

--

--	--	--	--	--

--	--	--	--

9702/51

May/June 2011

1 hour 15 minutes

No Additional Materials are required.

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

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.

- 1 When light is incident on the front of a photocell, an e.m.f. is generated in the photocell.

A student wishes to investigate the effect of adding various thicknesses of glass in front of a photocell. This may be carried out in the laboratory by varying the number of identical thin glass sheets between a light source and the front of the photocell.

It is suggested that the e.m.f. V is related to the number n of glass sheets by the equation

$$V = V_0 e^{-\alpha nt}$$

where t is the thickness of one sheet, α is the absorption coefficient of glass and V_0 is the e.m.f. for $n = 0$.

Design a laboratory experiment to determine the absorption coefficient of glass. You should draw a diagram, on page 3, showing the arrangement of your equipment. In your account you should pay particular attention to

- (a) the procedure to be followed,
- (b) the measurements to be taken,
- (c) the control of variables,
- (d) the analysis of the data,
- (e) the safety precautions to be taken.

[15]

Diagram

For
Examiner's
Use

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

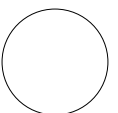
.....

.....

.....

[illegible]

For Examiner's Use	Defining the problem	Methods of data collection	Method of analysis	Safety considerations	Additional detail



- 2 A student is investigating how a volume of nitrogen gas is affected by the pressure exerted on it.

For
Examiner's
Use

A sample of nitrogen gas is trapped in a vertical tube of uniform cross-sectional area by a small volume of oil. Pressure is applied by a pump. The applied pressure is measured on a gauge, as shown in Fig. 2.1.

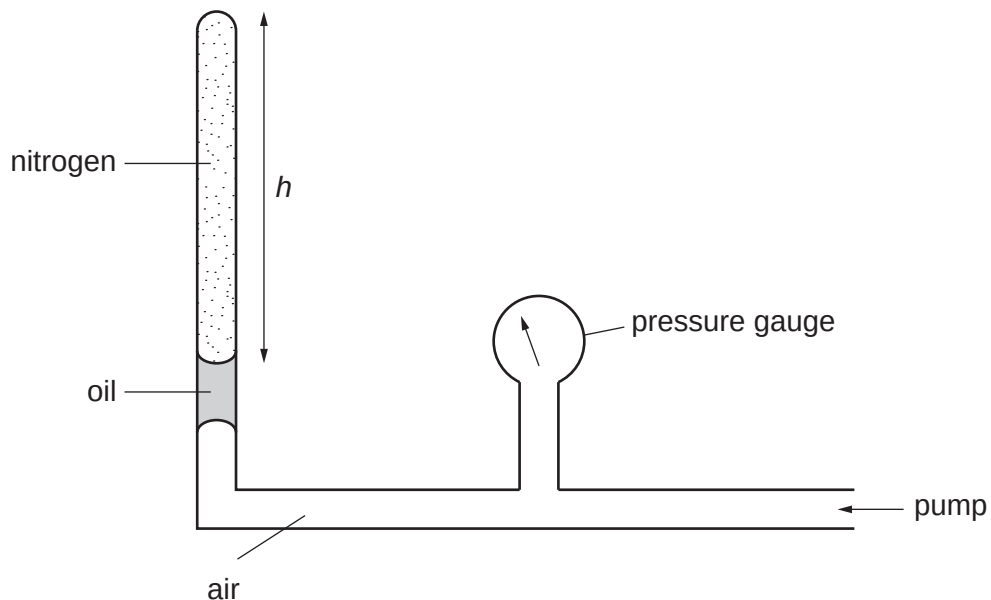


Fig. 2.1

The temperature T of the nitrogen is 290 K.

An experiment is carried out to investigate how the height h of nitrogen trapped in the tube varies with the pressure p .

Question 2 continues on the next page.

It is suggested that p and h are related by the equation

$$pAh = NkT$$

where A is the cross-sectional area of the tube, k is the Boltzmann constant and N is the number of molecules of nitrogen gas.

- (a) A graph is plotted of p on the y -axis against $\frac{1}{h}$ on the x -axis. Express the gradient in terms of N .

gradient =[1]

- (b) Values of p and h are given in Fig. 2.2.

$p/10^5 \text{ Pa}$	$h/10^{-3} \text{ m}$	
1.10	400 ± 5	
1.22	360 ± 5	
1.38	320 ± 5	
1.57	280 ± 5	
1.83	240 ± 5	
2.09	210 ± 5	

Fig. 2.2

Calculate and record values of $\frac{1}{h}$ in Fig. 2.2. Include the absolute uncertainties in $\frac{1}{h}$.

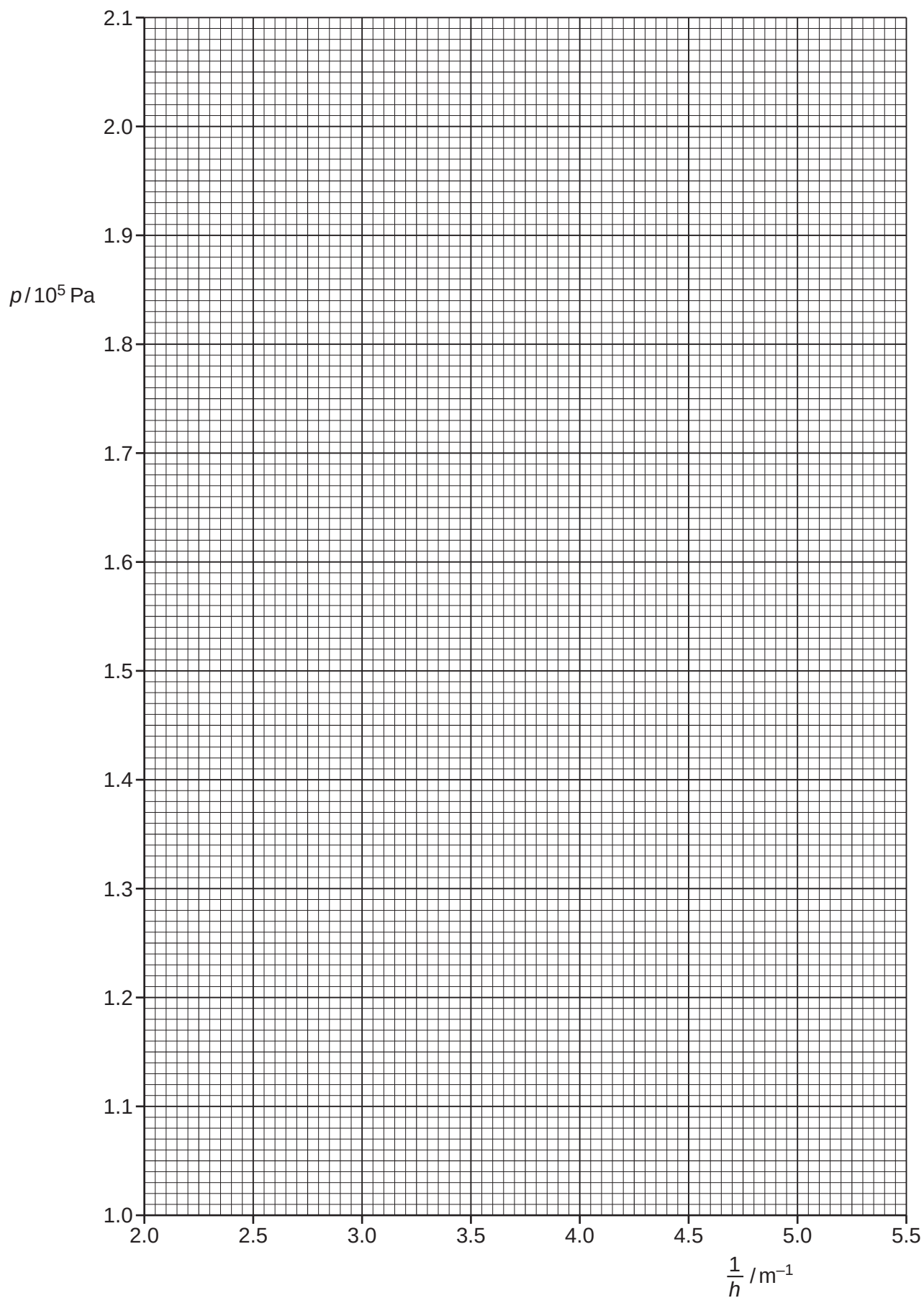
[3]

- (c) (i) Plot a graph of $p/10^5 \text{ Pa}$ against $\frac{1}{h}/\text{m}^{-1}$. Include error bars for $\frac{1}{h}$. [2]

- (ii) Draw the straight line of best fit and a worst acceptable straight line on your graph. Both lines should be clearly labelled. [2]

- (iii) Determine the gradient of the line of best fit. Include the uncertainty in your answer.

gradient =[2]



For
Examiner's
Use

- (d) In this experiment, $A = 3.14 \times 10^{-6} \text{ m}^2$ and $k = 1.38 \times 10^{-23} \text{ J K}^{-1}$. Using your answer in (c)(iii), determine the value of N . Include the absolute uncertainty in your value.

For
Examiner's
Use

$$N = \dots\dots\dots [2]$$

- (e) (i) The pressure is reduced so that $p = 1.10 \times 10^5 \text{ Pa}$ and the temperature decreases by $12 \pm 1 \text{ K}$.

Determine h using the relationship given and your answer in (d).

$$h = \dots\dots\dots [2]$$

- (ii) Determine the percentage uncertainty in your value of h .

$$\text{percentage uncertainty} = \dots\dots\dots \% [1]$$

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.