ACCELERATION OF FREE FALL

1 A student is determining the acceleration of free fall g using a pendulum. Fig. 1.1 shows the pendulum. Fig. 1.2 shows one complete oscillation of the pendulum.

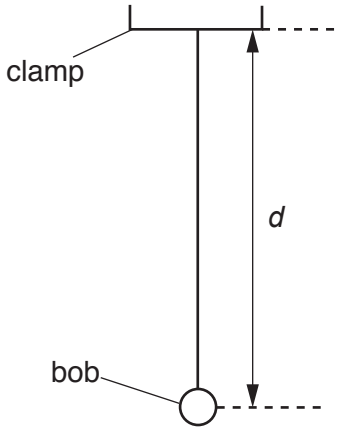

Fig. 1.1

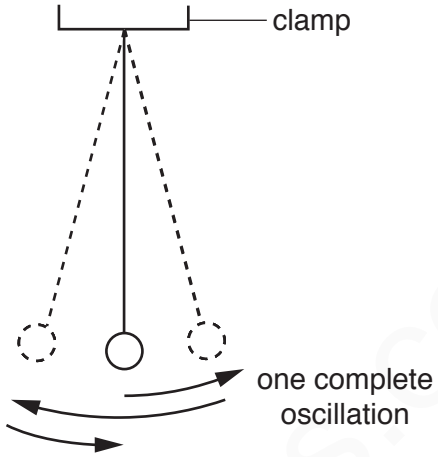

Fig. 1.2

(a) On Fig. 1.1, measure the distance d.

d = ... cm [1]

(b) Fig. 1.1 is drawn 1/10th actual size.

(i) Calculate the actual distance D from the bottom of the clamp to the centre of the bob.

D = ... cm [1]

The student displaces the bob slightly and releases it so that it swings. He measures the time t for 10 complete oscillations. The time t is shown on the stopwatch in Fig. 1.3.

Fig. 1.3

(ii) Write down the time t shown in Fig. 1.3.

t = ... [1]

(iii) Calculate the period T of the pendulum. The period is the time for one complete oscillation.

T = ... [1]

(iv) Calculate T^2.

T^2 = ... [1]

(v) Calculate the acceleration of free fall g using the equation $g = \frac{20}{T^2}$.

g = ... [1]

(c) The student adjusts the pendulum until the distance D measured to the centre of the bob is 100.0 cm.

He repeats the procedure and obtains another value of T^2.

T^2 = 3.94

(i) On the dotted line above, write the unit for T^2. [1]

(ii) Calculate the acceleration of free fall g using the equation $g = \frac{40}{T^2}$ and the value of T^2 from **(c)**. Give your answer to a suitable number of significant figures for this experiment.

g = ... [1]

(d) Another student states that repeating the experiment improves the reliability of the value obtained for g.

Suggest **two** changes that you would make to improve the reliability. The stopwatch cannot be changed.

1. .....

.....

2. .....

.....

[2]

(e) State **one** precaution that you would take in this experiment in order to obtain accurate readings.

.....

..... [1]

[Total: 11]

MARKING SCHEME

(a)	d = 5(.0) (cm)	**1**
(b)(i)	D = 50 (cm)	**1**
(b)(ii)	t = 14.06	**1**
(b)(iii)	T = 1.406 (allow ecf from 1(b)(ii): t/10 (s))	**1**
(b)(iv)	T^2 = 1.98 or 1.99 (allow ecf from 1(b)(iii))	**1**
(b)(v)	g = 10.1 (allow ecf from 1(b)(iv))	**1**
(c)(i)	Unit s^2	**1**
(c)(ii)	g given to 2 or 3 significant figures	**1**
(d)	Use of additional d values **OR** use a larger d value	**1**
	Count more swings	**1**
(e)	Any **one** from: Perpendicular viewing of rule Counting beginning with zero (owtte) Use of fiducial mark (owtte) Use of set-square or horizontal rule to aid measurement of d Use rule close to/touching the bob Time taken from centre of swing, (not extremities) Measure length to top and bottom of bob and average Measure string length and add radius of bob measured with callipers or micrometer	**1**