

2 In this experiment, you will investigate the motion of a sphere rolling along a track.

- (a) You are provided with a length of plastic channel. When the channel is positioned with its open side at the top, it forms a track with a pair of rails along which a sphere can roll.

An end view of the channel is shown in Fig. 2.1.

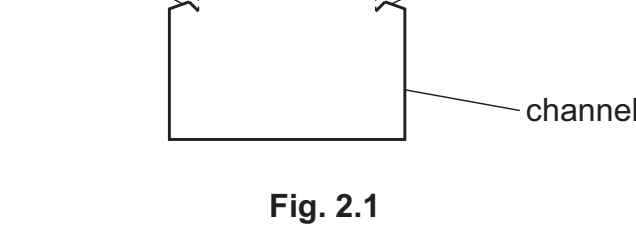


Fig. 2.1

The distance between the rails is x .
Measure and record x .

$x =$ [1]

- (b) (i) • Set up the apparatus as shown in Fig. 2.2.

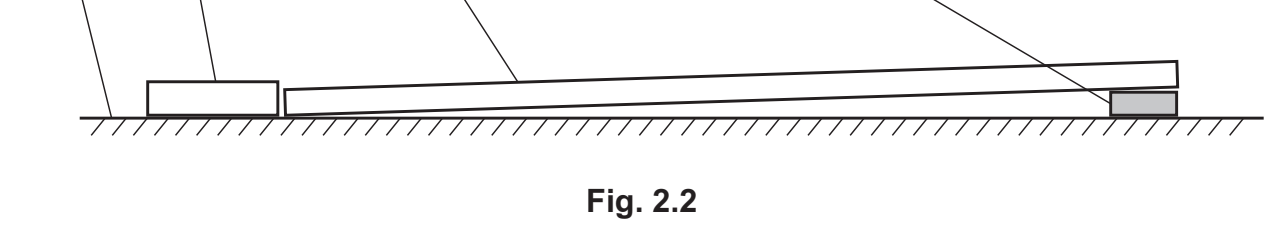


Fig. 2.2

- You are provided with two spheres.
- Place the **smaller** sphere on the track. If necessary, adjust the position of the wooden block until the sphere is able to roll along the full length of the track and into the box.
- Secure the block and track with a small piece of adhesive putty as shown in Fig. 2.3. **The block and track must remain in these positions for the rest of the experiment.**

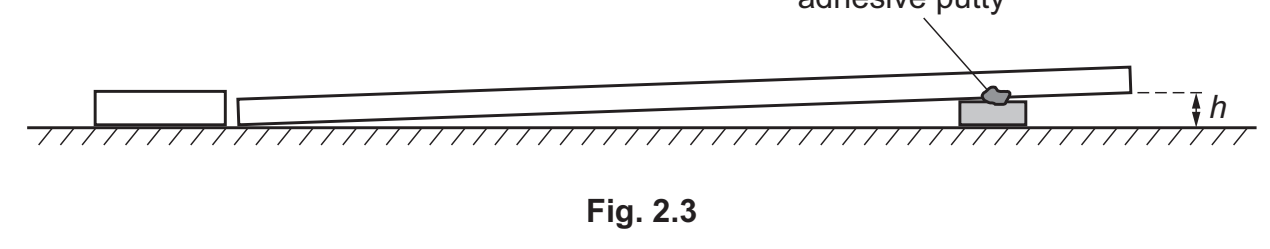


Fig. 2.3

- The height of the raised end of the track above the bench is h , as shown in Fig. 2.3. Measure and record h .

$h =$ [1]

- (ii) Estimate the percentage uncertainty in your value of h . Show your working.

percentage uncertainty = % [1]

- (c) (i) • Measure and record the diameter d of the smaller sphere.

$d =$

- Calculate $1 - (\frac{x}{d})^2$.

$1 - (\frac{x}{d})^2 =$ [1]

- (ii) • Place the smaller sphere on the track at the raised end.
• Release the sphere.
• The time taken for the sphere to roll along the track into the box is t .
Take measurements to determine t .

$t =$ [2]

- (d) Repeat (c) using the **larger** sphere.

$d =$

$1 - (\frac{x}{d})^2 =$

$t =$ [3]

- (e) It is suggested that the relationship between t , h , x and d is

$$t^2 h = k \left(5 + \frac{2}{1 - (\frac{x}{d})^2} \right)$$

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 that you have given for your values of k .
.....
..... [1]

- (f) It is suggested that the percentage uncertainty in the values of k is 30%.
Using this uncertainty, explain whether your results support the relationship in (e).

.....
..... [1]

- (g) (i) Describe **four** sources of uncertainty or limitations of the procedure for this experiment.
For any uncertainties in measurement that you describe, you should state the quantity being measured and a reason for the uncertainty.

-
.....
-
.....
-
.....
-
.....

[4]

- (ii) Describe **four** improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

-
.....
-
.....
-
.....
-
.....

[4]