

Wednesday 22 June 2016 – Morning

**GCSE TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A/FURTHER ADDITIONAL SCIENCE A**

A173/01 Module C7 (Foundation Tier)

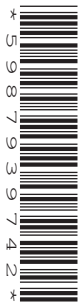
Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: 1 hour



Candidate forename		Candidate surname	
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Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

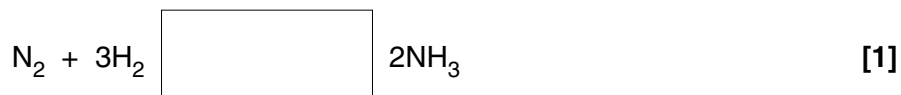
- The quality of written communication is assessed in questions marked with a pencil (✎).
- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- The Periodic Table is printed on the back page.
- This document consists of **20** pages. Any blank pages are indicated.

Answer **all** the questions.

1 The Haber process uses nitrogen and hydrogen to make ammonia for fertilisers.

(a) The reaction between nitrogen and hydrogen is reversible.

Complete the equation for the process by drawing the symbol for a reversible reaction in the box.



(b) The Haber process uses particular conditions to increase the rate of the reaction.

Which conditions increase the rate?

Put ticks (✓) in the boxes next to the **three** correct answers.

high temperature

using a catalyst

recycling unreacted hydrogen and nitrogen

high pressure

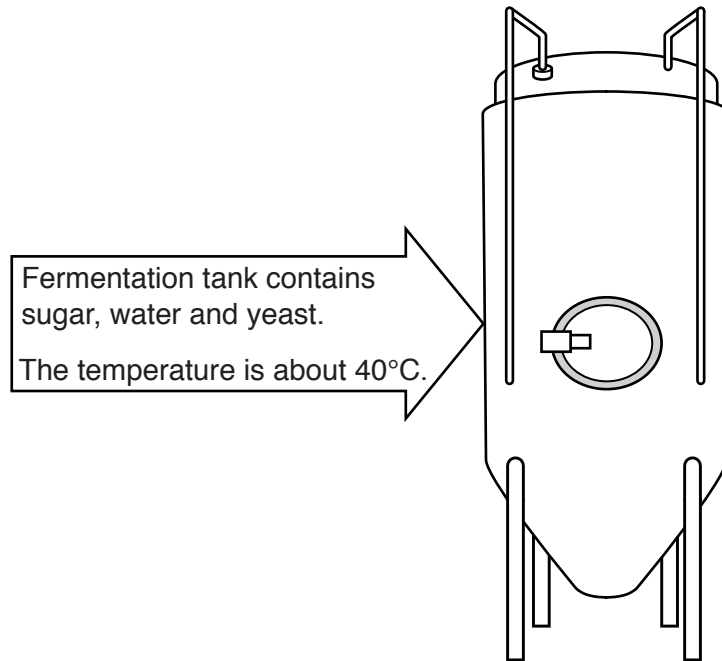
using nitrogen from the air as a feedstock

[2]

[Total: 3]

2 Whisky is an alcoholic drink that contains ethanol.

The first stage in making whisky is fermentation.



(a) Which statements about fermentation are true?

Put ticks (✓) in the boxes next to the **two** correct answers.

The sugar is a waste product of the yeast.

The conditions are optimum for yeast to grow.

A very high temperature would make ethanol much faster.

Yeast uses sugar as a source of food.

[2]

(b) Fermentation can only be used to make solutions that contain about 12% ethanol.

Fermentation **cannot** be used to make the ethanol more concentrated.

Which statement explains why?

Put a tick (✓) in the box next to the correct answer.

The alcohol stops the yeast from working.

There is no sugar left.

The temperature is too low.

The water boils and kills the yeast.

[1]

(c) Whisky contains about 40% ethanol.

After fermentation, another process makes the ethanol solution more concentrated.

What process is used to make the ethanol more concentrated?

Put a (ring) around the correct answer.

desiccation

distillation

filtration

saturation

[1]

[Total: 4]

- 3 A company makes chemical compounds and uses them to make products such as fertilisers and drugs.

(a) The table gives information about these products.

Product	Type of process	Use
fertilisers	bulk	spread on soil to help crops grow
drugs	fine	used on people and animals

- (i) What is the difference between the processes used to make bulk and fine chemicals?

.....

.....

.....

..... [2]

- (ii) Monitoring of purity is much more important for compounds used in drugs than for compounds used in fertilisers.

Use the information in the table to help you to explain why.

.....

.....

.....

..... [2]

- (iii) Each manufacturing process has many stages.

Chemists work in the stages that involve making the chemical compounds.

Which stages involve making the chemical compounds?

Put ticks (✓) in the boxes next to the **two** correct answers.

choosing feedstocks

designing labels

choosing the best reaction conditions

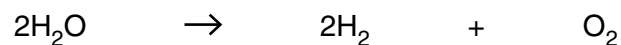
deciding on how the products are advertised

transporting the products

[2]

- (c) Scientists are working on a new process to produce hydrogen.

The new process splits water to make hydrogen. A catalyst is used in the process.



- (i) What is the name of the by-product of this reaction?

..... [1]

- (ii) Using a catalyst reduces the energy needed to break up the water.

How does the catalyst work?

Put ticks (✓) in the boxes next to the **two** correct answers.

The catalyst increases the time taken for the reaction.

The catalyst lowers the activation energy.

The catalyst provides a different route for the reaction

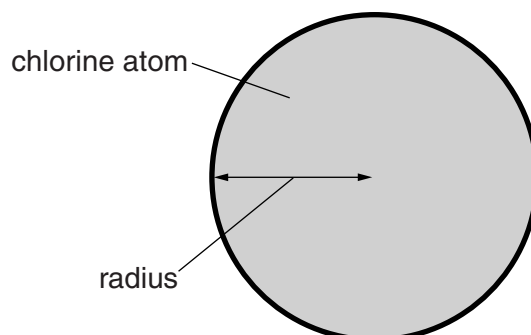
The catalyst is used up instead of the water.

[2]

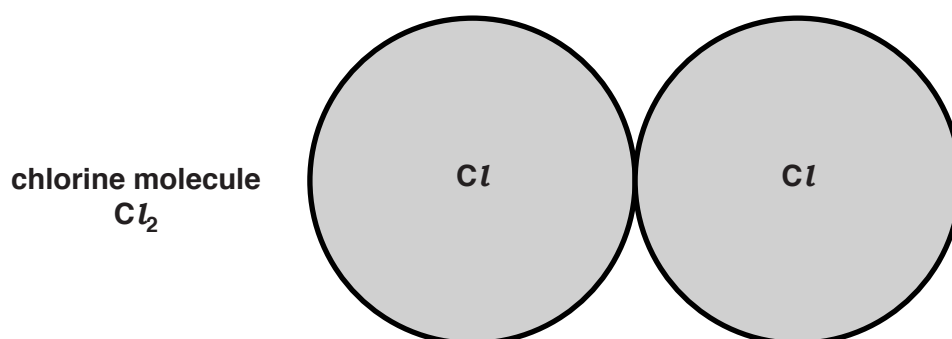
[Total: 15]

4 Len looks up data about the sizes of atoms of chlorine and some other Group 7 elements.

(a) The size of an atom is measured by measuring its **radius**.



Two atoms bond together to make a molecule.

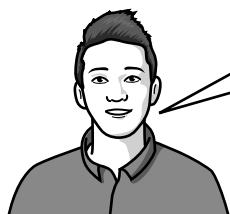


Len also finds out the **energy needed to break the bond** that holds the atoms together in a molecule.

This is his data.

Element	Radius of an atom (pm)	Energy needed to break bond (kJ/mol)
Fluorine F ₂	42	155
Chlorine Cl ₂	79	242
Bromine Br ₂	94	193
Iodine I ₂	115	151

He talks about the data with Mack.



Len

I think the bigger the atoms, the weaker the bonds between them.



Mack

I don't agree. I think your idea is only true for some elements.

Use examples and data from the table to explain why Len's idea is only true for some elements.



The quality of written communication will be assessed in your answer.

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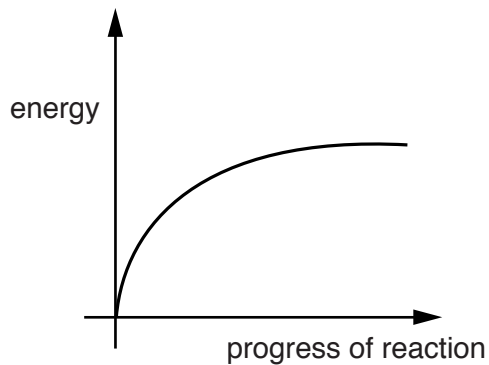
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[6]

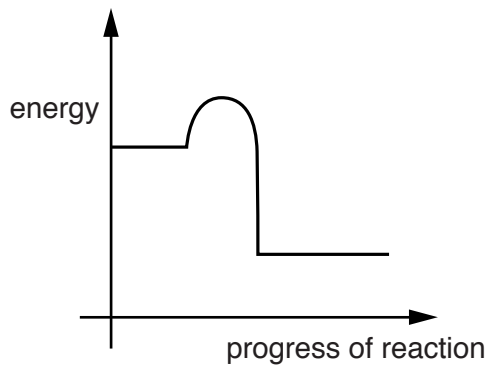
(b) Shining a bright light on a mixture of chlorine gas and hydrogen gas makes it explode.

The reaction is very exothermic.

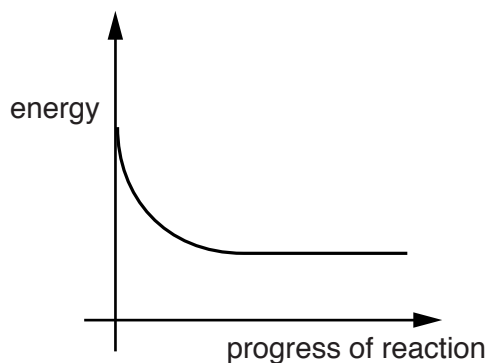
(i) Which energy level diagram, **A**, **B**, **C** or **D**, is correct for the reaction between chlorine and hydrogen?



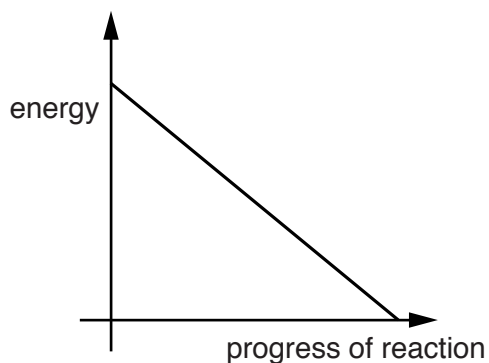
A



B



C



D

Put a (ring) around the correct answer.

A

B

C

D

[1]

(ii) Complete the sentences about this reaction between chlorine and hydrogen by putting a (ring) around the correct words in each sentence.

To start the reaction bonds need to **break** / **form**.

To start the reaction, energy is **taken in** / **given out**.

The reaction is exothermic and so overall energy is **taken in** / **given out**.

During the reaction **more** / **less** energy is taken in than given out. [3]

[Total: 10]

5 A scientist works in a quality control laboratory for a chemical company.

The company makes acids for use in cleaning products.

(a) The scientist tests two acids, **acid A** and **acid B**.

He does a series of titrations for each acid.

He does a rough titration. He then repeats the titration three times taking more care.

These are his results.

Acid	Volume of sodium hydroxide solution used in cm ³				
	Rough	Repeat 1	Repeat 2	Repeat 3	
A	25.0	24.5	24.4	24.6	
B	28.0	27.7	26.1	25.0	

(i) What is the range of volumes of sodium hydroxide used for the **repeats** for each acid?

range for **acid A**: from tocm³

range for **acid B**: from tocm³

[2]

(ii) The scientist looks at the ranges to decide whether he needs to do more repeats.

Do you think he needs to do more repeats for **acid A**?

Do you think he needs to do more repeats for **acid B**?

Explain your reasons.

acid A

.....

acid B

.....

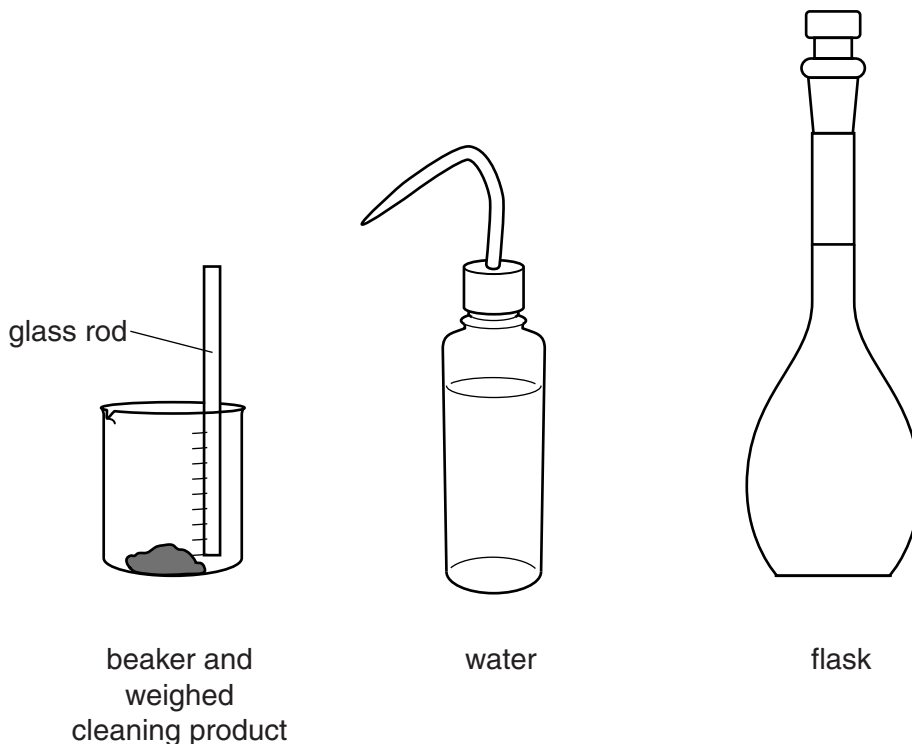
[2]

(b) The scientist tests the quality of one of the cleaning products.

He makes up a standard solution of a cleaning product.

He starts by weighing some of the solid cleaning product into a beaker.

He uses this apparatus to make up his standard solution.



Write down how he should use this apparatus to make a standard solution of cleaning product.

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[4]

[Total: 8]

13
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Question 6 begins on page 14
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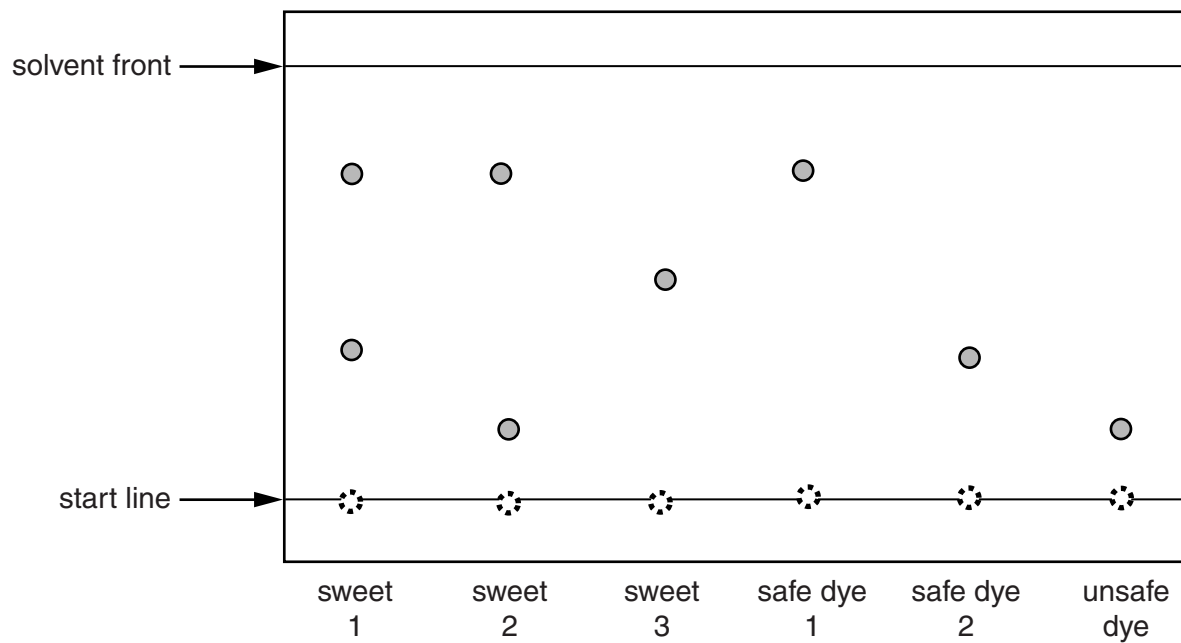
6 Alex uses chromatography to check that the food dyes used in some sweets are safe.

He tests three sweets against three known reference dyes.

Two of the references are known safe dyes.

One reference is a known unsafe dye.

Here is the chromatogram showing his results.



(b) Alex decides to calculate the R_f of safe dye 1.

What measurements does he need to make from the chromatogram to use in his calculation?

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.....

.....

..... [2]

(c) Alex also uses chromatography to identify the **flavourings** used in sweets.

At the end of his experiment he sprays his chromatogram with a locating agent.

Why does he need to do this?

Put a tick (✓) in the box next to the correct answer.

To separate the spots.

To remove the solvent.

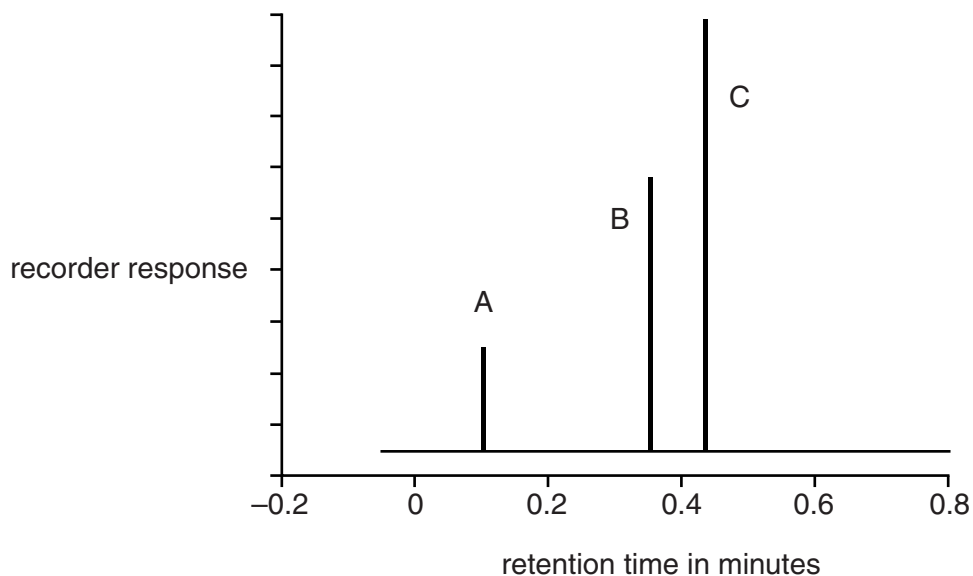
To see the spots.

To speed up the movement of the solvent.

[1]

- (d) Alex decides to use a chromatography machine to analyse the dyes from a different type of sweet.

This is the printout he gets.



- (i) The printout shows that three dyes have been used in the sweet.

Alex thinks that there is more of dye C in the sweet than either dye A or dye B.

How does the printout show that he is right?

Put a tick (✓) in the box next to the correct answer.

Dye C has the highest peak.

Dye C has the longest retention time.

There is more than 0.4 g of dye C in the sweet.

Dyes A and B both have retention times below 0.4 minutes.

[1]

- (ii) Alex says that the chromatography printout gives both **qualitative** and **quantitative** information about the dyes used in the sweet.

Explain why this is true.

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.....

.....

..... [2]

7 The table shows some information about the first four alkanes.

Name	Formula
methane
.....	C_2H_6
.....	C_3H_8
butane

(a) Complete the table by filling in the missing boxes. Use names and formulae from these lists.

ethanol

propane

butanol

ethane

methanol

C_2H_4

CH_4

C_2H_5OH

CH_3COOH

C_4H_{10}

[3]

(b) Alkenes are another family of hydrocarbons.

The table shows the structures of some alkanes and alkenes that have the same number of carbon atoms.

Number of carbon atoms	Structure of alkane	Structure of alkene
2	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	$\begin{array}{c} \text{H} \quad \quad \text{H} \\ \quad \quad \quad \backslash \quad / \\ \quad \quad \quad \text{C}=\text{C} \\ \quad \quad \quad / \quad \backslash \\ \text{H} \quad \quad \quad \text{H} \end{array}$
3	$\begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$	$\begin{array}{c} \text{H} \quad \quad \text{H} \quad \text{H} \\ \quad \quad \quad \backslash \quad / \quad \\ \quad \quad \quad \text{C}=\text{C}-\text{C}-\text{H} \\ \quad \quad \quad / \quad \quad \\ \text{H} \quad \quad \quad \text{H} \end{array}$
5	$\begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \end{array}$	$\begin{array}{c} \text{H} \quad \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \quad \backslash \quad / \quad \quad \quad \\ \quad \quad \quad \text{C}=\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \quad / \quad \quad \quad \quad \\ \text{H} \quad \quad \quad \text{H} \quad \text{H} \quad \text{H} \end{array}$

(i) What are the **similarities** and **differences** between the structures of alkanes and alkenes?

.....

.....

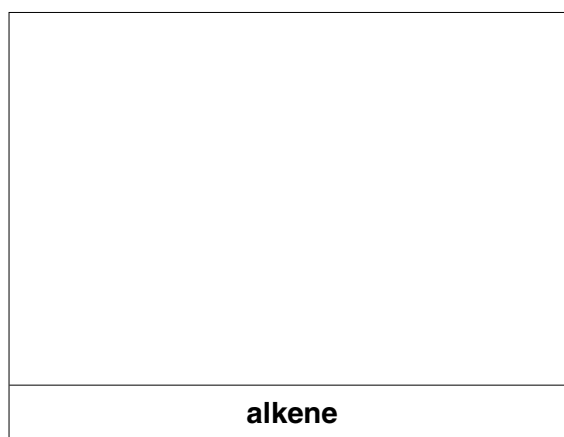
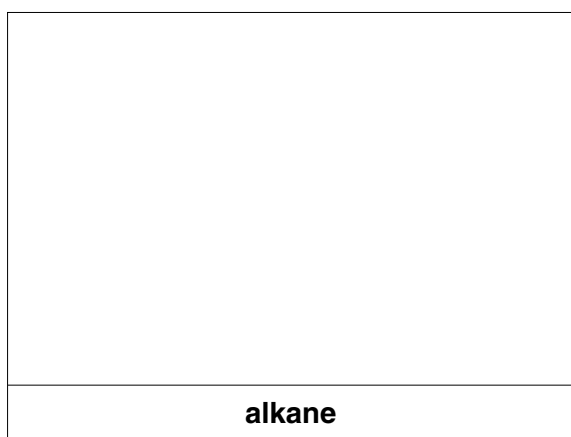
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..... [3]

(ii) Draw the structure of an alkane and an alkene that contain 6 carbon atoms.



[2]

[Total: 8]

END OF QUESTION PAPER

The Periodic Table of the Elements

	1	2	3	4	5	6	7	0										
	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 1 H hydrogen 1 </div>							<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 4 He helium 2 </div>										
	<div style="border: 1px solid black; padding: 5px; margin: auto; width: fit-content;"> Key relative atomic mass atomic symbol name atomic (proton) number </div>																	
	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 7 Li lithium 3 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 9 Be beryllium 4 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 11 Na sodium 11 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 12 Mg magnesium 12 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 13 Al aluminium 13 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 14 N nitrogen 7 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 15 P phosphorus 15 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 16 O oxygen 8 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 17 Cl chlorine 17 </div>									
	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 19 K potassium 19 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 20 Ca calcium 20 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 21 Sc scandium 21 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 22 Ti titanium 22 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 23 V vanadium 23 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 24 Cr chromium 24 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 25 Mn manganese 25 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 26 Fe iron 26 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 27 Co cobalt 27 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 28 Ni nickel 28 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 29 Cu copper 29 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 30 Zn zinc 30 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 31 Ga gallium 31 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 32 Ge germanium 32 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 33 As arsenic 33 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 34 Se selenium 34 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 35 Br bromine 35 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 36 Kr krypton 36 </div>
	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 37 Rb rubidium 37 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 38 Sr strontium 38 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 39 Y yttrium 39 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 40 Zr zirconium 40 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 41 Nb niobium 41 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 42 Mo molybdenum 42 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 43 Tc technetium [98] </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 44 Ru ruthenium 44 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 45 Rh rhodium 45 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 46 Pd palladium 46 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 47 Ag silver 47 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 48 Cd cadmium 48 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 49 In indium 49 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 50 Sn tin 50 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 51 Sb antimony 51 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 52 Te tellurium 52 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 53 I iodine 53 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 54 Xe xenon 54 </div>
	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 55 Cs caesium 55 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 56 Ba barium 56 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 57 La* lanthanum 57 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 72 Hf hafnium 72 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 73 Ta tantalum 73 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 74 W tungsten 74 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 75 Re rhenium 75 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 76 Os osmium 76 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 77 Ir iridium 77 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 78 Pt platinum 78 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 79 Au gold 79 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 80 Hg mercury 80 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 81 Tl thallium 81 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 82 Pb lead 82 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 83 Bi bismuth 83 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 84 Po polonium [209] </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 85 At astatine [210] </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> 86 Rn radon [222] </div>
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> [223] Fr francium 87 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> [226] Ra radium 88 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> [227] Ac* actinium 89 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> [261] Rf rutherfordium 104 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> [262] Db dubnium 105 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> [266] Sg seaborgium 106 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> [264] Bh bohrium 107 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> [277] Hs hassium 108 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> [268] Mt meitnerium 109 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> [271] Ds darmstadtium 110 </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> [272] Rg roentgenium 111 </div>	Elements with atomic numbers 112-116 have been reported but not fully authenticated							

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.