1 In what molar ratio do the following substances react?

a sulfuric acid acid with barium hydroxide **1 : 1** (1)

b nitric acid with potassium carbonate **2 : 1** (1)

**2** Write an ionic equation, including state symbols, for each of the following reactions.

a reaction of aqueous ammonia with hydrochloric acid

$H^+(aq) + NH_3(aq) \rightarrow NH_4^+(aq)$ (2)

b precipitation of lead(II) bromide when aqueous lead(II) nitrate is mixed with aqueous sodium bromide

$Pb^{2+}(aq) + 2Br^-(aq) \rightarrow PbBr_2(s)$ (2)

3 Deduce the limiting reagent and calculate what mass of magnesium oxide is formed when 486 mg of magnesium reacts with 240 mg of oxygen.

$$2Mg + O_2 \rightarrow 2MgO$$
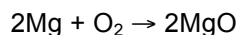
mol O$_2$ $= \frac{0.240}{32.0} = $ **0.00750**

mol Mg $= \frac{0.486}{24.3} = $ **0.0200**

0.00750 mol of O$_2$ reacts with 0.0150 mol of Mg to form 0.0150 mol of MgO

mass MgO = 0.0150 x 40.3 = 0.605 g (3sf) (4)

4 What is the atom economy to make tungsten in this reaction: $WO_3 + 3H_2 \rightarrow W + 3H_2O$

atom economy $= 100 \ x \ \frac{183.8}{183.8 + 3(18.0)} = $ **77.3%** (2)