



Sec 3 Physics Practical 06 Marble Rolling Down a Ramp Marking Scheme

Record of Experimental Data

(c) Value of θ = about 3° (below 5°)

Check your measurement against the calculated value: $\tan \theta = h / x$

E.g. calculated $\theta = \tan^{-1} (5.0/100) = 2.9^\circ$

Table of data for steps (f) to (j)

s / m	t ₁ / s	t ₂ / s	t ₃ / s	<t> / s	<t> ² / s ²
1.000	2.50	2.45	2.56	2.50	6.27
0.900	2.35	2.40	2.38	2.38	5.65
0.800	2.22	2.20	2.25	2.22	4.94
0.700	2.10	2.13	2.05	2.09	4.38
0.600	1.88	1.95	1.90	1.91	3.65
0.500	1.78	1.75	1.75	1.76	3.10
0.400	1.47	1.60	1.53	1.53	2.35

* optional to include 1.000 m

Check that

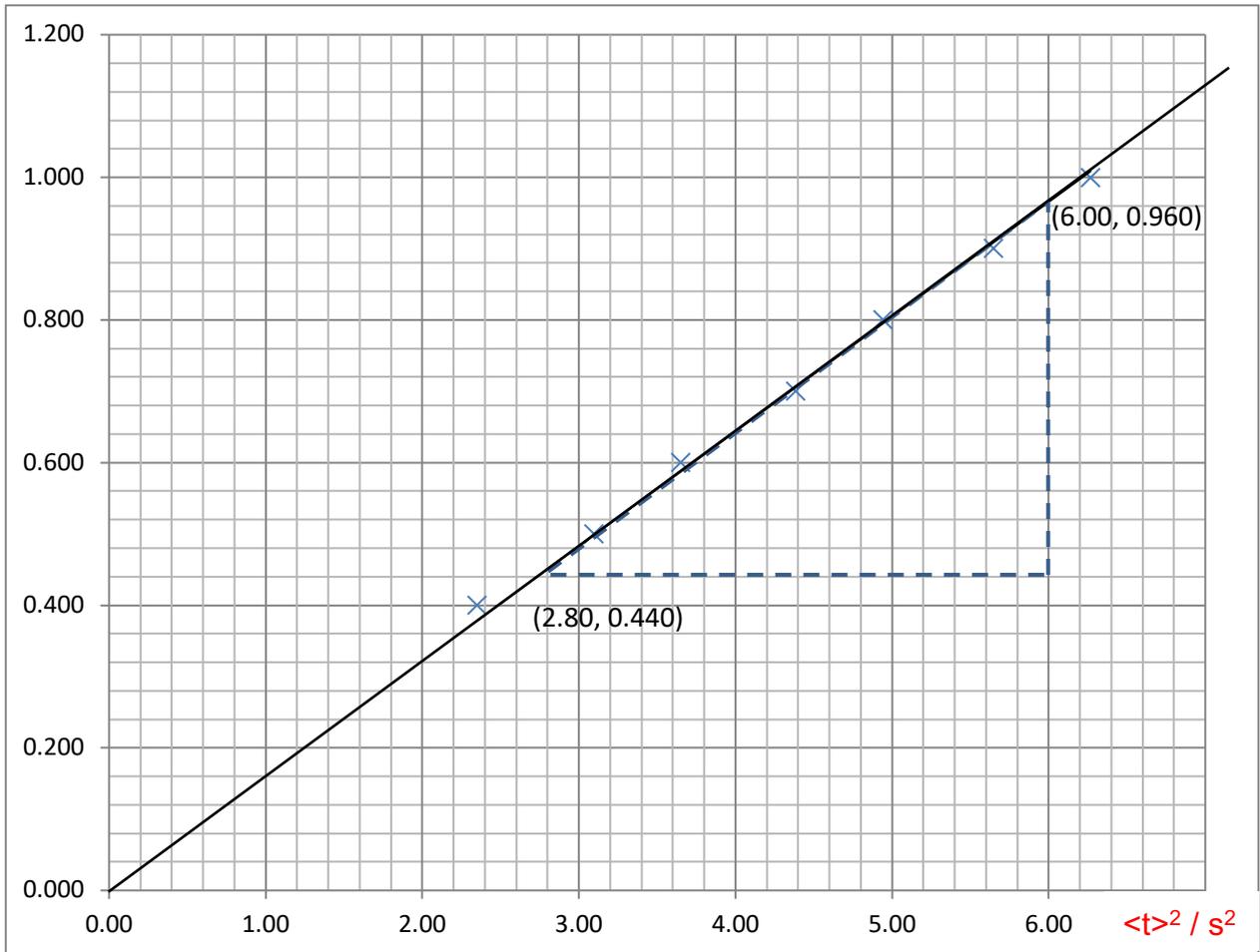
- units for the headings are correct as above
- at least 6 sets of readings recorded
- t₁, t₂, t₃ and <t> are recorded to 2 d.p
- s is recorded to 3 d.p in m or 1 d.p in cm
- <t>² is recorded to 3 s.f. same as <t>

(k) Graph of s against <t>² on graph paper.

Check that

- **S**: graph is of a suitable scale
- **P**: points are plotted accurately
- **L**: line of best fit is drawn
- **A**: axes labelled correctly
 - s / m is on the vertical axis & <t>² / s² is on the horizontal axis

s / m



(l) Gradient of the graph

Check that

- **C**: Coordinates of two suitable points on best fit line are shown
- **T**: a large dotted right angled triangle is drawn
- the working shows the substitution of the coordinates
- gradient = 0.13 to 0.18 m/s^2
OR 13 to 18 cm/s^2

E.g. gradient = $(0.960 - 0.440) / (6.00 - 2.80) = 0.52 / 3.2 = 0.163$

Questions

1 Draw a conclusion from the graph obtained.

s varies linearly with t^2

[Note: t^2 is not same as t^2]

OR s is directly proportional to t^2

[only if the graph passes through (0,0) or very close to origin]

2 State a significant source of error that might have affected the collected data.

- There is a lag in human reaction when starting and stopping the stopwatch causing errors in the time measured.

[This error becomes more significant for smaller values of s as t will be shorter.]

- Human judgement error in judging the exact instant the marble passes the required distance marking.

3 Suggest how to minimize the stated source of error.

- Repeat the experiment many times for each value of s and select the 3 values of t that are closest together so that when the average is taken the error is reduced.
- Use a longer ramp to increase the total time needed for the ball to roll down the ramp so that the error due to the lag in human reaction time will be reduced.

4 Student A suggested repeating the experiment for lengths of s until 10 cm for more sets of data to make the experiment more reliable. Discuss if you agree with Student A.

Disagree. The lag in human reaction time to start and stop will become more significant as the distance s , and therefore the time t decreases. The time taken for the marble to roll down 10 cm of the ramp will be too short to be measured reliably with a stopwatch. Hence, including these readings will not make the experiment more reliable.

OR Human reaction time is about 0.2 s. Using a shorter length of the ramp would reduce the time of travelling and increase the percentage error in the measurement of time t and make the results less reliable.