• Use the thermochemical data provided to calculate the heat of reaction of the following reaction:

$$\text{PCl}_3(l) + \text{Cl}_2(g) \rightarrow \text{PCl}_5(s)$$

Data:

<table>
<thead>
<tr>
<th>Reaction</th>
<th>Heat of Reaction ($\Delta H^\circ$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{P}_4(s) + 6\text{Cl}_2(g) \rightarrow 4\text{PCl}_3(l)$</td>
<td>$-1280$ kJ mol$^{-1}$</td>
</tr>
<tr>
<td>$\text{P}_4(s) + 10\text{Cl}_2(g) \rightarrow 4\text{PCl}_5(s)$</td>
<td>$-1774$ kJ mol$^{-1}$</td>
</tr>
</tbody>
</table>

**ANSWER:**

• Identify one property of a molecule necessary for it to be considered a “greenhouse gas”.

`1 Marks`
The normal boiling point of chloroform is 61.7 °C and its enthalpy of vaporisation is 31.4 kJ mol\(^{-1}\). Calculate the entropy of vaporisation for chloroform at 1 atm.

Answer:
When 156 g of aluminium metal at 50.0 °C is added to 100 g of water at 20.0 °C, the final temperature becomes 30.0 °C. The heat capacity of water is 4.18 J K⁻¹ g⁻¹. Calculate the specific heat capacity of aluminium.

Answer:

What would the final temperature have been if the 156 g of aluminium metal at 50 °C had been added to iced water containing 10 g ice and 90 g water at 0 °C? ∆H for the freezing of water is –6.02 kJ mol⁻¹.

Answer:
In an experiment, 50.0 mL of 1.00 M HNO$_3$ was combined with 50.0 mL of 0.540 M NaOH in a calorimeter. Give an equation for the reaction that took place.

The temperature of the solution was found to increase by 2.98 °C. If the heat capacity of the calorimeter was 80.0 J K$^{-1}$ and the heat capacity of the final solution was 426 J K$^{-1}$, determine the molar heat of reaction.

Answer:

The average bond enthalpy of the O-H bond is 463 kJ mol$^{-1}$. Explain briefly why the heat of neutralisation calculated in the first part of this question differs significantly from this value.