OSCILALTIONS-SIMPLE PENDULUM

1 The IGCSE class is investigating the period of oscillation of a simple pendulum.

Fig. 1.1 shows the set-up.

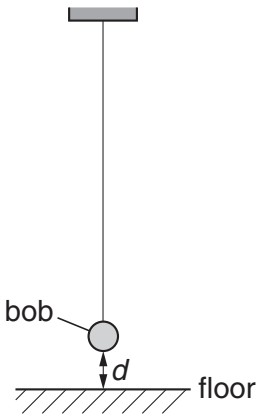


Fig. 1.1

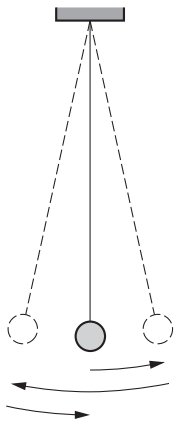


Fig. 1.2

(a) (i) On Fig. 1.1, measure the vertical distance *d* from the floor to the bottom of the pendulum bob.

d = ...

(ii) Fig. 1.1 is drawn one twentieth actual size. Calculate the actual distance *x* from the floor to the bottom of the pendulum bob. Enter this value in the top row of Table 1.1.

The students displace the pendulum bob slightly and release it so that it swings. They measure and record in Table 1.1 the time *t* for 20 complete oscillations of the pendulum (see Fig. 1.2).

Table 1.1

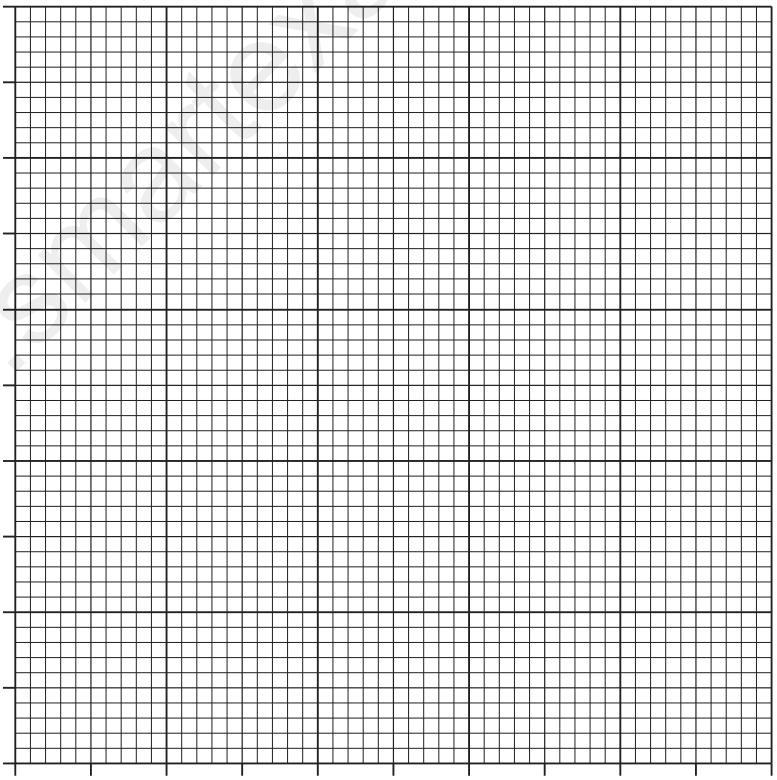
x/cm	*t*/s	*T*/s	T^2/s^2
	20.0		
20.0	19.0		
30.0	17.9		
40.0	16.8		
50.0	15.5		

[4]

(b) **(i)** Calculate the period T of the pendulum for each set of readings. The period is the time for one complete oscillation. Enter the values in Table 1.1.

(ii) Calculate the values of T^2. Enter the T^2 values in Table 1.1.

(c) Use your values from Table 1.1 to plot a graph of T^2/s^2 (y-axis) against x/cm (x-axis). Draw the best-fit line.



[5]

(d) State whether or not your graph shows that T^2 is directly proportional to x. Justify your statement by reference to the graph.

statement .....

justification .....

..... [1]

[Total: 10]

(a) (i) *d* 0.5 cm or 5mm [1]

(ii) *x* 10.0 [1]

(b) (i)–(iii)

table: *T* 1.0, 0.95, 0.895 (0.90, 0.9), 0.84, 0.775 (0.78) [1]
T^2 1.00, 0.903, 0.801, 0.706, 0.601 (if *T* correct) [1]

(c) graph:

axes labelled [1]
scales suitable, plots occupying at least half grid [1]
plots all correct to ½ square [1]
well judged line [1]
thin line, 5 neat plots [1]

(d) statement NO and not through origin/
inverse/negative gradient/
x increases, T^2 decreases/ wtte [1]

[Total: 10]

2 The class is investigating two different types of pendulum.

Figs. 1.1 and 1.2 show the apparatus used.

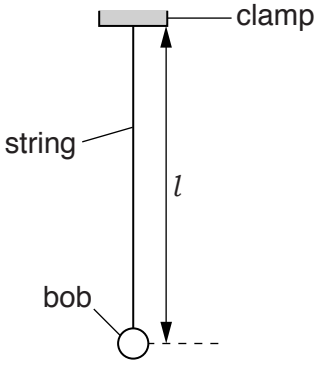


Fig. 1.1

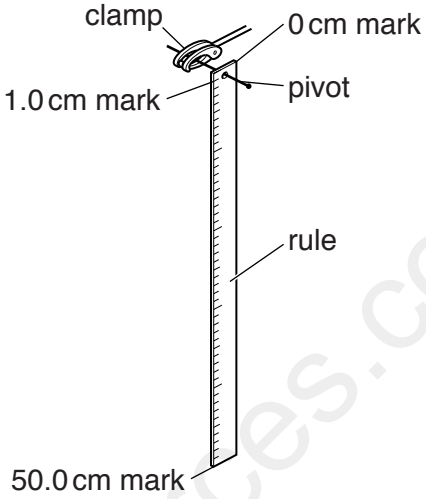


Fig. 1.2

(a) **(i)** On Fig. 1.1, measure the length l of the pendulum.

l = ...[1]

(ii) Explain briefly how you would measure the length l of a pendulum, of the type shown in Fig. 1.1, as accurately as possible.

.....

.....[1]

(b) A student adjusts the length l of the pendulum shown in Fig. 1.1 to be exactly 50.0 cm. She displaces the pendulum bob slightly and releases it so that it swings. She measures the time t_S for 20 complete oscillations of the pendulum.

(i) Record the time t_S as shown in Fig. 1.3.

Fig. 1.3

t_S = ...[1]

(ii) Calculate the period T_S of the pendulum. The period is the time for one complete oscillation.

T_S = ...[1]

(iii) Explain why measuring the time for 20 oscillations, rather than for 1 oscillation, gives a more accurate value for T_S.

.....

.....

.....[1]

(c) The pendulum shown in Fig. 1.2 is a 50.0 cm rule. The student displaces this pendulum slightly and releases it so that it swings. She measures the time t_C for 20 complete oscillations of the pendulum.

t_C = 23.2 s

(i) State a precaution that you would take to ensure that the measurement of time t_C is reliable.

.....

(ii) Calculate the period T_C of the pendulum. The period is the time for one complete oscillation.

T_C = ...
[1]

(d) A student suggests that T_C should be equal to T_S.

State whether the results support this suggestion. Justify your answer by reference to the results.

statement .....

justification .....

.....

.....
[2]

(e) Assume that the length l of the first pendulum has been measured accurately at 50.0 cm and that the length of the strip that forms the second pendulum is exactly 50.0 cm long.

Suggest why it may not be correct to state that both pendulums have the same length l = 50.0 cm.

.....

.....[1]

[Total: 9]

(a) (i) 4.2 (cm) OR 42 (mm) [1]

(ii) centre of bob touching rule OR how to use fiducial aid, e.g. set-square OR measure to top / bottom of bob and add / subtract radius OR measure to top and bottom of bob and average OR look perpendicularly at scale [1]

(b) (i) 28.2(0) (s) [1]

(ii) 1.41(s) (e.c.f. from **(i)** AND T_C = 1.16(s)) [1]

(iii) (reaction time) inaccuracy – smaller part of total time measured owtte [1]

(c) (i) repeats OR start counting at nought OR use a fiducial mark owtte [1]

(ii) see **(b)(ii)**

(d) correct statement for results [1]
justification must include idea of too different to be within limits of experimental accuracy
(e.c.f. close enough to be within limits of experimental accuracy) [1]

(e) pivot at 1 cm mark owtte OR centre of mass of rule not 50 cm below pivot [1]

[Total: 9]