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. Which of the following pair will be formed by the decomposition of $KMnO_4$?

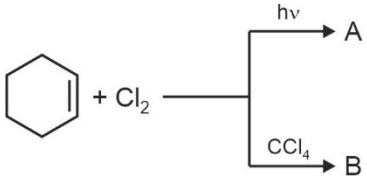
(1) $KMnO_4, MnO_2$ (2) K_2MnO_4, MnO_2

(3) K_2MnO_4, H_2O (4) MnO_2, H_2O

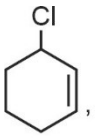
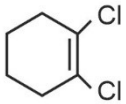
Answer (2)

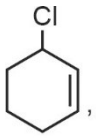
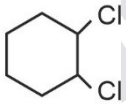
Sol. $KMnO_4$ decomposes upon heating at 513 K and forms K_2MnO_4 and MnO_2.

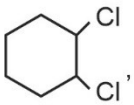
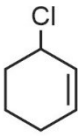
$$2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + O_2 + MnO_2$$

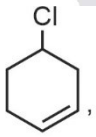
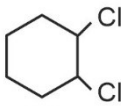
2. 

In the following reactions, find the product A and B?

(1)  , 
(A) (B)

(2)  , 
(A) (B)

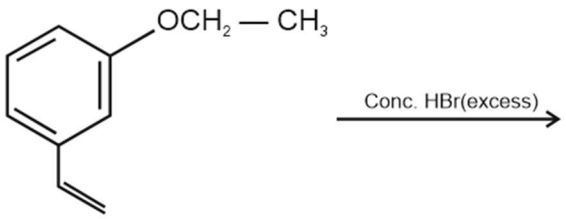
(3)  , 
(A) (B)

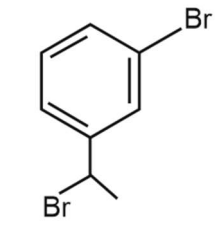
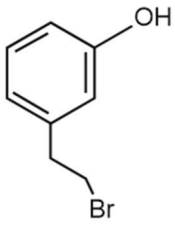
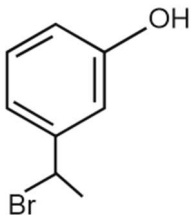
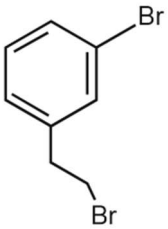
(4)  , 
(A) (B)

Answer (2)

Sol.
- In presence of light allylic substitution occur.
- In presence of CCl_4, addition reaction will occur.

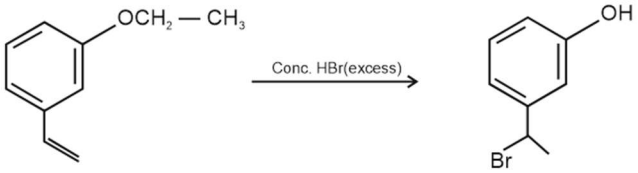
3. The major product formed in the following reaction is :



(1) 
(2) 
(3) 
(4) 

Answer (3)

Sol. HBr adds to alkene in accordance with Markovnikov's rule



4. Which of the following coordination compounds has bridging carbonyl ligand?

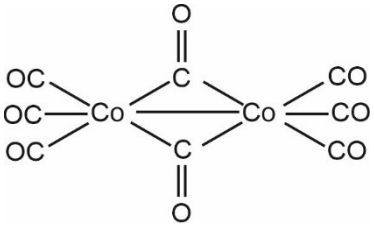
(1) $[Mn_2(CO)_{10}]$

(2) $[Co_2(CO)_8]$

(3) $[Cr(CO)_6]$

(4) $[Fe(CO)_5]$

Answer (2)

Sol. 

From structure it is clear $[Co_2(CO)_8]$ has bridging carbonyl ligand.

5. Energy difference between actual structure of compound and most stable resonating structure having least energy is called:

(1) Heat of hydrogenation

(2) Resonance energy

(3) Heat of combustion

(4) Exchange energy

Answer (2)

Sol. Resonance energy is the energy difference between most stable resonating structure and actual structure.

6. What is the effect that occurs between lone pair and π-bond?

(1) Inductive (2) Electromeric

(3) Resonance (4) Hyperconjugation

Answer (3)

Sol. $\overset{\odot}{X}-Y=Z \longleftrightarrow \overset{\oplus}{X}=Y-\overset{\ominus}{Z}$

Resonance

Above effect is called Resonance.

Correct answer is option (3).

7. Which of the following statement is incorrect?

(1) $\Delta G = 0$ for reversible process

(2) $\Delta G < 0$ for spontaneous process

(3) $\Delta G > 0$ for spontaneous process

(4) $\Delta G > 0$ for non-spontaneous process

Answer (3)

Sol. For spontaneous process $\Delta G < 0$

For reversible process $\Delta G = 0$

8. Alkaline $KMnO_4$ oxidises Iodide to a particular product (A). Determine the oxidation state of Iodine in compound (A).

(1) +2 (2) +3

(3) +5 (4) +7

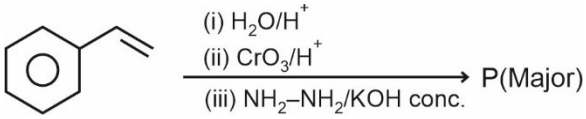
Answer (3)

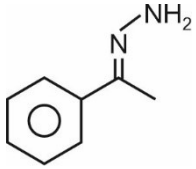
Sol. Potassium permanganate in alkaline medium oxidise Iodide to Iodate.

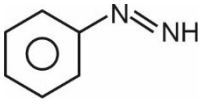
$$2MnO_4^- + H_2O + I^{\ominus} \longrightarrow 2MnO_2 + 2OH^{\ominus} + \underset{(A)}{IO_3^{\ominus}}$$

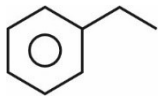
Compound A is $IO_3^{\ominus}$. Therefore, oxidation state of I is +5.

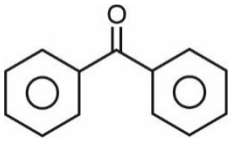
9. Find product P of the following reaction.



(1) 

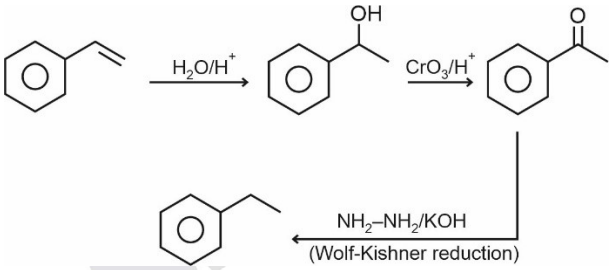
(2) 

(3) 

(4) 

Answer (3)

Sol.



10. A container contains 1 g H_2 gas and 1 g O_2 gas, what is the ratio of partial pressure of H_2 and O_2 $\left(\frac{p_{H_2}}{p_{O_2}}\right)$?

(1) 16 : 1 (2) 8 : 1

(3) 4 : 1 (4) 1 : 1

Answer (1)

Sol. $p_{H_2} = P_T\chi_{H_2}$ (P_T = total pressure)

(χ_{H_2} = mole fraction of H_2)

$p_{O_2} = P_T\chi_{O_2}$ (χ_{O_2} = mole fraction of O_2)

$$\frac{p_{H_2}}{p_{O_2}} = \frac{\chi_{H_2}}{\chi_{O_2}} = \frac{n_{H_2}}{n_{O_2}}$$

$$n_{H_2} = \frac{1}{2} \text{ mol}$$

$$n_{O_2} = \frac{1}{32}$$

$$\frac{p_{H_2}}{p_{O_2}} = \frac{1}{2\times 1} \times 32$$

$$\frac{p_{H_2}}{p_{O_2}} = \frac{32}{2} = \frac{16}{1}$$

11. Match the following.

	Column I (Ores)		Column II (Formula)
(A)	Fluorspar	(p)	$Al_2O_3.2H_2O$
(B)	Cryolite	(q)	CaF_2
(C)	Bauxite	(r)	$MgCO_3.CaCO_3$
(D)	Dolomite	(s)	$Na_3[AlF_6]$

(1) (A)-(s); (B)-(q); (C)–(r); D-(p)
(2) (A)-(q); (B)-(s); (C)–(p); D-(r)
(3) (A)-(p); (B)-(q); (C)–(s); D-(r)
(4) (A)-(q); (B)-(s); (C)–(r); D-(p)

Answer (2)

Sol. (A) Fluorspar – CaF_2
(B) Cryolite – $Na_3[AlF_6]$
(C) Bauxite – $Al_2O_3.2H_2O$
(D) Dolomite – $MgCO_3.CaCO_3$

12. Which of the following element(s) is/are confirmed by appearance of blood red colour with $FeCl_3$ in Lassaigne's test?
(1) Presence of S only (2) Presence of N & S
(3) Presence of N only (4) Presence of P only

Answer (2)

Sol. $Na + C + N + S \rightarrow NaSCN$

$$Fe^{3+} + SCN^- \longrightarrow \underset{\text{Blood red}}{\left[Fe(SCN)\right]^{2+}}$$

13. Statement 1 : Electronegativity of group 14 elements decreases from Si to Pb.
Statement 2 : Group 14 has metals, metalloids and non-metals.
(1) Both Statements 1 and 2 are correct
(2) Both Statements 1 and 2 are incorrect
(3) Statement 1 is correct and Statement 2 is incorrect
(4) Statement 1 is incorrect and Statement 2 is correct

Answer (4)

Sol. Electronegativity generally decreases as we move down the group but Pb has higher electronegativity than Sn.

- C $\Rightarrow$ non-metal
  Si and Ge $\Rightarrow$ metalloids
  Sn and Pb $\Rightarrow$ metals

E.N. of Sn = 1.8, Pb = 1.9

14. Hydrolysis of proteins gives which type of amino acid?
(1) α-Amino acid (2) β-Amino acid
(3) γ-Amino acid (4) δ-Amino acid

Answer (1)

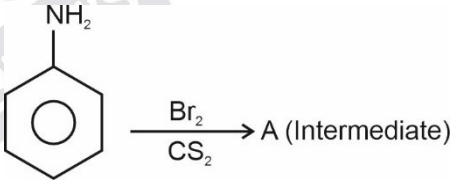
Sol. Proteins on hydrolysis gives α-amino acid because α-amino acids are building block of proteins. It is also fact that amino acids contain both $-NH_2$ and –COOH group.

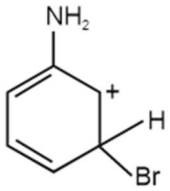
15. Statement 1 : Ionisation energy decreases in a period.
Statement 2 : In a period Z dominates over screening effect
(1) Both statements 1 and 2 are correct
(2) Both statements 1 and 2 are incorrect
(3) Statement 1 is correct and statement 2 is incorrect
(4) Statement 1 is incorrect but statement 2 is correct

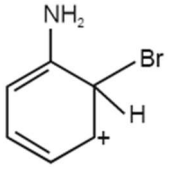
Answer (4)

Sol. Ionisation enthalpy increases in a period. Z dominates over screening effect (σ) in a period as $Z_{eff.}$ increases.

16. Consider the following reaction

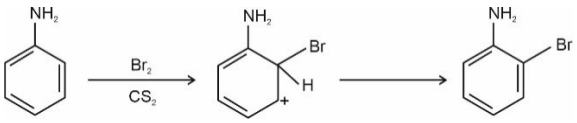


(1) 

(2) 

(3) Both (1) & (2)
(4) None of these

Answer (2)

Sol. 

17. Match the following

	Column I (Complexes)		Column II (Metals)
A.	Vitamin B_{12}	(p)	Ti
B.	Wilkinson catalyst	(q)	Co
C.	Ziegler-Natta catalyst	(r)	Fe
D.	Haemoglobin	(s)	Rh

(1) A(q), B(s), C(p), D(r) (2) A(s), B(q), C(r), D(p)
(3) A(q), B(p), C(r), D(s) (4) A(q), B(r), C(p), D(s)

Answer (1)

Sol. A. Vitamin B_{12} – Co
B. Wilkinson catalyst – $Rh([Rh(PPh_3)_3\ Cl])$
C. Ziegler-Natta catalyst – Ti $(TiCl_4 + Al(C_2H_5)_3)$
D. Haemoglobin – Fe

18. $K_2Cr_2O_7 + H_2O_2 + H_2SO_4 \xrightarrow[\text{conditions}]{\text{ether cold}}$ compound 'X'

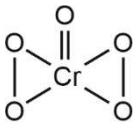
X is a chromium compound, what is the oxidation state of chromium in compound 'X'.

(1) +6 (2) +3
(3) +5 (4) +10

Answer (1)

Sol. $K_2Cr_2O_7 + H_2O_2 + H_2SO_4 \rightarrow \underset{('X')}{CrO_5} + K_2SO_4 + H_2O$

compound 'X' is $\Rightarrow CrO_5$



Oxidation state of chromium = +6.

19. $xCl_2 + yOH^- \longrightarrow zCl^- + pClO^-$

Balance the above reaction and find out values of x, y, z and p.

(1) x = 1, y = 2, z = 2, p = 1
(2) x = y = z = p = 1
(3) x = 1, y = 1, z = 2, p = 1
(4) x = 1, y = 2, z = 1, p = 1

Answer (4)

Sol. $\overset{0}{Cl_2} + \overset{0}{Cl_2} \longrightarrow \overset{-1}{2Cl^-} + \overset{+1}{2ClO^-}$

−2

+2

After balancing change in oxidation state,

$2Cl_2 \longrightarrow 2Cl^- + 2ClO^-$

Next, balance 'O' atoms,

$2Cl_2 + 4OH^- \longrightarrow 2Cl^- + 2ClO^- + 2H_2O$

Simplifying to get simplest ratios,

$Cl_2 + 2OH^- \longrightarrow Cl^- + ClO^- + H_2O$

x = 1, y = 2, z = 1, p = 1

20. For Rb(37) which of the following set of quantum numbers are correct for valence electron?

(1) $5, 0, 0, +\frac{1}{2}$ (2) $5, 0, 1, -\frac{1}{2}$
(3) $5, 0, 1, +\frac{1}{2}$ (4) $5, 1, 1, +\frac{1}{2}$

Answer (1)

Sol. $_{37}Rb = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6\ 5s^1$

Last electron enters in 5s subshell

Value of quantum numbers

$n = 5, l = 0, m = 0, s = \pm\frac{1}{2}$

SECTION - B

Numerical Value Type Questions: This section contains 10 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. Calculate the molarity of a solution having density = 1.5 g/mL %(w/w) of solute is 36% and molecular weight of solute is 36 g/mol.

Answer (15)

Sol. Assume mass of solution
= 100 g
Mass of solute = 36 gm
Moles of solute = 1

$\text{Molarity} = \frac{1\times1000}{\left(\frac{100}{1.5}\right)} = \frac{1000}{100}\times1.5 = 15$

22. Given $K_{net} = \frac{K_1K_2}{K_3}$ when E_{a_1} = 40 kJ/mol

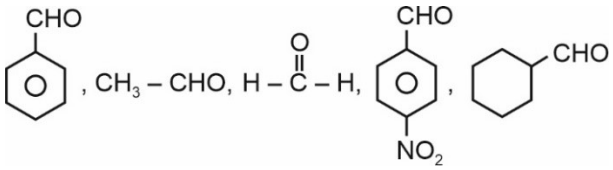
E_{a_2} = 50 kJ/mol, E_{a_3} = 60 kJ/mol.

Calculate value of $(E_a)_{net}$ in kJ/mol

Answer (30)

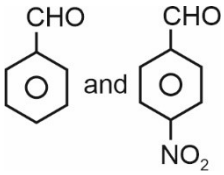
Sol. $(E_a)_{net} = E_{a_1} + E_{a_2} - E_{a_3}$
= 40 + 50 – 60
= 90 – 60
= 30 kJ/mol

23. Positive Fehling solution test is given by



Answer (3)

Sol. Fehling solution test can be given by aldehyde except aromatic aldehyde.



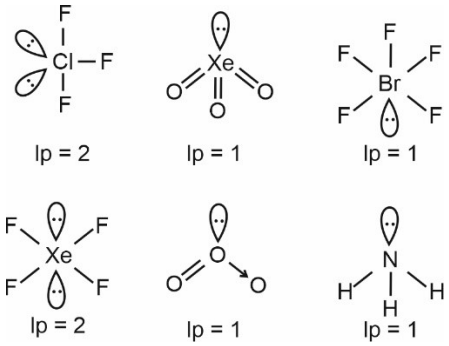
can't give Fehling solution test, other all three given can give Fehling solution test.

24. How many of the following compounds have one lone pair in central atom?

ClF_3, XeO_3, BrF_5, XeF_4, O_3, NH_3

Answer (4)

Sol.



25. How many of the following species have bond order = 1 and are paramagnetic as well?

$He_2^{2+}; O_2^{2-}; Ne_2^{2+}; F_2; B_2; H_2; O_2^{2+}$

Answer (1)

Sol. B_2 have bond order equal to 1 and also paramagnetic.

$He_2^{2+}; O_2^{2-}; Ne_2^{2+}; F_2; H_2$ have bond order equal to 1 but are diamagnetic.

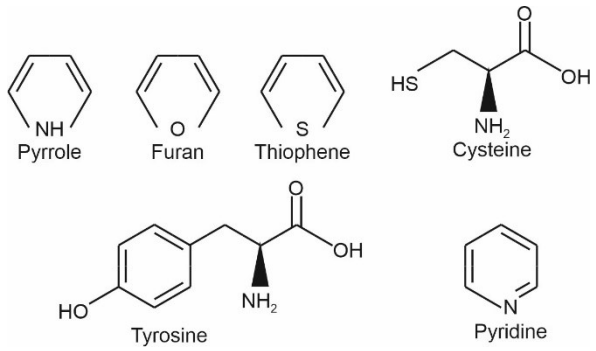
O_2^{2+} have bond order equal to 3.

26. How many of the following compound contain sulphur atom?

Pyrrole, Furan, Thiophene, Cysteine, Tyrosine, Pyridine

Answer (2)

Sol.



Thiophene and cysteine contain sulphur atom.

27. Through a $ZnSO_4$ solution, 0.015 A current was passed for 15 minutes. What is the mass of Zn deposited? (in mg)

(Atomic weight of Zn = 65.4)

Answer (5)

Sol. Charge passed = It

$= 0.015 \times 15 \times 60$ C

Moles of electrons passed = $\frac{0.015 \times 15 \times 60}{96500}$

Moles of Zn deposited = $\frac{1}{2} \times \frac{0.015 \times 15 \times 60}{96500}$

$= 0.00007$

Mass of Zn deposited = 0.00007×65.4 g = 4.58 mg

28. Osmotic pressure at 273 K is 7×10^5 Pa, then what will be the value of x, if its osmotic pressure at 283 K is $x \times 10^4$ Pa?

Answer (73)

Sol. $\pi_1 = iCRT_1$

$\pi_2 = iCRT_2$

$\frac{\pi_1}{T_1} = \frac{\pi_2}{T_2}$

$\pi_2 = \frac{\pi_1 \times T_2}{T_1}$

$= \frac{7 \times 10^5 \times 283}{273}$

$= 7.256 \times 10^5$ Pa

$= 72.56 \times 10^4$ Pa

$\pi_2 = x \times 10^4$

$\therefore \quad x = 72.56 \approx 73$

29. K_p for the given reaction is $(36 \times 10^{-2}\ atm^{-1})$. Find out K_c (M^{-1}) (nearest integer).

$(2NO_2 \rightleftharpoons N_2O_4)$

(R = 0.0821 atm.L/mol.K)

(T = 300 K)

Answer (9)

Sol. $K_p = K_c(RT)^{\Delta ng}$

$36 \times 10^{-2} = K_c(0.0821 \times 300)^{-1}$

$K_c = 0.36 \times 0.0821 \times 300 = 8.86 \approx 9$

30. ??