PEARSON EDEXCEL GCSE COMBINED SCIENCE (HIGHER) · 1SC0

CHEMISTRY



EXAM QUESTION PACK

TOPIC 8: FUELS AND EARTH SCIENCE: FUELS (PAPER 2)

SCORE	PERCENTAGE
/114	%

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Q1.

Figure 5 shows the molecular formulae and boiling points of four alkanes.

alkane	molecular formula	boiling point in °C
propane	C_3H_8	–42
butane	C_4H_{10}	0
pentane	C_5H_{12}	36
hexane	C_6H_{14}	69

Figure 5

(i) Describe how the boiling points of these alkanes change as the numbers of carbon atoms in one of their molecules change.

(1)

.....

.....

(ii) Calculate the relative formula mass of a molecule of propane, C_3H_8. (relative atomic masses: C = 12, H = 1)

(1)

.....

relative formula mass = ...

(iii) Propane reacts with excess oxygen to form carbon dioxide and water.

Write the word equation for this reaction.

(2)

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.....

(iv) Explain a problem caused by the incomplete combustion of propane.

(2)

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(Total for question = 6 marks)

(**Q03b 1SC0/2CF/S2, SAM**)

Q2.

Propane, C_3H_8, and butane, C_4H_{10}, are members of the same homologous series, called the alkanes.

(i) Explain why both propane and butane are alkanes.

(2)

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(ii) Draw the structure of a molecule of butane, C_4H_{10}, showing all covalent bonds.

(2)

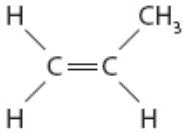
(**Q16 1SC0/2CF, June 2015**)

Q3.

(a) The table shows information about two alkenes.

Complete the table to show the names and structures of these alkenes.

(2)

name	structure of a molecule
ethene	
	

(b) (i) Ethene is an unsaturated compound.

State what is meant by **unsaturated**.

(1)

.....

(ii) Describe what is **seen** when ethene is passed into bromine water.

(2)

.....

.....

.....

(c) Alkenes can be obtained by cracking some fractions obtained from crude oil.

Explain what is meant by **cracking**.

(2)

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.....

.....

(d) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

Molecules of ethene are reacted together to form poly(ethene).
The reaction taking place is

(1)

☒ **A** combustion

☒ **B** photosynthesis

☒ **C** decomposition

☒ **D** polymerisation

(ii) Poly(ethene) is used to make plastic carrier bags.
Many of these bags are put into landfill sites.

Explain why the presence of waste plastic in landfill sites causes problems.

(2)

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(Total for Question = 10 marks)

(**Q27 1SC0/2CF, June 2013**)

Q4.

A student investigates the effect of acid rain on cress plants.

The student uses this method.

step 1 grow 20 cress plants in each of two dishes, **A** and **B**

step 2 water the cress plants in dish **A** with 10 cm^3 of dilute hydrochloric acid with a pH of 2

step 3 water the cress plants in dish **B** with 10 cm^3 of pure water with a pH of 7

step 4 repeat steps 2 and 3 every day for one week

step 5 count how many plants are still alive after one week.

(i) State what piece of equipment the student could use to measure the pH of each liquid.

(1)

.....

(ii) Explain **one** improvement that the student could make to the method to make the results more valid.

(2)

.....

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.....

(Total for question = 3 marks)

(**QU03d 1SC0/2CH, June 2023**)

Q5.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Crude oil is a mixture of hydrocarbons.

Crude oil can be separated into useful fractions by the process of fractional distillation in a fractionating column.

Figure 10 shows a fractionating column, the fractions obtained and the trend in viscosity of the fractions.

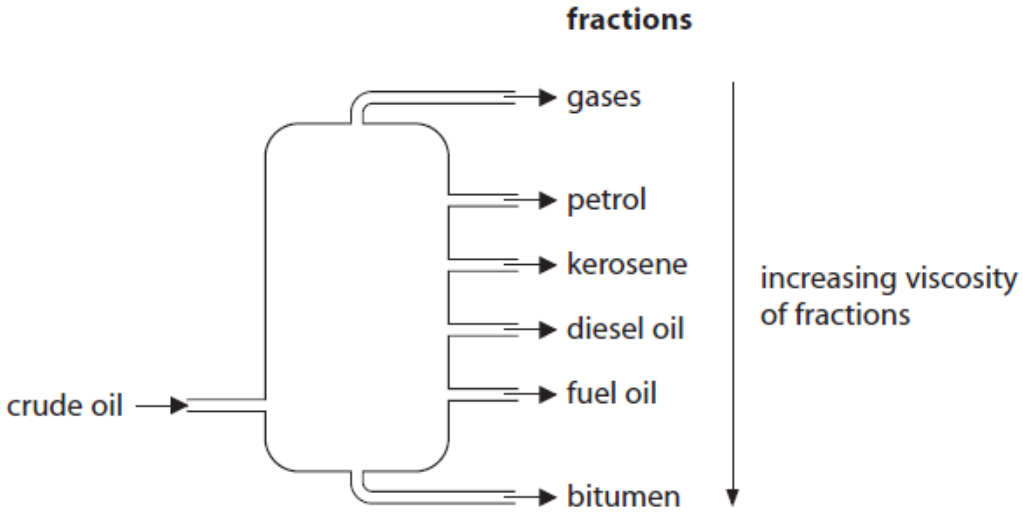


Figure 10

(i) Which row shows the correct uses for bitumen, diesel oil and fuel oil?

(1)

		bitumen	diesel oil	fuel oil
☒	**A**	fuel for large ships	surfacing roads	fuel for trains
☒	**B**	fuel for large ships	fuel for trains	surfacing roads
☒	**C**	surfacing roads	fuel for trains	fuel for large ships
☒	**D**	surfacing roads	fuel for large ships	fuel for trains

(ii) Explain the trend in the viscosity of the fractions.

(2)

.....

.....

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.....

.....

(Total for question = 3 marks)

(**QU06a 1SC0/2CH, June 2023**)

Q6.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Figure 5 shows the structure of one molecule of three different compounds, **X**, **Y** and **Z**.

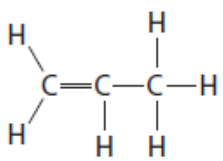
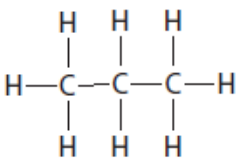
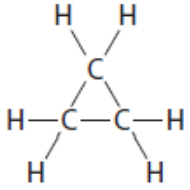
X	Y	Z
		

Figure 5

The molecules of the compounds shown in Figure 5 all contain the same number of carbon atoms.

(i) Give the number of carbon atoms in a molecule of compound **X**.

(1)

.....

(ii) Compound **X** contains carbon and one other element.

Give the **name** of the other element in compound **X**.

(1)

.....

(iii) Which of the compounds in Figure 5 is a hydrocarbon?

(1)

☒ **A** **X** only

☒ **B** **Y** only

☒ **C** **X** and **Y** only

☒ **D** **X**, **Y** and **Z**

(iv) Which of the compounds in Figure 5 have the same molecular formula?

(1)

☒ **A** none of them

☒ **B** **X** and **Y** only

☒ **C** **X** and **Z** only

☒ **D** **X**, **Y** and **Z**

(Total for question = 4 marks)

(**QU03a 1SC0/2CF, June 2024**)

Q7.

(i) When hydrocarbon fuels are burned, the products are water and carbon dioxide.

Describe what needs to be done to the apparatus in Figure 5 to collect the water and show that carbon dioxide has been produced.

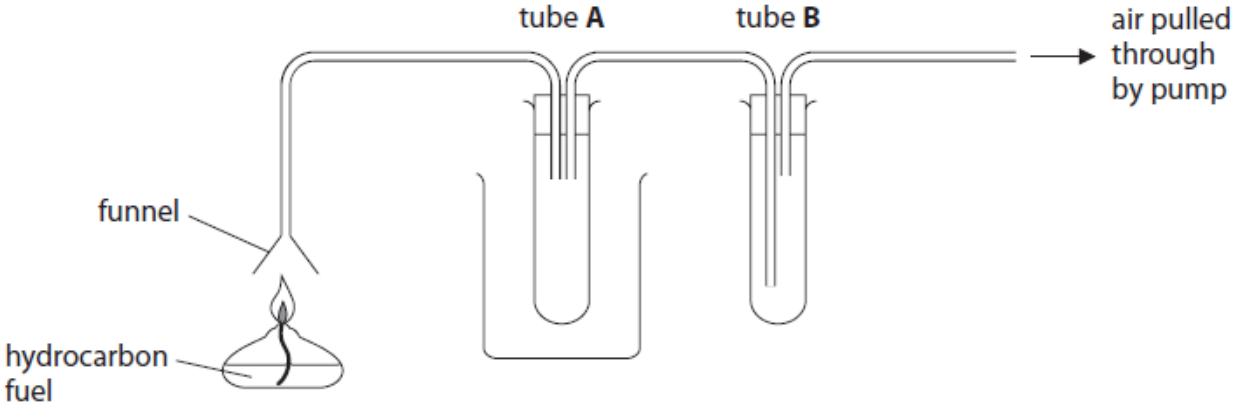


Figure 5

(2)

.....

.....

.....

.....

(ii) A hydrocarbon, C_xH_y, is burned in excess oxygen, forming 26.4 g of carbon dioxide and 5.4 g of water.

The relative formula mass of C_xH_y is 78.

Calculate the molecular formula of the hydrocarbon C_xH_y.

(relative atomic masses: H = 1.0, C = 12;
relative formula masses: H_2O = 18, CO_2 = 44)

(4)

.....

.....

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molecular formula = ...

(Total for question = 6 marks)

(**QU04b 1SC0/2CH, June 2024**)

Q8.

Figure 8 shows one molecule of each of four different substances, **A**, **B**, **C** and **D**.

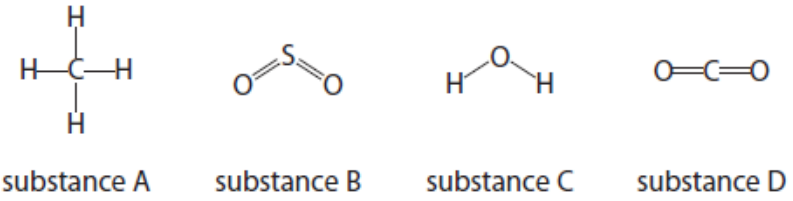


Figure 8

(i) Substance **C** can be formed by burning an element in oxygen.

Write the word equation for this reaction.

(1)

.....

(ii) Consider substances **A**, **B**, and **D**.

Give the letters of the two substances that can be formed by burning an element in oxygen.

(1)

.....

(Total for question = 2 marks)

(**Q16 1SC0/2CF, June 2018**)

Q9.

Crude oil is found in the Earth's crust.

In January 2015 the United Kingdom produced 850 000 barrels of crude oil per day. 45% of this crude oil was fuel oil.

Calculate the number of barrels of fuel oil present in the 850 000 barrels of crude oil.

Give your answer to two significant figures.

(3)

.....

.....

..... barrels

(Total for question = 3 marks)

(**Q14 1SC0/2CF, June 2018**)

Q10.

(a) Which of these is the formula of a molecule of a hydrocarbon?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** CH_3COOCH_3

☒ **B** CH_3CH_2Cl

☒ **C** CH_3CH_3

☒ **D** CH_3COOH

(b) The formula of a molecule of propene is C_3H_6.

Draw the structure of a molecule of propene, showing all covalent bonds.

(2)

(c) Methane burns in oxygen to form carbon dioxide and water.
Write the balanced equation for this reaction.

(3)

.....

*(d) Natural gas is mainly methane.
A gas with similar composition, known as bio-methane, can be produced from plants grown specifically for this purpose.

Describe the advantages and disadvantages of using bio-methane rather than natural gas as a source of energy.

(6)

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(Total for Question is = marks)

(**Q24 1SC0/2CH, June 2013**)

Q11.

When decane undergoes complete combustion, a mixture of carbon dioxide and water is formed.

Complete the balanced equation for this reaction.

(2)

$2C_{10}H_{22}$ + ... O_2 → ..... CO_2 + ... H_2O

(Total for question = 2 marks)

(**Q03ciii 1SC0/2CH, SAM 2016**)

Q12.

* When hydrocarbon fuels burn in a plentiful supply of air they undergo complete combustion, forming carbon dioxide and water vapour.

If the air supply is limited incomplete combustion occurs and carbon monoxide and carbon may be formed.

Describe the problems that can be caused by these products of complete and incomplete combustion.

(6)

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(**Q36 1SC0/2CF, June 2013**)

Q13.

1 mole of pentadecane can be cracked to form 1 mole of octane, C_8H_{18}, and 1 mole of propene, C_3H_6, and 2 moles of another product.

Complete the balanced equation for this reaction by adding the formula of the missing product.

(1)

$C_{15}H_{32} \rightarrow C_8H_{18} + C_3H_6 + 2$ .....

(Total for question = 1 mark)

(**Q06b 1SC0/2CH, Nov 2021**)

Q14.

When fuels such as diesel oil are burned, the high temperatures produced can cause nitrogen and oxygen in the air to form the pollutant nitrogen dioxide.

Complete the balanced equation for the reaction.

(2)

$N_2 + 2O_2 \rightarrow$ .....

(Total for question = 2 marks)

(**Q02c 1SC0/2CH, Nov 2021**)

Q15.

When fuels such as diesel oil are burned, the high temperatures produced can cause nitrogen and oxygen in the air to form the pollutant nitrogen dioxide.

Complete the balanced equation for the reaction.

(2)

$N_2 + 2O_2 \rightarrow$ .....

(Total for question = 2 marks)

(**Q06c 1SC0/2CF, Nov 2021**)

Q16.

Figure 6 shows where fractions are produced in the fractional distillation of crude oil.

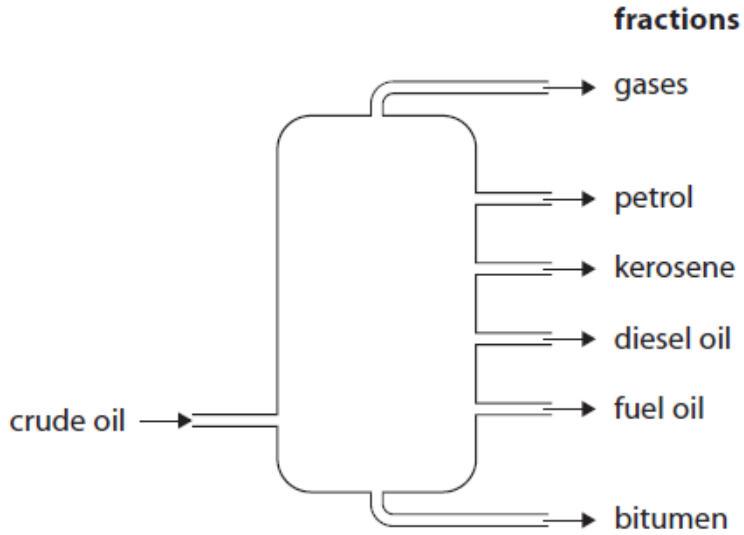


Figure 6

Complete the sentences about fractions obtained from crude oil.

(3)

The fraction with the smallest molecules is called ..... .

Compared to petrol, the boiling point of kerosene is ..... .

When petrol burns, one product is ..... .

(Total for question = 3 marks)

(**QU03b 1SC0/2CF, June 2024**)

Q17.

Methane is a hydrocarbon fuel.

(i) Complete the word equation for the **complete** combustion of methane in oxygen.

(2)

methane + ... → water + ...

(ii) The incomplete combustion of methane can produce carbon and carbon monoxide.

Give the reason why carbon and carbon monoxide are produced in the incomplete combustion of methane.

(1)

.....

.....

(Total for question = 3 marks)

(**Q04a 1SC0/2CF, Nov 2020**)

Q18.

Crude oil is a complex mixture of substances.

When crude oil is separated into fractions, the amount of each fraction obtained rarely matches the demand for that fraction.

Figure 9 shows the relative amounts of six of the fractions present in a crude oil and the relative demand for each of these fractions.

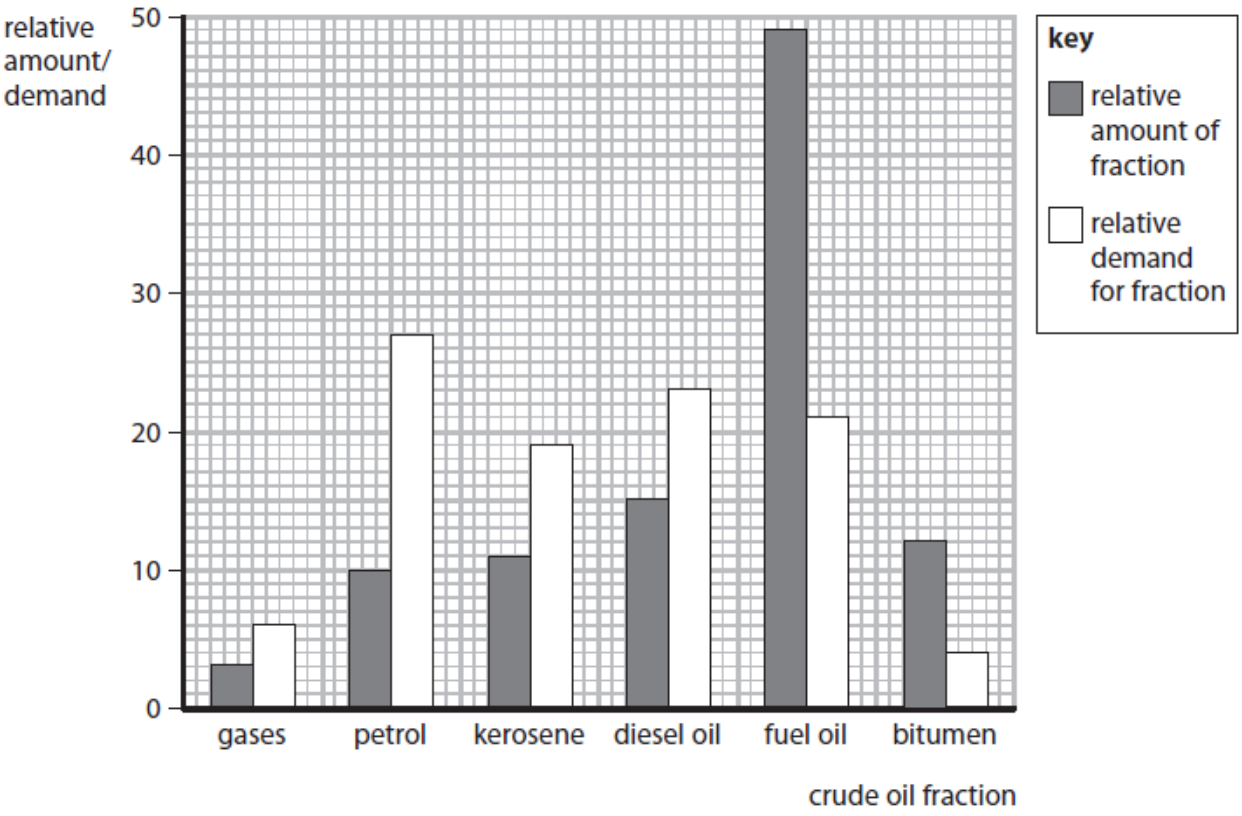


Figure 9

Cracking is used to match the relative amount of a fraction of crude oil to the demand for that fraction.

(i) Use the information in Figure 9 to give the name of the fraction that is most likely to need to be cracked.

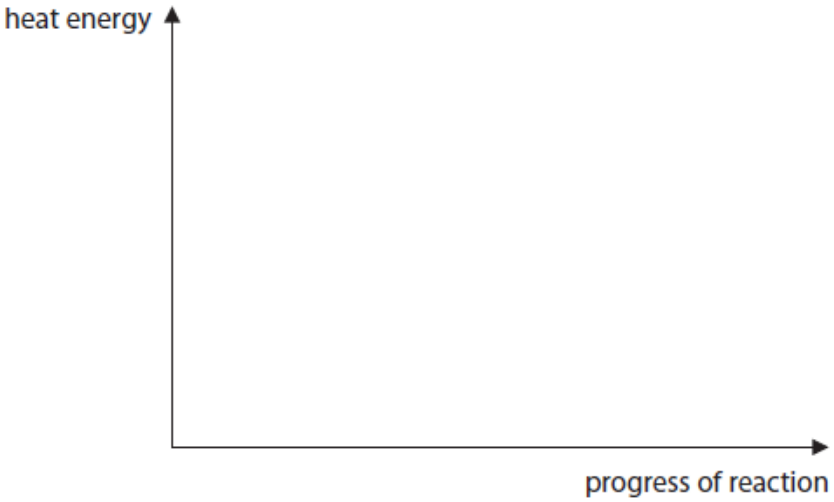
(1)

.....

(ii) In a cracking reaction, reactants are heated to form products.
This reaction is endothermic.

On the axes provided, draw the reaction profile of this reaction.
Label the energy of the reactants, the energy of the products and the activation energy of the reaction.

(3)



(iii) Dodecane, $C_{12}H_{26}$, can be cracked to form useful products.

Complete the equation for the cracking of dodecane by filling in the formula of the single molecule needed to balance the equation.

(1)

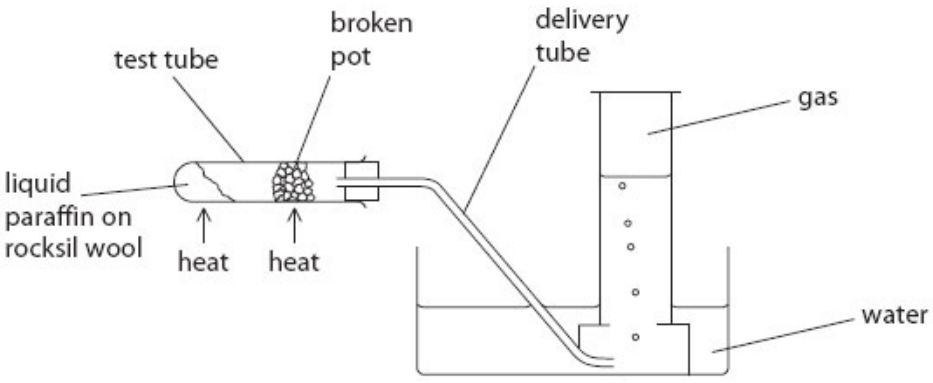
$$C_{12}H_{26} \rightarrow \text{.....} + 3C_2H_4$$

(Total for question = 5 marks)

(**Q15 1SC0/2CH, June 2018**)

Q19.

In the laboratory this apparatus is used to crack long chain hydrocarbon molecules to form shorter chain hydrocarbon molecules.



When the experiment is complete there is a danger that water will rise up the delivery tube into the hot test tube.

State what you would do to prevent this.

(1)

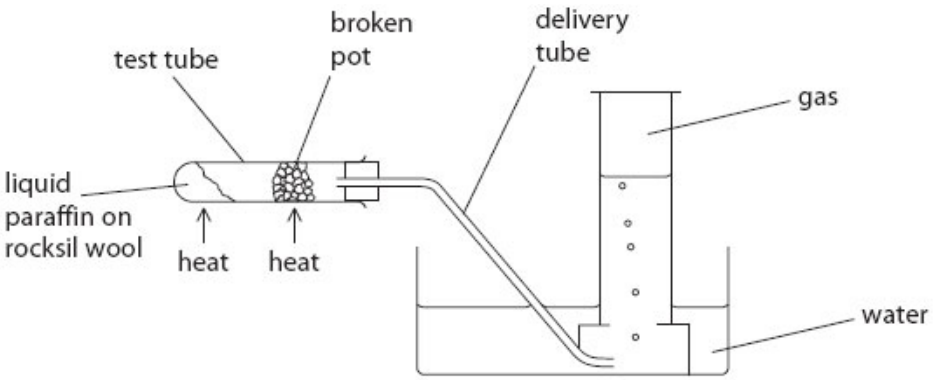
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(**Q27 1SC0/2CH, June 2013**)

Q20.

(a) In the laboratory this apparatus is used to crack long chain hydrocarbon molecules to form shorter chain hydrocarbon molecules.



When the experiment is complete there is a danger that water will rise up the delivery tube into the hot test tube.

State what you would do to prevent this.

(1)

.....

.....

(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

The equation for a reaction that occurs during cracking is

$$C_{12}H_{26} \rightarrow C_2H_6 + C_6H_{12} + X$$

In the balanced equation, X is

(1)

☒ **A** C_3H_8

☒ **B** C_4H_8

☒ **C** C_4H_{10}

☒ **D** C_6H_{14}

(c) Alkenes are unsaturated hydrocarbons.

State what is meant by **unsaturated.**

(1)

.....

(d) Propane and propene are bubbled through separate samples of bromine water.

Describe what you would **see** in these tests.

(3)

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.....

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(e) In industry, long chain hydrocarbon molecules are cracked to form shorter chain hydrocarbon molecules.

Explain why this process is important.

(2)

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(Total for Question = 8 marks)

(**Q22 1SC0/2CH, June 2013**)

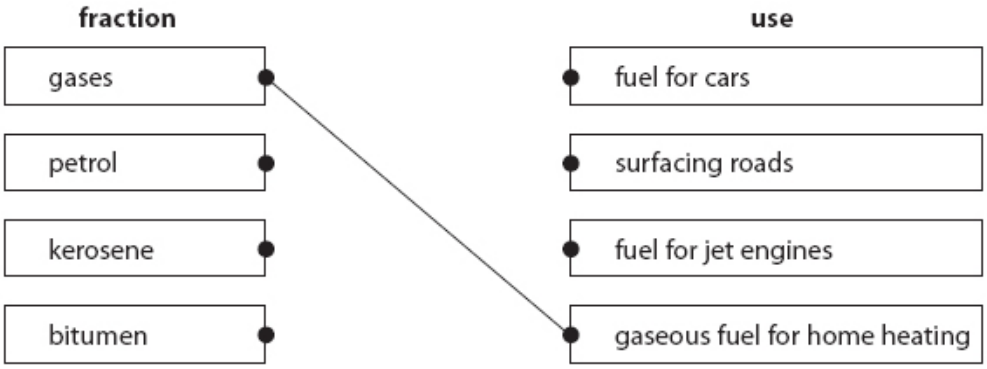
Q21.

The table shows some crude oil fractions and some uses.

Draw one straight line from each fraction to its correct use.

One has been completed for you.

(2)



(**Q35 1SC0/2CF, June 2013**)

Q22.

Hydrocarbon **X** was cracked to form one molecule of hexane, C_6H_{14}, and one molecule of alkene **Y**.

$$\mathbf{X} \rightarrow C_6H_{14} + \mathbf{Y}$$

The relative formula mass of **Y** is 56.
The empirical formula of **Y** is CH_2.

Deduce the molecular formula of hydrocarbon **X**.

Show your working.

(relative atomic masses: H = 1.0, C = 12)

(4)

.....

.....

.....

.....

.....

.....

.....

molecular formula of **X** = ...

(Total for question = 4 marks)

(**QU06b 1SC0/2CH, June 2023**)

Q23.

Alkenes can be obtained by cracking some fractions obtained from crude oil.

Explain what is meant by **cracking**.

(2)

.....

.....

.....

(**Q31 1SC0/2CF, June 2013**)

Q24.

Crude oil is found in the Earth's crust.

When crude oil is separated into fractions, the amount of each fraction obtained rarely matches the demand for that fraction.

Figure 7 shows the relative amounts of four of the fractions obtained from a crude oil and the relative demand for each of these fractions.

fraction	relative amount obtained from the crude oil	relative demand
gases	5	5
petrol	10	25
kerosene	20	25
fuel oil	45	5

Figure 7

State the fraction for which the relative amount obtained exceeds the relative demand.

(1)

.....

(Total for question = 1 mark)

(**Q13 1SC0/2CF, June 2018**)

Q25.

Crude oil is a mixture of hydrocarbons.

* Crude oil is separated into useful products called fractions using fractional distillation.

Figure 9 shows a fractional distillation column and the fractions kerosene and fuel oil.

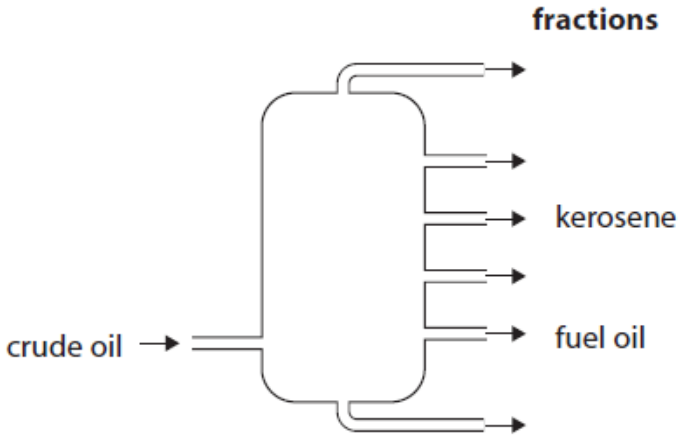


Figure 9

Kerosene and fuel oil have different uses depending on their properties.

Describe the properties and uses of kerosene and fuel oil.
Include in your answer

- the difference in boiling point
- the difference in viscosity
- the difference in ease of ignition
- their uses and how fuel oil can be converted into kerosene.

(Total for question = 6 marks)

Q26.

Cracking involves the breaking down of large hydrocarbon molecules into smaller hydrocarbon molecules.

(i) Octane, C_8H_{18}, can be cracked to produce one molecule of ethene, C_2H_4, and one molecule of C_xH_{14}.

$$C_8H_{18} \rightarrow C_2H_4 + C_xH_{14}$$

Determine the value of x in the molecule of C_xH_{14}.

(1)

x = ...

(ii) Dodecane is a large hydrocarbon molecule.
When one molecule of dodecane is cracked the products are one molecule of octane and one molecule of butene.

dodecane → octane + butene

Calculate the maximum mass of octane that could be produced when 340 g of dodecane is cracked in this reaction.

(relative formula masses: dodecane = 170, octane = 114)

(2)

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.....

.....

.....

.....

.....

mass of octane = ... g

(Total for question = 3 marks)

(**Q04d 1SC0/2CF, Nov 2020**)

Q27.

* Diesel is the fuel used in most bus engines.

Research is being carried out into the use of hydrogen, instead of diesel, as a fuel for buses.

Discuss the advantages and disadvantages of using hydrogen, rather than diesel, as a fuel for buses.

(6)

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(Total for question = 6 marks)

(**Q06c 1SC0/2CF, SAM 2016**)

Q28.

Petrol and diesel are used as fuels for cars.

The emissions from three similar sized cars were investigated.
The first car was the oldest, had no catalytic converter and used petrol.
The other two cars were only a few years old.
One of these was fitted with a catalytic converter and used petrol and the other car used diesel.

Figure 7 shows the emissions in grams for each kilometre travelled by these three cars.

	emissions in g km^{-1}			
	carbon monoxide	nitrogen oxides	carbon dioxide	carbon particulates
car with no catalytic converter using petrol	1.60	0.09	180	0.00
car with catalytic converter using petrol	0.67	0.02	180	0.00
car using diesel	0.05	0.19	130	0.02

Figure 7

Discuss and compare the impact on the environment of the emissions from these three cars using the information from Figure 7.

(Total for question = 6 marks)

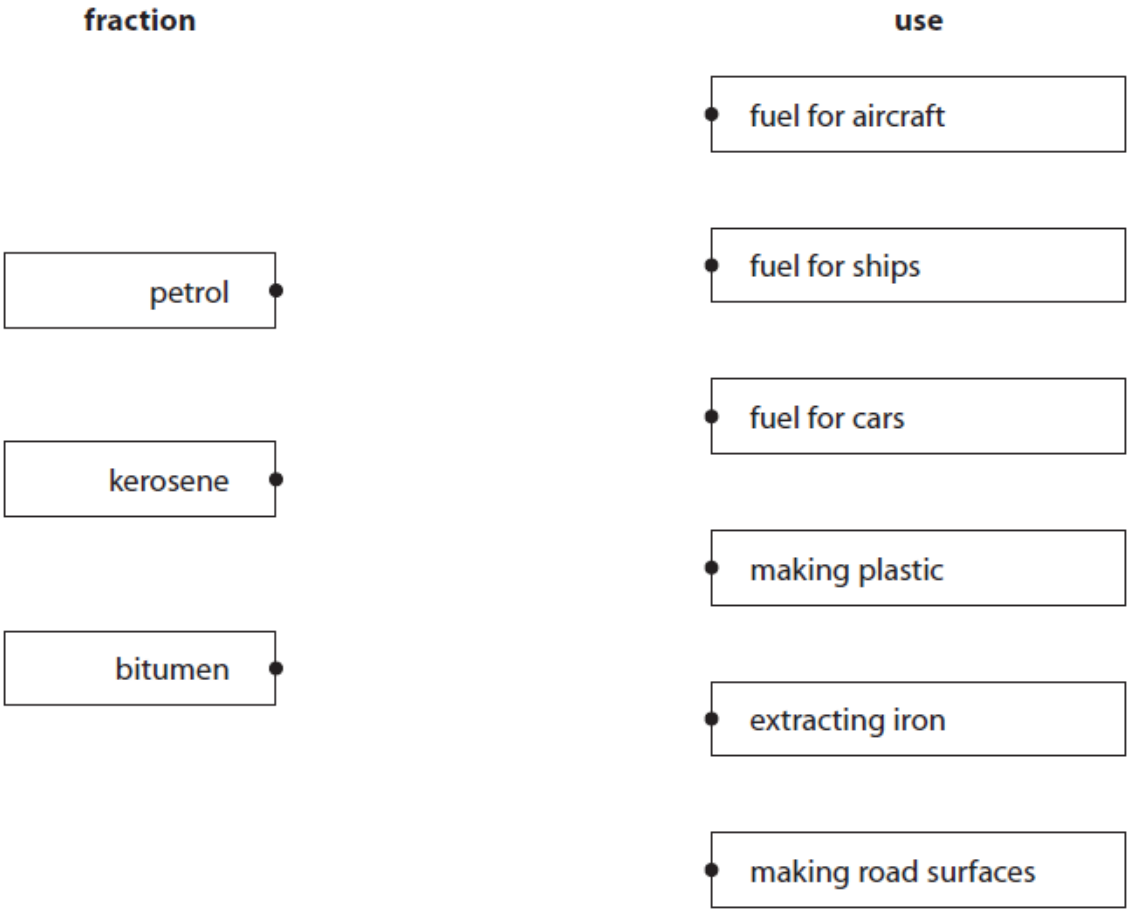
(**Q06c 1SC0/2CH, Nov 2020**)

Q29.

Crude oil can be separated into different fractions.

Draw **one** straight line from each fraction to a use of that fraction.

(3)



(Total for question = 3 marks)

(**QU03b 1SC0/2CF, June 2019**)

Q30.

Crude oil can be separated into different fractions.

Draw **one** straight line from each fraction to a use of that fraction.

(3)

fraction	use
petrol	fuel for aircraft
kerosene	fuel for ships
bitumen	fuel for cars
	making plastic
	extracting iron
	making road surfaces

(Total for question = 3 marks)

(**QU03b 1SC0/2CF, June 2022**)

Q31.

Several processes change the composition of the Earth's atmosphere.

Describe how the composition of the atmosphere is affected by burning fossil fuels.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

(**Q01b 1SC0/2CH, SAM 2016**)

Q32.

(a) Ethanol can be produced by reacting ethene with steam.

Write the balanced equation for this reaction.

(2)

.....

(b) Ethanol can also be produced by fermentation.

Describe how ethanol can be produced from sugar by fermentation.

(2)

.....

.....

.....

.....

(c) A country has large amounts of available fertile land.
It has no reserves of crude oil.
It is not a wealthy country.

Explain why this country produces the ethanol it needs by fermentation rather than from ethene.

(3)

.....

.....

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.....

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.....

(d) An atom of phosphorus contains 15 electrons.

Describe how these 15 electrons are arranged in a phosphorus atom.

(2)

.....

.....

.....

.....

(c) A country has large amounts of available fertile land.
It has no reserves of crude oil.
It is not a wealthy country.

Explain why this country produces the ethanol it needs by fermentation rather than from ethene.

(3)

.....

.....

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.....

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.....

(d) Ethanol is a member of the homologous series of alcohols.
The first three members of the series are

methanol CH_3OH

ethanol C_2H_5OH

propanol C_3H_7OH

Use the formulae of these molecules to explain why these alcohols are members of the same homologous series.

(2)

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(Total for Question = 9 marks)

(**Q36 1SC0/2CH, June 2013**)

Q33.

Ethanol

Ethanol is present in alcoholic drinks.

(a) Ethanol is produced by fermentation of carbohydrates.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The conditions used for fermentation are

(1)

☒ **A** add manganese(IV) oxide, temperature below 20°C

☒ **B** add yeast, temperature of about 35°C

☒ **C** add manganese(IV) oxide, temperature of 45°C

☒ **D** add yeast, temperature above 60°C

(b) Ethanol, C_2H_5OH, is also produced by the reaction of ethene with steam.

Write the balanced equation for this reaction.

(2)

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(c) Ethanol is a member of the homologous series, the alcohols.

(i) Describe what is meant by an **homologous series**.

(2)

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(ii) Draw the structure of a molecule of methanol, CH_3OH.

Show all the covalent bonds.

(1)

(d) When a bottle of wine is left open for a few days, ethanol in the wine changes into ethanoic acid.

(i) State the type of reaction that occurs when ethanol changes into ethanoic acid.

(1)

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(ii) Describe what you would **see** when a piece of magnesium ribbon is added to dilute ethanoic acid.

(2)

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(Total for question = 9 marks)

(**Q11 1SC0/2CH, June 2014**)

Q34.

* Diesel oil can contain impurities of sulfur.
Burning diesel oil containing impurities of sulfur can result in acid rain.
Acid rain is harmful to the environment.

Explain how acid rain is formed and the harm it can do.

(6)

(Total for question = 6 marks)

Q35.

Fractions of crude oil contain alkanes.

A sample of decane, $C_{10}H_{22}$, was cracked using the apparatus in Figure 12.

This produced a mixture of products, including ethene.

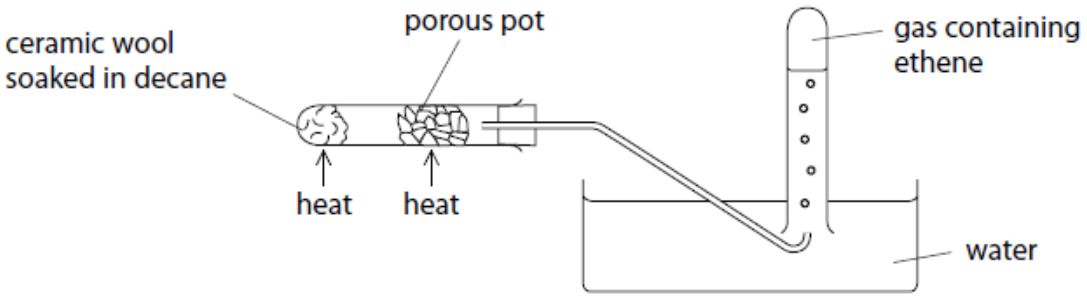


Figure 12

(i) Explain how ethene is produced using the apparatus in Figure 12.

(3)

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(ii) One molecule of decane produced two molecules of propene, C_3H_6, and one molecule of product **Z**.

$C_{10}H_{22} \rightarrow 2C_3H_6$ + product **Z**

What is the formula of product **Z**?

(1)

☒ **A** C_4H_8

☒ **B** C_4H_{10}

☒ **C** C_7H_{14}

☒ **D** C_7H_{16}

(Total for question = 4 marks)

(**Q06d 1SC0/2CF, SAM 2016**)

Q36.

Fractions of crude oil contain alkanes.

A sample of decane, $C_{10}H_{22}$, cracked using the apparatus in Figure 4.

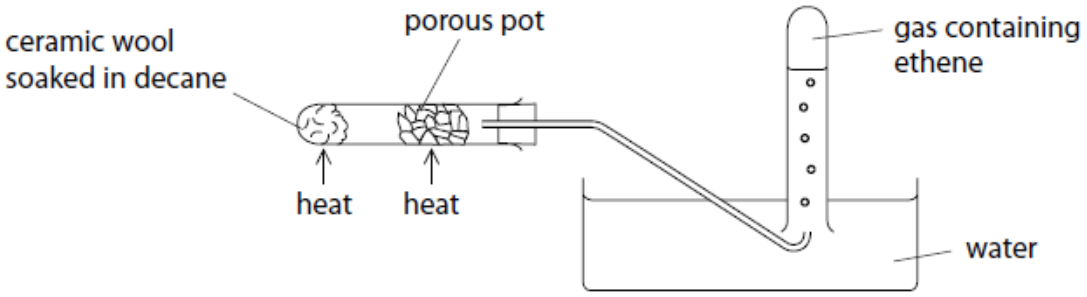


Figure 4

Explain how ethene is produced using the apparatus in Figure 4.

(3)

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(Total for question = 3 marks)

(**Q03ci 1SC0/2CH, SAM 2016**)

Q37.

Acid rain is caused by some pollutant gases present in the atmosphere.

Explain how impurities in fossil fuels can result in acid rain.

(3)

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(Total for question = 3 marks)

(**QU03c 1SC0/2CH, June 2023**)

Q38.

A fossil fuel contains carbon and sulfur.

Explain how the products of the complete combustion of this fossil fuel would affect the environment.

(4)

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(Total for question = 4 marks)

(**QU03b 1SC0/2CH, June 2024**)

Q39.

Explain how the greenhouse effect is caused by the gases produced by the complete combustion of diesel oil.

(3)

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(Total for question = 3 marks)

(**Q06d 1SC0/2CF, Nov 2021**)

Q40.

Explain how the greenhouse effect is caused by the gases produced by the complete combustion of diesel oil.

(3)

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(Total for question = 3 marks)

(**Q02d 1SC0/2CH, Nov 2021**)