JEE MAIN 2024

Paper with Solution

Chemistry | 31th January 2024 _ Shift-1

SECTION – A

1. Given below are two statements:

Statement I: Noble gases have very high boiling points.

Statement II: Noble gases are monoatomic gases. They are held together by strong dispersion forces. Because of this they are liquefied at very low temperature. Hence, they have very high boiling points.

In the light of the above statements, choose the correct answer from the options given below:

(1) Statement I is false but statement II is true.

(2) Both statement I and statement II are true.

(3) Statement I is true but statement II is false.

(4) Both statement I and statement II are false.

Ans. **4**

Fact → both statement are false.

2. The product (C) in the below mentioned reaction is:

$$CH_3-CH_2-CH_2-Br \xrightarrow[\Delta]{KOH(alc)} A \xrightarrow{HBr} B \xrightarrow[KOH(aq.)]{\Delta} C$$

(1) Propene (2) Propan-2-ol (3) Propyne (4) Propan-1-ol

Ans. **2**

$$CH_3-CH_2-CH_2-Br \xrightarrow[\Delta]{\text{alc. KOH}} \underset{A}{CH_3-CH=CH_2} \xrightarrow{HBr} \underset{B}{CH_3-\underset{Br}{\underset{|}{CH}}-CH_3} \xrightarrow[\Delta]{\text{alc. KOH}} \underset{C}{CH_3-\underset{OH}{\underset{|}{CH}}-CH_3}$$

(Propan-2-ol)

3. Identify the mixture that shows positive deviations from Raoult's Law

(1) $CHCl_3 + (CH_3)_2CO$ (2) $CHCl_3 + C_6H_6$

(3) $(CH_3)_2CO + C_6H_5NH_2$ (4) $(CH_3)_2CO + CS_2$

Ans. **4**

Acetone and CS_2 is an example of solutions showing positive deviation from raoult's law

Since acetone $-CS_2$ attractions are weaker than acetone-acetone attractions.

4. Given below are two statements:

Statement I: IUPAC name of $HO-CH_2-(CH2)_3-CH_2-COCH_3$ is 7-hydroxyheptan-2-one.

Statement II: 2-oxoheptan-7-ol is the correct IUPAC name for above compound.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is correct but statement II is incorrect.

(2) Statement I is incorrect but statement II is correct.

(3) Both Statement I and statement II are correct.

(4) Both statement I and statement II are incorrect.

Ans. **1**

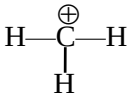
Statement-I : $\overset{7}{HO}-\overset{6}{CH_2}-\overset{5}{CH_2}-\overset{4}{CH_2}-\overset{3}{CH_2}-\overset{2}{\overset{\overset{O}{\|}}{C}}-\overset{1}{CH_3}$ Correct IUPAC name will be : 7- hydroxypentan-2-one.

5. A species having carbon with sextet of electrons and can act as electrophile is called -

(1) pentavalent carbon (2) carbon free radical

(3) carbocation (4) carbanion

Ans. **3**



; The species which have sextet of electron and act as an electrophile called as carbocation.

6. Match List I with List II

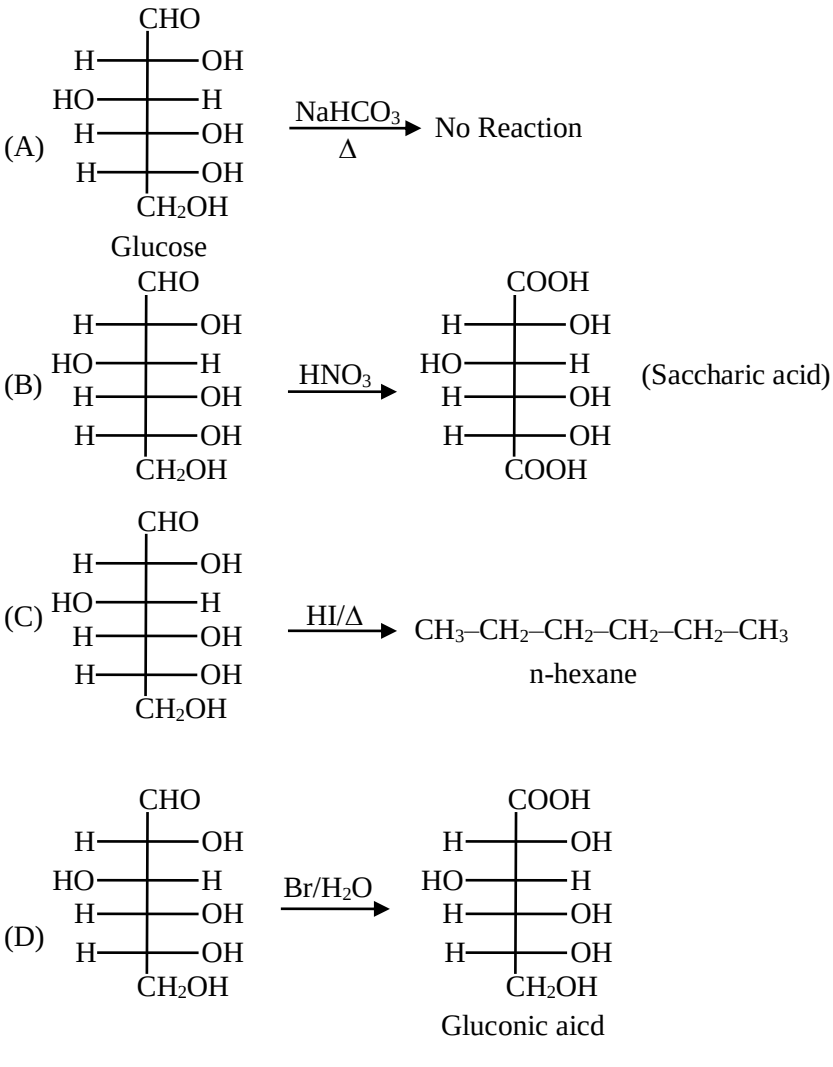
List I		List II	
A.	Glucose/$NaHCO_3/\Delta$	I.	Gluconic acid
B.	Glucose/HNO_3	II.	No reaction
C.	Glucose/HI/Δ	III.	n-hexane
D.	Glucose/Bromine water	IV.	Saccharic acid

Choose the correct answer from the options given below:

(1) A-IV,B-I, C-III, D-II (2) A-I, B-IV, C-III, D-II

(3) A-II, B-IV, C-III, D-I (4) A-III, B-II, C-I, D-IV

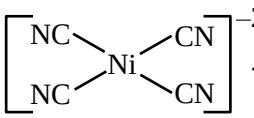
Ans. **3**



7. Identify the factor from the following that does not affect electrolytic conductance of a solution.
(1) The nature of solvent used (2) Concentration of the electrolyte.
(3) The nature of the electrode used (4) The nature of the electrolyte added.

Ans. **3**
Conductivity of electrolytic cell is affected by concentration of electrolyte, nature of electrolyte and temperature.

8. The correct statements from following are:
A. The strength of anionic ligands can be explained by crystal field theory.
B. Valence bond theory does not give a quantitative interpretation of kinetic stability of coordination compounds.
C. The hybridization involved in formation of $[Ni(CN)_4]^{2-}$ complex is dsp^2.
D. The number of possible isomer(s) of cis-$[PtCl_2(en)_2]^{2+}$ is one
Choose the correct answer from the options given below:
(1) B, C only (2) A, C only (3) A, D only (4) B, D only

Ans. **1**
Option B $\rightarrow$ Fact
(C) 

$\rightarrow$ C.N. = 4
SFL thus
Hybridisation is dsp^2

9. The correct sequence of electron gain enthalpy of the elements listed below is -
A. Ar B. Br C. F D. S
Choose the most appropriate from the options given below:
(1) A > D > B > C (2) D > C > B > A (3) A > D > C > B (4) C > B > D > A

Ans. **1**
Order of electron affinity F > Br > S > Ar, order of e^- gain enthalpy is reverse of e^- affinity thus
F < Br < S < Ar

10. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R:
Assertion A: pKa value of phenol is 10.0 while that of ethanol is 15.9.
Reason R : Ethanol is stronger acid than phenol.
In the light of the above statements, choose the correct answer from the options given below:
(1) A is true but R is false.
(2) Both A and R are true but R is NOT the correct explanation of A.
(3) Both A and R are true and R is the correct explanation of A.
(4) A is false bur R is true.

Ans. **1**
More the acidic character, more will be K_a value or p^{K_a} value will be less. So Assertion is true, but reason is wrong.

11. Consider the oxides of group 14 elements
SiO_2, GeO_2, SnO_2, PbO_2, CO and GeO. The amphoteric oxides are
(1) GeO, GeO_2 (2) SiO_2, GeO_2 (3) SnO_2, CO (4) SnO_2, PbO_2

Ans. **4**
In group, 14^{th} the oxides of Tin(Sn) and Pb are amphoteric oxide in nature. Thus SnO_2 PbO_2 amphoteric oxides.

12. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R:
Assertion A: Alcohols react both as nucleophiles and electrophiles.
Reason R: Alcohols react with active metals such as sodium, potassium and aluminum to yield corresponding alkoxides and liberate hydrogen.
In the light of the above statements, choose the correct answer from the options given below:
(1) Both A and R are true bur R is NOT the correct explanation of A.
(2) A is true but R is false
(3) Both A and R are true and R is the correct explanation of A.
(4) A is false bur R is true.

Ans. **1**

Assertion is ture, alcohol reacts both as nucleophiles & nucleophile

$$R-OH+\text{Metal(M)}\longrightarrow \underset{\text{Alkoxide}}{R-O^{-}M^{+}}+\frac{1}{2}H_2$$

Both given reason is wrong.

13. The compound that is white in color is
(1) ammonium sulphide
(2) lead sulphate
(3) ammonium arsinomolybdate
(4) lead iodide

Ans. **2**

→ Colour of lead sulphate is white
Ammonium sulphide → yellow
Ammonium arsinomolybdate → yellow
Lead iodide → yellow

14. Integrated rate law equation for a first order gas phase reaction is given by (where P_i is initial pressure and P_t is total pressure at time t)

(1) $k=\frac{2.303}{t}\times\log\frac{(2P_i-P_t)}{P_i}$
(2) $k=\frac{2.303}{t}\times\log\frac{P_i}{(2P_i-P_t)}$
(3) $k=\frac{2.303}{t}\times\log\frac{2P_i}{(2P_i-P_t)}$
(4) $k=\frac{2.303}{t}\times\log\frac{P_i}{(2P_i-P_t)}$

Ans. **4**

	$A(g)\rightarrow$	$B(g)+$	$C(g)$
$t=0$	P_i	0	0
$t=t$	(p_i-x)	x	x

where P_i is initial pressure
$P_t=P_i-x+x+x$
$P_t=P_i+x$
$x=P_t-P_i$

$$K=\frac{2.303}{t}\log\frac{P_i}{P_i-x}$$

$$K=\frac{2.303}{t}\log\frac{Pi}{P_i-(P_t-P_i)}$$

$$K=\frac{2.303}{t}\log\frac{P_i}{2P_i-P_t}$$

15. The linear combination of atomic orbitals to form molecular orbitals takes place only when the combining atomic orbitals.

A. have the same energy

B. have the minimum overlap

C. have same symmetry about the molecular axis

D. have different symmetry about the molecular axis

Choose the most appropriate from the options given below:

(1) A, B, C only (2) A and C only (3) B and D only (4) B, C, D only

Ans. **2**

In the LCAO method.

The energy of atomic orbital is nearly same also have same symmetry about the molecular axis.

16. Adsorption' principle is used for which of the following purification method ?

(1) Chromatography (2) Sublimation

(3) Extraction (4) Distillation

Ans. **1**

It is a fact base i.e. adsorption principle is used for 'Chromatography'

17. For the given reaction, choose the correct expression of K_C from the following:-

$$Fe^{3+}_{(aq)} + SCN^{-}_{(aq)} \rightleftharpoons (FeSCN)^{2+}_{(aq)}$$

(1) $K_C = \frac{[FeSCN^{2+}]^2}{[Fe^{3+}][SCN^-]}$ (2) $K_C = \frac{[FeSCN^{2+}]}{[Fe^{3+}]^2[SCN^-]^2}$

(3) $K_C = \frac{[Fe^{3+}][SCN^-]}{[FeSCN^{2+}]}$ (4) $K_C = \frac{[FeSCN^{2+}]}{[Fe^{3+}]SCN^-]}$

Ans. **4**

$Fe^{3+}(aq)+SCN^{-}(aq) \rightleftharpoons (FeSCN)^{2+}(aq)$

$$K_C = \frac{\left[FeSCN^{2+}\right]}{\left[Fe^{3+}\right]\left[SCN^-\right]}$$

18. Identify correct statements from below:

(A) The chromate ion is square planar.

(B) Dichromates are generally prepared from chromates.

(C) The green mangante ion is diamagnetic.

(D) Dark green colored K_2MnO_4 disproportionates in a neutral or acidic medium to give permanganate.

(E) With increasing oxidation number of transition metal, ionic character of the oxides decreases.

Choose the correct answer from the options given below:

(1) B, C, D only (2) A, D, E only (3) A, B, C only (4) B, D, E only

Ans. **4**

B, D, E are correct.

Fact

19. Match List I with List II

List I (Technique)		List II (Application)	
A.	Distillation	I.	Separation of glycerol from spent-lye
B.	Fractional distillation	II.	Aniline – Water mixture
C.	Steam distillation	III.	Separation of crude oil fraction
D.	Distillation under reduced pressure	IV.	Chloroform – Aniline

Choose the correct answer from the options given below:

(1) A-IV,B-I, C-II, D-III (2) A-IV, B-III, C-II, D-I

(3) A-I, B-II, C-IV, D-III (4) A-II, B-III, C-I, D-IV

Ans. **2**

It is a fact base.

- Chloroform-Aniline can be separated by distillation.
- Aniline-Water can be separated by steam distillation.
- Glycerol from spent-lye can be separated by distillation under reduced pressure.
- Crude oil fraction can be separated by fractional distillation.

20. The metals that are employed in the battery industries are

A. Fe B. Mn C. Ni

D. Cr E. Cd

Choose the correct answer from the options given below:

(1) A, B, C and D only (2) B, C and E only

(3) B, D and E only (4) A, B, C, D and E

Ans. **2**

Theory based

SECTION – B

21. Consider the following reaction at 298 K. $\frac{3}{2}O_{2(g)} \rightleftharpoons O_3(g).K_P = 2.47\times10^{-29}$

$\Delta_r G^\circ$ for the reaction is _____ kJ. (Given R = 8.314 JK^{-1} mol^{-1})

Ans. $\frac{3}{2}O_2(g) \rightleftharpoons O_3(g)$

$K_P=2.47\times10^{-29}$

$\Delta G^o = -RT \log_{10} K_p$

$= -8.314\times298\times\log_{10}(2.47\times10^{-29})$

$= -8.314\times298\times(\log_{10}(2.47)-29)$

$= -8.314\times298\times(0.30-29)$

$\Rightarrow -8.314\times298\times(-28.7)$

$\Rightarrow$ 71106 J/mol.K

$\Rightarrow$ 71.1 KJ/mol.K

22. Molar mass of the salt from NaBr, $NaNO_3$, KI and CaF_2 which does not evolve coloured vapours on heating with concentrated H_2SO_4 is _____ g mol^{-1}.
(Molar mass in g mol^{-1} : Na : 23, N : 14, K : 39, O : 16, Br : 80, I : 127, F : 19, Ca : 40)

Ans. 78

$$2NaBr + 2H_2SO_4 \xrightarrow{\Delta} \underset{\text{Conc.}}{} \quad \underset{\text{Reddish Brown Vap.}}{Br_2} + SO_2 + 2H_2O + Na_2SO_4$$

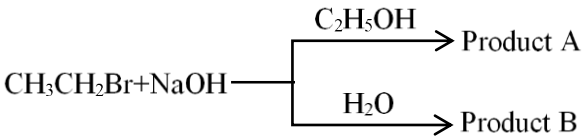
$$NaNO_3 + H_2SO_4 \xrightarrow{\Delta} \underset{\text{Conc.}}{} \quad \underset{\text{Reddish brown}}{NO_2}$$

$$2KI + H_2SO_4 \xrightarrow{\Delta} \underset{\text{Conc.}}{} \quad \underset{\text{Violet Vap.}}{I_2} + SO_2 + 2H_2O + Na_2SO_4$$

$$CaF_2 + H_2SO_4 \xrightarrow{\Delta} \underset{\text{Conc}}{} CaSO_4 + \underset{\text{Colourless}}{2HF}$$

Molar mass of Caf_2 = 78

23.



The total number of hydrogen atoms in product A and product B is _____ .

Ans. 10

$$CH_3 - CH_2 - Br + NaOH \xrightarrow{C_2H_5OH} \underset{(A)}{CH_2 = CH_2}$$

$$CH_3 - CH_2 - Br \xrightarrow[H_2O]{NaOH} \underset{(B)}{CH_3 - CH_2 - OH}$$

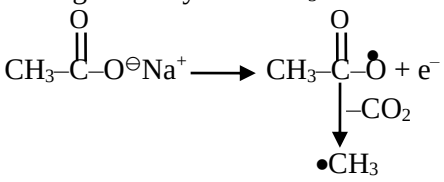
The total no of hydrogen atom in product A & product B is 10.

24. Number of alkanes obtained on electrolysis of a mixture of CH_3COONa and C_2H_5COONa is _____ .

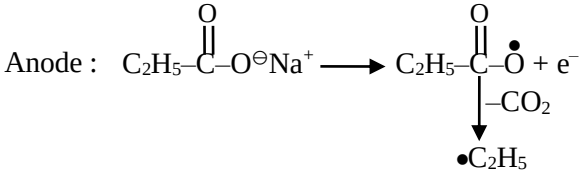
Ans. 3

$CH_3COONa + C_2H_5COONa \xrightarrow{\text{electrolysis}}$

During electrolysis of CH_3COONa



During electrolysis of C_2H_5COONa



Now; $\dot{C}H_3 + \dot{C}H_3 \longrightarrow CH_3 - CH_3$

$\dot{C}_2H5 + \dot{C}_2H_5 \longrightarrow CH_3 - CH_2 - CH_2 - CH_3$

$\dot{C}H_3 + CH_3 - \dot{C}H_2 \longrightarrow CH_3 - CH_2 - CH_3$

Total (3) product is obtain.

25. The number of species from the following in which the central atom uses sp^3 hybrid orbitals in its bonding is _____ .

NH_3, SO_2, SiO_2, $BeCl_2$, CO_2, H_2O, CH_4, BF_3

Ans. **4**

NH_3, SiO_2, H_2O and CH_4

26. Number of moles of methane required to produce 22g $CO_2(g)$ after combustion is $x \times 10^{-2}$ moles. The value of x is _____ .

Ans. **50**

$$CH_4 + 2O_2 \rightarrow \underset{22gm}{CO_2} + 2H_2O$$

$$\frac{22}{44} = 0.5 \text{ mole}$$

1 mole $CO_2 \rightarrow$ 1 mole CH_4

0.5 mole $CO_2 \rightarrow$ 0.5 mole CH_4

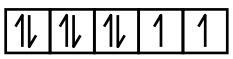
27. The 'Spin only' Magnetic moment for $[Ni(NH_3)_6]^{2+}$ is _____ $\times 10^{-1}$ BM.

(given = Atomic number of Ni: 28)

Ans. **28**

$Ni^{+2} \Rightarrow d8 \Rightarrow \sqrt{n(n+2)}$ n = unpected e^-

n=



$\Rightarrow \sqrt{2\times4} = \sqrt{8} = 2.8 = 28\times10^{-1}$ BM

28. The ionization energy of sodium in kJ mol^{-1}, if electromagnetic radiation of wavelength 242 nm is just sufficient to ionize sodium atom is _____ .

An.s **492.7**

$$E = \frac{hc}{\lambda} = \frac{6.6\times10^{-34}\times3\times10^{8}}{242\times10^{-9}}$$

$\Rightarrow 8.2\times10^{-19}$ Joule/atom

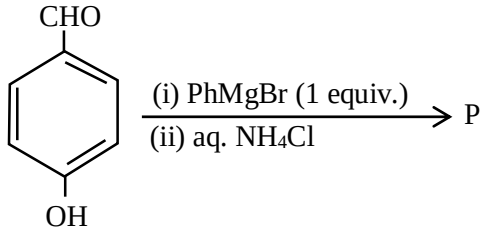
$\Rightarrow 8\times10^{-19}$ Joule/atom

$E = 8\times10^{-19}\times6.022\times10^{23}$ atom/mole

E = 492709 J/mole

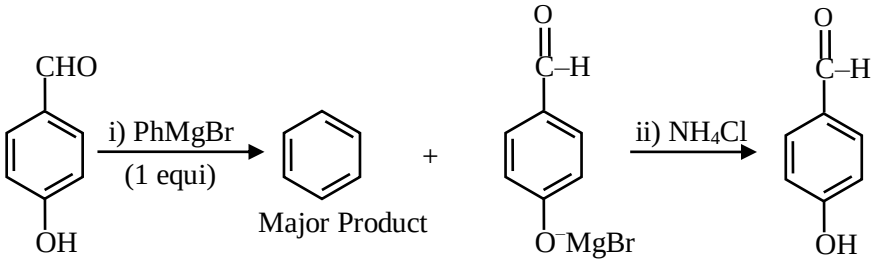
E = 492.7 kJ/mole

29. The product of the following reaction is P.



The number of hydroxyl groups present in the product P is _____ .

Ans. **0**



So the total number of hydroxyl group present in major product will be zero.

30. One Faraday of electricity liberates $x \times 10^{-1}$ gram atom of copper from copper sulphate. x is _____ .

Ans. **5**

$Cu^{2+} + 2e^- \rightarrow Cu$

1 Faraday $\rightarrow$ 1 gm eq. Cu

moles of Cu $\equiv$ gram atom of Cu $= \dfrac{\text{gram equivalent}}{n_f} = \dfrac{1}{2} = 0.5$

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