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India's Number 1 Education App

## CHEMISTRY

# BOOKS - CENGAGE CHEMISTRY (ENGLISH) 

## GENERAL ORGANIC CHEMISTRY

Illustration

1. Determine the $F . C$ on each atom in :
(a) HOBr
(b) $\stackrel{\oplus}{N} H_{4}$
(c) $\mathrm{H}_{2} \mathrm{O}: \mathrm{BBr}_{3}$.
(D) Watch Video Solution
2. (a) Draw Lewis structures for:
(i) Ethanol $\left(\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{OH}\right)$
(ii) $\mathrm{Br} N O$
(iii) $H O C N$
(b) Give an isomeric structure for $\mathrm{NH}_{2} \mathrm{OH}$ and explain which structure is more stable.

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3. With the help of $F$. $C$. Explain which Lewis structure is more stable for the following molecules:
(a) $N_{2} O:(i):{ }^{\Theta} \ddot{N}=\stackrel{2+}{O}=\ddot{N}:^{\Theta}$ or $(i i): N \equiv \stackrel{\oplus}{N}-\ddot{O}:^{\Theta}$
(b).


$$
H N O_{3}(i) H-O-\underset{\mid}{\stackrel{\oplus}{N}}=\ddot{O}: \text { or }(i i) H-O-\stackrel{+2}{N}-\ddot{\mid}-\stackrel{\ddot{O}}{\bullet}:^{\Theta}
$$

(d). $C I_{2} O:(i): \ddot{C} I-\ddot{O}-\ddot{C} I:$ or $(i i): \ddot{O}-\ddot{C} I-\ddot{C} I$ :

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4. Determine $F$. $C$ on each atom in
(a) carbocation $\mathrm{H}_{3} \mathrm{O}^{\oplus}$
(b) carbanion $H_{3} C^{\text {® }}$
( c) free radical $\mathrm{H}_{3} \mathrm{C}$.
(d) carbene $\mathrm{H}_{2} \mathrm{C}$ :

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5. Explain whether oxidation, reductio, or neither occurs in the following reactions :
(a) $\mathrm{H}_{2} \mathrm{C}=\mathrm{CH}_{2} \rightarrow \mathrm{H}_{3} \mathrm{C}-\mathrm{CH}_{3}$
(b) $\mathrm{HC} \equiv \mathrm{CH} \rightarrow \mathrm{H}_{3} \mathrm{C}-\mathrm{CH}=\mathrm{O}$
(c) $\mathrm{CH}_{4} \rightarrow \mathrm{CH}_{3} \mathrm{OH}$
(d) $\mathrm{H}_{2} \mathrm{CBr}_{2} \rightarrow \mathrm{H}_{2} \mathrm{C}=\mathrm{O}$
II. Give the structural formula for the simplest hydrocarbon in which $C$ has a zero $O . N$.

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6. Explain :
(i) $\mathrm{mofNH}_{3}>\mathrm{NF}_{3}$
(ii) $\mu o f \mathrm{CO}_{2}$ is zero, nut $\mu o f \mathrm{SO}_{2} \neq 0$
(iv) Why the lone pair of $\bar{e}$,s has no effect on the $\mu$ of $P H_{3}$. The bond angle in $\mathrm{PH}_{3}$ is $92^{\circ}$.
(v) $\mu o f \mathrm{CH}_{2} \mathrm{C1}_{2}>\mathrm{CHC1}_{3}$.

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7. Describe heterolytic (polar) bond cleavage of:
(i) Agl,
(ii) $H^{\oplus}{ }^{\ominus}$
(ii) $H_{3} N B F_{3}$,
(iii) $\left[\mathrm{Cu}\left(\mathrm{OH}_{2}\right)_{4}\right]^{2 \oplus}$
(b) Name the reverse of heterolytic cleavage.
(c) Describe homolytic bond cleavage of $\mathrm{CH}_{3}-\mathrm{Co}-\mathrm{Co}-\mathrm{CH}_{3}$.
(d) Compare the relative energies of singlet and triplet carbenes.
(e) Of $X_{C}$ : (singlet) and $X_{2} C$ : (triplet), which is stable?
(f) Of $F_{2} C:, C 1_{2} C:, B r_{2} C:, I_{2} C$ : (singlet), which is more stable?
(g) Compare and explain the difference in the $I E$ and $E A$ of $\cdot \mathrm{CH}_{3}$
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8. Give the decreasing order of the stabilities of the following :
a. i.

b. i.



iv.

v.

i.

iii.

iv.


9. Classify the following species as
(a) nuclephile,
(b) electrophile,
(c) both, or
(d) neither.
$B F_{3}, I^{-}$

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10. Name the intermediate species formed in the following reactions:
(a) $\mathrm{CH}_{3} \mathrm{CH}_{2}-\underset{\oplus}{\mathrm{N}} \equiv \underset{.}{N} \rightarrow I+: N \equiv N$ :
(b) $\mathrm{CH}_{3} \mathrm{CH}_{2}-\mathrm{C} \equiv \mathrm{C}-\mathrm{H}+\stackrel{\oplus}{\mathrm{K}} \stackrel{\ominus}{\mathrm{N}} \mathrm{H}_{2} \rightarrow \mathrm{II}+\mathrm{NH}_{3}$
(c) $\mathrm{Ph}-\mathrm{CH}=\mathrm{CH}-\mathrm{Me}+\mathrm{HBr} \rightarrow \mathrm{III}+\mathrm{Br}^{\ominus}$
(d) $\mathrm{Ph}-\underset{\mathrm{OH}}{\mid}-\mathrm{CH}_{3}+H^{\oplus} \rightarrow \mathrm{IV}+\mathrm{H}_{2} \mathrm{O}$
( e) $\mathrm{CH}_{3} \mathrm{CH}_{2} \ddot{\mathrm{O}} \mathrm{H} \xrightarrow{-\bar{e}} V \rightarrow V I+. \mathrm{CH}_{3}$
(f) $\mathrm{CH}_{3}-\ddot{N}=\ddot{N}-\mathrm{CH}_{3} \xrightarrow{\Delta} V I I I+Z n I_{2}$
(h) $\mathrm{PhCH}_{2} \mathrm{C} 1+A 1 C 1_{3} \rightarrow I X+[A 1 C 1]^{\ominus}$
(i) $\mathrm{CH}_{3}-\mathrm{C} \equiv \mathrm{C}-\mathrm{CH}+L i \underset{C_{2} \mathrm{H}_{5} O H}{\text { liq. } \mathrm{NH}_{3}} X+L i^{\oplus}$.

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11. Designate the species (A) and (B) as electrophile ( E) or nucleophile ( Nu ) in the following reactions :
(a) $B E t_{3}+M e_{2} \ddot{O}: \rightarrow M e_{2} \stackrel{\oplus}{O}-\stackrel{\ominus}{B} E t_{3}$
(b) $\mathrm{CH}_{2}=\mathrm{O}+\underset{\text { Bisulphite ion }}{\stackrel{\ominus}{\mathrm{S}} \mathrm{O}_{3} \mathrm{H} \rightarrow \underset{O^{\ominus}}{\mathrm{C}} \underset{2}{\mathrm{H}_{2}}-\mathrm{SO}_{3} \mathrm{H}}$
(c) $\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{C} 1+: \mathrm{CH}^{\ominus} \rightarrow \mathrm{C}_{2} \mathrm{H}_{5}-\mathrm{CN}+\mathrm{C1}^{\ominus}$
$\mathrm{CH}_{3}-\mathrm{CH}=\mathrm{CH}_{2}+: \ddot{\mathrm{C}} \mathrm{l}-\ddot{\mathrm{C}}!:$

$$
\mathrm{CH}_{3}-\stackrel{\oplus}{\mathrm{C}} \mathrm{H}-\underset{\mathrm{Cl}}{\mathrm{CH}_{2}}+\mathrm{Cl}^{\ominus} \longleftarrow
$$


(f) $: \stackrel{\oplus}{N} H_{2}+C H_{3}-C \equiv C H \rightarrow C H_{3}-C \equiv C^{\ddot{\Theta}}+N H_{3}$

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12. Give the decreasing order of acidic character.
(a) $\mathrm{NO}_{2} \mathrm{CH}_{2} \mathrm{OH}$,
(b) $\mathrm{C1CH}_{2} \mathrm{COOH}$,
(c) HCOOH ,
(d) $\mathrm{CH}_{3} \mathrm{COOH}$,
(e) $\mathrm{CH}_{3} \mathrm{OH}$
13. Arrange the following In decreasing order of $p K_{b}$ values
(I) $\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{NH}_{2}$
(II) PhNHMe
(III) $\left(\mathrm{C}_{2} \mathrm{H}_{5}\right)_{2} \mathrm{NH}$
(IV) $\mathrm{PhNH}_{2}$

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14. Arrange the following in decreasing order of basicities :
a. I. $\mathrm{Me} \longrightarrow \mathrm{NH}_{2}$ II. $\mathrm{HO} \sim \mathrm{NH}_{2}$ III. $\mathrm{HO} \longrightarrow \mathrm{NH}_{2} \mathrm{IV} . \mathrm{OH} \longrightarrow \mathrm{NH}_{2}$
b. I. $\mathrm{EtNH}_{2}$
II. $\mathrm{MeCONH}_{2}$
III. $\mathrm{PhCONH}_{2}$
c. I. $\mathrm{PrNH}_{2}$
II. $\mathbf{H C} \equiv \mathrm{C}-\mathrm{CH}_{2} \mathrm{NH}_{2}$
III. $\mathrm{H}_{2} \mathrm{C}=\mathrm{CH}-\mathrm{CH}_{2} \mathrm{NH}_{2}$
d. I. $\mathbf{P h C H}_{\mathbf{2}} \mathbf{N H}_{\mathbf{2}}$
II. $\square-\mathrm{CH}_{2} \mathrm{NH}_{2}$
III. $\mathrm{O}_{2} \mathrm{~N}-\mathrm{O}_{-}-\mathrm{CH}_{2} \mathrm{NH}_{2}$
e. I. $\square-\mathrm{NH}_{2}$
II. $\mathbf{P h}_{2} \mathbf{N H}$
III. $\mathbf{P h N H}_{2}$
(f) Write the conjugate base and conjugate acid of
(I) $\mathrm{HOCH}_{2} \mathrm{CH}_{2} \mathrm{NH}_{2}$.

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15. Which of the following pairs do not constitute resonanting structures ?
a. $\mathrm{Me}-\stackrel{\oplus}{\mathrm{N}}<\mathrm{O}^{\ominus}$ O $\quad$ and $\quad \mathrm{Me}-\mathrm{O}-\mathrm{N}=\mathrm{O}$

c. $\begin{gathered}\mathrm{Me} \\ \mathrm{Me}\end{gathered}>=\mathrm{O}$

d. $\mathrm{MeCH}=\mathrm{CHMe}$ and $\mathrm{MeCH}_{2} \mathrm{CH}=\mathrm{CH}_{2}$

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16. Arrange the following resonating structures in the order of decreasing stability :

$$
\begin{gathered}
\underset{\text { (I) }}{C H} \underset{\sim}{C H}-\ddot{C} I: \leftrightarrow \\
\text { (Vinyl chloride) }
\end{gathered}
$$

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17. (a) Write the resonance structures of $\mathrm{NO}_{2}^{\ominus}$ (nitrite) and $\mathrm{NO}_{3}^{\ominus}$ (nitrate ion) in terms of:
(i) outer shell $\bar{e}, s$ with formal charges
(ii) overlapping atomic orbitals.
(c) Compare the resonance (delocalisation) energy adn stabilities of $\mathrm{NO}_{2}^{\ominus}$ and $\mathrm{NO}_{3}^{\ominus}$.
(b) (i) Write the resonance contributing and hybrid structures of (I)
$\mathrm{N}_{2} \mathrm{O}$ (II) $\mathrm{H}_{2} \mathrm{C}-\mathrm{N}_{2}$ (diazomethane).
(ii) Give the hybridised state of each atom in each structure.
(iii) Discuss their bond length in each resonance contributing structure and compare with those in hybrid structures.

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18. Which $N$ of guanidine ( $I$ ) is more basic and is more likely to be protonated ?

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19. Compare the stabilities of the following pairs of resonance contributing structures
(a) $R-\underset{(I)}{\stackrel{\oplus}{C}}=\ddot{O}: \leftrightarrow R-C=\stackrel{\oplus}{\ddot{O}}:(\underset{(I I)}{(\operatorname{acylium} i o n)}$
(b) $M e-\underset{\|}{\stackrel{\oplus}{S}}-M e \leftrightarrow M e-\underset{\|}{\ddot{S}}-M e$

$$
\begin{array}{cc}
: \ddot{O} & \vdots O \\
(\ddot{O} I I) & (\ddot{I V})
\end{array}
$$

(c) $M e_{2} C=\underset{\mid}{C} \underset{\substack{M e \\(V)}}{\underset{O}{O}}: \leftrightarrow M e_{2} \stackrel{\oplus}{C}-\underset{\mid}{C}=\stackrel{\oplus}{\ddot{O}}:$
(d) $H_{2} C \underset{(V I I)}{=} \ddot{O}: \leftrightarrow \underset{(V I I)}{H_{2} \stackrel{\oplus}{C}}-\ddot{O}:{ }^{\Theta}$
20. Give the decreasing order of stabilities of the following alkenes :
(i) Ethene,
(ii) Propene,
(iii) cis - 2 - butene
(iv) trans-2-Butene
(v) 2 - Methy1-2-butene,
(vi) 2, 3 - Dimethy1-2-butene

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21. Give the resonance structure of the conjugate bases of the following :
I.

22. Give the decreasing order of acidities of :
(a) (I) $\mathrm{H}_{3} \mathrm{C}-\stackrel{\mathrm{II}}{\mathrm{C}}-\mathrm{OMe}$ (II) $\mathrm{H}_{3} \mathrm{C}-\mathrm{CH}=\mathrm{O}$
(III) $H_{3} C-\stackrel{\oplus}{\underset{\mid}{\mid}} \underset{O^{\ominus}}{ }=O$ and explain.

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## Solved Example

1. Which of the following is the most stable resonance structure
a.

b.

c.

d.

a. $\mathrm{H}_{2} \mathrm{C}$

A.
B.

C.

D.


## Answer:

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2. Which of the following is a most likely product from the reaction as shown below?

a. Me

A.
B.

C.

D.
d.


Answer:
3. Give the stability of the following resonance structures
(a) $H_{2} C=\stackrel{\oplus}{N}=\stackrel{\ominus}{C}$
(b) $H_{2} \stackrel{\oplus}{C}-N=\stackrel{\ominus}{N}$
(c ) $H_{2} \stackrel{\ominus}{C}-\stackrel{\oplus}{N} \equiv N$
(d) $H_{2} \stackrel{\ominus}{C}-N=\stackrel{\oplus}{N}$.

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4. Write the correct resonance structure of the given compound.

5. The correct stability order for the following species is

(I)

(II)

(III)

(IV)

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6. Explain the following :
(a) Why $\mathrm{MeNH} \stackrel{\oplus}{\mathrm{C}} \mathrm{H}_{2}$ (I) is more stable more than $\mathrm{MeCH} \stackrel{\oplus}{\mathrm{C}} \mathrm{H}_{2}$ (II) when both are $1^{\circ}$ carbocations ?
(b) Which of the following intermediate is unstable?

(II)
( c) Why allylic free radical $\left(\mathrm{CH}_{2}-\mathrm{CH}=\mathrm{CH}_{2}\right)(\mathrm{I})$ is more stable than propy1 free radical $\left(\dot{\mathrm{C}} \mathrm{H}_{2}-\mathrm{CH}_{2}-\mathrm{CH}_{3}\right)(\mathrm{II})$, when both are $1^{\circ}$ free radicals?

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7. Give decreasing order of the stabilities of the following :
a. (1)
 (2)

(3)

(4)


(5)

b. (1)

(3)

(4)

(5)


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8. Arrange the following compounds in the order of increasing boiling points :
(i) $\mathrm{CH}_{3} \mathrm{COC1}$
(ii) $\left(\mathrm{CH}_{3} \mathrm{CO}\right)_{2} \mathrm{O}$
(iii) $\mathrm{CH}_{3} \mathrm{CONH}_{2}$
(iv) $\mathrm{CH}_{3} \mathrm{COOH}$.
9. (I) Arrange the compounds ( aO in the order of decreasing boilling points and (b) in the order of decreasing solubility in water (A) (1) Ethanol (2) Propane, (3) Pentanol

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10. Arrange the following in the decreasing order of boiling points :
(i) (1) $\mathrm{C}_{3} \mathrm{H}_{8}$
(2) $\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{OH}$
(3) $\left(\mathrm{CH}_{3}\right)_{2} \mathrm{O}$
(4) $\mathrm{CH}_{2} \mathrm{OHCH} \mathrm{H}_{2} \mathrm{OH}$
11. Arrange the following alcohols:

In the decreasing order of their boiling points.
(1) $n-$ Butylalcohol
(2) sec - Butylalcohol
(3) tert - Butylalcohol.

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12. Arrange the following alcohols in the decreasing order of reactivity towards

Lucas reagent
(1) 1-Butanol
(2) 2-butanol
(3) 2-Methyl-2-propanol.
13. Arrange the following alchols in the decreasing order of their reactivity with $H R r$ :
(1) $\mathrm{C}_{6} \mathrm{H}_{5} \mathrm{CH}_{2} \mathrm{OH}$
(2) $\left(\mathrm{C}_{6} \mathrm{H}_{5}\right)_{2} \mathrm{CHOH}$
(3) $\left(\mathrm{C}_{6} \mathrm{H}_{5}\right)_{3} \mathrm{COH}$

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14. Arrange the following in the decreasing order of acidity :
(1) $n$ - Butanol
(2) sec-Butanol
(3) tert-Butanol

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15. Arrange the following in the order of decreasing basic character
(1) $\mathrm{CH}_{3} \mathrm{NH}_{2}$
(2) $\left(\mathrm{CH}_{3}\right)_{2} \mathrm{NH}$
(3) $\mathrm{NH}_{3}$

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16. Arrange in decreasing order of basicity.
(1) $m-\mathrm{BO}_{2}-\mathrm{C}_{6} \mathrm{H}_{4}-\mathrm{NH}_{2}$
(2) $\mathrm{C}_{6} \mathrm{H}_{5} \mathrm{NH}_{2}$
(3) $p-\mathrm{NO}_{2}-\mathrm{C}_{6} \mathrm{H}_{4} \mathrm{NH}_{2}$
(4) $o-\mathrm{NO}_{2}-\mathrm{C}_{6} \mathrm{H}_{4} \mathrm{NH}_{2}$

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17. Compare the acidities of amide $\left(R-\underset{O}{C}-N H_{2}\right)$ and sulphonamide $\binom{O}{\left.R-\underset{S}{\mid} \begin{array}{l}\mid \\ O\end{array}\right)-N H_{2}}$
18. Which of the following pairs would have higher boiling points ?
a. (I)
 $\mathrm{Et} \backslash=\mathrm{O}$ $\mathrm{Et}^{\prime}$ Et
b. (I) $\mathrm{Me}^{\wedge} \mathrm{OH}$
b. (I) Me

11
0
(II) $\mathrm{Me}^{\wedge}$



c. (I) $\mathrm{Br} \overbrace{\mathrm{Br}}$
(II) $\mathrm{F} \longrightarrow \mathrm{F}$
d. (I)

(II)


Subjective

1. Give the decreasing order of acidic character of the following :
(1) Benzene
(2) $\mathrm{CH}_{3} \mathrm{OH}$
(3) $\mathrm{H}_{2} \mathrm{O}$
(4) $\mathrm{CH}_{3} \mathrm{SH}$

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2. Give the decreasing order of basic character at $a, b, c, d$ in the following compounds :
I. $\begin{array}{ll}\mathrm{a} & \mathrm{b} \mathrm{H}_{2} \\ \mathrm{NH}_{2}\end{array}$


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3. Why cyanoanilinium ion $\left(C_{6} H_{4}(C N) \stackrel{\oplus}{N} H_{3}\right)(I)$ is a stronger acid than anilinium ion (II) ?

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4. Give the order of acidic character, $o-, p-$, and $m-$ cyanoanilinium ions.
5. Give the order of acidic character of the following :
(i) (a) $\mathrm{Ph}_{3} \mathrm{CH}$
(b) $\mathrm{Ph}_{2} \mathrm{Ch}_{2}$
(c) $\mathrm{PhCH}_{3}$

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6. Give the order of the stabilities of the following :
(i) (a) $\mathrm{PhCH}_{2}{ }^{\oplus}$
(b) $P h_{2} C \stackrel{\oplus}{H}$
(c) $M e_{2} C h^{\oplus}$
(d) $M e_{3} C^{\oplus}$
(e) $\mathrm{C}_{2} \mathrm{H}_{5}^{\oplus}$
(f) $C h_{3}^{\oplus}$
7. Why pyridine is a much weaker base than aliphatic amines ?

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8. Give the decreasing order of the stabilities of the following free radicals :
(a) $P h \dot{C} H P h$
(b) $\mathrm{PhCHCH}=\mathrm{CH}_{2}$
(c) $M e \dot{C} H M e$
(d) PhCHMe
(e) $\mathrm{MeCH}=\mathrm{CHCH}_{2} \dot{\mathrm{C}} \mathrm{H}_{2}$
(f) $E t-\dot{C}-M e_{2}$.
9. Arrange the following acids in the decreasing order of their acid strength:

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10. Which is a stronger base towards a proton $\stackrel{\ominus}{P} H_{2}$ or $\stackrel{\ominus}{N} H_{2}$ ?

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11. Give the decreasing order of basic strength of the following :
(a) $\mathrm{NH}_{3}$
(b) $\mathrm{NH}_{2} \mathrm{OH}$
(c) $\mathrm{NH}_{2}-\mathrm{NH}_{2}$.

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## Concept

1. Using curved-arrow notation, show the formation of reactive intermediates when the following covalent bonds undergo heterolytic cleavage.
(a) $\mathrm{CH}_{3}-\mathrm{SCH}_{3}$,
(b) $\mathrm{CH}_{3}-\mathrm{CN}$, (c) $\mathrm{CH}_{3}-\mathrm{Cu}$

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2. Giving justification, categorise the following molecules/ions as nucleophile or electrophile:
$\mathrm{HS}^{-}, \mathrm{BF}_{3}, \mathrm{C}_{2} \mathrm{H}_{5} \mathrm{O}^{-},\left(\mathrm{CH}_{3}\right)_{3} \mathrm{~N}$,
$\mathrm{C}^{+}, \mathrm{CH}_{3}-\stackrel{+}{\mathrm{C}}=\mathrm{O}, \mathrm{H}_{2} \mathrm{~N}^{-},, \stackrel{+}{\mathrm{N}} \mathrm{O}_{2}$

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3. Identify electrophilic centre in the following: $\mathrm{CH}_{3} \mathrm{CH}=\mathrm{O}, \mathrm{CH}_{3} \mathrm{CN}, \mathrm{CH}_{3} \mathrm{I}$.

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4. Which bond is more polar in the following pairs of molecules: (a)
$H_{3} C-H, H_{3} C-B r$
(b) $\mathrm{H}_{3} \mathrm{C}-\mathrm{NH}_{2}, \mathrm{H}_{3} \mathrm{C}-\mathrm{OH}$
$\mathrm{H}_{3} \mathrm{C}-\mathrm{OH}, \mathrm{H}_{3} \mathrm{C}-\mathrm{SH}$

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5. In which C-C bond of $\mathrm{CH}_{3} \mathrm{CH}_{2} \mathrm{CH}_{2} \mathrm{Br}$, the inductive effect is expected to be the least?
6. Write resonance structures of $\mathrm{CH}_{2}=\mathrm{CH}-\mathrm{CHO}$. Indicate relative stability of the contributing structures.

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7. Explain why the following two structures, I and II cannot be the major contributors to the real structure of $\mathrm{CH}_{3} \mathrm{COOCH}_{3}$


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8. Explain why $\left(\mathrm{CH}_{3}\right)_{3} \stackrel{+}{\mathrm{C}}$ is more stable than $\mathrm{CH}_{3} \stackrel{+}{\mathrm{C}} \mathrm{H}_{2}$ and $\mathrm{CH}_{3}$ is the least stable cation
9. Draw the complete structures of bromomethane

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10. Which of the following pairs of structures do not constitude resonance structures?
a. $\mathrm{H}_{3} \mathrm{C}-\stackrel{+}{\mathrm{N}} / \mathrm{CO}_{\mathrm{O}^{-}}^{\mathrm{O}}$ and $\mathrm{H}_{3} \mathrm{C}-\mathrm{O}-\mathrm{N}=\mathrm{O}$

c. $\left(\mathrm{CH}_{3}\right)_{2} \mathrm{CO}$ and $\mathrm{CH}_{3}-\mathrm{C}_{\stackrel{\mathrm{CH}}{2}}^{\stackrel{\mathrm{OH}}{( })}$
d. $\mathrm{CH}_{3} \mathrm{CH}=\mathrm{CHCH}_{3}$ and $\mathrm{CH}_{3} \mathrm{CH}_{2} \mathrm{CH}=\mathrm{CH}_{2}$
11. Which is expected to be more stable,
(I) $\mathrm{O}_{2} \mathrm{NCH}_{2} \mathrm{CH}_{2} \mathrm{O}^{-}$or
(II) $\mathrm{CH}_{3} \mathrm{CH}_{2} \mathrm{O}^{-}$any why ?

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12. Draw the resonance structures for the following compounds.

Show the electron shift using curved-arrow notation.
$\mathrm{C}_{6} \mathrm{H}_{5}-\mathrm{CHO}$

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13. Explain why alkyl groups act as electron donors when attached to a n system

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14. Classify the reagents shown in bonds in the following equations as nucleophilies or electrophiles. Use curved-arrow notation to show the electron movement.
(a) $\mathrm{CH}_{3} \mathrm{COOH}+\mathrm{HO}^{\ominus} \rightarrow \mathrm{CH}_{3} \mathrm{COO}^{\ominus}+\mathrm{H}_{2} \mathrm{O}$
(b) $\mathrm{CH}_{3} \mathrm{COCH}_{3}+\mathrm{NC}^{\ominus} \rightarrow \mathrm{CH}_{3} \mathrm{C}(\mathrm{CN}) \mathrm{OHCH}_{3}$

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15. Classify the following reactions in one of the reaction type studied in this unit.
$\mathrm{CH}_{3} \mathrm{CH}_{2} \mathrm{Br}+\mathrm{HS}^{-} \rightarrow \mathrm{CH}_{3} \mathrm{CH}_{2} \mathrm{SH}$

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16. What is the relationship between the members of following pairs of structures ? Are they structural or geometrical isomers or
resonance contributors?
(a)


(b)


(c)
$\stackrel{\stackrel{+}{\mathrm{O}} \mathrm{H}}{\mathrm{H}-\stackrel{\mathrm{C}}{\mathrm{C}}-\mathrm{OH}}$ $\stackrel{\stackrel{\mathrm{OH}}{\mathrm{O}_{+}}-\mathrm{OH}}{\mathrm{O}}$

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17. For the following bond cleavages, use curved-arrows to show the electron flow and classify each as homolysis or heterolysis. Identify reactive intermediate produced as free radical, carbocation and carbanion.

$$
\mathrm{CH}_{3} \mathrm{O}-\mathrm{OCH}_{3} \longrightarrow \mathrm{CH}_{3} \stackrel{\circ}{\mathrm{O}}+\dot{\mathrm{O}} \mathrm{CH}_{3}
$$


(c)

(d)


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## Comprehension

1. An organic reaction occurs by using reagents called electrophiles and nucleophiles via the formation of some reactive intermediates
called carbocations, carbanions, free radicals, carbenes, nitrenes, radical cations, and radical anions.

Which of the following contains nucleophiles only ?
A. $\mathrm{PH}_{3}, \mathrm{ROH}, \mathrm{CH}_{2}=\mathrm{CH}_{2}$
B. $\mathrm{SnF}_{4}, \mathrm{BeF}_{2}, \mathrm{NH}_{3}$
C. $\mathrm{Cr}^{3+}, \stackrel{\ominus}{\mathrm{N}} \mathrm{H}_{2}, \mathrm{H}_{2} \mathrm{O}$
D. $: C C l_{2}, I^{\ominus}, H^{\ominus}$

## Answer: A

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2. An organic reaction occurs by using reagents called electrophiles and nucleophiles via the formation of some reactive intermediates called carbocations, carbanions, free radicals, carbenes, nitrenes,
radical cations, and radical anions.
Which of the following contains electrophiles only?
A. $\mathrm{Br}^{\oplus}, \mathrm{PH}_{3}, \mathrm{H}_{2} \mathrm{O}$
B. $\mathrm{NO}_{2}^{\oplus},: \mathrm{CBr}_{2}, \mathrm{SO}_{3}$
C. $\mathrm{NH}_{3}, \mathrm{H}_{2} \mathrm{O}, \mathrm{A1Br}_{3}$
D. $\mathrm{AlC1} 1_{3}, \mathrm{CH}_{2}=\mathrm{CH}_{2}, \mathrm{SO}_{3}$

## Answer: B

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3. An organic reaction occurs by using reagents called electrophiles and nucleophiles via the formation of some reactive intermediates called carbocations, carbanions, free radicals, carbenes, nitrenes, radical cations, and radical anions.

The most stable carbanion is :
A. $\mathrm{PhCH}_{2} \mathrm{CH}_{2}$
B. $\mathrm{Ph} \stackrel{\ominus}{C} \mathrm{H}_{2}$
c. $\mathrm{O}_{2} \mathrm{~N}$

C.
D.
d. MeO


## Answer: C

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4. An organic reaction occurs by using reagents called electrophiles and nucleophiles via the formation of some reactive intermediates called carbocations, carbanions, free radicals, carbenes, nitrenes, radical cations, and radical anions.

The most stable carbocation is :
A. $P h \stackrel{\oplus}{C} H_{2}$
B.
b. Me

C.

D.


## Answer: B

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5. An organic reaction occurs by using reagents called electrophiles and nucleophiles via the formation of some reactive intermediates called carbocations, carbanions, free radicals, carbenes, nitrenes, radical cations, and radical anions.

The most stable free radical is :
A. $\mathrm{PhCH} \mathrm{H}_{2} \dot{\mathrm{C}} \mathrm{H}_{2}$
B. $\mathrm{Me} \dot{\mathrm{C}} \mathrm{H}_{2}$

## C. $M e_{2} \dot{C} H$

D. $\mathrm{Ph} \dot{\mathrm{C}} \mathrm{HMe}$

## Answer: D

## D Watch Video Solution

6. An organic reaction occurs by using reagents called electrophiles and nucleophiles via the formation of some reactive intermediates called carbocations, carbanions, free radicals, carbenes, nitrenes, radical cations, and radical anions.

The least stable carbocation is :
A.

B.

C.

D.
d. MeO


## Answer: A

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7. Carbene intermediates are produced by the photolysis of diazomethane $\left(\mathrm{CH}_{2} \mathrm{~N}_{2}\right)$ or ketene $\left(\mathrm{CH}_{2}=\mathrm{C}=\mathrm{O}\right)$. They are also produced by the reaction of $\mathrm{CH}_{3}$ with base or by Simmons-Smith reaction. There are two types of carbenes, singlet and triplet. They are so called due to their spin state.

Spin state of carbene is determined by using the formula :
where $S$ is the sum of all electron spin numbers.
A. $S+2$
B. $2 S+1$
C. $2 S+2$
D. $S+1$

## Answer: B

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8. Carbene intermediates are produced by the photolysis of diazomethane $\left(\mathrm{CH}_{2} \mathrm{~N}_{2}\right)$ or kenene $\left(\mathrm{CH}_{2}=\mathrm{C}=\mathrm{O}\right)$. They are also produced by the reaction of $\mathrm{CH} X_{3}$ with base or by Simmons-Smith reaction. There are two types of carbenes, singlet and triplet. They are so called due to their spin state.

Singlet and triplet carbene are same in :
A. Types of hybridisation
B. Number of unshared $\bar{e}$ pairs (or $L P \bar{e}, s$ )
C. Number of $\sigma-$ bonds
D. Bond angle

## Answer: C

9. Carbene intermediates are produced by the photolysis of diazomethane $\left(\mathrm{CH}_{2} \mathrm{~N}_{2}\right)$ or kenene $\left(\mathrm{CH}_{2}=\mathrm{C}=\mathrm{O}\right)$. They are also produced by the reaction of $\mathrm{CHX}_{3}$ with base or by Simmons-Smith reaction. There are two types of carbenes, singlet and triplet. They are so called due to their spin state.

In which reaction, the insertion of methylene increases potential energy ?
A. $\mathrm{CH}_{2}=\mathrm{CH}_{2}+: \mathrm{CH}_{2} \rightarrow \mathrm{CH}_{3}-\mathrm{CH}=\mathrm{CH}_{2}$
B.
b. Me
C. $\mathrm{Me}-\mathrm{Ch}=\mathrm{CH}_{2}+: \mathrm{CH}_{2} \rightarrow \mathrm{Me}-\mathrm{CH}=\mathrm{CH}-\mathrm{CH}_{3}$
D.


Answer: B
10. Carbene intermediates are produced by the photolysis of diazomethane $\left(\mathrm{CH}_{2} \mathrm{~N}_{2}\right)$ or kenene $\left(\mathrm{CH}_{2}=\mathrm{C}=\mathrm{O}\right)$. They are also produced by the reaction of $\mathrm{CH} X_{3}$ with base or by Simmons-Smith reaction. There are two types of carbenes, singlet and triplet. They are so called due to their spin state.

Which carbene is produced in the following reactions ?

A. : CClBr
B. $: C B r I$
C. : CClI
D. All
11. Carbene intermediates are produced by the photolysis of diazomethane $\left(\mathrm{CH}_{2} \mathrm{~N}_{2}\right)$ or kenene $\left(\mathrm{CH}_{2}=\mathrm{C}=\mathrm{O}\right)$. They are also produced by the reaction of $\mathrm{CH} X_{3}$ with base or by Simmons-Smith reaction. There are two types of carbenes, singlet and triplet. They are so called due to their spin state.

An optically active alkene (I) with lowest molecular mass on hydrogenation gives optically inactive alkene, but on insertion of methylene carbene $\left(: \mathrm{CH}_{2}\right)$ in (I), it gives optically active
compound $(I I)$. The compounds $(I)$ and $(I I)$ are :

A. P
B. $P, R$
C. P,Q,
D. $P, Q, R$
12. Consider the following reaction :


Me

[ O ]
$\mathrm{KMnO}_{4 / \mathrm{H}^{\oplus}}$
$(\mathrm{D})+(\mathrm{E})$

Me
C.

The compound $D$ is an ortho-isomer and $E$ is a $p-i s o m e r$. Thecompounds D and E , respectively, are :
A. Phthalic and isophthalic acids
B. Isophthalic and phthalic acids
C. Terephthalic and phthalic acids
D. Phthalic and terephthalic acids.

## Answer: D

## ( Watch Video Solution

13. Consider the following reaction :


The $m-i$ somer of $D$ and $E$ is called :
A. Phthalic acid
B. Isophthalic acid
C. Terephthalic acid
D. None

Answer: B
14. Consider the following reaction :



The decreasing order of acidic strengths of (I) phthalic (II) terephthalic, and (III) isophthalic acids is :
A. $I>I I>I I I$
B. $I>I I I>I I$
C. $I I I>I I>I$
D. $I I>I I I>I$

## Answer: A

## - Watch Video Solution

15. Consider the following reaction :


Me

[O] $\xrightarrow[\mathrm{KMnO}_{4} / \mathrm{H}^{\oplus}]{ }(\mathrm{D})+(\mathrm{E})$

Me
C.

Which of the above three acids, $I, I I$, and $I I I$ forms anhydribe on

## heating ?

A. I
B. II
C. III
D. All

## Answer: A

## D Watch Video Solution

16. Consider the Hofmann ammonolysis reaction :

$$
R-X+\ddot{N} H_{3} \rightarrow H X+\underset{1^{\circ} a \min e}{R N H_{2}} \xrightarrow[373 K]{R-X}
$$

$\mathrm{R} \quad X \mid \ddot{\mathrm{N}} \mathrm{H}_{3} \longrightarrow \mathrm{HX}+\mathrm{RNH}_{2} \xrightarrow{\mathrm{R}-x} 373 \mathrm{~K}$ $1^{\circ}$ amine

$$
\begin{aligned}
& \underset{2^{\circ} \text { amine }}{\mathrm{HX}}+\underset{373 \mathrm{~K}}{\mathrm{R}_{2} \mathrm{NII}} \xrightarrow{\mathrm{R}_{3} \mathrm{~N}+\mathrm{HX}}{ }^{\circ} \text { amine } \\
& 4^{\circ} \text { salt }
\end{aligned}
$$

If $R=\mathrm{CH}_{3}$, the correct order of basic character of $1^{\circ}$ amine, $2^{\circ}$ amine, $3^{\circ}$ amine, and $\mathrm{NH}_{3}$ in aqueous medium is:
A. $1^{\circ}>2^{\circ}>3^{\circ}>\mathrm{NH}_{3}$
B. $2^{\circ}>3^{\circ}>1^{\circ}>\mathrm{NH}_{3}$
C. $2^{\circ}>1^{\circ}>3^{\circ}>\mathrm{NH}_{3}$
D. $2^{\circ}>1^{\circ}>\mathrm{NH}_{3}>3^{\circ}$

## Answer: C

17. Consider the Hofmann ammonolysis reaction :

$$
R-X+\ddot{N} H_{3} \rightarrow H \underset{1^{\circ} a \min e}{R N H_{2}} \underset{373 K}{R-X}
$$

$$
\mathrm{R} \quad X \mid \ddot{\mathrm{NH}}_{3} \rightarrow H X+\mathrm{RNH}_{2} \xrightarrow[373 \mathrm{~K}]{\mathrm{R}-\mathrm{X}}
$$

$$
1^{\circ} \text { amine }
$$


$4^{\circ}$ salt

If $R=C_{2} H_{5}$, the correct of basic character of the above amines in aqueous medium is :
A. $2^{\circ}>3^{\circ}>1^{\circ}>\mathrm{NH}_{3}$
B. $2^{\circ}>1^{\circ}>3^{\circ}>N H_{3}$
C. $3^{\circ}>2^{\circ}>1^{\circ}>\mathrm{NH}_{3}$
D. $\mathrm{NH}_{3}>1^{\circ}>2^{\circ}>3^{\circ}$

## - Watch Video Solution

18. Consider the Hofmann ammonolysis reaction :

$$
R-X+\ddot{N} H_{3} \rightarrow H \underset{1^{\circ} a \min e}{R N H_{2}} \underset{373 K}{R-X}
$$

$$
1^{\circ} \text { amine }
$$

$$
\underset{2^{\circ} \text { amine }}{\mathrm{HX}}+\underset{373 \mathrm{~K}}{\mathrm{R}_{2} \mathrm{NII}} \stackrel{\mathrm{R}}{3^{\circ} \text { amine }}
$$


$4^{\circ}$ salt

If $R=M e_{2} C H-(i s o \propto y l)$, the correct order of basic character of the above amines in aqueous medium is :
A. $3^{\circ}>2^{\circ}>1^{\circ}>\mathrm{NH}_{3}$
B. $N H_{3}>1^{\circ}>2^{\circ}>3^{\circ}$
C. $1^{\circ}>2^{\circ}>\mathrm{NH}_{3}>3^{\circ}$
D. $1^{\circ}>\mathrm{NH}_{3}>2^{\circ}>3^{\circ}$

## Answer: D

## - Watch Video Solution

19. Consider the Hofmann ammonolysis reaction :

$$
R-X+\ddot{N} H_{3} \rightarrow H X \underset{1^{\circ} a \min e}{R N H_{2}} \underset{373 K}{R-X}
$$

$$
\mathrm{R} \quad X \mid \ddot{N H}_{3} \rightarrow H X+\mathrm{RNH}_{2} \xrightarrow[373 \mathrm{~K}]{\mathrm{R}-\mathrm{X}}
$$

$1^{\circ}$ amine


$4^{\circ}$ salt

If $R=M e_{3} C-(t-b u t y l)$, the correct order of basic character of the above amines in aqueous medium is :
A. $N H_{3}>1^{\circ}>2^{\circ}>3^{\circ}$
B. $3^{\circ}>2^{\circ}>1^{\circ}>\mathrm{NH}_{3}$
C. $1^{\circ}>2^{\circ}>\mathrm{NH}_{3}>3^{\circ}$
D. $1^{\circ}>\mathrm{NH}_{3}>2^{\circ}>3^{\circ}$

## Answer: A

## D Watch Video Solution

20. Consider the Hofmann ammonolysis reaction :

$$
R-X+\ddot{N} H_{3} \rightarrow H \underset{1^{\circ} a \min e}{H X}+\underset{373 K}{ } \xrightarrow{R-X}
$$

$\mathrm{R} \quad \mathrm{X}: \ddot{\mathrm{N}} \mathrm{H}_{3} \longrightarrow \mathrm{HX}+\mathrm{RNH}_{2} \xrightarrow{\mathrm{R}-X} 373 \mathrm{~K}$ $1^{\circ}$ amine
$\underset{2^{\circ} \text { amine }}{\mathrm{HX}}+\underset{373 \mathrm{~K}}{\mathrm{~K}} \xrightarrow{\mathrm{R}} \xrightarrow[3^{\circ} \text { amine }]{\mathrm{R}}$

$4^{\circ}$ salt

For any value of $R$, the correct order of basic character of the above amines in gaseous phase of nonpolar solvent is :
A. $3^{\circ}>2^{\circ}>\mathrm{NH}_{3}>1^{\circ}$
B. $3^{\circ}>2^{\circ}>1^{\circ}>\mathrm{NH}_{3}$
C. $2^{\circ}>3^{\circ}>\mathrm{NH}_{3}>1^{\circ}$
D. $1^{\circ}>2^{\circ}>3^{\circ}>\mathrm{NH}_{3}$

## Answer: B

## Multiple Correct

1. Which of the following statement is correct ?
A. Dipole moment :

B. Stability of free radical :

C. Basic strength : $\mathrm{CH}_{3} \mathrm{O}^{\ominus}>\stackrel{\ominus}{\mathrm{O}} \mathrm{H}>\mathrm{RS}^{\ominus}$
D. Basic and nucleophilic strength : $I^{\ominus}>B r^{\ominus}>C 1^{\ominus}>F^{\ominus}$

Answer: A: B
2. In which of the following $\Delta G$ decreases if there can be some intramolecular rearrangement?
a.

A.

C.

D.


## Answer: A::B::C

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3. Which of the following statement is/are correct ?
A. Dipole moment of :

B. Dipole moment of : $\mathrm{CH}_{3} \mathrm{~F}>\mathrm{CH}_{3} \mathrm{C1}>\mathrm{CH}_{3} \mathrm{Br}>\mathrm{CH}_{3} \mathrm{I}$
C. Dipole moment of : $\mathrm{NH}_{3}>\mathrm{NF}_{3}$
D. Dipole moment of : $\mathrm{CH}_{3} \mathrm{C1}>\mathrm{CH}_{2} \mathrm{C1}_{2}>\mathrm{CHC1}_{3}>\mathrm{CC1}_{4}$

## Answer: A::C::D

## - Watch Video Solution

4. Which of the following is a hard acid ?
A. $B r_{2}$
B. $C d^{2+}$
C. $\mathrm{CO}_{2}$
D. $F e^{3+}$

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5. Which of the following statement is/are correct ?
A. $p K_{a 1}$ of meleic acid is less than $p K_{a 1}$ of fumaric acid.
B. $p K_{a 2}$ of maleic acid is greater than $p K_{a 2}$ of fumaric acid.
C. Phthalic acid is a stronger acid than isophthalic acid.
D. Isopthalic acid is a stronger acid than terephthalic acid.

## Answer: A::B::C

## - Watch Video Solution

6. Which of the following statement (s) is/are correct ?
A. Inductive effect is permanent shifting of $\sigma \bar{e}, s$ towards more $E N$ element.
B. Mesomeric effect is delocalisation of $L P \bar{e}, s$ with $\pi \bar{e}, s$ in conjugation.
C. Hyperconjugation is simultaneous shift of $\sigma$ and $\pi \bar{e}, s$ at 1,3 - position without the movement of $H$ atom from its position.
D. Tautomerism is simultaneous shift of $\sigma$ and $\pi \bar{e} \cdot s$ at 1,3 - position with the movemet of $H$ atom from its position.

## Answer: A::B::C::D

## Watch Video Solution

7. Which of the following group (s) is/are $o-$ and $p$-directing ?
A. $-C N$
B. $-\mathrm{SO}_{3} \mathrm{H}$
C. $-\mathrm{NH}_{2}$
D. $-O-\stackrel{O}{\|}{ }_{C}^{\|}-R$

## Answer: C::D

## - Watch Video Solution

8. Which of the following group (s) is/are m-directing ?
A. $-C l$
B. $-P h$
C. -CHO
D. -COOH

## Answer: C::D

## (D) Watch Video Solution

9. Which of the following are nucleophiles ?
A. $\mathrm{PH}_{3}$
B. $F^{\ominus}$
C. $\mathrm{NH}_{3}$
D. $\mathrm{H}_{2} \mathrm{O}$

## Answer: A::B::C::D

## Watch Video Solution

10. Which of the following are electrophiles ?
A. $\mathrm{BeCl}_{2}$
B. $\mathrm{CH}_{2}=\mathrm{CH}_{2}$
C. HCl
D. $\mathrm{BCl}_{3}$

## Answer: A::B::C

- Watch Video Solution

11. Which of the following have $+M$ effect
( $\bar{e}$-donating mesomeric effect) ?
A. $-\mathrm{NO}_{2}$
B. -COOH
C. $-\mathrm{NH}_{2}$
D. $-S R$

## Answer: C::D

## (D) Watch Video Solution

12. Which of the following have $-M$ effect ( $\bar{e}$ - withdrawing mesomeric effect) ?
A. $\mathrm{C}=\mathrm{O}$
B. $-\mathrm{SO}_{3} \mathrm{H}$
C. $-O R$
D. $-B r$

## Answer: A::B

13. Which of the following statement (s) is/are correct ?
A. HCOOH is stronger acid than PhCOOH
B. Oximes $\left(R_{2} C=N-O H\right)$ are more acidic than hydroxylamine $\left(\mathrm{NH}_{2} \mathrm{OH}\right)$
C. $\mathrm{R}_{3} \mathrm{SiCH}_{2} \mathrm{COOH}$ is more acidic than $\mathrm{R}_{3} \mathrm{CCH}_{2} \mathrm{COOH}$.
D. Highly branched carboxylic acids are less acidic than unbranched acids.

## Answer: A::B::D

## ( Watch Video Solution

14. Which of the following statemenet (s) is/are correct ?
A. 3, 5 - Dimethy1-4-nitrophenol (I)

acidic than the isomeric 2,6 - demthy-4-nitrophenol

B. $(I)$ is more acidic than ( $I I)$
C. $I$ is less acidic than ( $I I$ ) due to steric inhibition of resonance of two ( Me ) groups with $\left(\mathrm{NO}_{2}\right)$ group.
D. $(I)$ is more acidic than $(I I)$ due to less $+I$ effect of two (Me) groups in (I)

## Answer: A::C

15. Which of the following statement is/are correct ?
A. 3,3-Dimethyl-4-cyanophenol (I)

is more acidic than

B. $(I I)$ is more acidic than $(I)$
C. $(I)$ is more acidic than $(I I)$ due to no steric inhibition of the two $M e$ groups with $(C N)$ groups, since $(-C N)$ group is linear.
D. Acidic character of $(I)$ and $(I I)$ is determines by $+I$ effect of twp $M e$ groups in $(I)$ and $+I$ and $H$. $C$ effects of two $M e$ groups in (II)

## - Watch Video Solution

16. Which of the following statement (s) is/are correct ?
A. 3, 4, 5 - Trinitroaniline (I)
 than 4-cyano-

3,5-dinitroaniline (II)

B. $(I I)$ is more basic than ( $I$ )
C. $(I)$ is more basic than (II) due to steric inhibition of resonance in ( $I$ )
D. There is no steric inhibition resonance in (II)

## Answer: A::C::D

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17. Which benzene sulphonic acid and $p$ - nitrophenol are treated with $\mathrm{NaHCO}_{3}$, the gases released, respectively are :
A. $\mathrm{SO}_{2}, \mathrm{NO}_{2}$
B. $\mathrm{SO}_{2}, \mathrm{NO}$
C. $\mathrm{SO}_{2}, \mathrm{CO}_{2}$
D. $\mathrm{CO}_{2}, \mathrm{CO}_{2}$

## Answer: D

18. The decreasing order of $p K_{a}$ value of the following is : (I)
I. $\mathrm{CH} \equiv \mathrm{CH} \quad$ II.

III.

A. $I I I>I>I I$
B. $I I>I>I I I$
C. $I>I I I>I I$
D. $I>I I \equiv I I I$

## Answer: B

## - Watch Video Solution

19. Among the following which is correct ?
A. Both cyclopentadienyl anion and benzene are aromatic and have the same stability.
B. Benzene is aromatic and more stable than cyclopentadienyl anion and it is nonaromatic.
C. Both cyclopentadienyl anion and benzene are aromatic, but benzene is more stable than cyclipentadienyl anion.
D. Cycloptentadienyl anion is more stable than benzene althrough both are aromatic.

## Answer: C

## D Watch Video Solution



H
Pyridine (1) 20.

Which one (s) is/are true ?
A. $(I)$ and $(I I I)$ are modest Bronsted bases whereas $(I I)$ is not.
B. In $(I I I) N^{a}$ is more basic than $N^{b}$.
C. When (II) is protonated in the presence of a strong acid, protonation occurs at $C-2$.
D. All the nitrogen present in $(I),(I I)$, and $(I I I)$ is $s p^{2}$ hybridised.

## Answer: A::C::D

## 21.


21.

## H

 (I)(II)

(IV)

Which of the following statement is/are correct ?
A. (I) and (II) are aromatic and have equal basic strength.
B. $(I)$ is aromatic and $(I I)$ is anti-aromatic, but $(I I)$ is stronger base than ( $I$ )
C. The order of basicity of the above compounds is $(I V)>(I I I)>(I I)>(I)$.
D. The conjugate acid of $(I V)$ is more stabilised than the conjugate acid of (II).

## Answer:

## - View Text Solution

22. What is the decreasing order of strength of the bases $\mathrm{OH}^{-}, \mathrm{NH}_{2}^{-}, \mathrm{HC} \equiv \mathrm{C}^{-}$and $\mathrm{CH}_{3} \mathrm{CH}_{2}^{-}$?
A. $\mathrm{CH}_{3}-\mathrm{CH}_{2}^{\ominus}>\mathrm{NH}_{2}^{\Theta}>\mathrm{H}-\mathrm{C} \equiv \mathrm{C}^{\ominus}>\stackrel{\ominus}{\mathrm{O}} \mathrm{H}$
B. $\mathrm{H}-\mathrm{C} \equiv \mathrm{C}^{\ominus}>\mathrm{CH}_{3}-\mathrm{CH}_{2}^{\ominus}>\mathrm{NH}_{2}^{\ominus}>\stackrel{\ominus}{\mathrm{O}} \mathrm{H}$
c. $\stackrel{\ominus}{O} H>N H_{2}^{\ominus}>H-C \equiv C^{\ominus}>C H_{3}-C H_{2}^{\ominus}$
D. $N H_{2}^{\ominus}>H-C \equiv C^{\ominus}>\stackrel{\ominus}{\mathrm{O}} \mathrm{H}>\mathrm{CH}_{3}-C H_{2}^{\ominus}$

## Answer: A

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## Single Correct

1. The decreasing order of acidic character of the following is :
(I) $\mathrm{CH}_{3} \mathrm{SH}$
(II) $\mathrm{CH}_{3} \mathrm{OH}$
(III) $\mathrm{H}_{2} \mathrm{O}$
(IV) EtOH .
A. $I>I I>I I I>I V$
B. $I V>I I I>I I>I$
C. $I>I I I>I I>I V$
D. $I I I>I>I I>I V$

## Answer: A

## D Watch Video Solution

2. The decreasing basic character of the following is :
(I) $\mathrm{PhO}^{\ominus}$
(II) $\mathrm{CH}_{3} S^{\ominus}$
(III) $\stackrel{\ominus}{O} H$
(IV) $M e O^{\ominus}$.
A. $I>I I>I I I>I V$
B. $I I I>I V>I I>I$
C. $I V>I I I>I I>I$
D. $I>I I>I V>I I I$

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3. The decreasing nucleophilicity of the following is:
(I) $\mathrm{CH}_{3} S^{\ominus}$
(II) $\mathrm{CH}_{3} \mathrm{O}^{\ominus}$
$\ominus$
(III) OH
(IV) $E t O^{\ominus}$.
A. $I V>I I I>I I>I$
B. $I>I I>I I I>I V$
C. $I V>I I I>I>I I$
D. $I I>I>I I I>I V$

## Answer: C

4. Arrange the following in their decreasing order of Basicity.

II.

(I)

(III)
(IV) $\mathrm{NH}_{3}$.
A. $I I I>I V>I I>I$
B. $I>I I>I I I>I V$
C. $I V>I I I>I I>I$
D. $I I>I I I>I>I V$

## Answer: A

## D Watch Video Solution

5. Which of the following carbocations is least stable?
A. $P h \stackrel{\oplus}{C} H_{2}$
B. $\stackrel{C}{H}=\mathrm{CH}_{2}$
C. $M e_{2} \stackrel{\oplus}{C} H$
D. $\mathrm{CH}_{2}=\mathrm{CH}-\stackrel{\stackrel{C}{H}}{2}$

## Answer: B

6. Which of the following carbocations is most stable ?
A. a. $\mathrm{Me} \overbrace{\mathrm{Me}}^{\oplus}$
B. b. Me ( Me
c. $\mathrm{Me} \overbrace{\mathrm{Me}}^{\mathrm{Me}} \stackrel{\oplus}{\mathrm{C}} \mathrm{H}_{2}$
D.
d. $\overbrace{\mathrm{Me}^{\mathrm{Me}}}^{\mathrm{Me}}$

## Answer: A

## - Watch Video Solution

7. The compound which gives the most stable carbonium ion on dehydration is
A.

A.

C. Me
D. d. $\mathrm{Me}^{\mathrm{Me}}$

## Answer: C

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8. In the following graph, stability of different carbocations have been shows:

I.

II.
$\mathrm{Ph}-\stackrel{\oplus}{\mathrm{C}}-\mathrm{Ph}$
Ph
III.

Reaction coordinates

Match the potential energy curve with carbocation.
A. $\begin{array}{lll}I & I I & I l I\end{array}$
$A \quad B \quad C$
B. II lII
B.
$B \quad A \quad C$
C. ${ }^{I} \quad I I \quad l I I$
$C B A$
D. $\begin{array}{lll}I & I I l\end{array}$
$C A B$

## Answer: C

9. Which of the following is a soft base ?
A. $C O$
B. $\mathrm{CO}_{3}^{2-}$
C. $\mathrm{Cl}^{-}$
D. $\mathrm{Pb}^{2+}$

## Answer:

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10. Which of the following is least stable ?
A. $\mathrm{Me}-\mathrm{O}-\stackrel{\ominus}{\mathrm{C}} \mathrm{H}_{2}$
B.

C. $\mathrm{PhCH}{ }_{2}$


Answer: A

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11. Which of the following species is most stable ?
A. $\mathrm{CH}_{2}=\dot{\mathrm{C}} H$
B. $\mathrm{Ph} \dot{\mathrm{C}} \mathrm{H}_{2}$
C. $M e_{3} \dot{C}$
D. $M e_{2} \dot{C} H$

## Answer: B

## - Watch Video Solution

12. The decreasing order of $-I$ effect of the following is :
(I) $R_{3} N^{\oplus}$
(II) $\mathrm{NO}_{2}$
(III) $C N$
(IV) $\mathrm{SO}_{3} \mathrm{H}$
(v) COOH .
A. $I>I I>I I I>I V>V$
B. $I I>I>I I I>I V>V$
C. $I>I I>I I I>V>I V$
D. $I I>I>V>I V>I I I$

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13. The decreasing order of $-I$ effect of the following is :
(I) CHO
(II) $F$
(III) $O R$
(IV) $\mathrm{NH}_{2}$
(v) OH
(VI) $P h$.
A. $I>I I>I I I>I V>V>V I$
B. $I I>I>I I I>I V>V>V I$
C. $I>I I>V>I I I>I V>V I$
D. $I I>I>V>I I I>I V>V I$

## - Watch Video Solution

14. The decreasing order of $+I$ effect of the following is :
(I) $-O^{\ominus}$
(II) $M e-$
(III) $E t-$
(IV) $\mathrm{Me}_{2} \mathrm{CH}-$
(V) $M e_{3} C-$.
A. $I>I I>I I I>I V>V$
B. $V>I V>I I I>I I>I$
C. $I>V>I V>I I I>I I$
D. $I I>I I I>I V>V>I$

## -

15. The decreasing order of $-I$ effect of the orbitals is :
(I) $s p$
(II) $s p^{2}$
(III) $s p^{3}$.
A. $I>I I>I I I$
B. $I I I>I I>I$
C. $I>I I I>I I$
D. $I I>I I I>I$

## Answer: A

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16. Give the decreasing order of hyperconjugative effect of $R$ in R-CH $=\mathrm{CH}_{2}$, where $R$ is :
(I) $M e-$
(II) $E t-$
(III) $\mathrm{Me}_{2} \mathrm{CH}-$
(IV) $M e_{3} C-$.
A. $I>I I>I I I>I V$
B. $I V>I I I>I I>I$
C. $I I>I>I I I>I V$
D. $I V>I I I>I>I I$

## Answer: A

17. The decreasing order of the acidic character is:
I. $\mathrm{HOOC}-\equiv-\mathrm{H}$
II. HOOC
III. $\mathrm{HOOC}_{\text {Me }}$
A. $I>I I>I I I$
B. $I I I>I I>I$
C. $I I>I>I I I$
D. $I I I>I>I I$

## Answer: A

## D Watch Video Solution

18. The decreasing order of boiling points of the following is:
(I) RCOCl
(II) $(\mathrm{RCO})_{2} \mathrm{O}$
(III) $\mathrm{RCONH}_{2}$
(IV) RCOOH .
A. $I>I V>I I>I I I$
B. $I I I>I I>I V>I$
C. $I V>I I I>I>I I$
D. $I I>I>I I I>I V$

## Answer:

## D Watch Video Solution

19. The decreasing order of basic character of the following is :

A. $I I I>I>I V>I I$
B. $I I>I>I V>I I I$
C. $I V>I I I>I I>I$
D. $I>I I>I I I>I V$

## Answer:

## D Watch Video Solution

20. The decreasing order of acidic character of the following is :

A. $I>I I>I I I$
B. $I I>I>I I I$
C. $I I I>I I>I$
D. $I>I I I>I I$

## Answer: B

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21. The decreasing order of acidic character of the following is :
(I) p-Nitrophenol
(II) o-Nitrophenol
(III) m-Nitrophenol
(IV) Phenol.
A. $I>I I>I I I>I V$
B. $I I>I>I I I>I V$
C. $I>I I>I V>I I I$
D. $I I>I>I V>I I I$

## Answer:

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22. The decreasing order of basic characters of the following is:
(I) Aniline
(II) o-Nitroaniline
(III) m-Nitroaniline
(IV) p-Nitroaniline.
A. $I>I I>I I I>I V$
B. $I V>I I I>I I>I$
C. $I>I I I>I V>I I$
D. $I>I I I>I I>I V$

Answer:
23. The increasing order of $p K_{b}$ value of the following is:
(I) $H C \equiv C^{\ominus}$
$H^{\ominus}$
$\ominus$
$\mathrm{NH}_{2}$
$\stackrel{\ominus}{\ominus}$
(IV) $\mathrm{CH}_{3}$.
A. $I V<I I I<I I<I$
B. $I<I I<I I I<I V$
C. $I V<I I<I I I<I$
D. $I<I I I<I I<I V$

Answer: A

## D Watch Video Solution

Assertion Reasoning

1. A: Alkene $A\left(M e_{2} C=C M e_{2}\right)$ is more stable than alkene $B\left(E t_{2} C=C e t_{2}\right)$

R: Baker-Nathan effect.
A. If both (A) and (R) are true and (R) is the correct explanation of (A).
B. If both (A) and (R) are true but (R) is not correct explanation of (A).
C. If (A) is true but (R) is false.
D. If (A) is false but ( $R$ ) if true.

## Answer: A

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2. A: Methylene has a sextet of $\bar{e}, s$.

R: Methylene behaves as a nucleophile.
A. If both (A) and (R) are true and (R) is the correct explanation of (A).
B. If both (A) and (R) are true but (R) is not correct explanation of (A).
C. If (A) is true but (R) is false.
D. If (A) is false but ( $R$ ) if true.

## Answer: C

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3. p-methyl benzyl carbocation ( $I$ ) is more stable than benzyl

Heterovalent or no bond resonance.
A. If both (A) and (R) are true and (R) is the correct explanation of (A).
B. If both (A) and (R) are true but (R) is not correct explanation of (A).
C. If (A) is true but (R) is false.
D. If (A) is false but ( $R$ ) if true.

## Answer: A

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4. Explain why $\left(\mathrm{CH}_{3}\right)_{3} \stackrel{+}{\mathrm{C}}$ is more stable than $\mathrm{CH}_{3} \stackrel{+}{\mathrm{C}} \mathrm{H}_{2}$ and $\mathrm{CH}_{3}$ is the least stable cation
A. If both (A) and (R) are true and (R) is the correct explanation of (A).
B. If both (A) and (R) are true but (R) is not correct explanation of (A).
C. If (A) is true but (R) is false.
D. If (A) is false but ( $R$ ) if true.

## Answer: D

D Watch Video Solution

## 5.

The
$p K_{a}$
value

(I) is less
than
the
$p K_{a}$
value
to

(II).

Nonaromatic compounds are more stable than anti-aromatic compounds.
A. If both (A) and (R) are true and (R) is the correct explanation of (A).
B. If both (A) and (R) are true but (R) is not correct explanation of (A).
C. If (A) is true but (R) is false.
D. If (A) is false but ( $R$ ) if true.

## Answer: A

## (D) Watch Video Solution

## Archives

1. Polarization in acrolein as:
A. $\stackrel{-}{\delta}^{\delta} H_{2}=C H-\stackrel{+\delta}{C}=O$
B. ${ }^{-\delta} H_{2}=C H-C H=\stackrel{+\delta}{O}$
C. ${ }^{-\delta} H_{2}=\stackrel{+\delta}{C} H-C H=O$
D. ${ }^{-\delta} H_{2}=C H-C H=O^{-\delta}$

## Answer: D

## - Watch Video Solution

2. The compound which gives the most stable carbonium ion on dehydration is
```
A. \(\mathrm{CH}_{3}-\mathrm{CH}-\mathrm{CH}_{2} \mathrm{OH}\)
            \({ }^{\mathrm{CH}}\)
                \(\mathrm{CH}_{3}\)
B. \(\mathrm{CH}_{3}-\stackrel{\text { । }}{\mathrm{C}} \mathrm{C}\)
C. \(\mathrm{CH}_{3}-\mathrm{CH}_{2}-\mathrm{CH}_{2}-\mathrm{CH}_{2} \mathrm{OH}\)
D. \(\mathrm{CH}_{3}-\stackrel{\mathrm{OH}}{\mathrm{C}} \mathrm{C}-\mathrm{CH}_{2}-\mathrm{CH}_{3}\)
```

Answer: B
3. Which of the following hydrocarbons has the lowest dipole moment.
a.

b.

C. $\mathrm{CH}_{3}-\mathrm{CH}_{2} \mathrm{CH}=\mathrm{CH}_{2}$
D. $\mathrm{CH}_{2}=\mathrm{CH}-\mathrm{CH}=\mathrm{CH}_{2}$

## Answer: B

## - Watch Video Solution

4. Which of the following molecules has highest dipole moment?
A. $\mathrm{CH}_{3} \mathrm{Cl}$
B. $\mathrm{CH}_{2} \mathrm{Cl}_{2}$
C. $\mathrm{CHCl}_{3}$
D. $C C l_{4}$

Answer: A

## D Watch Video Solution

5. Arrange in the order of increasing acidic strengths.

A. $X>Z>Y$
B. $Z<X>Y$
C. $X>Y>Z$
D. $Z>X>Y$

## Answer: A

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6. Which of the following resonating structures of 1-methoxy-1,3butadiene is least stable ?
A. $\stackrel{\ominus}{\mathrm{C}} \mathrm{H}_{2}-\mathrm{CH}=\mathrm{CH}-\mathrm{CH}=\stackrel{\oplus}{\mathrm{O}}-\mathrm{CH}_{3}$
B. $\mathrm{CH}_{2}=\mathrm{CH}-\stackrel{\ominus}{\mathrm{C}} \mathrm{H}-\mathrm{CH}=\stackrel{\oplus}{\mathrm{O}}-\mathrm{CH}_{3}$
c. $\stackrel{\ominus}{\mathrm{C}} \mathrm{H}_{2}-\stackrel{\oplus}{\mathrm{C}} \mathrm{H}-\mathrm{CH}=\mathrm{CH}-\mathrm{O}-\mathrm{CH}_{3}$
D. $\mathrm{CH}_{2}=\mathrm{CH}-\stackrel{\ominus}{\mathrm{C}} \mathrm{H}-\stackrel{\oplus}{\mathrm{C}} \mathrm{H}-\mathrm{O}-\mathrm{CH}_{3}$

## D Watch Video Solution

7. Which of the following is the most stable resonance structure
a.

b.

c.

d.

a.

B.

C.

d.


## Answer: A

## - Watch Video Solution

8. Hyperconjugation involves overlap of which of the following orbitals?
A. $\sigma-\sigma$
B. $\sigma-p$
C. $p-p$
D. $\pi-\pi$

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9. The correct stability order for the following species is

A. $(I I)>(I V)>(I)>(I I I)$
B. $(I)>(I I)>(I I I)>(I V)$
C. $(I I)>(I)>(I V)>(I I I)$
D. $(I)>(I I I)>(I I)>(I V)$

## Answer:

10. In the following carbocation, $\mathrm{H} / \mathrm{CH}_{3}$ that is most likely to migrate to the positively charged carbon is :
A. $\mathrm{CH}_{3} a t \mathrm{C}-4$
B. $H a t C-4$
C. $\mathrm{CH}_{3} a t C-2$
D. $\mathrm{HatC}-2$

## Answer:

(D) Watch Video Solution
11. The correct of acidities of the following is :

I


Cl
II


$\mathrm{CH}_{3}$
IV
A. $I I I>I V>I I>I$
B. $I V>I I I>I>I I$
C. $I I I>I I>I>I V$
D. $I I>I I I>I V>I$

## Answer: A

12. Give the stability of the following resonance structures
(a) $H_{2} C=\stackrel{\oplus}{N}=\stackrel{\ominus}{C}$
(b) $H_{2} \stackrel{\oplus}{C}-N=\stackrel{\ominus}{N}$
(c ) $H_{2} \stackrel{\ominus}{C}-\stackrel{\oplus}{N} \equiv N$
(d) $H_{2} \stackrel{\ominus}{C}-N=\stackrel{\oplus}{N}$.
A. $I>I I>I V>I I I$
B. $I>I I I>I I>I V$
C. $I I>I>I I I>I V$
D. $I I I>I>I V>I I$

## Answer:

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1. Among the given cations,........is most stable (sec-bytyl carbonium ion, tert-butyl carbonium ion, n-butyl carbonium ion).

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2. The shape of $(\underset{3}{\underset{C}{H}})$ is

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3. The bond dissociation energy needed to form the benzyl radical from toluene is $\qquad$ than the formation of the methyl radical from methane.
(D) Watch Video Solution
4. The kind of delocalisation involving sigma bond orbitals is called......

## D Watch Video Solution

## Analytical And Descriptive

1. Arrange the following in increasing order of basic strength:

Aniline,p-Nitroaniline and p-toluidine

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