Honors Chemistry

Answers to More Chapter 3 Study Questions

1. a) In 1 mole Na_2SO_4: 2 mole Na = 2(23.0 g) = 46.0 g; 1 mole S = 32.1 g; 4 mol O = 4(16.0 g) = 64.0 g. Molar mass = 46.0 + 32.1 + 64.0 = 142.1 g/mole
Na: 46.0/142.1 = 32.4% Na. S: 32.1/142.1 = 22.6% S. O: 64.0/142.1 = 45.0% O.

32.4% Na, 22.6% S, 45.0% O

b) $2.00 \text{ g S} \times \frac{100 \text{ g cpd}}{22.6 \text{ g S}} =$ 8.85 g cpd

2. Mass of Sn = 33.40 g – 31.50 g = 1.90 g Sn
Mass of O = 33.91 g – 33.40 g = 0.51 g O

moles Sn: $1.90 \text{ g Sn} \times \frac{1 \text{ mole Sn}}{118.7 \text{ g Sn}} = 0.0160$ moles Sn 0.0160/0.160 = 1.0

moles O: $0.51 \text{ g O} \times \frac{1 \text{ mole O}}{16.0 \text{ g O}} = 0.032$ moles O 0.32/0.160 = 2.0

formula = SnO_2

3. a) In 100 g of this compound, there are 30.4 g N and 69.6 g O

$30.4 \text{ g N} \times \frac{1 \text{ mole N}}{14.0 \text{ g N}} = 2.17$ moles N 2.17/2.17 = 1

$69.6 \text{ g O} \times \frac{1 \text{ mole O}}{16.0 \text{ g O}} = 4.35$ moles O 4.35/2.17 = 2 empirical formula = NO_2

b) Molar mass of NO_2 = 14.0 + 2(16.0) = 46.0 g/mole

92.0/46.0 = 2 → molecular formula = N_2O_4

4. a) $2\ C_8H_{18}(l) + 25\ O_2(g) \rightarrow 16\ CO_2(g) + 18\ H_2O(l)$

b) $1.00 \text{ mol } C_8H_{18} \times \frac{25 \text{ mol } O_2}{2 \text{ mol } C_8H_{18}} = 12.5 \text{ mol } O_2$

c) $6.63 \text{ mol } H_2O \times \frac{2 \text{ mol } C_8H_{18}}{18 \text{ mol } H_2O} \times \frac{114 \text{ g } C_8H_{18}}{1 \text{ mol } C_8H_{18}} = 84.0 \text{ g } C_8H_{18}$

d) $101 \text{ g } C_8H_{18} \ \frac{1 \text{ mol } C_8H_{18}}{114 \text{ g } C_8H_{18}} \times \frac{16 \text{ mol } CO_2}{2 \text{ mol } C_8H_{18}} = 7.09 \text{ mol } CO_2$

e) $4.77 \text{ g } O_2 \times \frac{1 \text{ mol } O_2}{32.0 \text{ g } O_2} \times \frac{16 \text{ mol } CO_2}{25 \text{ mol } O_2} \times \frac{44.0 \text{ g } CO_2}{1 \text{ mol } CO_2} = 4.20 \text{ g } CO_2$

f) $2.1 \text{ g } C_8H_{18} \times \frac{1 \text{ mol } C_8H_{18}}{114 \text{ g } C_8H_{18}} \times \frac{18 \text{ mol } H_2O}{2 \text{ mol } C_8H_{18}} \times \frac{6.022 \times 10^{23} \text{ molecules}}{1 \text{ mol } H_2O}$

$= 1.0 \times 10^{23}$ molecules

4. g) $5.00\text{ g } O_2 \times \frac{1\,mol\,O_2}{32.0\,g\,O_2} \times \frac{16\,mol\,CO_2}{25\,mol\,O_2} \times \frac{44.0\,g\,CO_2}{1\,mol\,CO_2} = 4.40\text{ g } CO_2$

$1.62\text{ g } C_8H_{18} \times \frac{1\,mol\,C_8H_{18}}{114\,g\,C_8H_{18}} \times \frac{16\,mol\,CO_2}{2\,mol\,C_8H_{18}} \times \frac{44.0\,g\,CO_2}{1\,mol\,CO_2} = 5.00\text{ g } CO_2$

O_2 is limiting; **4.40 g CO_2** is produced

h) $1.62\text{ g } C_8H_{18} \times \frac{1\,mol\,C_8H_{18}}{114\,g\,C_8H_{18}} \times \frac{16\,mol\,CO_2}{2\,mol\,C_8H_{18}} \times \frac{44.0\,g\,CO_2}{1\,mol\,CO_2} = 5.00\text{ g } CO_2$

$\%\text{ yield} = \frac{actual\ yield}{theoretical\ yield} x\,100\% = \frac{3.70\,g\,CO_2}{5.00\,g\,CO_2} x\,100\% =$ **74.0%**

5. In 100 g of this compound, there are 45.0 g Pb and 55.0 g I

$45.0\text{ g Pb} \times \frac{1\,mole\,Pb}{207\,g\,Pb} = 0.217\text{ moles Pb}$ 0.217/0.217 = 1

$55.0\text{ g I} \times \frac{1\,mole\,I}{127\,g\,I} = 0.433\text{ moles I}$ 0.433/0.217 = 2

empirical formula = **PbI_2** lead(II) iodide