Resources available from kickstart tutors

Student number

Name _____

Date _____

Attempt/Time taken _____

GCSE
CHEMISTRY

Topic Paper: 3 Quantitative chemistry
Part 1

Time allowed: 45 minutes

Materials

For this paper you must have:

- the Periodic Table/Data Sheet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a calculator, which you are expected to use where appropriate.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The Periodic Table/Data Sheet is provided as in insert.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.

40 Marks

Q1. The label shows the ingredients in a drink called Cola.

Cola

Ingredients:

Carbonated water
Sugar
Colouring
Phosphoric acid
Flavouring
Caffeine

(a) (i) The pH of carbonated water is 4.5.

The pH of Cola is 2.9.

Name the ingredient on the label that lowers the pH of Cola to 2.9.

.....

(1)

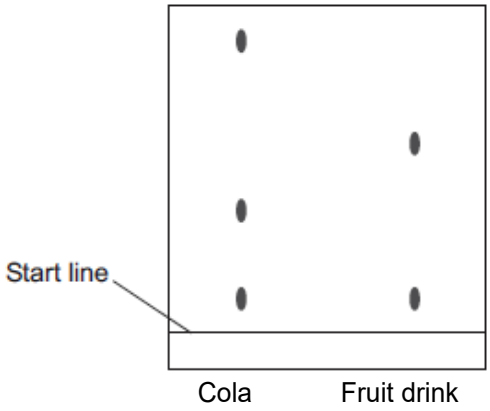
(ii) Which ion causes the pH to be 2.9?

.....

(1)

(b) A student investigated the food colouring in Cola and in a fruit drink using paper chromatography.

The chromatogram in the figure below shows the student's results.



(i) Complete the sentence.

The start line should be drawn with a ruler and ..... .

Give a reason for your answer.

.....

.....

(2)

(ii) Suggest **three** conclusions you can make from the student's results.

.....

.....

.....

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.....

.....

(3)

(c) Caffeine can be separated from the other compounds in the drink by gas chromatography.

Why do different compounds separate in a gas chromatography column?

.....

.....

(1)

(d) Caffeine is a stimulant.

Large amounts of caffeine can be harmful.

(i) Only **one** of the questions in the table **can** be answered by science alone.

Tick (✓) **one** question.

Question	Tick (✓)
Should caffeine be an ingredient in drinks?	
Is there caffeine in a certain brand of drink?	
How much caffeine should people drink?	

(1)

(ii) Give **two** reasons why the other questions **cannot** be answered by science alone.

Reason 1 .....

.....

Reason 2 .....

.....

(2)

(Total 11 marks)

Q2. Some students investigated magnesium oxide.

(a) Magnesium oxide has the formula MgO.

(i) Calculate the relative formula mass (M_r) of magnesium oxide.

Relative atomic masses: O = 16; Mg = 24.

.....

.....

Relative formula mass = ...

(2)

(ii) Calculate the percentage by mass of magnesium in magnesium oxide.

.....

.....

Percentage by mass of magnesium in magnesium oxide = ...%

(2)

(iii) Calculate the mass of magnesium needed to make 25 g of magnesium oxide.

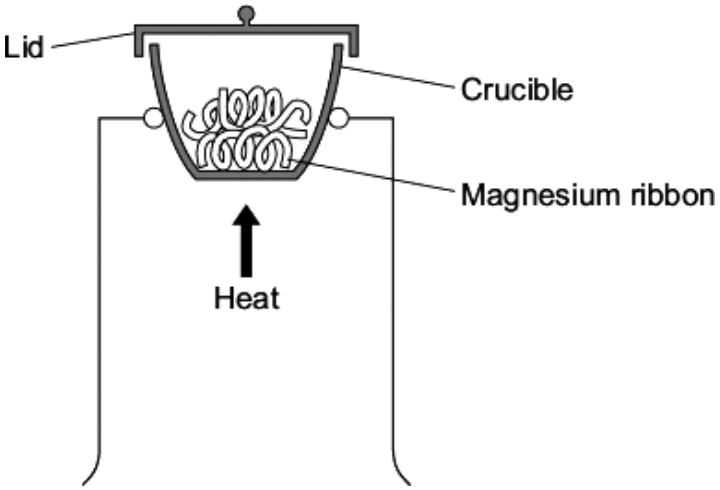
.....

Mass of magnesium = ... g

(1)

(b) The students calculated that if they used 0.12 g of magnesium they should make 0.20 g of magnesium oxide.

They did this experiment to find out if this was correct.



The students weighed 0.12 g of magnesium ribbon into a crucible.

They heated the magnesium ribbon.

They lifted the lid of the crucible slightly from time to time to allow air into the crucible.

The students tried to avoid lifting the lid too much in case some of the magnesium oxide escaped.

When all of the magnesium appeared to have reacted, the students weighed the magnesium oxide produced.

The results of the experiment are shown below.

Mass of magnesium used in grams	0.12
Mass of magnesium oxide produced in grams	0.18

(i) The mass of magnesium oxide produced was lower than the students had calculated.
They thought that this was caused by experimental error.

Suggest **two** experimental errors that the students had made.

.....

.....

.....

.....

(2)

(ii) The students only did the experiment once.

Give **two** reasons why they should have repeated the experiment.

.....

.....

.....

.....

(2)
(Total 9 marks)

Q3. (a) The table gives information about two isotopes of hydrogen, hydrogen-1 and hydrogen-2.

	Hydrogen-1	**Hydrogen-2**
Atomic number	1	1
Mass number	1	2

An atom of hydrogen-1 is represented as: $^{1}_{1}\mathrm{H}$

Show how an atom of hydrogen-2 is represented.

(1)

(b) (i) Calculate the relative formula mass (M_r) of water, H_2O

Relative atomic masses: H = 1; O = 16.

.....

.....

Relative formula mass (M_r) = ...

(1)

(ii) Simple molecules like water have low boiling points.

Explain why, in terms of molecules.

.....

.....

.....

.....

(2)

(c) Molecules of heavy water contain two atoms of hydrogen-2 instead of two atoms of hydrogen-1.

Explain why a molecule of heavy water has more mass than a normal water molecule. You should refer to the particles in the nucleus of the two different hydrogen atoms in your answer.

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.....

(2)
(Total 6 marks)

Q4. Iron is an essential part of the human diet. Iron(II) sulfate is sometimes added to white bread flour to provide some of the iron in a person's diet.

(a) The formula of iron(II) sulfate is $FeSO_4$

Calculate the relative formula mass (M_r) of $FeSO_4$

Relative atomic masses: O = 16; S = 32; Fe = 56.

.....

.....

The relative formula mass (M_r) = ...

(2)

(b) What is the mass of one mole of iron(II) sulfate? Remember to give the unit.

.....

(1)

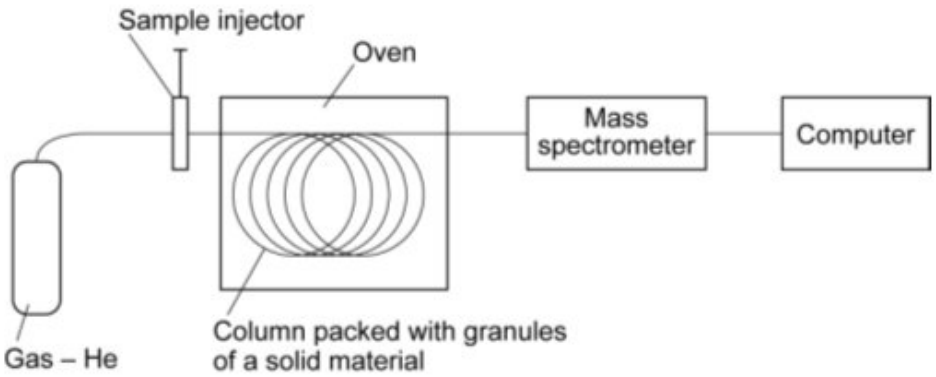
(c) What mass of iron(II) sulfate would be needed to provide 28 grams of iron?

Remember to give the unit.

.....

(1)
(Total 4 marks)

Q5. The diagram shows the main parts of an instrumental method called gas chromatography linked to mass spectroscopy (GC-MS).



This method separates a mixture of compounds and then helps to identify each of the compounds in the mixture.

(a) In which part of the apparatus:

(i) is the mixture separated? .....

(1)

(ii) is the relative molecular mass of each of the compounds in the mixture measured?

.....

(1)

(b) (i) Athletes sometimes take drugs because the drugs improve their performance. One of these drugs is ephedrine.

Ephedrine has the formula:

$$C_{10}H_{15}NO$$

What relative molecular mass (M_r) would be recorded by GC-MS if ephedrine was present in a blood sample taken from an athlete?

Show clearly how you work out your answer.

Relative atomic masses: H = 1; C = 12; N = 14; O = 16.

.....

.....

.....

.....

Relative molecular mass = ...

(2)

(ii) Another drug is amphetamine which has the formula:

$$C_9H_{13}N$$

The relative molecular mass (M_r) of amphetamine is 135.

Calculate the percentage by mass of nitrogen in amphetamine.

Relative atomic mass: N = 14

.....

.....

Percentage of nitrogen = ... %

(2)

(c) Athletes are regularly tested for drugs at international athletics events.

An instrumental method such as GC-MS is better than methods such as titration.

Suggest **two** reasons why.

.....

.....

.....

.....

(2)

(d) When a blood sample is taken from an athlete the sample is often split into two portions. Each portion is tested at a different laboratory.

Suggest why.

.....

.....

.....

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(2)
(Total 10 marks)