Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

9500402507

PHYSICS **9702/52**

Paper 5 Planning, Analysis and Evaluation **February/March 2016**

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.

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1 A student is interested in 'bungee jumping', where a person attached to an elastic cord falls from a height and travels downwards through a distance before moving upwards. Different cords are used for different people. A schematic diagram is shown in Fig. 1.1.

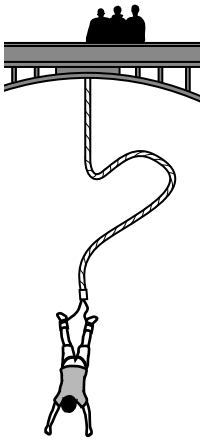

Fig. 1.1

The student models 'bungee jumping' in the laboratory by using elastic cords of unstretched length 50.0 cm with different spring constants. An object is attached to each cord.
The student investigates the relationship between the maximum distance h fallen by the object and the spring constant k of the elastic cord.

It is suggested that the relationship between h and k is

$$\tfrac{1}{2}k(h - L)^2 = mgh$$

where L is the unstretched length of the cord, m is the mass of the object and g is the acceleration of free fall.

Design a laboratory experiment to test the relationship between h and k.
Explain how your results could be used to plot a graph with $\frac{(h - L)^2}{h}$ on the y-axis and to determine the value of g. 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.

[15]

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Diagram

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[Total: 15]

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2 A student is investigating the heating of metal blocks immersed in water. A 100 g metal block is added to 250 cm^3 of water in an insulated beaker. The water is heated by an electrical heater as shown in Fig. 2.1.

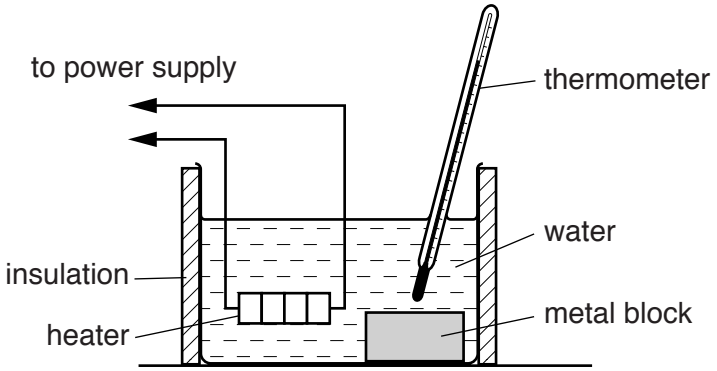

Fig. 2.1

A stopwatch is used to measure the time t for the temperature of the water and metal block of mass m_m to change by 20 °C.

The experiment is repeated by adding additional 100 g metal blocks to the water.

It is suggested that t and m_m are related by the equation

$$Pt = m_m c_m \Delta\theta + m_w c_w \Delta\theta + k$$

where P is the constant power of the heater,
c_m is the specific heat capacity of the metal,
c_w is the specific heat capacity of water,
$\Delta\theta$ is the temperature change,
m_w is the mass of the water and
k is a constant.

(a) A graph is plotted of t on the y-axis against m_m on the x-axis.
Determine expressions for the gradient and y-intercept.

gradient = ...

y-intercept = ...
[1]

(b) The number of 100 g metal blocks added to the water is n.
Values of n and t are given in Fig. 2.2.
The percentage uncertainty in the mass of each 100 g metal block is ±10%.

n	t / s	
1	465	
2	485	
3	505	
4	525	
5	545	
6	560	

Fig. 2.2

Calculate and record values of m_m / g in Fig. 2.2.
Include the absolute uncertainties in m_m. [2]

(c) **(i)** Plot a graph of t / s against m_m / g. Include error bars for m_m. [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]

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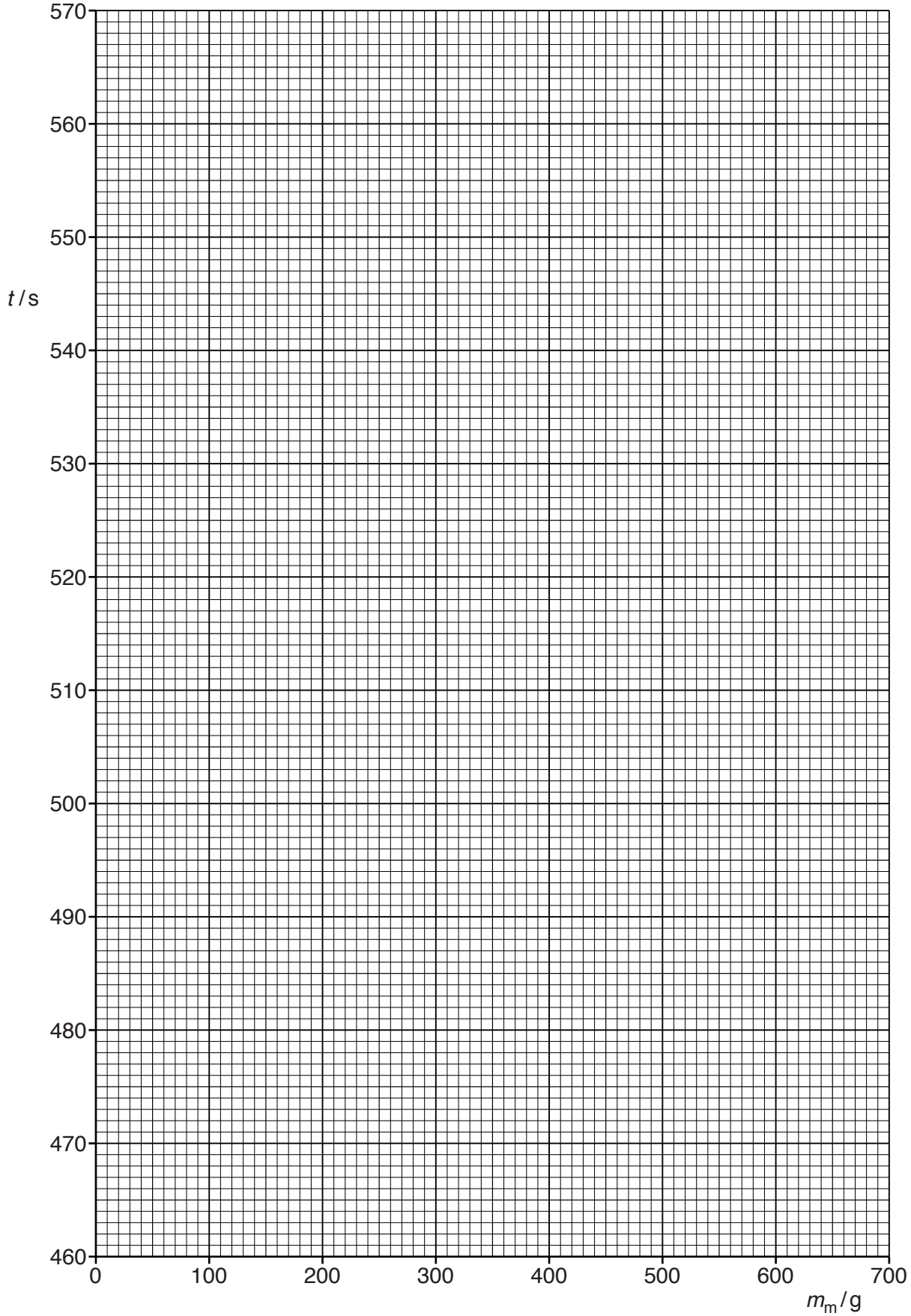
570
560
550
t / s
540
530
520
510
500
490
480
470
460
0
100
200
300
400
500
600
700
m_m / g

(iv) Determine the *y*-intercept of the line of best fit. Include the absolute uncertainty in your answer.

y-intercept = ...[2]

(d) (i) Using your answers to **(a)**, **(c)(iii)** and **(c)(iv)**, determine the values of c_m and k. Include appropriate units.

Data: $P = 50 \pm 5\,\text{W}$, $c_w = 4200\,\text{J kg}^{-1}\text{K}^{-1}$, $\Delta\theta = 20.0 \pm 0.5\,^\circ\text{C}$ and $m_w = 250\,\text{g}$.

c_m = ...

k = ...
[3]

(ii) Determine the percentage uncertainty in c_m.

percentage uncertainty in c_m = ... % [1]

[Total: 15]

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