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SUPERVISOR'S USE ONLY

Level 1 Chemistry, 2017

90932 Demonstrate understanding of aspects of carbon chemistry

9.30 a.m. Tuesday 14 November 2017
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of aspects of carbon chemistry.	Demonstrate in-depth understanding of aspects of carbon chemistry.	Demonstrate comprehensive understanding of aspects of carbon chemistry.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–10 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Achievement

TOTAL

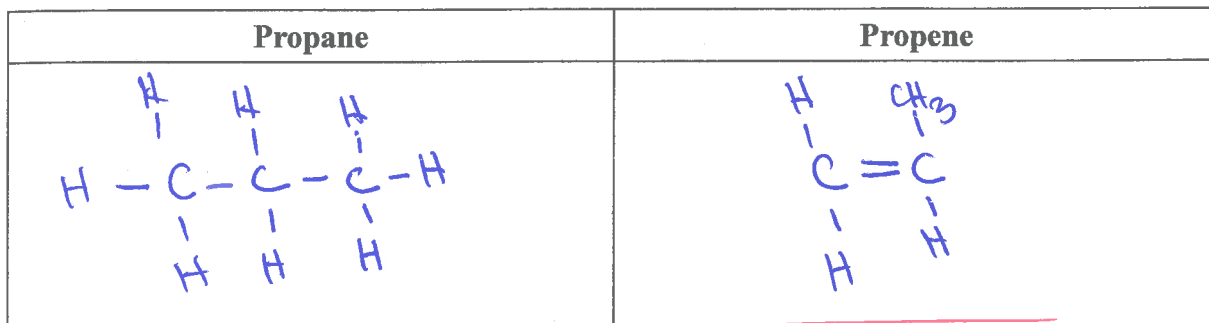
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QUESTION ONE

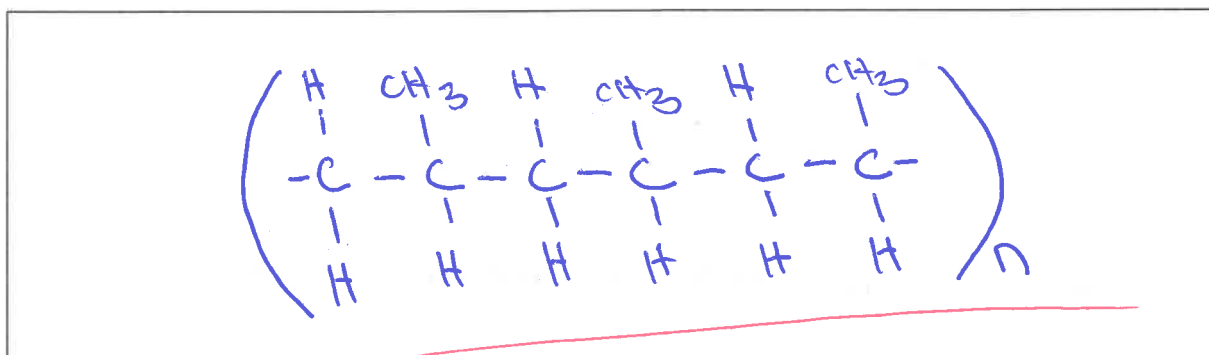
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- (a) Draw the structural formulae of propane and propene in the boxes below.



- (b) Propene is used to make the polymer polypropene.

In the box below, draw a section of the polymer polypropene with THREE repeating units.



- (c) The boiling point for ethene is -104°C and propene is -48°C .

Why does propene have a higher boiling point than ethene?

Explain your answer.

Propene has a higher boiling point than ethene as it has more Carbon to Carbon bonds and more hydrogen meaning it has a bigger molecular mass therefore meaning the intermolecular forces of bonds require more heat to break apart.

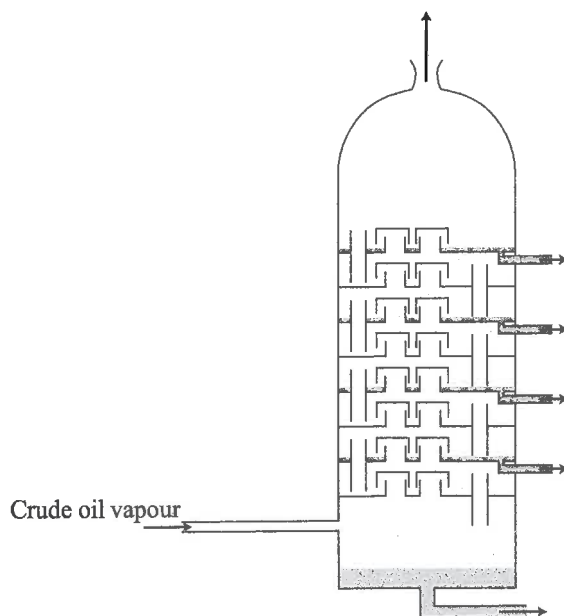
- (d) Explain why **propene** can be used to make polymers, but **propane** cannot.

In your answer, you should explain the chemical reaction that occurs between propene molecules to form the polymer, polypropene.

The ~~best~~ reason propene can be used to make a polymer and propane can't is because propane is an Alkane meaning it does not have a carbon to carbon double bond it has single covalent bonds so has no spare bonds to share to make a polymer. However because propene is an Alkene it has one double covalent bond therefore meaning it's ~~best~~ double bond that covalent bond can break apart making it single covalent bonds and the extra bonds can be used to form a polymer that has many repeating units. Propane would not be able to do this. Propene is also chemically inert meaning it will not react with anything making it a good insulator and ~~is~~ is used for themselves.

QUESTION TWO

Crude oil is fractionally distilled in tall towers, like the one shown in the diagram below.



- (a) (i) Why must crude oil be fractionally distilled before it can be used?

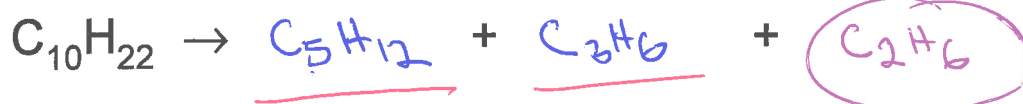
Explain your answer.

Crude oil is a mixture of hydrocarbons so can't be used on its own. ~~Therefore~~ which is why you need to separate these different hydrocarbons through their different melting / boiling points. ~~After~~ these different hydrocarbons can then be used.

- (ii) Explain why smaller hydrocarbons are collected at the top of the tower.

Smaller hydrocarbons are collected at the top of the tower due to the fact they have low boiling points this is because their molecular mass is smaller allowing it to go further up the tower where it will then condense. The smaller molecular mass allows a smaller amount of heat to break its bond which is why it has a low boiling point.

- (b) Complete the equation for the cracking of decane, $C_{10}H_{22}$, to produce pentane and two other products.



- (c) Contrast the processes of fractional distillation and cracking.

In your answer, you should refer to relevant physical and/or chemical properties of hydrocarbons.

Fractional distillation is the process in which hydrocarbons are separated from crude oil through their different boiling points, whereas Cracking involves a large alkane breaking down into a smaller alkane and alkene.

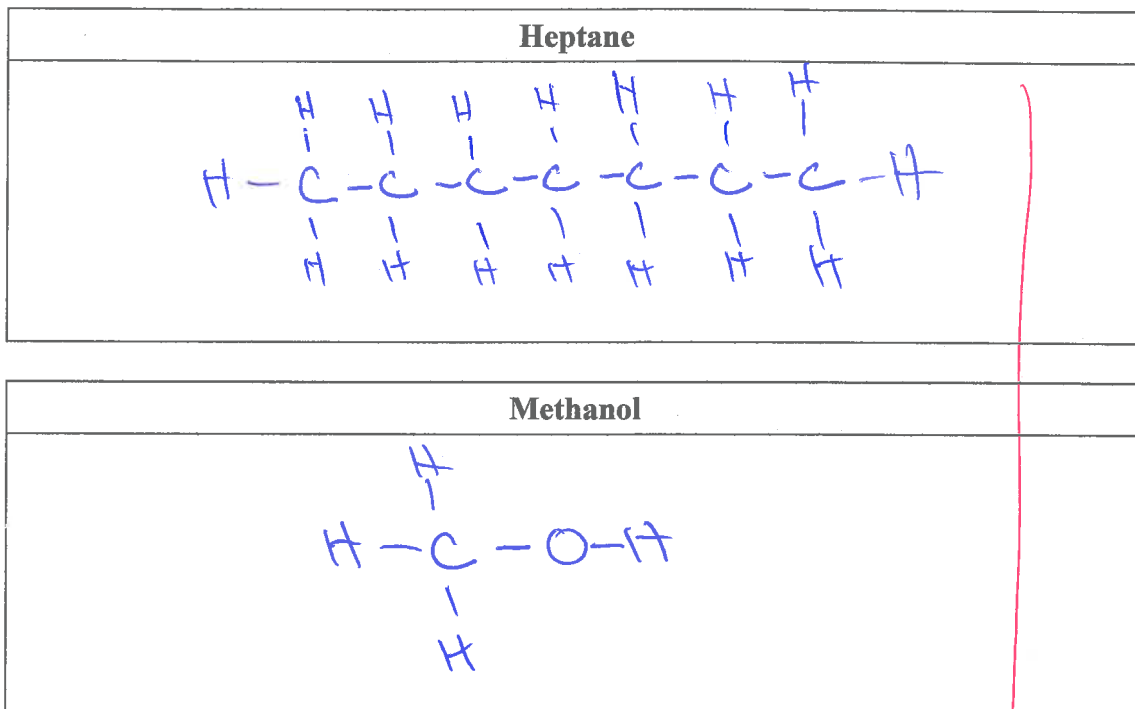
Cracking requires ~~heat~~ heat and pressure whereas fractional distillation only requires heat. The products of fractional distillation can be used for many things such as LPG produced that can be used for cooking. //

There is more space for your answer to this question on the following page.

QUESTION THREE

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- (a) (i) Draw the structural formulae of heptane and methanol in the boxes below.



- (ii) Explain why heptane is classified as a hydrocarbon, while methanol is not.

~~heptane~~ ~~methanol~~ is classified as a hydrocarbon because hydrocarbons are only made up of hydrogen and carbon atoms and heptane only has hydrogen and carbon atoms. Methanol has an OH group so is not entirely made up of hydrogen and carbon atoms therefore meaning it is not a hydrocarbon.

- (b) Heptane and methanol are both colourless liquids at room temperature (25°C).

How could water be used to distinguish between separate samples of heptane and methanol?

In your answer, you should include any observations that would be made, and explain the physical properties of BOTH compounds that allow this identification.

You could use water to distinguish heptane and methanol because methanol is polar so dissolves in water and heptane is non-polar so does not dissolve in water. Heptane will float on the water whereas methanol will not. Methanol is able to dissolve due to its OH. Heptane does not have an OH so ~~can't~~ is not soluble in water.

**Question Three continues
on the following page.**

- (c) Both heptane and methanol can be used as fuels and can undergo both complete and incomplete combustion.

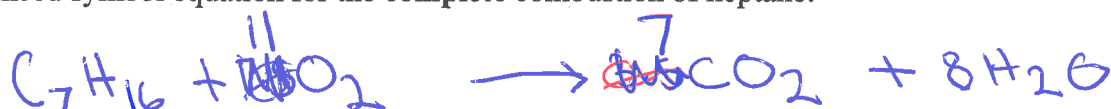
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Analyse the combustion reactions of the two fuels – heptane and methanol.

In your answer, you should include:

- a description of the observations that would be made for both complete and incomplete combustion of EITHER heptane OR methanol
- an explanation of the effect on human health for TWO combustion products from the **incomplete** combustion of EITHER heptane OR methanol
- an explanation of the advantages of using methanol as a fuel compared to heptane
- a balanced symbol equation for the **complete** combustion of each fuel.

Balanced symbol equation for the **complete** combustion of heptane:



Balanced symbol equation for the **complete** combustion of methanol:



when ~~you~~ heptane goes through complete Combustion Carbon dioxide and water are formed. heptane goes through complete Combustion when there is ^{a good supply} oxygen present. When heptane goes through incomplete Combustion the products Carbon monoxide and water are formed sometimes carbon is also produced. Incomplete Combustion happens when there is a limited or insufficient amount of oxygen present. Carbon monoxide produced from incomplete Combustion is a colourless and toxic gas to humans as it can stick to red blood cells stopping you from breathing. Carbon soot is also bad as it causes respiratory problems and cancer.

The reason methanol is a better fuel than heptane is because methanol burns cleaner due to the OH. This causes less pollution lowering the effects of global warming. Heptane does not have this OH group which means it does not burn as clean as methanol does. //

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A3

Subject:		Chemistry	Standard:	90932	Total score:	09
Q	Grade score	Annotation				
1	A3	<p>The candidate has correctly drawn propane, propene and polypropene. They have recognised that propene's boiling point is higher due to its larger molecular mass but did not link the larger mass to stronger intermolecular forces.</p> <p>The candidate also stated that alkanes only contain single carbon bonds whereas an alkene has a carbon double bond. To get M5 they needed to link the joining of propene molecules together to form the long-chain polymer.</p>				
2	A3	<p>The candidate has correctly identified that crude oil is a mixture of hydrocarbons that can be separated. They recognise that smaller hydrocarbons have a lower boiling point but do not link this to the size of the intermolecular forces or the temperature gradient in the tower.</p> <p>To secure A3 they have correctly stated what cracking is and identified one of the products from the cracking of decane.</p>				
3	A3	<p>The candidate has correctly drawn the structures of heptane and methanol and explained why heptane is a hydrocarbon in terms of its atoms. They have stated the observation of heptane and methanol being added to water but haven't linked it to the physical properties of the liquids which is require for Merit.</p> <p>They have stated the health effects of two incomplete combustion products and an advantage of using methanol but their explanations are lacking in detail.</p>				