Question 35 **(17 marks)**

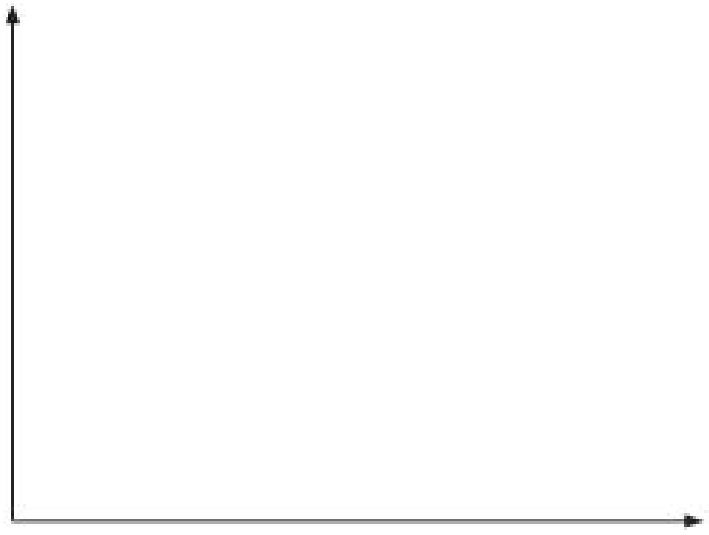
Thermite is a mixture of aluminium and iron(III) oxide that, when ignited, rapidly produces a large amount of heat as it burns. The reaction is represented by the equation:

$$2\,Al + Fe_2O_3 \rightarrow Al_2O_3 + 2\,Fe$$

The heat produced in the reaction is sufficient to melt iron, which is why the reaction is used to weld iron railway tracks.

(a) Use the following axes to sketch an energy profile diagram for the thermite reaction. Label the:

- axes
- reactants and products
- activation energy
- change in enthalpy. (4 marks)



(b) In order for the reaction to occur, the iron(III) oxide and aluminium are mixed as powders and a heat source, such as burning magnesium, is used to ignite the mixture. Using your understanding of collision theory, explain these observations. (4 marks)

(c) If the thermite reaction is 89.5% efficient, what mass of iron(III) oxide will be required to produce 667 kg of iron? Give your answer to the appropriate number of significant figures. (6 marks)

Aluminium can be refined through electrolysis. Molten aluminium oxide, which is mixed with a substance called cryolite to reduce the melting point, is electrolysed to produce aluminium and carbon dioxide, which is represented by the following equation:

$$2\,Al_2O_3(l) + 3\,C(s) \rightarrow 4\,Al(l) + 3\,CO_2(g)$$

(d) On the diagram below, correctly place the following in the boxes:

- anode
- cathode
- direction of cation flow and direction of anion flow
- direction of electron flow. (3 marks)