Appendice

C

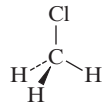
Risposte ai problemi

Capitolo 1

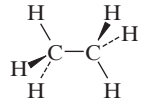
1.1. **(a)** 1 **(b)** 2 **(c)** 3

1.2. **(a)** B: $1s^2\ 2s^2\ 2p$ **(b)** P: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$
(c) O: $1s^2\ 2s^2\ 2p^4$ **(d)** Ar: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

1.3.

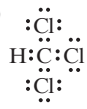


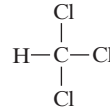
1.4.



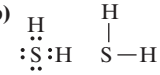
1.5. **(a)** CCl_4 **(b)** AlH_3 **(c)** CH_2Cl_2 **(d)** SiF_4

1.6. **(a)**

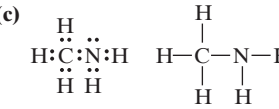




(b)

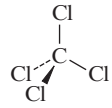


(c)



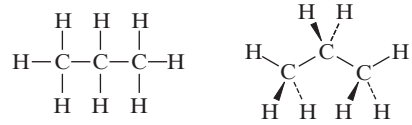
1.7. C_2H_7 ha troppi atomi di idrogeno per un composto con due soli atomi di carbonio.

1.8.

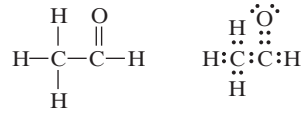


1.9. Un atomo di carbonio è più grande di un atomo di idrogeno.

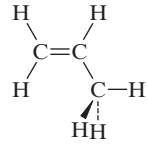
1.10. Tutti gli angoli di legame sono approssimativamente di 109°.



1.11.



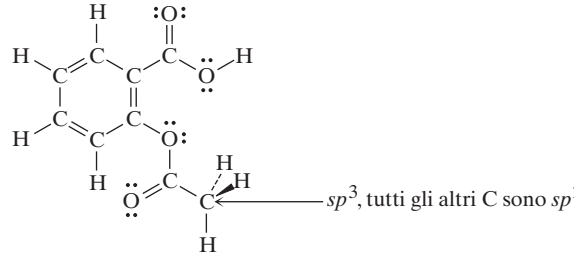
1.12. Il carbonio del CH_3 è ibridato sp^3, i carboni del doppio legame sono ibridati sp^2, l'angolo di legame C=C−C è approssimativamente di 120°.



1.13. Il carbonio del CH_3 è ibridato sp^3, i carboni del triplo legame sono ibridati *sp*, l'angolo di legame C≡C−C è approssimativamente di 180°.

1.14. Tutti gli atomi di carbonio sono ibridati sp^2 e tutti gli angoli di legame sono circa di 120°.

1.15.

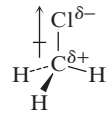


1.16. **(a)** H **(b)** Br **(c)** Cl

1.17. **(a)** C è δ+, Br è δ– **(b)** C è δ+, N è δ–
(c) H è δ+, N è δ– **(d)** C è δ+, O è δ–
(e) Mg è δ+, C è δ– **(f)** C è δ+, F è δ–

1.18. CCl_4 e ClO_2 < $TiCl_3$ < $MgCl_2$

1.19.



1.20. **(a)** Acido formico: $K_a = 1{,}8 \times 10^{-4}$; acido picrico: $K_a = 0{,}42$.
(b) L'acido picrico è più forte.

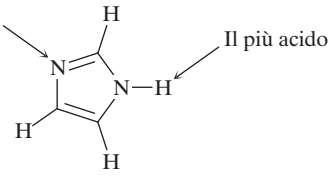
1.21. L'acqua è l'acido più forte.

1.22. **(a)** No **(b)** No

1.23. Acidi di Lewis: (c), (d), (e); basi di Lewis: (b), (f); entrambi: (a)

1.24. **(a)** $CH_3CH_2OH + HCl \rightarrow CH_3CH_2OH_2^+\ Cl^-$
$(CH_3)_3NH + HCl \rightarrow (CH_3)_2NH_2^+\ Cl^-$; $(CH_3)_3P + HCl \rightarrow (CH_3)_3PH^+\ Cl^-$
(b) $HO^- + CH_3^+ \rightarrow HO-CH_3$; $HO^- + B(CH_3)_3 \rightarrow HO-B(CH_3)_3^-$;
$HO^- + MgBr_2 \rightarrow HO-MgBr_2^-$

1.25. Il più basico



Il più acido

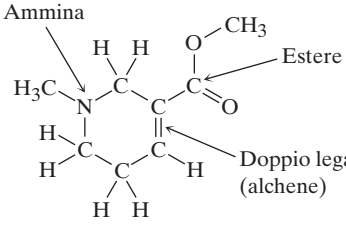
Capitolo 2

2.1. **(a)** Acido carbossilico, doppio legame
(b) Acido carbossilico, anello aromatico, estere
(c) Aldeide, alcol

2.2. **(a)** CH_3OH **(b)**  **(c)** $CH_3\overset{\overset{O}{\|}}{C}OH$ **(d)** CH_3NH_2

(e) $CH_3\overset{\overset{O}{\|}}{C}CH_2CH_2NH_2$ **(f)** $H_2C{=}CHCH{=}CH_2$

2.3. Ammina



Estere

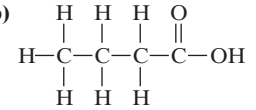
Doppio legame C–C (alchene)

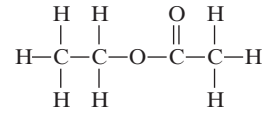
2.4. $CH_3CH_2CH_2CH_2CH_2CH_3$ $CH_3CHCH_2CH_2CH_3$ (CH₃ su CH) $CH_3CH_2CHCH_2CH_3$ (CH₃ su CH)

$CH_3CCH_2CH_3$ (CH₃ su C) (CH₃ su CH) $CH_3CHCHCH_3$ (CH₃ su CH)

2.5. **(a)** $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$
$(CH_3)_2CHCH_2CH_2CH_2CH_2CH_3$
$(CH_3)_3CCH_2CH_2CH_2CH_3$

(b)

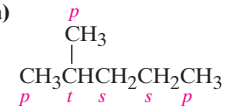


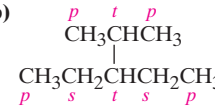


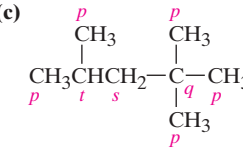
2.6. $CH_3CH_2CH_2CH_2CH_2$– $CH_3CH_2CH_2CH(CH_3)$– $CH_3CH_2CH(CH_2CH_3)$– $CH_3CHCH_2CH_2$–

$CH_3CH_2CH(CH_3)CH_2$– $CH_3CH_2C(CH_3)_2$– $CH_3CH(CH_3)CH(CH_3)$– $CH_3C(CH_3)_2CH_2$–

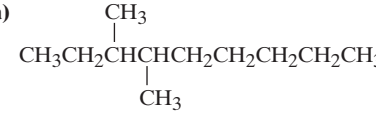
2.7. **(a)** $CH_3CH(CH_3)CH(CH_3)_2$ **(b)** $CH_3CH(CH_3)_2$ (CH₃ su CH) $CH_3CH_2CH(CH_3)CH_2CH_3$ **(c)** $CH_3C(CH_3)_2CH_2CH_3$ (CH₃ su C)

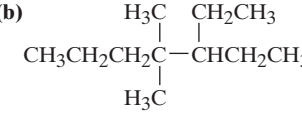
2.8. **(a)** 

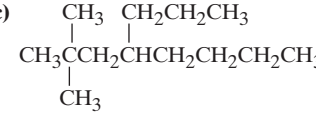
(b) 

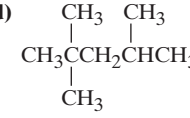
(c) 

2.9. **(a)** Pentano, 2-metilbutano, 2,2-dimetilpropano
(b) 3,4-Dimetilesano
(c) 2,4-Dimetilpentano
(d) 2,2,5-Trimetileptano

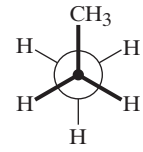
2.10. **(a)** 

(b) 

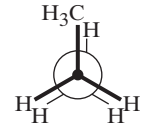
(c) 

(d) 

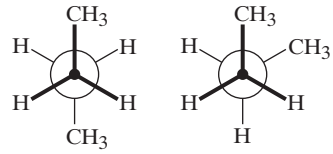
2.11. 3,3,4,5-Tetrametileptano

2.12. 

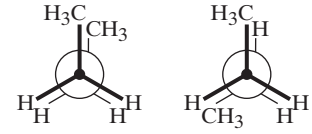
Conformazione più stabile (sfalsata)



Conformazione meno stabile (eclissata)

2.13. 

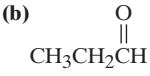
Butano sfalsato

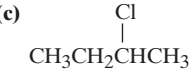


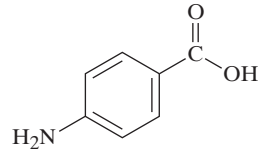
Butano eclissato

2.14. La prima conformazione sfalsata del butano è quella più stabile.

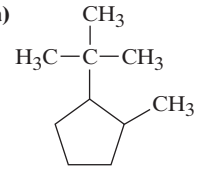
2.15. **(a)** C_5H_5N **(b)** $C_6H_{10}O$ **(c)** C_8H_7N

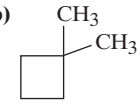
2.16. **(a)** $CH_3CH_2CH{=}CH_2$ **(b)** 

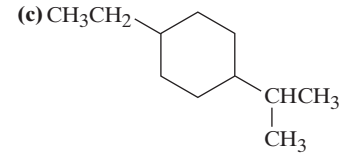
(c) 

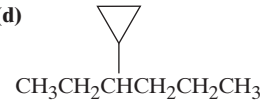
2.17. 

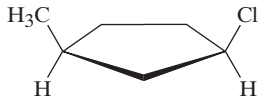
2.18. **(a)** 1,4-Dimetilcicloesano **(b)** 1-Etil-3-metilciclopentano
(c) Isopropilciclobutano

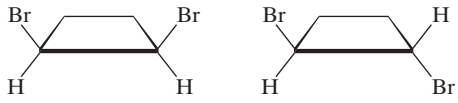
2.19. **(a)** 

(b) 

(c) 

(d) 

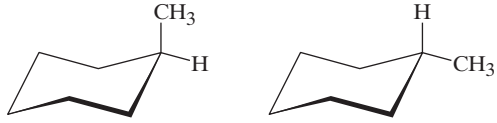
2.20. 

2.21. 

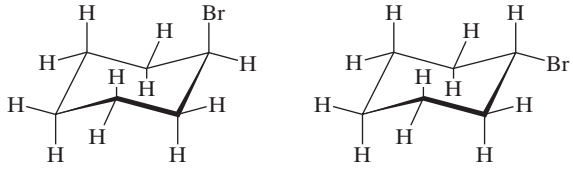
Cis Trans

2.22. I due gruppi ossidrilici sono in cis; le due catene di carbonio sono in trans.

2.23. (**a**) *cis*-1,2-Dimetilciclopentano
(**b**) *cis*-1-Bromo-3-metilciclobutano

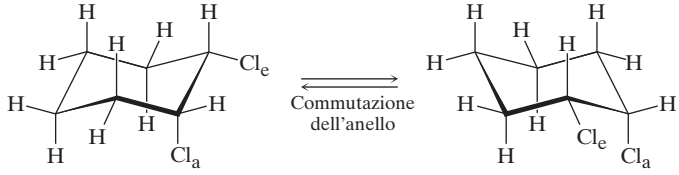
2.24. 

Assiale Equatoriale

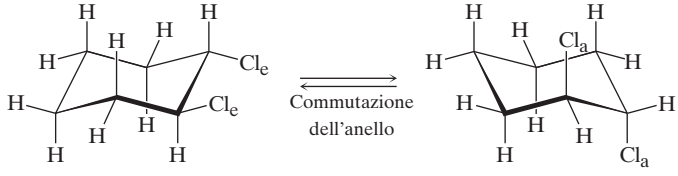
2.25. 

Assiale (meno stabile) Equatoriale (più stabile)

2.26. Le posizioni assiale ed equatoriale si alternano su ciascun lato dell'anello.



2.27. Le posizioni assiale ed equatoriale si alternano su ciascun lato dell'anello.



2.28. Meno stabile

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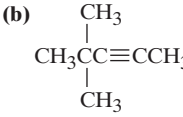
Capitolo 3

3.1. **(a)** 3,4,4-Trimetilpent-1-ene **(b)** 3-Metiles-3-ino
(c) 4,7-Dimetilotta-2,5-diene **(d)** 6-Etil-7-metilnon-4-ene

3.2. **(a)** 1,2-Dimetilcicloesene **(b)** 4,4-Dimetilcicloeptene
(c) 3-Isopropilciclopentene

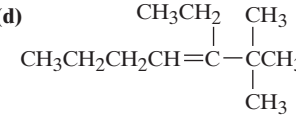
3.3. **(a)**

(b)



(c)

(d)



3.4. **(a)** 2,5-Dimetiles-3-ino **(b)** 3,3-Dimetilbut-1-ino
(c) 3,3-Dimetilotta-4-ino **(d)** 2,5,5-Trimetilept-3-ino

3.5. **(a)** 2,5,5- Trimetiles-2-ene **(b)** 2,2-Dimetiles-3-ino
(c) 2-Metilepta-2,5-diene **(d)** 1-Metilciclopenta-1,3-diene

3.6. I composti (c), (d), (e) e (f) possono esistere come coppie di isomeri.

3.7. **(a)** *cis*-3,4-Dimetil-es-2-ene **(b)** *trans*-6-Metil-ept-3-ene

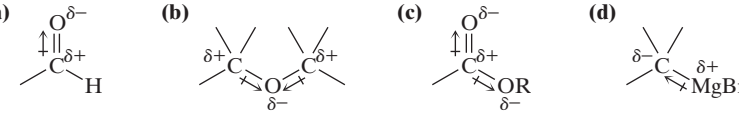
3.8. **(a)** $-Br$ **(b)** $-Br$ **(c)** $-CH_2CH_3$
(d) $-OH$ **(e)** $-CH_2OH$ **(f)** $-CH{=}O$

3.9. **(a)** *Z* **(b)** *E* **(c)** *E*

3.10. *Z*

3.11. **(a)** Sostituzione **(b)** Eliminazione **(c)** Addizione

3.12. **(a)** **(b)** **(c)** **(d)**



3.13. Elettrofili: (a), (c); nucleofili: (b), (d), (e)

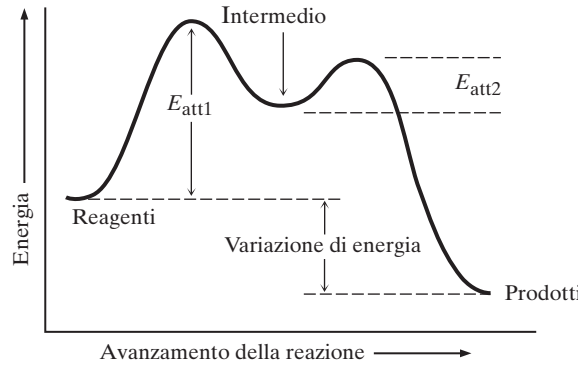
3.14. Il boro è un acido di Lewis/elettrofilo perché ha soltanto sei elettroni nel guscio più esterno.

3.15. $(CH_3)_3C^+$ è l'intermedio.

3.16. 2-Cloropentano e 3-cloropentano

3.17. $E_{att} = 60$ kJ/mol è più veloce.

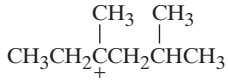
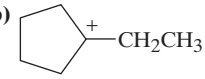
3.19.

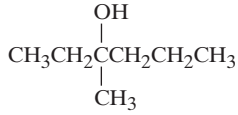
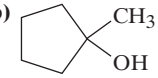
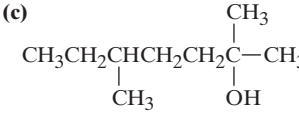


Capitolo 4

4.1. **(a)** Clorocicloesano **(b)** 2-Bromo-2-metilpentano
(c) 4-Metilpentan-2-olo **(d)** 1-Bromo-1-metilcicloesano

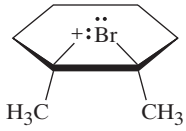
4.2. **(a)** Ciclopentene **(b)** 1-Etilcicloesene o etilidenecicloesano
(c) Es-3-ene **(d)** Vinilcicloesano (cicloesiletilene)

4.3. **(a)**  **(b)** 

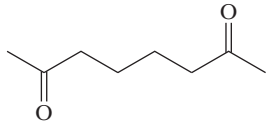
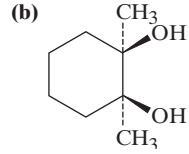
4.4. **(a)**  **(b)**  **(c)** 

4.5. **(a)** But-1-ene o but-2-ene
(b) 3-Metilpent-2-ene o 2-etilbut-1-ene
(c) 1,2-Dimetilcicloesene o 2,3-dimetilcicloesene

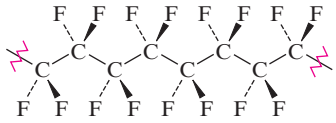
4.6. *trans*-1,2-Dibromo-1,2-dimetilcicloesano

4.7. 

4.8. **(a)** 2-Metilpentano **(b)** 1,1-Dimetilciclopentano

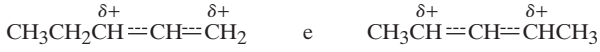
4.9. **(a)**  **(b)** 

4.10. **(a)** 2-Metilpropene **(b)** Es-3-ene

4.11. 

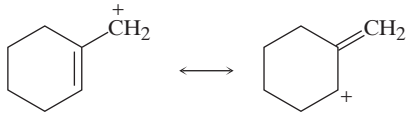
4.12. 1,4-Dibromobut-2-ene e 3,4-dibromobut-1-ene

4.13. 4-Cloropent-2-ene, 3-cloropent-1-ene, 1-cloropent-2-ene

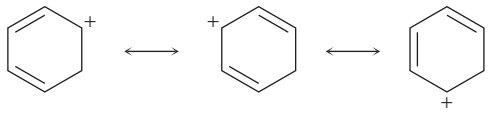
4.14.  e

Più stabile

4.15.

(a) 

(b) 

(c) 

4.16. **(a)** 6-Metilept-3-ino **(b)** 3,3-Dimetilbut-1-ino
(c) 5-Metiles-2-ino **(d)** Ept-2-en-5-ino

4.17. **(a)** 1,2-Dicloropent-1-ene
(b) 4-Bromoept-3-ene e 3-bromoept-3-ene
(c) *cis*-6-Metilept-3-ene

4.18. Ottan-4-one

4.19. **(a)** Pent-1-ino **(b)** Es-3-ino

4.20. **(a)** 1-Bromo-3-metilbutano + acetilene
(b) 1-Bromopropano + prop-1-ino, o bromometano + pent-1-ino
(c) bromometano + 3-metilbut-1-ino

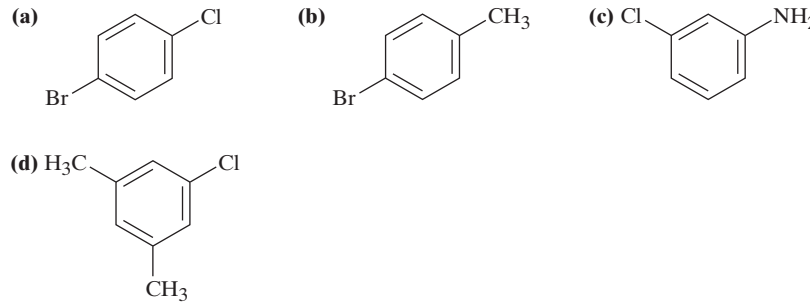
Capitolo 5

5.1. Le due strutture sono forme di risonanza, non isomeri.

5.2. **(a)** meta **(b)** para **(c)** orto

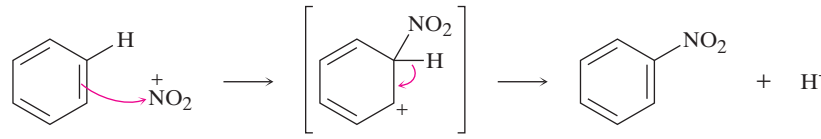
5.3. **(a)** *m*-Bromoclorobenzene **(b)** (3-Metilbutil)benzene
(c) *p*-Bromoanilina **(d)** 2,5-Diclorotoluene
(e) 1-Etil-2,4-dinitrobenzene **(f)** 1,2,3,5-Tetrametilbenzene

5.4.



5.5. *o*-, *m*- e *p*-bromotoluene

5.6.



Carbocatione intermedio

5.7. Il *p*-xilene ha un solo tipo di posizione dell'anello; l'*o*-xilene ne ha due.

5.8. Tre

5.9. **(a)** Etilbenzene **(b)** 2-Etil-1,4-dimetilbenzene

5.10. **(a)** *terz*-Butilbenzene; **(b)** Propanoilbenzene, $C_6H_5COCH_2CH_3$

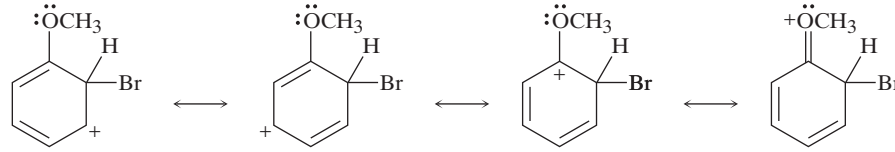
5.11. **(a)** Nitrobenzene < toluene < fenolo
(b) Acido benzoico < clorobenzene < benzene < fenolo
(c) Benzaldeide < bromobenzene < benzene < anilina

5.12. **(a)** *m*-Clorobenzonitrile **(b)** *o*- e *p*-Bromoclorobenzene

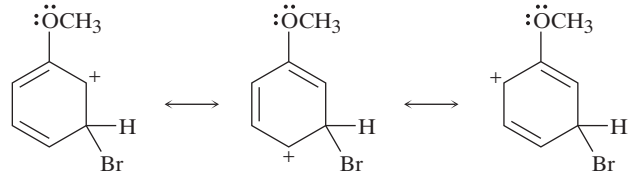
5.13. **(a)** Acido *m*-nitrobenzensolfonico
(b) Acido *o*- e *p*-bromobenzensolfonico
(c) Acido *o*- e *p*-metilbenzensolfonico
(d) Acido *m*-carbossibenzensolfonico
(e) Acido *m*-cianobenzensolfonico

5.14.

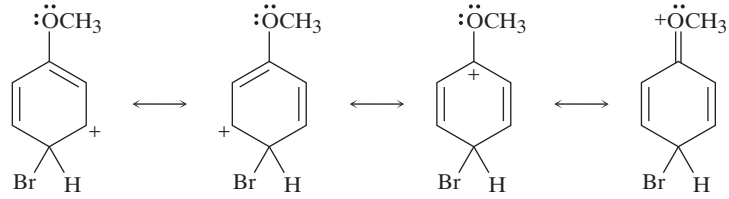
Orto



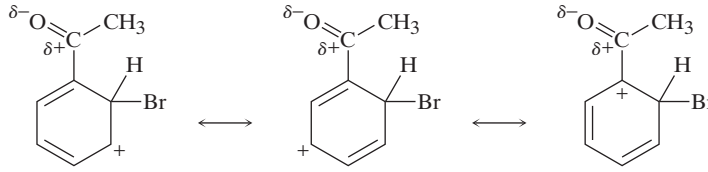
Meta



Para



5.15. Orto



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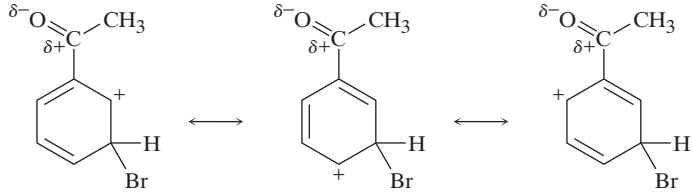
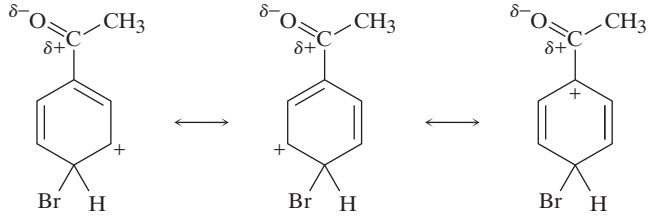
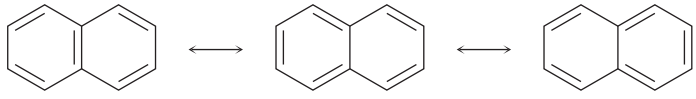


Para



5.16. **(a)** Acido *m*-clorobenzoico **(b)** Acido *o*-benzendicarbossilico

5.17.



5.18. **(a)** 1. CH_3Cl, $AlCl_3$; 2. CH_3COCl, $AlCl_3$
(b) 1. Cl_2, $FeCl_3$; 2. HNO_3, H_2SO_4

5.19. **(a)** 1. Br_2, $FeBr_3$; 2. CH_3Cl, $AlCl_3$; **(b)** 1. 2 CH_3Cl, $AlCl_3$; 2. Br_2, $FeBr_3$

5.20. 1. CH_3Cl, $AlCl_3$; 2. $KMnO_4$, H_2O; 3. Cl_2, $FeCl_3$

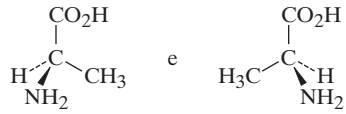
Capitolo 6

6.1. Chirali: vite, scarpa

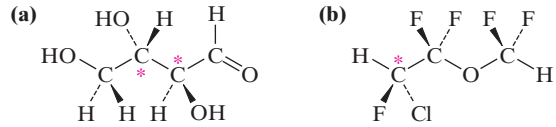
6.2. Chirali: (b), (c)

6.3. Chirale: (b)

6.4.



6.5.



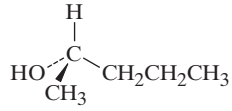
6.6. Levogira

6.7. +16,1

6.8. **(a)** $-OH$, $-CH_2CH_2OH$, $-CH_2CH_3$, $-H$
(b) $-OH$, $-CO_2CH_3$, $-CO_2H$, $-CH_2OH$
(c) $-NH_2$, $-CN$, $-CH_2NHCH_3$, $-CH_2NH_2$
(d) $-SSCH_3$, $-SH$, $-CH_2SCH_3$, $-CH_3$

6.9. **(a)** *S* **(b)** *S* **(c)** *R*

6.10.



6.11. *S*

6.12. **(a)** *R,R* **(b)** *S,R* **(c)** *R,S*

6.13. Le molecole (b) e (c) sono enantiomeri (immagini speculari). La molecola (a) è il diastereomero di (b) e (c).

6.14. **(a)** *R,R* **(b)** *S,R* **(c)** *R,S* **(d)** *S,S*

6.15. 6 Stereocentri; 64 stereoisomeri

6.16. *S,S*

6.17. Forma meso: (a) e (c)

6.18. Forma meso: (a) e (c)

6.19. Il prodotto è l'estere *S* puro.

6.20. **(a)** Isomeri costituzionali **(b)** Diastereomeri

Capitolo 7

7.1. **(a)** 2-Bromobutano **(b)** 3-Cloro-2-metilpentano
(c) 1-Cloro-3-metilbutano **(d)** 1,3-Dicloro-3-metilbutano
(e) 1-Bromo-4-clorobutano **(f)** 4-Bromo-1-cloropentano

7.2. **(a)** $CH_3CH_2CH_2C(CH_3)_2CH(Cl)CH_3$;
(b) $CH_3CH_2CH_2C(Cl)_2CH(CH_3)_2$
(c) $CH_3CH_2C(Br)(CH_2CH_3)_2$
(d) $CH_3CH(Cl)CH_2CH(CH_3)CH(Br)CH_3$

7.3. 1-Cloro-3-metilpentano, 2-cloro-3-metilpentano, 3-cloro-3-metilpentano, 3-(clorometil)pentano. I primi due sono chirali.

7.4. **(a)** 2-Metilpropan-2-olo + HCl **(b)** 4-Metilpentan-2-olo + PBr_3
(c) 5-Metilesan-1-olo + PBr_3 **(d)** 2,4-Dimetilesan-2-olo + HCl

7.5. **(a)** 4-Bromo-2-metilesano **(b)** 1-Cloro-3,3-dimetilciclopentano

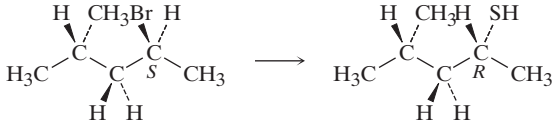
7.6. **(a)** $CH_3CH_2CH(I)CH_3$ **(b)** $(CH_3)_2CHCH_2SH$ **(c)** $C_6H_5CH_2CN$

7.7. **(a)** 1-Bromobutano + NaOH **(b)** 1-Bromo-3-metilbutano + NaN_3

7.8. **(a)** La velocità triplicherebbe. **(b)** La velocità quadruplicherebbe.

7.9. (*R*) $CH_3CO_2CH(CH_3)CH_2CH_2CH_2CH_3$

7.10.



7.11. **(a)** La reazione con $CH_3CH_2CH_2Br$ è più veloce.
(b) La reazione con $(CH_3)_2CHCH_2Cl$ è più veloce.

7.12. $CH_3I > CH_3Br > CH_3F$

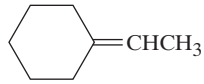
7.13. **(a)** La velocità rimarrebbe invariata. **(b)** La velocità raddoppierebbe.

7.14. 3-Bromo-3-metilottano racemo

7.15. Il substrato *S* dà una miscela racemica di alcoli.

7.16. **(a)** 2-Metil-pent-2-ene **(b)** 2,3,5-Trimetiles-2-ene

(c)



7.17. **(a)** 1-Bromo-3,6-dimetileptano
(b) 1,2-Dimetil-4-bromociclopentano

7.18. La velocità triplicherebbe.

7.19. **(a)** S_N2 **(b)** E2 **(c)** S_N1 **(d)** E1cB

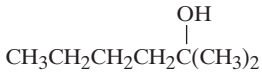
Capitolo 8

8.1. **(a)** 5-Metilesan-2,4-diolo **(b)** 2-Metil-4-fenilbutan-2-olo
(c) 4,4-Dimetilcicloesanolo **(d)** *trans*-2-Bromociclopentanolo
(e) 4-Bromo-3-metilfenolo **(f)** 3-Metossiciclopentene

8.2. Secondari: (a), (c), (d); terziario: (b)

8.3.

(a)



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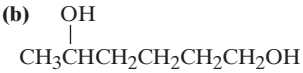

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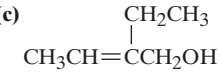
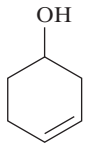


(d)



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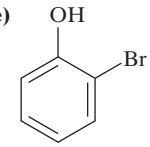

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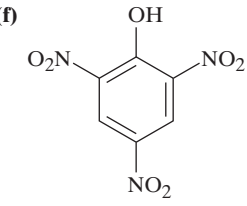


8.4. **(a)** Diisopropil etere
(b) Ciclopentil propil etere
(c) *p*-Bromoanisolo o 4-bromo-1-metossibenzene
(d) Etil isobutil etere

8.5. **(a)** $NaBH_4$ **(b)** $LiAlH_4$

8.6. **(a)** C_6H_5CHO, $C_6H_5CO_2H$, $C_6H_5CO_2R$
(b) $C_6H_5COCH_3$
(c) Cicloesanone

8.7. **(a)** 1-Metilciclopentanolo
(b) 1,1-Difeniletanolo
(c) 3-Metilesan-3-olo

8.8. **(a)** Acetone + CH_3MgBr
(b) Cicloesanone + CH_3MgBr
(c) Pentan-3-one + CH_3MgBr, o butan-2-one + CH_3CH_2MgBr

8.9. **(a)** 2,3-Dimetilpent-2-ene **(b)** 2-Metilpent-2-ene

8.10. **(a)** 2,3-Dimetilcicloesanolo **(b)** Eptan-4-olo

8.11. **(a)** 1-Feniletanolo **(b)** 2-Metilpropan-1-olo **(c)** Ciclopentanolo

8.12. **(a)** Cicloesanone **(b)** Acido esanoico **(c)** Esan-2-one

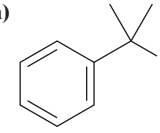
8.13. **(a)** Cicloesanone **(b)** Esanale

8.14. **(a)** $CH_3CH_2CH_2O^- + CH_3Br$
(b) $C_6H_5O^- + CH_3Br$
(c) $(CH_3)_2CHO^- + C_6H_5CH_2Br$

8.15. **(a)** Bromoetano > cloroetano > 2-bromopropano > 2-cloro-2-metilpropano

8.16. $CH_3CH_2COCH_2CH(CH_3)_2$;
(i) $CH_3CH_2CH(OCH_3)CH_2CH(CH_3)_2$;
(ii) $CH_3CH_2CH(Cl)CH_2CH(CH_3)_2$;
(iii) $CH_3CH_2COCH_2CH(CH_3)_2$

8.17. **(a)**



+ CH_3OH

(b) $CH_3CH_2CH(CH_3)OH + CH_3CH_2CH_2I$

8.18. Il prodotto è una miscela racemica di *R,R* e *S,S* butan-1,2-dioli.

8.19. **(a)** Butan-2-tiolo **(b)** 2,2,6-Trimetileptan-4-tiolo
(c) Ciclopent-2-ene-1-tiolo **(d)** Etil isopropil solfuro
(e) *o*-Di(metiltio)benzene **(f)** 3-(Etiltio)cicloesanone

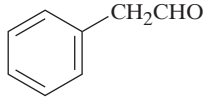
8.20. **(a)** 1. PBr_3; 2. $Na^+ {}^-SH$ **(b)** 1. $LiAlH_4$; 2. PBr_3; 3. $Na^+ {}^-SH$

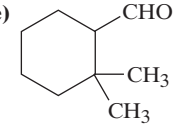
Capitolo 9

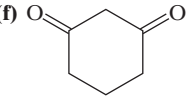
9.1. **(a)** Pentan-2-one **(b)** $CH_3CH_2CH_2CH{=}CHCHO$
(c) $CH_3CH_2COCH_2CH_2CHO$ **(d)** Ciclopentanone

9.2. **(a)** 2-Metilpentan-3-one
(b) 3-Fenilpropanale
(c) Ottan-2,6-dione
(d) *trans*-2-Metilcicloesancarbaldeide
(e) Pentandiale
(f) *cis*-2,5-Dimetilcicloesanone

9.3. **(a)** CH_3CHCH_2CHO (con CH_3 sul C2) **(b)** $H_2C{=}CCH_2CHO$ (con CH_3 sul C2) **(c)** $CH_3CHCH_2CCH_3$ (con Cl sul C2 e O sul C4)

(d) 

(e) 

(f) 

9.4. **(a)** Periodinano
(b) 1.$LiAlH_4$; 2. periodinano
(c) 1.$KMnO_4$; 2. $LiAlH_4$; 3. periodinano

9.5. **(a)** Periodinano **(b)** H_3O^+, $HgSO_4$ **(c)** $KMnO_4$, H_3O^+

9.6. **(a)** 1. H_3O^+; 2. periodinano **(b)** 1. CH_3COCl, $AlCl_3$; 2. $NaBH_4$

9.7. **(a)** Acido pentanoico
(b) Acido 2,2-dimetilesanoico
(c) Nessuna reazione

9.8. $(CH_3)_2C(OH)CN$

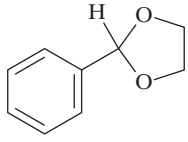
9.9. $(CH_3)_2C(OH)OCH_3$

9.10. **(a)** $C_5H_9MgBr + (CH_3)_2CHCHO$ o $(CH_3)_2CHMgBr + C_5H_9CHO$ o $C_5H_9COCH(CH_3)_2 + NaBH_4$
(b) $PhCH_2CHO + NaBH_4$ o $PhCH_2CO_2R + LiAlH_4$ o $PhCH_2MgBr + CH_2O$
(c) $C_6H_{11}MgBr + (CH_3)_2C{=}O$ o $CH_3MgBr + C_6H_{11}CO_2R$ o $CH_3MgBr + C_6H_{11}COCH_3$

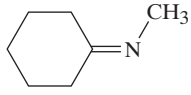
9.11. $C_5H_9COCH_3 + CH_3MgBr$ o $C_5H_9MgBr + (CH_3)_2C{=}O$

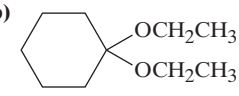
9.12. L'acqua marcata si addiziona irreversibilmente al gruppo carbonilico.

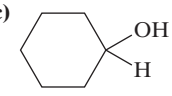
9.13. Il meccanismo di formazione dell'acetale è riportato in Figura 9.3.

9.14. 

9.15. 1. CH_3OH, catalizzatore acido; 2. CH_3MgBr; 3. H_3O^+

9.16. **(a)** 

(b) 

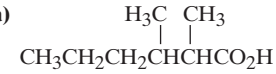
(c) 

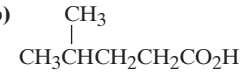
9.17. $(CH_3)_2CHCOCH_2CH_3 + CH_3NH_2$

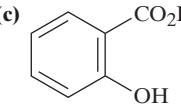
9.18. 6-Metilcicloes-2-enone + $(CH_3)_2CHOH$

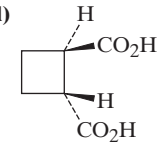
Capitolo 10

10.1. **(a)** Acido 3-metilbutanoico
(b) Acido 4-bromopentanoico
(c) Acido 2-etilpentanoico
(d) Acido *cis*-es-4-enoico
(e) Acido *cis*-ciclopentan-1,3-dicarbossilico

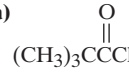
10.2. **(a)** 

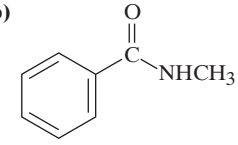
(b) 

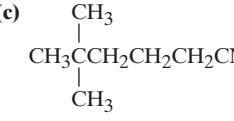
(c) 

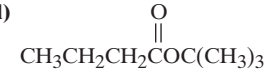
(d) 

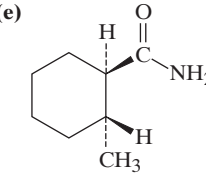
10.3. **(a)** Cloruro di 4-metilpentanoile
(b) Cicloesilacetammide
(c) 2-Metilpropanoato di isopropile
(d) Anidride benzoica
(e) Ciclopentancarbossilato di isopropile
(f) 2-Metilpropanoato di ciclopentile
(g) *N*-Metilpent-4-enammide
(h) 2-Metilbutanonitrile

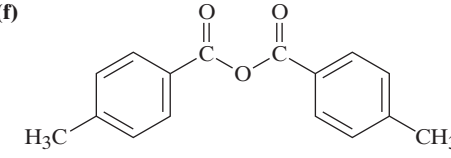
10.4. **(a)** 

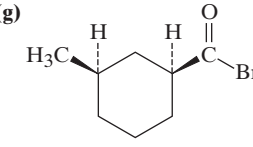
(b) 

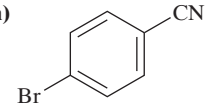
(c) 

(d) 

(e) 

(f) 

(g) 

(h) 

10.5. **(a)** $C_6H_5CO_2^-\ Na^+$ **(b)** $(CH_3)_3CCO_2^-\ K^+$

10.6. **(a)** Metanolo < fenolo < *p*-nitrofenolo < acido acetico < acido solforico
(b) Etanolo < acido benzoico < acido *p*-cianobenzoico

10.7. L'acido lattico è più forte a causa dell'effetto elettron-attrattore del gruppo –OH.

10.8. 1. NaCN; 2. NaOH, H_2O. Lo iodobenzene non può essere convertito in acido benzoico con questo metodo.

10.9. **(a)** CH_3COCl **(b)** $CH_3CH_2CO_2CH_3$
(c) $CH_3CO_2COCH_3$ **(d)** $CH_3CO_2CH_3$

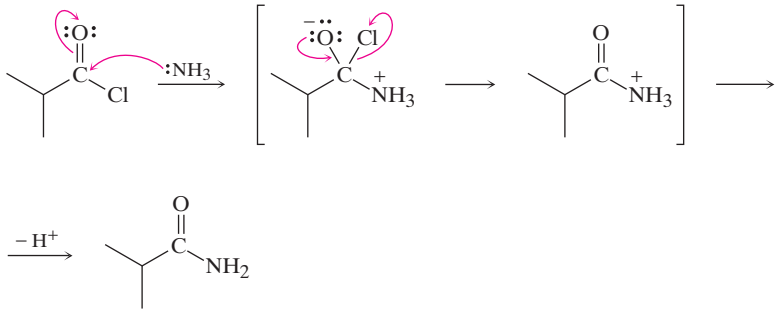
10.10. **(a)** $CH_3CO_2^-\ Na^+$ **(b)** CH_3CONH_2
(c) $CH_3CO_2CH_3 + CH_3CO_2^-\ Na^+$ **(d)** $CH_3CONHCH_3$

10.11. **(a)** C_6H_5COCl **(b)** $C_6H_5CO_2CH_3$
(c) $C_6H_5CH_2OH$ **(d)** $C_6H_5CO_2^-\ Na^+$

10.12. **(a)** CH_3CO_2H + $CH_3CH_2CH_2CH_2OH$
(b) $CH_3CH_2CH_2CO_2H$ + CH_3OH
(c) $PhCO_2H$ + $(CH_3)_2CHOH$

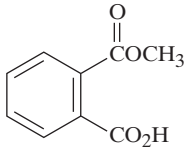
10.13. **(a)** CH_3CH_2COCl + CH_3OH **(b)** CH_3COCl + CH_3CH_2OH
(c) CH_3COCl + $C_6H_{11}OH$

10.14.



10.15. **(a)** CH_3CH_2COCl + NH_3 **(b)** $(CH_3)_2CHCH_2COCl$ + CH_3NH_2
(c) CH_3CH_2COCl + $(CH_3)_2NH$ **(d)** $PhCOCl$ + $(CH_3CH_2)_2NH$

10.17.



10.18. **(a)** $(CH_3)_2CHOH$ + CH_3CO_2H
(b) CH_3OH + $C_6H_{11}CO_2H$

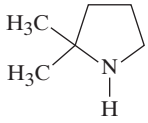
10.19. La reazione di un acido con un alcossido dà lo ione carbossilato non reattivo.

10.20. **(a)** $CH_3CH_2CH_2CH(CH_3)CH_2OH$ + CH_3OH
(b) C_6H_5OH + $C_6H_5CH_2OH$

10.21. **(a)** $C_5H_9CH_2CO_2R$ + CH_3CH_2MgBr
(b) CH_3CO_2R + $H_2C{=}CHMgBr$

10.22. **(a)** H_2O, NaOH **(b)** 1. H_2O, NaOH; 2. $LiAlH_4$ **(c)** $LiAlH_4$

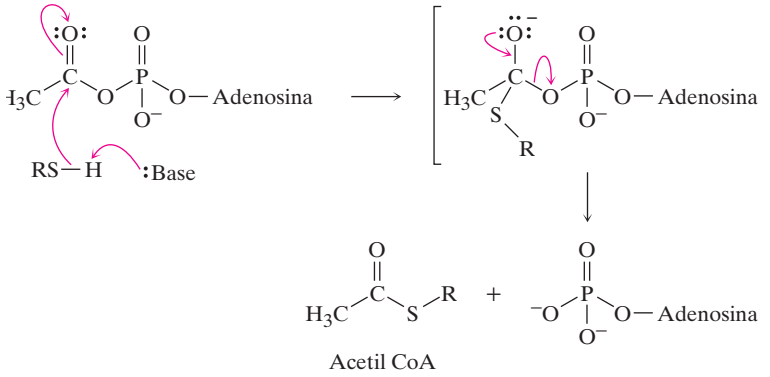
10.23.



10.24. **(a)** CH_3CH_2CN + CH_3CH_2MgBr, poi H_3O^+
(b) *p*-Nitrobenzonitrile + CH_3MgBr, poi H_3O^+

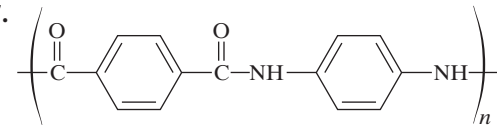
10.25. **1.** NaCN; 2. CH_3CH_2MgBr, poi H_3O^+

10.26.



Acetil CoA

10.27.



Capitolo 11

11.1.

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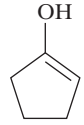
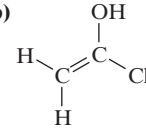
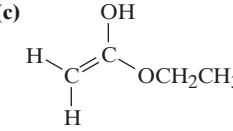
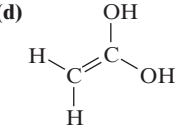
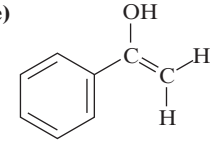


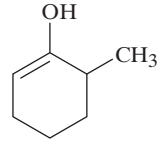
(b)


(c)


(d)


(e)


11.2. **(a)** 4 **(b)** 3 **(c)** 3 **(d)** 4 **(e)** 3

11.3.

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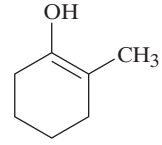
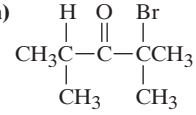


11.4. **(a)**

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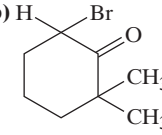
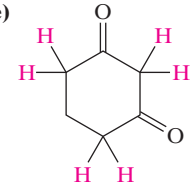
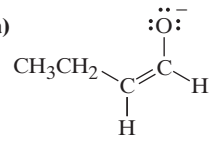
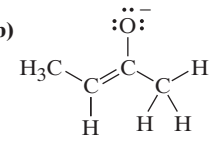


11.5. 1. Br_2; 2. Piridina, calore

11.6. **(a)** CH_3CH_2CHO **(b)** $(CH_3)_3CCOCH_3$
(c) CH_3CO_2H **(d)** $CH_3CH_2CH_2C{\equiv}N$
(e)


11.7. **(a)**

(b)

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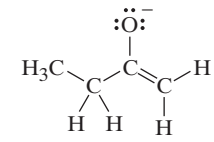

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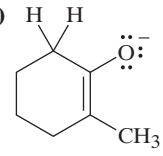
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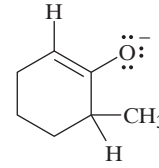
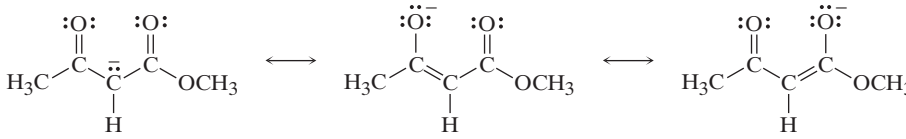


11.8.



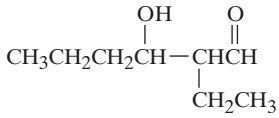
11.9. **(a)** CH_3CH_2Br **(b)** $C_6H_5CH_2Br$ **(c)** $(CH_3)_2CHCH_2CH_2Br$

11.10. **(a)** 1. $Na^+ {}^-OEt$; 2. $(CH_3)_2CHCH_2Br$; 3. H_3O^+
(b) 1. $Na^+ {}^-OEt$; 2. $CH_3CH_2CH_2Br$; 3. $Na^+ {}^-OEt$; 4. CH_3Br; 5. H_3O^+

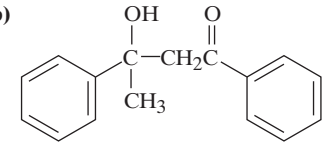
11.11. 1. $Na^+ {}^-OEt$; 2. $(CH_3)_2CHCH_2Br$; 3. $Na^+ {}^-OEt$; 4. CH_3Br; 5. H_3O^+

11.12. Solo (a) dà la condensazione aldolica.

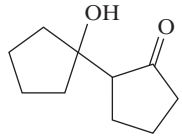
11.13. **(a)**



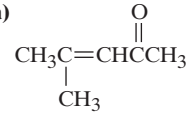
(b)



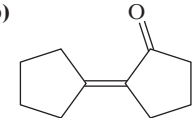
(c)



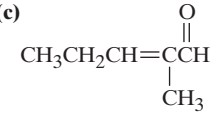
11.14. **(a)**



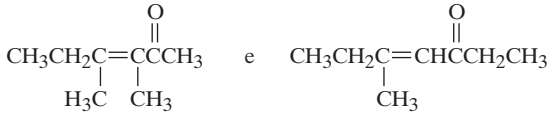
(b)



(c)

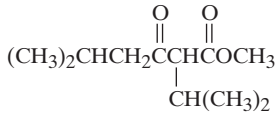


11.15.

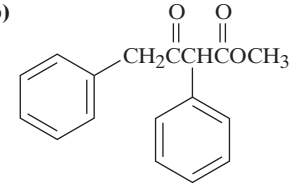


11.16. Solo (c) dà la condensazione di Claisen.

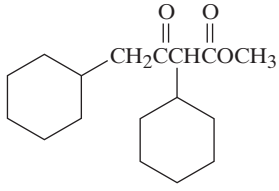
11.17. **(a)**



(b)



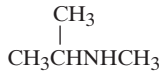
(c)



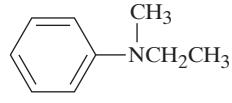
Capitolo 12

12.1. **(a)** Primaria **(b)** Secondaria **(c)** Terziaria

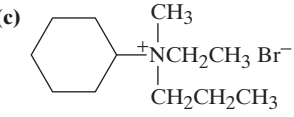
12.2. **(a)**



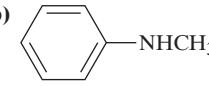
(b)

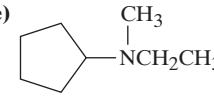


(c)



12.3. **(a)** Isopropilammina **(b)** Dietilammina
(c) *N*-metilpirrolo **(d)** *N*-Metil-*N*-etilcicloesilammina
(e) Diisopropilammina **(f)** Butan-1,3-diammina

12.4. **(a)** $(CH_3CH_2)_3N$ **(b)**  **(c)** $(CH_3CH_2)_4N^+\ Br^-$

(d)  **(e)** 

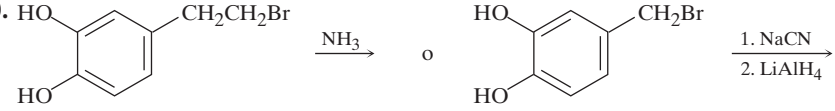
12.5. Bromuro di *N*-metilciclopentilammonio

12.6. **(a)** $CH_3CH_2NH_2$ **(b)** NaOH **(c)** CH_3NHCH_3 **(d)** $(CH_3)_3N$

12.7. **(a)** $CH_3CH_2CONH_2$ **(b)** $CH_3CH_2CONHCH_2CH_2CH_3$
(c) $PhCONH_2$

12.8. **(a)** $(CH_3)_2CHCH_2CN$ **(b)** PhCN

12.9. **(a)** 3 $CH_3CH_2Br + NH_3$ **(b)** 4 $CH_3Br + NH_3$

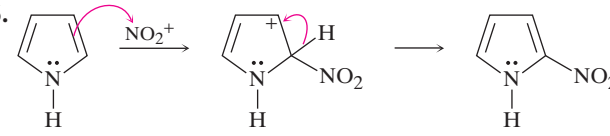
12.10. 

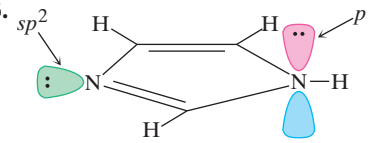
12.11. **(a)** $CH_3CH_2NH_2 + CH_3COCH_3$, o $(CH_3)_2CHNH_2 + CH_3CHO$
(b) $C_6H_5NH_2 + CH_3CHO$
(c) $C_5H_{11}NH_2 + CH_2O$, o CH_3NH_2 + ciclopentanone

12.12. $(CH_3)_2NH$ + *o*-metilbenzaldeide

12.13. **(a)** 1. CH_3Cl, $AlCl_3$; 2. $KMnO_4$, H_2O; 3. HNO_3, H_2SO_4; 4. H_2, catalizzatore Pt
(b) 1. HNO_3, H_2SO_4; 2. H_2, catalizzatore Pt; 3. 3 Br_2

12.14. **(a)** *N*-Metil-2-bromopirrolo **(b)** *N*-Metil-2-metilpirrolo
(c) *N*-Metil-2-acetilpirrolo

12.15. 

12.16. 

12.17. L'azoto di tipo piridinico, che reca il doppio legame, è più basico.

12.18. L'azoto della catena laterale è più basico dell'azoto dell'anello.

Capitolo 13

13.1. I_2

13.2. Acido butanoico

13.3. IR: $= 2{,}0 \times 10^{-19}$ J; raggi X: $= 6{,}6 \times 10^{-17}$ J

13.4. $\lambda = 9{,}0 \times 10^{-6}$ m ha energia più elevata.

13.5. **(a)** 0,16 m **(b)** 7,5 x 10^{-4} kJ/mol; molta meno energia della luce

13.6. **(a)** Chetone o aldeide **(b)** Nitro
(c) Nitrile o alchino **(d)** Acido carbossilico
(e) Alcol ed estere

13.7. **(a)** CH_3CH_2OH ha l'assorbimento dell'− OH
(b) L'es-1-ene ha l'assorbimento del doppio legame
(c) L'acido propanoico ha l'assorbimento molto allargato dell'− OH.

13.8. Nitrile: 2210-2260 cm^{-1}; chetone: 1690 cm^{-1}; doppio legame: 1640 cm^{-1}

13.9. 3×10^{-5} M

13.10. (a), (c), (d) e (f) hanno assorbimenti UV.

13.11. L'esa-1,3,5-triene assorbe a una lunghezza d'onda maggiore.

13.12. L'energia impiegata dalla spettroscopia NMR è minore di quella utilizzata nella spettroscopia IR.

13.13. **(a)** ^{1}H, 1; ^{13}C, 1 **(b)** ^{1}H, 1; ^{13}C, 1 **(c)** ^{1}H, 2; ^{13}C, 2
(d) ^{1}H, 1; ^{13}C, 1 **(e)** ^{1}H, 1; ^{13}C, 1 **(f)** ^{1}H, 1; ^{13}C, 1
(g) ^{1}H, 2; ^{13}C, 2 **(h)** ^{1}H, 2; ^{13}C, 2 **(i)** ^{1}H, 1; ^{13}C, 2

13.14. I protoni vinilici C−H non sono equivalenti.

13.15. ^{1}H, 5; ^{13}C, 7

13.16. **(a)** 210 Hz **(b)** 2,1 δ **(c)** 460 Hz

13.17. **(a)** 7,27 δ **(b)** 3,05 δ **(c)** 3,47 δ **(d)** 5,30 δ

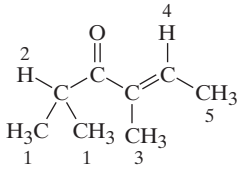
13.18. **(a)** 0,88 δ **(b)** 2,17 δ **(c)** 7,17 δ **(d)** 2,22 δ

13.19. Due picchi; rapporto 3:2

13.20. **(a)** $-CH_2Br_2$, quartetto; $-CH_3$, doppietto
(b) CH_3O-, singoletto; $-OCH_2-$, tripletto; $-CH_2Br$, tripletto
(c) $ClCH_2-$, tripletto; $-CH_2-$, quintetto
(d) CH_3-, tripletto; $-CH_2-$, quartetto; $-CH-$, settupletto; $(CH_3)_2$, doppietto
(e) CH_3-, tripletto; $-CH_2-$, quartetto; $-CH-$, settupletto; $(CH_3)_2$, doppietto
(f) =CH, tripletto; $-CH_2-$, doppietto; C−H aromatico, due multipletti

13.21. **(a)** CH_3OCH_3; **(b)** $CH_3CO_2CH_3$; **(c)** $(CH_3)_2CHCl$

13.22.



1 doppietto
2 settupletto
3 singoletto
4 quartetto
5 doppietto

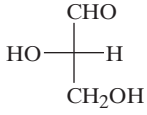
13.23. **(a)** 1 **(b)** 5 **(c)** 4 **(d)** 7 **(e)** 5 **(f)** 7

13.24. **(a)** Ept-1-ene
(b) 2-Metilpentano
(c) 1-Cloro-2-metilpropano

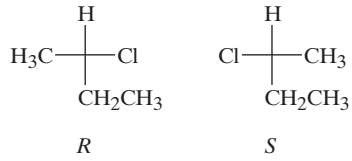
Capitolo 14

14.1. **(a)** Aldotetroso **(b)** Chetopentoso
(c) Chetoesoso **(d)** Aldopentoso

14.2.

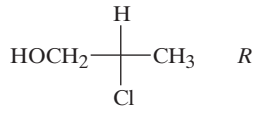


14.3.



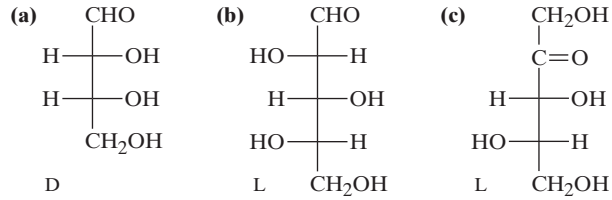
14.4. **(a)** *S* **(b)** *R* **(c)** *S*

14.5.

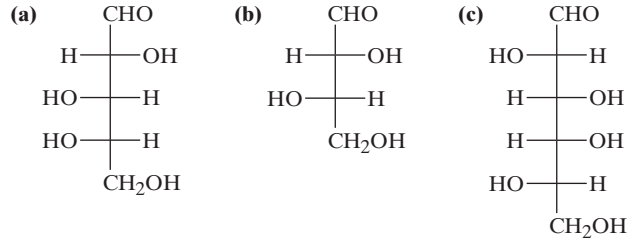


14.6. **(a)** L **(b)** D **(c)** D

14.7.

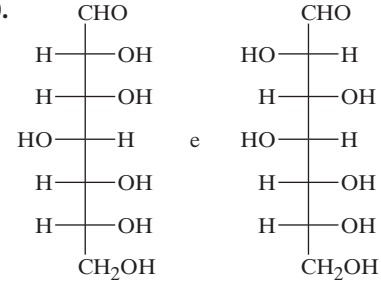


14.8.

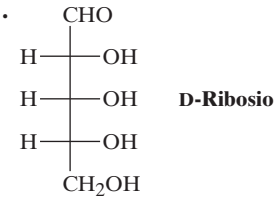


14.9. Ci sono 16 aldoeptosi D e 16 aldoeptosi L.

14.10.

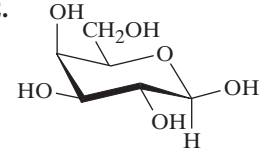


14.11.

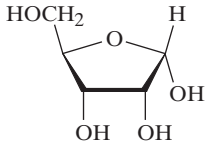


D-Ribosio

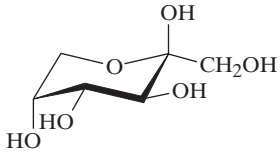
14.12.



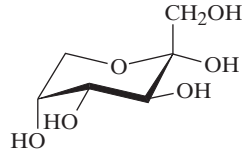
14.13.



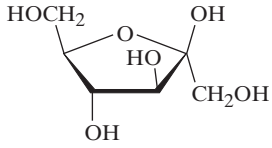
14.14.



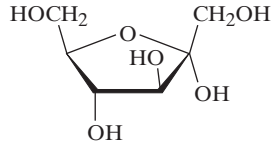
β-D-Fruttopiranosio



α-D-Fruttopiranosio

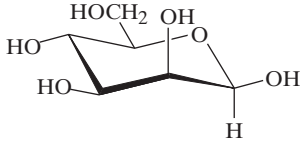


β-D-Fruttopiranosio

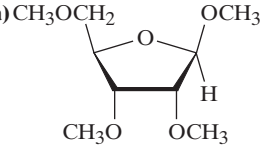


α-D-Fruttopiranosio

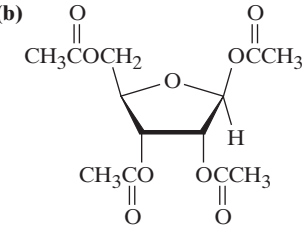
14.15. Uguale stabilità



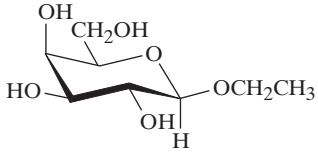
14.16. **(a)**



(b)



14.17.



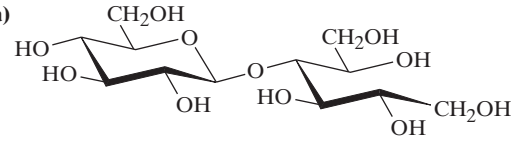
14.18. Il D-galattitolo è un composto meso.

14.19. Un alditolo reca un gruppo $-CH_2OH$ su entrambe le estremità; entrambe potrebbero essere state gruppi $-CHO$ nello zucchero di partenza.

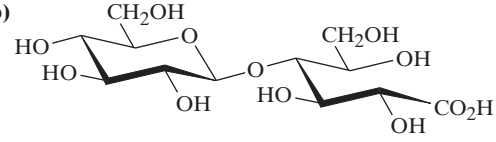
14.20. L'acido D-allarico è un composto meso; l'acido D-glucarico no.

14.21. Il D-allosio e il D-galattosio danno acidi aldarici meso; gli altri sei D-aldoesosi danno acidi aldarici otticamente attivi.

14.22. **(a)**



(b)

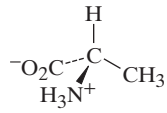


Capitolo 15

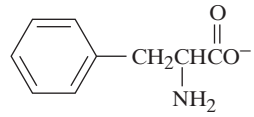
15.1. Anelli romatici: Phe, Tyr, Trp, His; contenenti zolfo: Cys, Met; alcoli: Ser, Trp; catene laterali idrocarburiche: Ala, Ile, Leu, Val.

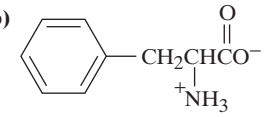
15.2. L'atomo di zolfo nel gruppo $-CH_2SH$ della cisteina conferisce alla catena laterale priorità più elevata di quella del gruppo $-CO_2H$.

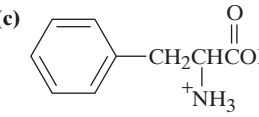
15.3.



15.4.

(a) 

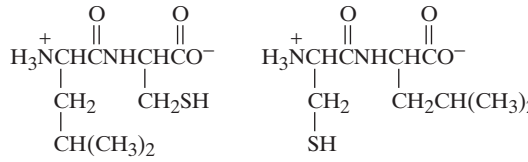
(b) 

(c) 

15.5. **(a)** Verso (+): Glu > Val; verso (–): nessuno
(b) Verso (+): Phe; verso (–): Gly
(c) Verso (+): Phe > Ser; verso (–): nessuno

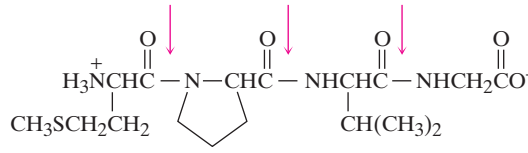
15.6. Netta positiva a pH = 5,3; netta negativa a pH = 7,3

15.7.

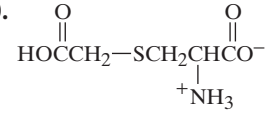


15.8. Val-Tyr-Gly (VYG), Tyr-Gly-Val (YGV), Gly-Val-Tyr (GVY), Val-Gly-Tyr (VGY), Tyr-Val-Gly (YVG), Gly-Tyr-Val (GYV)

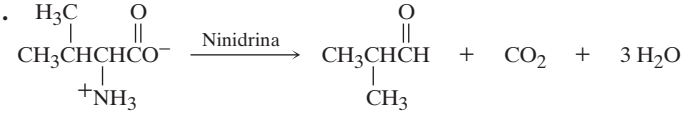
15.9.



15.10.



15.11.



15.12. Tripsina: Asp-Arg + Val-Tyr-Ile-His-Pro-Phe
Chimotripsina: Asp-Arg-Val-Tyr + Ile-His-Pro-Phe

15.13. Arg-Pro-Leu-Gly-Ile-Val

15.14. Metionina

15.15. (1) Proteggere il gruppo amminico della leucina.
(2) Proteggere il gruppo carbossilico dell'alanina.
(3) Accoppiare gli amminoacidi protetti con la DCC.
(4) Rimuovere il gruppo protettore della leucina.
(5) Rimuovere il gruppo protettore dell'alanina.

15.16. Questa è una tipica reazione di sostituzione nucleofila acilica, nella quale l'ammina dell'amminoacido è il nucleofilo e il carbonato di *terz*-butile è il gruppo uscente. Successivamente il carbonato di *terz*-butile perde CO_2 e forma il *terz*-butossido che viene protonato.

15.17. **(a)** Liasi **(b)** Idrolasi **(c)** Ossidoriduttasi

Capitolo 16

16.1. $CH_3(CH_2)_{18}CO_2CH_2(CH_2)_{30}CH_3$

16.2. Il distearato monoleato di glicerile ha punto di fusione più alto.

16.3. La molecola del grasso che ha l'acido stearico esterificato col gruppo −OH centrale del glicerolo non ha centri chirali ed è otticamente inattiva.

16.4. $[CH_3(CH_2)_7CH{=}CH(CH_2)_7CO_2^-]_2\ Mg^{2+}$

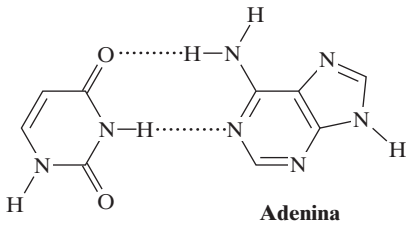
16.5. Monopalmitato dioleato di glicerile → glicerolo + 2 oleato di sodio + palmitato di sodio

16.6. Due chetoni, doppio legame

16.7. Entrambi hanno un anello aromatico.

16.10. (3') CCGATTAGGCA (5') o (5') ACGGATTAGCC (3')

16.11.



Uracile **Adenina**

16.12. (3') CUAAUGGCAU (5') o (5') UACGGUAAUC (3')

16.13. (3') AAGCGTCTCA (5') o (5') ACTCTGCGAA (3')

16.14. **(a)** GCU, GCC, GCA, GCG **(b)** UUU, UUC
(c) UUA, UUG, CUU, CUC, CUA, CUG **(d)** UAU, UAC

16.15. Leu-Met-Ala-Trp-Pro-Stop

16.16. (3') GAA-UAC-CGA-ACC-GGG-AUU (5')

16.17. (3') GAA-TAC-CGA-ACC-GGG-ATT (5')

Capitolo 17

17.1. $HOCH_2CH(OH)CH_2OH + ATP \rightarrow HOCH_2CH(OH)CH_2OPO_3^{2-} + ADP$

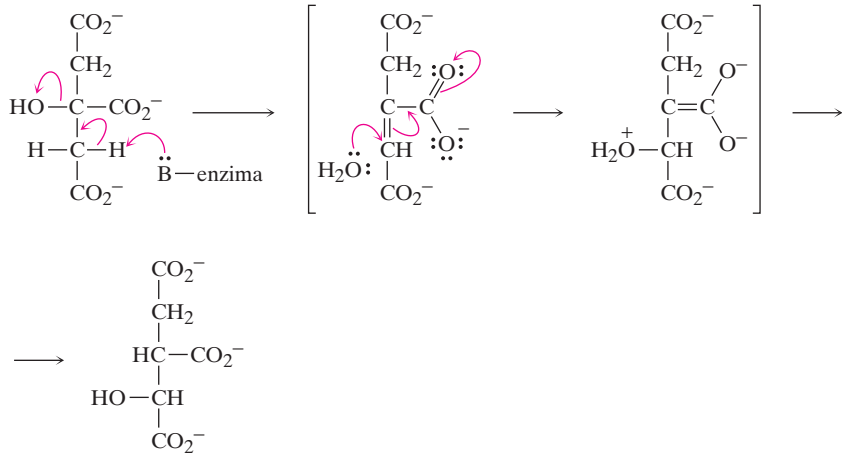
17.3. **(a)** 8 acetil CoA; 7 passaggi **(b)** 10 acetil CoA; 9 passaggi

17.4. Stadi 7 e 10

17.5. Stadio 1: sostituzione nucleofila acilica al fosforo
stadio 2: isomerizzazione per tautomerizzazione cheto-enolica
stadio 3: come lo stadio 1
stadio 4: retrocondensazione aldolica
stadio 5: come lo stadio 2
stadio 6: ossidazione
stadio 7: come lo stadio 2
stadio 8: isomerizzazione
stadio 9: reazione E1cB
stadio 10: sostituzione al fosforo, seguita da tautomerizzazione

17.6. Citrato e isocitrato

17.7.



17.8. $(CH_3)_2CHCH_2COCO_2^-$

17.9. Asparagina