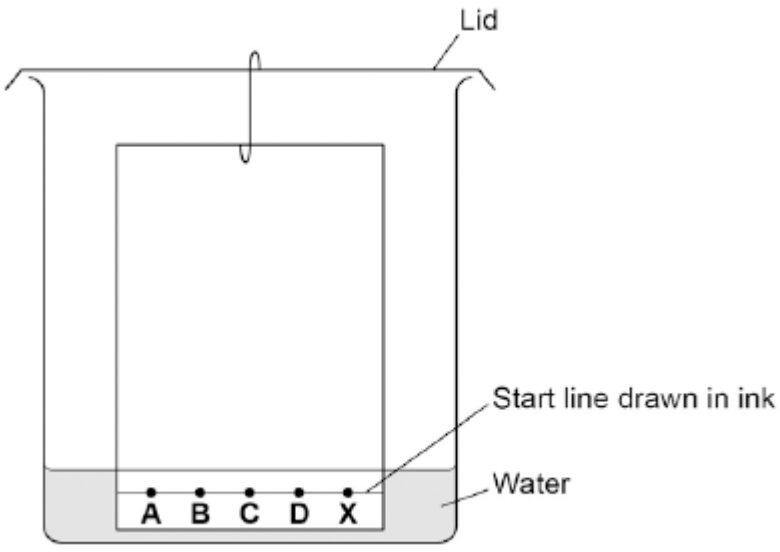
**Q1.**A student investigated food dyes using paper chromatography.

This is the method used.

1. Put a spot of food colouring **X** on the start line.
2. Put spots of four separate dyes, **A**, **B**, **C** and **D**, on the start line.
3. Place the bottom of the paper in water and leave it for several minutes.

**Figure 1** shows the apparatus the student used.

**Figure 1**




(a) Write down **two** mistakes the student made in setting up the experiment and explain what problems one of the mistakes would cause.

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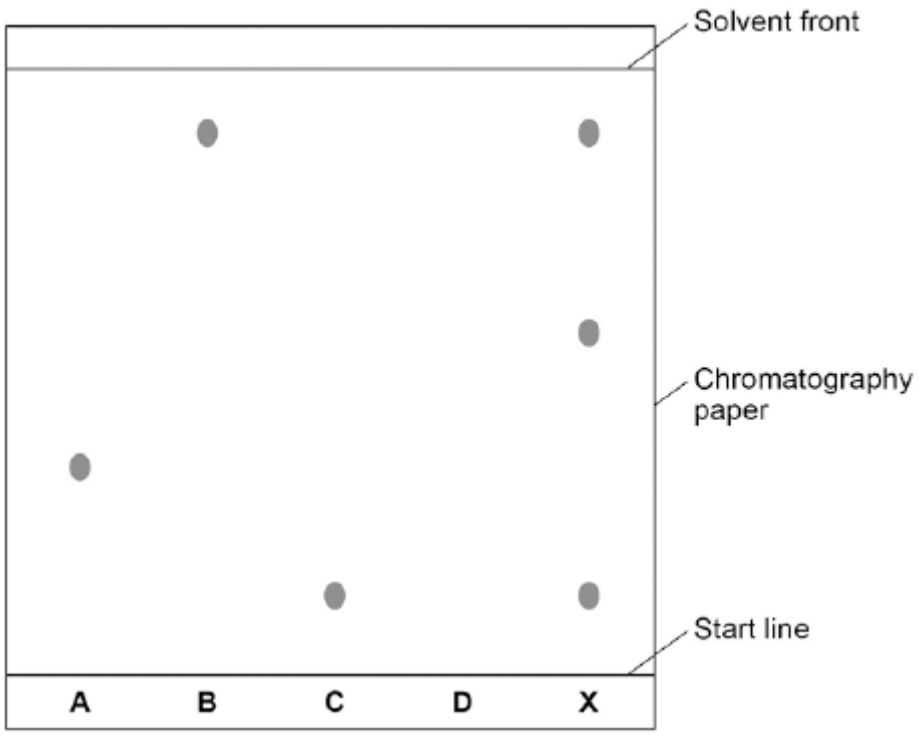
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**(2)**

(b) Another student set up the apparatus correctly.

**Figure 2** shows the student's results. The result for dye **D** is not shown.

**Figure 2**




Calculate the $R_f$ value of dye **A**

Give your answer to two significant figures.

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$R_f$ value = .....

**(3)**

(c) Dye **D** has an $R_f$ value of 0.80. Calculate the distance that dye **D** moved on the chromatography paper.

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Distance moved by dye **D** = .....

**(1)**

(d) Explain how the different dyes in **X** are separated by paper chromatography.

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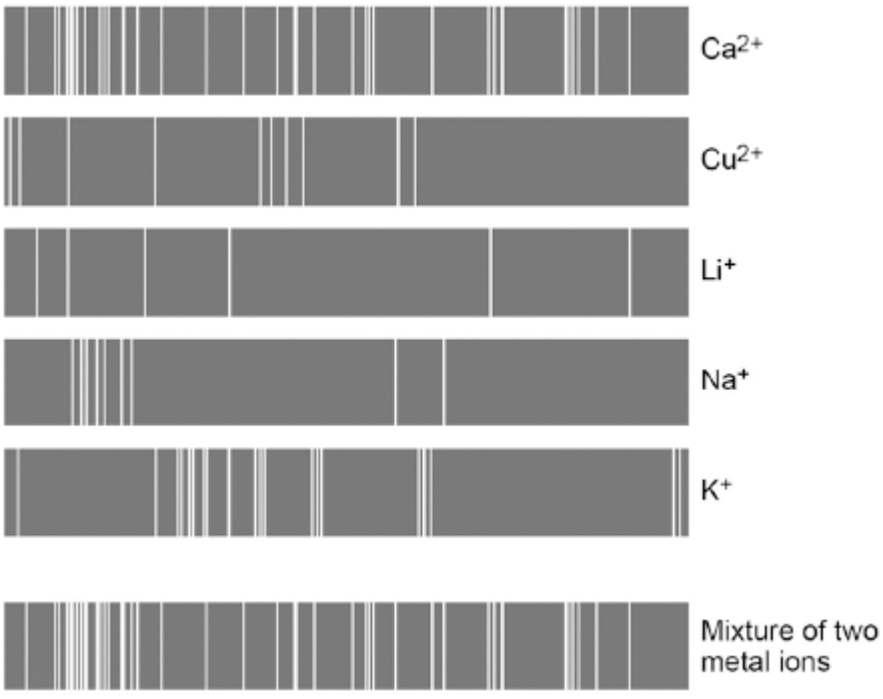
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**(4)**

(e) Flame emission spectroscopy can be used to analyse metal ions in solution.

**Figure 3** gives the flame emission spectra of five metal ions, and of a mixture of two metal ions.

**Figure 3**




Use the spectra to identify the **two** metal ions in the mixture.

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**(2)**

(f) Explain why a flame test could **not** be used to identify the two metal ions in the mixture.

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**(2)**

(g) Two students tested a green compound **X**.
The students added water to compound **X**.
Compound **X** did not dissolve.

The students then added a solution of ethanoic acid to compound **X**.
A gas was produced which turned limewater milky.

Student **A** concluded that compound **X** was sodium carbonate.
Student **B** concluded that compound **X** was copper chloride.

Which student, if any, was correct?

Explain your reasoning.

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**(4)**
**(Total 18 marks)**

**Q2.** Limestone is used as a building material. Acid rain erodes limestone.

(a) Limestone contains calcium carbonate.
The symbol equation for the reaction of calcium carbonate with hydrochloric acid is shown.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

Describe a test to show that carbon dioxide is produced in this reaction.

Give the result of the test.

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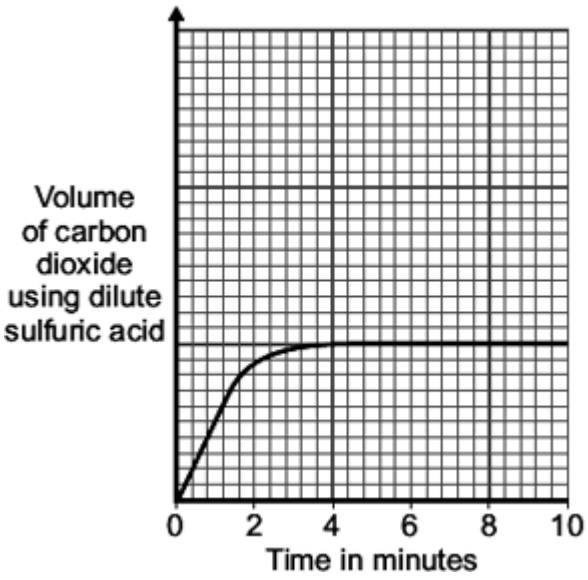
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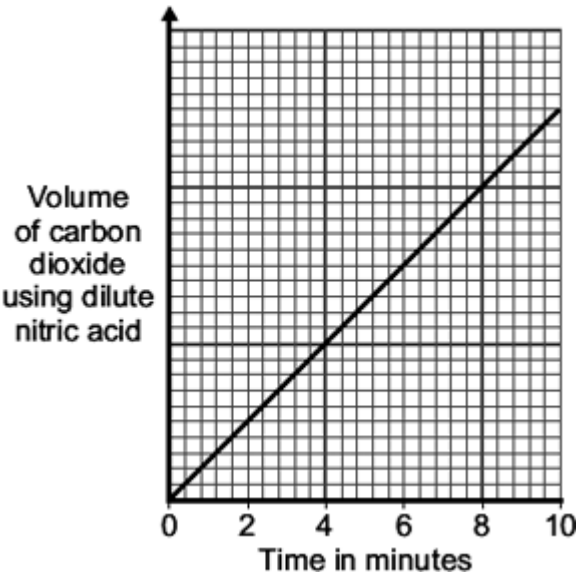
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**(2)**

(b) Gases from vehicle exhausts produce sulfuric acid and nitric acid.

A student investigated the reaction of these two acids with calcium carbonate (limestone).
The type of acid was changed but all other variables were kept the same.
The student measured the volume of carbon dioxide produced each minute for a total of 10 minutes. He did this first for the reaction between dilute sulfuric acid and a cube of calcium carbonate (limestone).
The student repeated the experiment using dilute nitric acid in place of the dilute sulfuric acid.
The results are shown below.




(i) State **two** variables that must be kept the same for this investigation.

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**(2)**

(i) Reacting calcium carbonate with sulfuric acid gave different results to nitric acid.

The symbol equations for the reaction of calcium carbonate with sulfuric acid and with nitric acid are shown below.

$CaCO_3(s) + H_2SO_4(aq) \rightarrow CaSO_4(s) + H_2O(l) + CO_2(g)$

$CaCO_3(s) + 2HNO_3(aq) \rightarrow Ca(NO_3)_2(aq) + H_2O(l) + CO_2(g)$

Describe how the results for sulfuric acid are different **and** use the symbol equations to explain this difference.

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**(3)**
**(Total 7 marks)**

**Q3.** A student investigated an egg shell.



Trish Steel [CC-BY-SA-2.0], via Wikimedia Commons

(a) The student did some tests on the egg shell.

The student's results are shown in the table below.

| | Test | Observation |
|---|---|---|
| **1** | Dilute hydrochloric acid was added to the egg shell. | A gas was produced.<br><br>The egg shell dissolved, forming a colourless solution. |
| **2** | A flame test was done on the colourless solution from test **1**. | The flame turned red. |
| **3** | Sodium hydroxide solution was added to the colourless solution from test **1**. | A white precipitate formed that did not dissolve in excess sodium hydroxide solution. |
| **4** | Silver nitrate solution was added to the colourless solution from test **1**. | A white precipitate formed. |

(i) The student concluded that the egg shell contains carbonate ions.

Describe how the student could identify the gas produced in test **1**.

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**(2)**

(ii) The student concluded that the egg shell contains aluminium ions.

Is the student's conclusion correct? Use the student's results to justify your answer.

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**(2)**

(iii) The student concluded that the egg shell contains chloride ions.

Is the student's conclusion correct? Use the student's results to justify your answer.

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**(2)**

(b) Some scientists wanted to investigate the amount of lead found in egg shells.
They used a modern instrumental method which was *more sensitive* than older methods.

(i) Name **one** modern instrumental method used to identify elements.

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**(1)**

(ii) What is the meaning of *more sensitive*?

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**(1)**
**(Total 8 marks)**

**Q4.** Acids and bases are commonly found around the home.

(a) Baking powder contains sodium hydrogencarbonate mixed with an acid.

(i) When water is added, the baking powder releases carbon dioxide. How could you test the gas to show that it is carbon dioxide?

Test .....

Result of test .....

**(2)**

(ii) Complete and balance the chemical equation for the reaction of sodium hydrogencarbonate with sulphuric acid.

$NaHCO_3$ + $H_2SO_4$ → ..... + ..... + .....

**(2)**

(b) Indigestion tablets contain bases which cure indigestion by neutralising excess stomach acid.




(i) One type of indigestion tablet contains magnesium hydroxide. This base neutralises stomach acid as shown by the balanced chemical equation.

$Mg(OH)_2$ + 2HCl → $MgCl_2$ + $2H_2O$

Write a balanced **ionic** equation for the neutralisation reaction.

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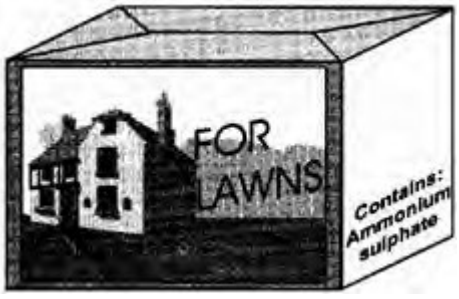
**(2)**

(ii) How does the pH in the stomach change after taking the tablets?

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**(1)**

(c) Ammonium sulphate is used as a lawn fertiliser.




Using ammonia solution, describe how you would make the fertiliser ammonium sulphate.

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**(3)**
**(Total 10 marks)**