TYPE – **RESEARCH**

OUTCOMES TO BE ASSESSED:
Outcome 1: Investigating and Communicating

Outcome 2: Structure, Properties and Uses of Materials

ADDITIONAL EVIDENCE:

Outcome 3: Interaction and Change

ESSENTIAL CONTENT - UNIT 2
The practice of chemistry
Models theories and language
Chemistry in and around the Home

UNIT 2 RESEARCH ASSIGNMENT: VALIDATION



OPEN QUESTION: Energy and fuel value

1. **What does the term sustainable mean? Give an example from your studies.** **[2 marks]**

   Sustainable means to maintain at a constant level [1]
   Eg. To keep our fuel resources at a maintained level [1] or any suitable correct example.

2. **Outline how we refine oils to obtain the vast variety of hydrocarbon fuels. Draw a labelled [1] diagram [1]of the equipment used. [3 marks]**
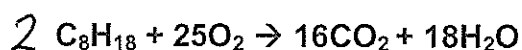
   Fractional Distillation – boiling point [1]
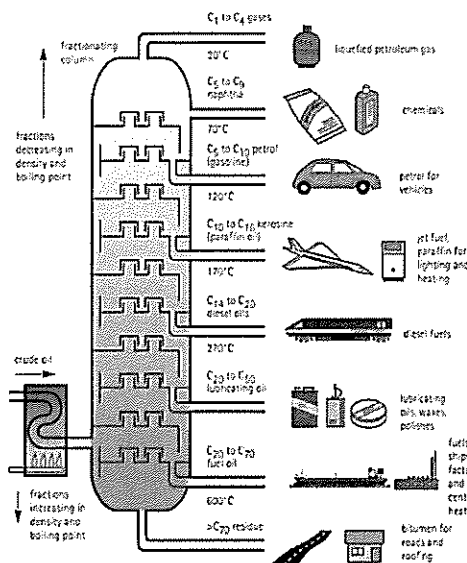
3. **Describe how biofuels such as bioethanol are most commonly made.** **[2 marks]**

   Fermentation [1] using yeast [1]

4. **Draw a balanced chemical equation for octane burning in air [1 mark]**

$$2\ C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$$

5. Complete the following equation:

a) _2_ C_3H_8 + ___7O_2___ → 6 CO + 8 H_2O [1 mark]

b) What would you define this type of reaction as?   [1 mark]
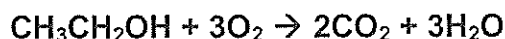
Incomplete combustion

c) Would there be more or less of an enthalpy change in this reaction? Explain why.   [2 marks]

Less. [1] bonds formed to bonds broken ratio is less so the net change in energy is less [1].

6. Draw a balanced chemical equation for ethanol burning in air [1 mark]

$$CH_3CH_2OH + 3O_2 → 2CO_2 + 3H_2O$$

7. As you can see below, the enthalpy of combustion values for the two fuels are significantly different.

ΔH_c of Ethanol = 1360 kJ/mol & Density = $0.79g/cm^3$
ΔH_c of Octane = 5460 kJ/mol & Density = $0.70g/cm^3$

Compare the energy from 10mL of each fuel to determine which fuel is more efficient at providing energy.   [5 marks]

$m(CH_3CH_2OH)$: 10mL = 7.9g
$n(CH_3CH_2OH)$ = m / Mr = 7.9g / 46 = 0.1717 moles [1]
ΔH = 1360 x 0.1717 = 233.56 kJ [1]

$m(C_8H_{18})$: 10mL = 7.0g
$n(C_8H_{18})$ = m/Mr = 7 / 114 = 0.0614 moles [1]
ΔH = 5460 x 0.0614 = 335.3 kJ [1]

C_8H_{18} > CH_3CH_2OH [1] in quantity of energy per 10 mL

8. Compare and contrast the fuels in terms of carbon footprint and efficiency to generate an opinion on which fuel is "best" to use.
                                                      [5 marks]
Ethanol produces ¼ the amount of CO_2 per molecule to octane [1]
ΔH_c of Ethanol = 1360 x 4 = 5440 kJ [1]
Opposed to Octane = 5460 kJ for the same carbon footprint [1]

In low concentrations of oxygen ethanol is more likely to completely combust [1]
Best to use as it is more efficient at producing energy. [1]
Ethanol production and combustion is carbon neutral [1]
Octane comes from crude oil that takes millions of years to make. [1]
Bioethanol is expensive to produce [1] octane is cheap [1]