Question 23 (3 marks)

(a) Write a balanced chemical equation for the complete combustion of 1-butanol.

\[ \text{C}_4\text{H}_{10}\text{O} + 9\text{O}_2 \rightarrow 4\text{CO}_2 + 5\text{H}_2\text{O} \]

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(b) A student measured the heat of combustion of three different fuels. The results are shown in the table.

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Heat of combustion (kJ g(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-48</td>
</tr>
<tr>
<td>B</td>
<td>-38</td>
</tr>
<tr>
<td>C</td>
<td>-28</td>
</tr>
</tbody>
</table>

The published value for the heat of combustion of 1-butanol is 2676 kJ mol\(^{-1}\).

Which fuel from the table is likely to be 1-butanol? Justify your answer.

\[ n = \frac{2}{0.0175 \text{ mol}} \]

\[ 1 \text{ mol} = 7 \text{ L} \]

\[ 2 \text{ mol} = 2 \times 7 \text{ L} = 14 \text{ L} \]

\[ A \Rightarrow 0.0175 \text{ mol} \rightarrow 48 \text{ kJ} \]

\[ 1 \text{ mol} = 7 \text{ L} \]

\[ 1 \text{ mol} = 7 \times 48 \text{ kJ} = 336 \text{ kJ} \]

\[ x = 336 \times 0.0175 \text{ mol} \]

\[ x = 234 \text{ kJ mol}^{-1} \]

\[ \therefore \text{ Fuel B is most likely 1-butanol as its heat is closest to 2676 kJ mol}^{-1} \]