Ammonia: Answers

1. (a) (i) Natural gas, air and water. All three required. [1]

(ii) Carbon dioxide [1]

(iii) Potassium carbonate (alkali) [1]

(iv) Iron [1]

(b) (i) About 33% [1]

(ii) The system has not reached equilibrium. [1]

(iii) Increasing the pressure increases the yield of ammonia. [1]

(iv) Increasing the pressure of the gases is expensive or operating at a higher pressure means pipework is more expensive to resist explosion. [1]

(v) Lowering the temperature increases the yield. [1]

(vi) Lowering the temperature slows down the rate of reactions. [1]

(c) (i) Cool gases below −33 °C, ammonia liquefies and can be removed. [1]

(ii) At higher pressures particles are closer together. [1]

Stronger forces between particles have to be broken down. [1]

(iii) In a liquid the particles are much closer together. [1]

More ammonia can be contained in a given volume. [1]

(d) Noble gases are not reacted and, as unreacted gases are re-cycled, their concentrations will build up. [1]