Making Connections

7. Examples of controlled oxidation reactions: cellular respiration; rusting of iron; tarnishing of silver; souring of wine.

   Controlled oxidations are "preferred" when temperature must be kept low, and rate of oxidation controlled, e.g., molecules of food are "burned" to release energy in the cell, at body temperatures.

   Uncontrolled oxidations are ideal when we want energy released quickly, raising the surrounding temperature, e.g., burning of wood as fuel.

8. (Answers may include the following occupations: chemist in perfume industry, wine industry, pharmaceutical industry, or cosmetics industry; nutritionist; forensic scientist. Sample answer)

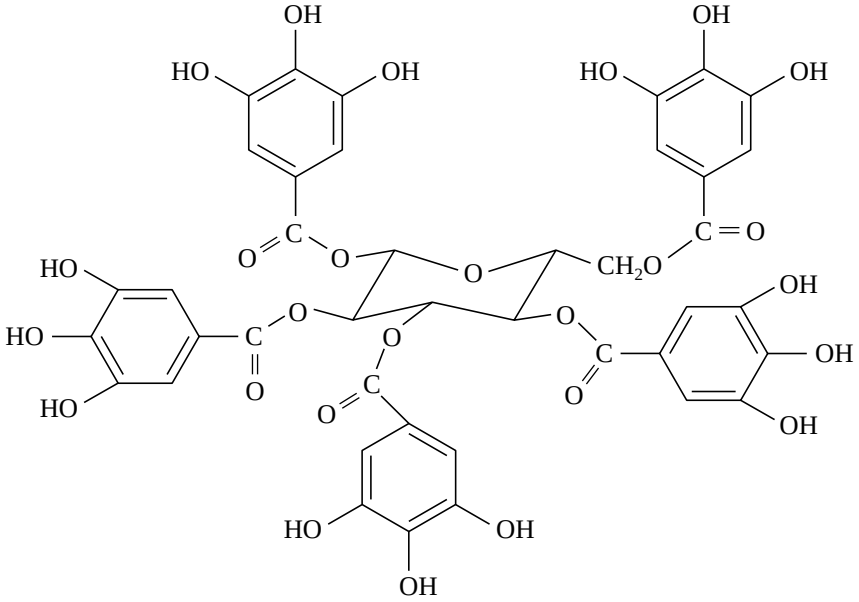
   Chemist in wine industry

   Strengths and qualities needed – strong scientific background, strong technical analytical skills, research skills, good teamwork skills

   Academic training – undergraduate or graduate degree in science, particularly in chemistry, biology, or biochemistry

   Degree in Oenology and Viticulture available at Brock University (See weblinks.)

   Job opportunities – wineries in Ontario and other parts of Canada (See weblinks.)

9. 

   Animal hides decompose quickly unless they are cured to remove the water from the skin. The hide is first soaked in water to remove water-soluble substances and hair is removed by soaking in a mixture of lime and water, followed by an enzyme mixture. The hair and any remaining tissue is removed by machine and the hide is washed and treated with tannic acid. The tannic acid displaces water from the spaces between the hide's protein fibres, allowing the fibres to cement together to form a strong water-resistant leather.

1.8 AMINES AND AMIDES

PRACTICE

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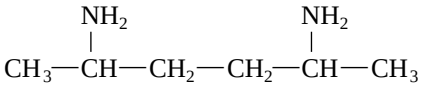
Understanding Concepts

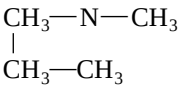
1. putrescine: 1,4-diaminobutane; cadaverine: 1,5-diaminopentane
2. (a) diethylamine, *N*-ethylaminoethane; 2° amine
   (b) trimethylamine, *N*,*N*-diethylaminoethane; 3° amine
   (c) *i*-propylamine, 2-aminopropane; 1° amine
   (d) *n*-hexylamine, 1-aminohexane; 1° amine
   (e) 2-bromo-6-*N*-methylaminohexane; *N*-methyl-*N*-5-bromohexylamine; 2° amine; 2° amine

3. (a)



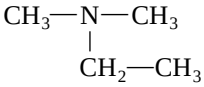
2,5-diaminohexane

(b)



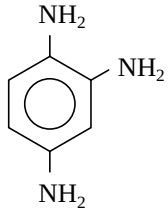
dimethylethylamine

(c)



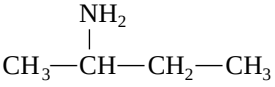
dimethylethylamine

(d)

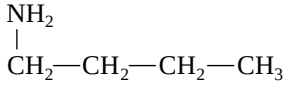


1,2,4-triaminobenzene

(e)



2-methylbutane



1-methylbutane

PRACTICE

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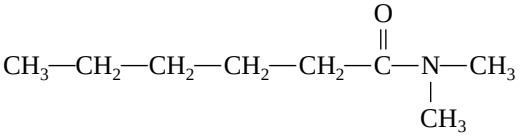
Understanding Concepts

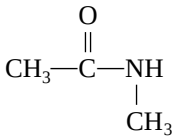
4. (a) *N*-ethyl butanamide
   (b) *N*-methyl propanamide
   (c) *N*,*N*-dimethyl propanamide
   (d) *N*-ethyl-*N*-methyl pentanamide

5. (a)



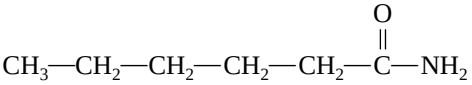
N,*N*-dimethyl hexanamide

(b)



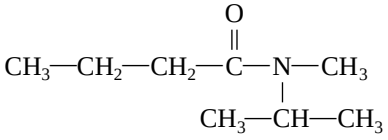
N-methyl acetamide

(c)



hexanamide

(d)



N-isopropyl-*N*-methyl-butanamide

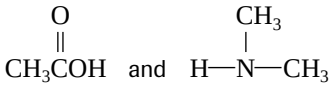
6. (a) amine; propylamine
   (b) amine; ethylmethylamine
   (c) amide; ethanamide

PRACTICE

(Page 77)

Understanding Concepts

7.



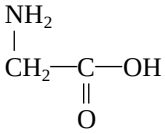
ethanoic acid and dimethylamine

PRACTICE

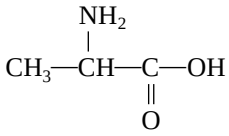
(Page 78)

Understanding Concepts

8. An OH is removed from the carboxylic acid and an H from the amide, to produce a small molecule (H_2O).
9. (a)

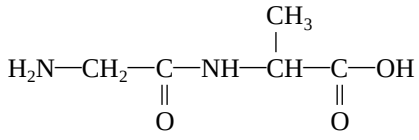


glycine

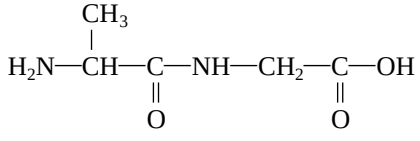


alanine

(b)



glycine-alanine



alanine-glycine

10. Amines contain —NH groups which are less polar than —OH groups in alcohols, and are less capable of hydrogen bonding than are —OH groups.
11. Starting reactants: methane, chlorine, ammonia, an oxidizing agent

$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$

$CH_3Cl + NH_3 \rightarrow CH_3NH_2 + HCl$

$CH_3CH_2OH + (O) \rightarrow CH_3CHO + H_2O$

$CH_3CHO + (O) \rightarrow CH_3COOH$

$CH_3COOH + CH_3NH_2 \rightarrow CH_3CONHCH_3 + H_2O$

SECTION 1.8 QUESTIONS

(Page 78)

Understanding Concepts

1. $CH_3CH_2COOH + HN(CH_2CH_3) \rightarrow CH_3CH_2CON(CH_2CH_3) + H_2O$

2. (a) alcohol, amine; the OH group in alcohols is more polar than the NH group in amines, making them less soluble in nonpolar solvents than are amines.
   (b) primary amine, tertiary amine; tertiary amines do not contain the polar NH groups that are present in primary amines. The more polar primary amine is less soluble in nonpolar solvents than is the tertiary amine. However, if the nonpolar group on the primary amine is large, the increased attraction between nonpolar groups may make it more soluble in the nonpolar solvents.
   (c) tertiary amine, hydrocarbon; bonds between N and C are more polar than bonds between H and C, and therefore, tertiary amines are slightly more polar than hydrocarbons, making them less soluble in nonpolar solvents. However, if the nonpolar groups on the tertiary amine are large, the increased attraction between nonpolar groups may make it more soluble in the nonpolar solvents.
   (d) low molecular mass, high molecular mass; both are primary amines with the same number of NH bonds. The higher molecular mass amine has a larger nonpolar hydrocarbon component and is therefore more soluble in nonpolar solvents.

3. $CH_3—CH_2—CH_2—NH_2$ primary amine: *n*-propylamine

   $CH_3—CH_2—NH—CH_3$ secondary amine: ethylmethylamine

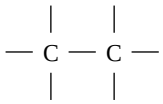
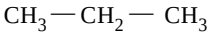
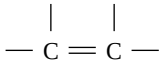
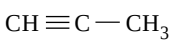
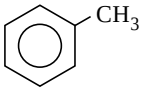
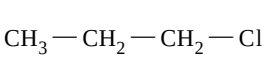
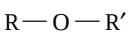
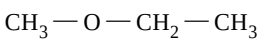
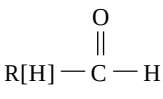
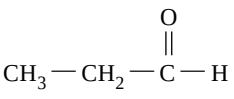
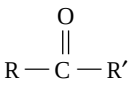
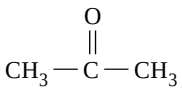
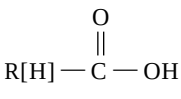
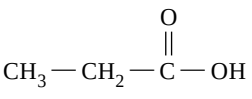
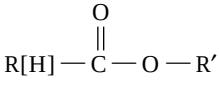
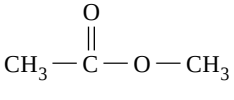
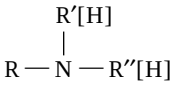
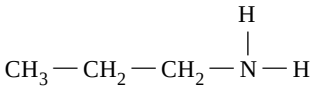
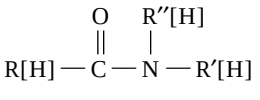
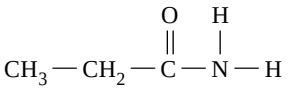
   $CH_3—N(CH_3)—CH_3$ tertiary amine: trimethylamine

4. (a) $HCOOH + NH_3 \rightarrow HCOONH_2$
   (b) $CH_3CH_2COOH + NH_3 \rightarrow CH_3CH_2COONH_2$

5. (a) propanamide
   (b) dimethylpropylamine
   (c) *N*,*N*-diethyl propanamide
   (d) 4-amino-2-chloroheptane
   (e) 4,6-diamino-1-heptene
   (f) 2-aminoethanoic acid

6. (a)

Table 1 Families of Organic Compounds

Family name	General formula	Example
alkanes		propane 
alkenes		propene (propylene) 
alkynes		propyne 
aromatics		methyl benzene (phenyl methane, toluene) 
organic halides		chloropropane 
alcohols		propanol
ethers		methoxyethane (ethyl methyl ether) 
aldehydes		propanal 
ketones		propanone (acetone) 
carboxylic acids		propanoic acid 
esters		methyl ethanoate (methyl acetate) 
amines		propylamine 
amides		propanamide 

(b) (No doubt some students will have their own suggestions for simplifying the naming system. Sample answer) The names for esters should reflect the order in which the components are drawn.

7. presence of length of nonpolar hydrocarbon component: $CH_3CH_2CH_2CH_2CH_3$
   double or triple bonds: $CH_2{=}CH_2$, $CH{\equiv}CCH_3$
   OH bonds: CH_3CH_2OH
   NH bonds: H_2NCH_3
   C=O bonds: CH_3CHO, CH_3COOH

Applying Inquiry Skills

8. The products formed are likely to be a mixture of ethylamine, diethylamine, and triethylamine. These amines have different numbers of NH bonds and different numbers of ethyl groups; thus, they have different intermolecular attractions and different melting points and boiling points. The amines can be separated by fractional distillation.

Making Connections

9. The carboxylic acids such as citric acid in lemons and acetic acid in vinegar react with the amines responsible for the fishy taste in fish to produce amides. For example,

$$CH_3COOH + HNCH_3 \rightarrow CH_3CONCH_3 + H_2O$$
$$\qquad\quad\ \ |\qquad\qquad\quad\ \ |$$
$$\qquad\quad CH_3\qquad\qquad CH_3$$

ethanoic acid + dimethylamine → *N,N*-dimethyl ethanamide + water

10. (a) Each small unit must contain an amino group and a carboxyl group, so that an amide bond can form between small units.
    (b) With both amino groups and carboxyl groups, amino acids are likely fairly soluble in water; they are capable of forming strong amide bonds.

1.9 SYNTHESIZING ORGANIC COMPOUNDS

PRACTICE

(Page 82)

Understanding Concepts

1. (a) $CH_2{=}CHCH_2CH_2CH_3 + H_2O \xrightarrow{H_2SO_4} CH_3CH(OH)CH_2CH_2CH_3$

$$CH_3CH_2CH_2CHO + (O) \rightarrow CH_3CH_2CH_2COOH$$

$$CH_3CH_2CH_2COOH + CH_3CH(OH)CH_2CH_2CH_3 \rightarrow$$
$$CH_3CH_2CH_2COOCHCH_2CH_2CH_3$$
$$\qquad\qquad\qquad\quad|$$
$$\qquad\qquad\qquad CH_3$$

(b) $CH_3CHCH_2OH + (O) \rightarrow CH_3CH_2CHO + H_2O$
$\qquad\quad|\qquad\qquad\qquad\quad|$
$\qquad CH_3\qquad\qquad\quad CH_3$

$$CH_3CHCHO + (O) \rightarrow CH_3CH_2COOH$$
$$\quad|\qquad\qquad\quad|$$
$$CH_3\qquad\qquad CH_3$$