Answers to worksheet questions

Chapter 9

Worksheet 9.1

1   A = mixture of iron ore, coke and limestone in

      B = hot gases out

      C = blast of hot air in

      D = molten slag out

      E = molten iron out

      F = 1500 °C

2   **a** $C + O_2 \rightarrow CO_2$
      b $CO_2 + C \rightarrow 2CO$
      c $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
      d $CaCO_3 \rightarrow CaO + CO_2$
      e $CaO + SiO_2 \rightarrow CaSiO_3$

Worksheet 9.2

1   **a** Al_2O_3
      b Al^{3+} and O^{2-}
      c to lower the melting point of the electrolyte

2   **a** the anode: $2O^{2-}(aq) - 4e^- \rightarrow O_2(g)$
      b the cathode: $Al^{3+}(l) + 3e^- \rightarrow Al(l)$

3   **a** Oxidation (*loss* of electrons) occurs at the *anode*.
      b Reduction (*gain* of electrons) occurs at the *cathode*.

4   The graphite anodes have to be replaced regularly because they slowly burn away at the high temperatures to form carbon dioxide. $C + O_2 \rightarrow CO_2$

5   The electrolysis is very expensive in terms of energy consumption.

Worksheet 9.3

1   A = hydrogen and nitrogen

      B = 450

      C = iron

      D = 200

      E = condenser

      F = liquid ammonia

2 **a i** 15%

    ii 50%

    iii 95%

  b 1000 atm and 200 °C

  c The high-pressure vessels required are too expensive to build and the rate of reaction is lower at 200 °C.

  d about 30%; the conditions used produce sufficient ammonia at a reasonable rate

Worksheet 9.4

1 **a** at the anode: $2Cl^-(aq) - 2e^- \rightarrow Cl_2(g)$

  b at the cathode: $2H^+(aq) + 2e^- \rightarrow H_2(g)$

2 Chlorine and sodium hydroxide would react together.

3 electrical energy

4 hydrogen: for making ammonia / making hydrogen chloride

   chlorine: for water treatment / making polymers

   sodium hydroxide: for making soaps and detergents

Worksheet 9.5

1 They are used to supply the three elements to the soil: nitrogen (N), phosphorus (P) and potassium (K).

2 **a** nitrogen

  b nitrogen

  c potassium

3 magnesium

4 formula mass of $NH_4NO_3 = (2 \times 14) + (4 \times 1) + (3 \times 16) = 80$

   % N $= (28/80) \times 100 = 35\%$

5 The potassium nitrate also supplies potassium to the soil.