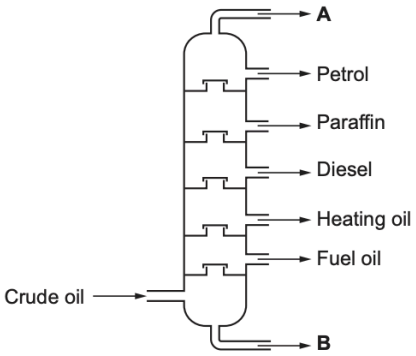
[Crude oil as a mixture, fractional distillation, hydrocarbons]

Q1.a(2018)

2 Crude oil can be separated into useful substances called fractions.



(a) Write down the name of the process that separates crude oil into fractions.

..... **[1]**

Q1.b(2018)

Name the fractions **A** and **B**.

A .....

B .....

[2]

Q2.a(2018)

c) Here are the boiling ranges for petrol and diesel.

Fraction	Approximate boiling range (°C)	Number of carbons
Petrol	30–80	5–10
Diesel	205–290	13–17

(i) How do the sizes of molecules in petrol and diesel differ?

..... **[1]**

Q2.b(2018)

Explain why the boiling range for petrol is different from the boiling range for diesel.

.....

.....

.....

..... **[3]**

Q3.(2018)

The table shows some hydrocarbons from crude oil.

Name	Formula
Methane	CH_4
Propane	C_3H_8
Butane	C_4H_{10}

(a) Nonane is another hydrocarbon from crude oil.

It contains 9 carbon atoms.

Predict the formula of nonane.

..... **[1]**

Q4.(2018)

Write down the name of this homologous series of hydrocarbons.

..... **[1]**

Q5.(2019)

One homologous series of organic compounds is called the alkanes.

They have the general formula C_nH_{2n+2}.

(a) The alkane with one carbon atom, $n = 1$, is called methane.

Write down the formula of methane.

..... **[1]**

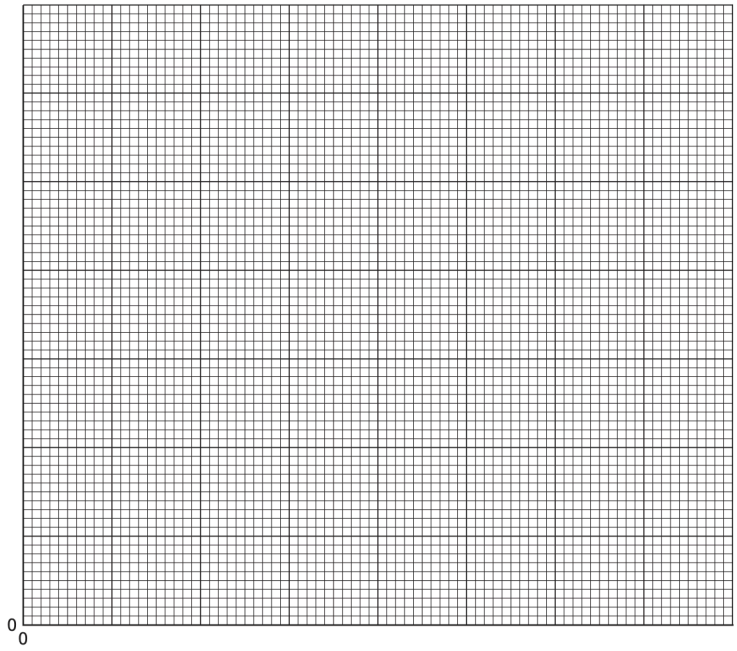
Q6.a(2019)

Table 13.1 shows the energy released when some alkanes burn in oxygen.

Alkane	Number of C atoms	Energy released (kJ/mol)
C_3H_8	3	2220
C_4H_{10}	4	2877
C_5H_{12}	5	3510
C_6H_{14}	6	4163
C_7H_{16}	7	4816
C_8H_{18}	8	5470

Table 13.1

(i) Plot a graph of number of carbon atoms against energy released using the data in **Table 13.1** and draw a line of best fit.



[4]

Q6.b(2019)

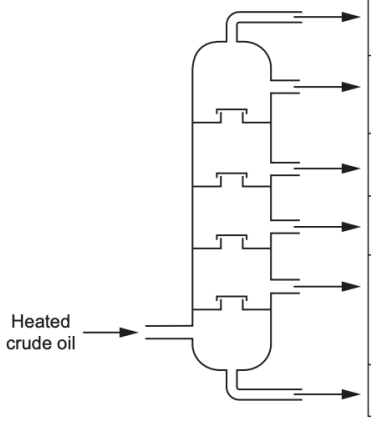
Use the graph to predict the energy released when methane burns (1 carbon atom).

Energy released = ... kJ/mol **[1]**

Q7.(2019)

14* Fractional distillation can be used to separate different fractions from crude oil.

Fig. 14.1 gives some information about the process.



Fraction	Boiling point (°C)	Average number of carbon atoms in alkanes present in fraction
LPG	< 40	3
Naphtha	40 – 190	10
Kerosene	190 – 270	15
Gas oil	270 – 360	20
Lubricating oil	360 – 540	35
Residue	> 540	40

Fig. 14.1

Explain how fractional distillation produces the different fractions from crude oil.

Use the information in **Fig. 14.1** and include ideas about intermolecular forces in your answer.

.....

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..... **[6]**

Q8.(2020)

A mixture contains two liquids, hexane and decane.

The table shows the boiling points of hexane and decane.

	Boiling point (°C)
Hexane	69
Decane	174

Which method is used to separate and collect **hexane** from a mixture of hexane and decane?

A Crystallisation

B Evaporation

C Filtration

D Fractional distillation

Your answer ☐ **[1]**

Q9.a(2020)

Look at the flowchart. It shows how crude oil is changed into useful substances.

Process 1. Fractional distillation	Crude oil is separated into fractions of similar hydrocarbons.
↓	
Process 2.	Some long chain hydrocarbons are turned into short chain hydrocarbons.
↓	
Process 3. Polymerisation	Some of the short chain hydrocarbons are used to make plastics.

(a) Complete the flowchart with the name of **Process 2**. **[1]**

Q9.b(2020)

Table 17.1 shows the supply and demand of two fractions of crude oil.

Fraction	Millions of barrels per day	
	Supply	Demand
Petrol	26	39
Fuel oil	19	11

Table 17.1

Explain the importance of **Process 2**.

Use information from **Table 17.1** in your answer.

.....

.....

.....

..... **[2]**

Q9.c(2020)

The hydrocarbon fractions from **Process 1** contain different alkanes.

Table 17.2 shows the boiling point of different alkanes produced in **Process 1**.

Number of carbon atoms in a molecule of the alkane	Boiling point (°C)
1	−162
2	−89
3	.....
4	−1
5	36

Table 17.2

(i) Complete **Table 17.2** with an estimate of the missing boiling point for an alkane molecule with **3 carbon atoms**. **[1]**

Q9.d(2020)

Write the formula for an alkane with **7 carbon atoms**.

..... **[1]**

Q10.(2021)

Octane, C_8H_{18}, is a compound in petrol.

Which statement about octane is correct?

A It is a hydrocarbon with a relative molecular mass of 66.

B It is a hydrocarbon with the empirical formula C_4H_9.

C It is extracted from crude oil by filtration.

D It is in the bitumen fraction of crude oil.

Your answer ☐ **[1]**

Q11.(2021)

Crude oil is a mixture of different chemicals called fractions.

(a) What is the name of the process used to separate crude oil into fractions?

..... **[1]**

Q12.(2021)

) Table 13.1 shows the stages in the separation of crude oil into fractions.

The stages are **not** in the correct order.

	Stages in the separation of crude oil into fractions
W	The vapours are piped into the bottom of the fractionating column.
X	The vapours cool and the fractions condense at different temperatures.
Y	Crude oil is heated and vaporised.
Z	The vapours rise up the column.

Table 13.1

Write **W**, **X**, **Y** and **Z** in the boxes to show the correct order of the stages.

☐ ☐ ☐ ☐

[1]

Q13.a(2021)

Table 13.2 shows information about the different gases in the LPG (liquefied petroleum gas) fraction separated from crude oil.

Gas in the LPG fraction	Formula	Boiling point (°C)
Methane	CH_4	−162
Ethane	C_2H_6	−89
Propane	C_3H_8	−42
Butane	C_4H_{10}	

Table 13.2

(i) Write the name of the homologous series of the gases in the LPG fraction.

..... **[1]**

Q13.b(2021)

What is the correct general formula for this homologous series?

Put a (ring) around the correct answer.

C_nH_n C_nH_{2n} C_nH_{2n+2} $C_{2n}H_{2n}$ $C_{2n}H_{2n+2}$

[1]

Q13.c(2021)

Use the data in **Table 13.2** to estimate the boiling point of butane.

Estimated boiling point = ... °C **[1]**

Q14.(2022)

Alkanes are hydrocarbons with the formula C_nH_{2n+2}.

Which compound is an alkane?

A C_6H_8

B C_7H_{12}

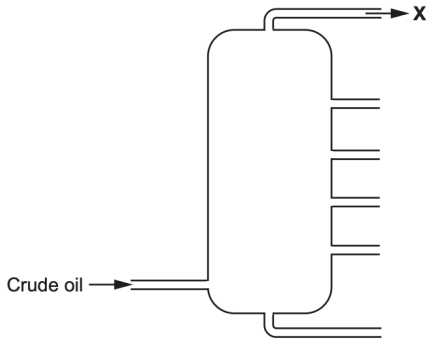
C C_8H_{16}

D C_9H_{20}

Your answer ☐ **[1]**

Q15.(2022)

The diagram shows the fractional distillation of crude oil.



The table shows the boiling point ranges of four different fractions.

Fraction	Boiling point range (°C)
A	below 20
B	20–80
C	180–260
D	260–320

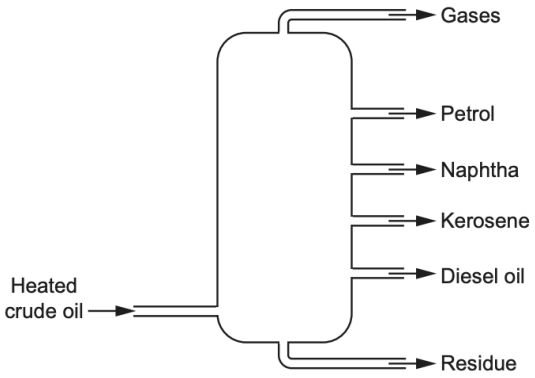
Which fraction is collected at **X**?

Your answer ☐ **[1]**

Q16.a(2023)

Fig. 12.1 shows the separation of the chemicals found in crude oil.

Fig. 12.1



(i) What is the name of the process shown in **Fig. 12.1**?

..... **[1]**

Q16.b(2023)

Crude oil is heated and vaporised as it enters the column.

Describe what happens to the vapours as they rise up the column.

.....

.....

.....

..... **[2]**

Q16.c(2023)

Which of the chemicals separated from crude oil has the **smallest** molecules?

Tick (✓) **one** box.

Gases ☐

Naphtha ☐

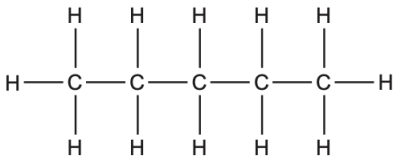
Residue ☐

[1]

Q16.d(2023)

Fig. 12.2 shows the structure of a molecule found in crude oil.

Fig. 12.2



(i) Which words describe the molecule?

Tick (✓) **two** boxes.

Alkane ☐

Hydrocarbon ☐

Mixture ☐

Polymer ☐

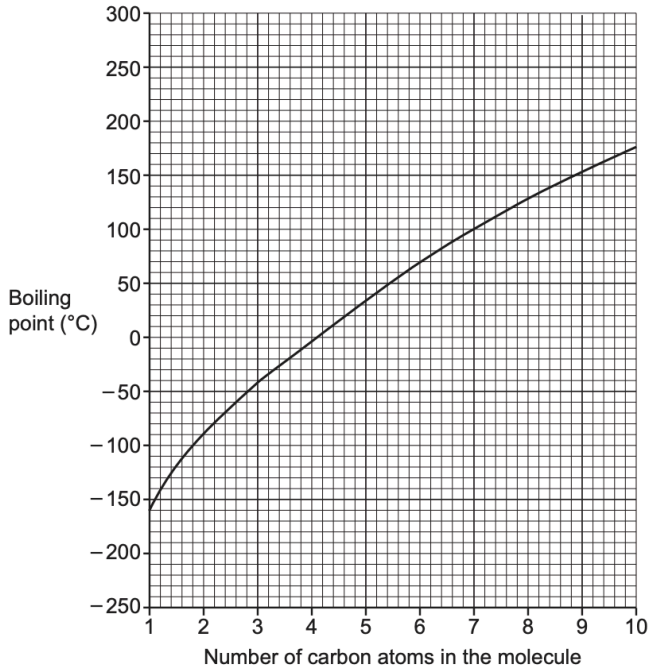
[2]

Q16.e(2023)

There are other molecules similar to **Fig. 12.2** but with different numbers of carbon atoms.

Fig. 12.3 shows how the boiling point of these molecules changes with the number of carbon atoms in the molecule.

Fig. 12.3



Use the graph to estimate the boiling point of the molecule shown in **Fig. 12.2**.

Boiling point = ... °C **[1]**

Q16.f(2023)

160 litres of crude oil contains 75 litres of petrol.

Calculate the percentage of petrol in the crude oil.

Give your answer to **2** significant figures.

Percentage of petrol = ... % **[3]**

Q17.(2024)

Crude oil is a source of useful chemicals called hydrocarbons.

Complete the sentence about crude oil.

Put a ring around the correct option.

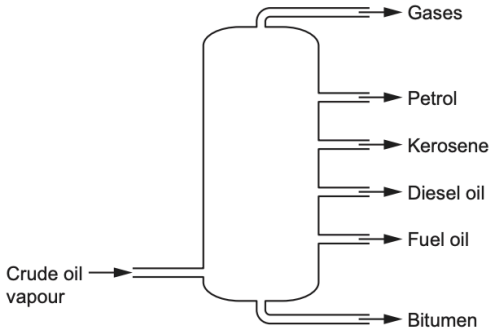
Crude oil is a **compound / feedstock / renewable resource** used by the petrochemical industry.

[1]

Q18.a(2024)

The diagram shows the fractionating column used in the fractional distillation of crude oil.

Fractionating Column



Which state symbol describes the crude oil as it enters the fractionating column?

Tick (✓) **one** box.

(g) ☐

(l) ☐

(s) ☐

[1]

Q18.b(2024)

Write an **X** on the fractionating column where it is **coolest**. **[1]**

Q19.a(2024)

The table shows the boiling point of four hydrocarbons.

Hydrocarbon	Boiling point (°C)
P	69
Q	126
R	36
S	98

Which of the hydrocarbons **P**, **Q**, **R** or **S** is produced nearest to the **top** of the fractionating column?

..... **[1]**

Q19.b(2024)

Which of the hydrocarbons **P**, **Q**, **R** or **S** has the **largest** molecules?

..... **[1]**

[Alkenes (Cracking and making alkenes, Test for alkenes (bromine water))]

Q1.(2018)

Not enough petrol is made from crude oil to meet world demand.

Oil refineries make more petrol using a process called **cracking**.

Describe how cracking makes more petrol from other hydrocarbons.

Include the conditions needed.

.....

.....

.....

..... **[3]**

Q2.a(2022)

The processing of crude oil by the petrochemical industry can be shown by different experiments.

Fig. 14.1 shows an experiment where paraffin is turned into decane and gas **X**.

Fig. 14.1

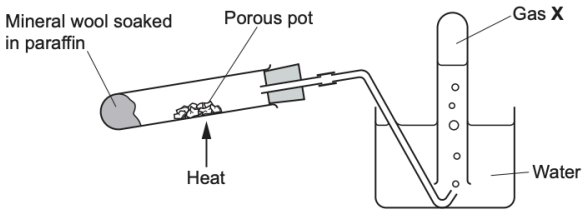
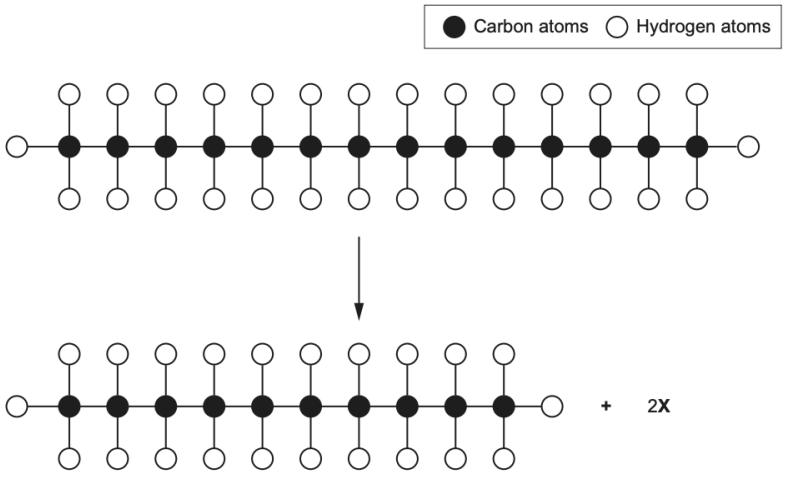


Fig. 14.2 shows the reaction of paraffin, $C_{14}H_{30}$, to make decane, $C_{10}H_{22}$, and gas **X**.

Fig. 14.2



Complete the sentences below to describe the experiment.

Put a ring around the correct choice to complete each sentence.

The experiment is called **cracking** / **displacement** / **distillation**.

It is an example of **combustion** / **reduction** / **thermal decomposition**.

[2]

Q2.b(2022)

The porous pot in **Fig. 14.1** acts as a **catalyst** in the reaction.

(i) What effect does the porous pot have on the **rate of the reaction**?

Put a ring around the correct answer.

decreases it **increases it** **no effect**

[1]

Q2.c(2022)

What effect does the porous pot have on the **activation energy** of the reaction?

Put a ring around the correct answer.

decreases it **increases it** **no effect**

[1]

Q2.d(2022)

Use **Fig. 14.2** to answer these questions.

(i) Write the formula of gas **X**.

..... **[1]**

Q2.e(2022)

Describe what happens to a molecule of paraffin as it turns into a molecule of decane.

.....

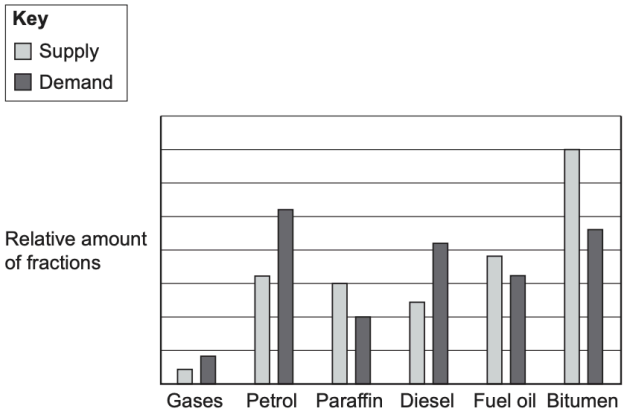
.....

..... **[2]**

Q2.f(2022)

Fig. 14.3 shows the supply and demand of different fractions of crude oil.

Fig. 14.3



Give **two** reasons why the oil industry turns paraffin into different hydrocarbons.

Use data from **Fig. 14.3**.

1 .....

.....

2 .....

.....

[2]

Q3.a(2024)

Large hydrocarbons can be made more useful by cracking.

The equation shows the cracking of hydrocarbon **X**.

X $\rightarrow$ C_6H_{14} + $2C_2H_4$

What is the formula of hydrocarbon **X**?

..... **[1]**

Q3.b(2024)

Which homologous series of hydrocarbons does C_6H_{14} belong to?

..... **[1]**

Q3.c(2024)

The hydrocarbon C_2H_4 belongs to a different homologous series.

Suggest the **general formula** of the homologous series that contains C_2H_4.

Tick **one** (✓) box.

C_nH_n ☐

C_nH_{2n} ☐

$C_{2n}H_n$ ☐

[1]

[Alcohols (Ethanol production, fermentation vs hydration)]

[Properties and reactions of carboxylic acids]

Q1.a(2019)

Hexane is a liquid alkane that burns in oxygen.

hexane + oxygen → carbon dioxide + water

(i) Which element in hexane is oxidised to produce water?

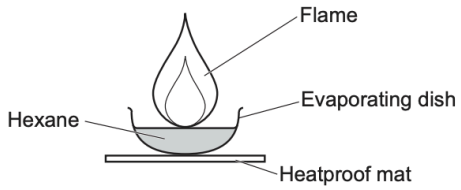
Give a reason for your answer.

element .....

reason ..... **[1]**

Q1.b(2019)

A student burns 10.0 g of hexane.



These are his results.

Mass of hexane before burning = 10.0 g
Mass of hexane after burning = 0.0 g

The law of conservation of mass is **true** for this reaction.

Explain why.

.....

.....

.....

..... **[2]**