4.1 Crude oil alkanes and alkenes

Name: _____ Class: _____ Date: _____ **Total: 21 marks**

Objective

Cover introduction, crude oil, alkanes and alkenes (4.1–4.28): formula types and naming, fractional distillation, combustion and pollution, cracking, alkane substitution and alkene addition with bromine water. Original IGCSE-level practice.

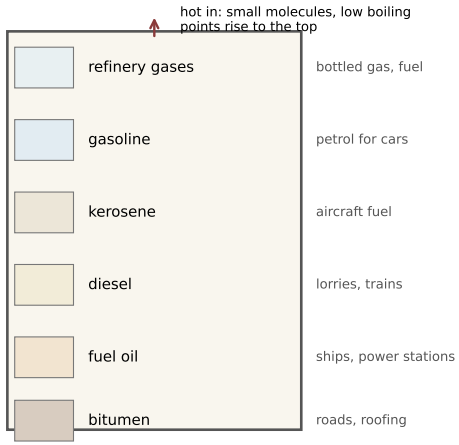
1 Key knowledge and worked examples

Families and their formulae

alkanes	alkenes	alcohols (C)
C_nH_{2n+2}	C_nH_{2n}	$C_nH_{2n+1}OH$
C-C single bonds only	one C=C double bond	-OH group

carboxylic acids (C)	esters (C)
$C_nH_{2n+1}COOH$	$RCOOR'$
-COOH group	-COO- link

The column and the furnace



Cracking: long alkane → alkene + shorter alkane (silica/alumina, 600–700 °C), because long fractions are oversupplied and short ones and alkenes are wanted.

Two reaction types

Alkane + halogen, UV: **substitution** (H swapped). Alkene + bromine: **addition** across C=C – bromine water decolourises.

2 Practice

2.1 State the general formulae of alkanes and alkenes. [2]

2.2 Name the fraction used for aircraft fuel and the one used for roads. [2]

2.3 Write the two products of complete combustion of propane. [2]

2.4 Name the two conditions for catalytic cracking, and name the catalyst. [3]

2.5 Give the colour change when ethene is bubbled through bromine water, and the reaction type. [2]

3 Exam-style questions

3.1 Explain how fractional distillation separates crude oil into fractions, referring to boiling points and the column's temperature gradient. [4]

3.2 Explain why carbon monoxide forms in car engines and why it is dangerous. [3]

3.3 Dodecane ($C_{12}H_{26}$) cracks into ethene and one other product. Write the equation, and give one reason industry wants more ethene. [3]

Solutions

2.1 C_nH_{2n+2}; C_nH_{2n}.

2.2 Kerosene; bitumen.

2.3 Carbon dioxide and water.

2.4 Temperature 600–700 °C; catalyst silica or alumina; (the vapour is passed over the hot catalyst) – conditions: heat + catalyst.

2.5 Orange to colourless; addition.

3.1 The furnace vaporises the crude oil; vapours rise up the fractionating column which is cooler towards the top; each fraction condenses where the temperature falls to its boiling point; small molecules with low boiling points condense at the top, large viscous molecules at the bottom.

3.2 When oxygen is limited, incomplete combustion gives carbon monoxide instead of CO_2; CO binds to haemoglobin, reducing the blood's capacity to transport oxygen, causing poisoning.

3.3 $C_{12}H_{26} \rightarrow C_{10}H_{22} + C_2H_4$; ethene is used to make polymers/plastics – ethanol – for which demand exceeds supply.