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

JEE (Main) 2021

Questions & Solutions

(Reproduced from memory retention)

Date : 25 February, 2021 (SHIFT-2) Time ; (3.00 pm to 6.00 pm)

Duration : 3 Hours | Max. Marks : 300

SUBJECT : CHEMISTRY

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CHEMISTRY

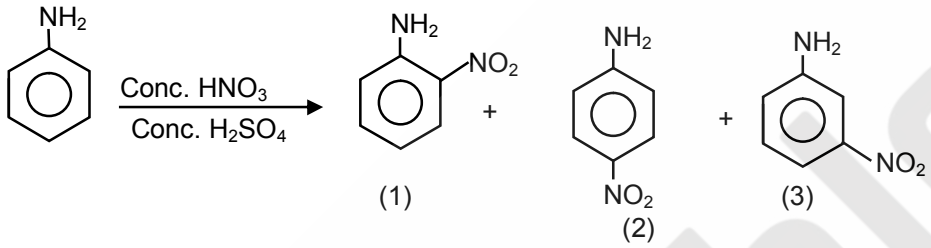
1. $HO–CH_2–CH_2–OH + HOOC–COOH \xrightarrow{210°C}$ Major product is :

(1)  (2) $CH_2=CH_2$ (3)  (4) 

Ans. **(2)**

Sol. $HO–CH_2–CH_2–OH + HOOC–COOH \xrightarrow{210°C} CH_2=CH_2$

2. Which of the following statement is correct for the given reaction ?



(1) NH_2 group is ortho-para directing & product (3) would not form.

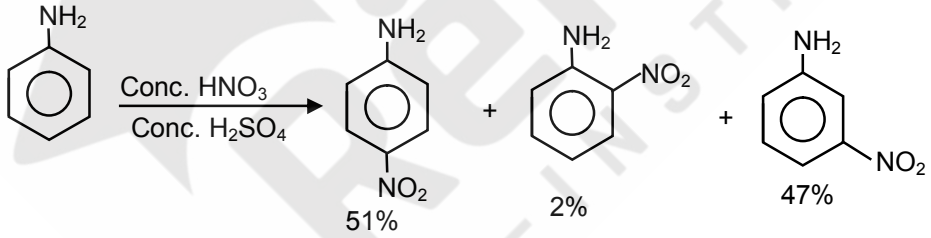
(2) Reaction is possible and (2) is major product.

(3) Product (3) is major product.

(4) Sulfonation takes place rather than nitration.

Ans. **(2)**

Sol.



In acidic medium, aniline is converted into anilinium ion which is meta directing so meta product is formed in significant amount.

3. **Statement –I** : Normal rain water pH is 5.6

Statement – II : Acidic rain water pH is less than 5.6

(1) Statement I is true ,Statement II is false

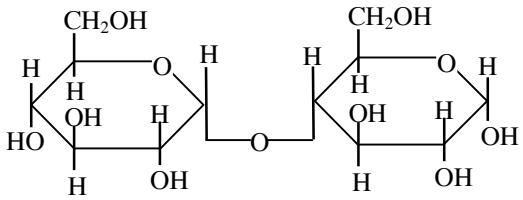
(2) Statement I is false ,Statement II is true

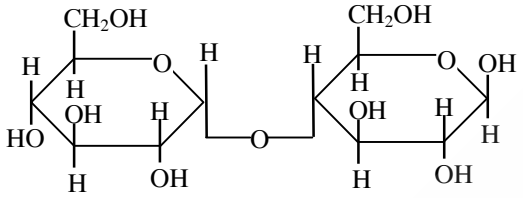
(3) Statement I , II both are true

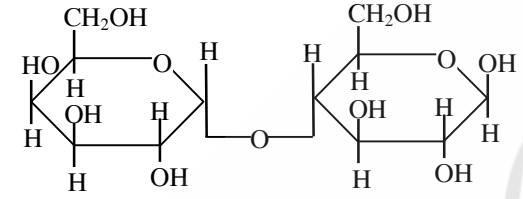
(4) Statement I , II both are false

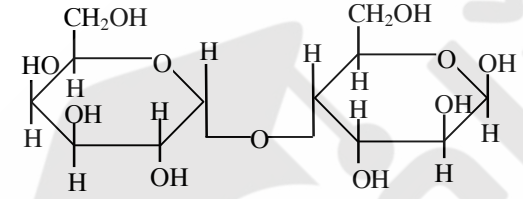
Ans. **(3)**

4. Correct structure of α-anomer of maltose is :

(1) 

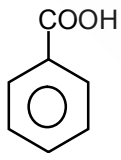
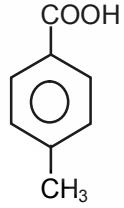
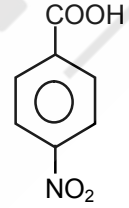
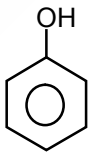
(2) 

(3) 

(4) 

Ans. (1)

5. Which is the correct K_a order for the following compounds ?

(a)  (b)  (c)  (d) 

(1) a < b < c < d

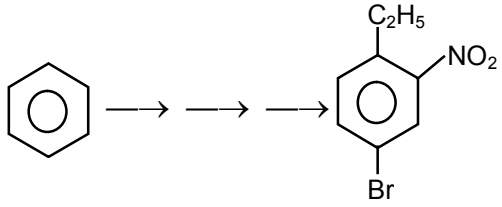
(2) c < a < b < d

(3) d < b < a < c

(4) c < b < a < d

Ans. (3)

6. Which is correct sequence of reagents for following conversion



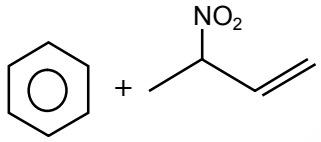
(1) (i) CH_3COCl, $AlCl_3$ (ii) Zn-Hg, HCl (iii) Br_2, Fe (iv) HNO_3, H_2SO_4

(2) (i) Br_2, Fe (ii) CH_3COCl, $AlCl_3$ (iii) Zn-Hg, HCl (iv) HNO_3, H_2SO_4

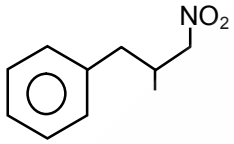
(3) (i) HNO_3, H_2SO_4 (ii) CH_3COCl, $AlCl_3$ (iii) Zn-Hg, HCl (iv) Br_2, Fe

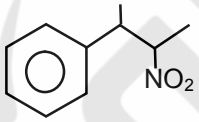
(4) (i) CH_3COCl, $AlCl_3$ (ii) Zn-Hg, HCl (iii) HNO_3, H_2SO_4 (iv) Br_2, Fe

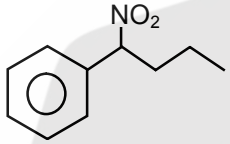
Ans. (1)

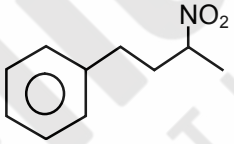
7. 

Major product is :

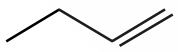
(1) 

(2) 

(3) 

(4) 

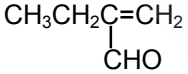
Ans. (4)

8. 

Product is :

(1) CH_3CHCH_2–CHO

(2) $CH_3CH_2CH_2CH_2CHO$

(3) 

(4) CH_3CH_2CH=CH–CHO

Ans. (2)

9. In estimation of halide from sodium fusion extract which compound is used before adding $AgNO_3$?

(1) NH_3 (2) HCl (3) HNO_3 (4) NaOH

Ans. (3)

10. What is composition of German silver?

(1) Cu Zn Ni (2) Ag Ni Cu (3) Zn Ni Ag (4) Ag Au Zn

Ans. (1)

11. Correct order of bond dissociation energy of following halogens is

(1) $Cl_2 > Br_2 > F_2 > I_2$ (2) $F_2 > Cl_2 > Br_2 > I_2$

(3) $Cl_2 > F_2 > Br_2 > I_2$ (4) $I_2 > Br_2 > Cl_2 > F_2$

Ans. **(1)**

Sol. Theory

12. Which is false for hydrophilic colloids ?

(1) Viscosity remains almost same as that of H_2O

(2) Electrolyte is needed for stabilisation

(3) It is reversible in nature

(4)

Ans. **(1)**

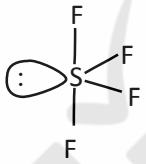
13. In which of the following more than one type of bond length is present

(1) CF_4 (2) SiF_4 (3) XeF_4 (4) SF_4

Ans. **(4)**

Sol. SF_4 see-saw structure

Axial bond length is more than equitorial bond length



14. **Statement -1 :** α- sulphur and β-sulphur are reversibly converted to each other under slow heating

Statement-2 : Monoclinic sulphur exists as most stable allotropic form of Sulphur at room temperature.

(1) Both statements are correct

(2) Both statements are incorrect

(3) Statement 1 is correct and statement -2 is incorrect

(4) Statement 1 is incorrect and statement 2 is correct

Ans. **(2)**

15. Statement -1 : Ni^{2+} is detected by dimethylglyoxime and NH_4OH

Statement -2 : Dimethylglyoxime is a neutral bidentate ligand.

(1) Both statements are correct

(2) Both statements are incorrect

(3) Statement 1 is correct and statement -2 is incorrect

(4) Statement 1 is incorrect and statement 2 is correct

Ans. **(1)**

Sol. Both are correct

16. K_{sp} of $Ca(OH)_2 = 5.5 \times 10^{-6}$

Determine its solubility in pure water

(1) 1.11×10^{-2} M (2) 1.11×10^{-6} M (3) 1.77×10^{-2} M (4) 1.77×10^{-6} M

Ans. **(1)**

Sol. For $Ca(OH)_2$

$K_{sp} = 4s^3$

$5.5 \times 10^{-6} = 4s^3$

$$s = \sqrt[3]{\frac{5.5}{4} \times 10^{-6}} = 1.11 \times 10^{-2} M$$

17. $[FeF_6]^{3-}$ $[Cu(NH_3)_4]^{2+}$ $[Co(NH_3)_6]^{3+}$ $[NiCl_4]^{2-}$

(i) (ii) (iii) (iv)

Correct order of spin only magnetic moment of above complexes?

(1) $[FeF_6]^{3-} > [NiCl_4]^{2-} > [Cu(NH_3)_4]^{2+} > [Co(NH_3)_6]^{3+}$

(2) $[FeF_6]^{3-} > [Co(NH_3)_6]^{3+} > [Cu(NH_3)_4]^{2+} > [NiCl_4]^{2-}$

(3) $[Co(NH_3)_6]^{3+} > [FeF_6]^{3-} > [NiCl_4]^{2-} > [Cu(NH_3)_4]^{2+}$

(4) $[NiCl_4]^{2-} > [FeF_6]^{3-} > [Cu(NH_3)_4]^{2+} > [Co(NH_3)_6]^{3+}$

Ans. **(1)**

Sol. $[FeF_6]^{3-} \Rightarrow sp^3d^2$ & n = 5 ; $[NiCl_4]^{2-} \Rightarrow sp^3$ & n = 2

$[Cu(NH_3)_4]^{2+} \Rightarrow dsp^2$ & n = 1 ; $[Co(NH_3)_6]^{3+} \Rightarrow d^2sp^3$ & n = 0

18. Which of the following cannot form CO on reaction with H_2O?

(1) CH_4 (2) C_3H_8 (3) CO_2 (4) C

Ans. **(3)**

19. Indium is refined by which of the following methods?

(1) Van-Arkel (2) Zone-refining (3) Distillation (4) Liquation

Ans. **(2)**

20. In a galvanic cell Cu is reacting with nitric acid to produce NO_2 or NO.

At what $\left[NO_3^-\right]$ tendency of formation of NO & NO_2 is same.

$E^\circ_{Cu^{2+}/Cu} = 0.34V$

$E^\circ_{NO_3^-|NO_2|H^+} = 0.79V$

$E^\circ_{NO_3^-|NO|H^+} = 0.96V$

Assume pressure of all the gases are taken as unity, $P_{NO_2} = P_{NO}$

Ans. 144.54

Sol. $Cu + 2NO_3^- + 4H^+ \longrightarrow Cu^{2+} + 2NO_2(g) + 2H_2O$

$$E_{NO_3^-|NO_2|H^+} = E_1^\circ - \frac{0.059}{2}\log\frac{1}{x^2(x)^4} = 0.79 + 0.59 \times 3\log(x) \quad .....(i)$$

$3Cu + 2NO_3^- + 8H^+ \longrightarrow 3Cu^{2+} + 2NO(g) + 4H_2O$

$$E_{NO_3^-|NO|H^+} = E_2^\circ - \frac{0.059}{6}\log\frac{1}{x^2(x)^8}$$

$$= 0.96 + \frac{0.059}{6} \times 10\log(x) \quad .....(ii)$$

From (i) & (ii) $0.79 + 0.059 \times 3\log x = 0.96 + \frac{0.059}{6} \times 10\log(x)$

$$0.059 \times \frac{8}{6}\log(x) = 0.17$$

$\log_{10} x = 2.16 \Rightarrow x = 10^{2.16} = 144.54$

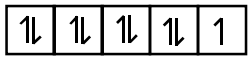
21. What is the spin only magnetic moment of divalent cation of Z = 29 in aqueous solution?

Ans. 1.732

Sol. Z = 29 [Cu element]

$Cu \rightarrow [Ar]4s^1\ 3d^{10}$

$Cu^{+2} \rightarrow [Ar]3d^9$



No of unpaired electron = 1

Magnetic moment $\mu = \sqrt{n(n+2)}$ BM

$= \sqrt{1\times 3}$ BM = 1.732 BM

22. On increasing temperature from 27ºC to 52ºC rate becomes 5 times. Determine activation energy in kJ/mole (R = 8.314 J/mole-K)

Ans. 51.74

Sol. $\log_{10}\frac{k_2}{k_1}=\frac{E_a}{2.303R}\left[\frac{1}{T_1}-\frac{1}{T_2}\right]$

$\log_{10}5=\frac{E_a}{2.303\times8.314}\left[\frac{1}{300}-\frac{1}{325}\right]$

$0.693=\frac{E_a}{2.303\times8.314}\times\frac{25}{300\times325}$

$E_a = 51.74$ kJ/mole

23. What should be molality of AB (α = 75%) solution which can cause a rise of boiling point of 2.5ºC ($K_b = 0.52\ ^oCm^{-1}$)

Ans. 2.747

Sol. $\Delta T_b = i\ m\ K_b$

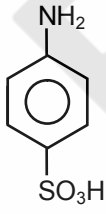
$2.5 = (1 + (2-1)\times0.75)\times m\times0.52$

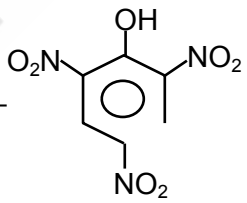
$2.5 = 1.75\times m\times0.52$

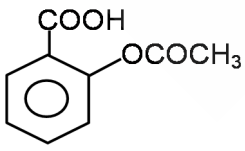
$m=\frac{2.5}{1.75\times0.52}=2.747$

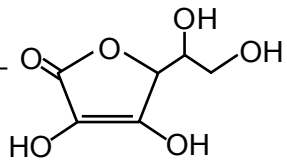
24. In how many of the following compounds carboxylic (–COOH) functional group is present?
Sulphanilic acid, Picric acid, Aspirin, Ascorbic acid

Ans. 1

Sol. Sulphanilic acid – 

, Picric acid — 

Aspirin— 

, Ascorbic acid— 

25. Determine density of Cu having fcc lattice with edge length 3.69Å. (Atomic mass of Cu = 63.54u)

Ans. 8

Sol. $d=\frac{Z\times At.Mass}{a^3\times N_A}=\frac{4\times63.54}{\left(3.69\times10^{-8}\right)^3\times6.022\times10^{23}}=8.4g/cm^3$

26. What is the value of energy in kJ/mole for a light with $\lambda = 633nm$, $c = 3\times10^8 m/sec$

$N_A = 6.02 \times 10^{23}$; $h = 6.63 \times 10^{-34}$ Js

Ans. **181**

Sol. $$E = \frac{hc}{\lambda} = \frac{\left(6.62\times10^{-34}\right)\left(3\times10^{8}\right)}{\left(663\times10^{-9}\right)} \times \frac{6.02\times10^{23}}{1000}$$

$$= \frac{6.62\times3\times6.02}{66.3}\times1000\frac{kJ}{mole}$$

= 180.6 kJ/mole

27. How many of the following metals are used in photoelectric cell?

Li, Na, Rb, Cs

Ans. 1 (Cs)

28. 10 ml of an oxalic acid solution is titrated against NaOH solution several times.

Reading of NaOH are

(i) 4.5 ml (ii) 4.5 ml (iii) 4.4 ml (iv) 4.4 ml (v) 4.4 ml

Determine the molarity of NaOH solution if concentration of $H_2C_2O_4$ acid solution is 1.25 M.

Ans. 6

Sol. meq. of NaOH = meq. of $H_2C_2O_4$

$M \times 1 \times 4.4 = 1.25 \times 2 \times 10$

$M = 5.68$ M

29. Five moles of an ideal gas are expanded at constant temperature of 273 K from initial pressure of 2.10 MPa to 1.30 MPa against constant external pressure of 4.31 MPa. Determine heat?

Ans. 1.36

Sol. $$V_f = \frac{nRT}{P_1} = \frac{5\times8.314\times273}{1.3\times10^6}\ m^3 = 0.087297\ m^3$$

$$V_i = \frac{P_1V_1}{P_2} = \frac{1.3}{2.1}\times\frac{5\times8.31\times273}{1.3\times10^6} = 0.054041\ m^3$$

$W = -P_{ext}(\Delta V) = -4.31 \times 10^6 (0.033256)$

$Q = -w = 1.36$ J