

5. Chemical energetics

5.2 Hess's law

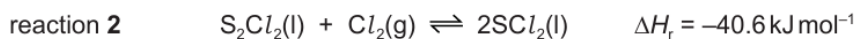
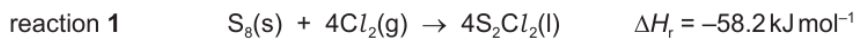
Paper 2

Question Paper

- 1 Some of the common chlorides of Period 3 elements are shown in the list.



- (d) Sulfur, S_8 , reacts with chlorine to form several different chlorides. The most common are S_2Cl_2 and SCl_2 . SCl_2 forms when sulfur reacts with an excess of chlorine.

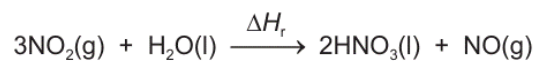


- (ii) Calculate the enthalpy change of formation, ΔH_f , of $\text{SCl}_2(\text{l})$. You may find it useful to use Hess's Law to construct an energy cycle.

enthalpy change of formation of $\text{SCl}_2(\text{l})$, $\Delta H_f = \dots\dots\dots \text{ kJ mol}^{-1}$
[2]

- 2** Nitric acid, HNO_3 , can be made by reacting nitrogen dioxide with water.

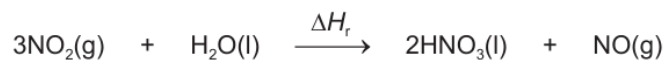
The enthalpy change for the reaction can be measured indirectly using a Hess' cycle.



- (b)** Complete the Hess' cycle using the values given in the table and hence calculate the enthalpy change, ΔH_r , for this reaction.

Show your working.

substance	$\Delta H_f/\text{kJ mol}^{-1}$
$\text{NO}_2(\text{g})$	34.0
$\text{H}_2\text{O}(\text{l})$	-286
$\text{HNO}_3(\text{l})$	-173
$\text{NO}(\text{g})$	91.1



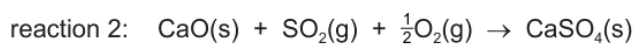
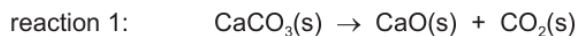
$$\Delta H_r = \dots\dots\dots \text{kJ mol}^{-1}$$

[3]

3 Phosphorus, sulfur and chlorine can all react with oxygen to form oxides.

(c) Emissions of SO_2 from coal-fired power stations can be reduced by mixing the coal with powdered limestone.

Limestone is heated to form CaO in reaction 1. This then reacts with SO_2 and O_2 to form CaSO_4 in reaction 2.



(ii) Use the data to calculate the enthalpy change of reaction 2.

compound	$\Delta H_f / \text{kJ mol}^{-1}$
$\text{CaO}(\text{s})$	-635
$\text{SO}_2(\text{g})$	-297
$\text{CaSO}_4(\text{s})$	-1434

enthalpy change of reaction 2 = kJ mol^{-1} [2]