All questions are for separate science students only

Q1.

This question is about alcohols and carboxylic acids.

Alcohols are used as fuels.

A student burned 1.00 g of six alcohols and determined the energy released from each.

The table below shows the results.

Alcohol	Formula of one molecule of the alcohol	Energy released in kJ/g
Ethanol	C_2H_5OH	29.6
Propanol	C_3H_7OH	33.6
Butanol	C_4H_9OH	36.1
Pentanol	$C_5H_{11}OH$	37.7
Hexanol	$C_6H_{13}OH$	38.9
Heptanol	$C_7H_{15}OH$	39.8

(a) Calculate the mass of ethanol that must be burned to release the same amount of energy as burning 1.00 g of heptanol. **(chemistry only) (HT only)**

_____

_____

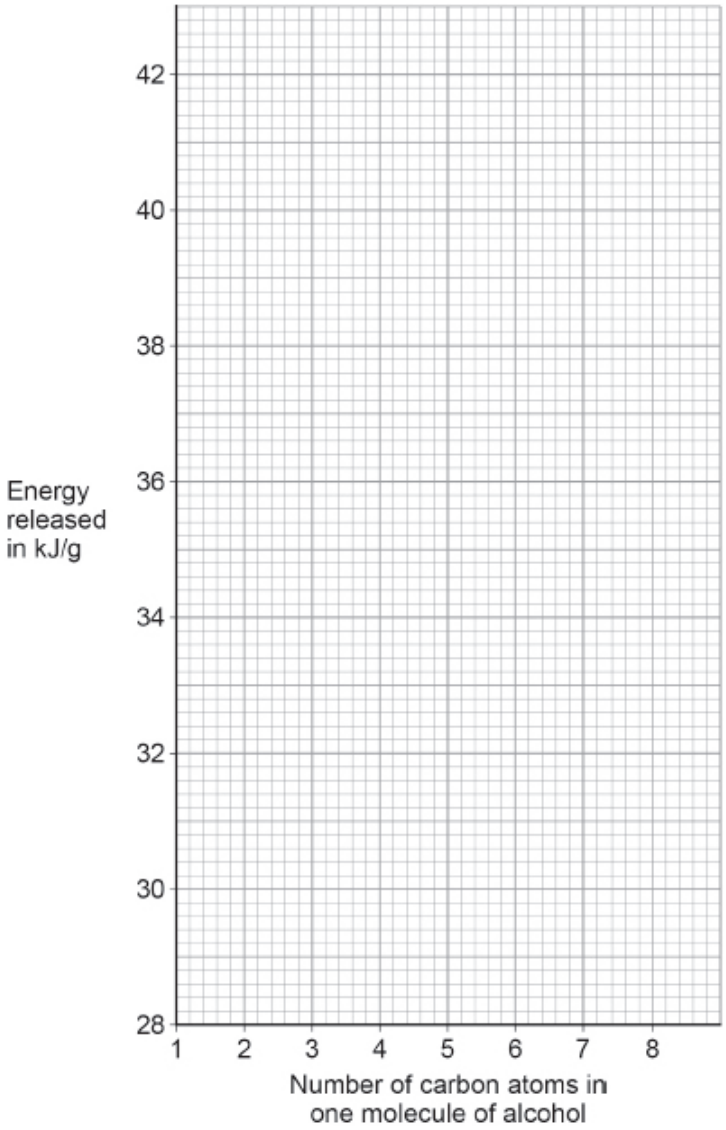
_____

Mass = _____ g

(2)

(b) The energy released in kJ/g varies with the number of carbon atoms in one molecule of each alcohol.

Plot the data from the table above on the figure below. **(chemistry only)**



(2)

(c) Estimate the energy released in kJ when 1.00 g of octanol ($C_8H_{17}OH$) is burned.

Use the figure above. **(chemistry only) (HT only)**

Energy released = _____ kJ

(1)

Carbon dioxide is produced when alcohols are burned.

Carbon dioxide is identified by bubbling the gas through limewater.

(d) Complete the sentence.

Choose the answer from the box.

calcium chloride	**calcium hydroxide**	**calcium nitrate**	**calcium sulfate**

Limewater is an aqueous solution of _____.

(1)

(e) Give the result of the test when carbon dioxide is bubbled through limewater.

_____

_____

(1)

Ethanoic acid can be produced from ethanol.

(f) What is reacted with ethanol to produce ethanoic acid? **(chemistry only)**

Tick (✓) **one** box.

A halogen ☐

An alkali metal ☐

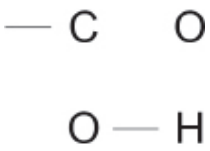
An oxidising agent ☐

Water ☐

(1)

(g) Ethanoic acid contains the functional group –COOH

Complete the displayed structural formula of this functional group. **(chemistry only)**



(1)

(h) Ethanoic acid reacts with different compounds.

Draw **one** line from each compound to a product of the reaction of the compound with ethanoic acid. **(chemistry only)**

Compound	**Product of the reaction with ethanoic acid**
	Carbon dioxide
Ethanol	Ethene
	Ethyl ethanoate
Sodium carbonate	Hydrogen
	Poly(ethene)

(2)

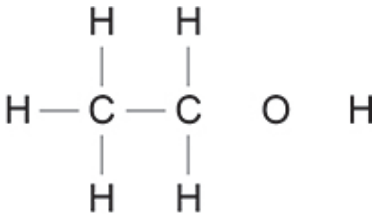
(Total 11 marks)

Q2.

This question is about ethanol.

(a) The formula of ethanol is C_2H_5OH

Complete the displayed structural formula of ethanol. **(chemistry only)**



(1)

(b) Which is **one** use of ethanol? **(chemistry only)**

Tick (✓) **one** box.

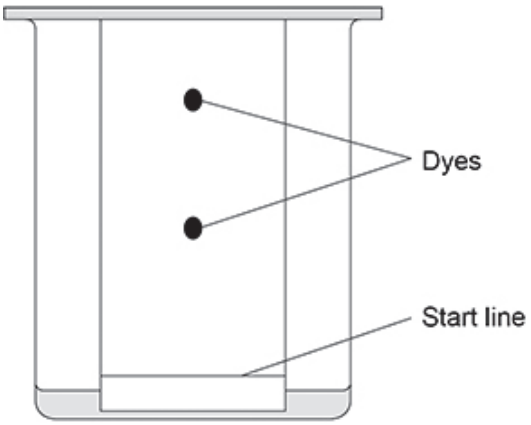
As a protective coating on aluminium	☐
In hand gel to kill microbes	☐
To test for the presence of hydrogen gas	☐

(1)

(c) Ethanol is used as a solvent in some inks.

A student used paper chromatography to show that an ink contained two different dyes.

The figure below shows the apparatus at the end of the investigation.



Describe a method the student could have used for the investigation.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(d) Ethanol can be produced from sugar solution by fermentation.

What must be added to sugar solution to produce ethanol? **(chemistry only)**

_____

(1)

E5 and E10 are types of fuel used in cars.

These fuels contain ethanol and petrol.

Table 1 shows information about E5 and E10.

Table 1

Fuel	Percentage (%) by mass of ethanol	Percentage (%) by mass of petrol
E5	5	95
E10	10	90

(e) Calculate the mass of ethanol in 4.4 kg of E5.

Give your answer in grams. **(chemistry only) (HT only)**

Use **Table 1**.

_____

_____

_____

_____

_____

Mass = _____g

(3)

(f) The ethanol in E5 and E10 is produced from sugar.

Sugar is produced from plants.

Explain why the production of E10 removes more carbon dioxide from the atmosphere than the production of E5. **(chemistry only)**

Use **Table 1**.

_____

_____

_____

_____

_____

_____

(3)

(g) **Table 2** shows the energy content of ethanol and petrol.

Table 2

	Energy content in MJ (megajoules) per kg
Ethanol	30.0
Petrol	46.4

Suggest **one** disadvantage of using E10 instead of E5.

Complete the sentence. **(chemistry only)**

A disadvantage of using E10 is
that _____

_____

(1)

(Total 14 marks)