NANYANG GIRLS' HIGH SCHOOL

Sec 3 Physics Practical

Marking Scheme for PR2 Pendulum

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Record of L, t_1, t_2, <t>, T and T^2 *(total 4 marks)*

- Neat table drawn with the headings and units (**L/cm**, **t_1/s t_2/s**, **<t>/s**, **T/s** and **T^2/s^2**) [1]

- At least 6 sets of evenly spread readings of **L** taken with **L** between 30 and 100 cm (inclusive of 100 cm) with minimum range of 50 cm. [1]

- **L** tabulated to 1 d.p in cm / 3 d.p in m; **t_1, t_2, <t>** in 1 or 2 d.p in s [1]

- **T** and **T^2** calculated correctly and tabulated to correct s.f. [1]

Graph (total 4 marks)

- **S**: Suitable scales used. [1]

- **P**: All points correctly plotted (give allowance of 1 error). [1]

- **L**: Best fitted line passing through the origin. [1]

- **A**: Axes correct (**T^2** on y-axis and **L** on x-axis); axes correctly labelled (with or without units) from origin with values labelled at regular intervals on both axes. [1]

Conclusion

<u>**T^2** is directly proportional to **L**.</u> [1]

Questions

1 From your graph, what is the length of the pendulum which will give a period of 1.5 s?

<u>Values read off the length L from the graph when $T^2 = 1.5^2 = 2.25 \text{ s}^2$.</u> [1]

2 State and explain **two** possible sources of error in this experiment.

- There could be human judgment error in judging when the pendulum has completed <u>exactly one complete oscillation</u> [1].
- This may cause <u>error in recording the period</u> of oscillation [1]

- The <u>thread used for the pendulum is elastic OR can be stretched</u>. [1]
- This may affect the accuracy of the length of pendulum measured. [1]

<mark>**Not acceptable!**</mark>
- *<u>Air currents</u> in the laboratory may affect the oscillation of the pendulum. This may affect the accuracy of the timings measured.*
  - ○ ***Expected to ensure no air currents (switched off fan, closed windows)!***
- *The pendulum swing <u>may not be steady or occur in an elliptical path</u>. This may affect the accuracy of the timings measured.*
  - ○ ***Expected to use only steady oscillations in a vertical plane!***

3 State and explain **two** other precautions you took in this experiment to reduce the errors mentioned above.

- The pendulum bob was allowed to <u>swing freely for several oscillations before starting</u> to take readings   [1]
- This ensured that the oscillation was regular OR this ensured the <u>oscillations occurred steadily in a vertical plane</u>, allowing <u>more precise measurements of the period</u>   [1]

- The length of the pendulum was <u>measured after suspending it from the split cork</u>   [1]
- This is to take into account any changes in length due to the extension of the string under tension.   [1]

<mark>Not acceptable!</mark>
- *<u>The fans were switched off during the experiment.</u>*   [1]
- *This allowed the pendulum to oscillate steadily, allowing <u>more precise measurements of the period</u>*   [1]
  - o ***Expected procedure for proper experiment.***
- *The <u>retort stand was positioned behind the pendulum swing</u> when viewed from the front.*   [1]
- *This served as a reference line to count the number of swings accurately.*
  - o ***<mark>This is already mentioned in the procedure</mark>. Otherwise, it would be acceptable.***

4 Given that $T = 2\pi\sqrt{\dfrac{L}{g}}$, explain how you can determine the gravitational acceleration g from your results.

<u>Rearrange the equation to obtain $T^2 = \dfrac{4\pi^2 L}{g}$</u>   of the form Y = mX + c

<u>From the graph of T^2 against L plotted, gradient of the graph m = $\dfrac{4\pi^2}{g}$</u> .   [1]

<u>Hence, the gravitational acceleration g $= \dfrac{4\pi^2}{gradient}$</u>   [1]

Extension: Get students to determine the gradient and calculate g.