**1**

**a)** Why is crude oil called a ‘fossil fuel’? (2)

**b)** Why do we have to be careful about how much crude oil we use? (1)

Crude oil is a mixture of different compounds. These are separated as shown in the diagram below according to their chain length.

**c)** What happens to the boiling point as the chain length increases? (1)

**d)** Using the diagram above, explain how petrol is separated out from crude oil. (6)



**2** One group of compounds found in crude oil are the alkanes. They are simplest homologous series. They are hydrocarbons.

**a)** What is an ‘homologous series’? (2)

**b)** What two elements are hydrocarbons made from? (2)

**c)** Below is a table showing the first four alkanes. Fill in the missing gaps. (5)

|  |  |  |  |
| --- | --- | --- | --- |
| **Alkane** | **Display structure** | **Structural formula** | **Molecular formula** |
| Methane |  | CH4 | CH4 |
| Ethane |  | CH3CH3 | C2H6 |
|  |  | CH3CH2CH3 |  |
| Butane |  |  |  |

**d)** What is the general formula for alkanes? (1)

**e)** How does the viscosity change as the chain gets longer? (1)

**f)** Alkanes can be burnt in oxygen to produce energy and two products. Write the word equation for the complete combustion of ethane. (2)

Ethane + oxygen → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**g)** If not enough oxygen is present then the results is incomplete combustion. This produces carbon monoxide (CO). Why is this dangerous? (1)

**h)** Write the *balanced chemical* equation for the *incomplete* combustion of ethane. (3)

**3** Another homologous series are the alkenes. They are unsaturated*.*

**a)** What does *unsaturated* mean? (1)

**b)** What is a chemical test for alkenes? (2)

**c)** Below is a table of some alkenes. Fill in the gaps. (3)

|  |  |  |  |
| --- | --- | --- | --- |
| **Alkene** | **Display structure** | **Structural formula** | **Molecular formula** |
|  |  |  | C2H4 |
| Propene |  | CH3CHCH2 |  |

Long chain alkanes are ‘cracked’ to make more useful shorter chain alkanes and alkenes.

**d)** Write the chemical equation for the cracking of octane (C8H18) into ethane and an alkane.

C8H18 → C2H4 + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (1)

**e)** Alkenes can be made into polymers. Molecules of propene combine to form polypropene. Draw the repeating unit of polypropene. (2)

*n*(CH3CHCH2) →

**f)** Polypropene is a man-made polymer and is formed by an *additional polymerisation* reaction.

Polyamides are made by condensation polymerisation.

What is the difference between these two methods of polymerisation? (2)

**4** Alcohols are another homologous series. One alcohol is ethanol. This can be made from sugar.

**a)** What is the process called that makes ethanol from sugar? (1)

**b)** What are the conditions needed for this reaction? (2)

**c)** Apart from being used in drinks, alcohols are used in inks. Why? (1)

**d)** Write the chemical equation for the complete combustion of ethanol. (3)

**e)** Alcohols oxidise to carboxylic acids. What would you see when sodium carbonate is added to ethanoic acid (CH3COOH)? (1)

**f)** Alcohols react with carboxylic acids to make esters. Below is a chemical and word equation for one such reaction. Fill in the gaps. (3)

Ethanoic acid + ethanol → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ + water

CH3COOH + \_\_\_\_\_\_\_\_\_ → CH3COOCH2CH3 + \_\_\_\_\_\_\_\_\_\_

**g)** Give a use for esters. (1)

Total = 50

**1**

**a)** It is a fuel that is made from **dead sea creatures** that died **millions** of years ago. (2)

**b)** It is non-renewable / it will run out / valuable resource. (1)

**c)** Boiling point increases as chain length increases. (1)

**d)**

|  |  |
| --- | --- |
| **Marks** |  |
| 6–5 | At least three different points well expressed |
| 4–3 | A couple of points mentioned |
| 2–1 | Not much detail |

* The crude oil is heated and vaporised.
* The vaporised crude oil enters the fractionating tower.
* This is hotter at the bottom and cooler at the top.
* The hydrocarbons cool as they rise up the tower.
* They condense at different heights because they have different boiling points.
* Hydrocarbons with large molecules are collected as liquids near the bottom of the tower while those with small molecules collect at the top.

**2**

**a)** A homologous series is a family of compounds with the same general formula / the same functional group / similar chemical properties. (any 2, 1 mark each)

**b)** Hydrogen and carbon (2)

**c)** (1 mark for each correct answer)(5)

|  |  |  |  |
| --- | --- | --- | --- |
| **Alkane** | **Display structure** | **Structural formula** | **Molecular formula** |
| Methane |  | CH4 | CH4 |
| Ethane |  | CH3CH3 | C2H6 |
| **Propane** |  | **CH3CH2CH3** | **C3H8** |
| Butane |  | **CH3CH2CH2CH3** | **C4H10** |

**d)** C*n*H2*n*+2 (1)

**e)** The alkane gets thicker/more viscous. (1)

**f)** carbon dioxide + water (2)

**g)** Carbon monoxide – poisonous / stops oxygen getting round body. (1)

**h)** C2H6 + 2½O2 → 2CO + 3H2O or × 2 (LHS = 1 mark, RHS = 1 mark, balance = 1 mark)

**3**

**a)** Contains C=C double bonds. (1)

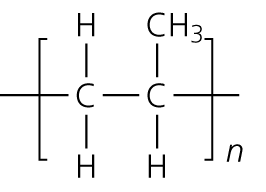
**b)** Decolourises bromine water. (2)

**c)** (1 mark for each correct answer) (3)

|  |  |  |  |
| --- | --- | --- | --- |
| **Alkene** | **Display structure** | **Structural formula** | **Molecular formula** |
| **Ethene** |  | **CH2CH2** | C2H4 |
| Propene |  | CH3CHCH2 | **C3H6** |

**d)** C6H14 (1)

**e)**

 (1 mark for no double bond, 1 mark for rest)

**f)** Addition: many monomers with double C=C bonds add together; condensation: small molecule (often water) given off. (2)

**4**

**a)** Fermentation (1)

**b)** No oxygen/warmth/yeast (any 2, 1 mark for each)

**c)** Used in inks, etc.; evaporate easily / dissolve substances better than water. (1)

**d)** C2H5OH + 3O2 → 2CO2 + 3H2O (LHS = 1, RHS = 1, balance = 1)

**e)** Bubbles/effervesces (1)

**f)** Ethanoic acid + ethanol → e**thyl ethanoate** + water

CH3COOH + **C2H5OH** → CH3COOCH2CH3 + **H2O** (3)

**g)** Esters are used in perfumes/soaps/flavourings. (1)

Total = 50