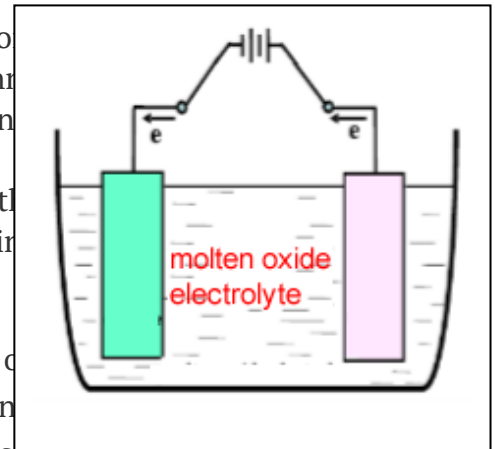


Electrolysis worksheet 11

- 1) Producing iron by electrolysis rather than conventional smelting could prevent the emission of a billion tons of carbon dioxide into the atmosphere every year. In conventional smelting, iron ore is combined with a coal-derived carbon called coke. The coke reacts with the iron, producing CO₂ and carbon monoxide, leaving pure iron behind.



Electrolysis produces iron a different way. The iron ore (Fe₂O₃) is dissolved in a solvent of silicon dioxide and calcium oxide at 1600°C and an electric current passed through it. Negatively-charged oxygen ions migrate to one electrode producing oxygen gas that is allowed to bubble off. Positively-charged iron ions migrate to the other electrode where they are reduced to elemental iron which collects in a pool at the bottom of the cell and is siphoned off.

- (a) Write the half-equation for the production of liquid iron and state at which electrode this reaction takes place at and the polarity of this electrode.

- (b) Write the half-equation for the production of oxygen gas and state at which electrode this reaction takes place at and the polarity of this electrode.

- (c) If the iron electrolytic cell operates at 100.0 kA for 0.800 hours, what is the total mass of iron that is deposited?

Step 1 Calculate the charge delivered

$$\Rightarrow Q = 100,000.00 \times 0.800 \times 60 \times 60 = 2.88 \times 10^8 \text{ C}$$

Step 2 Calculate the mol of electrons

$$\Rightarrow 2.88 \times 10^8 \text{ C} / 96500 = 2984$$

Step 3 Calculate the mol of iron

$$\Rightarrow \text{The ratio of } n_{\text{Fe}} : n_e \text{ is } 1 : 3$$

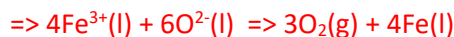
$$\Rightarrow \frac{1}{3} \times 2984 = 994 = n_{\text{Fe}}$$

Step 4 Calculate the mass of iron

$$\Rightarrow 994 \times 55.8 = 55.5 \text{ Kg}$$

- (d) What volume of oxygen at 101.3 kPa and 0 °C (STP) is formed when the amount of iron in (c) above is produced?

Step 1 Derive the overall equation for the reaction



Step 4 Calculate the mol of O₂ that will form when 994 mol of Fe formed.

$$\Rightarrow \frac{3}{4} \times 994 \times 22.4 = 1.67 \times 10^3 \text{ litres}$$

