1. The following reaction is exceptional in that a single reactant species is both oxidized and reduced:
$2\,KClO_3(s) \rightarrow 2\,KCl(s) + 3\,O_2(g)$.
What mass of oxygen gas would be formed by the decomposition of 45.65 g of $KClO_3$? (How should your answer compare to the mass of reactant? Does your answer make sense?)

$$45.65\,g\,KClO_3 \times \frac{1\,mol}{122.6\,g} \times \frac{3\,mol\,O_2}{2\,mol} \times \frac{32.0\,g\,O_2}{1\,mol\,O_2} = \boxed{17.9\,g}$$

2. This *unbalanced* equation shows one possible set of products for the reaction of aluminum and nitric acid:
$Al(s) + HNO_3(aq) \rightarrow Al(NO_3)_3(aq) + H_2(g)$.
Use the balanced version of this equation to determine the mass of nitric acid required to form 170 kg of hydrogen gas.

$$170\,kg \times \frac{1\,mol\,H_2}{0.0020\,kg} \times \frac{2\,mol\,HNO_3}{1\,mol\,H_2} \times \frac{63.0\,g\,HNO_3}{1\,mol\,HNO_3} = \boxed{1.1 \times 10^7\,g} \left(\text{or } 11{,}000\,kg\right)$$

3. Hydrogen gas can be used as a reducing agent in the production of pure boron from boron trichloride. How many moles of boron would form from the reduction of 500.0 g of boron trichloride with excess hydrogen gas?

Equation: $2BCl_3 + 3H_2 \longrightarrow 2B + 6HCl$

$$500.0\,g\,BCl_3 \times \frac{1\,mol}{117.3\,g} \times \frac{2\,mol\,B}{2\,mol\,BCl_3} = \boxed{4.263\,mol}$$

4. Write a balanced chemical equation for the reaction between sodium metal and water.
How many moles of hydrogen gas would form if 2 mol of sodium reacted with excess water? What volume would this gas occupy at STP conditions?

$2Na + 2H_2O \longrightarrow 2NaOH + H_2$

$$2\,mol\,Na \times \frac{1\,mol\,H_2}{2\,mol\,Na} = \boxed{1\,mol\,H_2}$$

1 mole of gas = $\boxed{22.4\,L}$