

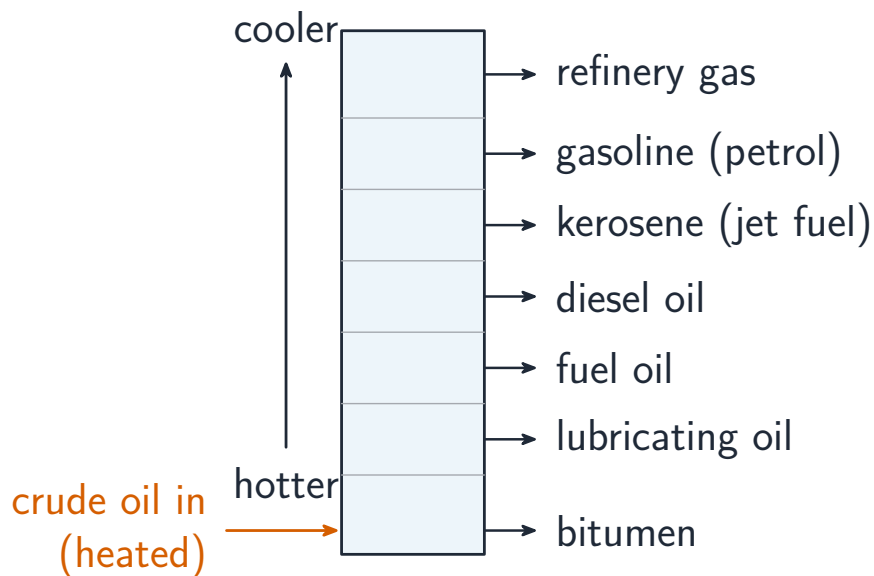
Exercise walk-through

11.3

Fuels

IGCSE Chemistry

Fuels: fractional distillation



up the column: smaller molecules,
lower boiling points, more volatile

Petroleum fractions is split into by boiling point in a tall column.

Top (cool): short chains, more **volatile**, low **viscosity**. Bottom (hot): long chains, **bitumen**.

Separating crude oil

The fractionating column

Crude oil is heated and fed into a **fractionating column** that is hot at the bottom and cool at the top.

Why it works

Longer molecules have stronger forces between them, so a longer **chain length** means a higher boiling point – and it condenses lower down.

Top to bottom

Refinery gases, petrol, naphtha, kerosene, diesel, fuel oil, bitumen.

Cracking

Long fractions in surplus are cracked into short ones in demand, giving alkenes for plastics as well as petrol.

One property – chain length – explains the order, the boiling points, the viscosity and how easily each fraction burns.

The fractions, top to bottom

Fraction	What it is used for
refinery gas	gas for heating and cooking
gasoline (petrol)	fuel for cars
naphtha	raw material for making chemicals
kerosene (paraffin)	fuel for aircraft
diesel oil	fuel for lorries and some cars
fuel oil	fuel for ships and home heating
bitumen	surfacing roads and roofs

Going **up** the column the chains get shorter: lower boiling point, higher **volatility** , lower **viscosity** , and they burn more easily.

Alkanes

combustion

burn in $\text{O}_2 \rightarrow \text{CO}_2 + \text{water}$

substitution

+ Cl_2 in **UV light**

Alkanes are **saturated** & generally unreactive. $\text{CH}_4 + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{HCl}$ (a photochemical reaction).

Cracking

large alkane molecule



heat + catalyst



smaller alkane + alkene (C=C)

Cracking breaks a big alkane into a smaller alkane + an **alkene**, using heat & a catalyst. It makes useful small molecules & alkenes for plastics.

Exercises 2.1·2.2

2.1 Define a hydrocarbon.

[1]

2.2 Name the fraction used as fuel for cars.

[1]

Exercises 2.1·2.2

2.1 Define a hydrocarbon.

[1]

2.1

- a hydrocarbon contains **hydrogen and carbon only**
-

2.2 Name the fraction used as fuel for cars.

[1]

2.2

- the car-fuel fraction is **gasoline / petrol**

Exercise 3.1

3.1 Going up the fractionating column, the boiling point of the fractions:

[1]

☐

A increases

B decreases

C stays the same

D increases then decreases

Exercise 3.1

3.1 Going up the fractionating column, the boiling point of the fractions: [1]

☐

A increases

B decreases

C stays the same

D increases then decreases

3.1 B

- boiling point **decreases** going up the column
- A is the opposite; C and D are wrong

Exercise 3.2 (a)

3.2 Petroleum is separated by fractional distillation.

(a) Explain why the different fractions separate.

[2]

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(a) Explain why the different fractions separate.

[2]

(a)

- the fractions have **different boiling points**
- they **condense at different heights** as the column cools towards the top

Exercise 3.2 (b)

3.2 Petroleum is separated by fractional distillation.

(b) State one use of bitumen.

[1]

Exercise 3.2 (b)

3.2 Petroleum is separated by fractional distillation.

(b) State one use of bitumen.

[1]

(b)

- bitumen is used for **making roads**

Exercise 3.3

3.3 Explain why a fraction near the top of the column flows more easily than one near the bottom. [2]

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3.3

- fractions near the top have **smaller molecules / lower viscosity**
- so they **flow more easily** than the larger molecules near the bottom