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SUPERVISOR'S USE ONLY

Level 1 Chemistry, 2016

90932 Demonstrate understanding of aspects of carbon chemistry

2.00 p.m. Monday 21 November 2016
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

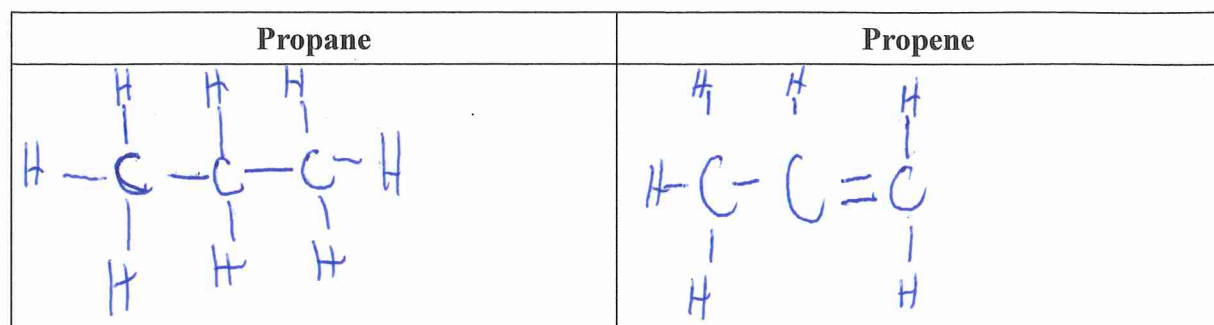
TOTAL

10

ASSESSOR'S USE ONLY

QUESTION ONE

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



- (b) (i) What is the type of bonding present in a molecule of propane?

Covalent

Give a reason for your answer.

The bonding is covalent because it is between two non-metals carbon and hydrogen.

- (ii) How does the structure of propene differ to propane?

Propene is an alkene meaning it has a double bond and is unsaturated where as propane is an alkane and is saturated and only a single bonds.

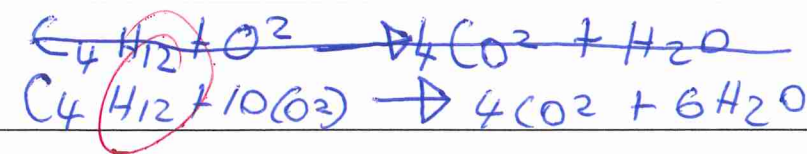
- (c) Alkanes can be used as fuels. Compare and contrast: the complete combustion of alkanes, which produces carbon dioxide; and the incomplete combustion, which produces carbon monoxide and carbon in addition to carbon dioxide.

In your answer, you should:

- use butane as an example to illustrate your answer
- give an explanation of an effect on the environment for TWO combustion products
- include balanced symbol equations for the reactions occurring, in the labelled boxes below.

~~Alkanes~~ Butane ~~comp~~ under takes complete combustion ^{when it has plenty of oxygen} as it is an alkane meaning it produces carbon dioxide. Butane under takes incomplete combustion ^{when it has limited oxygen} meaning it produces carbon monoxide, carbon and carbon dioxide. Complete combustion has less of an effect on the environment as it produces carbon dioxide compared to incomplete which produces carbon monoxide which is poisonous and can negatively impact the environment ~~and~~ incomplete combustion also produces carbon which ~~negatively~~ harms the environment.

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



Balanced symbol equation for the **incomplete** combustion of butane:



QUESTION TWO

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

| Methanol | Ethanol |
|--|---|
| $\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H} \end{array}$ | $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{OH} \\ \quad \\ \text{H} \quad \text{H} \end{array}$ |

- (b) (i) The boiling point for methanol is 65°C and ethanol is 78°C.

Why does ethanol have a higher boiling point than methanol?

|| Ethanol has a higher boiling point than methanol because it is a longer carbon chain meaning it has more carbon than methanol because of this ethanol has more bonds to break so it has a higher boiling point. ||

- (ii) Why are both methanol and ethanol soluble in water?

|| Because of the amount of hydrogens in each of them meaning they can bond with the water H₂O. ||

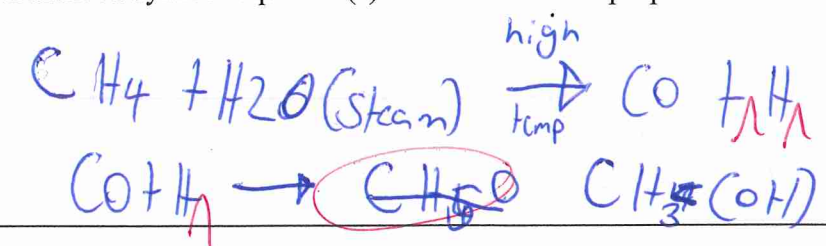
- (c) How does the industrial preparation of methanol from natural gas differ from the process of fermentation to form ethanol?

In your answer, you should include:

- a description of the two processes
- explanations of any conditions required
- balanced symbol equations for any reactions occurring, in the labelled boxes below.

|| Methanol is produced using methane + st water (Steam) reacts in a catalyst with high temperature to create carbon monoxide and hydrogen. Carbon monoxide and hydrogen are then reacted together to create methanol. Ethanol is produced ~~is~~ with glucose reacts through yeast and enzymes to create ~~methanol~~ ethanol and Carbon dioxide. The condition for the fermentation of ethanol is damp and warm and methanol is high temperature. ~~Methanol~~ ethanol is produced differently as it used a living organism (yeast) to be created whereas as methanol does not. ||

Balanced symbol equation(s) for the industrial preparation of methanol:

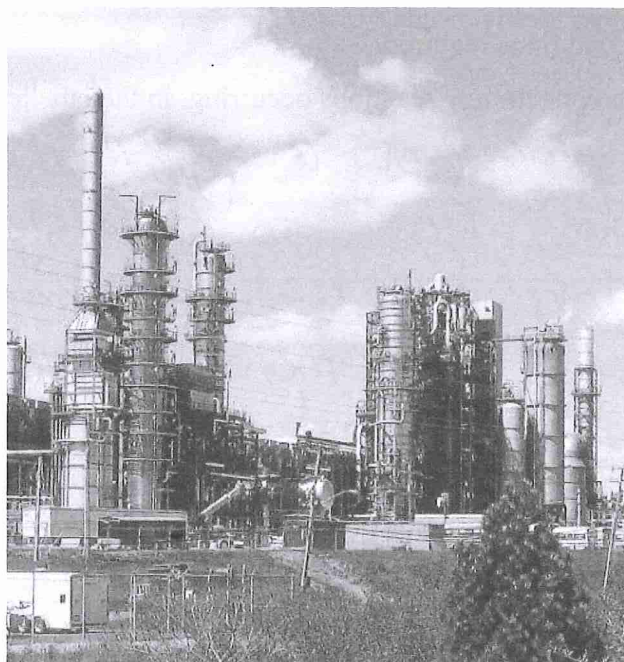


Balanced symbol equation for preparation of ethanol using fermentation:



QUESTION THREE

Crude oil undergoes fractional distillation in tall towers, like the ones shown in the photograph below. The different fractions produced have many uses.



http://photoartforums.com/forums/uploads/1277616145/gallery_85_17_924301.jpg

- (a) Name TWO of the fractions obtained from a fractional distillation tower, and describe ONE use for each.

| Fraction | Name | Use |
|----------|---------|------|
| 1 | Propane | Fuel |
| 2 | | |

- (b) (i) Why does crude oil need to undergo fractional distillation before it can be used?

Crude oil is made up of lots of different length hydrocarbons. The hydrocarbons need to be separated using fractional distillation to be useful.

- (ii) Explain why fractional distillation is carried out in tall towers.

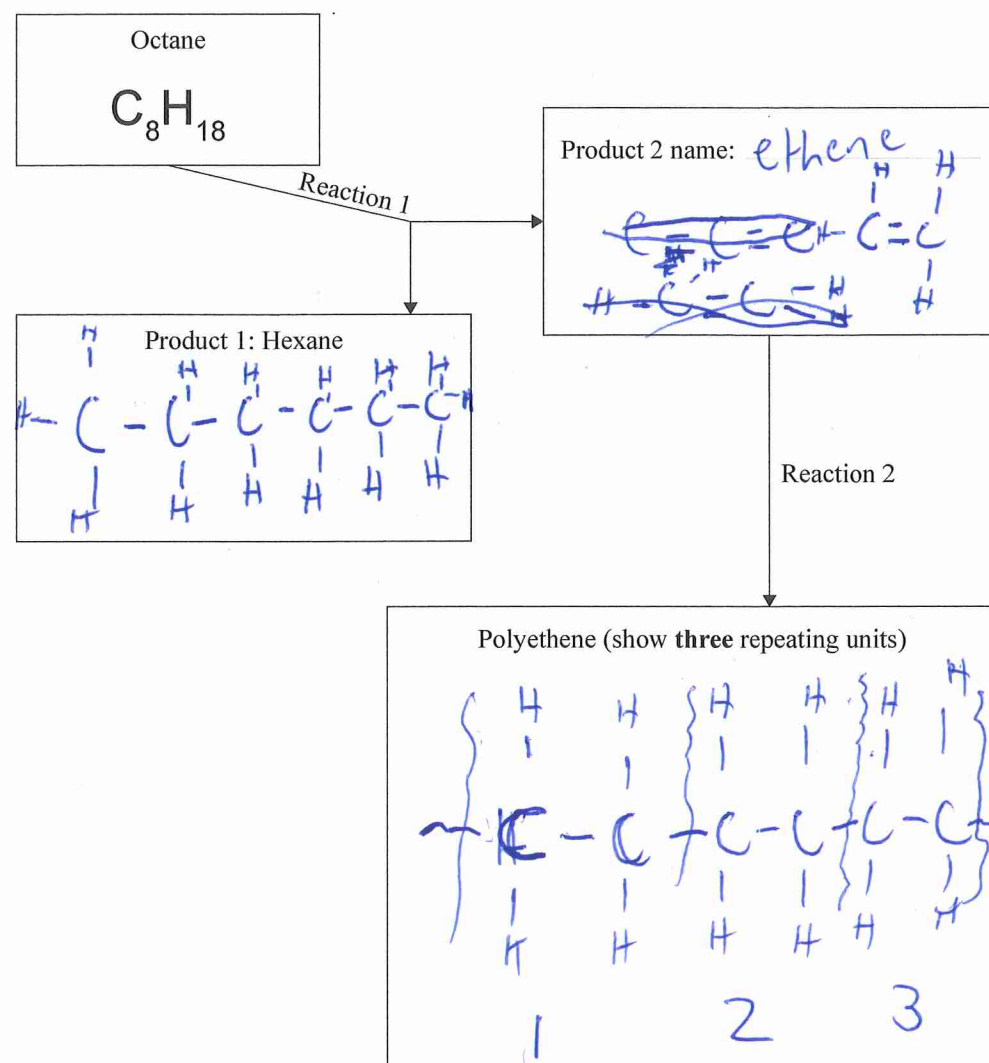
In your answer you should link the process of fractional distillation to the physical properties and chemical structure of the hydrocarbons in crude oil.

Fractional distillation is carried out in tall towers because the crude oil is heated at the bottom until the hydrocarbons become gas. The tall towers are used so that as the gases rise the temperature cools so each of the different hydrocarbons ~~solidify~~ ^{turn to liquid} at different temperatures so as the gases rise they turn to liquid at different temperatures and are separated at different points of the towers. The towers need to be tall so there is a large enough temperature difference from the bottom to the top.

Question Three continues on the following page.

(c) Octane can be used to produce the polymer, polyethene. Octane undergoes Reaction 1 to form hexane and Product 2. Product 2 can be used to produce polyethene.

(i) Complete the reaction scheme by filling in the boxes to show all structural formulae, as well as the name for Product 2.



(ii) Elaborate on Reaction 1 and Reaction 2.

In your answer, you should:

- name the types of reactions occurring
- give the conditions required for each reaction
- explain how polyethene can be made from Product 2.

Octane is ~~cracked~~ ^{split} to create Hexane and ethene. In reaction 2 ethene is cracked to create poly ethene meaning the double bond of ethene is broken. Each reaction requires high temperature. ~~product two makes pro~~

Achieved exemplar 2016

| Subject: | | Chemistry | Standard: | 90932 | Total score: | 10 |
|-----------------|--------------------|--|------------------|--------------|---------------------|-----------|
| Q | Grade score | Annotation | | | | |
| 1 | A3 | The candidate has no correct symbol equations as they have incorrectly written the formulae for butane. The candidate does not link a product of combustion to an environmental effect, spending most of question (c) restating the information given in the question. They have correctly drawn both structures for propane and propene. Even though they correctly recognise that non-metals covalently bond, they do not state that this is by sharing electrons for a full outer shell, to gain merit. The candidate also misses merit through omitting the carbon or C to C in double and single bonds. | | | | |
| 2 | A4 | The candidate has incorrect formulae in their equations, not knowing the formulae for glucose or hydrogen gas and using brackets incorrectly in both alcohols. They can describe both processes but do not recall many of the conditions involved. The candidate correctly links the size of the carbon chain to the boiling point but did not explain why. It is implied that there is an attraction between water and alcohols. | | | | |
| 3 | A3 | (b)(ii) The candidate recognises that fractional distillation is based on boiling point but does not link these to the molecular mass of the hydrocarbon chain and the size of the intermolecular forces, so does not get to merit level. (c)(ii) This candidate does not recall sufficient detail about cracking or polymerisation to achieve this question. | | | | |