Chemistry

Standard level

Paper 1B

Practice paper

Topic: Energy Content of Fuels (SL)

1. A student performed an experiment to determine the specific energy of three different alcohols using a simple calorimetry setup.

Alcohol	Mass Burned / g	Temp Change / K	Mass of Water / g
Methanol	0.80	12.0	100.0
Ethanol	0.60	18.5	100.0
Propan-1-ol	0.50	19.2	100.0

(a) Calculate the energy released (q) by Ethanol in the experiment, using the formula $q = mc\Delta T$ (specific heat capacity of water = 4.18 J g^{-1} K^{-1}). **[2]**

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(b) Determine the experimental specific energy of Ethanol in kJ g^{-1}. **[2]**

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(c) Suggest two reasons why the experimental specific energy value is likely much lower than the theoretical value found in Section 13 of the Data Booklet. **[2]**

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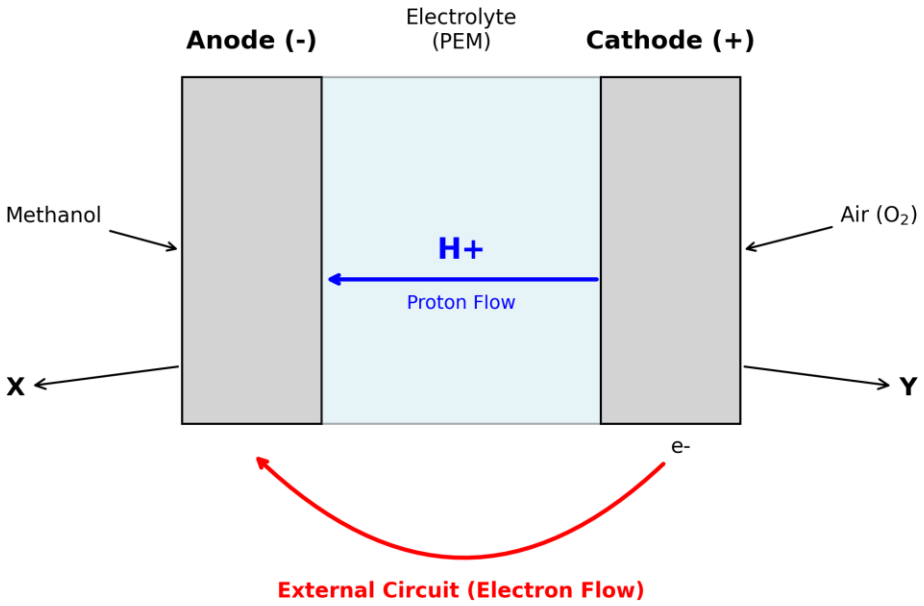
2. The diagram below represents a Direct Methanol Fuel Cell (DMFC) operating under acidic conditions.

Direct Methanol Fuel Cell (DMFC) Schematic



(a) Identify the chemical species labeled X and Y in the diagram. **[2]**

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(c) Explain the function of the Proton Exchange Membrane (PEM) in preventing the direct combustion of methanol with oxygen. **[2]**

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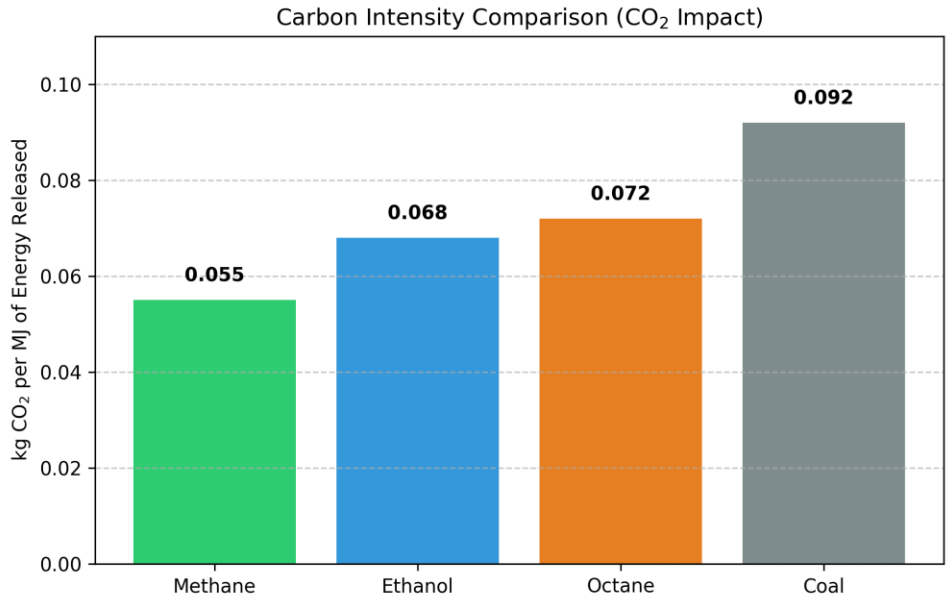
3. The environmental impact of fossil fuels is measured by their carbon intensity (mass of CO_2 produced per MJ of energy).



(a) Calculate the mass of CO_2 produced (in g) when 1.0 MJ of energy is released by Methane, given its specific energy is 55.5 kJ g^{-1} and its combustion produces 2.75 g of CO_2 per g of fuel. **[2]**

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(b) Explain using the Carbon-to-Hydrogen ratio why Coal has a significantly higher carbon intensity than Methane. **[2]**

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(c) Discuss why Ethanol (a biofuel) might be considered a 'cleaner' fuel than Octane, even if their carbon intensities per MJ are similar. **[2]**

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