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9701/53

October/November 2011

**1 hour 15 minutes**

No Additional Materials are required.

## READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

Use of Data Booklet is unnecessary.

The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
1	
2	
Total	

This document consists of **8** printed pages and **4** blank pages.



- 1 If a container of gas has a tiny hole in it, the gas will gradually escape through the hole. This process is called **effusion** and the rate at which it occurs is called **the rate of effusion**.

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You are to plan an experiment to investigate how the **rate of effusion** depends on the **relative molecular mass,  $M_r$** , of a gas.

- (a) At a constant temperature, the rate of effusion of a gas depends on the kinetic energy of the molecules of the gas. So, for a series of gases all at the same temperature, as the  $M_r$  of a gas increases the speed of the molecules of the gas decreases.

- (i) Predict how the rate of effusion will change as the  $M_r$  of the gas **increases**. Explain your prediction using the information in part (a) above.

prediction .....

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explanation .....

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- (ii) Display your prediction in the form of a sketch graph below, clearly labelling the axes.



[3]

- (b) In the experiment you are about to plan, identify the following.

(i) the independent variable .....

(ii) the dependent variable .....

[2]

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- (d) State a hazard that must be considered when planning the experiment and describe precautions that should be taken to keep risks to a minimum.

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.....[2]

- (e) Draw a table with appropriate headings to show the data you would record when carrying out your experiments and the values you would calculate in order to construct a graph to support or reject your prediction in (a). The headings **must** include the appropriate units. Ensure that the table covers all the detail relating to the five gases listed in (c).

[A<sub>r</sub>: H, 1.0; C, 12.0; O, 16.0; Cl, 35.5]

[2]

[Total: 15]

- 2 There are three oxides of lead,  $\text{PbO}$ ,  $\text{PbO}_2$  and  $\text{Pb}_3\text{O}_4$  all of which can be reduced to metallic lead by hydrogen. A sample of one of these oxides is reduced to find out which of the three oxides it is.

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An experiment was carried out as follows.

- An empty reduction tube was weighed and the mass recorded.
- A sample of the lead oxide was added to the reduction tube and the new mass recorded.
- The reduction tube and lead oxide was heated strongly for five minutes in a stream of hydrogen and then allowed to cool back to room temperature.
- The reduction tube and contents were then reweighed and the mass recorded.

- (a) The results of several such experiments are recorded below.

[ $A_r$ : O, 16.0; Pb, 207.0]

Process the results in the table to calculate the number of moles of lead **atoms** and the number of moles of oxygen **atoms**.

Record these values in the additional columns of the table. You may use some or all of the columns. Label the columns you use.

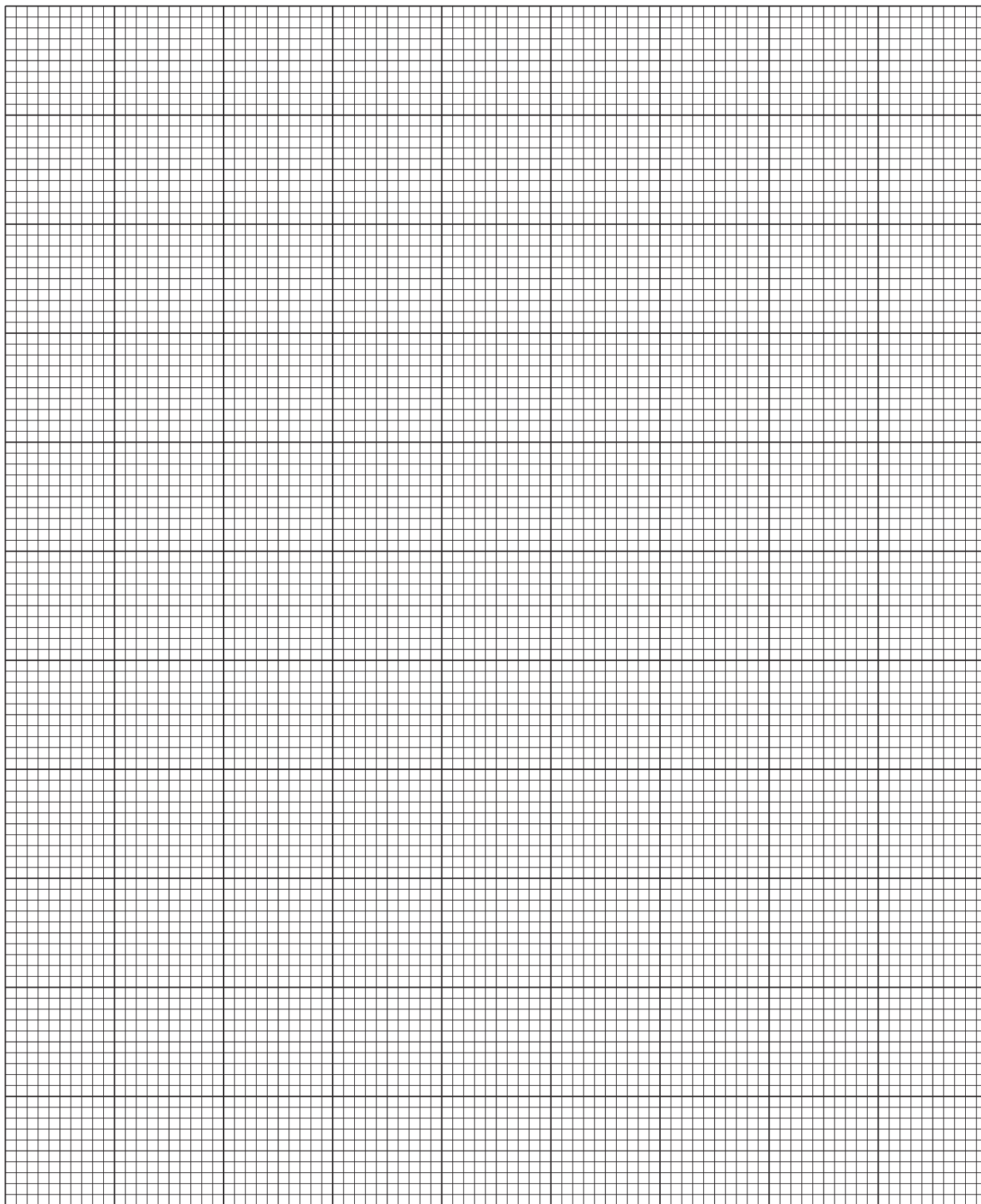
Masses should be recorded to **two decimal places** while the number of moles should be recorded to **two significant figures**.

For each column you use include units where appropriate and an expression to show how your values are calculated.

You may use the column headings A to G for these expressions (e.g. A–B). [3]

A	B	C	D	E	F	G
mass of reduction tube /g	mass of reduction tube + lead oxide /g	mass of reduction tube + lead /g				
9.90	14.95	14.48				
10.05	16.17	15.60				
10.25	17.92	17.21				
9.80	18.12	17.43				
9.60	18.43	17.61				
10.30	20.27	19.34				
11.05	22.05	21.03				
10.00	21.46	20.26				
9.75	24.07	22.74				
10.15	26.15	24.66				

- (b) Plot a graph to show the relationship between the number of moles of oxygen **atoms** and the number of moles of lead **atoms**.  
Draw the line of best fit.



[3]

- (c) Circle and label on the graph any point(s) you consider to be anomalous. For each anomalous point give a different reason why it is anomalous, clearly stating which point you are describing.

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.....[3]

- (d) Comment on whether the results obtained can be considered as reliable.

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.....[1]

- (e) Determine the slope of the graph. Mark clearly on the graph any construction lines and show clearly in your calculation how the values from the intercepts were used in the calculation of the slope.

[2]



- (f) Comment on the value of the slope of the graph.  
Deduce and explain the formula of the oxide investigated in this experiment.

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comment .....

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deduction and explanation .....

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..... [3]

[Total: 15]





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