

Wednesday 22 June 2016 – Morning

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

A173/02 Module C7 (Higher Tier)

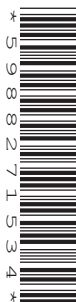
Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: 1 hour



Candidate forename		Candidate surname	
Centre number		Candidate number	

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. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- 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 A company makes chemical compounds and uses them to make products such as fertilisers and drugs.

(a) The table gives information about these products.

Type of product	Type of manufacture	Use	Other notes
fertilisers	bulk	spread on soil to help crops grow	Company makes ammonium nitrate for fertilisers. Millions of tonnes of fertiliser compounds are needed in the UK every year.
drugs	fine	used as medicines by people and animals	Company makes a range of different compounds for use to make drugs. Purity of compounds very important.

Use the information in the table to explain why fertilisers and drugs need to be manufactured differently.

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..... [2]



Use the information to help you to explain why this process is **not** sustainable.



..... [6

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

The new process uses a reaction that runs at a lower temperature than the reaction between methane and steam.

- (i) Which two statements explain why some reactions work at a lower temperature than others?

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

The rate of reaction is lower.

☐

The reaction has a lower activation energy.

☐

More gases are made in the reaction.

☐

The reaction uses a catalyst.

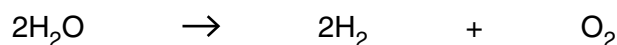
☐

Steam is less reactive than hydrogen.

☐

[2]

- (ii) The new process splits water into hydrogen.



The atom economy of the reaction can be calculated using this formula.

$$\text{atom economy} = \frac{\text{total mass of atoms of hydrogen in products}}{\text{total mass of all atoms in reactants}} \times 100\%$$

Use the formula to calculate the atom economy for the reaction.

..... % [2]

- (iii) The oxygen made in the new process is considered to be a by-product rather than a waste product.

Explain the difference between a by-product and a waste product.

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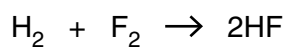
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..... [2]

[Total: 14]

2 Len investigates the bond energies of some Group 7 elements and their compounds.

- (a) He calculates the energy change of the reaction when hydrogen and fluorine react together to make hydrogen fluoride.



He uses this data.

Type of bond	Bond energy (kJ/mol)
H-H	432
F-F	155
H-F	567

The boxes below show some of his working.

Energy change when bonds break	
H-H	+ 432
F-F	
Total energy change = ...kJ/mol	

Energy change when bonds form	
Total energy change = ...kJ/mol	

- (i) Complete the boxes above to show the total energy change when bonds **break** and bonds **form** in the reaction. [3]
- (ii) Use your answers to calculate the overall energy change for the reaction that happens when hydrogen and fluorine make hydrogen fluoride.

energy change = ...kJ/mol [1]

(b) Len finds some data about the bond energies of group 7 elements and their compounds.

Group 7 element	Bond energy (kJ/mol)
F_2	155
Cl_2	242
Br_2	193
I_2	151

Group 7 compound	Bond energy (kJ/mol)
HF	567
HBr	431
HCl	366
HI	299

He talks about the data with Mack.



Len

I think for Group 7 all of the bonds in the elements and compounds get weaker down the group.

I don't agree. I think your idea is only true for some of the bonds.



Mack

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



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

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..... [6]

[Total: 10]

- 3 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 to cm³

range for **acid B**: from to cm³

[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]

10
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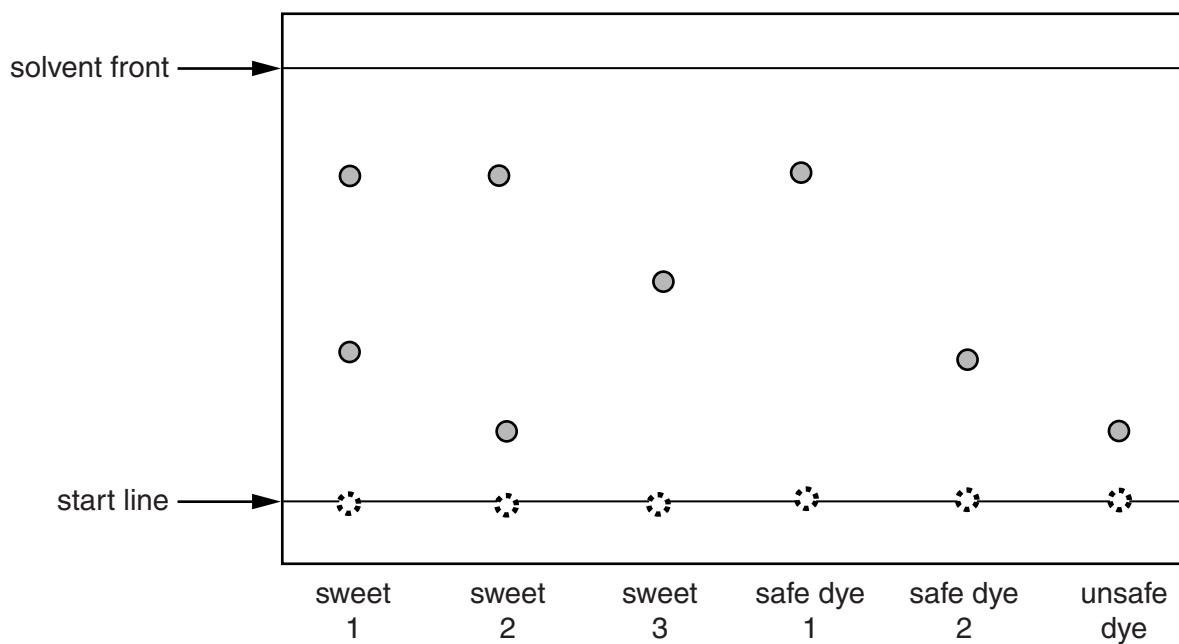
- 4 Alex uses chromatography to analyse the food dyes used in a packet of sweets.

The packet contains three different coloured sweets.

Alex tests one sweet of each colour.

He uses two known safe food dyes and one known unsafe dye as references.

Here is the chromatogram showing his results.



- (a) How many different dyes have been used in the three sweets?

..... [1]

- (b) Alex looks at the results and makes this statement:

‘The results show that it is possible that two of the sweets contain an unsafe dye.’

Explain how the results of the chromatogram support Alex’s conclusion.

.....

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..... [2]

- (c) 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]

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

He sprays his chromatogram with a locating agent.

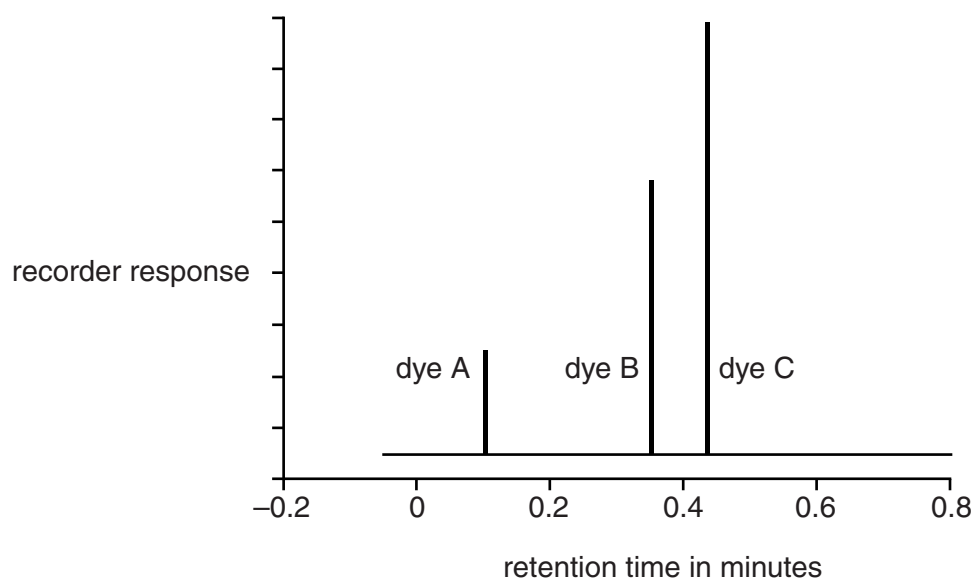
Why does Alex need to use a locating agent?

.....

..... [1]

- (e) Alex uses a chromatography machine to analyse the food 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.

Which dye has been used in the largest quantity?

Explain how you can tell.

.....

.....

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..... [2]

- (ii) Alex wants to identify dye A.

He uses data from the chromatography printout.

He also uses data from printouts for known dyes.

How does he use the data to identify dye A?

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..... [2]

- (iii) 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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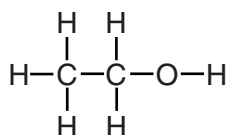
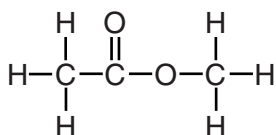
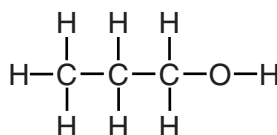
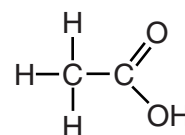
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[Total: 12]

5 The diagrams show the structural formula of some substances, **A**, **B**, **C** and **D**.

**A****B****C****D**

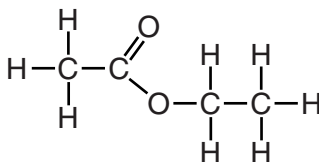
(a) Which substance is found in vinegar?

Put a (ring) around the correct answer.

A**B****C****D**

[1]

(b) Which two of the substances react together to make this ester?

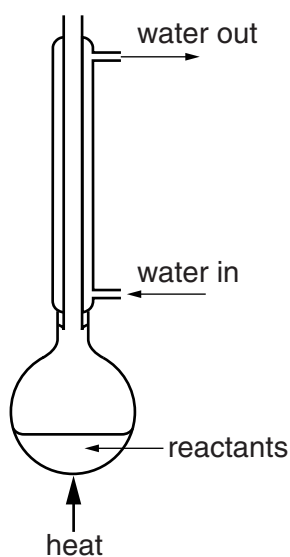


Put a (ring) around each of the **two** correct answers.

A**B****C****D**

[1]

(c) Sue makes an ester by heating the reactants together using this apparatus.



Why did Sue fit a vertical condenser to the flask?

.....

.....

.....

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..... [3]

(d) After the reaction the mixture is not pure.

Sue carries out two further stages.

- She separates the ester from the reaction mixture.
- She purifies the ester.

How does she do each stage?

.....

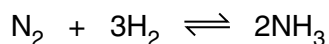
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..... [2]

[Total: 7]

- 6 Ammonia for making fertilisers is made in this reaction.



- (a) In a closed container, this reaction does not give 100% yield, even if the reaction is left to run for a very long time.

Explain why.

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..... [2]

- (b) On an industrial scale, conditions for the reaction between hydrogen and nitrogen can be chosen to increase the rate of reaction and the yield.

Which conditions increase only the rate, which increase only the yield and which increase both?

Put a tick (✓) in one box in each row.

Condition	Increases rate only	Increases yield only	Increases both rate and yield
High temperature			
High pressure			
Use of a catalyst			
Recycling unreacted hydrogen and nitrogen			

[3]

- (c) Some living organisms use natural processes to make nitrogen compounds from nitrogen in the air.

Which **two** statements about these processes are true?

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

The reactions happen in the organisms at room temperature.

☐

Organisms use large amounts of hydrogen from the air in the reactions.

☐

The reactions take place in the organisms under high pressure.

☐

The organisms use iron metal to act as a catalyst.

☐

The reactions in living organisms rely on enzymes.

☐

[2]

[Total: 7]

END OF QUESTION PAPER

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This image shows a blank sheet of white paper designed for handwriting practice. It features a solid vertical line on the left side, creating a narrow margin. The rest of the page is filled with evenly spaced horizontal dashed lines, providing guides for letter height and placement. There are no markings, text, or illustrations on the page.

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* 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.