

Oscillating Paper Clips Investigation – the Planning section

Name.....

Date.....

You are going to plan and carry out an experiment that looks at how the period of oscillation of a paperclip chain varies with the number of paperclips in it.

You have available:

20 identical paper clips, 6 connected in a chain and 14 others

a ½ metre rule / a metre rule

a stopwatch timer

a nail to suspend the chain from

a fiducial marker (pin in a cork)

clamps, bosses, clampstand

Explain why it would be poor practice to try and time a single oscillation

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(2 marks)

You should time a number of oscillations e.g. 10T (ten oscillations), 15T (fifteen oscillations), etc.

Explain why this is much better practice. There are 2 major reasons.

1. ....

2. ....

(2 marks)

It is suggested that the period, T, of small oscillations of a chain of paperclips is given by

$$T = 2\pi \sqrt{\frac{kx}{g}}$$

Where x = number of paperclips in chain, l = length of each link of chain, k = a constant, g = 9.8 m s<sup>-2</sup>

By creating chains of different lengths you are going to investigate whether k is independent of x.

First you would need to create the longest chain you can measure with your rule. Then you would determine the link length, l. (NOTE that it is a link length not an individual paperclip length that you need to determine).

Explain clearly how you would determine l.

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(2 marks)

In order to more fully investigate the relationship between T and x, we can square the original equation to give:

$$T^2 = \frac{4\pi^2 kx}{l} \quad \text{or} \quad T^2 = \frac{4\pi^2 k}{l} \times x$$

Sketch a clearly labelled diagram of the apparatus set-up you would use.

(2 marks)

Explain below how you are going to use the apparatus to obtain the data required for your graph.

Remember to state the variable you are going to change and how you are going to take the measurements including steps taken to improve the reliability of the timings beyond timing nT.

From the equation for a straight line graph ('y = mx + c') state the graph you should plot to show the relationship between T and x. State clearly what belongs on the y axis, x axis, the expected gradient and how you can obtain a value for k from the graph.

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(11 marks)

Check your method and modify it as necessary from the answer given.