SMART EXAM RESOURCES
IGCSE PHYSICS
ATP- TOPIC QUESTIONS+MARKSCHEMES
OSCILALTIONS OF A PENDULUM

1 A student investigates the period of a pendulum.

Fig. 1.1 shows the set-up.

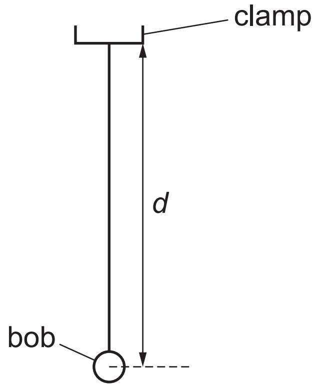


Fig. 1.1

(a) The distance *d* is measured from the bottom of the clamp to the centre of the bob.

The student adjusts the length of the pendulum until *d* = 50.0 cm.

He displaces the bob slightly and releases it so that it swings.

He uses a stop-watch to measure the time *t* for 10 complete oscillations.

Fig. 1.2

(i) Fig. 1.2 shows the reading on the stop-watch.

Record, in Table 1.1, the time *t* for 10 complete oscillations. [1]

(ii) Calculate and record in Table 1.1, the period *T* of the pendulum. The period is the time for one complete oscillation. [1]

(iii) Calculate T^2 and record your value in Table 1.1. [1]

(iv) Write the units in the column headings. [2]

Table 1.1

d /	*t* /	*T* /	T^2 /
50.0			
100.0	20.20	2.02	4.08

(b) The student repeats the procedure in **(a)** using d = 100.0 cm. The readings and results are shown in Table 1.1.

Another student suggests that T^2 is directly proportional to d.

Explain briefly how to test the suggestion using the results in Table 1.1.

....

....

....

.... [2]

(c) The procedure can be repeated to plot a graph.

Suggest additional values of d that are suitable for the experiment.

....

.... [1]

(d) Explain how you would measure the distance d as accurately as possible. Draw a diagram to help your explanation.

....

.... [2]

(e) Explain why timing 10 oscillations gives a more accurate result for the period T than timing one oscillation.

....

.... [1]

[Total: 11]

MARK SCHEME:

Question	Answer	Marks
(a)(i)	*t* = 14.21	1
(a)(ii)	*T* = 1.42(1)	1
(a)(iii)	T^2 = 2.02	1
(a)(iv)	cm, s, s	1
	s^2	1
(b)	calculate T^2 / d (or reciprocal of this) judge if (close enough to be considered) equal **OR** compare the T^2 and *d* values judge if the second value is (close enough to) double the first value **OR** plot a graph of T^2 against *d* (if directly proportional) it will be a straight line passing through the origin	1 1
(c)	at least three values between 10 (cm) and 100 (cm)	1
(d)	diagram to show (correct use of) a horizontal aid (e.g., a set-square / ruler)	1
	matching wording **OR** measure the diameter of the bob with two blocks and a ruler / micrometer divide by 2 to find the radius and add this on to the length of the string **OR** measure to the top and the bottom of the bob find the average	1
(e)	reduces the effect of (reaction) timing errors / reduces the percentage error / uncertainty / the (reaction time) error is spread over 20 oscillations	1

2 A student investigates the period of a pendulum. Fig. 1.1 and Fig. 1.2 show the arrangement.

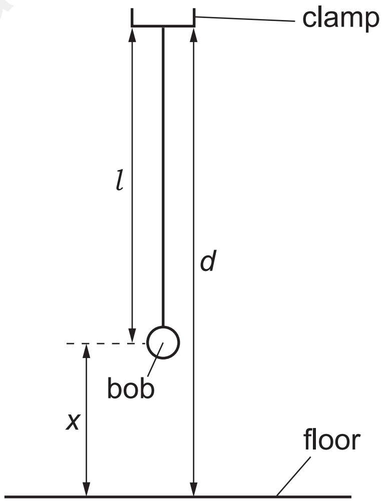


Fig. 1.1

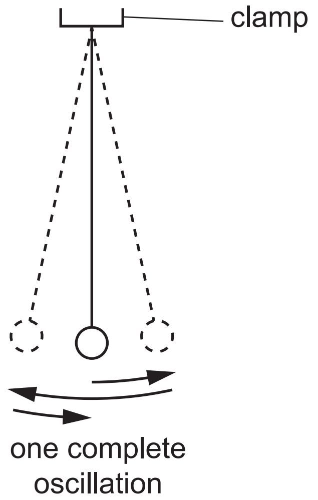


Fig. 1.2

(a) The student measures the distance *d* between the bottom of the clamp and the floor.

d = ... 120.0 cm ....

This distance *d* remains constant throughout the experiment.

He adjusts the length *l* of the pendulum to 70.0 cm.

Calculate the distance *x* between the centre of the pendulum bob and the floor. Record the value of *x* in the first row of Table 1.1. [1]

(b) The student displaces the bob slightly and releases it so that it swings. Fig. 1.2 shows one complete oscillation of the pendulum.

He measures, and records in the first row of Table 1.1, the time *t* for 10 complete oscillations.

(i) Calculate, and record in the first row of Table 1.1, the period *T* of the pendulum. The period is the time for one complete oscillation. [1]

(ii) Calculate, and record in the first row of Table 1.1, T^2. [2]

(iii) Complete the column headings in Table 1.1. [1]

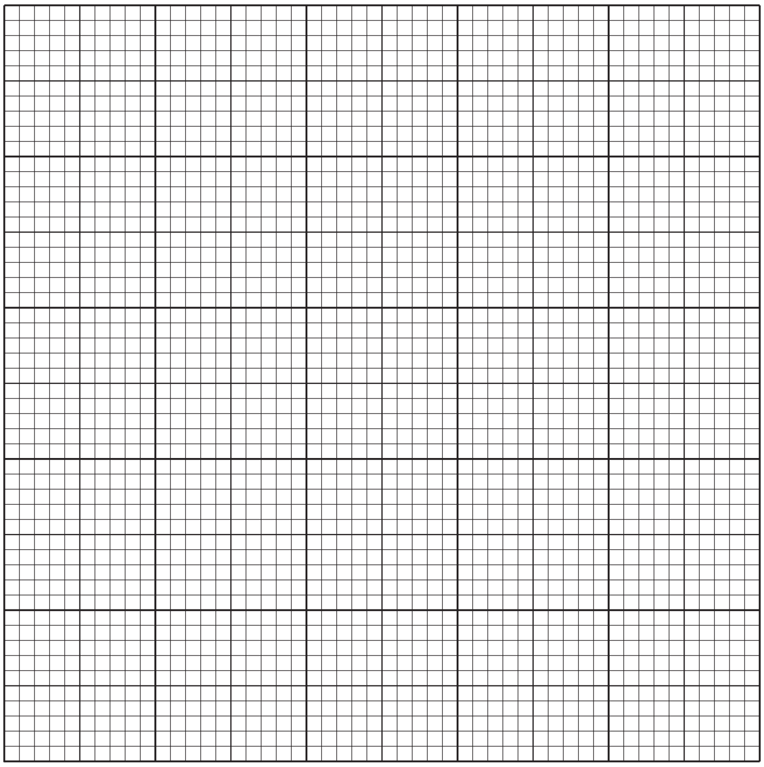
Table 1.1

x /	t /	T /	T^2 /
	16.7		
45.0	17.3	1.73	2.99
40.0	17.9	1.79	3.20
35.0	18.4	1.84	3.39
30.0	19.0	1.90	3.61

(c) He repeats the procedure using x = 45.0 cm, 40.0 cm, 35.0 cm and 30.0 cm.

He records the readings in Table 1.1.

Plot a graph of T^2 (y-axis) against x (x-axis). You do **not** need to start your axes at the origin (0,0).



[4]

(d) State whether the graph line shows that T^2 is proportional to x. Give a reason for your answer.

statement ....

reason ....
[1]

(e) Explain why timing 10 oscillations gives a more accurate result for the period T than timing one oscillation.

....

.... [1]

[Total: 11]

MARK SCHEME:

Question	Answer	Marks
(a)	x = 50.0 (cm)	1
(b)(i)	T = 1.67	1
(b)(ii)	T^2 = 2.79 (or 2.789 or 2.7889)	1
	T^2 given to 3 significant figures	1
(b)(iii)	cm, s, s, s^2	1
(c)	Graph: Axes correctly labelled with quantity and unit and right way round	1
	Suitable scales	1
	All the plots from their table correct to better than ½ small square	1
	Good line judgement, thin, continuous line	1
(d)	No. Not through origin	1
(e)	(Timing) errors less significant / have a smaller percentage uncertainty / the error is spread over 10 periods / is divided by 10	1

3 A student investigates the period of a pendulum. Fig. 1.1 and Fig. 1.2 show the set-up.

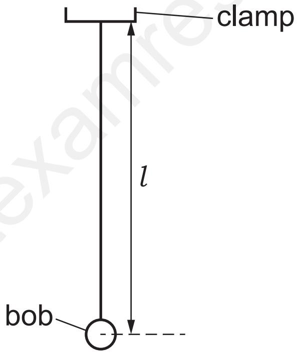


Fig. 1.1

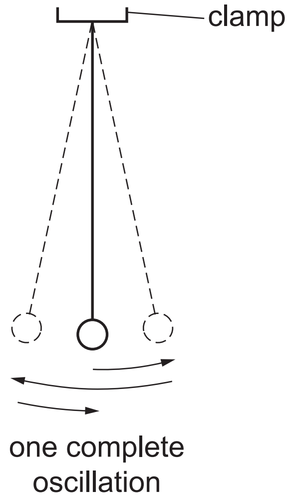


Fig. 1.2

(a) Explain briefly how to measure to the centre of the pendulum bob as accurately as possible.

....

.... [1]

(b) The student adjusts the length of the pendulum until the distance l, measured from the bottom of the clamp supporting the pendulum to the centre of the pendulum bob, is 50.0 cm.

He displaces the bob slightly and releases it so that it swings. Fig. 1.2 shows one complete oscillation of the pendulum.

He measures and records the time t for 20 complete oscillations.

(i) Calculate, and record in Table 1.1, the period T of the pendulum. The period is the time for one complete oscillation. [1]

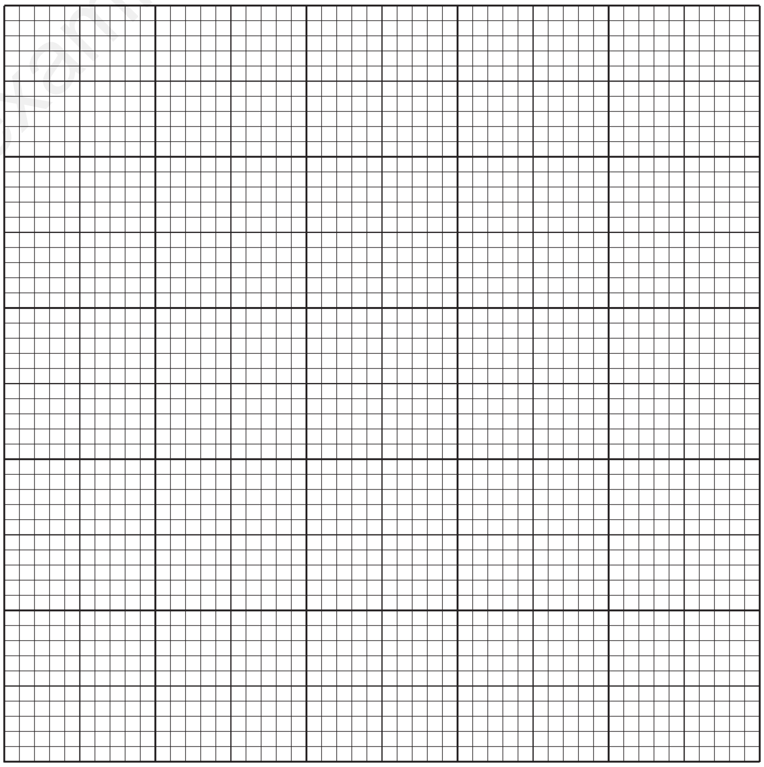
(ii) Calculate, and record in Table 1.1, the value of T^2. [1]

Table 1.1

l / cm	t / s	T / s	T^2 / s^2
50.0	28.2		
60.0	31.2	1.56	2.43
70.0	33.6	1.68	2.82
80.0	35.8	1.79	3.20
90.0	38.2	1.91	3.65

He repeats the procedure using l values of 60.0 cm, 70.0 cm, 80.0 cm and 90.0 cm. The readings and results are shown in Table 1.1.

(c) Plot a graph of T^2/s^2 (y-axis) against l/cm (x-axis). Start the T^2/s^2 axis at a convenient value close to the minimum value of T^2/s^2.



[4]

(d) Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information.

G = ... [3]

(e) Explain briefly why timing 20 oscillations gives a more accurate result for the period T than timing 1 oscillation.

....

.... [1]

[Total: 11]

MARK SCHEME:

Question	Answer	Marks
(a)	Clear use of horizontal aid OR bob touching rule	1
(b)(i)	*T* = 1.41	1
(b)(ii)	T^2 = 1.99 (to 2 decimal places only, correctly rounded)	1
(c)	Axes of graph correctly labelled with quantity and unit and right way round	1
	Suitable scales	1
	All plots correct to ½ small square	1
	Good line judgement, thin, continuous line	1
(d)	Triangle method clear <u>on graph</u>	1
	Triangle at least half the length of the line between extreme plots used	1
	G value in range 0.038 – 0.044	1
(e)	Reaction time / human error a smaller part of time measured	1