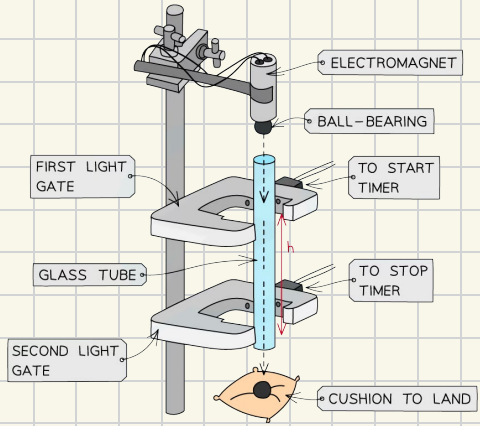
Calculating gravity



1. Set up the apparatus by attaching the electromagnet to the top of a tall clamp stand. Do not switch on the current till everything is set up
2. Attach both light gates at a starting distance of around 10 cm
3. Measure this distance between the two light gates as the height, h with a metre ruler
4. Place the cushion directly underneath to catch the ball-bearing when it falls through
5. Switch the current on the electromagnet and place the ball-bearing directly underneath so it is attracted to it
6. Turn the current to the electromagnet off. The ball should drop
7. When the ball drops through the first light gate, the timer starts
8. When the ball drops through the second light gate, the timer stops
9. Read the time on the timer and record this as time, t
10. Increase h and repeat the experiment.
11. Repeat this method at least 3 times for each value of h and calculate an average t for each

height (m)	T_1 / s	T_2 / s	T_3 / s	mean	$2h/t$
0.1	0.151	0.143	0.144	0.146	1.380
0.13	0.166	0.161	0.161	0.168	1.566
0.16	0.183	0.185	0.183	0.184	1.739
0.19	0.200	0.197	0.208	0.201	1.891
0.22	0.215	0.219	0.214	0.218	2.037
0.25	0.276	0.232	0.229	0.230	2.174
0.28	0.242	0.246	0.244	0.244	2.245
0.31	0.257	0.267	0.253	0.256	2.422
0.34	0.261	0.271	0.270	0.269	2.528
0.37	2.295	0.284	0.286	0.285	2.701

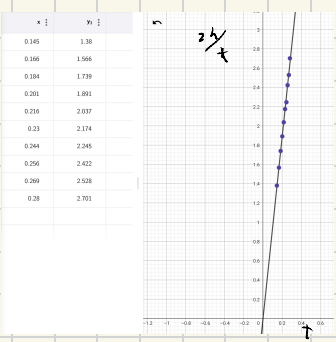
$s = ut + \frac{1}{2}at^2$ $\quad \frac{2s}{t} = 2u + at$

$g = 9.81$ $\quad \frac{2h}{t} = gt - 2u$ $\quad u = 0$

gradient $= 9.45$ $\quad$ so $\frac{2h}{t} = gt$

% uncertainty $= 3.67\ \%$

$3.67 < 5$ so the experiment was successful



errors

- Large uncertainty in h from using a metre rule with a precision of 1 mm
- Parallax error from reading h
- The ball may not fall accurately down the centre of each light gate

Safety Considerations

The electromagnetic requires current

To reduce the risk of electrocution, only switch on the current to the electromagnet once everything is set up

A cushion or a soft surface must be used to catch the ball-bearing so it doesn't roll off / damage the surface

The tall clamp stand needs to be attached to a surface with a G clamp so it stays rigid

The experiment went successfully as it was within the 5% error range required.

Making the experiment easy to replicate as you could use a stopwatch instead of the light gates (though it will be less accurate)