Q1. This question is about hydrocarbons.

(a) The names and formulae of three hydrocarbons in the same homologous series are:

Ethane	C_2H_6
Propane	C_3H_8
Butane	C_4H_{10}

The next member in the series is pentane.

What is the formula of pentane?

.....

(1)

(b) Which homologous series contains ethane, propane and butane?

Tick **one** box.

Alcohols ☐

Alkanes ☐

Alkenes ☐

Carboxylic acids ☐

(1)

(c) Propane (C_3H_8) is used as a fuel.

Complete the equation for the complete combustion of propane.

C_3H_8 + $5O_2$ → 3 ..... + 4 .....

(2)

(d) Octane (C_8H_{18}) is a hydrocarbon found in petrol.

Explain why octane is a hydrocarbon.

.....

.....

(2)

(e) The table below gives information about the pollutants produced by cars using diesel or petrol as a fuel.

Fuel	**Relative amounts of pollutants**		
	Oxides of Nitrogen	**Particulate matter**	**Carbon dioxide**
Diesel	31	100	85
Petrol	23	0	100

Compare the pollutants from cars using diesel with those from cars using petrol.

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.....

.....

(3)

(f) Pollutants cause environmental impacts.

Draw **one** line from each pollutant to the environmental impact caused by the pollutant.

Pollutant	**Environmental impact caused by the pollutant**

	Acid rain
Oxides of nitrogen	Flooding
	Global dimming
Particulate matter	Global warming
	Photosynthesis

(2)
(Total 11 marks)

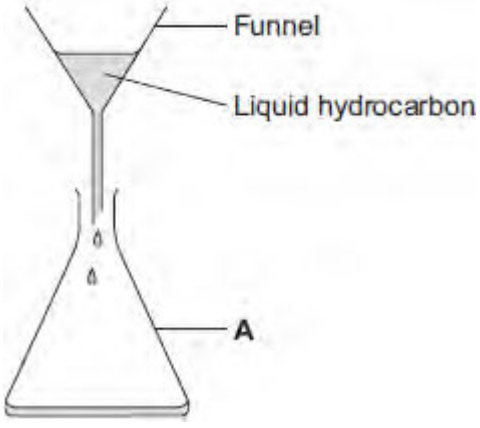
Q2.A student investigated the viscosity of liquid hydrocarbons.

A viscous liquid is a liquid that flows slowly.

The student used this method.

- Measure 50 cm^3 of the liquid hydrocarbon.
- Pour the liquid hydrocarbon into the funnel, as shown in **Figure 1**.

Figure 1



- Time how long it takes for all of the liquid hydrocarbon to run out of the funnel.
- Repeat the experiment for other liquid hydrocarbons.

(a) (i) Give the name of apparatus **A** in **Figure 1**.

.....

(1)

(ii) Name the apparatus that could be used to measure 50 cm^3 of liquid hydrocarbon.

.....

(1)

(b) The student's results for six liquid hydrocarbons are shown in **Table 1**.

Table 1

Formula of liquid hydrocarbon	Time for liquid hydrocarbon to run out of the funnel in seconds			Mean time in seconds
	Experiment 1	Experiment 2	Experiment 3	

C_5H_{12}	12	11	13	12
C_6H_{14}	14	15	15	15
C_7H_{16}	19	20	18	
C_8H_{18}	27	26	28	27
$C_{10}H_{22}$	46	48	24	47
$C_{12}H_{26}$	65	67	69	67

(i) The student did the experiment three times with each liquid hydrocarbon.

Give **two** reasons why.

.....

.....

.....

.....

(2)

(ii) Use the data in **Table 1** to calculate the mean time, in seconds, for C_7H_{16}

.....

.....

Mean time = ... seconds

(1)

(iii) Complete the sentence.

As the number of carbon atoms in a molecule of liquid hydrocarbon increases, the time taken for the liquid hydrocarbon to run out of the funnel

..... .

(1)

(iv) A ring has been drawn around one result in **Table 1**.

This result has **not** been used to calculate the mean time for $C_{10}H_{22}$

Suggest why this result was not used.

.....

.....

(1)

(v) Suggest **one** error the student may have made to get the ringed result.

.....

.....

.....

(1)

(c) The student investigated the effect of temperature on the viscosity of one of the liquid hydrocarbons.

The liquid hydrocarbon he was using had the hazard symbols shown in **Figure 2**.

Figure 2



(i) Suggest why the student warmed the liquid hydrocarbon using warm water and **not** a Bunsen flame.

.....

.....

(1)

(ii) The student wore safety glasses.

Give **one** other safety precaution the student should take, and give a reason for this safety precaution.

Safety precaution .....

Reason .....

.....

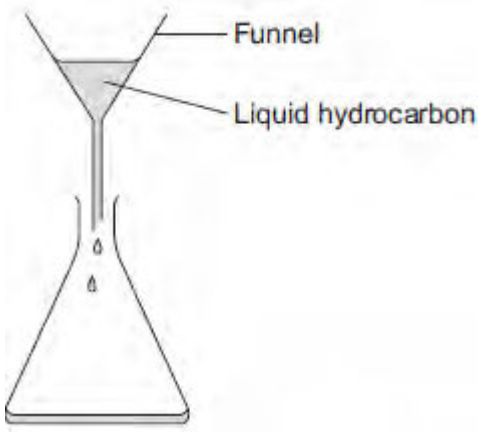
(2)

(d) This is the method the student used to investigate the effect of temperature on the viscosity of one of the liquid hydrocarbons.

- Measure 50 cm^3 of the liquid hydrocarbon and pour it into a beaker.

- Stand the beaker of liquid hydrocarbon in a heated water bath.
- Leave for a few minutes.
- Measure the temperature of the liquid hydrocarbon.
- Pour the liquid hydrocarbon into the funnel, as shown in **Figure 3**.

Figure 3



- Time how long it takes for all of the liquid hydrocarbon to run out of the funnel.
- Repeat the experiment at different temperatures.

(i) The student's results are shown in **Table 2**.

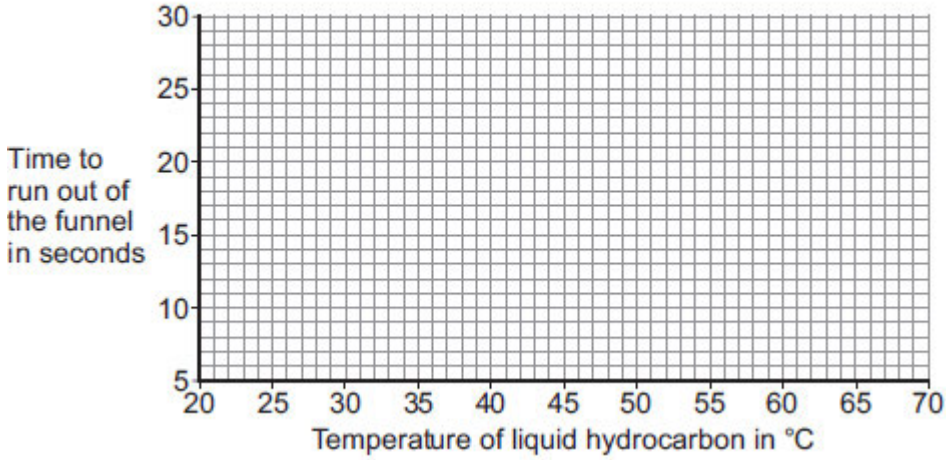
Table 2

Temperature of liquid hydrocarbon in °C	Time to run out of the funnel in seconds
23	27
30	21
37	17
46	16
55	11
65	9

Plot the results shown in **Table 2** on the graph in **Figure 4**.

Draw a curve of best fit.

Figure 4



(3)

(ii) One of the points is anomalous.

Draw a ring around the anomalous point on your graph.

(1)

(iii) Predict how long it will take the liquid hydrocarbon to run through the funnel at 70 °C.

Show your working on your graph.

Time = ... seconds

(2)

(iv) Describe the relationship between the temperature of the liquid hydrocarbon and the viscosity of the liquid hydrocarbon.

.....

.....

.....

.....

.....

.....

(3)

(v) The apparatus the student used in **Figure 2** could lead to a systematic error in the results.

Identify **one** source of systematic error, and describe how the student could avoid or reduce the error.

.....

.....

.....

.....

(2)
(Total 22 marks)

Q3. Crude oil is a fossil fuel.

(a) To make crude oil more useful it is separated into fractions.

Use the correct word from the box to complete each sentence.

boiling	**compound**	**decomposition**	**distillation**
filtration	**mixture**	**molecule**	

(i) Crude oil is a ..... of different substances.

(1)

(ii) The substances in crude oil have different

..... points.

(1)

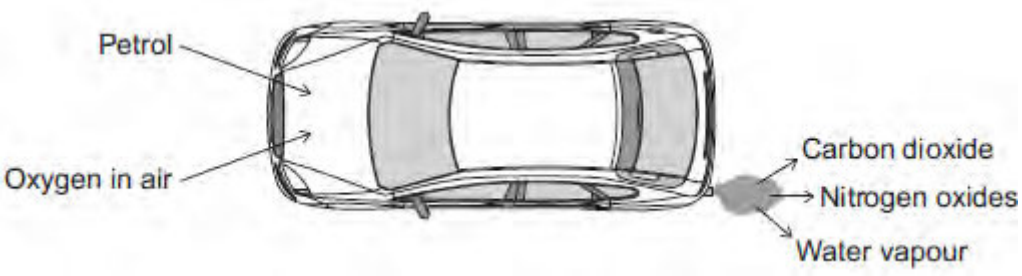
(iii) Crude oil is separated by fractional ..... .

(1)

(b) Petrol is one of the fractions produced from crude oil.

Car engines use a mixture of petrol and air.

The diagram shows some of the gases produced.



(i) What type of reaction happens to petrol in a car engine?

Tick (✓) **one** box.

combustion ☐

decomposition ☐

neutralisation ☐

(1)

(ii) Petrol contains octane (C_8H_{18}).

Complete the word equation for the reaction of octane with oxygen.

octane + ... ⟶ ..... + ...

(2)

(iii) Cars use sulfur-free petrol as a fuel.

Describe why sulfur should be removed from petrol.

.....

.....

.....

.....

(2)

(c) Some fractions from crude oil contain large hydrocarbon molecules.

These molecules can be cracked to produce smaller, more useful molecules.

An equation for cracking decane is:

$C_{10}H_{22}$ ⟶ C_3H_8 + C_2H_4 + C_5H_{10}

decane propane ethene pentene

(i) Why is propane useful?

Tick (✓) **one** box.

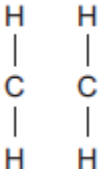
Propane is a polymer. ☐

Propane is an alloy. ☐

Propane is a fuel. ☐

(1)

(ii) Draw bonds to complete the displayed structure of ethene.



(1)

(iii) What is the colour change when bromine water reacts with ethene?

Tick (✓) **one** box.

Orange to colourless ☐

Orange to green ☐

Orange to red ☐

(1)

(iv) Complete the sentence.

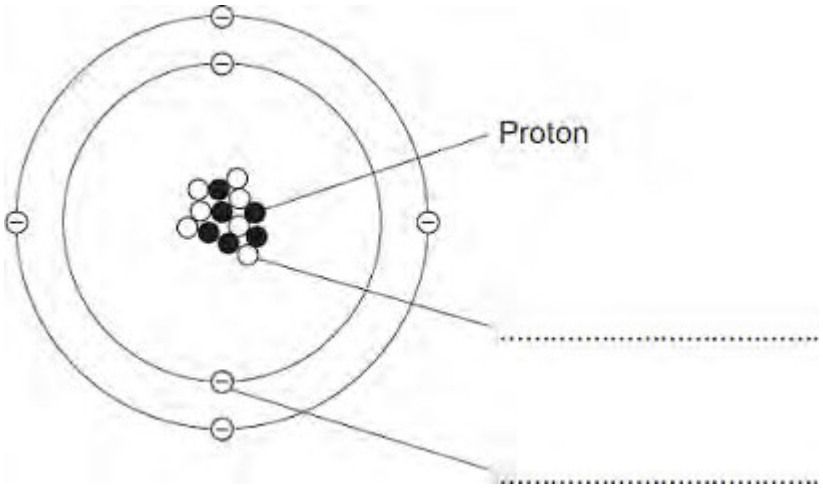
Pentene is useful because many pentene molecules can join together

to form ..... .

(1)

(Total 12 marks)

Q4. The diagram shows a carbon atom.



(a) (i) A proton is labelled.

Use the correct answer from the box to label each of the other sub-atomic particles.

electron	**ion**	**molecule**	**neutron**

(2)

(ii) The atom of carbon is represented as:

$$^{13}_{6}C$$

What is the mass number of this carbon atom?

Draw a ring around the correct answer.

6 **13** **19**

(1)

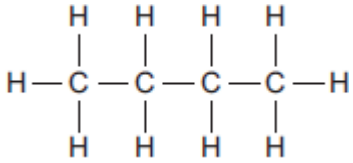
(iii) Complete the sentence.

Atoms of carbon have no overall electrical charge because the number

of protons is the same as the number of ..... .

(1)

(b) Butane is represented as:



(i) Use the correct answer from the box to complete each sentence.

bond	compound	helium	hydrogen	mixture	oxygen

Butane is a ..... .

Butane contains atoms of carbon and ..... .

Each line between the atoms in butane represents a chemical

..... .

(3)

(ii) Which is the correct formula for butane?

Tick (✔) **one** box.

C_4H_4 ☐

C_4H_8 ☐

C_4H_{10} ☐

(1)

(Total 8 marks)