O^+
 (B) CrO_3 /acetic anhydride, H_3O^+
 (C) $KMnO_4$ /HCl, H_3O^+
 (D) CO /HCl, anhydrous $AlCl_3$

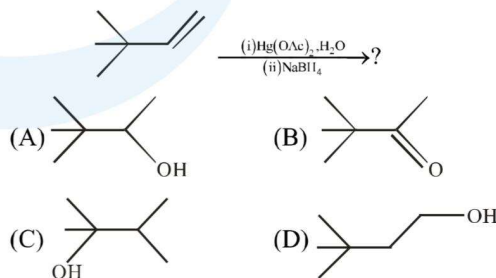
Official Ans. by NTA (B)

Ans. (B)

Sol.

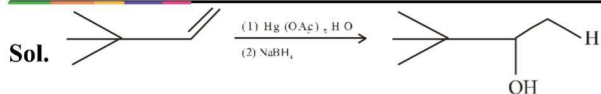


13. The major product in the following reaction



Official Ans. by NTA (A)

Ans. (A)

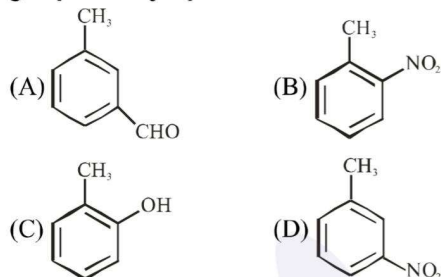


Oxymercuration – Demercuration

Addition of H₂O

Markovnikov's addition without rearrangement

14. Halogenation of which one of the following will yield m-substituted product with respect to methyl group as a major product?

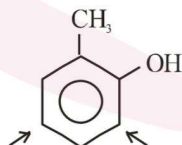


Official Ans. by NTA (C)

Ans. (C)

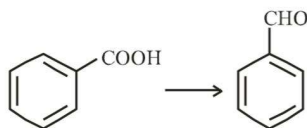
- Sol. Electrophile will attack at ortho and para position with respect to better electron releasing group (ERG)

ERG : -OH > -CH₃



Para position with respect to -OH (+R) group and it will be meta position with respect to -CH₃ group.

15. The reagent, from the following, which converts benzoic acid to benzaldehyde in one step is

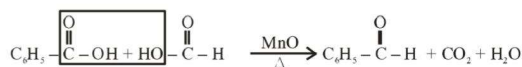
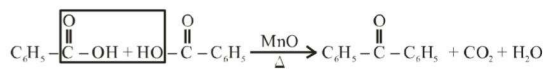


- (A) LiAlH₄ (B) KMnO₄
 (C) MnO (D) NaBH₄

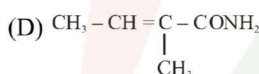
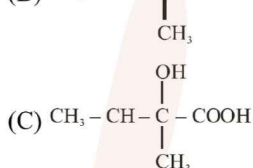
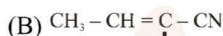
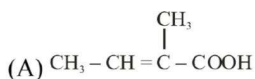
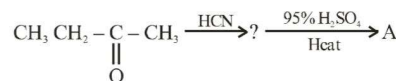
Official Ans. by NTA (C)

Ans. (D)

Sol.



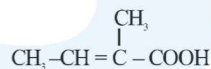
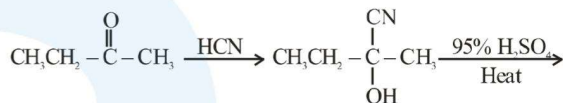
16. The final product 'A' in the following reaction sequence



Official Ans. by NTA (A)

Ans. (A)

Sol.



17. Which statement is NOT correct for p-toluenesulphonyl chloride?

- (A) It is known as Hinsberg's reagent.
 (B) It is used to distinguish primary and secondary amines.
 (C) On treatment with secondary amine, it leads to a product, that is soluble in alkali.
 (D) It doesn't react with tertiary amines.

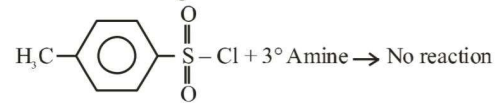
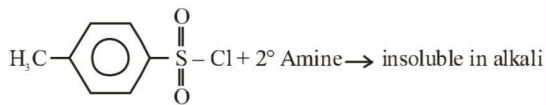
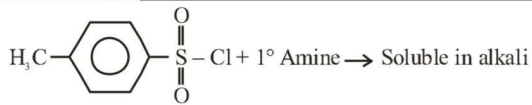
Official Ans. by NTA (C)

Ans. (C)

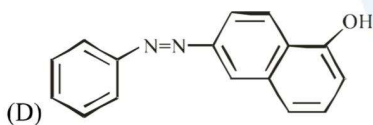
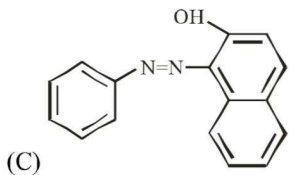
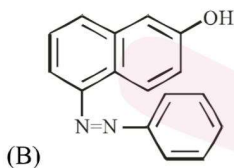
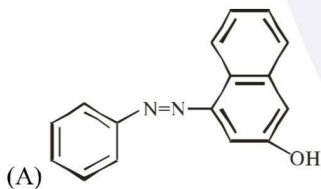
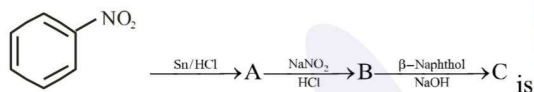
Sol.



Hinsberg's reagent

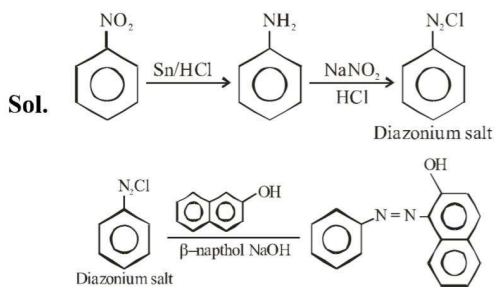


18. The final product 'C' is the following series series of reactions

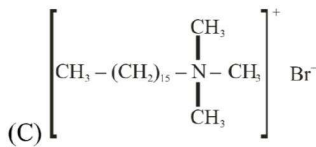
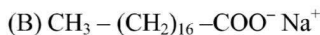
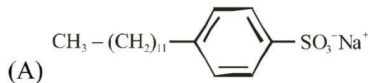


Official Ans. by NTA (C)

Ans. (D)



19. Which of the following is NOT an example of synthetic detergent?



Official Ans. by NTA (B)

Ans. (B)

Sol. Refer NCERT (Page No. 452)

20. Which one of the following is a water soluble vitamin, that is not excreted easily?

- (A) Vitamin B₂ (B) Vitamin B₁
(C) Vitamin B₆ (D) Vitamin B₁₂

Official Ans. by NTA (D)

Ans. (D)

Sol. Refer NCERT (Page No. 426)

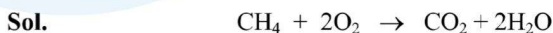
SECTION-B

1. CNG is an important transportation fuel. When 100 g CNG is mixed with 208 oxygen in vehicles, it leads to the formation of CO₂ and H₂O and produces large quantity of heat during this combustion, then the amount of carbon dioxide, produced in grams is _____. [nearest integer]

[Assume CNG to be methane]

Official Ans. by NTA (143)

Ans. (143)



	$\frac{100}{16}$	$\frac{208}{32}$	
Mole			
	= 6.25	= 6.5	

$\frac{\text{Mole}}{\text{Stoi. Coeff.}}$	$\frac{6.25}{1}$	$\frac{6.5}{2}$	= 3.25
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So, O₂ is limiting reagent

Mole – Mole analysis

$$\frac{n_{\text{O}_2}}{2} = \frac{n_{\text{CO}_2}}{1}$$

$$\frac{6.5}{2} = n_{\text{CO}_2}$$

$$\text{Mass of CO}_2 = \frac{6.5}{2} \times 44 = 143 \text{ gm}$$

2. In a solid AB. A atoms are in ccp arrangement and B atoms occupy all the octahedral sites. If two atoms from the opposite faces are removed, then the resultant stoichiometry of the compound is A_xB_y . The value of x is _____. [nearest integer]

Official Ans. by NTA (3)

Ans. (3)

Sol. $A \rightarrow 4 - \left(2 \times \frac{1}{2}\right) = 3$

$$B \rightarrow 12 \times \frac{1}{4} + 1 \times 1 = 4$$

So, Compound is A_3B_4

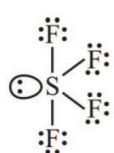
The value of x is 3.

3. Amongst SF_4 , XeF_4 , CF_4 and H_2O , the number of species with two lone pairs of electrons _____.

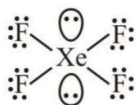
Official Ans. by NTA (3)

Ans. (1)

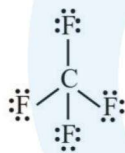
Sol.



Total lone pairs = 13

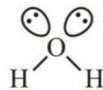


Total lone pairs = 14



Total lone pairs = 12

Total lone pairs = 2



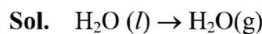
4. A fish swimming in water body when taken out from the water body is covered with a film of water of weight 36 g. When it is subjected to cooking at 100°C , then the internal energy for vaporization in kJ mol^{-1} is _____. [nearest integer]

[Assume steam to be an ideal gas. Given $\Delta_{\text{vap}}H^\ominus$

for water at 373 K and 1 bar is 41.1 kJ mol^{-1} ; $R = 8.31 \text{ JK}^{-1}\text{mol}^{-1}$]

Official Ans. by NTA (38)

Ans. (38)



$$n = \frac{36}{18} = 2 \text{ mol}$$

$$\Delta U = \Delta H - \Delta n_g RT$$

$$= 41.1 - \frac{1 \times 8.31 \times 373}{1000} \text{ kJ/mol}$$

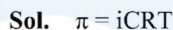
$$= 38 \text{ kJ/mol}$$

5. The osmotic pressure exerted by a solution prepared by dissolving 2.0 g of protein of molar mass 60 kg mol^{-1} in 200 mL of water at 27°C is _____ Pa. [integer value]

(use $R = 0.083 \text{ L bar mol}^{-1} \text{ K}^{-1}$)

Official Ans. by NTA (415)

Ans. (415)



$$= \frac{1 \times 2}{60000 \times 0.2} \times 0.083 \times 300$$

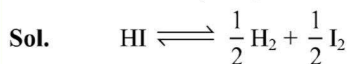
$$= 0.00415 \text{ bar} \quad (\because 1 \text{ bar} = 10^5 \text{ Pa})$$

So, $0.00415 \times 10^5 \text{ Pa} = 415 \text{ Pa}$

6. 40° of HI undergoes decomposition to H_2 and I_2 at 300 K . ΔG^\ominus for this decomposition reaction at one atmosphere pressure is _____ J mol^{-1} . [nearest integer]
(Use $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$; $\log 2 = 0.3010$. $\ln 10 = 2.3$, $\log 3 = 0.477$)

Official Ans. by NTA (2735)

Ans. (2735)



$$t_i \quad 1$$

$$t_{eq} \quad 1 - 0.4 \quad \frac{0.4}{2} \quad \frac{0.4}{2}$$

$$K_p = \frac{(0.2)^2 (0.2)^2}{1 - 0.4} = \frac{0.2}{0.6} = \frac{1}{3}$$

$$\Delta G = \Delta G^\circ + RT \ln K = 0$$

$$\Delta G^\circ = -RT \ln K \Rightarrow -8.31 \times 300 \times 2.3 \times \log\left(\frac{1}{3}\right)$$

$$= 2735 \text{ J/mol}$$



The Gibbs free energy change for the above reaction at 298 K is $x \times 10^{-1} \text{ kJ mol}^{-1}$;

The value of x is _____. [nearest integer]

[Given: $E_{\text{Cu}^{2+}/\text{Cu}}^\circ = 0.34\text{V}$; $E_{\text{Sn}^{2+}/\text{Sn}}^\circ = -0.14\text{V}$; $F = 96500 \text{ C mol}^{-1}$]

Official Ans. by NTA (983)

Ans. (983)



$$E_{\text{cell}}^\circ = E_{\text{cathode}}^\circ - E_{\text{anode}}^\circ$$

$$= -0.14 - (0.34)$$

$$= -0.48 \text{ V}$$

$$E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{0.059}{2} \log \frac{[\text{Cu}^{2+}]}{[\text{Sn}^{2+}]}$$

$$= -0.48 - \frac{0.059}{2} \log \frac{0.01}{0.001}$$

$$= -0.509$$

$$\Delta G = -nF E_{\text{cell}}$$

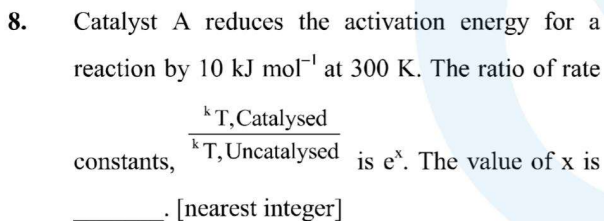
$$= -2 \times 96500 \times (-0.5095)$$

$$= 98333.5 \text{ J/mol}$$

$$= 98.335 \text{ kJ/mol}$$

$$= 983.35 \times 10^{-1} \text{ kJ/mol}$$

Nearest Integer : 983



[Assume that the pre-exponential factor is same in both the cases.]

Given $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$

Official Ans. by NTA (4)

Ans. (4)

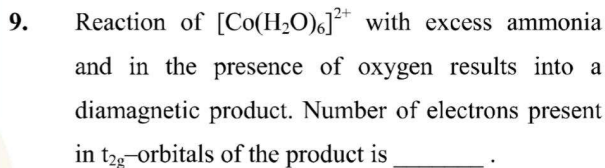
Sol.

$$K = A e^{\frac{-E_a}{RT}}$$

$$K_{\text{cat}} = A e^{\frac{-E_a}{RT}}, \quad K_{\text{uncat.}} = A e^{\frac{-E_a}{RT}}$$

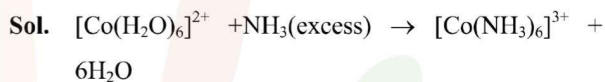
$$\frac{K_{\text{cat}}}{K_{\text{uncat.}}} = e^{\frac{E_a - E_a'}{RT}} = e^{\frac{10 \times 1000}{8.31 \times 300}} = e^{4.009} = e^x$$

$$\therefore x = 4$$



Official Ans. by NTA (6)

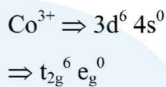
Ans. (6)



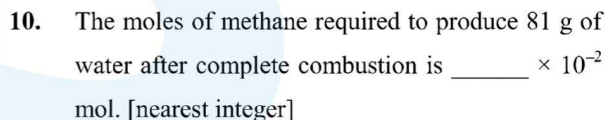
Diamagnetic



Low spin complex

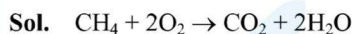


Total number electrons = 6



Official Ans. by NTA (225)

Ans. (225)



POAC on H atom

$$n_{\text{CH}_4} \times 4 = n_{\text{H}_2\text{O}} \times 2$$

$$n_{\text{CH}_4} = \frac{81}{18} \times 2 \times \frac{1}{4} = \frac{81}{36}$$

$$n_{\text{CH}_4} = 2.25$$

$$= 225 \times 10^{-2}$$

Nearest Integers = 225