CHAPTER

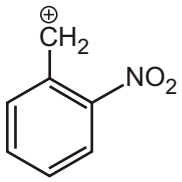
17

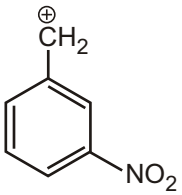
Application of Resonance, Hyperconjugation & Inductive Effect

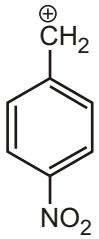
ADDITIONAL PROBLEMS BASED ON RESONANCE, HYPERCONJUGATION AND INDUCTIVE EFFECT

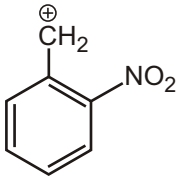
Solved Example

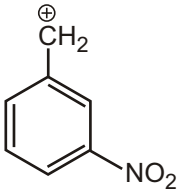
- What is correct order of Stability of given Carbocation :

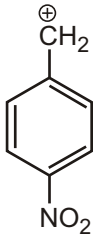












Sol.

(I)

(i) Increase in the magnitude of positive charge by – I and – R effect

(ii) – I and – R power is maximum

(II)

Increase in positive charge only by – I effect

(III)

(i) Increase in positive charge by – I – R effect

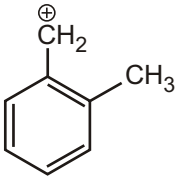
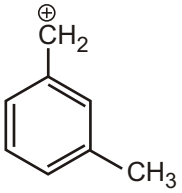
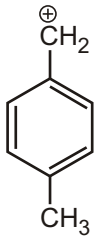
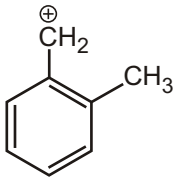
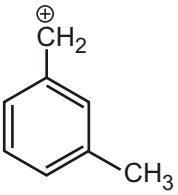
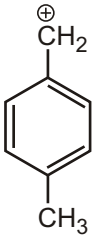
(ii) – I and – R power is minimum

Hence (II) is more stable than (III) which is more stable than (I).

Thus meta derivative is more stable than p-derivative which is more stable than o-derivative.

Solved Example

- What is correct order of Stability of given Carbocation :

Sol.

(I)

Positive charge is decreased by +I and +H group or stabilised by +I and +H group and +I and +H power is maximum

(II)

Stabilised by +I group only

(III)

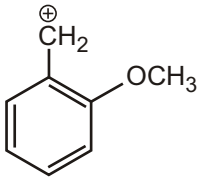
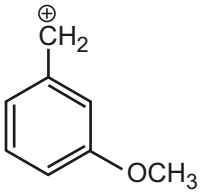
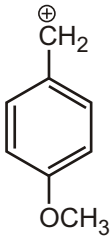
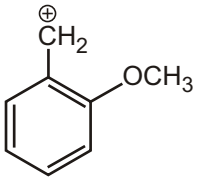
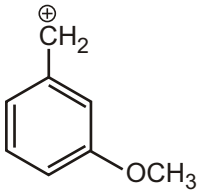
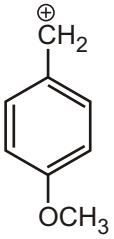
Stabilised by +I and +H effect and +I and +H power is minimum

Hence (I) is more stable than (III) which is more stable than (II).

Thus o-derivative is more stable than p-derivative which is more stable than m-derivative.

Solved Example

- What is correct order of Stability of given Carbocation :

Sol.

(I)

Stabilised by +R effect destabilised by –I effect –I power is maximum (due to distance)

(II)

Destabilised by –I effect

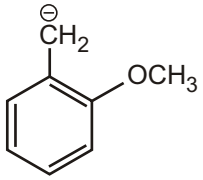
(III)

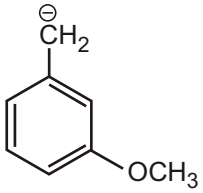
Stabilised by +R effect destabilised by –I effect –I power is minimum (due to distance)

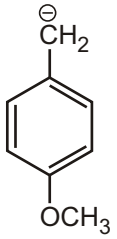
Hence III is more stable than I which is more stable than II.

Solved Example

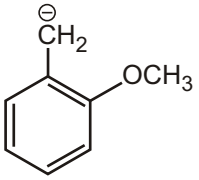
- What is correct order of Stability of given Carbanion :





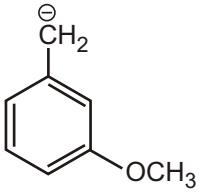


Sol.



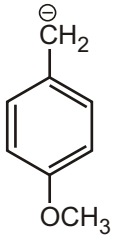
(I)

Destabilised by + R effect and stabilised by – I effect
– I power is maximum



(II)

Stabilised by – I effect



(III)

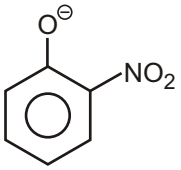
Destabilised by + R effect
stabilised by – I effect and
– I power is minimum

Thus m-derivative is more stable o-derivative which is more stable than p-derivative.

Solved Example

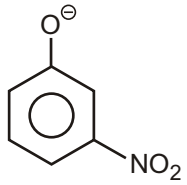
- What is the correct order of acidic strength of orthonitro phenol, metanitro phenol and paranitro phenol.

Sol. **Acidity of Substituted Phenols :** Acidity of substituted phenols depends on the stability of the phenoxide ion because acidity is the function of the stability of acid anion.



(I)

Phenoxide ion is stabilised by
– R and – I effect and
– I power is maximum
– R power is maximum



(II)

Stabilised by
– I effect only

(III)

Stabilised by – R and – I effect
and – I power is minimum
– R power is minimum

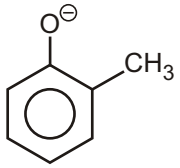
Thus according to stability of anions o-dervative will be more acidic than p-derivative which will be more acidic than m-derivative. But result is as follows in case of nitrophenols p-derivative is more acidic than o-derivative which is more acidic than m-derivative. In o-derivative, there is hydrogen bonding which decreases acidity. Thus order of acidity is as follows :

paranitro phenol > orthonitro phenol > metanitro phenol > phenol

Solved Example

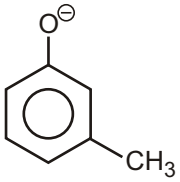
- What is the correct order of acidic strength of orthocresol, metacresol and paracresol.

Sol.



(I)

Destabilised by + H and + I effect and + I power is maximum



(II)

Destabilised by + I effect

(III)

Destabilised by + H and + I effect and + I power is minimum

Thus, m-derivative is more acidic than p-derivative which will be more acidic than o-derivative.

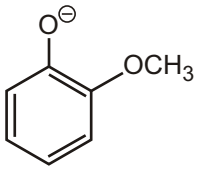
Phenol > m-derivative > p-derivative > o-derivative

Acidity in decreasing order

Solved Example

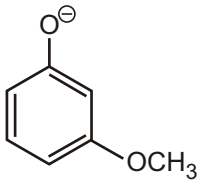
- What is the correct order of acidic strength of ortho, meta and para methoxy phenol.

Sol.



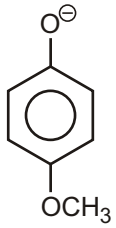
(I)

Destabilised by + R effect stabilised by – I effect – I power is maximum



(II)

Stabilised by – I effect



(III)

Destabilised by + R effect stabilised by – I effect and – I power is minimum

Therefore (II) is more stable than (I) which is more stable than (III).

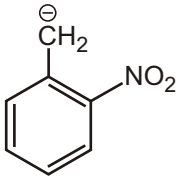
Thus, m-derivative is more acidic than o-derivative which is more acidic than p-derivative.

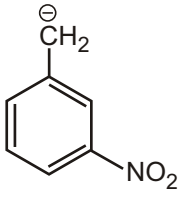
EXERCISE

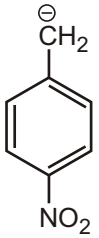
UNSOLVED EXAMPLE

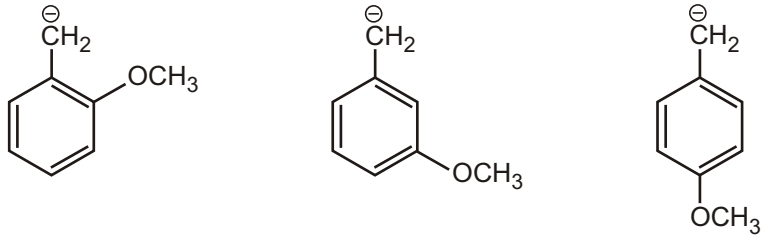
1. Correct order of Stability of given Carbanion :

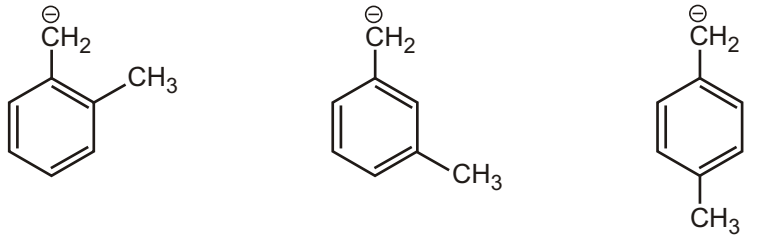
(i)

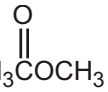




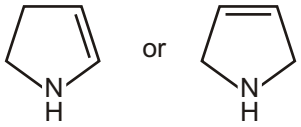


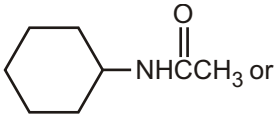
(ii) 

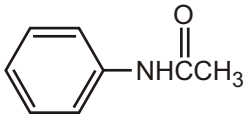
(iii) 

2. (a) Which oxygen atom has the greater electron density 

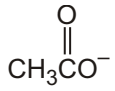
(b) Which compound has the greater electron density on its nitrogen atom

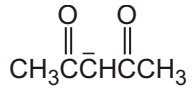


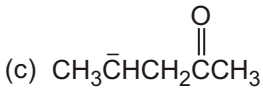
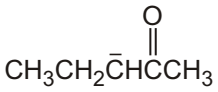
(c) Which compound has the greater electron density on its oxygen atom 

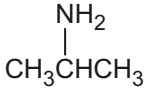
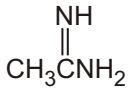


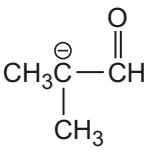
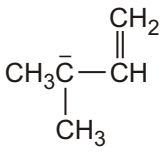
3. In each of the following pairs, which species is more stable?

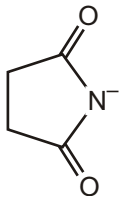
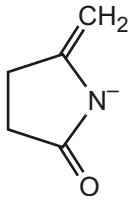
(a) $CH_3CH_2O^-$ or 

(b)  or 

(c)  or 

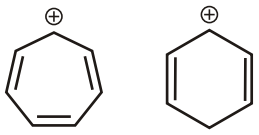
(d)  or 

(e)  or 

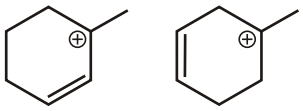
(f)  or 

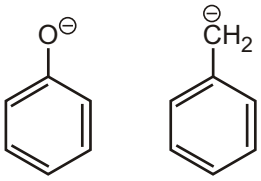
WORK SHEET - 1

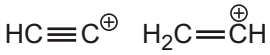
1. Which of the following is more stable, Write in the box?

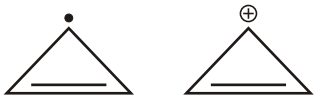
1. 

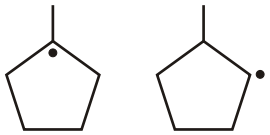
2. 

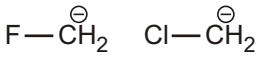
3. 

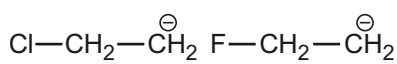
4. 

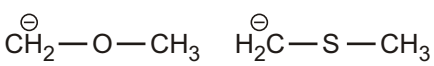
5. 

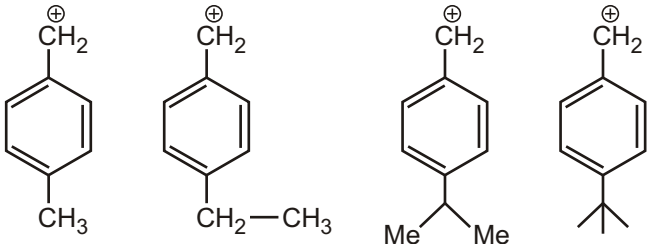
6. 

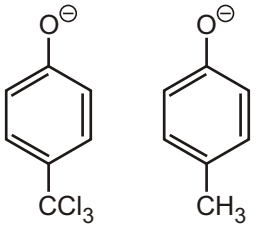
7. 

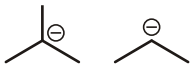
8. 

9. 

10. 

11. 

12. 

13. 

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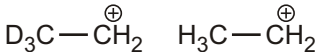
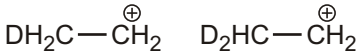
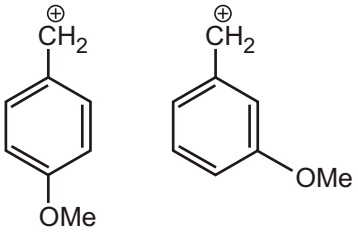
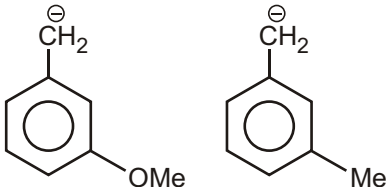
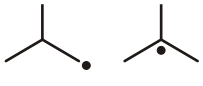
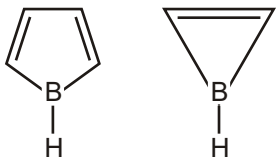
15. 

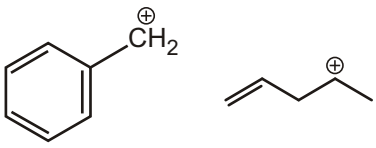
16. 

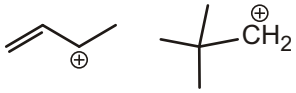
17. 

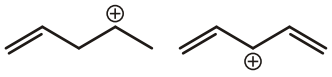
18. 

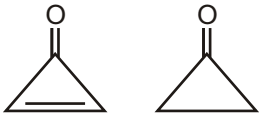
19. 

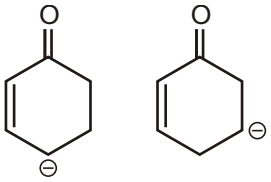
20. 

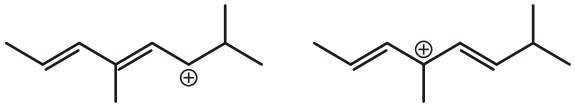
21. 

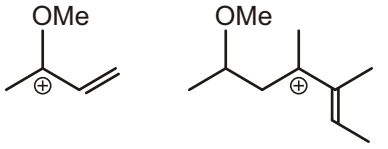
22. 

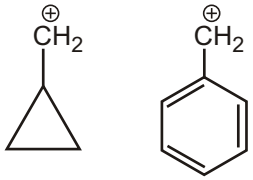
23. 

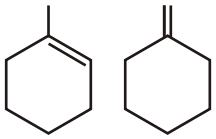
24. 

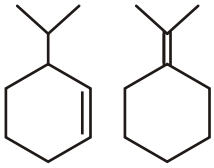
25. 

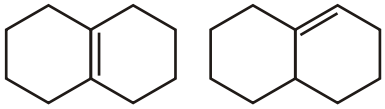
26. 

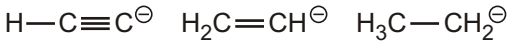
27. 

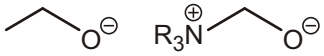
28. 

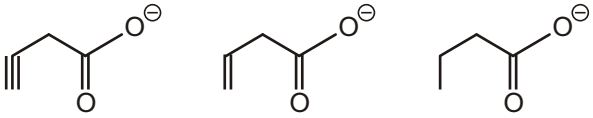
29. 

30. 

31. 

32. 

33. 

34. 

35. 

Answers

Unsolved Example

1. **(i)** **Stability order :** a > c > b

(ii) **Stability order :** b > a > c

(iii) **Stability order :** b > c > a

2. (a) $CH_3\overset{\overset{O}{\|}}{C}OCH_3$ (b) a < b (c) a > b

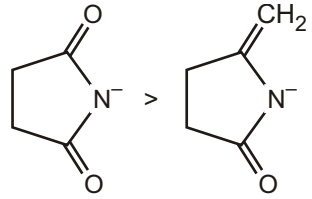
3. (a) $CH_3CH_2O^- < CH_3\overset{O}{\overset{\|}{C}}O^-$

(b) $CH_3\overset{O}{\overset{\|}{C}}\overset{-}{C}HCH_2\overset{O}{\overset{\|}{C}}H < CH_3\overset{O}{\overset{\|}{C}}\overset{-}{C}H\overset{O}{\overset{\|}{C}}CH_3$

(c) $CH_3\overset{-}{C}HCH_2\overset{O}{\overset{\|}{C}}CH_3 < CH_3CH_2\overset{-}{C}H\overset{O}{\overset{\|}{C}}CH_3$

(d) $CH_3\overset{NH_2}{\overset{|}{C}}HCH_3 < CH_3\overset{NH}{\overset{\|}{C}}NH_2$

(e) $CH_3\overset{\ominus}{C}(CH_3)-\overset{O}{\overset{\|}{C}}H > CH_3\overset{-}{C}(CH_3)-CH=CH_2$

(f) 

Work sheet - 1

1. a > b	**2.** a > b	**3.** a > b	**4.** a > b	**5.** a < b	**6.** a < b	**7.** a > b	**8.** a < b
9. b > a	**10.** a < b	**11.** a > b > c > d	**12.** a > b	**13.** a < b	**14.** a > b	**15.** a < b	**16.** a > b
17. a > b	**17.** a > b	**18.** a > b	**19.** a < b	**20.** a < b	**21.** a > b	**22.** a > b	**23.** a < b
24. a > b	**25.** a > b	**26.** a > b	**27.** a > b	**28.** a > b	**29.** a > b	**30.** a < b	**31.** a > b
32. a > b > c	**33.** a < b	**34.** a > b > c	**35.** a > b				

❑❑❑