Chemistry

Standard level

Paper 2

Practice paper

Topic: Energy Content of Fuels (SL)

1. Biodiesel is produced via the transesterification of triglycerides from vegetable oil.

(a) Define 'transesterification' and identify the two main types of reactants required for this process. **[2]**

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(b) Using a word or structural formula, state the identity of the glycerol byproduct formed during the reaction. **[1]**

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(c) Discuss one environmental advantage and one economic disadvantage of using biodiesel over conventional petroleum diesel. **[2]**

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2. A proton-exchange membrane (PEM) fuel cell utilizes hydrogen gas and atmospheric oxygen.

(a) Deduce the balanced half-equations for the reaction occurring at the anode and cathode in acidic conditions. **[2]**

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(b) State the overall cell reaction. **[1]**

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(c) Explain why hydrogen-rich fuels like methanol are sometimes preferred over pure hydrogen for mobile applications. **[2]**

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3. Methane (CH_4) and Ethanol (C_2H_5OH) are common fuels.

(a) Given that the enthalpy of combustion (ΔH_c) of Methane is -890 kJ mol^{-1}, calculate its specific energy in kJ g^{-1}. **[2]**

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(b) Define 'energy density' and deduce which of these two fuels would likely occupy less space for the same amount of energy stored. **[3]**

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4. Energy security depends on diversifying energy sources beyond fossil fuels.

(a) Identify two renewable energy sources and state one disadvantage for each related to their reliability. **[3]**

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(b) Compare the environmental impact of nuclear energy and coal power in terms of greenhouse gas emissions and waste management. **[3]**

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(c) Write a balanced chemical equation for the incomplete combustion of Octane (C_8H_{18}) that produces carbon monoxide (CO) and water. **[2]**

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