Writing Chemical Equations

Write unbalanced chemical equations for the following chemical reactions. (Assume pure substances unless otherwise indicated. Include states of matter.)
Example: sodium metal + chlorine → sodium chloride
Answer: $Na_{(s)} + Cl_{2(g)} \rightarrow NaCl_{(s)}$

1. water → hydrogen + oxygen
   $H_2O_{(l)} \rightarrow H_{2(g)} + O_{2(g)}$

2. nitrogen + hydrogen → ammonia
   $N_{2(g)} + H_{2(g)} \rightarrow NH_{3(g)}$

3. sulfuric acid + aqueous sodium hydroxide → water + aqueous sodium sulfate
   $H_2SO_{4(aq)} + NaOH_{(aq)} \rightarrow HOH_{(l)} + Na_2SO_{4(aq)}$

4. aluminum + aqueous copper(II) nitrate → copper + aqueous aluminum nitrate
   $Al_{(s)} + Cu(NO_3)_{2(aq)} \rightarrow Cu_{(s)} + Al(NO_3)_{3(aq)}$

5. chlorine + aqueous potassium bromide → bromine + aqueous potassium chloride
   $Cl_{2(g)} + KBr_{(aq)} \rightarrow Br_{2(l)} + KCl_{(aq)}$

6. lead(II) nitrate$_{(aq)}$ + sodium iodide$_{(aq)}$ → lead(II) iodide$_{(s)}$ + sodium nitrate$_{(aq)}$
   $Pb(NO_3)_{2(aq)} + NaI_{(aq)} \rightarrow PbI_{2(s)} + NaNO_{3(aq)}$

7. aqueous sodium hydroxide + aqueous aluminum sulfate → solid aluminum hydroxide + aqueous sodium sulfate
   $NaOH_{(aq)} + Al_2(SO_4)_{3(aq)} \rightarrow Al(OH)_{3(s)} + Na_2SO_{4(aq)}$

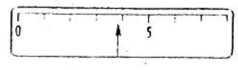
8. phosphorus + oxygen → solid tetraphosphorus decaoxide
   $P_{4(s)} + O_{2(g)} \rightarrow P_4O_{10(s)}$

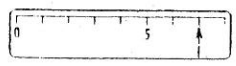
9. methanol + oxygen → carbon dioxide + water vapor
   $CH_3OH_{(l)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$

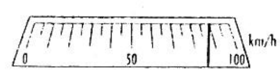
10. nitrogen dioxide gas + water → nitric acid + nitrogen monoxide gas
    $NO_{2(g)} + H_2O_{(l)} \rightarrow HNO_{3(aq)} + NO_{(g)}$

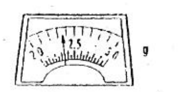
Certainty and Precision

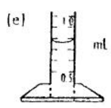
1. Communicate values with acceptable precision, for the following scale readings. Report the prec[ision] after each value; e.g., 12.5 cm (0.1 cm).

(a) 
(a) 3.8 mm (0.1 mm)

(b) 
(b) 7.0 mm (0.1 mm)

(c) 
(c) 89 km/h (1 km/h)

(d) 
(d) 2.36 g (0.01 g)

(e) 
(e) 0.75 mL (0.01 mL)

2. For each of the measurements, give the certainty (report the number of significant digits).

(a) 3.4 km	2 sig digs
(b) 51.85 g	4 sig digs
(c) 0.7 mL	1 sig dig
(d) 0.650 mol	3 sig digs
(e) 200.59 g/mol	5 sig digs

3. Round each of the following calculated answers to three significant digits. Then change the prefix (if neces[sary]) to report the answer according to the rule of a thousand.

(a) 1266.65 g	1.27 kg
(b) 0.0175 L	17.5 mL
(c) 1879 mL	1.88 L
(d) 0.0874 g	87.4 mg
(e) 34.08 g/mol	34.1 g/mol

4. For each of the following, show all work and report the answer in accepted units and certainty.

(a) $46 \text{ mol} \times 44.01 \text{ g/mol}$	2.0 kg	(f) $0.3785 \text{ m} \times 100 \text{ cm/m}$	37.85 c[m]
(b) $154 \text{ g} \times \frac{1 \text{ kg}}{1000 \text{ g}}$	0.454 kg	(g) $4.79 \text{ g} \times \frac{1 \text{ mol}}{159.61 \text{ g}}$	30.0 m[mol]
(c) $75.3 \text{ cm} + 0.85 \text{ cm} + 102 \text{ cm}$	178 cm	(h) $107.83 \text{ g} - 98.52 \text{ g}$	9.31 g
(d) $150.4 \text{ g} + 32.06 \text{ g}$	182.5 g	(i) $29.6^\circ C - 5.3^\circ C$	24.3°C
(e) $(39.10 + 12.01 + 14.01) \text{ g/mol} \times 0.225 \text{ mol}$	14.7 g		

5. The following are some experimentally determined molar masses for some common gases. Deter[mine] the accuracy of these values, i.e., calculate the percent difference between the respective experime[ntal] and predicted values.

(a) carbon dioxide, 45.2 g/mol and 44.01 g/mol	% difference = 2.6%
(b) sulfur trioxide, 79.3 g/mol and 80.06 g/mol	% difference = 1%
(c) dinitrogen pentoxide, 105.6 g/mol and 108.02 g/mol	% difference = 2.2%

Predicting Chemical Reactions

For each of the following questions, classify the reaction type (formation, simple decomposition, combustion, single replacement, double replacement, or other) and predict the balanced chemical equation. Provide a word equation as well.

1. $4\,Al_{(s)} + 3\,O_{2(g)} \rightarrow 2\,Al_2O_{3(s)}$
   formation or combustion
   aluminum + oxygen → aluminum oxide

2. $2\,Ag_2O_{(s)} \rightarrow 4\,Ag_{(s)} + O_{2(g)}$
   simple decomposition
   silver oxide → silver + oxygen

3. $Br_{2(l)} + 2\,KI_{(aq)} \rightarrow I_{2(s)} + 2\,KBr_{(aq)}$
   single replacement
   bromine + potassium iodide → iodine + potassium bromide

4. A strip of zinc metal is placed into a copper(II) nitrate solution.
   $Zn_{(s)} + Cu(NO_3)_{2(aq)} \rightarrow Cu_{(s)} + Zn(NO_3)_{2(aq)}$
   single replacement
   zinc + copper(II) nitrate → copper + zinc nitrate

5. $BaCl_{2(aq)} + Na_2SO_{4(aq)} \rightarrow BaSO_{4(s)} + 2\,NaCl_{(aq)}$
   double replacement
   barium chloride + sodium sulfate → barium sulfate + sodium chloride

6. Sulfuric acid is neutralized by aqueous sodium hydroxide.
   $H_2SO_{4(aq)} + 2\,NaOH_{(aq)} \rightarrow 2\,HOH_{(l)} + Na_2SO_{4(aq)}$
   double replacement
   sulfuric acid + sodium hydroxide → water + sodium sulfate

7. $Na_2S_{(aq)} + Cu(CH_3COO)_{2(aq)} \rightarrow CuS_{(s)} + 2\,NaCH_3COO_{(aq)}$
   double replacement
   sodium sulfide + copper(II) acetate → copper(II) sulfide + sodium acetate

8. $2\,CuS_{(s)} + 3\,O_{2(g)} \rightarrow 2\,CuO_{(s)} + 2\,SO_{2(g)}$
   combustion
   copper(II) sulfide + oxygen → copper(II) oxide + sulfur dioxide

9. Propane burns in air.
   $C_3H_{8(g)} + 5\,O_{2(g)} \rightarrow 3\,CO_{2(g)} + 4\,H_2O_{(g)}$
   combustion
   propane + oxygen → carbon dioxide + water

10. $Na_2CO_{3(aq)} + 2\,HCl_{(aq)} \rightarrow 2\,NaCl_{(aq)} + CO_{2(g)} + H_2O_{(l)}$
    other
    sodium carbonate + hydrochloric acid → sodium chloride + carbon dioxide + water

Balancing Chemical Reaction Equations

Use the Dalton theory of the conservation of atoms to balance the following chemica[l] equations.

1. $Ni_{(s)} + 2\,HCl_{(aq)} \rightarrow NiCl_{2(aq)} + H_{2(g)}$

2. $Ca(OH)_{2(s)} + 2\,HCl_{(aq)} \rightarrow CaCl_{2(aq)} + 2\,HOH_{(l)}$

3. $Cl_{2(g)} + 2\,NaBr_{(aq)} \rightarrow Br_{2(l)} + 2\,NaCl_{(aq)}$

4. $2\,Cr_2O_{3(s)} \rightarrow 4\,Cr_{(s)} + 3\,O_{2(g)}$

5. $2\,Fe_{(s)} + 6\,HCl_{(aq)} \rightarrow 2\,FeCl_{3(aq)} + 3\,H_{2(g)}$

6. $2\,C_3H_{6(g)} + 9\,O_{2(g)} \rightarrow 6\,CO_{2(g)} + 6\,H_2O_{(g)}$

7. $P_{4(s)} + 6\,F_{2(g)} \rightarrow 4\,PF_{3(l)}$

8. $Ca(NO_3)_{2(aq)} + 2\,KOH_{(aq)} \rightarrow Ca(OH)_{2(s)} + 2\,KNO_{3(aq)}$

9. $2\,KHCO_{3(s)} \rightarrow K_2CO_{3(s)} + H_2O_{(l)} + CO_{2(g)}$

10. $H_3PO_{4(aq)} + 3\,NaOH_{(aq)} \rightarrow Na_3PO_{4(aq)} + 3\,HOH_{(l)}$

11. $3\,Ca(NO_3)_{2(aq)} + 2\,Na_3PO_{4(aq)} \rightarrow Ca_3(PO_4)_{2(s)} + 6\,NaNO_{3(aq)}$

12. $Cu_{(s)} + 4\,HNO_{3(aq)} \rightarrow Cu(NO_3)_{2(aq)} + 2\,NO_{2(g)} + 2\,H_2O_{(l)}$

Ionic Nomenclature

Write the international chemical formula or the English IUPAC name for each of the compounds given. (This exercise involves all classes of ionic compounds.)

	International Chemical Formula	IUPAC Name
1.	$SrCl_{2(s)}$	strontium chloride
2.	$RbBr_{(s)}$	rubidium bromide
3.	$Na_2O_{(s)}$	sodium oxide
4.	$Al_2S_{3(s)}$	aluminum sulfide
5.	$ZnCl_{2(s)}$	zinc chloride
6.	$MgI_{2(s)}$	magnesium iodide
7.	$CoCl_{2(s)}$	cobalt(II) chloride
8.	$TiO_{2(s)}$	titanium(IV) oxide
9.	$Cu_2O_{(s)}$	copper(I) oxide
10.	$SnS_{(s)}$	tin(II) sulfide
11.	$Cr_2O_{3(s)}$	chromium(III) oxide
12.	$FeS_{(s)}$	iron(II) sulfide
13.	$KC_6H_5COO_{(s)}$	potassium benzoate
14.	$Na_2S_2O_{3(s)}$	sodium thiosulfate
15.	$NH_4HCO_{3(s)}$	ammonium hydrogen carbonate
16.	$(NH_4)_2S_{(s)}$	ammonium sulfide
17.	$BaSO_{3(s)}$	barium sulfite
18.	$Mg(OH)_{2(s)}$	magnesium hydroxide
19.	$FeSO_4 \cdot 7H_2O_{(s)}$	iron(II) sulfate-7-water or heptahydrate
20.	$LiCl \cdot 4H_2O_{(s)}$	lithium chloride-4-water or tetrahydrate
21.	$Na_2SO_4 \cdot 10H_2O_{(s)}$	sodium sulfate decahydrate
22.	$Au(NO_3)_{3(s)}$	gold(III) nitrate
23.	$Bi_2(SO_4)_{3(s)}$	bismuth(III) sulfate
24.	$Pb(CH_3COO)_2 \cdot 3H_2O_{(s)}$	lead(II) acetate-3-water
25.	$KMnO_{4(s)}$	potassium permanganate

Molecular Nomenclature

1. List the molecular prefixes from one to ten.

1	mono	6	hexa
2	di	7	hepta
3	tri	8	octa
4	tetra	9	ennea
5	penta	10	deca

2. For which type of molecular substances are these prefixes used?

Molecular prefixes are used for binary molecular compounds. Some binary compounds, like water (H_2O) and ammonia (NH_3), preferentially use common names.

3. Why is memorization required for the nomenclature of many molecular substances in this unit?

Memorization is required since neither a theory nor a complete communication system has been presented yet to predict the names and formulas for these compounds.

	Molecular Formula (with SATP state)	English IUPAC Name
4.	$O_{2(g)}$	oxygen
5.	$P_2O_{5(s)}$	diphosphorus pentaoxide
6.	$HCl_{(g)}$	hydrogen chloride
7.	$NH_{3(g)}$	ammonia
8.	$N_2H_{4(l)}$	dinitrogen tetrahydride (liquid)
9.	$ICl_{5(s)}$	iodine pentachloride
10.	$CH_{4(g)}$	methane
11.	$NI_{3(s)}$	nitrogen triiodide
12.	$CH_3OH_{(l)}$	methanol
13.	$C_{12}H_{22}O_{11(s)}$	sucrose
14.	$S_4N_{2(s)}$	tetrasulfur dinitride
15.	$C_2H_5OH_{(l)}$	ethanol
16.	$CO_{(g)}$	carbon monoxide
17.	$H_2O_{2(l)}$	hydrogen peroxide
18.	$H_2S_{(g)}$	hydrogen sulfide
19.	$S_{8(s)}$	octasulfur
20.	$C_3H_{8(g)}$	propane

ATOMIC ORBITALS AND MODELS

1. Name the four types of orbitals in the sublevels, the number of orbitals in each sublevel, and the maximum number of electrons in that sublevel.

   s, 1 orbital, 2 electrons
   p, 3 orbitals, 6 electrons
   d, 5 orbitals, 10 electrons
   f, 7 orbitals, 14 electrons

2. State Hund's rule.

   No electron pairing takes place in p, d, or f orbitals until each orbital of the given set contains one electron.

3. Write the full electron configurations for each of the following.

   (a) aluminum atom $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$

   (b) cobalt atom $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^7$

   (c) phosphide ion $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

4. What is the "kernel method" for writing electron configurations?

   It is an abbreviation of the electronic configuration of the atom an element using, as a starting point, the electron configuration of the atom of the noble gas element that immediately precedes the element in the periodic table.

5. Write the chemical symbols for the atoms corresponding to the following descriptions.

   (a) $[Ar]\ 4s^2$ **Ca**

   (b) $[Kr]\ 5s^2\ 4d^{10}\ 5p^1$ **In**

   (c) $[Xe]\ 6s^2\ 4f^{14}\ 5d^5$ **Re**

6. List the chemical symbols and names for six ions isoelectronic with an argon atom.

P^{3-}	**phosphide ion**	K^+	**potassium ion**
S^{2-}	**sulfide ion**	Ca^{2+}	**calcium ion**
Cl^-	**chloride ion**	Sc^{3+}	**scandium(III) ion**

7. What is the similarity among the atoms of Group 16 in terms of

   (a) electron configurations

   All atoms have a configuration that ends with $ns^2\ np^4$.

   (b) Lewis models

   All atoms have two lone pairs of electrons and two bonding electrons.

APPLICATIONS OF STOICHIOMETRY

1. In a chemical analysis to test the purity of a bottle of sodium bromide, a solution containing 1.17 g of sodium bromide was reacted with an excess of dimercury(I) acetate solution. The dry precipitate had a mass of 2.73 g. Calculate the percent yield for the precipitate and comment on the purity of sodium bromide.

$$2\ NaBr_{(aq)} + Hg_2(CH_3COO)_{2(aq)} \rightarrow Hg_2Br_{2(s)} + 2\ NaCH_3COO_{(aq)}$$

1.17 g — m

102.89 g/mol — 560.98 g/mol

$$n_{NaBr} = 1.17\text{ g} \times \frac{1\text{ mol}}{102.89\text{ g}} = 0.0114\text{ mol}$$

$$n_{Hg_2Br_2} = 0.0114\text{ mol} \times \frac{1}{2} = 0.005\ 69\text{ mol}$$

$$m_{Hg_2Br_2} = 0.005\ 69\text{ mol} \times \frac{560.98\text{ g}}{1\text{ mol}} = 3.19\text{ g}$$

$$\text{or } m_{Hg_2Br_2} = 1.17\text{ g NaBr} \times \frac{1\text{ mol NaBr}}{102.89\text{ g NaBr}} \times \frac{1\text{ mol } Hg_2Br_2}{2\text{ mol NaBr}} \times \frac{560.98\text{ g } Hg_2Br_2}{1\text{ mol } Hg_2Br_2} = 3.19\text{ g}$$

$$\%\text{ yield} = \frac{2.73\text{ g}}{3.19\text{ g}} \times 100 = 85.6\%$$

The purity of the sodium bromide is relatively poor and it is likely a technical grade not a reagent grade **(see Figure 7.8, page 261)****.**

2. A solution containing 2.56 g of aluminum nitrate is mixed with a solution containing 1.02 g of ammonium sulfide. Determine the unreacted mass of the excess reagent and the mass of precipitate formed.

$$2\ Al(NO_3)_{3(aq)} + 3(NH_4)_2S_{(aq)} \rightarrow Al_2S_{3(s)} + 6\ NH_4NO_{3(aq)}$$

2.56 g — 1.02 g — m

213.01 g/mol — 68.16 g/mol — 150.14 g/mol

$$n_{Al(NO_3)_3} = 2.56\text{ g} \times \frac{1\text{ mol}}{213.01\text{ g}} = 0.0120\text{ mol}$$

$$n_{(NH_4)_2S} = 1.02\text{ g} \times \frac{1\text{ mol}}{68.16\text{ g}} = 0.0150\text{ mol}$$

If $Al(NO_3)_3$ is the limiting reagent, the amount of $(NH_4)_2S$ required is

$$n_{(NH_4)_2S} = 0.0120\text{ mol} \times \frac{3}{2} = 0.0180\text{ mol}$$

Insufficient $(NH_4)_2S$ is present. Therefore $Al(NO_3)_3$ is the excess reagent and $(NH_4)_2S$ is the limiting reagent.

$$n_{Al(NO_3)_3} = 0.0150\text{ mol} \times \frac{2}{3} = 0.009\ 98\text{ mol} \quad \text{(required amount)}$$

$$n_{Al(NO_3)_3} = 0.0120\text{ mol} - 0.009\ 98\text{ mol} = 0.0020\text{ mol} \quad \text{(excess amount)}$$

$$m_{Al(NO_3)_3} = 0.0020\text{ mol} \times \frac{213.01\text{ g}}{1\text{ mol}} = 0.43\text{ g excess} \quad \text{(unreacted mass)}$$

$$n_{Al_2S_3} = 0.0150\text{ mol} \times \frac{1}{3} = 0.004\ 99\text{ mol}$$

$$m_{Al_2S_3} = 0.004\ 99\text{ mol} \times \frac{150.14\text{ g}}{1\text{ mol}} = 0.749\text{ g}$$

$$\text{or } m_{Al_2S_3} = 0.0150\text{ mol } (NH_4)_2S \times \frac{1\text{ mol } Al_2S_3}{3\text{ mol } (NH_4)_2S} \times \frac{150.14\text{ g } Al_2S_3}{1\text{ mol } Al_2S_3} = 0.749\text{ g}$$

GRAVIMETRIC STOICHIOMETRY

Complete the following stoichiometric problems. Communicate your problem-solving approach using internationally accepted symbols for elements, quantities, numbers and units.

1. Calculate the mass of iron(III) oxide (rust) produced by the reaction of 500 g of iron with oxygen from the air.

$$4\ Fe_{(s)} + 3\ O_{2(g)} \rightarrow 2\ Fe_2O_{3(s)}$$

500 g — m

55.85 g/mol — 159.70 g/mol

$$n_{Fe} = 500\text{ g} \times \frac{1\text{ mol}}{55.85\text{ g}} = 8.95\text{ mol}$$

$$n_{Fe_2O_3} = 8.95\text{ mol} \times \frac{2}{4} = 4.48\text{ mol}$$

$$m_{Fe_2O_3} = 4.48\text{ mol} \times \frac{159.70\text{ g}}{1\text{ mol}} = 715\text{ g}$$

$$\text{or } m_{Fe_2O_3} = 500\text{ g Fe} \times \frac{1\text{ mol Fe}}{55.85\text{ g Fe}} \times \frac{2\text{ mol } Fe_2O_3}{4\text{ mol Fe}} \times \frac{159.70\text{ g } Fe_2O_3}{1\text{ mol } Fe_2O_3} = 715\text{ g}$$

2. What mass of precipitate should form if 2.00 g of silver nitrate in solution is reacted with excess sodium sulfide solution?

$$2\ AgNO_{3(aq)} + Na_2S_{(aq)} \rightarrow Ag_2S_{(s)} + 2\ NaNO_{3(aq)}$$

2.00 g — m

169.88 g/mol — 247.80 g/mol

$$n_{AgNO_3} = 2.00\text{ g} \times \frac{1\text{ mol}}{169.88\text{ g}} = 0.0118\text{ mol}$$

$$n_{Ag_2S} = 0.0118\text{ mol} \times \frac{1}{2} = 0.005\ 89\text{ mol}$$

$$m_{Ag_2S} = 0.005\ 89\text{ mol} \times \frac{247.80\text{ g}}{1\text{ mol}} = 1.46\text{ g}$$

$$\text{or } m_{Ag_2S} = 2.00\text{ g } AgNO_3 \times \frac{1\text{ mol } AgNO_3}{169.88\text{ g } AgNO_3} \times \frac{1\text{ mol } Ag_2S}{2\text{ mol } AgNO_3} \times \frac{247.80\text{ g } Ag_2S}{1\text{ mol } Ag_2S} = 1.46\text{ g}$$

3. Determine the mass of water vapor formed when 1.00 g of butane, $C_4H_{10(g)}$, is burned in a lighter.

$$2\ C_4H_{10(g)} + 13\ O_{2(g)} \rightarrow 8\ CO_{2(g)} + 10\ H_2O(g)$$

1.00 g — m

58.14 g/mol — 18.02 g/mol

$$n_{C_4H_{10}} = 1.00\text{ g} \times \frac{1\text{ mol}}{58.14\text{ g}} = 0.0172\text{ mol}$$

$$n_{H_2O} = 0.0172\text{ mol} \times \frac{10}{2} = 0.0860\text{ mol}$$

$$m_{H_2O} = 0.0860\text{ mol} \times \frac{18.02\text{ g}}{1\text{ mol}} = 1.55\text{ g}$$

$$\text{or } m_{H_2O} = 1.00\text{ g } C_4H_{10} \times \frac{1\text{ mol } C_4H_{10}}{58.14\text{ g } C_4H_{10}} \times \frac{10\text{ mol } H_2O}{2\text{ mol } C_4H_{10}} \times \frac{18.02\text{ g } H_2O}{1\text{ mol } H_2O} = 1.55\text{ g}$$

4. Silver metal can be recovered from waste silver nitrate solutions by reaction with copper metal. What mass of silver can be obtained using 50 g of copper?

$$2\ AgNO_{3(aq)} + Cu_{(s)} \rightarrow 2\ Ag_{(s)} + Cu(NO_3)_{2(aq)}$$

50 g — m

63.55 g/mol — 107.87 g/mol

$$n_{Cu} = 50\text{ g} \times \frac{1\text{ mol}}{63.55\text{ g}} = 0.79\text{ mol}$$

$$n_{Ag} = 0.79\text{ mol} \times \frac{2}{1} = 1.6\text{ mol}$$

$$m_{Ag} = 1.6\text{ mol} \times \frac{107.87\text{ g}}{1\text{ mol}} = 0.17\text{ kg}$$

$$\text{or } m_{Ag} = 50\text{ g Cu} \times \frac{1\text{ mol Cu}}{63.55\text{ g Cu}} \times \frac{2\text{ mol Ag}}{1\text{ mol Cu}} \times \frac{107.87\text{ g Ag}}{1\text{ mol Ag}} = 0.17\text{ kg}$$

Hydrocarbon Derivatives

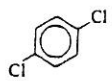
In the following questions, the IUPAC names of a variety of hydrocarbon derivatives are provided. Draw a structural diagram for each name and identify the organic family to which the compound belongs.

1. 2-bromopentane

$CH_3-CH(Br)-CH_2-CH_2-CH_3$

organic halide

2. 1,4-dichlorobenzene



organic halide

3. butanoic acid

$CH_3-CH_2-CH_2-C(=O)-OH$

carboxylic acid

4. ethyl methanoate

$H-C(=O)-O-CH_2-CH_3$

ester

5. 1-butanol

$CH_3-CH_2-CH_2-CH_2-OH$

alcohol

6. propanal

$CH_3-CH_2-C(=O)-H$

aldehyde

7. 1,1-dichloro-2,2-difluoroethane

$Cl-CH(Cl)-CH(F)-F$

organic halide

8. trimethylamine

$CH_3-N(CH_3)-CH_3$

amine

9. 2-methyl-2-propanol

$CH_3-C(CH_3)(OH)-CH_3$

alcohol

10. propanamide

$CH_3-CH_2-C(=O)-NH_2$

amide

Communicate acceptable English IUPAC names for the following structural models.

11. $CH_3-CH_2-CH(OH)-CH_3$

2-butanol

12. $Cl-CH_2-CH_2-CH_2-Cl$

1,3-dichloropropane

13. $CH_3-C(=O)-OH$

ethanoic acid (acetic acid)

14. $CH_3-C(=O)-O-CH_3$

methyl ethanoate

Alkanes

For each of the following IUPAC names, draw a structural diagram.
(You may want all hydrogen atoms shown as bonded atoms.)

1. 2-methylpentane

$CH_3-CH(CH_3)-CH_2-CH_2-CH_3$

2. 3-ethylhexane

$CH_3-CH_2-CH(C_2H_5)-CH_2-CH_2-CH_3$

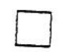
3. 2,3-dimethylbutane

$CH_3-CH(CH_3)-CH(CH_3)-CH_3$

4. octane

$CH_3-(CH_2)_6-CH_3$

5. cyclobutane

CH_2-CH_2 / CH_2-CH_2 (ring) or 

6. 2,3-dimethylhexane

$CH_3-CH(CH_3)-CH(CH_3)-CH_2-CH_2-CH_3$

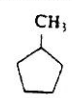
7. trimethylbutane

$CH_3-C(CH_3)_2-CH(CH_3)-CH_3$

8. 3-ethyl-3-methylhexane

$CH_3-CH_2-C(CH_3)(C_2H_5)-CH_2-CH_2-CH_3$

9. methylcyclopentane



10. 2,2,3-trimethylpentane

$CH_3-C(CH_3)_2-CH_2-CH(CH_3)-CH_3$

For each of the following questions, draw a structural diagram equation and classify the reaction type.

11. heptane burns in a fuel mixture

complete combustion

$CH_3-(CH_2)_5-CH_3 + O=O \rightarrow O=C=O + H-O-H$

12. cyclooctane + hydrogen → propane + pentane

cracking

 $+ H-H \rightarrow CH_3-CH_2-CH_3 + CH_3-CH_2-CH_2-CH_2-CH_3$

13. butane + propane → 2,3-dimethylpentane + hydrogen

reforming

$CH_3-CH_2-CH_2-CH_3 + CH_3-CH_2-CH_3 \rightarrow CH_3-CH(CH_3)-CH(CH_3)-CH_2-CH_3 + H-H$