

State Examinations Commission – Physics Higher Level, 2004.

Question 1

In an experiment to measure the acceleration due to gravity g by a free fall method, a student measured the time t for an object to fall from rest through a distance s . This procedure was repeated for a series of values of the distance s .

The table shows the data recorded by the student.

s/cm	30	40	50	60	70	80	90
t/ms	244	291	325	342	371	409	420

Describe, with the aid of a diagram, how the student obtained the data. (12)

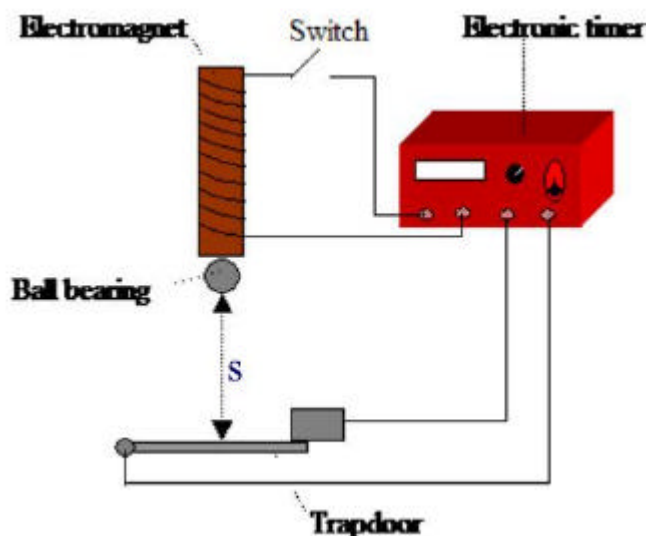
Calculate a value for the acceleration due to gravity g by drawing a suitable graph based on the recorded data. (21)

Give two precautions that should be taken to ensure a more accurate result. (7)

Describe, with the aid of a diagram, how the student obtained the data. (12)

Set up apparatus as shown in the diagram

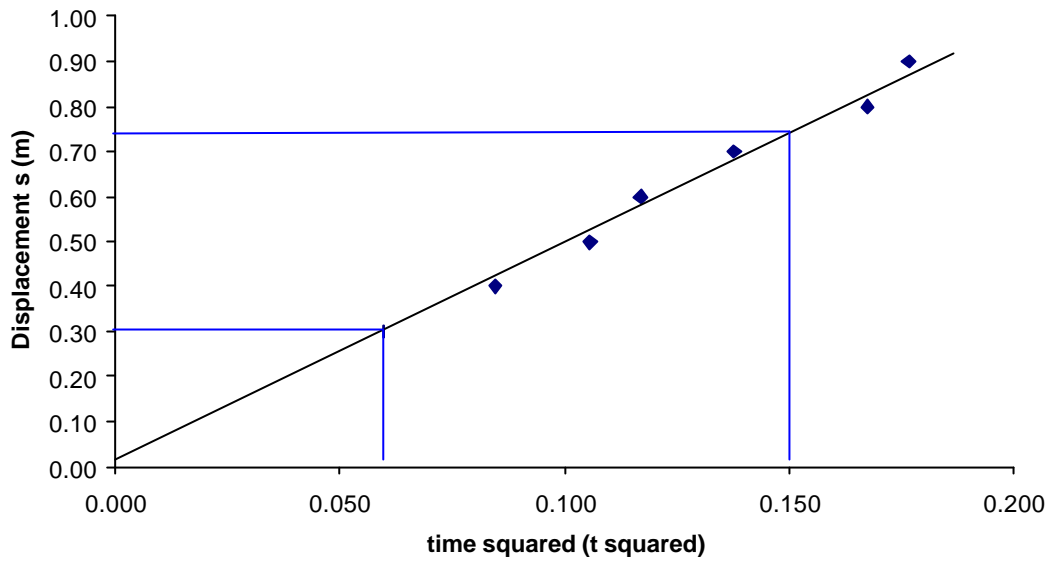
1. Zero the electronic timer.
2. Measure distance s from bottom of ball bearing to trapdoor.
3. Open switch of electromagnet to release ball bearing and start timer.
4. Record reading t on the timer after the bearing hits the trapdoor and stops it.
5. Repeat three times for this height s and take the smallest time as the correct value for t .
6. Change distance s from electromagnet to trapdoor and repeat above.
7. Repeat until sufficient readings obtained.



Calculate a value for the acceleration due to gravity g by drawing a suitable graph based on the recorded data. (21)

s/cm	30	40	50	60	70	80	90
t/ms	244	291	325	342	371	409	420
t^2/s^2	0.060	0.085	0.106	0.117	0.138	0.167	0.176
s/m	0.30	0.40	0.50	0.60	0.70	0.80	0.90

Graph of s against t squared



The slope of the graph is $(0.74-0.30)/(0.15-0.06) = 4.89$ (Difference of “y’s” over difference of “x’s”)

However, since $s = \frac{1}{2}gt^2$, the slope of the graph is $\frac{1}{2}g$. (Remember $y = mx + c$ and c is zero here)

Therefore, $g = 9.78\text{ms}^{-2}$.

Give two precautions that should be taken to ensure a more accurate result. (7)

1. Take a good spread of values for s to allow a more accurate line to be drawn.
2. For each value of s , repeat the drop several times and take the smallest value.
3. Place a thin piece of paper between ball bearing and electromagnet to assist speedy release.