MARKSCHEME - SL FUELS

P1A Answer Key:

1.A, 2.C, 3.B, 4.B, 5.A, 6.B, 7.B, 8.C, 9.B, 10.C, 11.A, 12.C, 13.C, 14.A, 15.B, 16.B, 17.B, 18.B, 19.B, 20.B

P1B Q1: (a) q = 100 * 4.18 * 18.5 = 7733 J = 7.73 kJ [2]. (b) 7.73 / 0.60 = 12.89 kJ g-1 [2]. (c) Heat loss to surroundings [1]; incomplete combustion [1].

P1B Q2: (a) X = CO_2 [1], Y = H_2O [1]. (b) $CH_3OH + H_2O \rightarrow CO_2 + 6H^+ + 6e^-$ [2]. (c) It allows protons to pass while blocking the crossover of methanol and oxygen [1], ensuring redox occurs at electrodes only [1].

P1B Q3: (a) 1 MJ = 1000 kJ. Mass fuel = 1000 / 55.5 = 18.0 g [1]. Mass CO_2 = 18.0 * 2.75 = 49.5 g [1]. (b) Methane has 4 Hydrogen atoms per Carbon; burning Hydrogen produces no CO_2 [1]. Coal is almost entirely Carbon [1]. (c) Biofuels are part of a closed carbon cycle (absorbed by plants) [1], whereas fossil fuels release long-sequestered carbon into the atmosphere [1].

P2 Q1: (a) Conversion of one ester to another [1]; Vegetable oil + Alcohol (Methanol/Ethanol) [1]. (b) Propane-1,2,3-triol / HO-CH2-CH(OH)-CH2-OH [1]. (c) Adv: Renewable/decreased net CO_2 [1]. Disadv: Higher production cost/land use [1].

P2 Q2: (a) Anode: $H_2 \rightarrow 2H^+ + 2e^-$ [1]. Cathode: $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$ [1]. (b) $2H_2 + O_2 \rightarrow 2H_2O$ [1]. (c) Hydrogen is difficult to store/compress [1]. Methanol is a liquid with higher energy density [1].

P2 Q3: (a) Molar mass of CH_4 = 16.05 [1]. 890 / 16.05 = 55.45 kJ g-1 [1]. (b) Energy released per unit volume [1]. Ethanol (liquid) is denser than Methane (gas) [1], hence has higher energy density [1].

P2 Q4: (a) Solar: Intermittent (day only) [1]; Wind: Intermittent (weather dependent) [1]. (b) Nuclear: Zero CO_2 emissions during operation [1]; Radioactive waste storage requires long-term management [1]. Coal: High CO_2 and SOx [1]. (c) $2C_8H_{18} + 17O_2 \rightarrow 16CO + 18H_2O$ [2].