C3 USE OF AMOUNT OF SUBSTANCE IN VOLUME OF GASES

Question Practice

Name: _____

Class: _____

Date: _____

Time: **24 minutes**

Marks: **24 marks**

Comments: **GCSE CHEMISTRY ONLY**

1 Lead bromide is a solid. Some students were measuring how soluble lead bromide is at different temperatures.

This is the method they used.

A Pour 100 cm^3 of water into a beaker.

B Heat or cool the water to the required temperature.

C Add lead bromide to the water.

D Stir until no more lead bromide dissolves.

E Transfer 50 cm^3 of the lead bromide solution into an evaporating basin of known mass.

F Heat the evaporating basin until all of the water has evaporated.

G Measure the mass of the evaporating basin containing the dry lead bromide.

(a) (i) How could the lead bromide solution be separated from the undissolved solid lead bromide after step **D**?

Draw a ring around the correct answer.

electrolysis **filtration** **neutralisation**

(1)

(ii) Draw a ring around the correct answer to complete the sentence.

A suitable item of apparatus for measuring 50 cm^3 of the lead bromide solution

in step **E** is a measuring

cylinder.
funnel.
tube.

(1)

(iii) One student's results are shown in **Table 1**.

Table 1

Volume of lead bromide solution	50 cm^3
Mass of empty evaporating basin	35.4 g
Mass of the evaporating basin containing dry lead bromide	36.0 g

Calculate the mass of lead bromide dissolved in 50 cm^3 of lead bromide solution.

_____

_____

Mass of lead bromide dissolved = _____ g

(2)

(b) A different student got the results shown in **Table 2**.

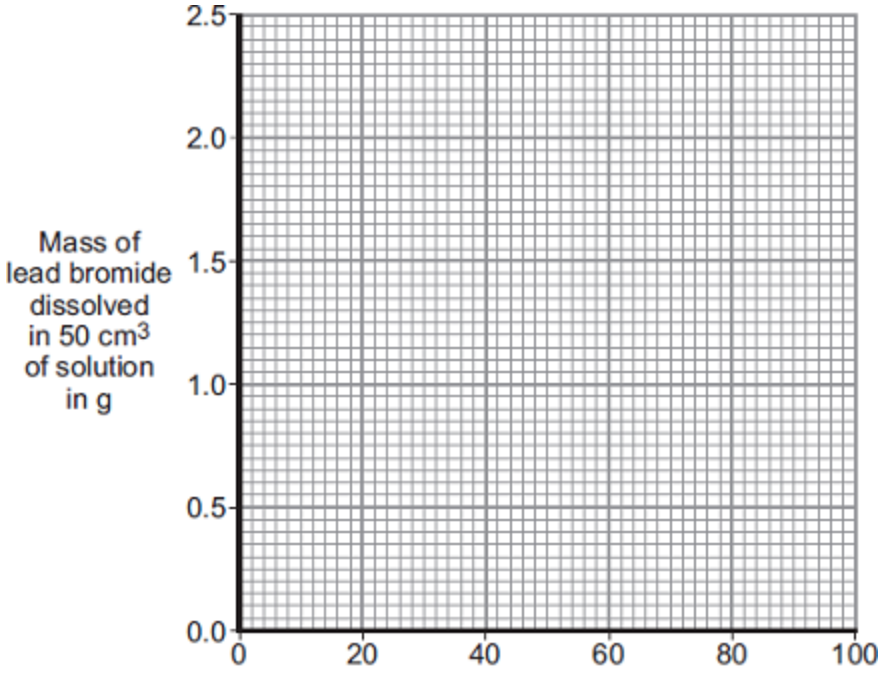
Table 2

Temperature of lead bromide solution in °C	**Mass of lead bromide dissolved in 50 cm^3 of solution in g**
0	0.20
20	0.40
40	0.70
60	1.70
80	1.55
100	2.30

(i) Plot these results on the grid in **Graph 1**.

Draw a smooth curve of best fit.

Graph 1



(3)

(ii) One of the points is anomalous.

Draw a ring around the anomalous point on the graph.

Suggest **one** possible error in the experiment, and give a reason why this error would cause the anomalous point.

_____

_____

_____

_____

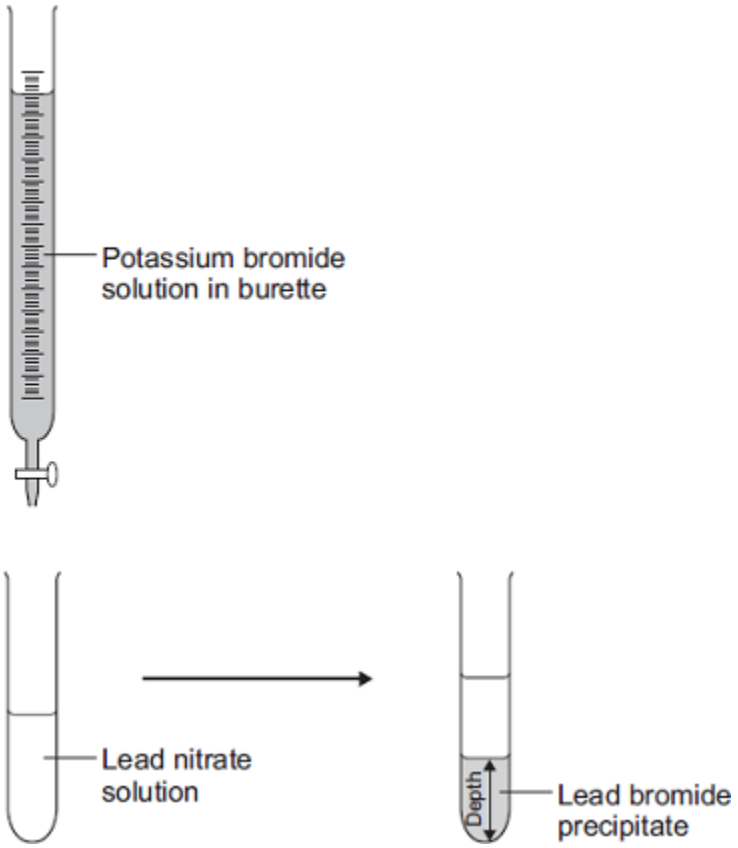
(3)

(c) The solubility of lead bromide is so low that it can be made using a precipitation reaction.

A student investigated how much lead bromide was precipitated when different volumes of potassium bromide and lead nitrate solutions were mixed together.

This is the method the student used.

- Place 10 cm^3 of lead nitrate solution in a boiling tube.
- Using a burette, add 2 cm^3 of potassium bromide solution to the boiling tube containing the lead nitrate solution.
- Leave the mixture to stand.
- Measure the depth of the lead bromide precipitate using a ruler.
- Repeat using different volumes of potassium bromide solution.



(i) A teacher suggested that the student should do the reaction in a measuring cylinder.

Explain why it is a good idea to do the reaction in a measuring cylinder.

_____

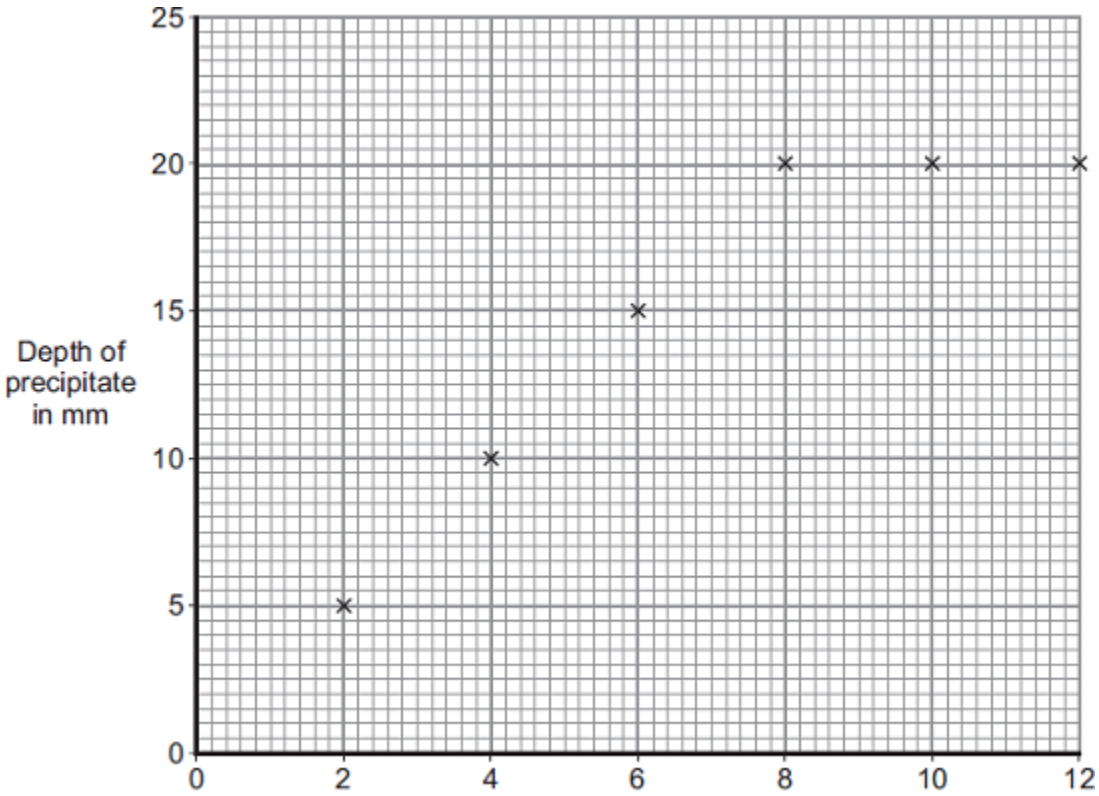
_____

_____

(2)

(ii) The student's results are plotted on **Graph 2**.

Graph 2



There are no anomalous points.

Complete the graph by drawing two straight lines through the points.

(2)

(iii) What depth of precipitate would you expect to get if 14 cm^3 of potassium bromide was used?

Give a reason for your answer.

Depth of precipitate _____ mm

Reason _____

_____

_____

(2)

(iv) How would the results be different if the experiment was repeated using solutions at a higher temperature?

Give a reason for your answer.

_____

_____

_____

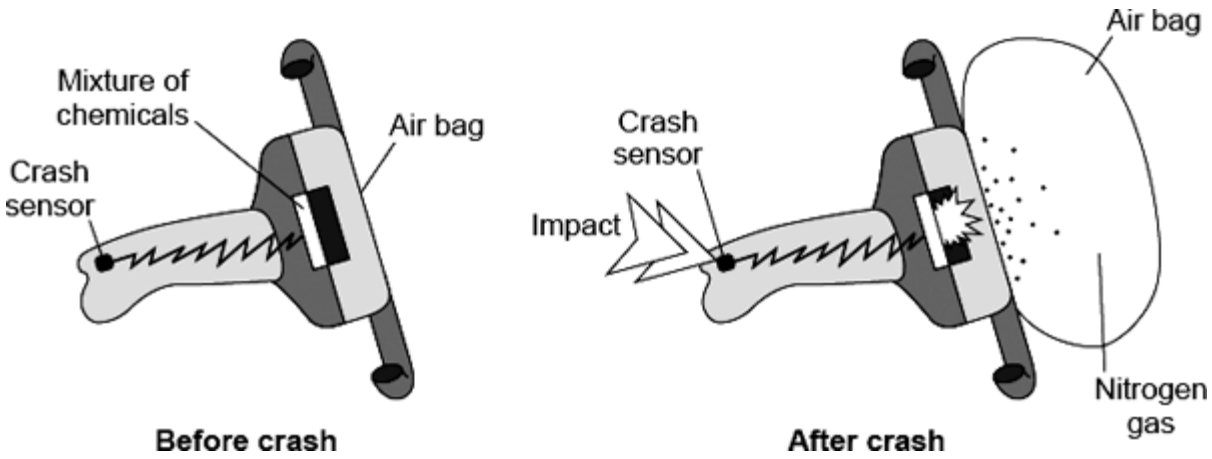
_____

_____

(2)

(Total 18 marks)

2 Air bags are used to protect the passengers in a car during an accident. When the crash sensor detects an impact it causes a mixture of chemicals to be heated to a high temperature. Reactions take place which produce nitrogen gas. The nitrogen fills the air bag.



(a) The mixture of chemicals contains sodium azide (NaN_3) which decomposes on heating to form sodium and nitrogen.

$$2NaN_3 \rightarrow 2Na + 3N_2$$

A typical air bag contains 130 g of sodium azide.

(i) Calculate the mass of nitrogen that would be produced when 130 g of sodium azide decomposes.

Relative atomic masses (A_r): N = 14; Na = 23

_____

_____

_____

_____

Mass of nitrogen = _____ g

(3)

(ii) 1 g of nitrogen has a volume of 0.86 litres at room temperature and pressure.

What volume of nitrogen would be produced from 130 g of sodium azide?

(If you did not answer part (a)(i), assume that the mass of nitrogen produced from 130 g of sodium azide is 80 g. This is **not** the correct answer to part (a)(i).)

_____

Volume = _____ litres

(1)

(b) The sodium produced when the sodium azide decomposes is dangerous.
The mixture of chemicals contains potassium nitrate and silicon dioxide which help to make the sodium safe.

(i) Sodium reacts with potassium nitrate to make sodium oxide, potassium oxide and nitrogen. Complete the balancing of the equation for this reaction.

$10Na + \_\_\_\_\_KNO_3 \rightarrow Na_2O + K_2O + N_2$

(1)

(ii) The silicon dioxide reacts with the sodium oxide and potassium oxide to form silicates.

Suggest why sodium oxide and potassium oxide are dangerous in contact with the skin.

_____

_____

(1)

(Total 6 marks)

Mark schemes

1 (a) (i) filtration

1

(ii) cylinder

1

(iii) 0.6

*correct answer with or without working gains **2** marks*

*if answer incorrect, allow mass of lead bromide = 36.0–35.4 for **1** mark*

2

(b) (i) all points plotted correctly

± half a small square

*4 or 5 correct for **1** mark*

2

smooth curve through five points (excluding anomaly)

*do **not** accept straight sections / multiple lines*

1

(ii) point at 60°C circled

1

measured out more than 50 cm^3

*explanation **must** explain why mass dissolved is too large*

1

so solution contained more lead bromide

or

did not heat until all water gone

so additional mass of water

or

heated water to over 60 °C

so more dissolved

allow correct explanation for an incorrectly circled point

1

(c) (i) because (a measuring cylinder) has graduations on it

1

so it is easier to read how much precipitate

or

(a measuring cylinder) has a flat bottom

so measurement of depth is more accurate

1

(ii) straight line covering points from (2,5) to (8,20)

line need not be extrapolated to (0,0), but line is correct only if any extrapolation would go through (0,0)

1

straight line through points (8,20) and (10,20)

all straight lines must be drawn with a ruler

1

(iii) 20 mm

1

all of the lead nitrate has reacted **or** lead nitrate is limiting **or** potassium bromide is in excess **or** reaction was over when 8 cm^3 potassium bromide were used

1

(iv) amount / depth of precipitate would be less

1

because lead bromide is more soluble at higher temperatures **or** less solid / more dissolved **or** solution of lead bromide more concentrated

1

[18]

2 (a) (i) 84 / 84.5 / 83.98

*correct answer with or without working gains **3** marks*

(moles of NaN_3 =) 130/65 (1)

moles of nitrogen = 3 (1)

mass of nitrogen = 3 x 28 = 84 (1)

or

2 x (23 + (3 x 14)) (1)

3 x (2 x14) (1)

or

$2NaN_3$ = 130 (1)

$3N_2$ = 84 (1)

if answer is incorrect then look for evidence of correct working.

allow ecf from previous stage

***1** mark lost for each mistake in the working if they do not have the correct answer.*

3

(ii) 72 / 72.24 / 72.2

allow ecf from part (i) × 0.86

or

ignore working

69 **or** 68.8

1

(b) (i) 2 **and** 5

1

(ii) any **one** from:

- corrosive / burns
- alkaline / basic

  *do **not** accept acidic*
- attacks / destroys / damages living tissue / cells

  allow irritant

  ignore reference to reactivity

  ignore reference to silicates

  ignore harmful / toxic

1

[6]