UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

8639749433

PHYSICS **9702/36**

Advanced Practical Skills 2 **October/November 2011**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

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 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 **both** questions.
You will be allowed to work with the apparatus for a maximum of one hour for each question.
You are expected to record all your observations as soon as these observations are made, and to plan the presentation of the records so that it is not necessary to make a fair copy of them.
You may lose marks if you do not show your working or if you do not use appropriate units.

Additional answer paper and graph paper should be submitted only if it becomes necessary to do so.
You are reminded of the need for good English and clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] after each question or part question.

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1	
2	
Total	

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1 In this experiment, you will investigate the equilibrium of a mass and pulley system.

(a) The apparatus has been set up in an arrangement similar to that shown in Fig. 1.1.

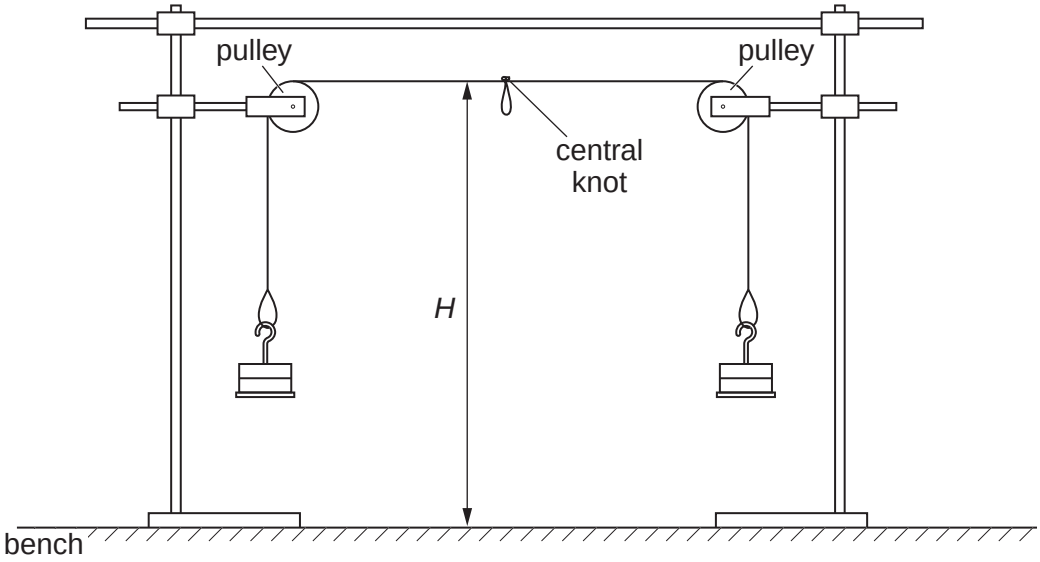


Fig. 1.1

(b) Measure and record the height *H* of the central knot above the bench.

H = ... m [1]

(c) **(i)** Suspend the mass hanger from the central loop as shown in Fig. 1.2.

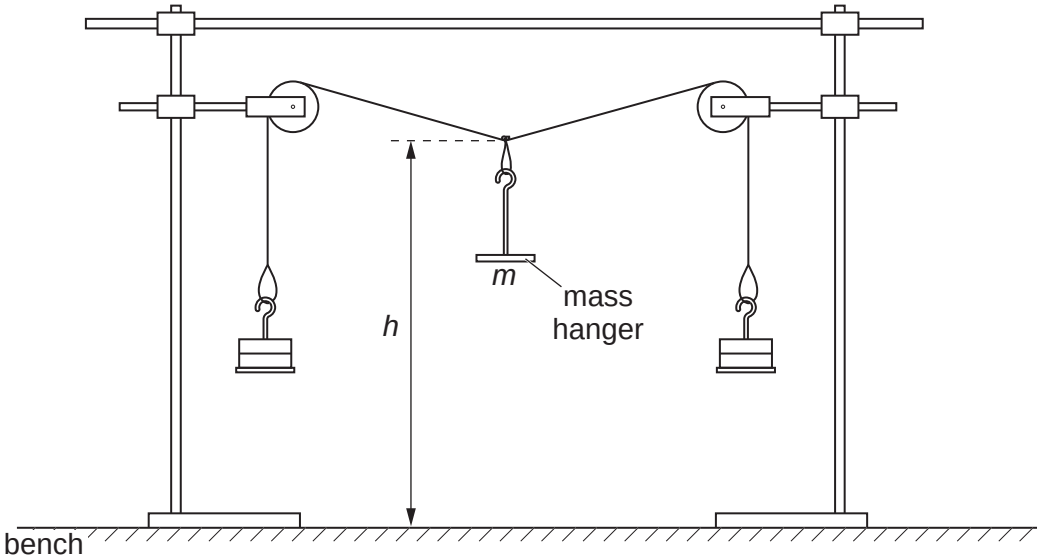


Fig. 1.2

(ii) Record the central suspended mass *m.*

m = ... kg [1]

(iii) Measure and record the height h of the central knot above the bench, as shown in Fig. 1.2.

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h = ... m

(iv) Calculate the deflection y, where $y = (H - h)$.

y = ... m

(d) Change m by adding masses to the hanger suspended from the central loop and repeat **(c)(ii)**, **(c)(iii)** and **(c)(iv)** until you have six sets of values for m, h and y.

Include in your table of results values for $\frac{1}{y^2}$ and $\frac{1}{m^2}$.

[10]

(e) **(i)** Plot a graph of $\frac{1}{y^2}$ on the y-axis against $\frac{1}{m^2}$ on the x-axis. [3]

(ii) Draw the straight line of best fit. [1]

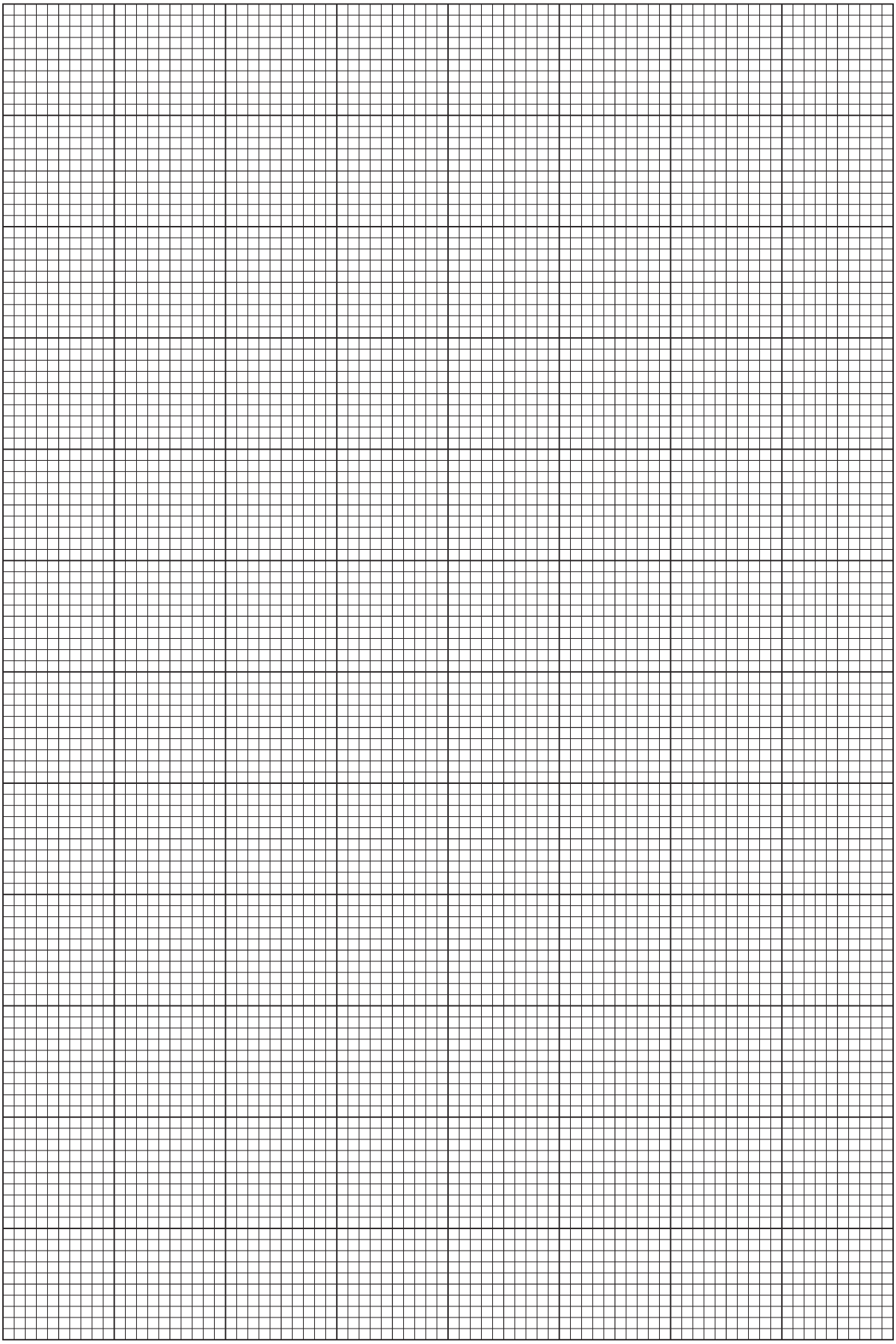
(iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...

[2]

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(f) The relationship between y and m is

$$\frac{1}{y^2} = \frac{p}{m^2} - q$$

where p and q are constants.

Using your answers from **(e)(iii)**, determine the values of p and q.
Give appropriate units.

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p = ...

q = ...
[2]

You may not need to use all of the materials provided.

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2 In this experiment you will investigate the range of a steel ball projectile.

(a) You are provided with a length of tube with a wooden block at each end. Mount the tube in clamps, with the tray of sand positioned below its lower end, as shown in Fig. 2.1.

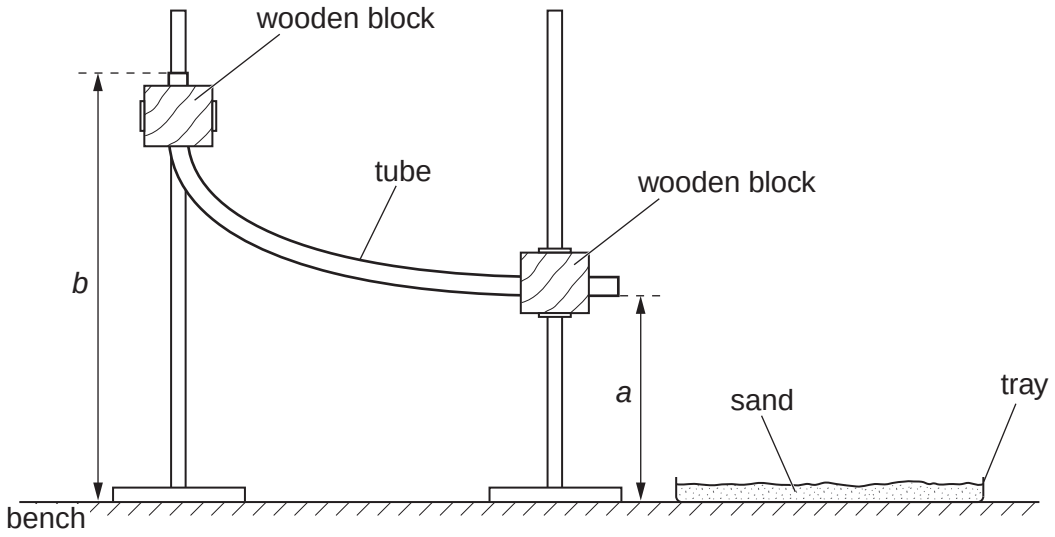


Fig. 2.1

(b) **(i)** Ensure that the lower end of the tube is horizontal and approximately 30 cm above the bench, and that the upper end of the tube is vertical and about 50 cm above the bench.

(ii) Measure and record the height *a* above the bench of the lower end of the tube, as shown in Fig. 2.1.

a = ...

(iii) Measure and record the height *b* above the bench of the higher end of the tube.

b = ...
[2]

(c) **(i)** Drop the steel ball into the top of the tube and note its landing position in the tray of sand. The range R is the horizontal distance of the landing position from the end of the tube, as shown in Fig. 2.2.

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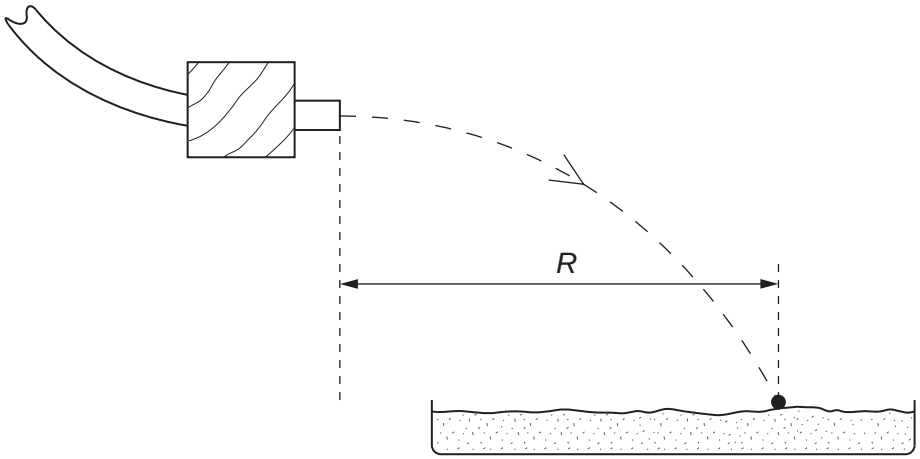


Fig. 2.2

(ii) Measure and record R.

R = ... m [2]

(d) Estimate the percentage uncertainty in R.

percentage uncertainty = ... [1]

(e) Calculate the horizontal velocity v of the steel ball using the relationship $v = R\sqrt{\frac{g}{2a}}$, where $g = 9.81\,\text{ms}^{-2}$.

v = ... [1]

(f) (i) Adjust the height of the upper end of the tube to about 30 cm above the bench, and adjust the height of the lower end to about 20 cm above the bench. Ensure that the lower end of the tube is horizontal.

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(ii) Repeat **(b)(ii)**, **(b)(iii)**, **(c)** and **(e)**.

a = ...

b = ...
[1]

R = ... m [2]

v = ...[1]

(g) (i) It is suggested that the relationship between v, b and a is

$$v^2 = k(b - a)$$

where k is a constant.
Using your data, calculate two values of k.

first value of k = ...

second value of k = ...
[1]

(ii) Explain whether your results support the suggested relationship.

.....

.....

.....

.....[1]

(h) (i) Describe four sources of uncertainty or limitations of the procedure for this experiment.

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1. .....

.....

2. .....

.....

3. .....

.....

4. .....

.....

[4]

(ii) Describe four improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

1. .....

.....

2. .....

.....

3. .....

.....

4. .....

.....

[4]

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