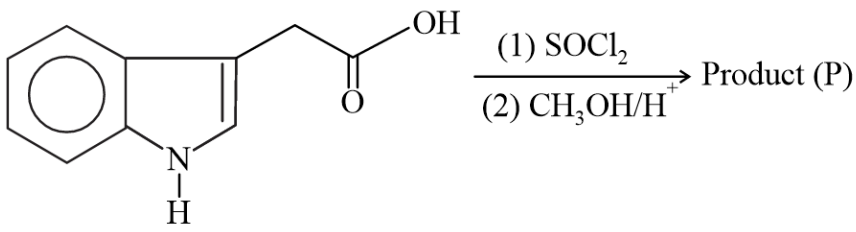
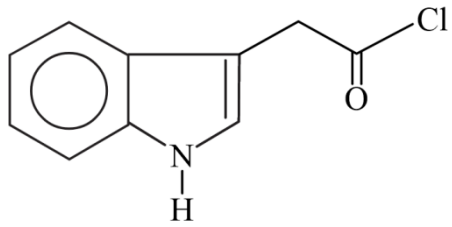
JEE Main 2021 August 26, Shift 1 Analysis (Chemistry)

Q1.

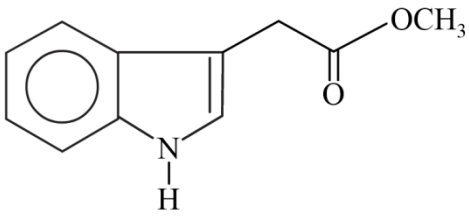


Identify the product P from the following:

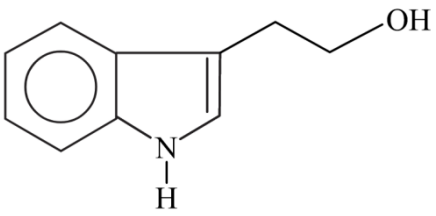
(a)



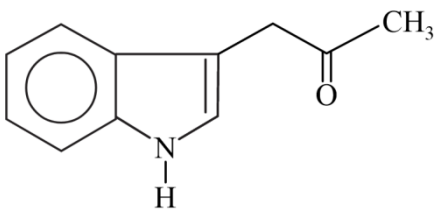
(b)



(c)

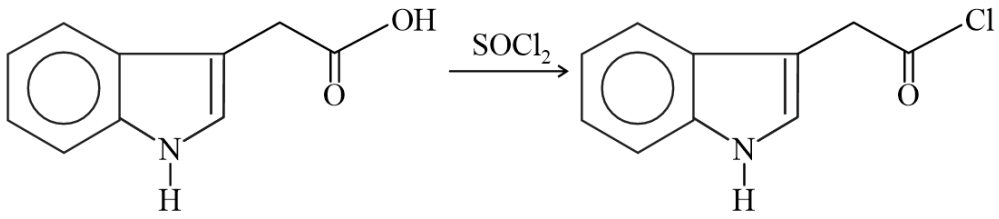


(d)

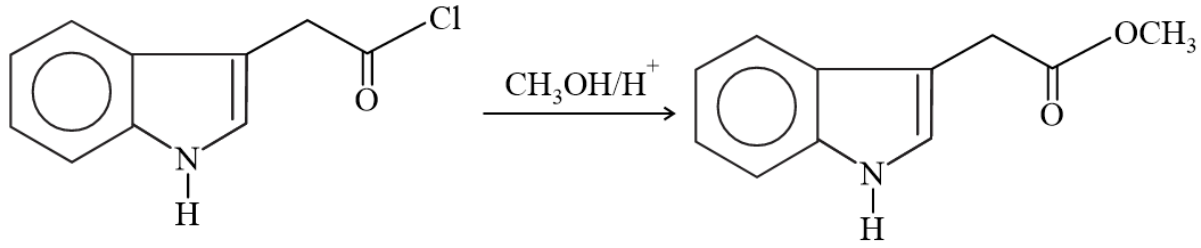


Answer: (b)

Solution: $SOCl_2$ is a halogenating agent.

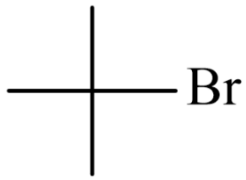


CH_3OH/H^+ and acid chloride undergo esterification reaction as follows:

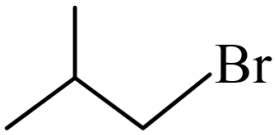


Q.2. Isobutane $+ Br_2 \xrightarrow{h\nu}$ product

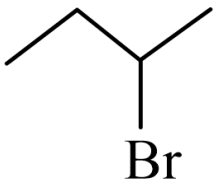
Product is:



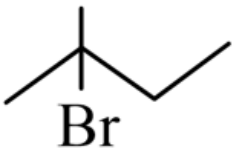
(a)



(b)

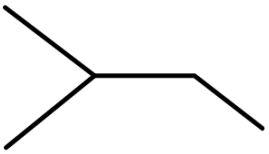


(c)

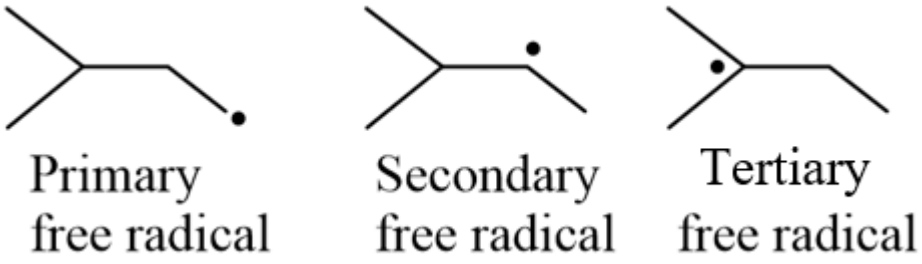


(d)

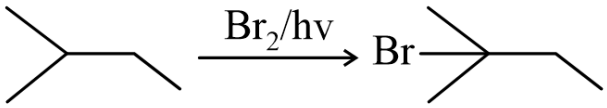
Answer: (d)

Solution: Isobutane is 

Bromination of alkanes in the presence of sunlight is a free radical substitution reaction.

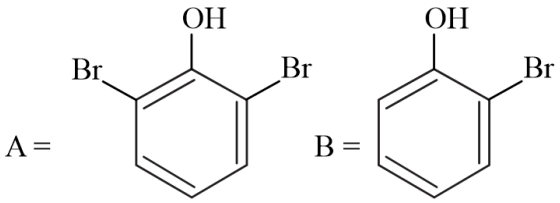


Among these, tertiary free radicals are more stable, which gives more product.

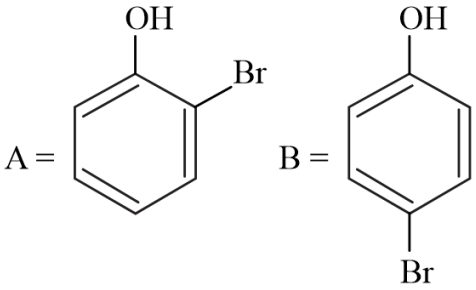


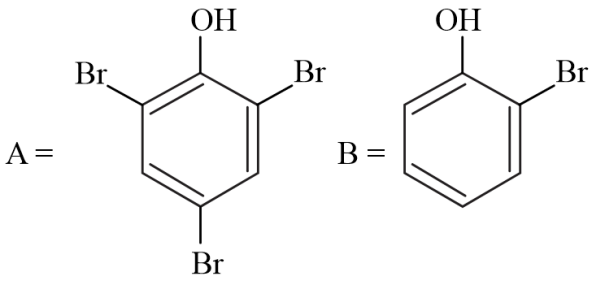
Q. 3. Reaction of phenol with Br_2 and H_2O gives A and reaction of phenol with Br_2 and CS_2 at less than 5°C gives B. Find the product A and B from the below options:

(a)

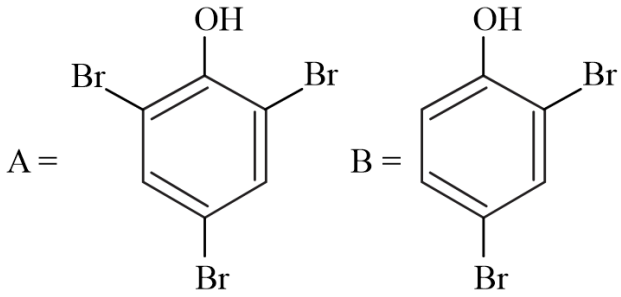


(b)





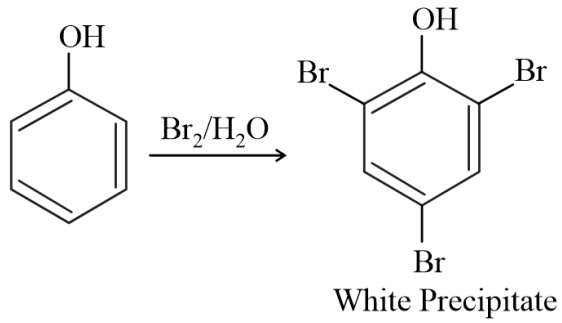
(c)



(d)

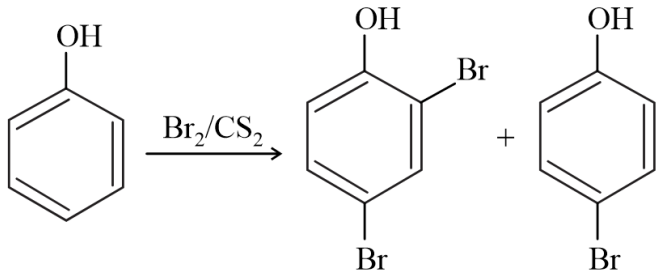
Answer: (d)

Solution: Phenol gives $2,4,6-$tribromophenol with bromine water



White Precipitate

But, in the presence of non-polar solvents like CS_2, Br_2 and phenol it gives ortho and para bromophenols.



Para bromo product is the major product.

Q. 4. On heating novolac with formaldehyde which of the following polymers will form?

(a) Melamine

(b) Resin

(c) Bakelite

(d) Polystyrene

Ans. (c)

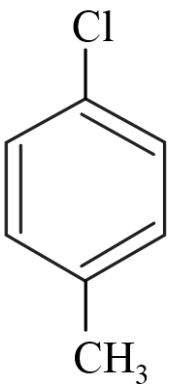
Solution : On heating novolac with formaldehyde, it undergoes crosslinking and froms a thermosetting polymer called Bakelite.

Q. 5. Which of the following reagents gives yellow precipitate for the following sequence?

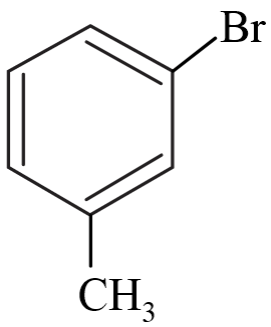
(i) NaOH

(ii) dil. HNO_3

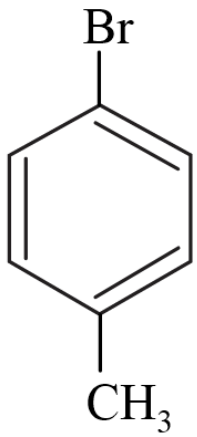
(iii) $AgNO_3$



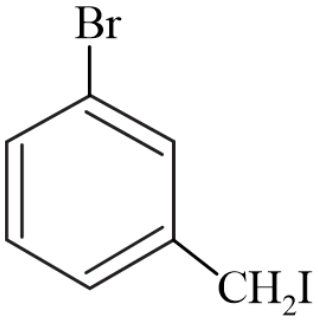
(a)



(b)



(c)



(d)

Answer: (d)

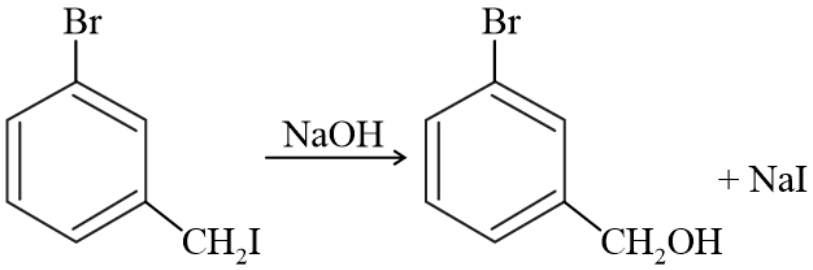
Solution: By the addition of $AgNO_3$ to a solution containing halide ion it gives different coloured precipitates

$$Cl^- + ANO_3 \rightarrow \underset{\text{White}}{AgCl\downarrow} + NO_3{}^-$$

$$Br^- + AgNO_3 \rightarrow \underset{\text{Pale yellow}}{AgBr\downarrow} + NO_3{}^-$$

$$I^- + AgNO_3 \rightarrow \underset{\text{dark yellow}}{AgI\downarrow} + NO_3^-$$

Among the given molecules a, b, c are aryl halides and they do not react with NaOH



$$NaI \xrightarrow[HNO_3]{AgNO_3} AgI$$

dark yellow precipitate

6. Which of the following is the correct sequential method to convert benzene to $3-$ nitrobenzoic acid?

(a) (i) $CH_3Cl + FeCl_3$, (ii) Conc. H_2SO_4, HNO_3 (iii) alkaline $KMnO_4$

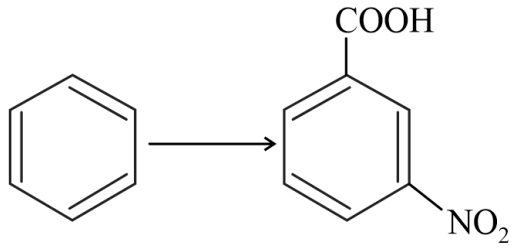
(b) (i) Conc. H_2SO_4, HNO_3, (ii) $CH_3Cl + FeCl_3$ (iii) alkaline $KMnO_4$

(c) (i) alkaline $KMnO_4$, (ii) $CH_3Cl + FeCl_3$ (iii) conc. H_2SO_4, HNO_3

(d) (i) alkaline $KMnO_4$, (ii) conc. H_2SO_4, HNO_3 (iii) $CH_3Cl + FeCl_3$

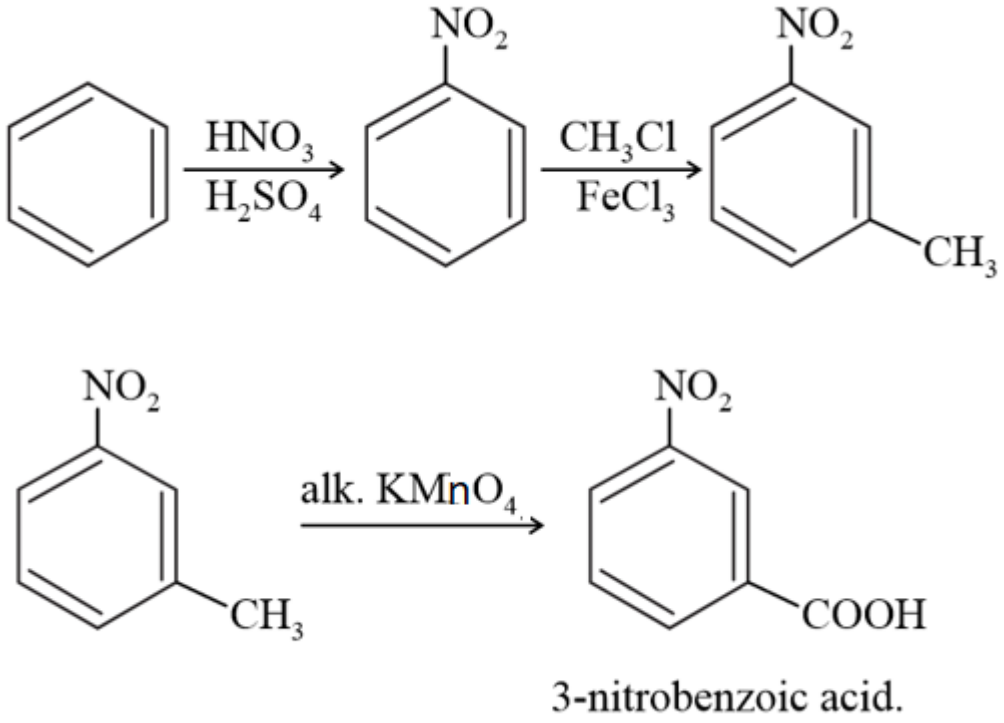
Ans. (b)

Solution:



It is required to introduce meta directing group on the benzene ring first.

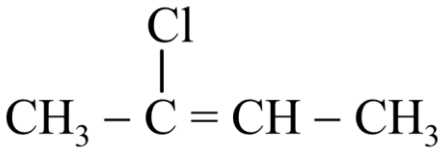
Nitro group is meta directing group. Hence, the correct sequence is:



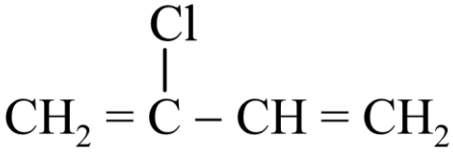
3-nitrobenzoic acid.

Q. 7. Structure of chloroprene is:

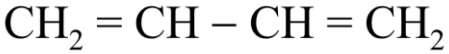
(a)

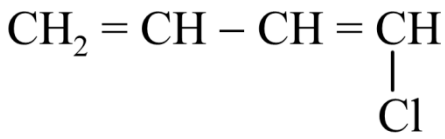


(b)



(c)





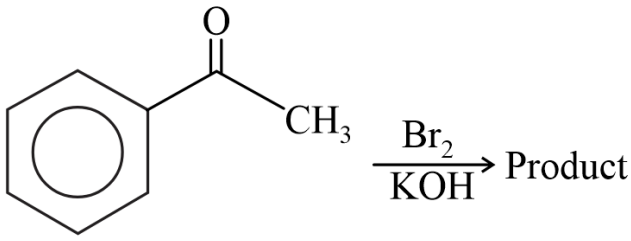
(d)

Answer: (b)

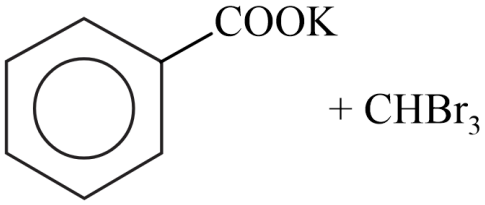
Solution: Chloroprene is a compound with IUPAC name 2-chloro-1,3-butadiene which on polymerisation produces neoprene

Chloroprene

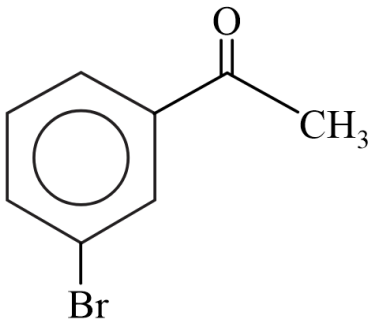
Q. 8.

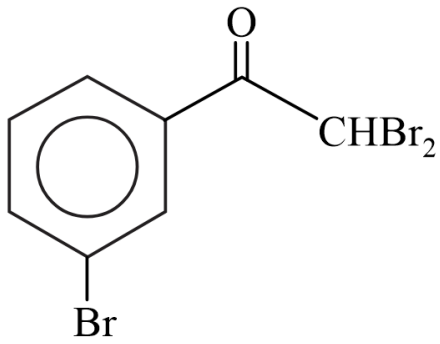


(a)

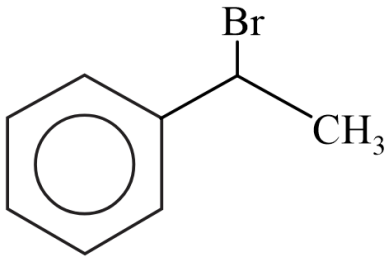


(b)





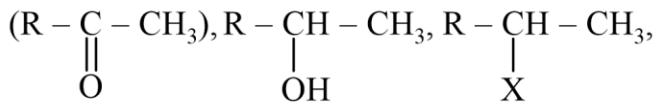
(c)

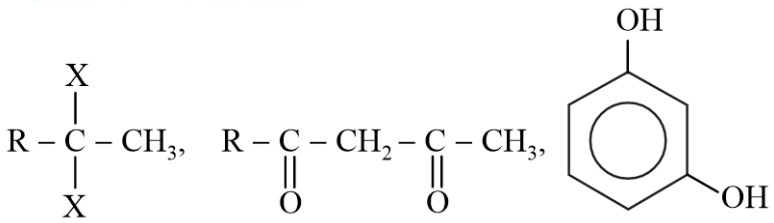


(d)

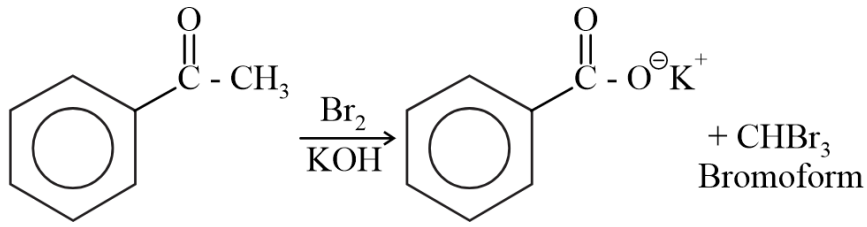
Answer: (a)

Solution: Given reaction is the haloform reaction which is given by methyl ketone





for methyl ketones, haloform reaction can be represented as:



Q. 9. Interhalogen compound AB_3 has a T-shaped structure, how many lone pairs are present on A?

(a) 2

(b) 3

(c) 1

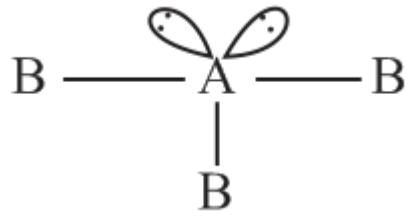
(d) 0

Answer (a)

Solution: Acc. to VSEPR theory:

$L.P.-L.P.$ repulsion $> L.P.-B.P.$ repulsion $> B.P.-B.P.$ repulsion for T-shaped structure:

Hybridisation of A should be sp^3d and $3B.P.$ & $2\ L.p.$ should be present.



Q. 10. Which is a violet compound among these?

(a) $[Fe(CN)_5NOs]^{4-}$

(b) $[Fe(CN)_6]^{4-}$

(c) $[Fe(CN)_6]^{3-}$

(d) $Fe(SCN)_3$

Answer (a)

Solution: Violet colour is shown by $[Fe(CN)_5NOs]^{4-}$, when s^{2-} ion reacts with Nitroprusside ion. It is the test for detection of sulphur.

Q. 11.
S1: The y-intercept in the molar conductance vs. concentration graph is always greater for strong electrolyte than weak electrolyte.

S2 : On decreasing the conc., molar conductivity decreases.

(a) Both S1 and S2 are correct.

(b) S1 is correct, but S2 is incorrect.

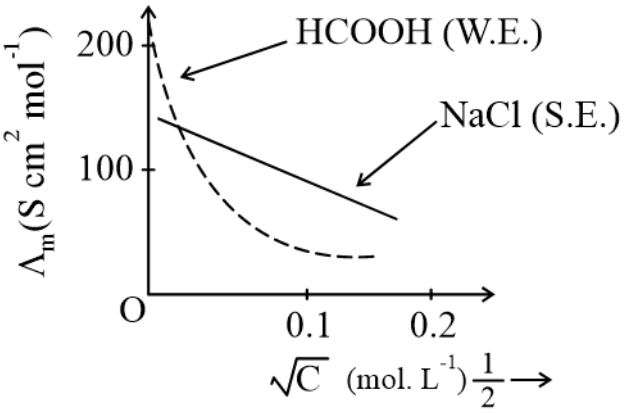
(c) S1 is incorrect, but S2 is correct.

(d) Both S, and S2 are incorrect.

Answer: (d)

Solution: By Huckel-debye equation

$\Lambda_m = \Lambda_m^0 - A\sqrt{C}$ (for strong electrolytes)



(Molar conductance varies with conc.) y- intercept in the molar. conductance is known as limiting molar conductance.

Limiting molar conductance value for weak electrolyte may be greater than that for strong electrolyte. (Acc. the diagram)

Molar conductance increases with dilution or decreasing the concentration.

Q. 12. When excess of CO_2 is passed through lime water then, what will be the sequence of the product?

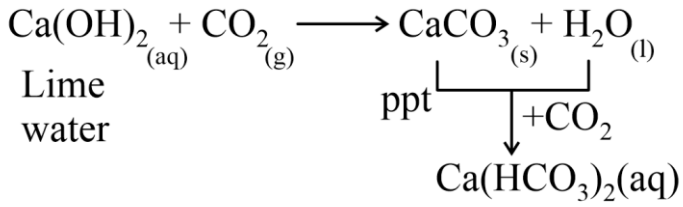
(a) $Ca(HCO_3)_2, CaO$

(b) $CaO, Ca(HCO_3)_2$

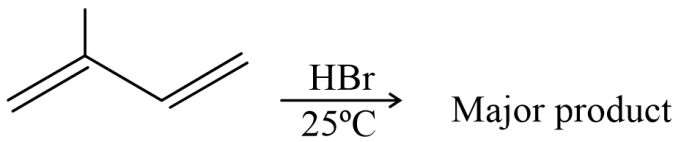
(c) $CaCO_3, Ca(HCO_3)_2$

(d) $CaO, CaCO_3$

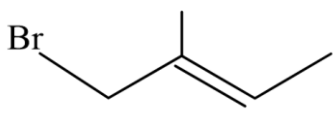
Ans. (c)



Q. 13. Predict the major product for following reaction:



(a)



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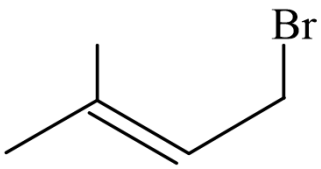
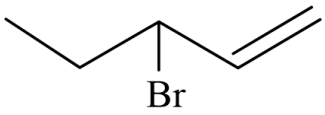
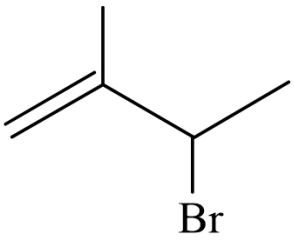


(c)



(d)



Ans. (b)

At low temperatures 1,2-addition is the major product (kinetically controlled product). At room temperature or more, 1,4-addition takes place (thermodynamically controlled product).

Q. 14.

$S1$: Frenkel defect is interstitial as well as vacancy defect.

$S2$: In Frenkel defect, solids show colour because of f −centre

(a) Both $S1$ and $S2$ are correct.

(b) $S1$ is correct, but $S2$ is incorrect

(c) $S1$ is incorrect, but $S2$ is correct

(D) Both $S1$ and $S2$are incorrect.

Ans. (b)

Solution: Frenkel defect is a defect in which the smaller ion (usually cation) gets dislocated from its normal state and gets deposited, cuts some interstitial site creating a vacancy at the previous site and an interstitial defect at the new site. Hence, $S1$ is correct.

f −centers are created in case of metal excess defect like $zn_{1+x}0$. The trapped electrons upon excitation and de-excitation in the visible region generate colour on the salt.

Q. 15.

$S1$: In Bohr's model, velocity of electron increases with decrease in positive charge of nucleus as electrons are not held lightly.

$S2$: Velocity decreases with an increase in principal quantum number.

(a) Both $S1$ and $S2$ are correct.

(b) $S1$ is correct but $S2$ is incorrect.

(c) $S1$ is uncorrect but $S2$ is correct.

(d) Both $S1$ and $S2$ are incorrect.

Answer: (a)

Solution: $V_n = v_0 \frac{z}{n}$ where $v_0 = 2.18 \times 10^6 m/s$

So, with decrease in z, V_n will also decrease.

Hence, $S1$ is correct.

$S2$: With increase in n, velocity will decrease as per the relation $V_n = v_0 \frac{z}{n}$

Hence, $S2$ is correct

Hence, the correct response is option (c).

Q. 16. Which of the following is true for adsorption of gas on a solid surface?
(a) $\Delta H > 0, \Delta S > 0$
(b) $\Delta H > 0, \Delta S < 0$
(c) $\Delta H < 0, \Delta S > 0$
(d) $\Delta H < 0, \Delta S < 0$
Ans. (d)

Solution: In case of adsorption, the particles get accumulated on the surface of an adsorbent. Hence, randomness and entropy decrease - $\Delta G = \Delta x - T\Delta S$.

In adsorption, $\Delta G < 0, \Delta S < 0$ and $T > 0$. Hence, Δx must be less than 0.

That is, $\Delta H < 0 L$ (adsorption is mainly enthalpy driven). Hence, the correct response is (d).

Q. 17. Which of the following will dissolve in water and give colour?

(a) Cu_2Cl_2 (b.) $CuCl_2$ c) AgBr (d.) $ZnCl_2$

Answer: (b)

Solution:
(a) Cu_2Cl_2 is insoluble in water

(b) $CuCl_2$ is soluble in water and is of blue colour. Colour is due to presence of one unpaired electron.

(c) AgBr is insoluble in water.

(d) $ZnCl_2$ forms colourless solution due to absence of unpaired electron.

Thus, $CuCl_2$ will dissolve in water and give blue colour.

Q. 18: How many electrons are present in 4f orbital of Gd^{2+}?

(a) 7
(b) 8
(c) 6
(d) 5

Answer: (b)

Solution: Gadolinium (Gd) has atomic number 64 and its electronic configuration is:

$[x_e]4f^7 5d^1 6s^2$

To form the cation, electron is removed from the outermost shell which is $6s$ in Gd.

Gd^{+2}: $[Xe]4f^7 5d^1$

Due to orbital contraction electron of 5d it will get transferred into 4f and electronic configuration will be Gd^{+2}: $[Xe]4f^8 5d^0$.

Thus, number of electrons present in $4f$ orbital of Gd^{+2} is equal to 8.

Q. 19. S1: Ellingham diagram is used to check which metal oxide is to be reduced by which compound.
S2: In Ellingham diagram as we move from left to right, ΔS always increases.
Options:
(a) Both S1 and S2 are correct.
(b) S1 is correct but S2 is incorrect.
(c) S1 is incorrect but S2 is correct.
(d) Both S1 and S2 are incorrect.

Ans. (b)

S1: Ellingham diagram is used to check which metal oxide is to be reduced by which compound. Graph of metal which lies below in Ellingham diagram has more affinity towards oxygen. Therefore, it can be used to predict which metal oxide can be reduced by using a particular compound.

S2: Slope of Ellingham diagram is equal to $-\Delta S$ and Ellingham diagram contains straight line for which slope is constant. It gets changed only when phase is changed.

Q. 20. By which of the following process deionized water can be obtained?

(a.) Calgon's process

(b.) Synthetic resin method

(c.) Clark's method

(c) Permutit process

Ans. (b)

Pure deionized water is free from all soluble mineral salt. It is obtained by passing water successively through cation exchange (in the H^+form) and an anion exchange (in the $HO^{\ominus}$ from).

Synthetic resin method involves the use of cation exchange resin and anion exchange resin for softening of water. Cation exchange resin contain large organic molecule with $-SO_3H$ group and are insoluble. Anion exchange resin contain large organic molecule with $-$ OH group and are insoluble.

Q. 21. Correct sequence of U_{rms} of O_2, CO_2, N_2 at constant temperature will be:

(a) $U_{N_2} > U_{O_2} > U_{CO_2}$

(b) $U_{CO_2} > U_{O_2} > U_{N_2}$

(c) $U_{O_2} > U_{N_2} > U_{CO_2}$

(d) $U_{CO_2} = U_{O_2} = U_{N_2}$

Ans. (a) $U_{N_2} > U_{O_2} > U_{CO_2}$

$V_{rms} = \sqrt{\frac{3RT}{M}}$

Hence, $V_{rms} \propto \frac{1}{\sqrt{M}}$ (At coustant temperature)

Molar mass: $CO_2 > O_2 > N_2$.

Hence, $V_{rms}: U_{N_2} > U_{O_2} > U_{CO_2}$

Q. 22. Identify the correct formula of Fluorapatite among the following?

(a) $Ca_9(PO_4)_6 \cdot CaF_2$

(b) $NaNO_3$

(c) CaF_2

(d) Na_3AlF_6

Ans. (a) $Ca_9(PO_4)_6 \cdot CaF_2$

Solution: The general formula of the apatite family is $Ca_9(PO_4)_6 \cdot CaX_2 (X = F, Cl, Br \text{ or } OH)$

Fluorapatite is $Ca_9(PO_4)_6CaF_2$ which is the main constituent of phosphate rocks.

Q. 23. Calculate the molarity of 3.3 molal solution of KCl whose density is $1.28\ gram/ml$

(a) 3.7 M

(b) 3.4 M

(c) 5.0 M

(d) 2.5 M

Ans. (b)

Solution: Molality $= 3.3$

$\therefore$ 3.3 mole of KCl in 1000 g H_2O

Mass of solution $= 1000 + 3.3 \times 74.5$

$= 1245.85$ g $= 1.24585$ kg

$d = \frac{M}{V} \Rightarrow V = \frac{\text{Mess of Solition}}{\text{density}} = \frac{1245.85}{1.28}$

$= 973.32$ ml

Volume in L$= \frac{973.32}{1000} = 0.97332$ L

Molarity$= \frac{3.3}{097332} \cong 3.4$ M

Q. 24. What is the water molecule ratio in potash alum and Mohr's salt?

Ans. 4

Solution:- Potash alum $= K_2(SO_4) \cdot Al_2(SO_4)_3 \cdot 24H_2O$

Mohr's salt $= (NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$

Ratio of water molecule $= \frac{24}{6} = 4$