1.2 Exercise 1 – Avogadro's Number and reacting masses

1. Calculate the number of moles present in each of the following cases:	2. Calculate the mass of substance present in the following cases:	3. Calculate the relative molecular mass of the following substances and suggest a possible identity of each substance:
a) 2.3 g of Na	a) 0.05 moles of Cl_2	a) 0.015 moles, 0.42 g
b) 2.5 g of O_2	b) 0.125 moles of KBr	b) 0.0125 moles, 0.50 g
c) 240 kg of CO_2	c) 0.075 moles of $Ca(OH)_2$	c) 0.55 moles, 88 g
d) 12.5 g of $Al(OH)_3$	d) 250 moles of Fe_2O_3	d) 2.25 moles, 63 g
e) 5.2 g of PbO_2	e) 0.02 moles of $Al_2(SO_4)_3$	e) 0.00125 moles, 0.312 g

4. Calculate the number of particles in the following substances:
a) 0.025 moles b) 2.5 g of CO_2 c) 5.0 g of Pb d) 100 g of N_2

5. Calculate the mass of the following substances:
a) 2.5×10^{23} molecules of N_2
b) 1.5×10^{24} molecules of CO_2
c) 2×10^{20} atoms of Mg

Reacting Masses

6. Calculate the mass of H_2O required to react completely with 5.0 g of $SiCl_4$:
$SiCl_4 + 2H_2O \rightarrow SiO_2 + 4HCl$

7. Calculate the mass of phosphorus required to make 200 g of phosphine, PH_3, by the reaction:
$P_4(s) + 3NaOH(aq) + 3H_2O(l) \rightarrow 3NaH_2PO_4(aq) + PH_3(g)$

8. Lead (IV) oxide reacts with concentrated hydrochloric acid as follows:
$PbO_2(s) + 4HCl(aq) \rightarrow PbCl_2(s) + Cl_2(g) + 2H_2O(l)$
What mass of lead chloride would be obtained from 37.2g of PbO_2, and what mass of chlorine gas would be produced?

9. When copper (II) nitrate is heated, it decomposes according to the following equation:
$2Cu(NO_3)_2(s) \rightarrow 2CuO(s) + 4NO_2(g) + O_2(g)$.
When 20.0g of copper (II) nitrate is heated, what mass of copper (II) oxide would be produced? What mass of NO_2 would be produced?

10. A blast furnace can produce about 700 tonnes of iron a day. How much iron (III) oxide will be consumed? Assuming coke is pure carbon, how much coke would be needed to produce the necessary carbon monoxide?
$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(l) + 3CO_2(g)$
$2C(s) + O_2(g) \rightarrow 2CO(g)$

Atom Economy

11. Calculate the percentage atom economy of the following processes:

a) the production of iron in the blast furnace:
$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

b) the production of titanium:
$TiCl_4 + 4Na \rightarrow Ti + 4NaCl$

c) the production of glass from sand:
$SiO_2 + 2NaOH \rightarrow Na_2SiO_3 + H_2O$

12. Calculate the atom economy of each of the following methods of producing iron and decide which is the most efficient process:

a) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
b) $Fe_2O_3 + 3H_2 \rightarrow 2Fe + 3H_2O$
c) $Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$