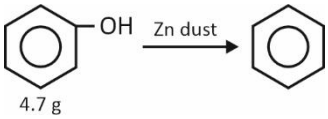
CHEMISTRY

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

1. Consider the reaction :



Find the number of moles of 'P' formed (if yield of reaction is 60 percent).

(1) 0.05

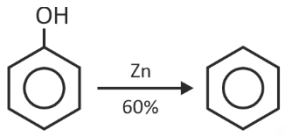
(2) 0.06

(3) 0.03

(4) 0.04

Answer (3)

Sol.

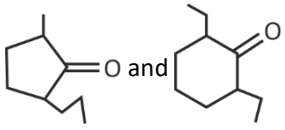


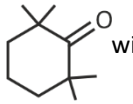
$\frac{4.7\text{ g}}{94}$ $\frac{4.7}{94} \times 0.6$

$= 0.03$ mol

MW of phenol = 77 + 16 + 1 = 94

2. Given below are two statements.

Statement I :  are metamer.

Statement II :  will show tautomerism.

In light of above statements, choose correct option.

(1) Both Statement I and Statement II are correct

(2) Statement I is incorrect, Statement II is correct

(3) Statement I is correct, Statement II is incorrect

(4) Both Statement I and Statement II are incorrect

Answer (4)

Sol. Statement I is incorrect because molecular formula is not same.

Statement II is incorrect because α-H is essential to show tautomerism.

3. Match list-I contain *d*-electronic configuration of tetrahedral complex with their CFSE value in list-II

	List-I		List-II
(A)	d^2	(i)	$-0.6\ \Delta_t$
(B)	d^4	(ii)	$-0.4\ \Delta_t$
(C)	d^6	(iii)	$-1.2\ \Delta_t$
(D)	d^5	(iv)	0

(1) (A)-(iii), (B)-(ii), (C)-(i), (D)-(iv)

(2) (A)-(ii), (B)-(iii), (C)-(i), (D)-(iv)

(3) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)

(4) (A)-(ii), (B)-(iii), (C)-(iv), (D)-(i)

Answer (1)

Sol. $d^4 = e^2t_2^2 = -0.4\Delta_t$

$d^2 = e^2 \Rightarrow -1.2\Delta_t$

$d^6 = e^3t_2^3 \Rightarrow -0.6\Delta_t$

$d^5 = e^2t_2^3 = 0$

4. Match the following.

List-I		List-II	
P.	Vitamin – A	I.	Scurvy
Q.	Vitamin – C	II.	Convulsion
R.	Vitamin – B_6	III.	Pernicious anaemia
S.	Vitamin – B_{12}	IV.	Xerophthalmia

(1) P – I, Q – III, R – II, S – IV

(2) P – II, Q – III, R – I, S – IV

(3) P – IV, Q – I, R – II, S – III

(4) P – IV, Q – I, R – III, S – II

Answer (3)

Sol. P – IV, Q – I, R – II, S – III

5. What will be the empirical formula of compound, if compound has 69.9% Fe and rest is oxygen?

(1) Fe_3O_4 (2) Fe_2O_3

(3) FeO (4) FeO_2

Answer (2)

Sol. Fe = 69.9%

O = 30.1%

Let mass of compound = 100 g

Fe = 69.9 g

O = 30.1 g

Mol of Fe = $\frac{69.9}{56} = 1.25$

Mol of O = $\frac{30.1}{16} = 1.88$

Molar ratio of Fe = $\frac{1.25}{1.25} = 1$

Molar ratio of O = $\frac{1.88}{1.25} = 1.5$

EF = Fe_2O_3

6. **Statement I :** 3-phenyl prop-1-ene will react with HBr and give an alkyl halide major product having 1 chiral C-atom.

Statement II : Aryl chloride and aryl cyanide both can be formed by Gattermann and Sandmeyer reaction.

(1) Statement I is correct, Statement II is incorrect

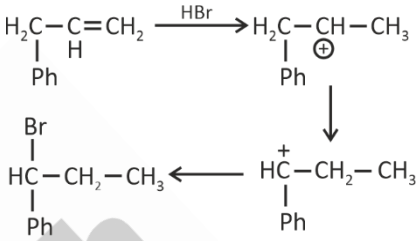
(2) Statement I is incorrect, Statement II is correct

(3) Both Statement I and Statement II are correct

(4) Both Statement I and Statement II are incorrect

Answer (3)

Sol.



7. If the wavelength of first line of Lyman Series for H-atom is x Å. Then the longest wavelength in Balmer series of He^+ ion will be

(1) $\frac{5x}{9}$ (2) $\frac{27x}{20}$

(3) $\frac{x}{27}$ (4) $\frac{5x}{27}$

Answer (2)

Sol. $\frac{\frac{1}{x} = R(1)^2\left(\frac{1}{1^2} - \frac{1}{2^2}\right)}{\frac{1}{\lambda} = R(2)^2\left(\frac{1}{2^2} - \frac{1}{3^2}\right)} \Rightarrow \frac{\frac{1}{x}}{\frac{1}{\lambda}} = \frac{\frac{3}{4}}{\frac{5\times4}{36}}$

$\frac{\lambda}{x} = \frac{9\times3}{4\times5}$

$\lambda = \frac{27x}{20}$

8. Which of the following can be used to form CH_4 gas?

(1) Kolbe's electrolysis

(2) From CH_3MgBr

(3) By Wurtz reaction

(4) By reduction of CH_3CH_2Cl

Answer (2)

Sol. $CH_3MgBr \xrightarrow{H_3O+} CH_4$

9. Match List-I with List-II and choose the correct option.

	List-I		List-II
A.	2s	(i)	One radial node + zero angular node
B.	3s	(ii)	Two radial node + zero angular node
C.	3p	(iii)	One radial node + 1 angular node
D.	3d	(iv)	Zero radial node + 2 angular node

(1) A(i), B(ii), C(iii), D(iv)

(2) A(ii), b(iv), C(iii), D(i)

(3) A(ii), B(i), C(iii), D(iv)

(4) A(iv), B(iii), C(ii), D(i)

Answer (1)

Sol.

	Radial node (n – l – 1)	Angular node (l)
2s	1	0
3s	2	0
3p	1	1
3d	0	2

10. Arrange the given compounds in increasing order of boiling point.

$\underset{I}{n\text{-}C_4H_9NH_2}$, $\underset{II}{(C_2H_5)_2NH}$, $\underset{III}{C_2H_5-N(CH_3)_2}$, $\underset{IV}{nC_4H_9OH}$

(1) II < III < I < IV

(2) I < II < IV < III

(3) III < II < I < IV

(4) III < I < II < IV

Answer (3)

Sol. I → 350.8 K ($n\text{-}C_4H_9NH_2$)

II → 329.3 K ($(C_2H_5)_2NH$)

III → 310 K [$C_2H_5N(CH_3)_2$]

IV → 390 K [$n\text{-}C_4H_9OH$]

11. 0.25 moles of a non-volatile and non-ionisable compound is mixed with 1 mole of solvent. Find the percentage relative lowering in vapour pressure.

(1) 20%

(2) 40%

(3) 60%

(4) 35%

Answer (1)

Sol. $\frac{P^0 - P_s}{P^0} = \frac{n}{n+N} = \frac{0.25}{0.25+1} = \frac{0.25}{1.25} = \frac{1}{5}$

Percentage relative lowering in vapour pressure

$= \frac{1}{5} \times 100$

= 20%

12. Consider the Lewis dot structure in following pair.

(A) SO_3^{2-} and CO_3^{2-} (B) O_2 and F_2

(C) NH_3 and H_3O^+ (D) CN^- and CO

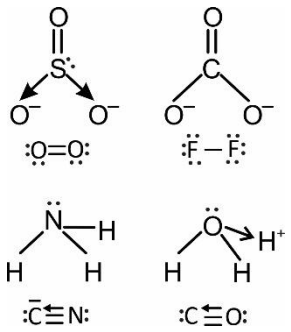
Choose pair which have same structure

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

(3) B, C & D only (4) C & D only

Answer (4)

Sol.



13. Find the limiting molar conductivity of $BaSO_4$.

[Given : $\Lambda_m^o(HCl) = x_1$

$\Lambda_m^o(H_2SO_4) = x_2$

$\Lambda_m^o(BaCl_2) = x_3$]

(1) $x_2 + x_3 - 2x_1$ (2) $2x_2 + x_3 - 2x_1$

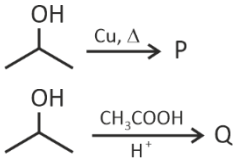
(3) $x_2 + x_3 - x_1$ (4) $x_2 + x_3 + 2x_1$

Answer (1)

Sol. $\Lambda_m^o H_2SO_4 + \Lambda_m^o BaSO_4 - 2(\Lambda_m^o HCl) = \Lambda_m^o BaSO_4$

So, $\Lambda_m^o BaSO_4 = x_2 + x_3 - 2x_1$

14. Consider the following reaction



Compound P and Q are respectively.

(1) CH_3COCH_3, $(CH_3)_2CHOOCCH_3$

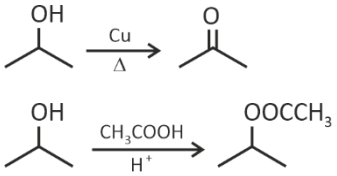
(2) $CH_3COOCH_2CH_2CH_3$, $CH_3 - CH = CH_2$

(3) C_2H_5CHO, $CH_3COOC_2H_5$

(4) $CH_3CH_2CH_3$, $CH_3COOC_3H_7$

Answer (1)

Sol.



15. Consider the following statements :

Statement I : Al is more reducing in nature than Tl.

Statement II : First three ionisation enthalpy of B are high, so it forms covalent compound

(1) Statement I and statement II both correct

(2) Statement I and statement II both incorrect

(3) Statement I correct and statement II incorrect

(4) Statement I incorrect and Statement II correct

Answer (1)

Sol. $E^o_{Al^{3+}/Al} = -1.66$ V

$E^o_{Tl^{3+}/Tl} = +0.72$ V $E^o_{Tl^{3+}/Tl^+} = 1.26$ V

Statement I correct

Due to small size of boron it has extremely high value of $(IE_1 + IE_2 + IE_3)$

Al due to larger size it has lower ionisation energy $(IE_1 + IE_2 + IE_3)$

16. 2-Methyl propene is added into a solvent (mixture of ethyl acetate and ether) and the R_f value is found to be 0.42.

If the same 2-methyl propene is reacted with dilute H_2SO_4 the major product obtained is x. Find the value of x.

(1) 0.12

(2) 0.42

(3) 0.65

(4) 0.84

Answer (1)

Sol. $CH_3-\underset{\underset{CH_3}{|}}{C}=CH_2 \xrightarrow[H_2SO_4]{dil} CH_3-\underset{\underset{CH_3}{|}}{C}-CH_3$

2-Methylpropene is a non-polar hydrocarbon when reacted with dilute H_2SO_4 polar alcohol due to presence of the –OH group, which allows for H-bonding with solvent.

So, a polar alcohol will have a lower R_f value than a non-polar alkene.

For 2-methylpropan-2-ol. R_f value showed be less than 0.42.

17. The correct order of magnitude of work done in the following cases for some volume change and pressure change as mentioned.

Case I : (a) Expansion in single step ($P_1 \rightarrow P_2$)

Case II : (b) Expansion in multistep ($P_1 \rightarrow P_2$)

Case III : (c) Compression in single step ($P_2 \rightarrow P_1$)

Case IV : (d) Compression in multistep ($P_2 \rightarrow P_1$)

(1) $W_C > W_D > W_B > W_A$

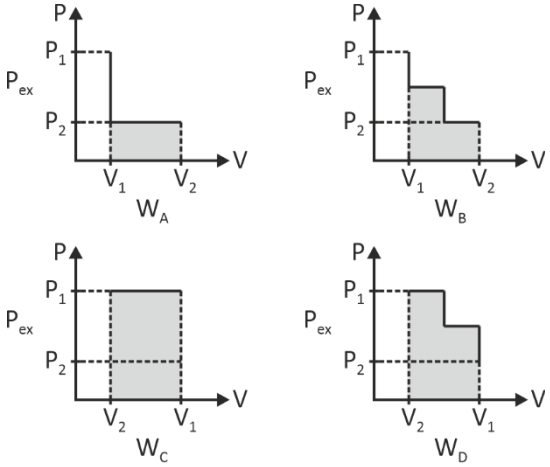
(2) $W_D > W_C > W_B > W_A$

(3) $W_A > W_B > W_D > W_C$

(4) $W_A > W_B > W_C > W_D$

Answer (1)

Sol.



18. He is mixed with a gas A in equimolar ratio at pressure P, total volume is 10 L at 300 K. $\left\{ \underset{(g)}{A} \rightleftharpoons \underset{(g)}{B},\ K_p = 4 \right\}$

The partial pressure of He, A and B at equilibrium is respectively.

(1) 0.5 P, 0.1 P and 0.4 P

(2) 0.2 P, 0.3 P and 0.5 P

(3) 0.5 P, 0.4 P and 0.1 P

(4) 0.5 P, 0.2 P and 0.3 P

Answer (1)

Sol. Initially $p_{He} = p_A$, and $P = p_{He} + p_A$, so $p_{He} = p_A = \frac{P}{2}$

	$A \rightleftharpoons B,\ K_p = 4$	
Initially	$\frac{P}{2}$	0
	$-x$	$+x$
At equilibrium	$\left(\frac{P}{2}-x\right)$	x

$4 = \frac{x}{\left(\frac{P}{2}-x\right)}$, on solving x = 0.4 P

So, at equilibrium $p_A = \left(\frac{P}{2}\right) - 0.4\ P = 0.1\ P$

$p_B = 0.4\ P$

$p_{He} = 0.5\ P$

19. Match compounds in column I with column II

	Column-I		Column-II
(a)	Lysine	(i)	Hinsberg Test
(b)	Glutamine	(ii)	Hoffmann Bromamide (starting material)
(c)	Serine	(iii)	Ceric ammonium nitrate
(d)	Tyrosine	(iv)	Neutral $FeCl_3$ test

(1) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

(2) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

(3) (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)

(4) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

Answer (1)

Sol. Lysine $\rightarrow$ Hinsberg test $H_2N–(CH_2)_4–$

Glutamine $\rightarrow$ Starting Hoffmann Bromamide

$H_2NCO–CH_2–CH_2–$

Serine $\rightarrow$ Cerric ammonium nitrate test

$(HO–CH_2–)$

Tyrosine – Neutral $Fecl_3$ test $(p)HO–C_6H_4 – CH_2–$

20. Choose the correct option of order of energy for square planar complex

(1) $dxz = dyz < dx^2 – y^2$

(2) $dxy = dxz > dz^2$

(3) $dxy = dyz = dxz$

(4) $dxy < dz^2 < dx^2 – y^2$

Answer (1)

Sol.

splitting pattern of square planar complex

energy

$– dx^2 – y^2$

$– dxy$

$– dz^2$

$–\quad –$

$dxz\ \ dyz$

SECTION - B

Numerical Value Type Questions: This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. Sucrose hydrolyses in acidic medium to form glucose and fructose which follows first order kinetics. If the half life of sucrose is 3 hrs. The % of sucrose left after 6 hrs.

Answer (25)

Sol. $t_{1/2} = 3$ hrs

$$\text{Sucrose}\,[A_0] \xrightarrow{3\,\text{hrs}} \frac{[A_0]}{2} \xrightarrow{3\,\text{hrs}} \frac{[A_0]}{4}$$

% of sucrose left is 25.

22. For the reaction,

$A(g) \rightleftharpoons B(g) + C(g)$

Consider the data

$\log K_p$	3.5	2.5
$\frac{1}{T}\,(K^{-1})$	0.04	0.05

Calculate the value of $\frac{\Delta H}{2.303R}$ (in K) based on above data.

Answer (100)

Sol. $$\log\frac{K_{p_2}}{K_{p_1}} = \frac{\Delta H}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\log K_{p_2} - \log K_{p_1} = \frac{\Delta H}{2.303R}[0.05 - 0.04]$$

$$1 = \frac{\Delta H}{2.303R} \times 0.01$$

$$\boxed{100 = \frac{\Delta H}{2.303R}}$$

23.

24.

25.