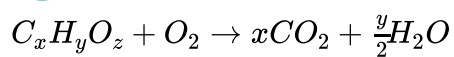


Organic Chemistry – Some Basic Principles and Techniques & Hydrocarbons

1. Complete combustion of 1.80 g of an oxygen containing compound ($C_xH_yO_z$) gave 2.64 g of CO_2 and 1.08 g of H_2O . The percentage of oxygen in the organic compound is:

- A. 50.33
 B. 53.33
 C. 51.63
 D. 63.53



2.64 g of CO_2 contains 0.72 g C

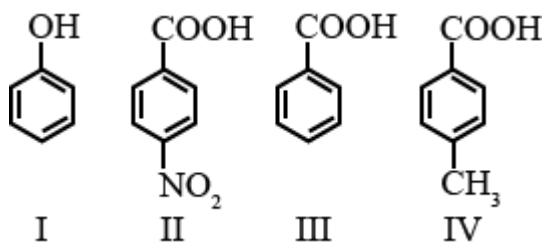
1.08 g of H_2O contains 0.12 g H

$$\therefore \text{mass of oxygen present} = 1.80 - (0.72 + 0.12) = 0.96 \text{ g}$$

$$\%O = \frac{0.96}{1.80} \times 100 = 53.33\%$$

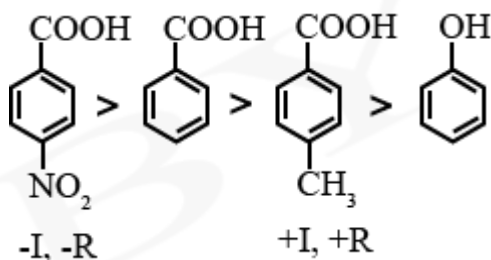
Organic Chemistry – Some Basic Principles and Techniques & Hydrocarbons

2. The correct order of acid character of the following compounds is :



- A. $IV > III > II > I$
- B. $II > III > IV > I$
- C. $I > II > III > IV$
- D. $III > II > I > IV$

Acidic strength



carboxylic acids are more acidic than phenols.

Reason:

The negative charge in carboxylate ion is dispersed over two oxygen atoms whereas in phenoxide it is distributed over only one oxygen atom.

Hence, the carboxylate ion is more stable than the phenoxide ion. Hence, carboxylic acids are more acidic than phenol and alcohol because of greater resonance stabilization of their conjugate base.

I is the least acidic

$-I$ and $-R$ effect increase the acidic strength since electron-withdrawing group will increase the acidity by stabilize the negative charge formed after the loss of H^+ , whereas $+I$ and $+R$ effect decrease the acidic strength of carboxylic acids.

Correct order is

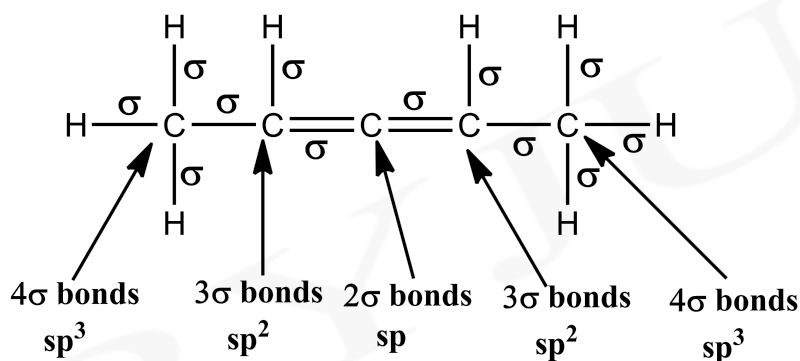
$II > III > IV > I$

Organic Chemistry – Some Basic Principles and Techniques & Hydrocarbons

3. The types of hybridisation on the five carbon atoms from left to right in the molecule

$CH_3 - CH = C = CH - CH_3$ are :

- A. $sp^3, sp^2, sp^2, sp^2, sp^3$
- B. $sp^3, sp, sp^2, sp^2, sp^3$
- C. $sp^3, sp^2, sp, sp^2, sp^3$
- D. $sp^3, sp^2, sp^2, sp, sp^3$



Organic Chemistry – Some Basic Principles and Techniques & Hydrocarbons

4. Among the following, the aromatic compounds are:



Choose the correct answer from the following options:

- A. (A), (B) and (C) only
- B. (B), (C) and (D) only
- C. (B) and (C) only
- D. (A) and (B) only

Conditions for aromaticity are

(i) Planarity

(ii) Complete delocalisation of the π electrons in the ring.

(iii) Presence of $(4n + 2)\pi$ electrons in the ring where n is an integer ($n = 0, 1, 2, \dots$).

Compounds B and C are aromatic since all the conditions for aromaticity are satisfied

Compound A is non-aromatic since it has sp^3 hybridised carbon. Hence non-planar

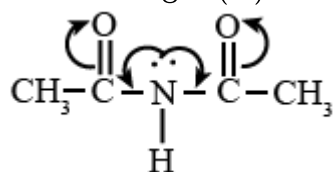
Compound D is anti-aromatic. It has $4n \pi e^-$

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5. Which of the following is least basic?

- A. $(CH_3CO)\ddot{N}HC_2H_5$
- B. $(CH_3CO)_2\ddot{N}H$
- C. $(C_2H_5)_2\ddot{N}H$
- D. $(C_2H_5)_3\ddot{N}$

Basic strength (\propto) availability of lone pair

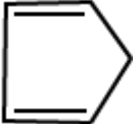
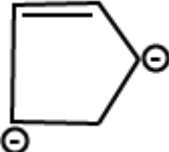

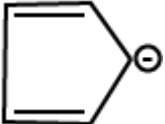


In this case lone pair of \ddot{N} is highly participating in resonance. So, least availability of lone pair for donation.

In (b) there is only one $-CH_3CO-$ group where nitrogen's lone pair can be delocalized. In (c) and (d) there is no delocalization.

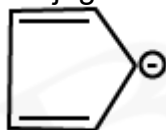
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6. Which of the following is an aromatic compound?

- A. 
- B. 
- C. 
- D. 

Answer : (d)

For a compound to be aromatic it should be cyclic, planar and should have conjugated π -bond. It should also obey $4n + 2$ rule.



$n = 1$ (Aromatic)

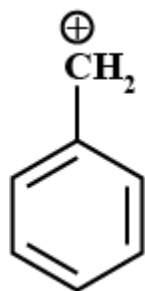
Compound (d) has 6π - electron and obeys all the condition. Hence, it is a aromatic compound.

Compound (c) is anti-aromatic since it has $4n \pi e^-$

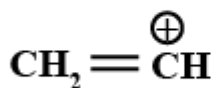
Compound (a) and (b) are non-aromatic because they are not planar. They have a sp^3 hybridised carbon.

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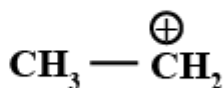
7.



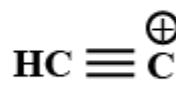
A



B



C



D

The correct order of stability of given carbocation is

A. $C > A > D > B$

B. $D > B > C > A$

C. $A > C > B > D$

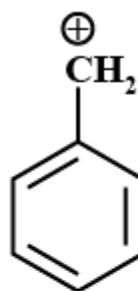
D. $D > B > A > C$

Order of electronegativity on hybridised carbons,
 $sp > sp^2 > sp^3$

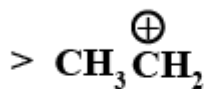
Thus, order of stability of positive charge on hybridised carbon,
 $sp^3 > sp^2 > sp$ (least stable)

Positive charge on compound A is stabilised by resonance effect of benzene ring.

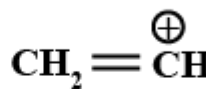
Order of stability of carbocation is



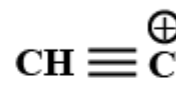
A



C



B



D

Resonance

**+ve charge
on sp^3
hybridized
carbon**

**+ve charge
on sp^2
hybridized
carbon**

**+ve charge
on sp
hybridized
carbon**

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8. Compound with molecular formula C_3H_6O can show:

- A. Both positional isomerism and metamerism
- B. Metamerism
- C. Positional isomerism
- D. Functional group isomerism

For a compound with molecular formula $C_cH_hX_xN_nO_o$

$$\text{Degree of unsaturation} = (c + 1) - \frac{h}{2} - \frac{x}{2} + \frac{n}{2}$$

Where, X = Halogen

c=number of carbon atom

h=number of hydrogen atom

n=number of nitrogen atom

o=number of oxygen atom

In C_3H_6O

$$\text{Degree of unsaturation} = (3 + 1) - \frac{6}{2} = 1$$

$$\text{Degree of unsaturation} = 1$$

No possible metamerism and positional isomers are possible.

Possible function group isomers are

CH_3-CH_2-CHO & $CH_3-CO-CH_3$. Therefore, functional group isomerism is the most appropriate.

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9. Which one of the following pairs of isomers is an example of metamerism?

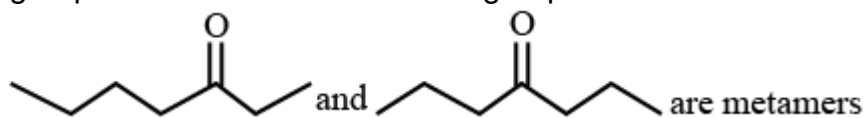
- A. $\text{H}_5\text{C}_6\text{CH}_2\text{CH}_2\text{OH}$ and $\text{H}_5\text{C}_6\text{CH}(\text{OH})\text{CH}_3$
- B. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ and $\text{H}_3\text{C}-\overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}}-\text{CH}_3$
- C. $\text{CH}_3\text{C}(=\text{O})\text{C}_6\text{H}_5$ and $\text{H}_5\text{C}_6\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$
- D. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{C}(=\text{O})\text{CH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{C}(=\text{O})\text{CH}_2\text{CH}_2\text{CH}_3$

Option (a) represent positional isomers

Option (b) represents positional isomers

The compounds in option (c) are not isomers. They have different molecular formula.

Metamers have a common functional group and differ in the type of alkyl groups attached to the functional group



Hence, option (d) is the correct answer.

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10. Which purification technique is used for high boiling organic liquid compound (decomposes near its boiling point)?

- A. Simple distillation
- B. Steam distillation
- C. Fractional distillation
- D. Reduced pressure distillation

Reduced pressure distillation or vacuum distillation is used for the purification of high boiling organic liquids which decomposes at or below their boiling point.

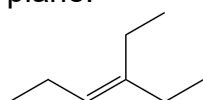
Hence, option (d) is correct.

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11. Which of the following molecules does not show stereo isomerism?

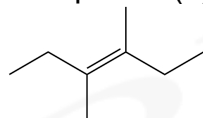
- A. 3, 4-Dimethylhex-3-ene
- B. 3-Methylhex-1-ene
- C. 3-Ethylhex-3-ene
- D. 4-Methylhex-1-ene

Geometrical and optical isomerism are stereoisomerism. Compound (c) does not show geometrical isomerism because same group is attached to the one of the sp^2 double bonded carbon. It also lacks optical isomerism due to absence of chiral carbon or chiral plane.



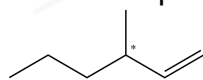
3-Ethylhex-3-ene

Compound (a) - It shows geometrical isomerism.



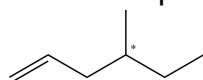
3, 4-Dimethylhex-3-ene

Compound (b) - It lacks geometrical isomerism but shows optical isomerism due to the presence of chiral carbon.



3-Methylhex-1-ene

Compound (d) - It lacks geometrical isomerism but shows optical isomerism due to the presence of chiral carbon.



4-Methylhex-1-ene

Hence, option (c) is correct.

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12. In chromatography technique, the purification of compound is independent of:

- A. Mobility or flow of solvent system
- B. Solubility of the compound
- C. Length of the column or TLC plate
- D. Physical state of the pure compound

We know that,

The separation of components can be expressed in terms of retardation factor i.e., R_f value.

$$R_f = \frac{\text{Distance travelled by solute}}{\text{Distance travelled by solvent}}$$

Hence, we need to fix the length of the column or TLC plate so as to measure the distance travelled by solute or solvent.

During separation, the components of the mixture move up along with the solvent to different distances depending on their degree of adsorption and separation takes place. Hence, the separation is dependent upon mobility or flow of solvent. Solubility is the property of how well a component of the mixture dissolves in the mobile phase. Higher the solubility in the mobile phase, the faster the molecule will move through the column. Hence, chromatographic separation is dependent on solubility of the compound.

Thus, in chromatography technique, the purification of a compound is independent of the physical state of the pure compound.

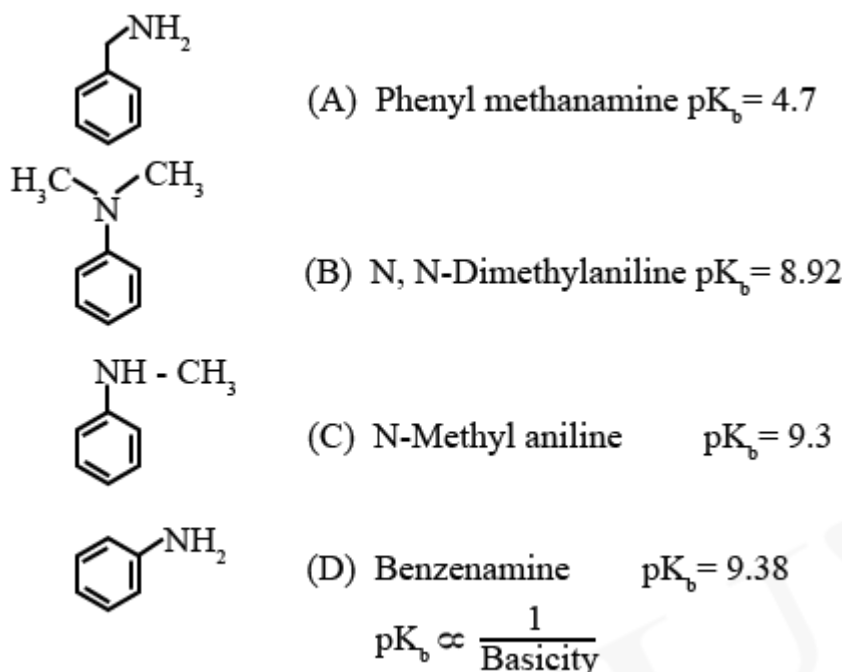
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13. A. Phenyl methanamine
 B. N,N-Dimethylaniline
 C. N-Methyl aniline
 D. Benzenamine

Choose the correct order of basic nature of the above amines.

- A.** $A > C > B > D$
- B.** $D > B > C > A$
- C.** $D > C < B > A$
- D.** $A > B > C > D$

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$$pK_b \propto \frac{1}{\text{Basicity}}$$

In B,C,D the lone pairs of nitrogen are involved in resonance with the ring, whereas it is not the case in compound A

So, tendency to donate the lone pair is the highest in A. So, A is most basic.

In B, there are two methyl groups attached to nitrogen which show +I effect.

In C, there is one methyl group attached to nitrogen which shows +I effect.

In D, there is no methyl group attached to nitrogen.

Higher the number of electron donating group (methyl groups) attached to nitrogen, more is the availability of nitrogen's lone pair and more is the basicity.

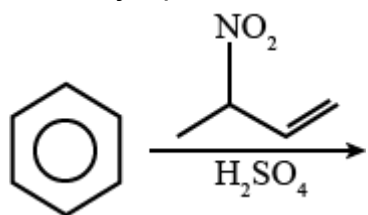
So, B is more basic than C and D is the least basic

Correct order is

$A > B > C > D$

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14. The major product of the following reaction is :

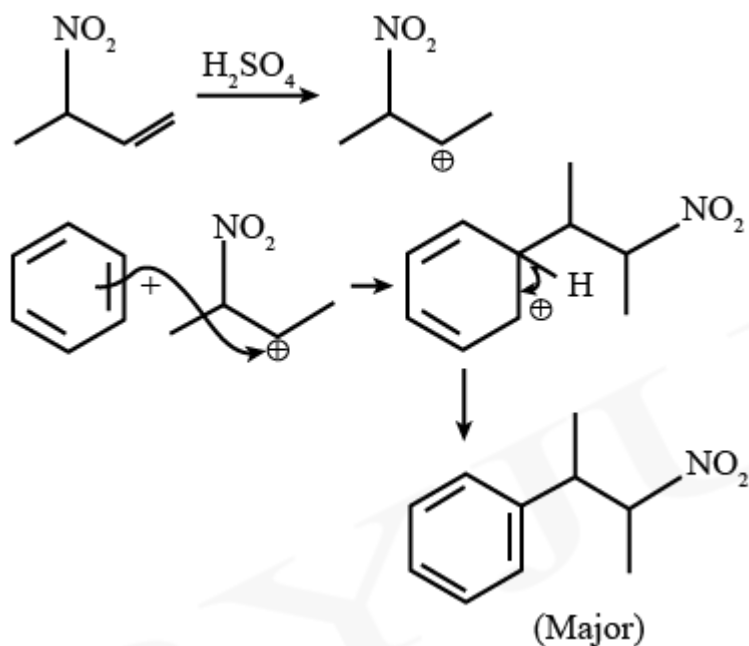


- A.
- B.
- C.
- D.

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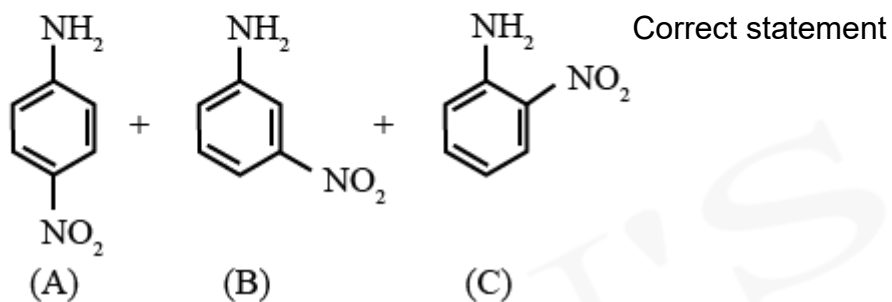
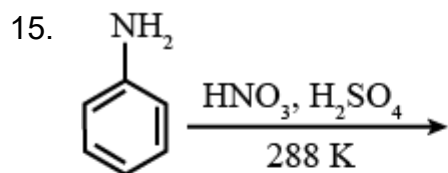
The double bond in alkene attacks the H^+ to form stable secondary carbocation. This act as electrophile for the electrophilic aromatic substitution.

Now, the benzene attack the nucleophile to give the following friedel craft alkylation product.



Hence, option (b) is correct.

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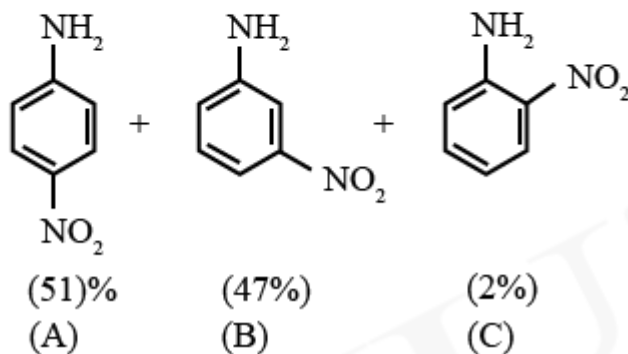
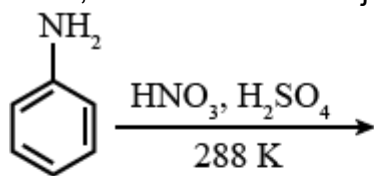


about the given chemical reaction is :

- A. The reaction will form sulphonated product instead of nitration.
- B. Reaction is possible and compound (B) will be the major product.
- C. Reaction is possible and compound (A) will be major product.
- D. $-NH_2$ group is ortho and para directive so product (B) is not possible

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A will be the major product because NH_2 is an ortho/para directing group. Here, ortho is not the major product due to steric hindrance.



Also in strong acidic medium aniline is protonated to form anilinium ion which is a meta-directing group.

That is why besides the ortho para derivatives, significant amount of meta derivatives is also formed.

Hence, option (c) is correct.

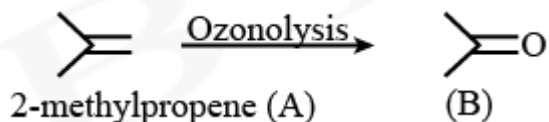
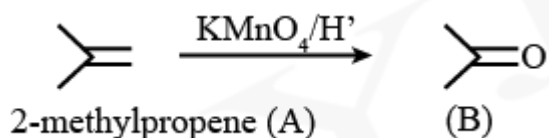
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16. An Organic compounds 'A' C_4H_8 on treatment with $KMnO_4/H^+$ yields compound 'B' C_3H_6O . Compound 'A' also yields compound 'B' an ozonolysis. Compound 'A' is

- A. Cyclobutane
- B. 2-Methylpropene
- C. But-2-ene
- D. 1-Methylcyclopropane

Unsaturated alkenes undergoes ozonolysis to form oxidised products. Thus, option (a) and (d) does not undergo ozonolysis.

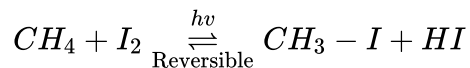
Also, acidic $KMnO_4$ oxidise terminal alkene to aldehyde or keto group.



Hence, option (b) is correct.

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17. Presence of which reagent will affect the reversibility of the following reaction, and change it to a irreversible reaction.

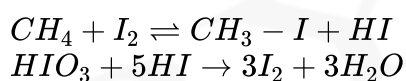


- A. Dilute HNO_2
- B. Liquid NH_3
- C. $HOCl$
- D. Concentrated HIO_3

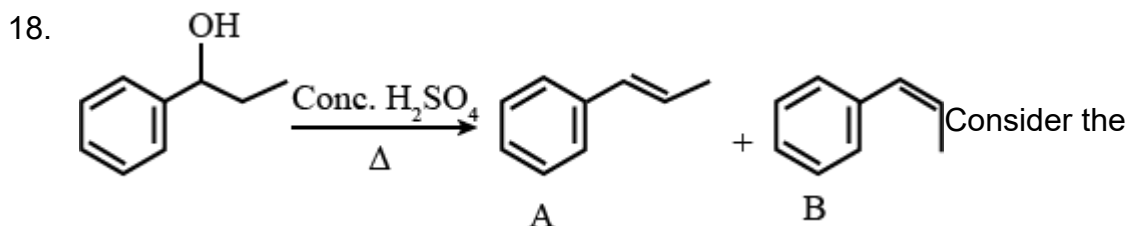
Iodination is very slow and a reversible reaction.

Formed HI in product side is powerful reducing agent, it will reduced alkyl iodide to I_2 .

The reaction can be irreversible in the presence of strong oxidising agent like *conc. HNO_3* or *conc. HIO_3* . It will oxidise the HI to I_2 and make the reaction irreversible.



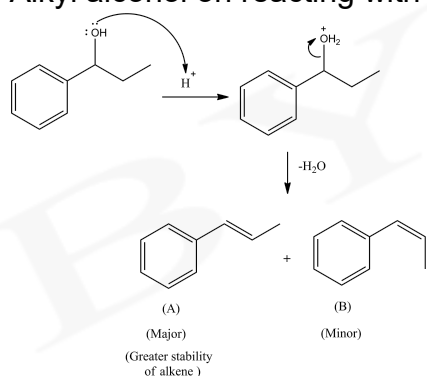
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above reaction, and choose the correct statement:

- A. Both compounds A and B are formed equally
- B. Compound A will be the major product
- C. Compound B will be the major product
- D. The reaction is not possible in acidic medium

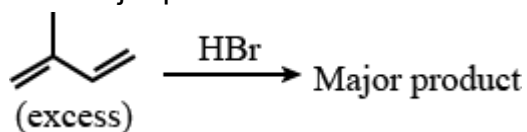
Alkyl alcohol on reacting with *conc.* H_2SO_4 undergoes dehydration.

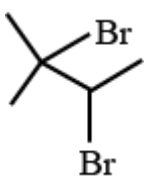
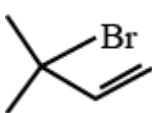
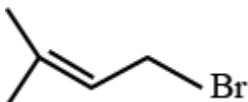
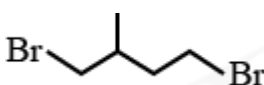


The carbocation formed undergoes $C - C$ bond rotation to form trans product which is more stable than the cis product due to less steric hindrance.

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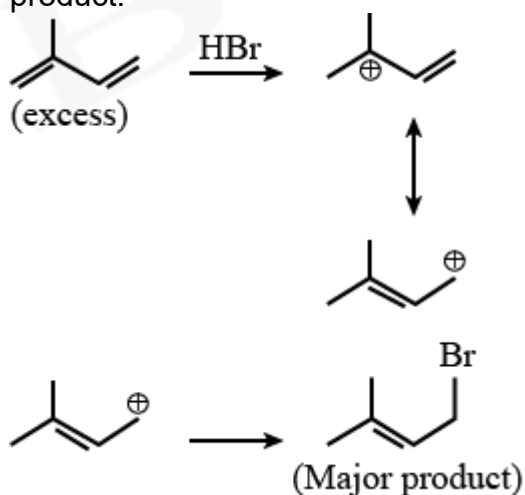
19. The major product formed in the following reaction



- A. 
- B. 
- C. 
- D. 

Addition of HBr:

In the given compound, the most substituted alkene will attack the H^+ to form a stable allylic carbocation which undergoes resonance to give the more substituted alkene followed by addition of Br^- to get the major product.

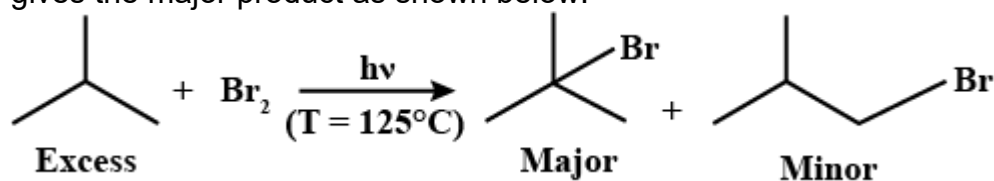


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20. Excess of isobutane on reaction with Br_2 in presence of light at $125^\circ C$ gives which one of the following, as the major product?

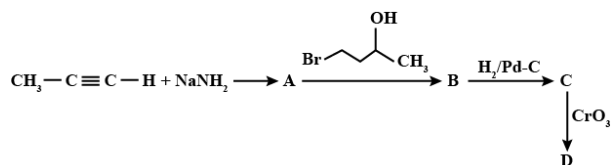
- A. $\begin{array}{c} CH_3 \\ | \\ CH_3 - C - Br \\ | \\ CH_3 \end{array}$
- B. $\begin{array}{c} CH_3 - CH - CH_2Br \\ | \\ CH_3 \end{array}$
- C. $\begin{array}{c} Br \\ | \\ CH_3 - C - CH_2 - Br \\ | \\ CH_3 \end{array}$
- D. $\begin{array}{c} CH_3 - CH - CH_2Br \\ | \\ CH_2Br \end{array}$

Halogenation alkane undergoes free radical mechanism. Tertiary free radicals are more stable than primary, Hence, $C - H$ bond breaking is favourable in tertiary carbon and thus, it gives the major product as shown below:



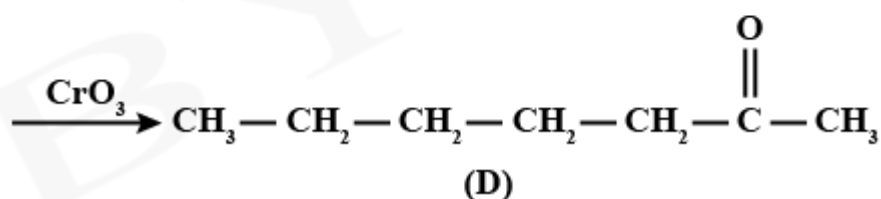
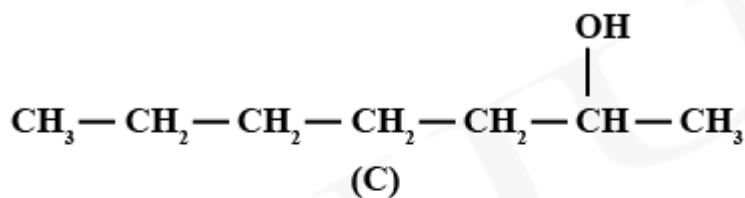
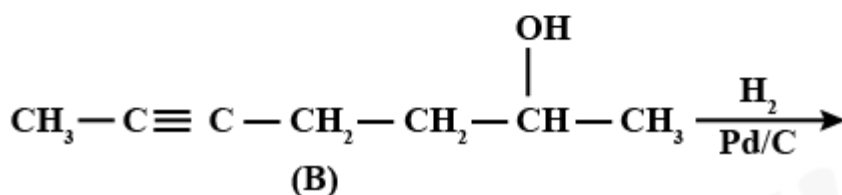
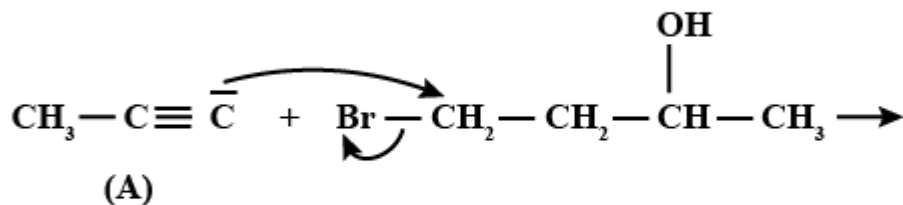
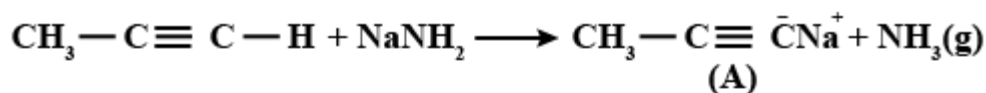
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21. In the following sequence of reactions, the final product 'D' is :



- A.** $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$
- B.** $\text{H}_3\text{C}-\text{CH}=\text{CH}-\text{CH}(\text{OH})-\text{CH}_2-\text{CH}_2-\text{CH}_3$
- C.** $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{COOH}$
- D.** $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$

Organic Chemistry – Some Basic Principles and Techniques & Hydrocarbons



Terminal alkyne have acidic proton, hence, on reacting with NaNH_2 it form acetylide ion. It undergoes nucleophilic substitution reaction with alkyl halide to form compound (B). Here, acetylide ion act as a nucleophile.

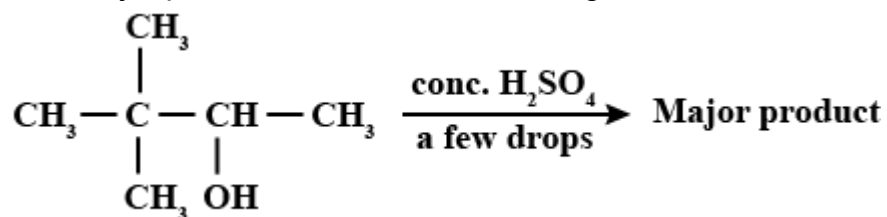
Compound (B), alkyne on reacting with H_2 in presence of Pd undergoes hydrogenation to give alkane, compound (C).

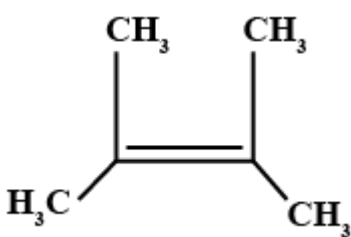
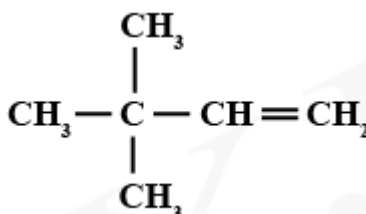
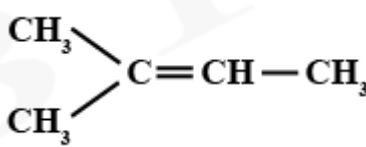
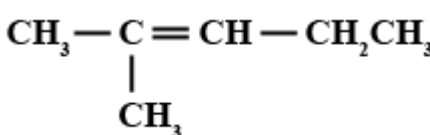
CrO_3 oxidise secondary alcohol to ketone group.

Hence, option (a) is correct.

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

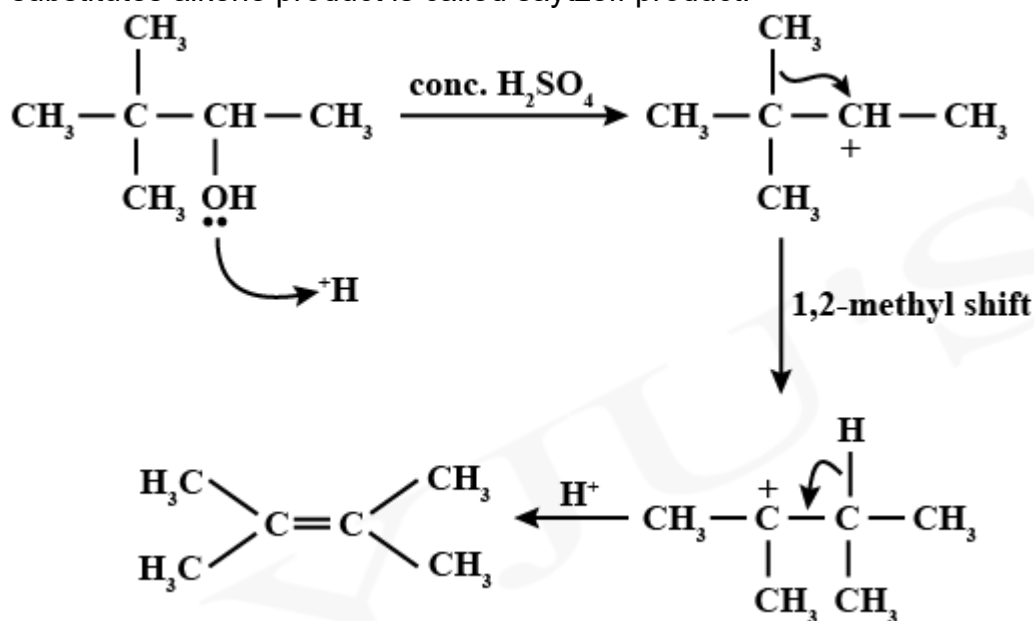


- A. 
- B. 
- C. 
- D. 

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Alkyl alcohol undergoes dehydration in presence of *conc.* H_2SO_4 acid.

In the given molecule, OH group get protonated and leaves the molecule to form a secondary carbocation. Now, it undergoes 1, 2-methyl shift to form relatively stable tertiary carbocation followed by deprotonation to give most stable alkene product (more substituted alkene) as major product. More substituted alkene product is called saytzeff product.



Thus, option (a) is correct.

Organic Chemistry – Some Basic Principles and Techniques & Hydrocarbons

23. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R)
- Assertion (A) : Treatment of bromine water with propene yields 1-bromopropan -2 - ol
- Reason (R) : Attack of water on bromonium ion follows Markovnikov rule and results in 1- bromopropan -2 - ol
- In the light of the above statements, choose the most appropriate answer from the options given below:

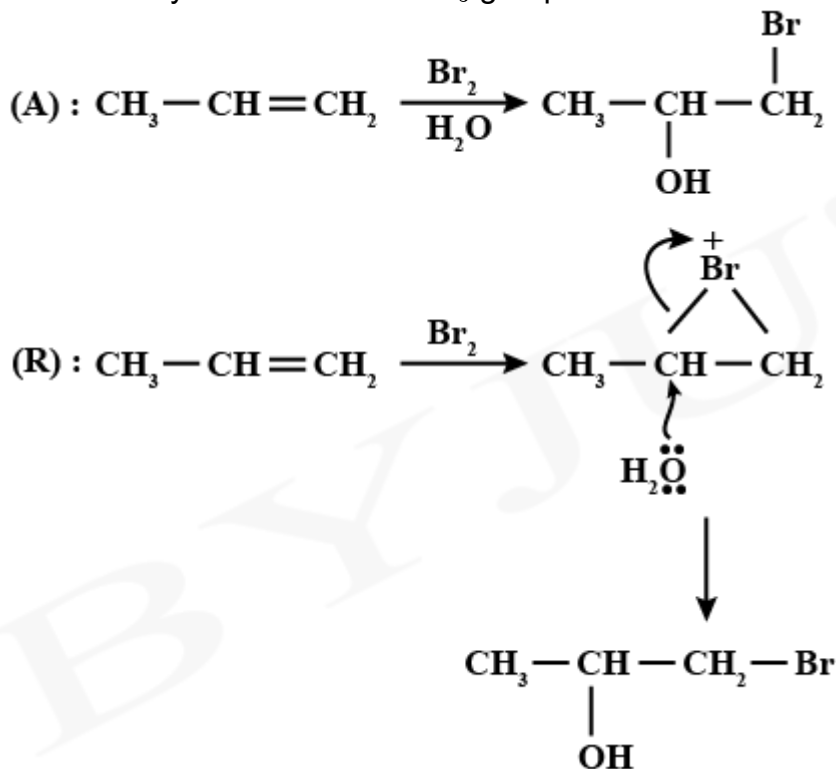
- A.** Both (A) and (R) are true and (R) is the correct explanation of (A)
- B.** (A) is true but (R) is false
- C.** Both (A) and (R) are true but (R) is NOT the correct explanation of (A)
- D.** (A) is false but (R) is true

Organic Chemistry – Some Basic Principles and Techniques & Hydrocarbons

Alkene with Br_2 forms bromonium ion and then water molecules attacks by Markovnikov rule to give the major product.

Markovnikov's rule: Negative part of the addendum (adding molecule) gets attached to that doubly bonded C which possesses lesser number of hydrogen atoms.

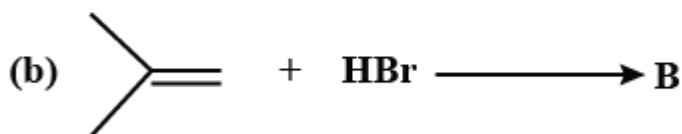
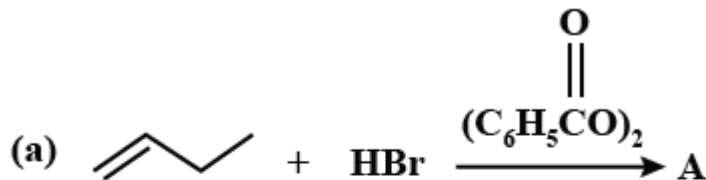
Here, the water molecule attacks the carbon which possesses less number of hydrogen atom because the partial positive charge on this carbon is stabilised by the +I effect of CH_3 group.



Hence, option (a) is correct.

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24. The increasing order of the boiling point of the major products A, B, and C of the following reaction will be:



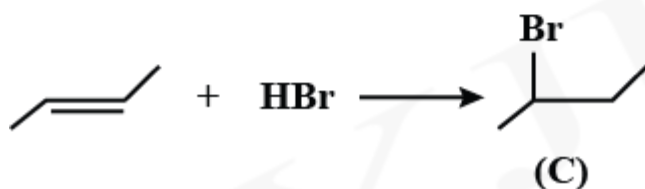
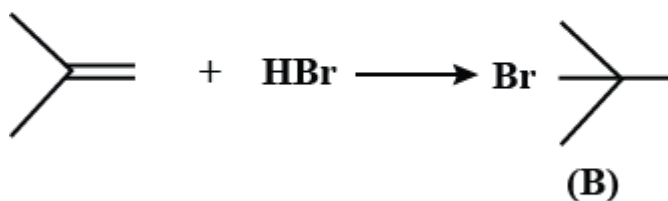
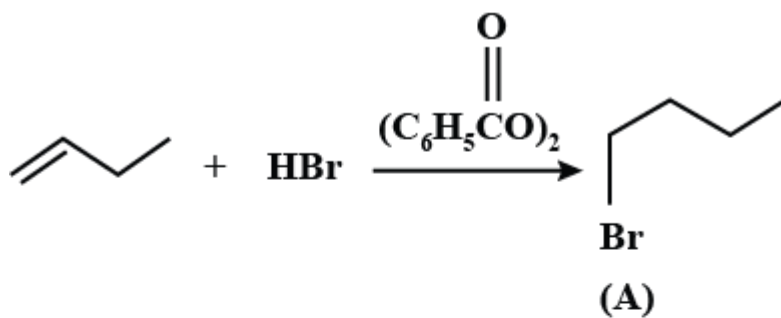
- A. $B < C < A$
- B. $C < A < B$
- C. $A < B < C$
- D. $A < C < B$

Addition of HBr to alkene follows Markovnikov's rule.

Markovnikov's rule: When an unsymmetrical reagent is added to an unsymmetrical alkene, the negative part of the reagent is attached to the unsaturated C atom having less number of hydrogen atoms.

Addition of HBr to alkene in presence of peroxide follows anti-Markovnikov rule.

Organic Chemistry – Some Basic Principles and Techniques & Hydrocarbons



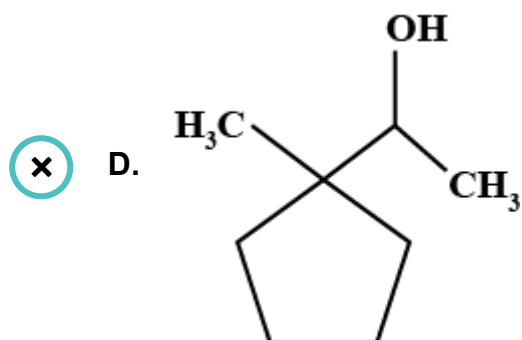
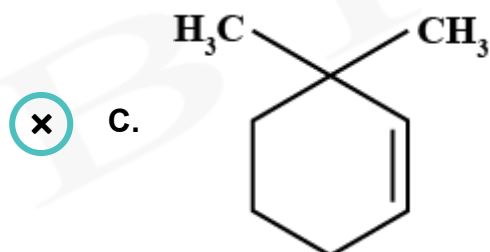
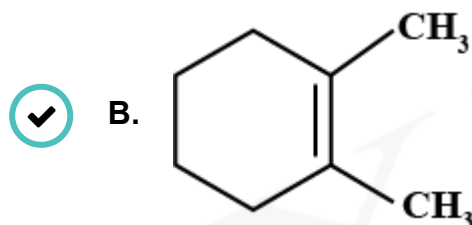
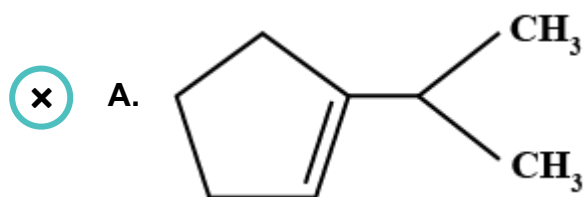
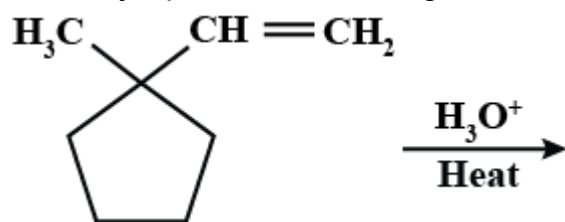
The boiling points of isomeric haloalkanes decrease with increase in branching.

So, order of boiling point is,
A > C > B.

Hence, option (a) is correct.

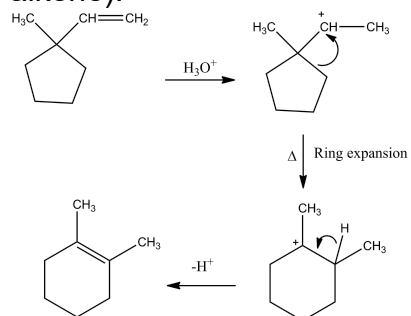
Organic Chemistry – Some Basic Principles and Techniques & Hydrocarbons

25. The major product in following reaction is:



Organic Chemistry – Some Basic Principles and Techniques & Hydrocarbons

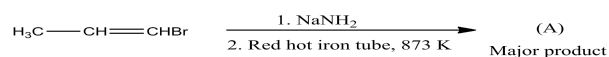
When alkene is heated in acidic condition, rearrangement is possible. Here, the alkene will attack the H^+ ion to form secondary carbocation. Now, the ring expansion takes place to form stable six membered ring and followed by elimination to form the stable alkene product (more substituted alkene).



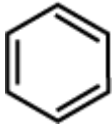
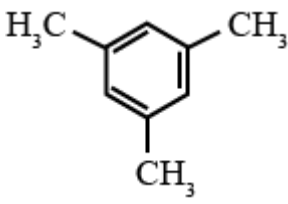
Hence, option (b) is correct.

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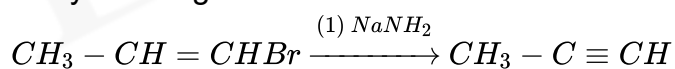
26. For the given reaction:



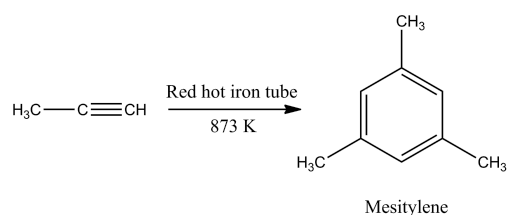
What is 'A' ?

- A. 
- B. 
- C. $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$
- D. $\begin{array}{c} \text{CH}=\text{CH}-\text{NH}_2 \\ | \\ \text{CH}_3 \end{array}$

Dehydrohalogenation:

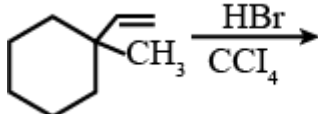


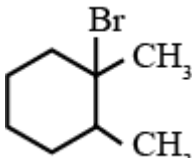
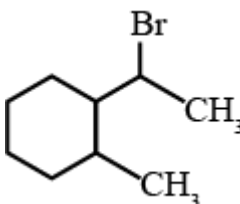
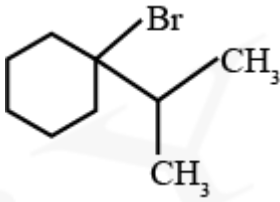
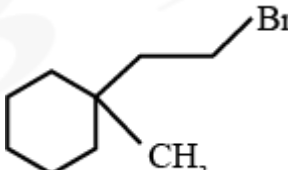
Propyne when passed through a hot iron tube at 873 K produces Mesitylene

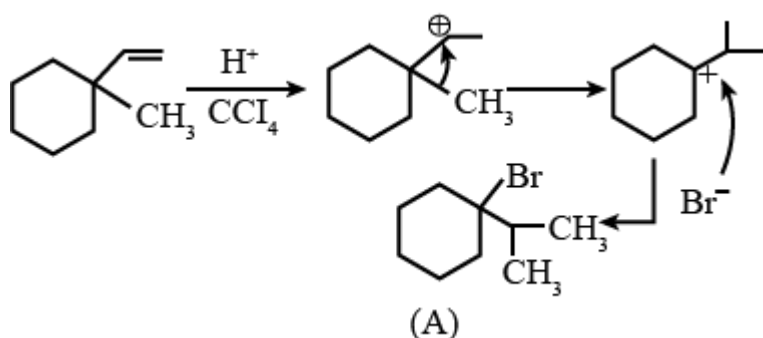


So, the correct option should be (b)

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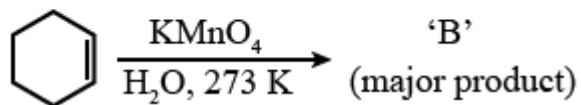
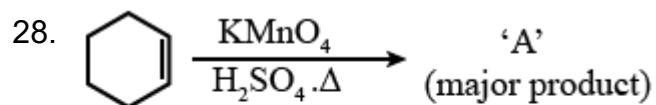
27.  (Major Product) Product "A" in the above chemical reaction is

- A. 
- B. 
- C. 
- D. 



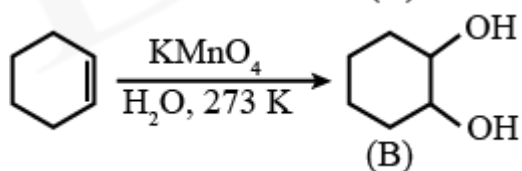
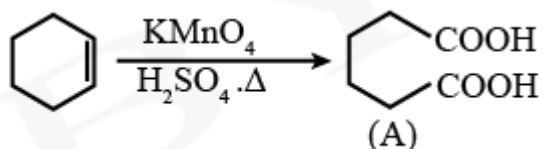
The reaction involves the formation of 2° carbocation followed by methanide shift to give 3° carbocation Br^- ion attacks the 3° carbocation to give the major product.

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For above chemical reactions, identify the correct statement from the following.

- A. Compound 'A' is dicarboxylic acid and compound 'B' is diol.
- B. Compound 'A' is diol and compound 'B' is dicarboxylic acid.
- C. Both compound 'A' and compound 'B' are dicarboxylic acids.
- D. Both compound 'A' and compound 'B' are diols.



Organic Chemistry – Some Basic Principles and Techniques & Hydrocarbons

29. The total of $C - C$ sigma bonds/s in mesityl oxide ($C_6H_{10}O$) is (Round off to the Nearest Integer).

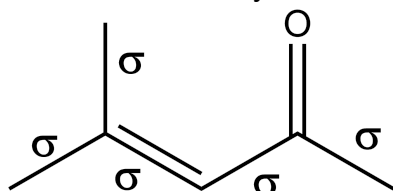
Accepted Answers

5 5.0 5.00

Solution:

Answer (5)

Structure of mesityl oxide is



mesityl oxide

5σ C-C bonds

Number of C - C sigma bonds = 5

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30. In Duma's method of estimation of nitrogen, 0.1840 g of an organic compound gave 30 mL of nitrogen collected at 287 K and 758 mm of Hg pressure. The percentage composition of nitrogen in the compound is _____. (Round to the nearest integer). [Given: Aqueous tension at 287 K = 14 mm of Hg]

Accepted Answers

19 19.0 19.00

Solution:

Pressure of N = 758 - aqueous tension (mm of Hg)

From $PV = nRT$,

$$\text{Moles of } N_2 = \frac{758 - 14}{760} \times \frac{30 \times 10^{-3}}{0.0821 \times 287}$$

$$= 1.246 \times 10^{-3} \text{ mol}$$

$$\text{Mass of } N = 1.246 \times 10^{-3} \times 28$$

$$\text{Mass \% of 'N'} = \frac{\text{mass of } N}{\text{total mass}} \times 100$$

$$= \frac{1.246 \times 28 \times 10^{-3}}{0.184} \times 100$$

$$= \frac{1.246 \times 28}{0.184} = 18.9\%$$

Nearest integer = 19%