JEE MAIN Sept. 2020

QUESTION PAPER WITH SOLUTION

CHEMISTRY _ 3 Sep. _ SHIFT - 1

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1. It is true that :

(1) A second order reaction is always a multistep reaction

(2) A first order reaction is always a single step reaction

(3) A zero order reaction is a multistep reaction

(4) A zero order reaction is a single step reaction

Sol. **3**

Factual

2. An acidic buffer is obtained on mixing :

(1) 100 mL of 0.1 M HCl and 200 mL of 0.1 M CH_3COONa

(2) 100 mL of 0.1 M HCl and 200 mL of 0.1 M NaCl

(3) 100 mL of 0.1 M CH_3 COOH and 100 mL of 0.1 M NaOH

(4) 100 mL of 0.1 M CH_3COOH and 200 mL of 0.1 M NaOH

Sol. **1**

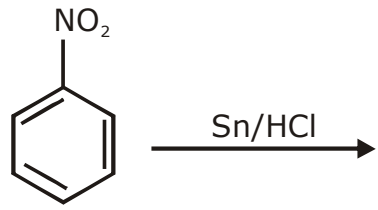
$2HCl + CH_3COO^- \longrightarrow CH_3COOH + OH^-$

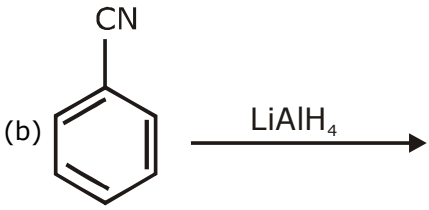
10 20

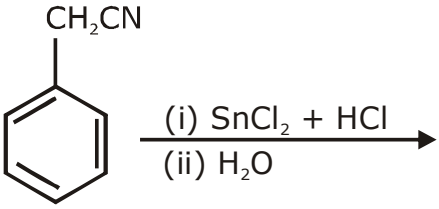
X 10 10

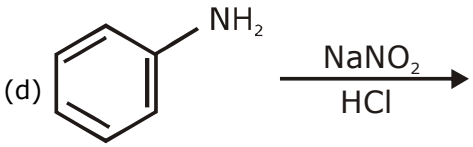
Acidic buffer

3. The Kjeldahl method of Nitrogen estimation fails for which of the following reaction products?

(a) 

(b) 

(c) 

(d) 

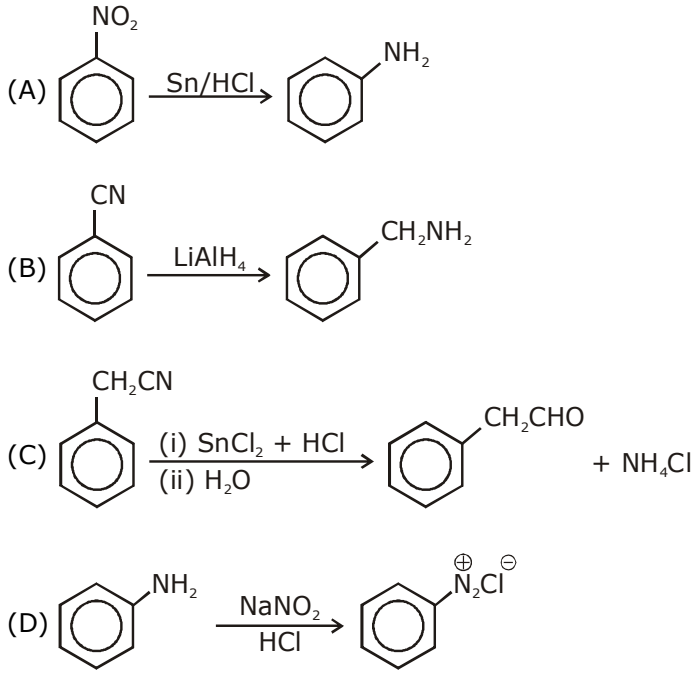
(1) (a), (c) and (d)

(2) (b) and (c)

(3) (c) and (d)

(4) (a) and (d)

Sol. **3**



Diazo compound and inorganic nitrogen can't be estimeted by kjeldal method.

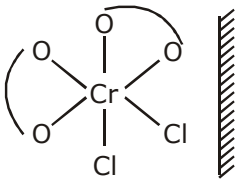
4. If the boiling point of H_2O is 373 K, the boiling point of H_2S will be :
(1) greater than 300 K but less than 373 K
(2) equal to 373 K
(3) more than 373 K
(4) less than 300 K

Sol. **4**
Less than 300 K (factual)

5. The complex that can show optical activity is :

(1) cis $-\left[CrCl_2(ox)_2\right]^{3-}$ (ox = oxalate)
(2) trans $-\left[Fe(NH_3)_2(CN)_4\right]^-$
(3) trans $-\left[Cr(Cl_2)(ox)_2\right]^{3-}$
(4) cis $-\left[Fe(NH_3)_2(CN)_4\right]^-$

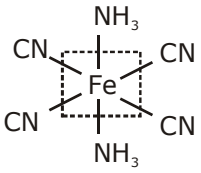
Sol. **1**



Nonsuper imposable
M.I.

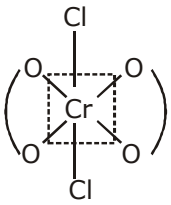
optically active

cis – $\left[CrCl_2(ox)_2\right]^{3-}$ (ox = oxalate)



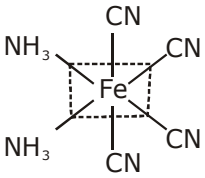
POS optically inactive

trans – $\left[Fe(NH_3)_2(CN)_4\right]^-$



→ POS optically inactive

trans – $\left[Cr(Cl_2)(ox)_2\right]^{3-}$

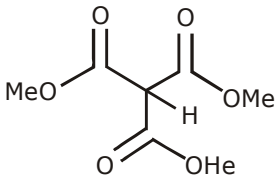


→ POS opticaly inactive

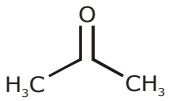
cis – $\left[Fe(NH_3)_2(CN)_4\right]^-$

6. Which one of the following compounds possesses the most acidic hydrogen?

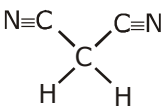
(1) $H_3C-C\equiv C-H$

(2) 

(3) 

(4) 

Sol. **3**



has most acidic hydrogen among given compound , this is due to strong –M effect of –CN group which stabilize –ve charge significantly.

7. Aqua regia is used for dissolving noble metals (Au, Pt, etc.). The gas evolved in this process is :
(1) N_2O_3 (2) N_2 (3) N_2O_5 (4) NO

Sol. **4**

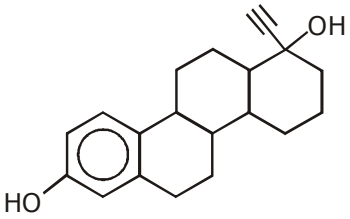
$Au + HNO_3 + HCl \rightarrow HAuCl_4 + NO + H_2O$

$Pt + \underbrace{HNO_3 + HCl}_{\text{aqua regia}} \rightarrow H_2PtCl_6 + NO + H_2O$

8. The antifertilituy drug "Novestrol" can react with :
(1) Br_2/water; $ZnCl_2$/HCl; $FeCl_3$ (2) Br_2/water; $ZnCl_2$/HCl; NaOCl
(3) Alcoholic HCN; NaOCl; $ZnCl_2$/HCl (4) $ZnCl_2$/HCl; $FeCl_3$; Alcoholic HCN

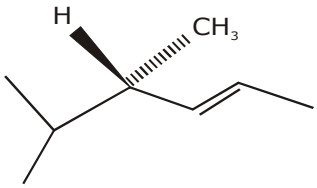
Sol. **1**

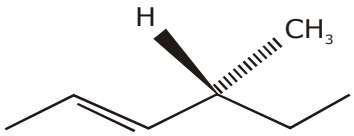
Novestrol

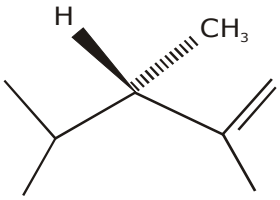


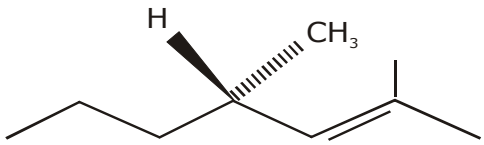
It can reacts with Br_2/water due to presence of unsaturation, with $ZnCl_2$/HCl due to –OH group and with $FeCl_3$ due to phenol.

9. Which of the following compounds produces an optically inactive compound on hydrogenation?

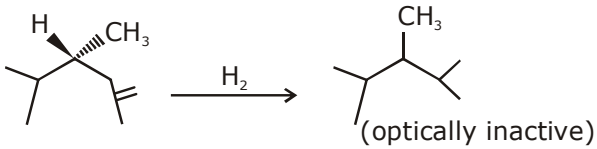
(1) 

(2) 

(3) 

(4) 

Sol. **3**



(optically inactive)

10. Of the species, NO, NO^+, NO^{2+} and NO^-, the one with minimum bond strength is :
(1) NO^- (2) NO^+ (3) NO^{2+} (4) NO

Sol. **1**

B.O. NO^- = 2

BO NO^+ = 3

BO NO^{2+} = 2.5

BO NO = 2.5

$$B.O \propto \frac{1}{B.L}$$

11. Glycerol is separated in soap industries by :

(1) Fractional distillation (2) Distillation under reduced pressure

(3) Differential extraction (4) Steam distillation

Sol. **2**

conceptual

Glycerol is separated in soap industries by distillation under reduced pressure

12. Thermal power plants can lead to :

(1) Ozone layer depletion (2) Blue baby syndrome

(3) Eutrophication (4) Acid rain

Sol. **4**

Refer enviornmental chemistry

It emits CO_2 that combine with mositure of atmosphere and forms H_2CO_3 (carbonic acid)

13. Henry's constant (in kbar) for four gases α, β, γ and δ in water at 298 K is given below :

	α	β	γ	δ
K_H	50	2	2×10^{-5}	0.5

(density of water = 10^3 kg m^{-3} at 298 K)

This table implies that :

(1) solubility of γ at 308 K is lower than at 298 K

(2) The pressure of a 55.5 molal solution of δ is 250 bar

(3) α has the highest solubility in water at a given pressure

(4) The pressure of a 55.5 molal solutio of γ is 1 bar

Sol. **1**

$p = K_H X$ mol fraction of gas in liquid.

On increasing tamp, 'K'_H increases

Hence solubility ↓

therefore, option 1

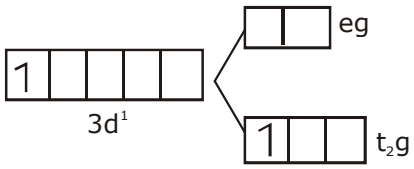
14. The electronic spectrum of $[Ti(H_2O)_6]^{3+}$ shows a single broad peak with a maximum at 20,300 cm^{-1}. The crystal field stabillization energy (CFSE) of the complex ion, in kJ mol^{-1}, is :

(1 kJ mol-1 = 83.7 cm^{-1})

(1) 83.7 (2) 242.5 (3) 145.5 (4) 97

Sol. **4**

$[Ti(H_2O)_6]^{3+}$ Ti^{3+} $3d^1$ in octahedral field of ligend



$CFSE = -0.4\ \Delta_0$

$$CFSE = \frac{-0.4 \times 20300}{83.7}$$

$= 97$ kJ mol

15. The atomic number of the element unnilennium is :

(1) 109 (2) 102 (3) 119 (4) 108

Sol. **1**

Unnilennium 109

16. An organic compound [A], molecular formula $C_{10}H_{20}O_2$ was hydrolyzed with dilute sulphuric acid to give a carboxylic acid [B] and an alcohol [C]. Oxidation of [C] with CrO_3 - H_2SO_4 produced [B]. Which of the following strucutres are not possible for [A]?

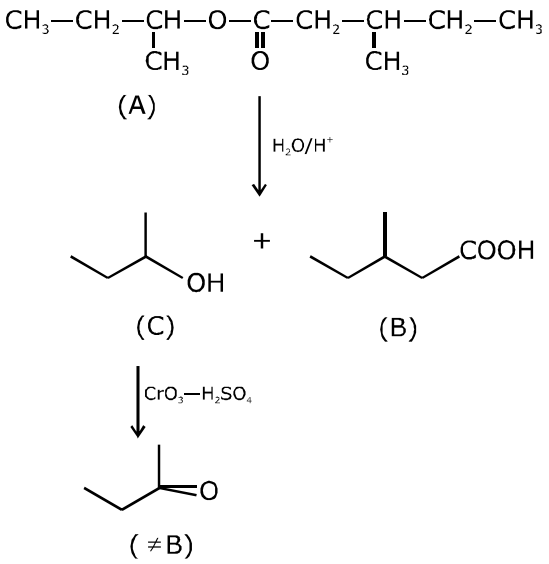
(1) $(CH_3)_3$ -C - $COOCH_2C(CH_3)_3$

(2) $CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-OCOCH_2\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2CH_3$

(3) $CH_3CH_2CH_2COOCH_2CH_2CH_2CH_3$

(4) $CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COOCH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2CH_3$

Sol. **2**



17. The mechanism of S_N1 reaction is given as :

$$R-X \rightarrow \underset{\text{Ion pair}}{R^{\oplus}X^{\ominus}} \rightarrow \underset{\text{Solvent Separated ion pair}}{R^{\oplus} \,\|\, X^{\ominus}} \xrightarrow{Y^{\ominus}} R-Y+X^{\ominus}$$

A student writes general characteristics based on the given mechanism as :
(a) The reaction is favoured by weak nucleophiles.
(b) $R^{\oplus}$ would be easily formed if the substituents are bulky.
(c) The reaction is accompanied by racemization.
(d) The reaction is favoured by non-polar solvents.
Which observations are correct?
(1) (a) and (b) (2) (a), (b) and (c)
(3) (a) and (c) (4) (b) and (d)

Sol. **2**
Statement (a), (b) & (c) are correct for S_N^1 reaction mechanism.

18. Tyndall effect is observed when:
(1) The diameter of dispersed particles is much smaller than the wavelength of light used.
(2) The diameter of dispersed particles is much larger than the wavelength of light used.
(3) The refractive index of dispersed phase is greater than that of the dispersion medium.
(4) The diameter of dispersed particles is similar to the wavelenght of light used.

Sol. **4**
Diameter of dispersed particles should not be much smaller than wavelength of light used.
Refer topic surface chemistry

19. Let C_{NaCl} and C_{BaSO_4} be the conductances (in S) measured for saturated aqueous solutions of NaCl and BaSO4, respectively, at a temperature T.
Which of the following is false?

(1) $C_{NaCl}\ (T_2) > C_{NaCl}\ (T_1)$ for $T_2 > T_1$

(2) $C_{BaSO_4}\ (T_2) > C_{BaSO_4}\ (T_1)$ for $T_2 > T_1$

(3) Ionic mobilities of ions from both salts increase with T.

(4) $C_{NaCl} >> C_{BaSO_4}$ at a given T

Sol. **4**

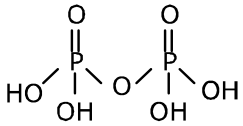
Ionic

$C_{NaCl} >> C_{BaSO_4}$ at temp 'T'

20. In a molecule of pyrophosphoric acid, the number of P-OH, P = O and P - O - P bonds/moiety(ies) respectively are :

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

Sol. **2**



P – OH bonds = 4
P = O bonds = 2
P – O – P linkage = 1
Ans. 4, 2, 1

21. The mole fraction of glucose ($C_6H_{12}O_6$) in an aqueous binary solution is 0.1. The mass percentage of water in it, to the nearest integer, is _____.

Sol. **47 %**

$x_{Glucose} = 0.1$

$$\text{mass\% of glucose} = \frac{0.1\times180}{0.1\times180+0.9\times18}\times100$$

$$= \frac{1800}{18+16.2}$$

$$= \frac{1800}{34.2}\%$$

$$= 52.63\%$$

$$= 53\%$$

$\therefore$ mass % of $H_2O = 47\%$

22. The volume strength of 8.9 M H_2O_2 solution calculated at 273 K and 1 atm is _____. (R = 0.0821 L atm K^{-1} mol^{-1}) (rounded off ot the nearest integer)

Sol. **100**

$$\text{Vol. strength} = \frac{8.9}{2} \times \frac{0.821 \times 273}{1}$$

$$= 99.73$$

$$= 100$$

23. An element with molar mass 2.7×10^{-2} kg mol^{-1} forms a cubic unit cell with edge length 405 pm. If its density is 2.7×10^3 kg m^{-3}, the radius of the element is approximately _____ $\times$ 10^{-12} m (to the nearest integer).

Sol. **143**

$$\text{Density} = \frac{Z \times GMM}{N_A \times a^3}$$

$$2.7 \times 10^3 = \frac{Z \times 2.7 \times 10^{-2}}{6.023 \times 10^{23} \times (405 \times 10^{-12})^3}$$

$$Z = 6.023 \times 405 \times 405 \times 405 \times 10^{23-36+3+2}$$

$$Z = 6.023 \times 405 \times 405 \times 405 \times 10^{-8}$$

$$Z = 4$$

FCC

$$4R = \sqrt{2} \times a$$

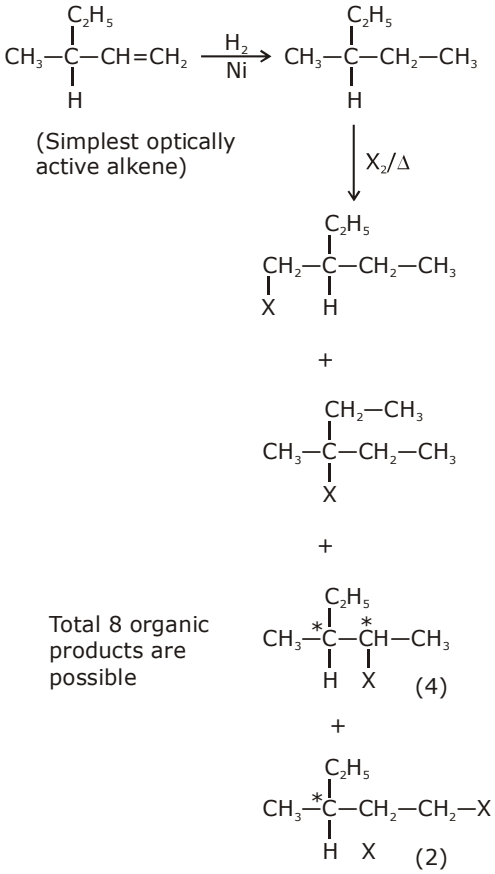
$$R = \frac{405}{2\sqrt{2}} \times 10^{-12} = 143.21 \times 10^{-12} m$$

$$= 143 \text{ ans}$$

24. The total number of monohalogenated organic products in the following (including stereoisomers) reaction is _____.

A (Simplest optically active alkene) $\xrightarrow[(ii)\ X_2/\Delta]{(i)\ H_2/Ni/\Delta}$

Sol. **8**



25. The photoelectric current from Na (Work function, w_0 = 2.3 eV) is stopped by the output voltage of the cell Pt(s) H_2(g, 1 Bar) HCl (aq. pH =1)$\left|AgCl(s)\right|$ Ag(s).

The pH of aq. HCl required to stop the photoelectric current form K(w_0 = 2.25 eV), all other conditions remaining the same, is _____ × 10^{-2} (to the nearest integer).

Given,

$2.303\frac{RT}{F} = 0.06\ V; E^0_{AgCl|Ag|Cl^-} = 0.22\ V$

Sol. **58**

Energy of photon = 2.3 – E_{cell} {for Na}

Energy of photon = 2.25 – E_{cell} {for K}

E_{cell} {for 'Na'} + 0.05 = E_{cell} {for 'K'}

$0.22 + 0.06 \log [H^+][Cl^-] + 0.05 = 0.22 + 0.06 \log [H^+]\ [Cl^-]$

$6 \log (10^{-2}) + 5 = 6 \log [H^+][Cl^-]$

$\log (10^{-12}) + \log (10^5) = \log \{[H^+][Cl^-]\}^6$

$\{[H^+][Cl^-]\}^6 = 10^{-7}$

$[H^+]^{12} = 10^{-7}$

$pH = \frac{7}{12} = 0.58$

$= 58 \times 10^{-2}$ = 58 Ans

Admission
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