Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

1024956386

PHYSICS **9702/36**

Paper 3 Advanced Practical Skills 2 **October/November 2015**

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 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 **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 are reminded of the need for good English and clear presentation in your answers.

Electronic calculators may be used.
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 used only if it becomes necessary to do so.

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	

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

1 In this experiment, you will investigate the upthrust on an object partly immersed in water.

(a) Measure and record the height *H* of the flask, as shown in Fig. 1.1.

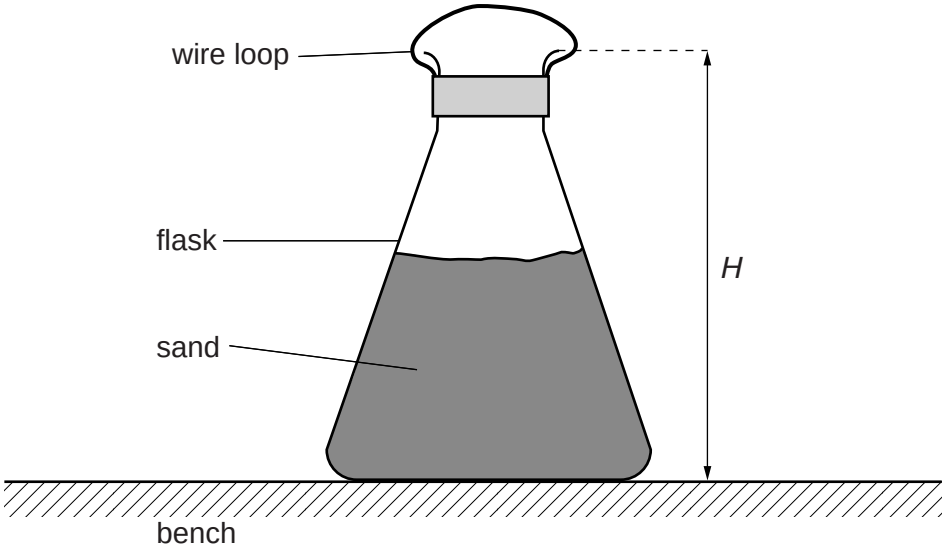


Fig. 1.1

H = ... cm [1]

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(b) Assemble the apparatus as shown in Fig. 1.2, with the bottom of the flask approximately 4 cm below the water surface.

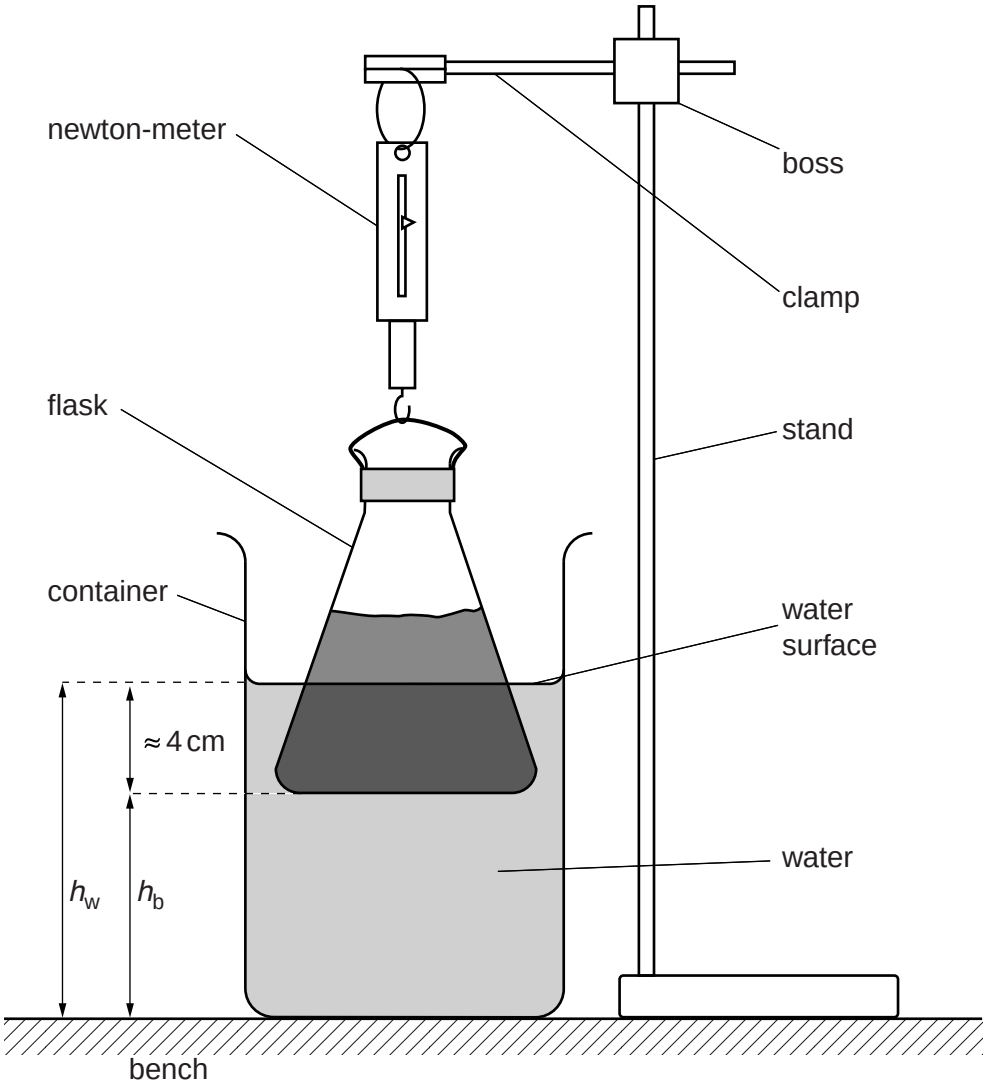


Fig. 1.2

(c) **(i)** Measure and record the height h_w of the water surface above the bench, as shown in Fig. 1.2.

h_w = ... cm

(ii) Measure and record the height h_b of the bottom of the flask above the bench, as shown in Fig. 1.2.

h_b = ... cm

(iii) Record the newton-meter reading F.

F = ... N [1]

(iv) Calculate x, using $x = h_w - h_b$.

x = ... cm [1]

(d) Adjust the height of the boss and repeat **(c)** until you have six sets of values of h_w, h_b and F.

For all values of h_b, the water surface should be in contact with the **sloping** sides of the flask.

Include values of x and $(H - x)^3$ in your table.

[9]

(e) **(i)** Plot a graph of F on the y-axis against $(H - x)^3$ on the x-axis. [3]

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

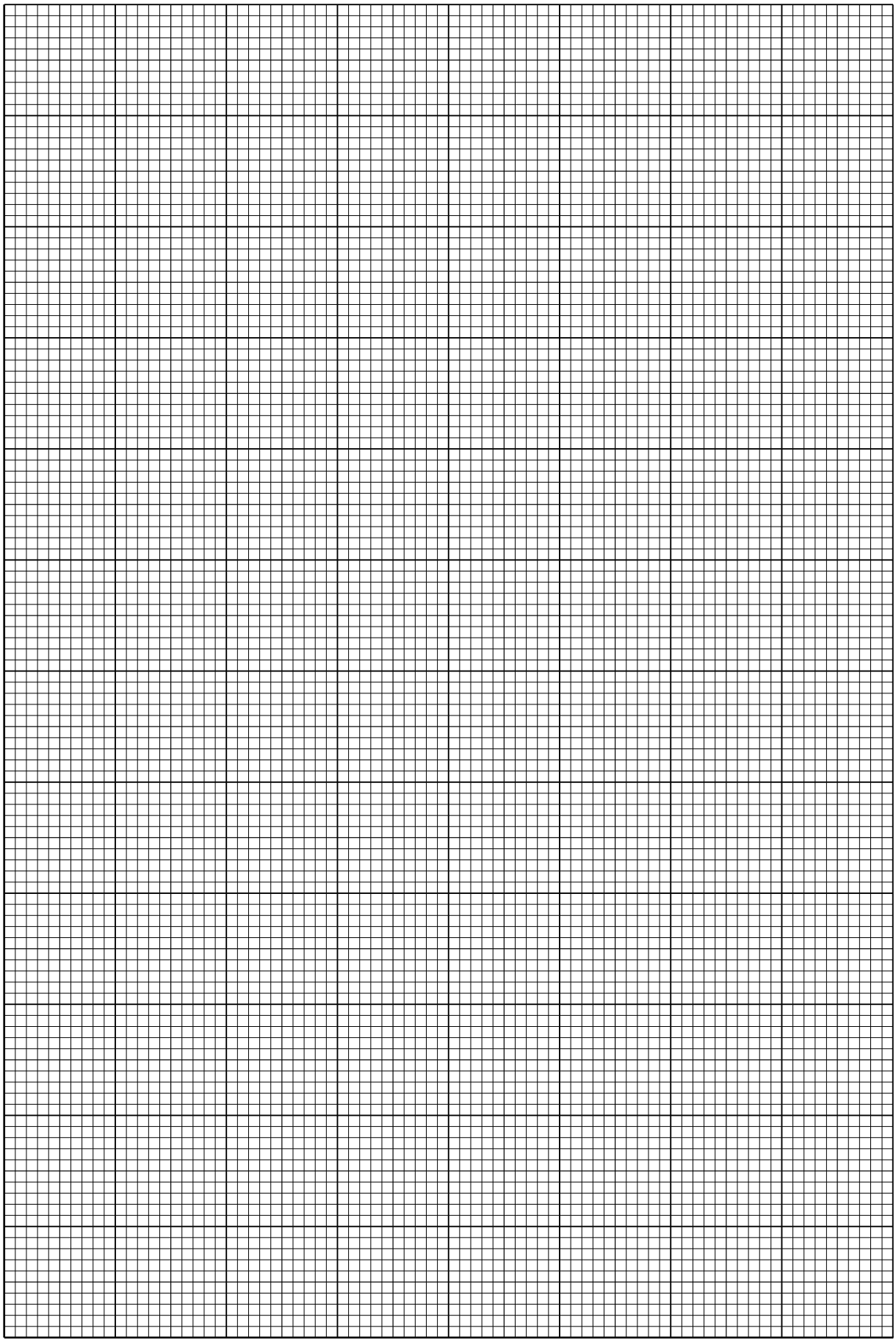
(iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...

[2]

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(f) The quantities F, H and x are related by the equation

$$F = a(H - x)^3 + b$$

where a and b are constants.

Using your answers in **(e)(iii)**, determine the values of a and b.
Give appropriate units.

$a =$ .....

$b =$ .....

[2]

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

2 In this experiment, you will investigate the motion of a flywheel rolling down a ramp.

(a) You are provided with a small flywheel, as shown in Fig. 2.1.

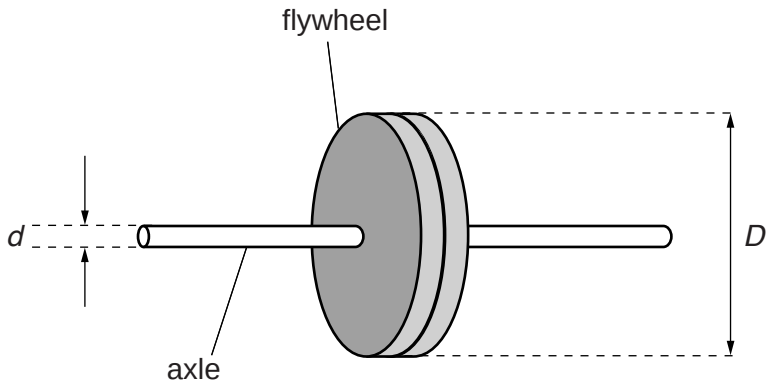


Fig. 2.1

(i) Measure and record the diameter *d* of the axle.

d = ... cm [1]

(ii) Measure and record the diameter *D* of the flywheel.

D = ... cm [1]

(b) You have also been provided with a track. Set up the track with one end raised above the bench, as shown in Fig. 2.2.

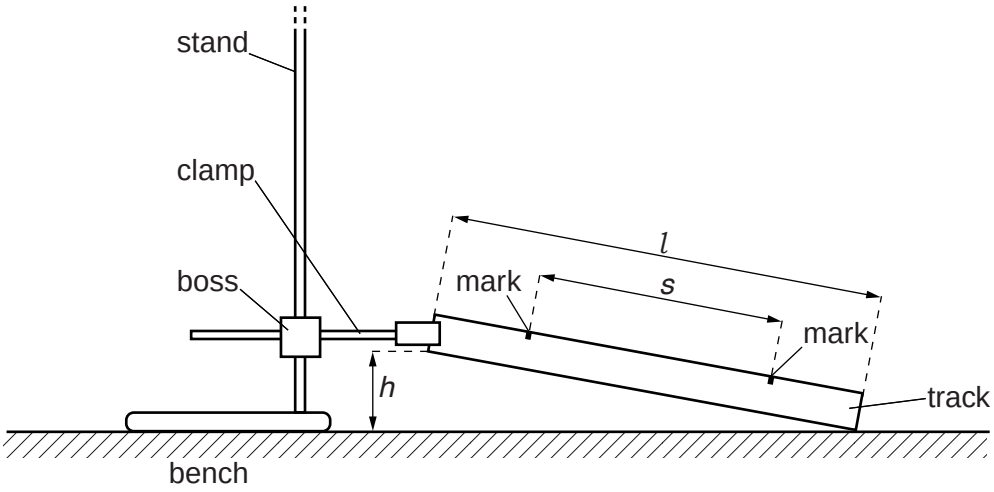


Fig. 2.2

The height *h* should be approximately 8 cm.

(i) Measure and record the length *l* of the track.

l = ...

(ii) Measure and record the height *h* above the bench of the raised end of the track.

h = ...

(iii) Measure and record the distance *s* between the two marks on the track.

s = ... [1]

(c) (i) Place the axle of the flywheel on the track at the upper mark as shown in Fig. 2.3. Release the flywheel and watch it roll down to the lower mark (the top of the flywheel may need a gentle push to start it rolling).

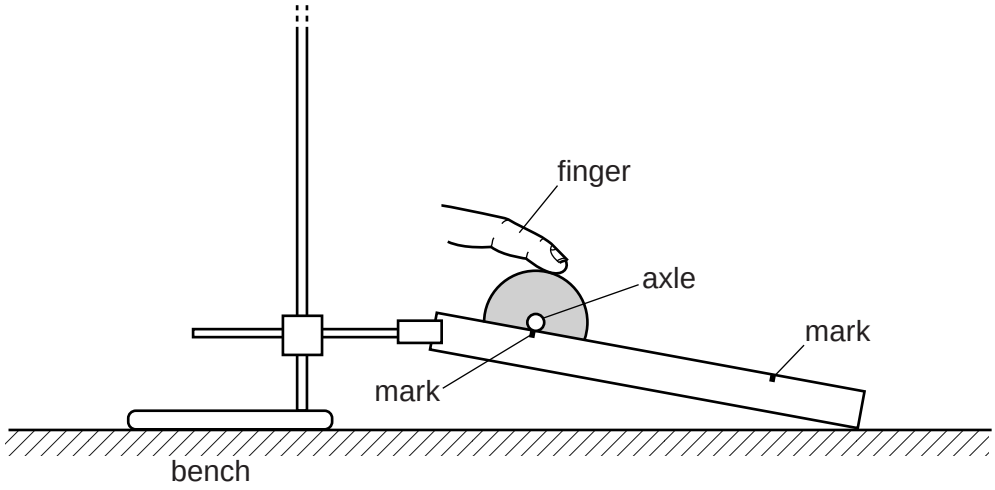


Fig. 2.3

(ii) Replace the axle of the flywheel on the track at the upper mark.
Take measurements to find the time *t* taken for the flywheel to roll from the upper mark to the lower mark.

t = ...[2]

(iii) Estimate the percentage uncertainty in your value of *t*.

percentage uncertainty = ...[1]

(iv) Theory suggests that an approximate value for the acceleration of free fall g is given by

$$g = \frac{slD^2}{hd^2t^2}.$$

Calculate a value for g. Give an appropriate unit.

g = ... [1]

(d) (i) Push the two plastic tubes onto the axle to increase the diameter of the axle, as shown in Fig. 2.4.

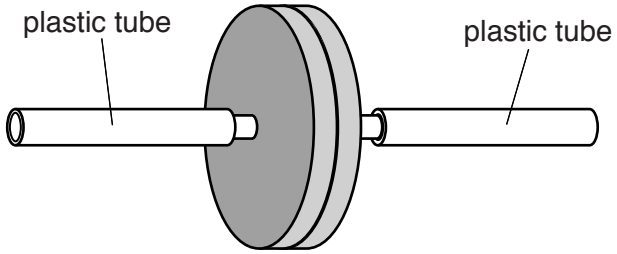


Fig. 2.4

(ii) Repeat **(a)(i)** and **(c)(ii)**.

d = ... cm

t = ...
[2]

(e) It is suggested that the relationship between t and d is

$$t = \frac{k}{d}$$

where k is a constant.

(i) Using your data, calculate two values of k.

first value of k = ...

second value of k = ...

[1]

(ii) Justify the number of significant figures you have given for your values of k.

.....

.....

.....[1]

(iii) Explain whether your results in **(e)(i)** support the suggested relationship.

.....

.....

.....

.....[1]

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

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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