Package title: Solomons Test Bank
Course Title: Solomons 11e
Chapter Number: 2

Question type: Multiple choice

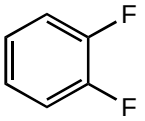
1) Which of the following compounds contains polar covalent bonds?

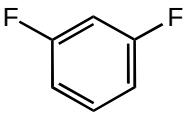
A) CS_2
B) LiF
C) F_2
D) CH_3F
E) None of these choices.

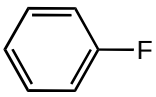
Answer: D

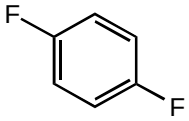
Topic: Polar Covalent Bonds
Section Reference 1: 2.2
Difficulty: Easy

2) Which molecule does not have a dipole moment?

A) 

B) 

C) 

D) 

E) None of these choices.

Answer: D

Topic: Molecular geometry, polarity
Section Reference 1: 2.3

Difficulty: Easy

3) Of the following solvents which one does ***not*** have a zero dipole moment?

A) Pentane
B) Cyclohexane
C) Diethyl ether
D) Cyclopentane
E) None of these choices.

Answer: C

Topic: Molecular geometry, polarity
Section Reference 1: 2.3
Difficulty: Easy

4) Which molecule has a zero dipole moment?

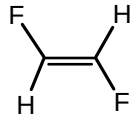
A) CH_3Cl
B) CH_2Cl_2
C) $CHCl_3$
D) CCl_4
E) None of these choices.

Answer: D

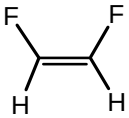
Topic: Molecular geometry, polarity
Section Reference 1: 2.3
Difficulty: Easy

5) Which molecule would you expect to have no dipole moment (i.e., $\mu = 0$ D) ?

A) CHF_3



B)
C) $:NF_3$

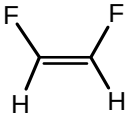
D) 

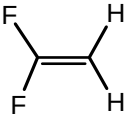
E) CH_2F_2

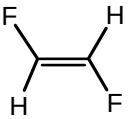
Answer: B

Topic: Molecular geometry, dipole moment
Section Reference 1: 2.3
Difficulty: Easy

6) Which molecule has a dipole moment greater than zero?

A) 

B) 

C) 

D) More than one of these choices.
E) None of these choices.

Answer: D

Topic: Molecular geometry, dipole moment
Section Reference 1: 2.3
Difficulty: Easy

7) Which of the following would have no net dipole moment (μ = 0 D) ?

A) CBr_4
B) cis-1,2-Dibromoethene
C) trans:-1,2-Dibromoethene
D) 1,1-Dibromoethene
E) More than one of these choices.

Answer: E

Topic: Molecular geometry, dipole moment

Section Reference 1: 2.3
Difficulty: Medium

8) For a molecule to possess a dipole moment, which following condition is necessary but not sufficient?

A) three or more atoms in the molecule
B) presence of one or more polar bonds
C) a non-linear structure
D) presence of oxygen or fluorine
E) absence of a carbon-carbon double or triple bond

Answer: B

Topic: Molecular geometry, polarity
Section Reference 1: 2.3
Difficulty: Medium

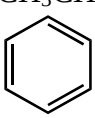
9) Which molecule has a zero dipole moment?

A) SO_2
B) CO_2
C) CO
D) $CHCl_3$
E) None of these choices.

Answer: B

Topic: Molecular geometry, polarity
Section Reference 1: 1.5 and 2.3
Difficulty: Easy

10) Which molecule has a zero dipole moment?

A) CO_2
B) CH_4
C) CH_3CH_3
D) 

E) All of these choices.

Answer: E

Topic: Molecular geometry, polarity
Section Reference 1: 1.5 and 2.3
Difficulty: Easy

11) Which molecule has a dipole moment of zero?

A) $CHCl_3$
B) CH_2Cl_2
C) $ClHC=CH_2$
D) trans-ClHC=CHCl
E) None of these choices.

Answer: D

Topic: Molecular geometry, polarity
Section Reference 1: 1.5 and 2.3
Difficulty: Medium

12) Which molecule would have a dipole moment greater than zero?

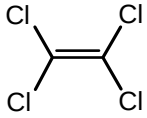
A) $BeCl_2$
B) BCl_3
C) CO_2
D) H_2O
E) CCl_4

Answer: D

Topic: Molecular geometry, polarity
Section Reference 1: 1.5 and 2.3
Difficulty: Medium

13) A non-zero dipole moment is exhibited by:

A) SO_2
B) CO_2

C) CCl_4
D) BF_3
E) 

Answer: A

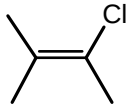
Topic: Molecular geometry, polarity
Section Reference 1: 1.5, 1.6 and 2.3
Difficulty: Medium

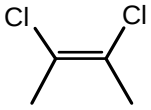
14) Of the following common organic solvents which one is predicted to have the smallest dipole moment?

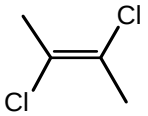
A) Chloroform, $CHCl_3$
B) Acetone, $(CH_3)_2CO$
C) Dimethylsulfoxide, $(CH_3)_2SO$
D) Acetonitrile, CH_3CN
E) Methanol, CH_3OH

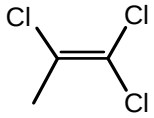
Answer: A

Topic: Molecular geometry, polarity
Section Reference 1: 1.5, 1.6, and 2.3
Difficulty: Hard

15) Which molecule(s) has/have dipole moment(s) equal to zero?
A) 

B) 

C) 

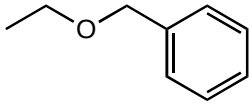
D) 

E) None of these choices have dipole moments equal to zero.

Answer: C

Topic: Molecular geometry, Polarity
Section Reference 1: 2.3
Difficulty: Easy

16) What alkyl groups make up the following ether?

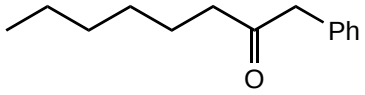


A) ethyl and phenyl
B) propyl and benzyl
C) ethyl and benzyl
D) propyl and phenyl
E) None of these choices.

Answer: C

Topic: Functional groups
Section Reference 1: 2.4
Difficulty: Easy

17) What alkyl groups make up the following ketone?



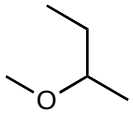
A) Phenyl, pentyl
B) Hexyl, phenyl
C) Benzyl, hexyl
D) Benzyl, heptyl
E) None of these choices.

Answer: C

Topic: Functional groups
Section Reference 1: 2.4

Difficulty: Medium

18) What alkyl groups make up the following ether?

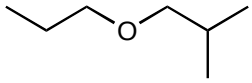


A) Isobutyl and methyl
B) Methyl and butyl
C) Ethyl and isopropyl
D) Methyl and *sec*-butyl
E) None of these choices.

Answer: D

Topic: Functional groups
Section Reference 1: 2.4
Difficulty: Easy

19) What alkyl groups make up the following ether?

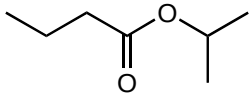


A) isobutyl and propyl
B) propyl and butyl
C) ethyl and isopropyl
D) propyl and *sec*-butyl
E) None of these choices.

Answer: A

Topic: Functional groups
Section Reference 1: 2.4
Difficulty: Easy

20) What alkyl group is attached to the oxygen in the following ester?

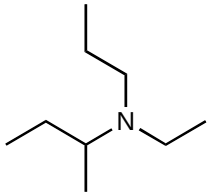


A) ethyl
B) propyl
C) *sec*-propyl
D) isopropyl
E) None of these choices.

Answer: D

Topic: Functional groups
Section Reference 1: 2.4
Difficulty: Easy

21) What alkyl groups make up the following 3^{o} amine?

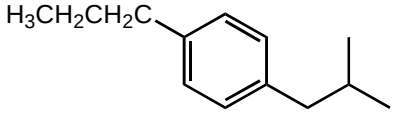


A) *sec*-butyl, ethyl, propyl
B) isobutyl, isopropyl, ethyl
C) *sec*-butyl, ethyl, isopropyl
D) butyl, ethyl, propyl
E) None of these choices.

Answer: A

Topic: Functional groups
Section Reference 1: 2.4
Difficulty: Easy

22) What alkyl groups are attached to the benzene ring in the following example?

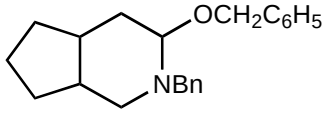


A) ethyl, butyl
B) ethyl, isobutyl
C) propyl, *sec*-butyl
D) propyl, butyl
E) None of these choices.

Answer: E

Topic: Functional groups
Section Reference 1: 2.4
Difficulty: Easy

23) What common group is attached to both the ether and 3^{o} amine in the following molecule?



A) benzyl
B) phenyl
C) heptyl
D) ethyl
E) None of these choices.

Answer: A

Topic: Functional groups
Section Reference 1: 2.4
Difficulty: Medium

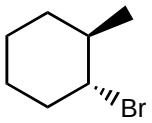
24) What group makes up the following aldehyde (benzaldehyde) ?
C_6H_5CHO

A) benzyl
B) phenyl
C) heptyl
D) ethyl
E) None of these choices.

Answer: B

Topic: Functional groups
Section Reference 1: 2.4
Difficulty: Medium

25) What functional group is present in the following compound?

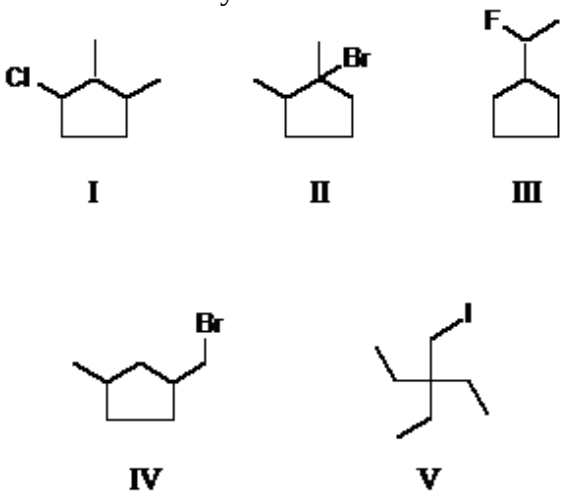


A) 1^{o} alkyl halide
B) 2^{o} alcohol
C) 2^{o} alkyl halide
D) 1^{o} amine
E) 3^{o} alkyl halide

Answer: C

Topic: Functional groups
Section Reference 1: 2.5
Difficulty: Easy

26) Which is a 3° alkyl halide?

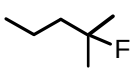


A) I
B) II
C) III
D) IV
E) V

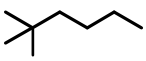
Answer: B

Topic: Functional Groups
Section Reference 1: 2.5
Difficulty: Easy

27) Which compound(s) contain(s) tertiary carbon atom(s) ?

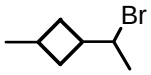


I

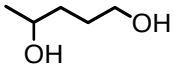


II

III



IV



V

A) I, II, III
B) I
C) II, III
D) I, IV
E) V

Answer: D

Topic: Functional groups
Section Reference 1: 2.5
Difficulty: Medium

28) Which of these compounds is a secondary alkyl chloride?

A) $CH_3CH_2CH_2CH_2CH_2Cl$

B) $CH_3\underset{\displaystyle Cl}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}CH_2CH_3$

C) $CH_3\underset{\displaystyle Cl}{\overset{}{\underset{|}{C}}}HCH_2CH_2CH_3$

D) $(CH_3)_2CHCHClCH_3$
E) Two of these choices.

Answer: E

Topic: Functional groups
Section Reference 1: 2.5
Difficulty: Medium

29) How many 2° alkyl bromides, neglecting stereoisomers, exist with the formula $C_6H_{13}Br$?

A) 4
B) 5
C) 6
D) 7
E) 8

Answer: C

Topic: Functional groups, Isomerism
Section Reference 1: 1.3 and 2.5
Difficulty: Medium

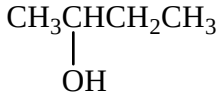
30) The number of unique open-chain structures corresponding to the molecular formula C_3H_5Cl is:

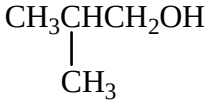
A) 2
B) 3
C) 4
D) 5
E) 6

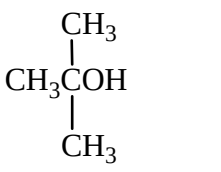
Answer: C

Topic: Isomers
Section Reference 1: 1.3 and 2.5
Difficulty: Medium

31) Which compound listed below is a secondary alcohol?

A) 

B) 

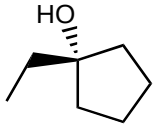
C) 

D) $CH_3CH_2CH_2CH_2OH$
E) $CH_3CH_2CH_2OCH_3$

Answer: A

Topic: Functional groups
Section Reference 1: 2.6
Difficulty: Easy

32) What functional group is present in the following compound?

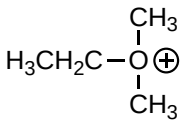


A) 1^{o} alcohol
B) ether
C) 2^{o} alcohol
D) ester
E) 3^{o} alcohol

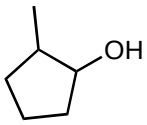
Answer: E

Topic: Functional groups
Section Reference 1: 2.6
Difficulty: Easy

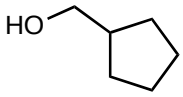
33) Which compound is a tertiary alcohol?



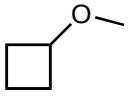
I



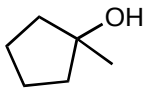
II



III



IV



V

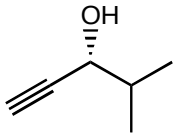
A) I
B) II
C) III
D) IV

E) V

Answer: E

Topic: Functional groups
Section Reference 1: 2.6
Difficulty: Medium

34) What functional group(s) is/are present in the following compound?

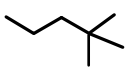


A) alkyne and 2^o alcohol
B) alkyne and 1^o alcohol
C) 2^o alcohol and alkene
D) nitrile and 1^o alcohol
E) alkene and 2^o alcohol

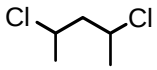
Answer: A

Topic: Functional groups
Section Reference 1: 2.1 and 2.6
Difficulty: Easy

35) A tertiary carbon atom is present in which of these compounds?

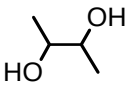


I

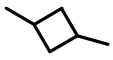


II

III



IV



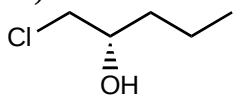
V

A) I
B) II, IV
C) III, V
D) IV
E) All of these choices.

Answer: C

Topic: Functional groups
Section Reference 1: 2.5 and 2.6
Difficulty: Easy

36) What functional group(s) is/are present in the following compound?



A) 1^o alcohol and 2^o alkyl chloride
B) ether and 2^o alcohol
C) 1^o alkyl chloride and 1^o alcohol
D) 1^o alkyl chloride and 2^o alcohol
E) None of these choices.

Answer: D

Topic: Functional groups
Section Reference 1: 2.5 and 2.6
Difficulty: Easy

37) How many constitutional isomers are possible with the formula $C_4H_{10}O$?

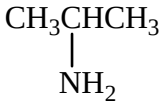
A) 3
B) 4
C) 5
D) 6
E) 7

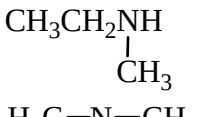
Answer: E

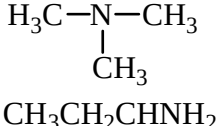
Topic: Functional groups, Isomerism
Section Reference 1: 1.3, 2.6, and 2.7
Difficulty: Easy

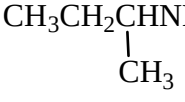
38) Which compound is a secondary amine?

A) $CH_3CH_2CH_2NH_2$

B) 

C) 

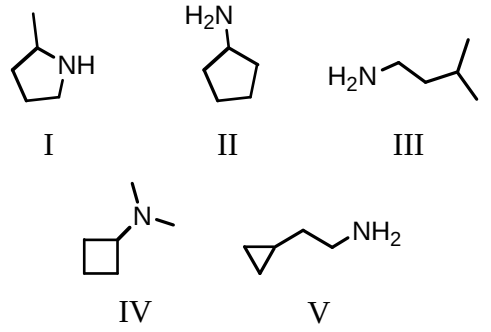
D) 

E) 

Answer: C

Topic: Functional groups
Section Reference 1: 2.8
Difficulty: Easy

39) Which compound is a primary amine with the formula $C_5H_{13}N$?



I II III

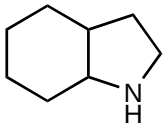
IV V

A) I
B) II
C) III
D) IV
E) V

Answer: C

Topic: Functional groups
Section Reference 1: 2.8
Difficulty: Easy

40) What functional group is present in the following compound?

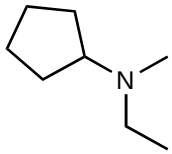


A) 1^{o} alkyl bromide
B) 2^{o} amine
C) nitrile
D) 1^{o} amine
E) 3^{o} amine

Answer: B

Topic: Functional groups
Section Reference 1: 2.8
Difficulty: Easy

41) What functional group is present in the following compound?

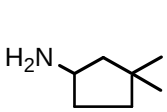


A) 1^{o} alkyl bromide
B) 2^{o} amine
C) nitrile
D) 1^{o} amine
E) 3^{o} amine

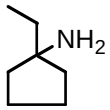
Answer: E

Topic: Functional groups
Section Reference 1: 2.8
Difficulty: Easy

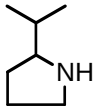
42) Which is a 3° amine?



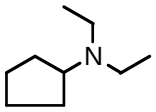
I



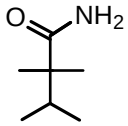
II



III



IV



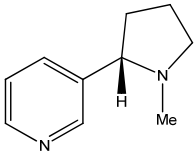
V

A) I
B) II
C) III
D) IV
E) V

Answer: D

Topic: Functional groups
Section Reference 1: 2.8
Difficulty: Easy

43) What functional groups are present in nicotine, an addictive substance found in tobacco?

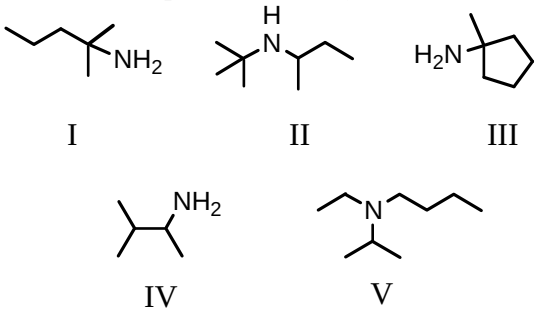


A) two tertiary amines
B) two secondary amines
C) phenyl ring and tertiary amine
D) secondary and tertiary anime
E) none of these choices

Answer: A

Topic: Functional groups
Section Reference 1: 2.8
Difficulty: Easy

44) An example of a tertiary amine is:



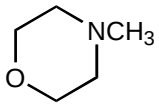
I II III IV V

A) I
B) II
C) III
D) IV
E) V

Answer: E

Topic: Functional groups
Section Reference 1: 2.8
Difficulty: Easy

45) What functional group(s) is/are present in the following compound?

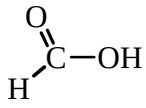


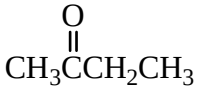
A) ether and 2^{o} amine
B) ester and 3^{o} amine
C) 3^{o} amine
D) 3^{o} amine and ether
E) None of these choices.

Answer: D

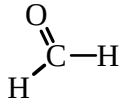
Topic: Functional groups
Section Reference 1: 2.7 and 2.8
Difficulty: Easy

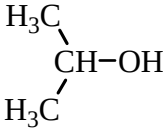
46) Which compound is a ketone?

A) 

B) 

C) 

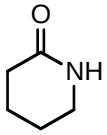
D) 

E) 

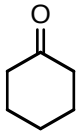
Answer: B

Topic: Functional groups
Section Reference 1: 2.9
Difficulty: Easy

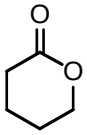
47) Which compound is an aldehyde?



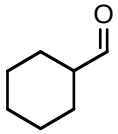
I



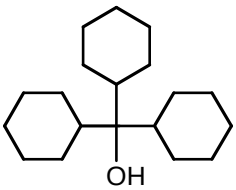
II



III



IV



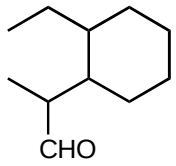
V

A) I
B) II
C) III
D) IV
E) V

Answer: D

Topic: Functional groups
Section Reference 1: 2.9
Difficulty: Easy

48) What functional group is present in the following compound?

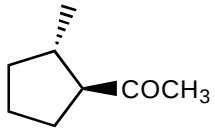


A) alcohol
B) ketone
C) aldehyde
D) ester
E) ether

Answer: C

Topic: Functional groups
Section Reference 1: 2.9
Difficulty: Medium

49) What functional group is present in the following compound?

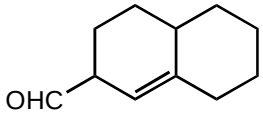


A) alcohol
B) ketone
C) aldehyde
D) ester
E) ether

Answer: B

Topic: Functional groups
Section Reference 1: 2.9
Difficulty: Medium

50) What functional group(s) is/are present in the following compound?

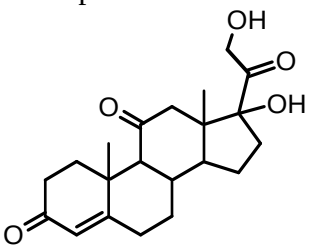


A) Ketone and alkene
B) Ketone and alkyne
C) Aldehyde and alkene
D) Aldehyde and alkyne
E) 1^{o} alcohol and alkene

Answer: C

Topic: Functional groups
Section Reference 1: 2.1 and 2.9
Difficulty: Medium

51) The compound below is an adrenocortical hormone called cortisone. Which functional group is *not* present in cortisone?

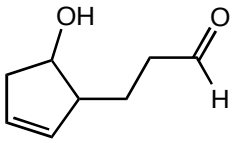


A) 1° alcohol
B) Ketone
C) 3° alcohol
D) Carboxylic acid
E) Alkene

Answer: D

Topic: Functional groups
Section Reference 1: 2.1, 2.6, and 2.9
Difficulty: Easy

52) Which functional groups are present in the following compound?

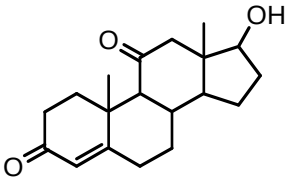


A) Alkene, 1º alcohol, ketone
B) Alkene, 2º alcohol, aldehyde
C) Alkene, 2º alcohol, ketone
D) Alkyne, 1º alcohol, aldehyde
E) Alkyne, 2º alcohol, ketone

Answer: B

Topic: Functional groups
Section Reference 1: 2.1, 2.6, and 2.9
Difficulty: Easy

53) The compound shown below is the male sex hormone, testosterone.



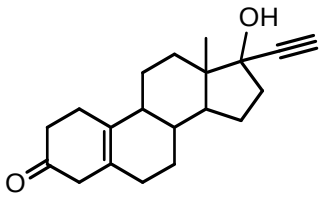
In addition to a cycloalkane skeleton, testosterone also contains the following functional groups:

A) Alkene, ester, tertiary alcohol
B) Alkene, ether, secondary alcohol
C) Alkene, ketone, secondary alcohol
D) Alkyne, ketone, secondary alcohol
E) Alkene, ketone, tertiary alcohol

Answer: C

Topic: Functional groups
Section Reference 1: 2.1, 2.6, and 2.9
Difficulty: Easy

54) The compound shown below is a synthetic estrogen. It is marketed as an oral contraceptive under the name Enovid.



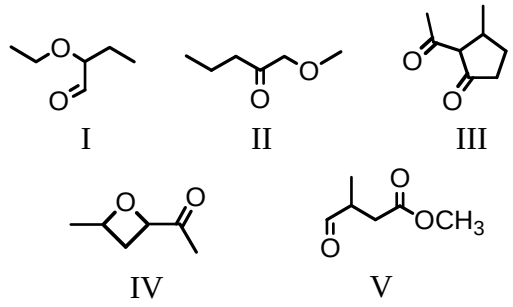
In addition to an alkane (actually cycloalkanE) skeleton, the Enovid molecule also contains the following functional groups:

A) Ether, alcohol, alkyne
B) Aldehyde, alkene, alkyne, alcohol
C) Alcohol, carboxylic acid, alkene, alkyne
D) Ketone, alkene, alcohol, alkyne
E) Amine, alkene, ether, alkyne

Answer: D

Topic: Functional groups
Section Reference 1: 2.1, 2.6, and 2.9
Difficulty: Medium

55) Many organic compounds contain more than one functional group. Which of the following is/are both an aldehyde and an ether?

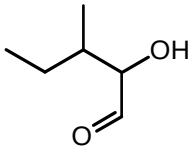


A) I
B) II, IV
C) V
D) I, V
E) III

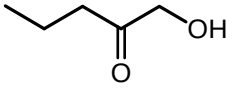
Answer: A

Topic: Functional Groups
Section Reference 1: 2.7 and 2.9
Difficulty: Easy

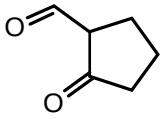
56) Which is a carboxylic acid?



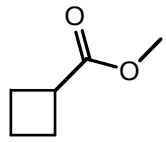
I



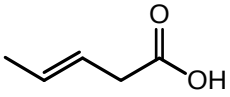
II



III



IV



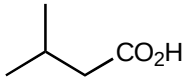
V

A) I
B) II
C) III
D) IV
E) V

Answer: E

Topic: Functional groups
Section Reference 1: 2.10
Difficulty: Easy

57) What functional group(s) is/are present in the following compound?

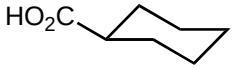


A) 1^{o} alcohol and ketone
B) carboxylic acid
C) ester
D) 1^{o} alcohol and aldehyde
E) alcohol

Answer: B

Topic: Functional groups
Section Reference 1: 2.10
Difficulty: Medium

58) What functional group(s) is/are present in the following compound?

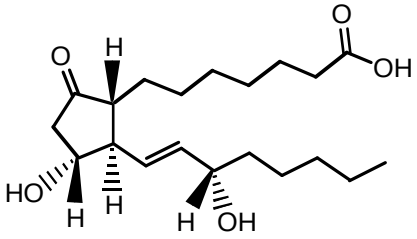


A) 1° alcohol and ketone
B) ester
C) carboxylic acid
D) 1° alcohol and aldehyde
E) alcohol

Answer: C

Topic: Functional groups
Section Reference 1: 2.10
Difficulty: Medium

59) Which functional group is *not* contained in prostaglandin E_1?



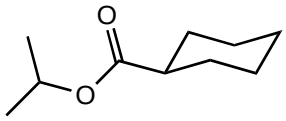
Prostaglandin E_1

A) Ketone
B) 2° alcohol
C) 3° alcohol
D) Carboxylic acid
E) Alkene

Answer: C

Topic: Functional groups
Section Reference 1: 2.1, 2.6, 2.9, and 2.10
Difficulty: Medium

60) What functional group(s) is/are present in the following compound?

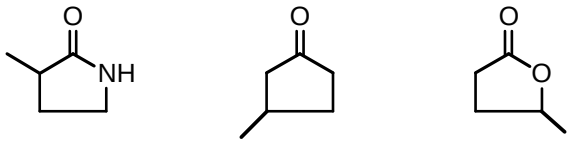


A) ether and ketone
B) carbonyl and ether
C) carboxylic acid and ether
D) ester
E) 1^{o} alcohol

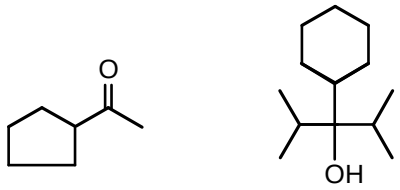
Answer: D

Topic: Functional groups
Section Reference 1: 2.10
Difficulty: Easy

61) Which compound is an ester?



I II III



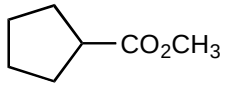
IV V

A) I
B) II
C) III
D) IV
E) V

Answer: C

Topic: Functional groups
Section Reference 1: 2.10
Difficulty: Easy

62) What functional group is present in the following compound?

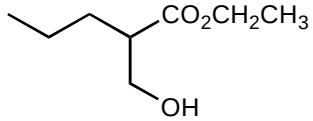


A) alcohol
B) ketone
C) aldehyde
D) ester
E) ether

Answer: D

Topic: Functional groups
Section Reference 1: 2.10
Difficulty: Medium

63) What functional group(s) is/are present in the following compound?

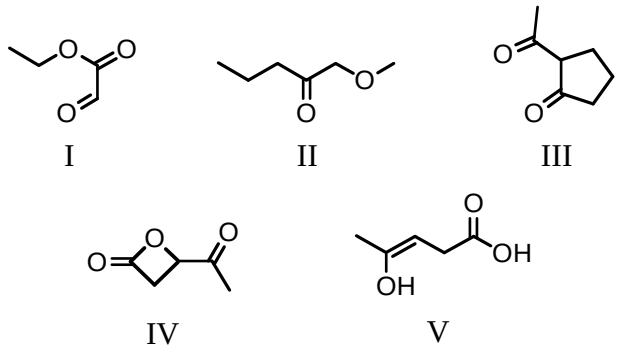


A) Ketone and 1^o alcohol
B) Ether and alcohol
C) Ester and ether
D) Ester and 1^o alcohol
E) 1^o alcohol and aldehyde

Answer: D

Topic: Functional groups
Section Reference 1: 2.6 and 2.10
Difficulty: Medium

64) Which compound can be classified as an ester as well as a ketone?



I II III

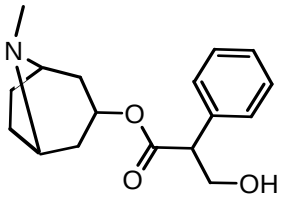
IV V

A) I
B) II
C) III
D) IV
E) V

Answer: D

Topic: Functional groups
Section Reference 1: 2.9 and 2.10
Difficulty: Medium

65) Drawn below is *Atropine*, found in *Atropa belladonna*, sometimes used in dilating pupils during an eye-exam. Which of the following functional groups is NOT in atropine?



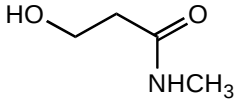
Atropine

A) Amine
B) Ester
C) Alcohol
D) Benzene Ring
E) Ketone

Answer: E

Topic: Functional groups
Section Reference 1: 2.1, 2.6, 2.8, and 2.10
Difficulty: Hard

66) What functional group(s) is/are present in the following compound?

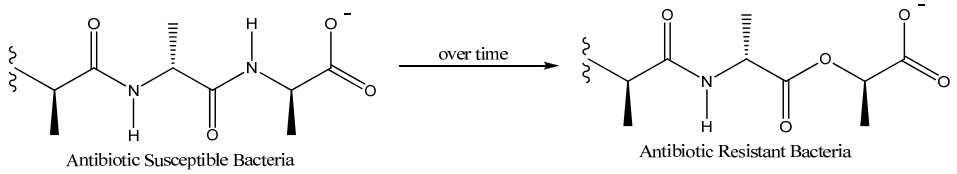


A) 1° alcohol and 2° amine
B) amide and 2° alcohol
C) nitrile and 1° alcohol
D) 2° amide and ether
E) None of these choices.

Answer: E

Topic: Functional groups
Section Reference 1: 2.6 and 2.10
Difficulty: Medium

67) Many bacterial cells will contain functional groups that are susceptible to antibiotic drugs, but may, over time, change their functional groups to become resistant to these drugs. What functional group change is occurring in the transition shown below?



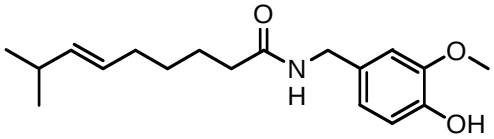
A) Amine to ether
B) Amine to ester
C) Amide to ester
D) Amide to ether
E) None of these choices.

Answer: C

Topic: Functional Groups
Section Reference 1: 2.10
Difficulty: Medium

68) The compound shown below is a substance called *Capsaicin*, found in varying

concentrations in several varieties of hot peppers, and responsible for their respective degrees of "heat." Which functional groups *are* present in the molecule of capsaicin?



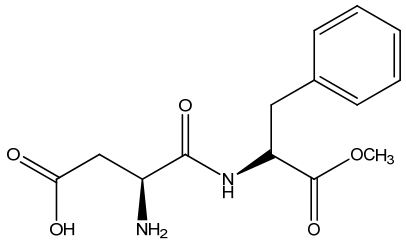
Capsaicin

A) Alkene, ketone, amine, alcohol, ester
B) Alkene, ketone, alcohol, ether
C) Alkene, amine, phenol, ether
D) Ether, phenol, alkene, amide
E) Ester, phenol, alkene, amide

Answer: D

Topic: Functional groups
Section Reference 1: 2.1, 2.6, 2.7, and 2.10
Difficulty: Medium

69) The compound aspartame is a dipeptide that is often used as a sugar substitute. Which functional groups are present in aspartame?

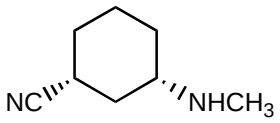


A) carboxylic acid, secondary amine, ketone, ester
B) alcohol, secondary amine, ketone, ester
C) carboxylic acid, ester, amide, secondary amine
D) ester, amide, secondary amine, ketone, carboxylic acid
e) none of these choices

Answer: D

Topic: Functional groups
Section Reference 1: 2.1, 2.6, 2.7, and 2.10
Difficulty: Medium

70) What functional group(s) is/are present in the following compound?



A) 1° amine and 2° amine
B) amide and 2° amine
C) 2° amine and nitrile
D) nitrile and 1° amine
E) amide and nitrile

Answer: C

Topic: Functional groups
Section Reference 1: 2.8 and 2.11
Difficulty: Medium

71) The strongest of attractive forces is which type?

A) Dispersion forces
B) Ion-dipole
C) Dipole-dipole
D) Cation-anion
E) Hydrogen bonds

Answer: D

Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Easy

72) Which of these is the weakest of the intermolecular attractive forces taken individually?

A) Ion-ion
B) Dispersion forces
C) Dipole-dipole
D) Covalent bonding
E) Hydrogen bonding

Answer: B

Topic: Intermolecular forces
Section Reference 1: 2.13

Difficulty: Easy

73) Which compound would you expect to have the highest melting point?

A) n-Butyl alcohol
B) Isobutyl alcohol
C) sec-Butyl alcohol
D) tert-Butyl alcohol
E) Diethyl ether

Answer: D

Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Medium

74) Which of the following is not found in the following substance?
$CH_3CH_2CH_2CH_2CH_2OH$

A) Ion-ion
B) Dispersion forces
C) Dipole-dipole
D) Covalent bonding
E) Hydrogen bonding

Answer: A

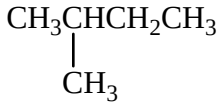
Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Medium

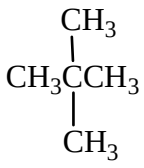
75) Which alkane is predicted to have the highest melting point of those shown?

A) $CH_3CH_2CH_2CH_3$

B) CH_3CHCH_3 with a CH_3 branch

C) $CH_3CH_2CH_2CH_2CH_3$

D) 

E) 

Answer: E

Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Medium

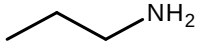
76) What intermolecular forces hold base pairs together in DNA?

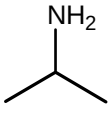
A) Ion-ion
B) Dipole-dipole
C) Hydrogen bonds
D) Dispersion forces
E) Covalent bonds

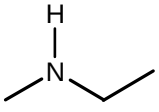
Answer: C

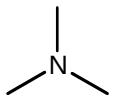
Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Easy

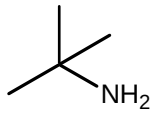
77) Which compound would you expect to have the lowest boiling point?

A) 

B) 

C) 

D) 

E) 

Answer: D

Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Easy

78) Which of these compounds would have the highest boiling point?

A) $CH_3OCH_2CH_2CH_2OCH_3$
B) $CH_3CH_2OCH_2CH_2OCH_3$
C) $CH_3CH_2OCH_2OCH_2CH_3$
D) $CH_3OCH_2CHOCH_3$ with CH_3 branch
E) $HOCH_2CH_2CH_2CH_2CH_2OH$

Answer: E

Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Easy

79) Which compound would have the highest boiling point?

A) $CH_3CH_2CH_2CH_2CH_2CH_3$
B) $CH_3CH_2OCH_2CH_2CH_3$
C) $CH_3CH_2CH_2CH_2CH_2OH$
D) $CH_3CH_2OCH(CH_3)_2$
E) $CH_3OCH_2CH_2CH_2CH_3$

Answer: C

Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Easy

80) Of the following compounds, the one with the highest boiling point is:

A) CH_3CH_3
B) CH_3CH_2Cl
C) $CH_3C(=O)H$
D) CH_3CH_2OH
E) $CH_3CH_2OCH_2CH_3$

Answer: D

Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Easy

81) Which compound would you expect to have the highest boiling point?

A) ethane
B) ethene
C) ethyne
D) bromoethane
E) methane

Answer: D

Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Medium

82) Which compound would you expect to have the highest boiling point?

A) ethyl alcohol
B) ethyl amine
C) chloroethane
D) water
E) ethane

Answer: D

Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Medium

83) Which of these would you expect to have the lowest boiling point?

A) $CH_3CH_2CH_2OH$

B) $CH_3\underset{\displaystyle OH}{\underset{|}{C}}HCH_3$

C) $CH_3OCH_2CH_3$

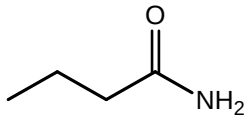
D) $CH_3CH_2CH_2CH_2OH$

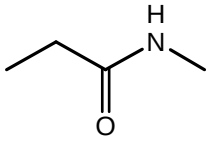
E) $CH_3CH_2OCH_2CH_3$

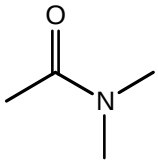
Answer: C

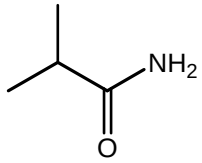
Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Medium

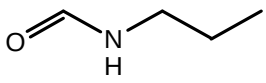
84) Which compound would you expect to have the lowest boiling point?

A) 

B) 

C) 

D) 

E) 

Answer: C

Topic: Intermolecular forces

Section Reference 1: 2.13
Difficulty: Medium

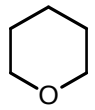
85) Which compound would you expect to have the highest boiling point?

A) $CH_3OCH_2CH_2OCH_3$
B) $CH_3OCH_2OCH_2CH_3$
C) $HOCH_2CH_2CH_2CH_2OH$
D) $CH_3OCH_2CH_2CH_2OH$
E) $(CH_3O)_2CHCH_3$

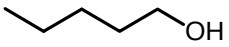
Answer: C

Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Medium

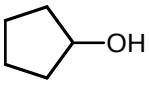
86) Which compound would have the lowest boiling point?



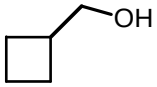
I



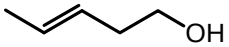
II



III



IV



V

A) I
B) II
C) III
D) IV
E) V

Answer: A

Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Medium

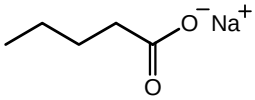
87) The solid alkane $CH_3(CH_2)_{18}CH_3$ is expected to exhibit the greatest solubility in which of the following solvents?

A) CCl_4
B) CH_3OH
C) H_2O
D) CH_3NH_2
E) $HOCH_2CH_2OH$

Answer: A

Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Easy

88) The following substance is expected to have the lowest solubility in which of the following solvent(s) ?



A) CCl_4
B) C_2H_5OH
C) $CHCl_3$
D) $CH_2OHCH_2CH_2CH_2CH_2CH_2OH$
E) The given substance is likely to be quite soluble in all of the solvents described.

Answer: A

Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Easy

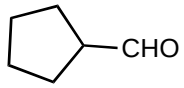
89) The compound NaOH is barely soluble in ethanol. The addition of which of the following solvents to ethanol would greatly increase its solubility of NaOH?

A) H_2O
B) Et_2O
C) CH_2Cl_2
D) Benzene
E) All of these choices.

Answer: A

Topic: Intermolecular forces
Section Reference 1: 2.13
Difficulty: Easy

90) For the functional group(s) on the following molecule what characteristic IR absorption(s) would be expected (ignoring C-H absorptions) ?

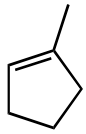


A) a peak around 1700 cm^{-1}
B) a peak around 3300 cm^{-1}
C) only normal alkane absorptions
D) a peak around 2250 cm^{-1}
E) None of these choices.

Answer: A

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Easy

91) For the functional group(s) on the following molecule what characteristic IR absorption(s) would be expected (ignoring C-H absorptions) ?



A) a peak around 1700 cm^{-1}
B) a peak around 3300 cm^{-1}
C) a peak around 1650 cm^{-1}
D) a peak around 2250 cm^{-1}
E) None of these choices.

Answer: C

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Easy

92) The IR spectrum of which type of compound will not show evidence of hydrogen bonding?

A) Aldehyde
B) Alcohol
C) Carboxylic acid
D) Phenol
E) Primary amine

Answer: A

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Easy

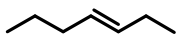
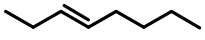
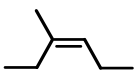
93) The IR spectrum of which type of compound generally exhibits evidence of hydrogen bonding?

A) Aldehyde
B) Carboxylic acid
C) Alkene
D) Ester
E) Ketone

Answer: B

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Easy

94) IR evidence for the presence of the C=C would be most difficult to detect in the case of which of these alkenes?

A) 
B) 
C) 
D) 

E) 

Answer: D

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Easy

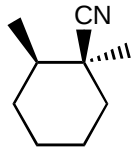
95) An oxygen-containing compound shows strong IR absorption at 1630-1780 cm^{-1} and 3200-3550 cm^{-1}. What type of compound is it likely to be?

A) an alcohol
B) a carboxylic acid
C) an ether
D) a ketone
E) an aldehyde

Answer: B

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Medium

96) For the functional group(s) on the following molecule what characteristic IR absorption(s) would be expected (ignoring C-H absorptions) ?

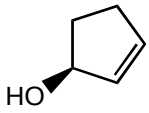


A) a peak around 1700 cm^{-1}
B) a peak around 3300 cm^{-1}
C) a peak around 1650 cm^{-1}
D) a peak around 2250 cm^{-1}
E) None of these choices.

Answer: D

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Medium

97) For the functional group(s) on the following molecule, what characteristic IR absorption(s) would be expected (ignoring C-H absorptions) ?

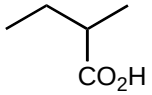


A) peaks around 1700 and 1650 cm^{-1}
B) peaks around 3300 and 1710 cm^{-1}
C) peaks around 1650 and 3300 cm^{-1}
D) only a peak around 3300 cm^{-1}
E) None of these choices.

Answer: C

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Medium

98) For the functional group(s) on the following molecule, what characteristic IR absorption(s) would be expected (ignoring C-H absorptions) ?

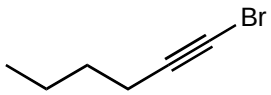


A) peaks around 1700 and 1650 cm^{-1}
B) a strong broad peak over 3600 to 2500 and around 1710 cm^{-1}
C) peaks around 1650 and 3300 cm^{-1}
D) peaks around 3300 and 1710 cm^{-1}
E) None of these choices.

Answer: B

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Medium

99) For the functional group(s) on the following molecule, what characteristic IR absorption(s) would be expected (ignoring C-H absorptions) ?

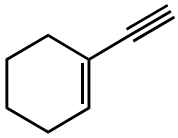


A) peaks around 1710 and 1650 cm^{-1}
B) a strong broad peak over 3600 to 2500 cm^{-1}
C) peaks around 1650 and 3300 cm^{-1}
D) a peak around 1710 cm^{-1}
E) None of these choices.

Answer: E

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Medium

100) For the functional group(s) on the following molecule, what characteristic IR absorption(s) would be expected (ignoring C-H absorptions) ?



A) peaks around 3300, 2150, and 1650 cm^{-1}
B) peaks around 1710 and 1650 cm^{-1}
C) peaks around 1650 and 3300 cm^{-1}
D) a peak around 2250 and 3300 cm^{-1}
E) None of these choices.

Answer: A

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Medium

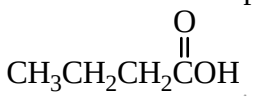
101) The absorption band for the O-H stretch in the IR spectrum of an alcohol is sharp and narrow in the case of

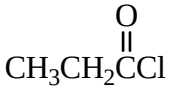
A) a Nujol mull of the alcohol.
B) a concentrated solution of the alcohol.
C) a gas phase spectrum of the alcohol.
D) the spectrum of the neat liquid.
E) None of these choices.

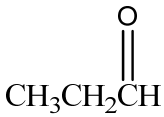
Answer: C

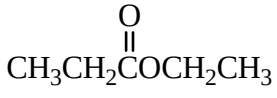
Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Medium

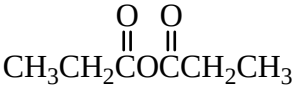
102) A split peak for the IR absorption due to bond stretching is observed for the carbonyl group in which of these compounds?

A) 

B) 

C) 

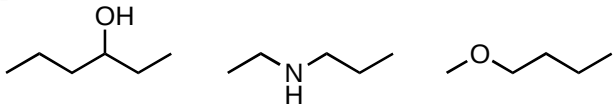
D) 

E) 

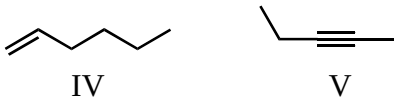
Answer: E

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Medium

103) The IR spectrum of which of the following substances is likely to show a small, but sharp peak at 2200 cm^{-1}?



I II III



IV V

A) I
B) II

C) III
D) IV
E) V

Answer: E

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Medium

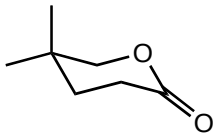
104) An anticipated IR absorption band may not be observed because

A) it occurs outside the range of the instrument used.
B) no change occurs in the dipole moment during the vibration.
C) the absorption band is eclipsed by another.
D) the intensity is so weak that it cannot be differentiated from instrument noise.
E) All of these choices.

Answer: E

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Medium

105) For the functional group(s) on the following molecule what characteristic IR absorption(s) would be expected (ignoring C-H absorptions) ?

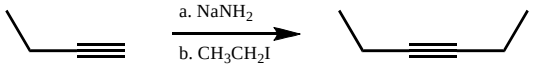


A) peaks around 1740 and 1650 cm^{-1}
B) a strong broad peak over 3600 to 2500 cm^{-1}
C) peaks around 1650 and 3300 cm^{-1}
D) a peak around 1740 cm^{-1}
E) None of these choices.

Answer: D

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

106) For the following reaction sequence (it is not necessary to understand the chemistry) what significant change(s) would be expected by IR (ignoring C-H absorptions) ?

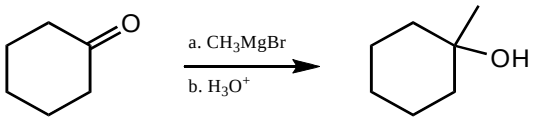


A) A peak around 1710 cm^{-1} would disappear.
B) A peak around 1710 cm^{-1} would appear.
C) A peak around 2150 cm^{-1} would disappear.
D) No change would be observed.
E) None of these choices.

Answer: C

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

107) For the following reaction sequence (it is not necessary to understand the chemistry) what significant change(s) would be expected by IR (ignoring C-H absorptions) ?

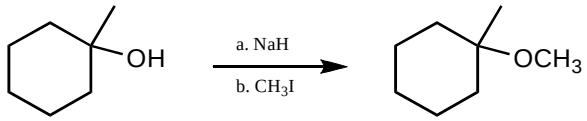


A) A peak around 1710 cm^{-1} would disappear and a new peak around 3300-3500 cm^{-1} would appear.
B) A peak around 1710 cm^{-1} would appear and a new peak around 1650 cm^{-1} would disappear.
C) A peak around 2150 cm^{-1} would disappear and a new peak around 3300-3500 cm^{-1} would appear.
D) No change would be observed.
E) None of these choices.

Answer: A

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

108) For the following reaction sequence (it is not necessary to understand the chemistry) what significant change(s) would be expected by IR (ignoring C-H absorptions) ?

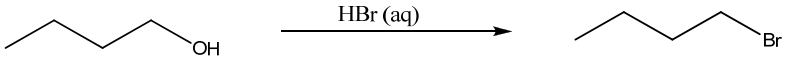


A) A peak around 3300 cm^{-1} would disappear.
B) A peak around 1710 cm^{-1} would appear and a new peak around 3300 cm^{-1} would disappear.
C) A peak around 2150 cm^{-1} would disappear and a new peak around 3300 cm^{-1} would appear.
D) No change would be observed.
E) None of these choices.

Answer: A

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

109) For the following reaction sequence (it is not necessary to understand the chemistry) what significant change(s) would be expected by IR (ignoring C-H absorptions) ?

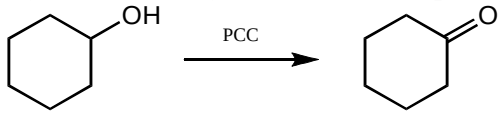


A) A peak around 3300 cm^{-1} would disappear.
B) A peak around 1710 cm^{-1} would appear and a new peak around 3300 cm^{-1} would disappear.
C) A peak around 2150 cm^{-1} would disappear and a new peak around 3300 cm^{-1} would appear.
D) No change would be observed.
E) None of these choices.

Answer: A

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

110) For the following reaction sequence (it is not necessary to understand the chemistry) what significant change(s) would be expected by IR (ignoring C-H absorptions) ?



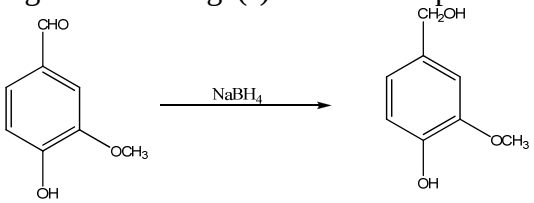
A) A peak around 3300 cm^{-1} would disappear and nothing new would appear.
B) A new peak around 1710 cm^{-1} would appear and a peak around 3300 cm^{-1} would disappear.

C) A peak around 2150 cm^{-1} would disappear and a new peak around 3300 cm^{-1} would appear.
D) No change would be observed.
E) None of these choices.

Answer: B

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

111) For the following reaction sequence (it is not necessary to understand the chemistry) what significant change(s) would be expected by IR (ignoring C-H absorptions) ?

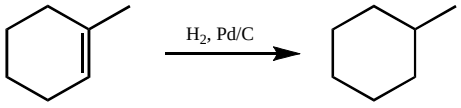


A) A peak around 3300 cm^{-1} would appear and nothing new would appear.
B) A peak around 1710 cm^{-1} would disappear and a new peak around 3300 cm^{-1} would appear.
C) A peak around 2150 cm^{-1} would disappear and a new peak around 3300 cm^{-1} would appear.
D) No change would be observed.
E) None of these choices.

Answer: E

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

112) For the following reaction sequence (it is not necessary to understand the chemistry) what significant change(s) would be expected by IR (ignoring C-H absorptions) ?

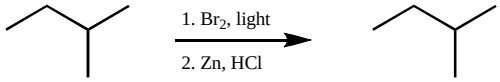


A) A peak around 3300 cm^{-1} would disappear and nothing new would appear.
B) A peak around 1710 cm^{-1} would appear and a new peak around 3300 cm^{-1} would disappear.
C) A peak around 1650 cm^{-1} would disappear and nothing new would appear.
D) No change would be observed.
E) None of these choices.

Answer: C

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

113) For the following reaction sequence (it is not necessary to understand the chemistry) what significant overall change(s) would be expected by IR (ignoring C-H absorptions) ?

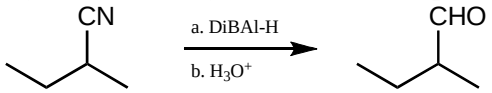


A) A peak around 3300 cm^{-1} would disappear and nothing new would appear.
B) A peak around 1710 cm^{-1} would appear and a new peak around 3300 cm^{-1} would disappear.
C) A peak around 1650 cm^{-1} would disappear and nothing new would appear.
D) No overall change would be observed.
E) None of these choices.

Answer: D

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

114) For the following reaction sequence (it is not necessary to understand the chemistry) what significant change(s) would be expected by IR (ignoring C-H absorptions) ?



A) A peak around 2250 cm^{-1} would disappear and nothing new would appear.
B) A peak around 1720 cm^{-1} would appear and a new peak around 3300 cm^{-1} would disappear.
C) A peak around 2250 cm^{-1} would disappear and new peak around 1720 cm^{-1} would appear.
D) A peak around 2250 cm^{-1} would disappear and new peak around 3300 cm^{-1} would appear.
E) No change would be observed.

Answer: C

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

115) The IR stretching frequency occurs at the lowest frequency for which of these bonds?

A) C–H
B) C–O
C) C–Br
D) C–N
E) C–F

Answer: C

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

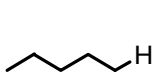
116) The IR stretching frequency can be predicted to occur at the highest frequency for which of these bonds?

A) C–H
B) C–F
C) C–Cl
D) C–Br
E) C–I

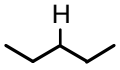
Answer: A

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

117) The IR absorption due to the stretching of which of these carbon-hydrogen bonds occurs at the highest frequency?

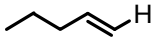


I

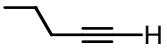


II

III



IV



V

A) I
B) II
C) III

D) IV
E) V

Answer: E

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

118) An oxygen-containing compound which shows sharp IR absorption at 2200 cm^{-1} and 3300 cm^{-1} is likely to contain which functional group?

A) An ester
B) An alkene
C) An alkyne
D) An ether
E) An aldehyde

Answer: C

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

119) n-Pentane has a higher boiling point than isopentane due to an increased surface to surface interaction of dispersion forces.

A) True
B) False

Answer: A

Topic: Intermolecular Forces
Section Reference 1: 2.13
Difficulty: Easy

120) Carbon dioxide has a higher boiling point than carbon disulfide due to its dipole-dipole forces.

A) True

B) False

Answer: B

Topic: Intermolecular Forces
Section 2.13
Difficulty: Medium

121) Even though methyl amine ($CH_3NH_{2)}$ has a higher molecular weight than water (H_2O) , its boiling point is much lower than water's boiling point since water has hydrogen bonding attractive forces.

A) True
B) False

Answer: B

Topic: Intermolecular Forces
Section Reference 1: 2.13
Difficulty: Hard

122) Hydrogen bonding will broaden the absorption band in an Infrared spectra.

A) True
B) False

Answer: A

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Easy

123) The higher the wave number in the infrared spectra, the greater the energy that is required to vibrate the bond.

A) True
B) False

Answer: A

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Medium

124) The molecule N_2 does not show up in an IR spectra because the dipole moment of the molecule does not change with the absorption of IR energy.

A) True
B) False

Answer: A

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

125) Hydrocarbons containing carbon-carbon double bonds are referred to as ___.

Answer: alkenes

Topic: Functional Groups
Section Reference 1: 2.1
Difficulty: Easy

126) All of the carbon-carbon bonds in ___ are equal to one and one-half bonds and have a bond length in between that of a single bond and a double bond with all of the bond angles at ___.

Answer: benzene, 120^{o}

Topic: Functional Groups
Section Reference 1: 2.1
Difficulty: Easy

127) Unsaturated hydrocarbons may be distinguished from saturated hydrocarbons by the presence of one or more ___.

Answer: Pi bonds

Topic: Functional Groups
Section Reference 1: 2.1
Difficulty: Easy

128) Draw a structural formula for C_8H_{18}, in which there are two quaternary carbons.

Answer: 

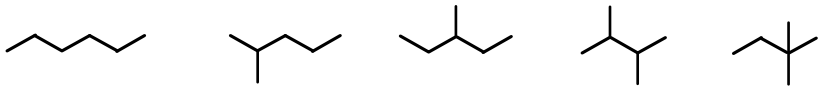
Topic: Isomers, Functional Groups
Section Reference 1: 2.1
Difficulty: Easy

129) The six *p*-electrons in benzene are ___ about the ring, which explains why all of the C-C bonds are the same length.

Answer: delocalized

Topic: General
Section Reference 1: 2.1
Difficulty: Easy

130) Draw all isomers of C_6H_{14}.

Answer: 

Topic: Isomers, Functional Groups
Section Reference 1: 1.3A and 2.1
Difficulty: Easy

131) A polar covalent bond is one in which electrons are ___.

Answer: not shared equally

Topic: General
Section Reference 1: 2.2

Difficulty: Easy

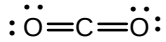
132) The ___ is defined as the product of the magnitude of the charge of a particle and the distance that separates them.

Answer: dipole moment

Topic: Polar Covalent Bond
Section Reference 1: 2.2
Difficulty: Easy

133) Carbon dioxide is non-polar, despite the fact that oxygen is much more electronegative than carbon. Briefly explain why, using relevant diagrams as appropriate to illustrate your Answer.

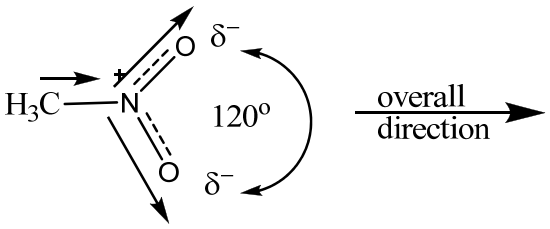
Answer: The overall dipole moment of a polyatomic molecule depends on two factors: the polarity of various bonds and molecular geometry, since dipole forces have both magnitude and direction. In some molecules containing bonds of identical polarity, the molecular geometry may result in a net cancellation of the overall dipole forces. This is what happens in carbon dioxide: although there are two polar C-O bonds, because of the linear geometry of the molecule, the net dipole is zero.



Topic: Molecular Geometry, Dipole Moment
Section Reference 1: 2.2 and 2.3
Difficulty: Medium

134) Nitromethane is a polar molecule but contains 2 equal polar covalent bonds. Briefly explain why and draw a relevant 3-dimensional structure to show the overall dipole moment of the molecule.

Answer: The nitro group has 2 polar N-O bonds that are pointing 120^{o} apart which do not completely cancel out and the C-N bond is polar as well which further add to the net direction of the dipole.



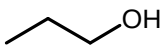
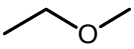
Topic: Molecular Geometry, Dipole Moment
Section Reference 1: 2.2 and 2.3
Difficulty: Medium

135) Organic compounds are classified into chemical families on the basis of similarities in chemical properties; these similarities are primarily due to the presence of characteristic arrangements of atoms known as ___.

Answer: functional groups

Topic: Functional Groups
Section Reference 1: 2.4
Difficulty: Easy

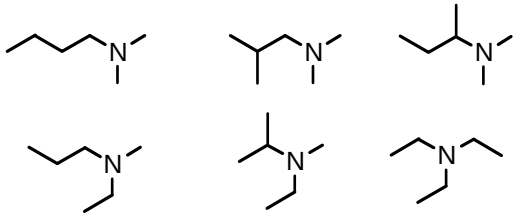
136) Draw all isomers of C_3H_8O and classify each according to functional group.

Answer: C_3H_8O   

primary alcohol secondary alcohol ether

Topic: Isomers, Functional Groups
Section Reference 1: 1.3, 2.6, and 2.7
Difficulty: Easy

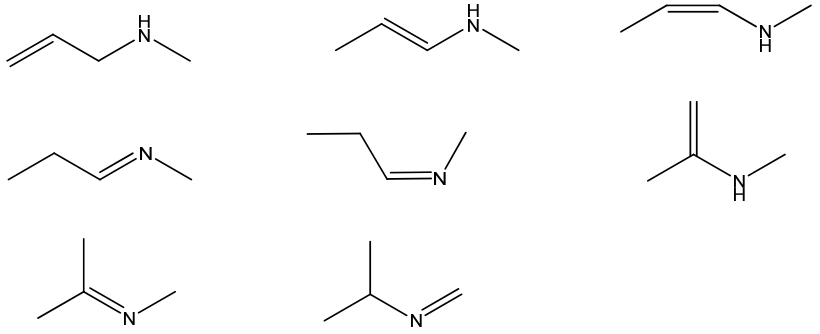
137) Draw all tertiary amine isomers of $C_6H_{15}N$.

Answer: 

Topic: Isomers, Functional Groups
Section Reference 1: 1.3 and 2.8
Difficulty: Medium

138) Draw all of the acyclic secondary amines that have the chemical formula C_4H_9N.

Answer:



Topic: Isomers, Functional Groups
Section Reference 1: 1.3 and 2.8
Difficulty: Medium

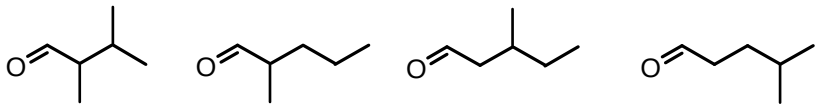
139) A group in which a carbon atom has a double bond to an oxygen atom is called a ___.

Answer: carbonyl

Topic: Functional Groups
Section Reference 1: 2.9
Difficulty: Easy

140) Draw all isomers of $C_6H_{12}O$ that are aldehydes and contain at least one secondary carbon.

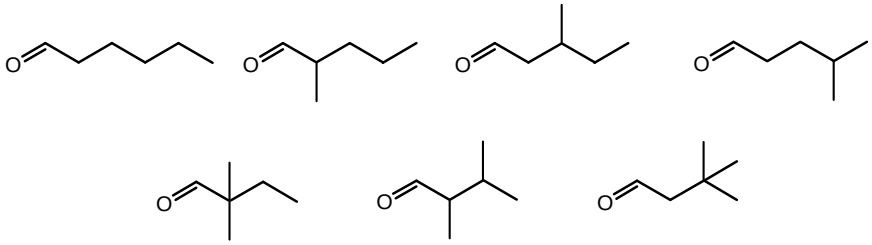
Answer:



Topic: Isomers, Functional Groups
Section Reference 1: 2.9
Difficulty: Easy

141) Draw all isomers of $C_6H_{12}O$ that are aldehydes.

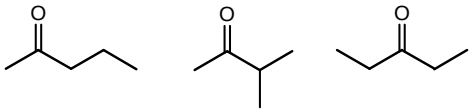
Answer:



Topic: Isomers, Functional Groups
Section Reference 1: 1.3 and 2.9
Difficulty: Easy

142) Draw all isomers of $C_5H_{10}O$ that are ketones.

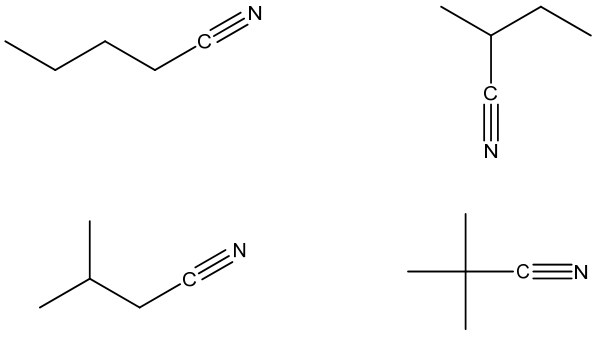
Answer:



Topic: Isomers, Functional Groups
Section Reference 1: 1.3 and 2.9
Difficulty: Easy

143) Draw all of the isomers of C_5H_9N that are nitriles.

Answer:



Topic: Isomers, Functional Groups
Section Reference 1: 1.3, 2.11
Difficulty: Easy

Question type: Essay

144) Ethanol, C_2H_5OH, and propane, C_3H_8, have approximately the same molar mass, yet ethanol has a much higher boiling point. Briefly explain why.

Answer: Strong hydrogen bonding between molecules of ethanol leads to elevation in boiling point. No hydrogen bonding is possible between molecules of propane, resulting in a lower boiling point compared with ethanol.

Topic: Intermolecular Forces
Section Reference 1: 2.13
Difficulty: Easy

145) Even though methanol (CH_3OH) and methylamine ($CH_3NH_{2)}$ have similar molecular weights, methanol has a much higher boiling point of 65 ^oC as opposed to methylamine's boiling point of -6 ^oC. Briefly explain why.

Answer: Both compounds have the same strong intermolecular forces of hydrogen bonding, but methanol's O-H bond is much more polarized than methylamine's N-H as oxygen is more electronegative than nitrogen. The greater polarization exposes the hydrogen nucleus further and creates stronger hydrogen bonds.

Topic: Intermolecular Forces
Section Reference 1: 2.13
Difficulty: Easy

146) Ethanol, C_2H_5OH, and dimethyl ether, CH_3OCH_3, have the same molar mass, yet ethanol has a much higher boiling point. Briefly explain why.

Answer: Strong hydrogen bonding between molecules of ethanol leads to elevation in boiling point. No hydrogen bonding is possible between molecules of dimethyl ether, resulting in a lower boiling point compared with ethanol.

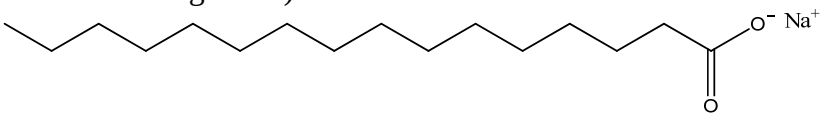
Topic: Intermolecular Forces
Section Reference 1: 2.13
Difficulty: Easy

147) Sodium chloride, which is quite soluble in water, is not very soluble in hexane. Why?

Answer: Sodium chloride, which is an ionic substance, is soluble in a polar solvent such as water, but not in a non-polar solvent such as hexane.

Topic: Bonding, Solubility
Section Reference 1: 2.13
Difficulty: Medium

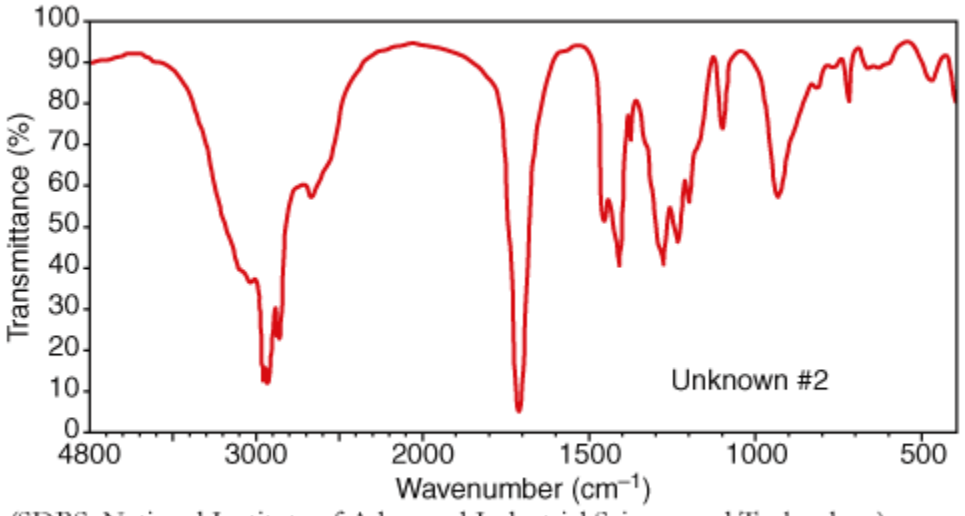
148) Explain why the compound shown is considered to be capable of being a soap (dissolving oily substances off of surfaces using water) .



Answer: The compound contains a long hydrophobic "fatty" carbon tail, which attracts grease particles as they have similar dispersion forces. The polar hydrophilic carboxylate head is forced to the outside, which the polar water can now dissolve.

Topic: Bonding, Solubility
Section Reference 1: 2.13
Difficulty: Medium

149) Examine the following IR spectrum, for substance **Q** ($C_7H_{14}O_2$) . Which oxygen containing functional group is most likely present in **Q**?

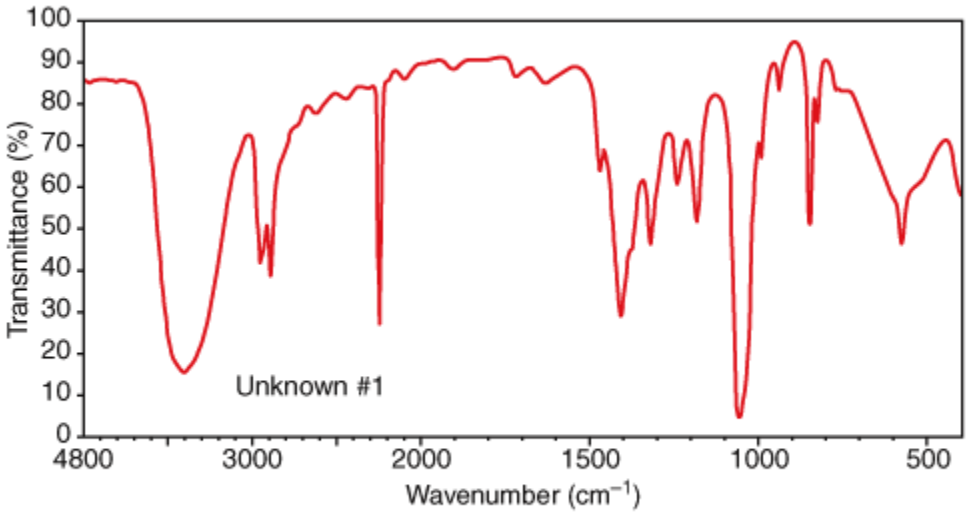


(SDBS, National Institute of Advanced Industrial Science and Technology)

Answer: A carboxylic acid

Topic: Functional Groups, IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Medium

150) Examine the following IR spectrum, for substance **P** (C_3H_5NO) . Which oxygen containing functional group is most likely present in **P**?



(SDBS, National Institute of Advanced Industrial Science and Technology)

Answer: Alcohol

Topic: Functional Groups, IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Medium

151) The IR absorption frequencies of the C-H bond in alkanes, alkenes, and alkynes are measurably different. Briefly explain why.

Answer: IR absorption frequency depends on bond strength; the bond strength of C-H bonds in alkanes, alkenes and alkynes is different because different atomic orbitals (hybridizeD) of carbon are involved in the bond: the C-H bond in alkanes is described as (sp^3-*s*) , that in alkenes is (sp^2-*s*) and in alkynes, it is (*sp*-*s*) . The relative % *s* v. % *p* character of the hybrid orbitals of carbon would indicate different bond lengths / bond strengths for alkanes, alkenes and alkynes, with the

bond length / bond strength being the longest/weakest respectively. This results in different IR absorption frequencies.

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Hard

152) IR absorption signals of alcohols are typically broad. However, IR spectra of gaseous samples show sharp peaks. Briefly explain why.

Answer: Broad signals of alcohols are due to hydrogen bonding associated with the O-H group. In gaseous samples, no hydrogen bonding is possible, and the signal becomes sharp.

Topic: IR Spectroscopy
Section Reference 1: 2.15 and 2.16
Difficulty: Medium

153) An IR spectrum has significant peaks at 3080 and 1650 cm^{-1}. What functional group is present in the molecule?

Answer: An alkene

Topic: Functional Groups, IR Spectroscopy
Section Reference 1: 2.1, 2.15, and 2.16
Difficulty: Easy

154) An IR spectrum has significant peaks at 2200 and 3300 cm^{-1}. What functional group is present in the molecule?

Answer: A terminal alkyne

Topic: Functional Groups, IR Spectroscopy
Section Reference 1: 2.1, 2.15, and 2.16
Difficulty: Hard