Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

0436081371

PHYSICS **9702/52**

Paper 5 Planning, Analysis and Evaluation **October/November 2019**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
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.

This document consists of **8** printed pages.

DC (ST/CT) 165328/2

Cambridge Assessment International Education

[Turn over

1 A student is investigating the maximum height reached by a light plastic ball when it is launched vertically from a compressed spring, as shown in Fig. 1.1.

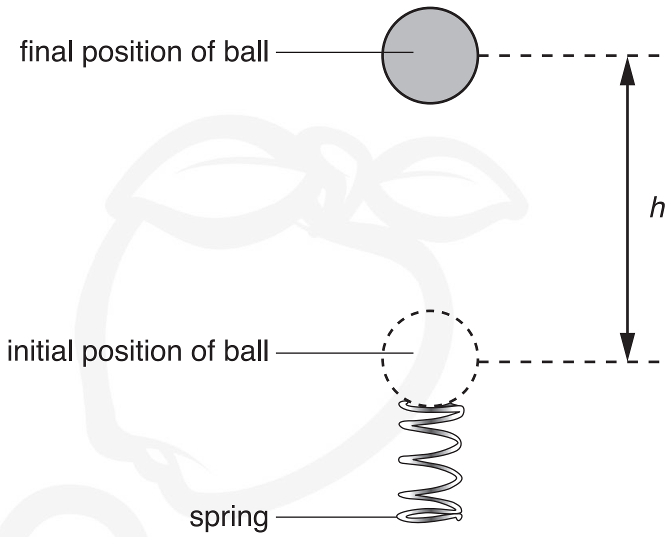

Fig. 1.1

It is suggested that the maximum height h of the ball and the compression x of the spring are related by the equation

$$\frac{4\pi r^3 \rho g h}{3} = \frac{1}{2}kx^2$$

where r is the radius of the ball, ρ is the density of the ball, g is the acceleration of free fall and k is the spring constant of the spring.

Design a laboratory experiment to test the relationship between h and x.
Explain how your results could be used to determine a value for ρ.

You should draw a diagram, on page 3, showing the arrangement of your equipment. In your account you should pay particular attention to:

- the procedure to be followed
- the measurements to be taken
- the control of variables
- the analysis of the data
- any safety precautions to be taken.

Diagram

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[15]

2 A student is investigating how the resistance of a thermistor varies with temperature. The thermistor is placed in water, as shown in Fig. 2.1.

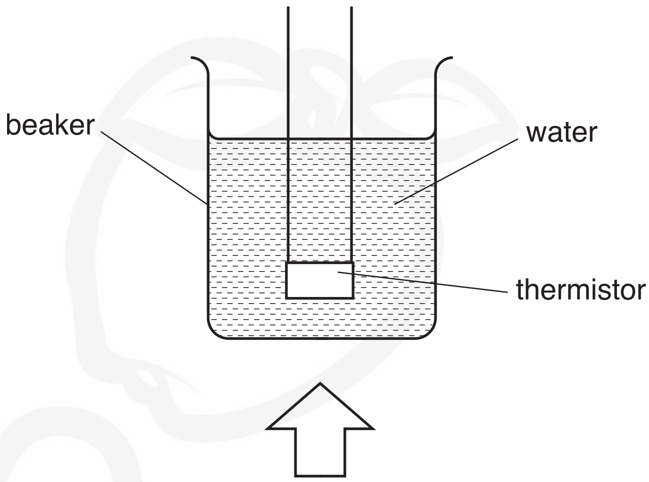


Fig. 2.1

The thermistor is connected to a battery with electromotive force (e.m.f.) E and negligible internal resistance. The current I in the thermistor is measured. The resistance R of the thermistor is then determined using the expression

$$R = \frac{E}{I}.$$

The experiment is repeated for different temperatures of the water.

It is suggested that the resistance R of the thermistor and the thermodynamic temperature T are related by the equation

$$R = pT^q$$

where p and q are constants.

(a) A graph is plotted of lg R on the y-axis against lg T on the x-axis.

Determine expressions for the gradient and the y-intercept.

gradient = ...

y-intercept = ...

[1]

(b) The value of E is 9.4 ± 0.1 V.

Values of T, I and lg T are given in Fig. 2.2.

T/K	I/mA	$R/10^3\,\Omega$	lg(T/K)	lg($R/10^3\,\Omega$)
303	1.0 ± 0.1		2.481	
313	1.6 ± 0.1		2.496	
323	2.4 ± 0.1		2.509	
333	3.7 ± 0.1		2.522	
343	5.5 ± 0.1		2.535	
353	8.7 ± 0.1		2.548	

Fig. 2.2

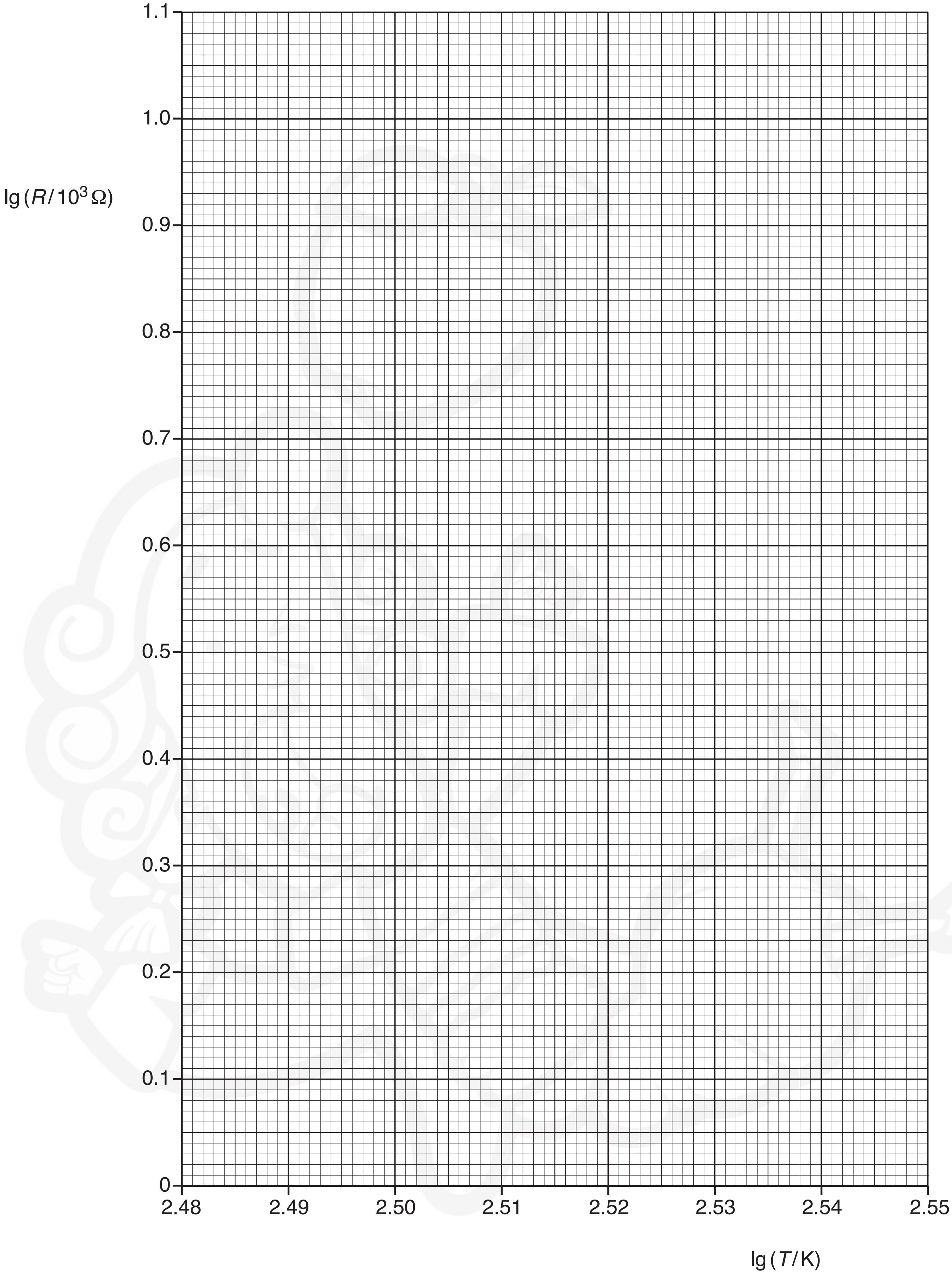
Calculate and record values of $R/10^3\,\Omega$ and lg($R/10^3\,\Omega$) in Fig. 2.2.
Include the absolute uncertainties in $R/10^3\,\Omega$ and lg($R/10^3\,\Omega$). [4]

(c) **(i)** Plot a graph of lg($R/10^3\,\Omega$) against lg(T/K).
Include error bars for lg($R/10^3\,\Omega$). [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 absolute uncertainty in your answer.

gradient = ... [2]


lg (R / 10^3 Ω)
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2.48
2.49
2.50
2.51
2.52
2.53
2.54
2.55
lg (T / K)

(iv) Determine the *y*-intercept of the line of best fit. Do **not** determine the absolute uncertainty.

y-intercept = ... [1]

(d) Using your answers to **(a)**, **(c)(iii)** and **(c)(iv)**, determine the values of *p* and *q*. You need not be concerned with units. Do **not** include the absolute uncertainties.

p = ...

q = ...
[2]

(e) Using your answers to **(d)**, determine the thermodynamic temperature *T* when the resistance of the thermistor is 15 kΩ.

T = ... K [1]

[Total: 15]