## 1.2 Motion

01. 0625_s18_qp_61 Q: 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.

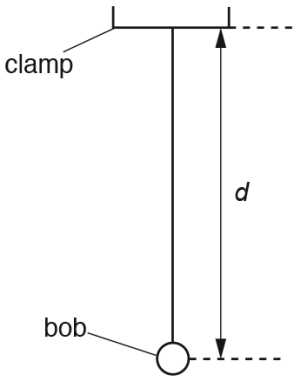


Fig. 1.1

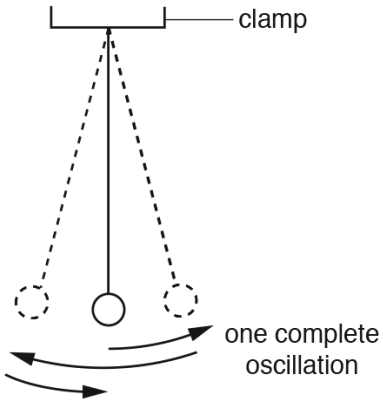


Fig. 1.2

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

*d* = ..... cm [1]

**(b)** Fig. 1.1 is drawn 1/10$^{th}$ 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]

02. 0625_w16_qp_61 Q: 1

A student uses a pendulum to determine a value for the acceleration of free fall *g*.

Figs. 1.1 and 1.2 show the apparatus.

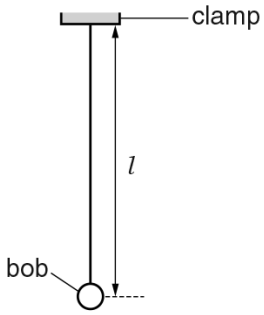


Fig. 1.1

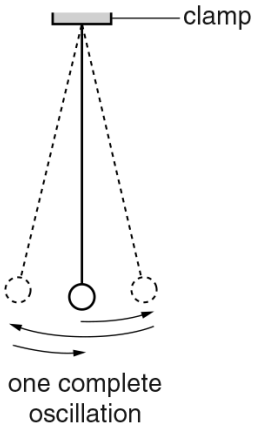


Fig. 1.2

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

$l$ = ..... cm [1]

**(b)** The student adjusts the pendulum until its length $l$ = 50.0 cm. The length $l$ is measured to the centre of the bob.

Explain briefly how the student avoids a parallax (line of sight) error when measuring length $l$.

.....

.....

.....[1]

**(c)** The student displaces the pendulum bob slightly and releases it so that it swings.

He measures the time $t$ for 20 complete oscillations of the pendulum.

$t =$ 27.8 s

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

$T =$ .....[1]

**(ii)** Measuring the time for a large number of oscillations, rather than for one oscillation, gives a more accurate value for $T$.

Suggest one practical reason why measuring the time for 200 oscillations, rather than 20 oscillations, may **not** be suitable.

.....

.....[1]

**(iii)** Calculate $T^2$.

$T^2 =$ .....[1]

**(iv)** Calculate the acceleration of free fall $g$ using the equation $g = \frac{4\pi^2 l}{T^2}$. Give your answer to a suitable number of significant figures for this experiment.



$g =$ ..... m/s$^2$ [2]

**(d)** The student checks the value of the acceleration of free fall $g$ in a text book. The value in the book is $9.8\,m/s^2$.

**(i)** Suggest a practical reason why the result obtained from the experiment may be different.

.....

.....

.....[1]

**(ii)** Suggest **two** improvements to the experiment.

1. .....

.....

2. .....

.....

[2]

[Total: 10]

03. 0625_s14_qp_62 Q: 5

An IGCSE student is investigating the average speed of a toy car travelling down a slope.

She releases the toy car on the slope. She uses a stopwatch to measure the time taken for the car to travel down part of the slope. Fig. 5.1 shows the slope.

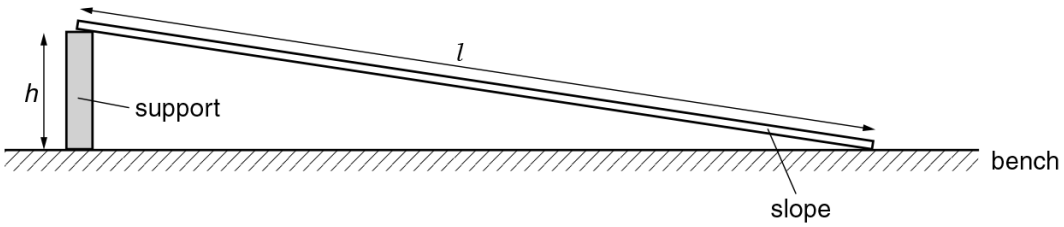


**Fig. 5.1**

**(a) (i)** Suggest a suitable length $l$ for the slope used in this school laboratory experiment.

$l$ = .....

**(ii)** Suggest a suitable height $h$, above the laboratory bench, for one end of the slope.

$h$ = .....
[2]

**(b)** The student tries to determine the time that the toy car takes to travel a distance down the slope.

Make three suggestions about what she could do to ensure that the distance travelled and the time taken by the toy car are measured as reliably as possible.

1. .....

.....

2. .....

.....

3. .....

.....
[3]

[Total: 5]

04. 0625_w14_qp_63 Q: 4

An IGCSE student is investigating the motion of a ball down a slope.

She is using the apparatus shown in Fig. 4.1.

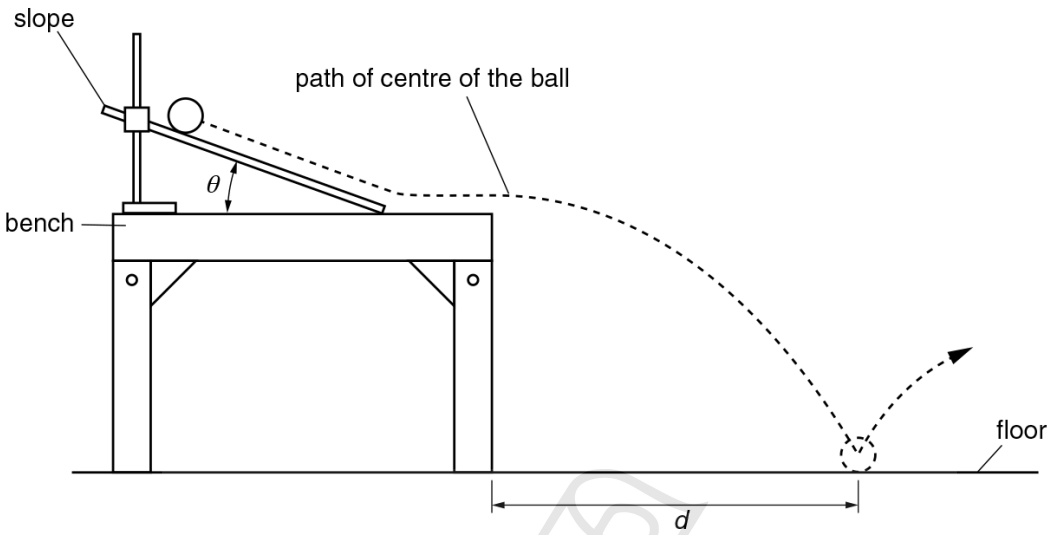


**Fig. 4.1**

She measures the angle $\theta$ of the slope, releases the ball from a marked p int on the slope and watches where it hits the floor.

She then measures the distance $d$ from the table to where the ball lands.

This is repeated for a number of angles, releasing the ball from the same point on the slope. Her results are shown in Table 4.1.



**Table 4.1**

| $\theta$/° | $d$/cm |
|---|---|
| 20 | 42 |
| 30 | 55 |
| 40 | 64 |
| 50 | 51 |
| 60 | 40 |

**(a)** **(i)** Describe the pattern in the values of $d$ as $\theta$ is increased.

.....

.....

..... [1]

**(ii)** From the pattern of results, predict what the $d$ values may be for slope angles of 10° and 70°.

10° .....

70° .....
[1]

**(b)** The student is being assessed and must carry out the experiment on her own. She says that it is difficult to release the ball carefully and then be able to see exactly where it lands.

Suggest an improvement she might make to the experiment, so that she could obtain a more accurate measurement of $d$.

.....

.....

..... [1]

**(c)** Suggest how she might make sure that the results of the experiment are reliable.

.....

.....

..... [2]

[Total: 5]

01. 0625_s18_MS_61 Q: 1

| | | |
|---|---|---|
| (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:<br>Perpendicular viewing of rule<br>Counting beginning with zero (owtte)<br>Use of fiducial mark (owtte)<br>Use of set-square or horizontal rule to aid measurement of $d$<br>Use rule close to/touching the bob<br>Time taken from centre of swing, (not extremities)<br>Measure length to top and bottom of bob and average<br>Measure string length and add radius of bob measured with callipers or micrometer | 1 |

---

02. 0625_w16_MS_61 Q: 1

| | | |
|---|---|---|
| (a) | $l$ = 4.1 – 4.2 (cm) | 1 |
| (b) | Either suitable use of a horizontal straight edge, explained briefly<br>Or holding rule close to pendulum<br>Or line of sight perpendicular (to rule) | 1 |
| (c)(i) | $T$ = 1.39 (s) OR 1.4 | 1 |
| (c)(ii) | Pendulum may stop OR student may lose count | 1 |
| (c)(iii) | 1.93 $s^2$ (ecf allowed) | 1 |
| (c)(iv) | 10.2(2)<br>2 or 3 significant figures | 1<br>1 |
| (d)(i) | Explanation of cause of inaccuracy in measurement of $t$ or $l$.<br>e.g. student did not react quickly enough when starting/stopping stopwatch OR difficulty in measuring accurately to centre of bob | 1 |
| (d)(ii) | Any two from:<br>Use different length(s)<br>Repeat timing<br>Use of a fiducial mark<br>Increased number of oscillations<br>Plot a graph using length and time or $time^2$ | 2 |
| | **Total:** | 10 |

---

03. 0625_s14_MS_62 Q: 5

**(a) (i)** 1 m–2.5 m [1]

**(ii)** 10 cm–1 m but $h$ must be less than $l/2$ [1]

**(b)** any three from:
- making marks / lines on track for start and finish
- repeats / find average time
- constant starting positions
- not pushing car
- time from same point on car
- use light gates / data logger / automatic timer for timing
- method for avoiding parallax error when judging finishing point / stand level with finish [max 3]

**[Total: 5]**

---

04. 0625_w14_MS_63 Q: 4

**(a) (i)** (as $\theta$ increases) $d$ increases (to a maximum at 40° / between 40° and 50° / between 30° and 40°) then decreases [1]

**(ii)** both in range 15 to 35 (cm) [1]

**(b)** any suitable means of detecting $d$ more easily, e.g. any one from:
- sand tray
- use of carbon paper
- ink on ball
- fixing rule to floor
- use of video
- reference to releasing ball remotely
- mark approximate point and repeat to confirm [1]

**(c)** repeats owtte [1]

qualification or detail regarding repeats, e.g. repeat at each value of $\theta$ / repeat and take an average / take more sets of readings / repeat for $\theta$ values between those given in table [1]

**[Total: 5]**

---