

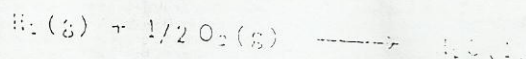
(e) Are volumes conserved when liquids are mixed? Explain briefly.

(f) A student calculated the heat of formation of MgO and obtained  $-610 \text{ kJ mol}^{-1}$ . The true value for the heat of formation of MgO is  $-602 \text{ kJ mol}^{-1}$ . Therefore the % error was  $-1.32\%$ . In discussing his results he stated that "the differences may be due to loss of heat due to poor insulation of the calorimeter". This is not acceptable. Discuss.

(g) A solution of ethyl acetate and sodium hydroxide was prepared that contained (at  $t = 0$ )  $5 \times 10^{-2} \text{ mol L}^{-1}$  ethyl acetate and  $8 \times 10^{-3} \text{ mol L}^{-1}$  sodium hydroxide. After 400s at  $25^\circ\text{C}$  a  $25 \text{ ml}$  aliquot was found to neutralize  $33.3 \text{ ml}$  of  $5 \times 10^{-3} \text{ mol L}^{-1}$  hydrochloric acid.

- (i) Calculate the rate constant for this second order reaction
- (ii) At what time would you expect  $20.0 \text{ ml}$  of hydrochloric acid to be required.

(h) Find the heat of formation of water (in  $\text{kJ mol}^{-1}$ )



Given

- (i)  $\text{Ca}(\text{s}) + 2\text{H}^+(\text{aq}) \longrightarrow \text{Ca}^{2+}(\text{aq}) + \text{H}_2(\text{g}) \Delta H_1 = -545 \text{ kJ mol}^{-1}$
- (ii)  $\text{CaO}(\text{s}) + 2\text{H}^+(\text{aq}) \longrightarrow \text{Ca}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \Delta H_2 = -194 \text{ kJ mol}^{-1}$
- (iii)  $2\text{CaO}(\text{s}) \longrightarrow 2\text{Ca}(\text{s}) + \text{O}_2(\text{g}) \Delta H_3 = +1212 \text{ kJ mol}^{-1}$

(1) A student mixes  $5.00 \text{ g}$  of a metal (M) with  $200 \text{ ml}$  of  $0.500 \text{ M HCl}$  and measures the change in temperature for 25 minutes as  $50^\circ\text{C}$ . The molar mass of the metal is  $50 \text{ g/mol}$ . The heat capacity of the solution is  $4.184 \text{ J/g}^\circ\text{C}$  and density of the solution is  $1.00 \text{ g/ml}$ .

(i) Find the molar heat of reaction (in  $\text{kJ mol}^{-1}$ ) for



(ii) Show by appropriate calculations that metal (M) is the limiting reagent.

1.00 M HCl

NaOH

40 s

Calculated

25 ml

33 ml

0.500 M