Marking scheme for Practical 3

Record of Experimental Data

(c) Value of θ = about 3° (below 5°)

**check your data against the calculated value.*

calculated $\theta = \tan^{-1}(5.0/100) = 2.9$ °

Table of data for (f), (h), (i) and (j)

s / cm	t_1 / s	t_2 / s	t_3 / s	<t> / s	$\langle t \rangle^2$ / 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

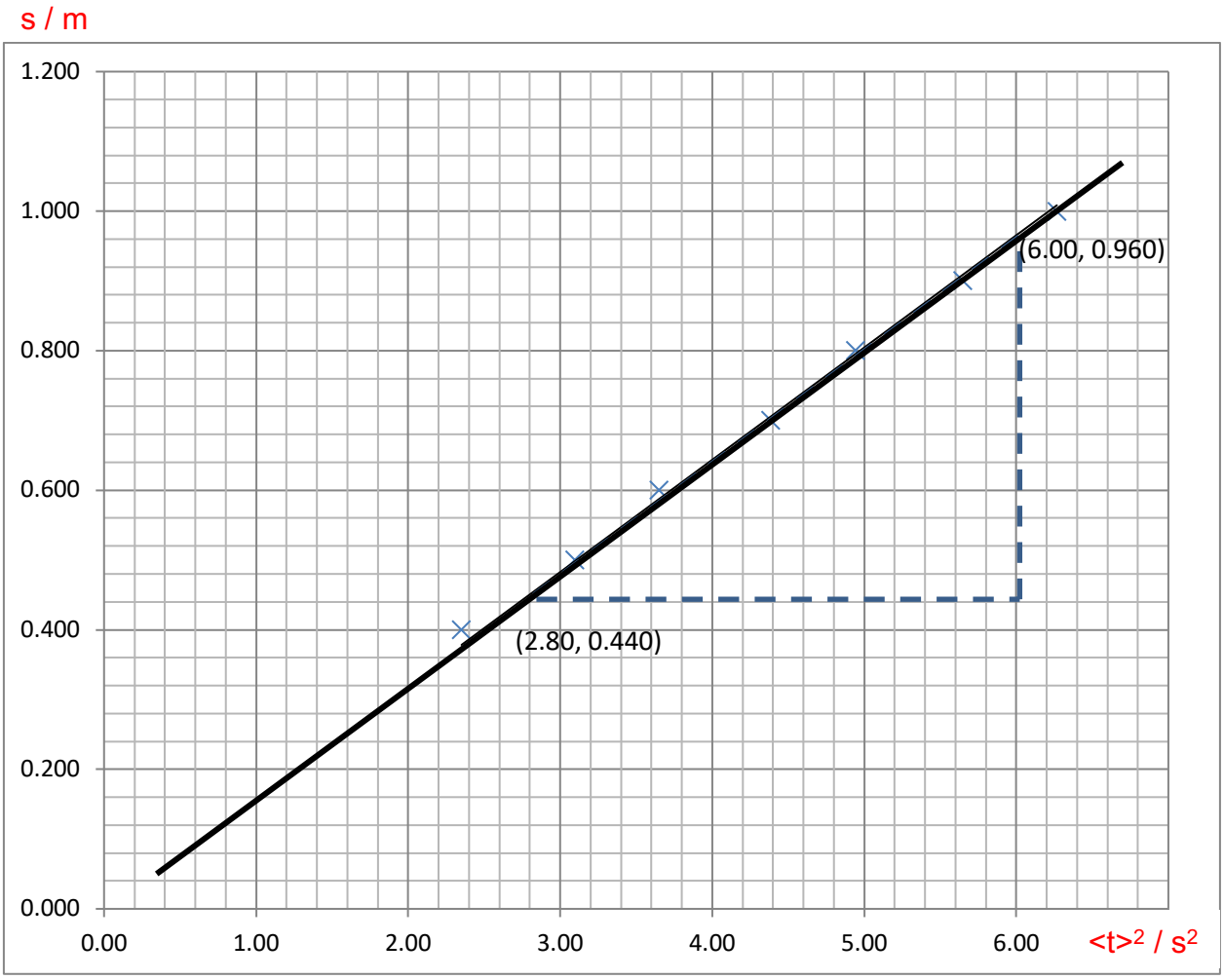
Check that

- units for the headings are correct as above
- at least 6 sets of readings recorded
- t_1, t_2, t_3 and <t> are recorded to 2 d.p
- s is recorded to 3 d.p in m and 1 d.p in cm
- $\langle t \rangle^2$ is recorded to 3 s.f

(k) Graph of s against $\langle t \rangle^2$ on graph paper.

Check that

- S – graph is of a suitable scale
- P – points are plotted accurately
- s /m is on the vertical axis
- t^2 / s^2 is on the horizontal axis
- line of best fit is drawn



(I) Gradient of the graph

Check that

- two suitable points on best fit line are chosen
- a dotted right angled triangle is drawn
- the working shows the substitution of the coordinates
- gradient could be 0.13 to 0.18 m/s^2 (error may be high)

OR 13 to 18 cm/s^2

Gradient of the graph = (0.960 – 0.440) / (6.00 – 2.80) = 0.52 / 3.2 = 0.163

(m) Draw a conclusion from the graph obtained.

$\langle t \rangle^2$ varies linearly with s or

$\langle t \rangle^2$ is directly proportional to s [only if the graph shows a line through (0,0) or passes very close to origin]

(n) State a possible 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.]

- It is difficult for one person to start the stopwatch when the marble starts rolling and stop the stopwatch at the exact instant that the marble reaches the end of the ramp causing errors in the time measured.
  (human judgement error in judging the exact instant the marble passes the required distance marking).

(o) 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.
- Work with a partner so that one person can position her eye at the start of s and focus on releasing the marble and one can focus on starting the stopwatch upon the hearing the command and keep her eye at the bottom of the ramp to stop the stopwatch as quickly as possible when the marble reaches the bottom of the ramp.

(p) Student A suggested that repeating the experiment for lengths of s until 10 cm for more sets of data would 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 s, and therefore t decreases. The time taken for the marble to roll down 10 cm of the ramp will be too short to be measured reliably. Hence, including those readings will not make the experiment more accurate.

OR Human reaction time is about 0.2 s. Using a shorter length of the ramp should reduce time of travelling and increase the percentage error in the measurement of time.