Planning Exercise 1

1 In this experiment, you will investigate the motion of a mass suspended from a spring and then plan an experiment to determine the spring constant of the spring.

You have been provided with
- a spring,
- a 50 g mass hanger and three 100 g slotted mass,
- a stopwatch,
- a pin in a cork,
- a retort stand with two clamps.

Set up the apparatus as shown in **Fig. 1.1**, with a total mass of 350 g suspended from the spring.

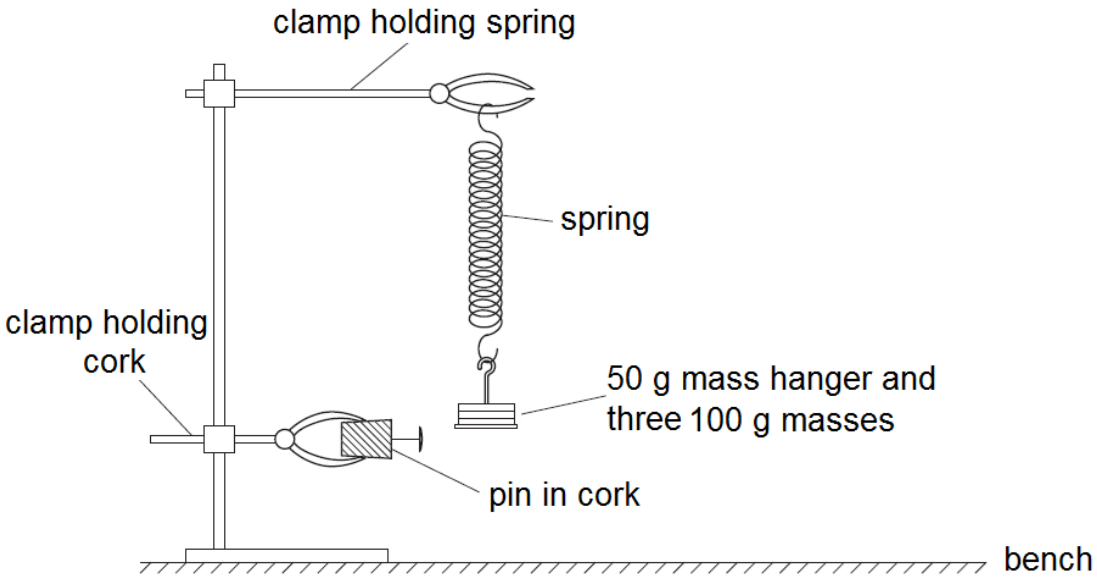

Fig. 1.1

Adjust the lower clamp so that the pin marks the position of the bottom of the mass hanger when the mass is stationary. When the mass is pulled downwards a small distance and released, it vibrates up and down. One complete vibration is from the position of the pin, up to the highest position, down to the lowest position and back up to the position of the pin, as shown in **Fig. 1.2**.

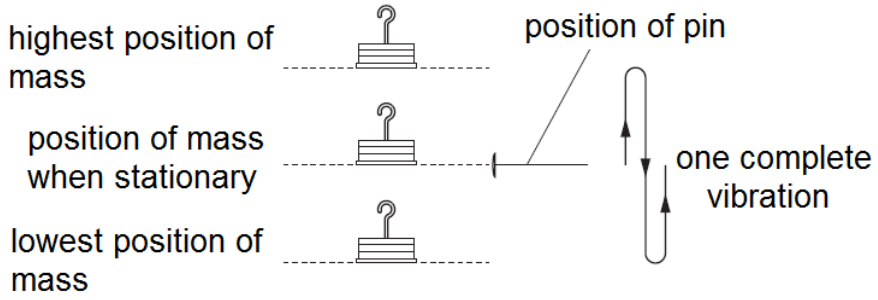

Fig. 1.2

(a) **(i)** The time for 20 complete vibrations is *t*. Take measurements to determine an accurate average value of *t*.

t = ... [2]

(ii) Calculate the time *T* for one vibration.

T = ... [1]

(iii) Calculate T^2.

T^2 = ... [1]

(iv) Calculate the spring constant *k* of the spring using the equation below where m is the total mass of the load in kg.

$$k = \frac{4\pi^2 m}{T^2}$$

k = ... [1]

(b) Plan

The equation in **(a)(iv)** may be rewritten in the form below.

$$T^2 = \frac{4\pi^2 m}{k}$$

Using the same apparatus in part **(a)**, plan an experiment to determine a more accurate value of *k*.

Your plan should include

- a list of quantities that remain constant,
- a description of how you would perform the experiment,
- a statement of the graph that you would plot,
- an explanation of how to determine *k* from the graph.

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Planning exercise 2

In this experiment, you will make measurements on a stand in order to investigate the stability of the stand. You will then plan an investigation into the stability of the stand.

You are provided with

- a stand,
- a metre rule,
- a wood block,
- a loop of thread,
- a set square,
- a newton meter.

(a) Measure and record the height *h* of the the top of the stand above the bench.

h = ... [1]

(b) **(i)** Place edge B of the base of the stand against the edge of the woodblock. Attach the newton meter to P, a point 1.0 cm below the top of the stand, as shown in Fig. 1.1.

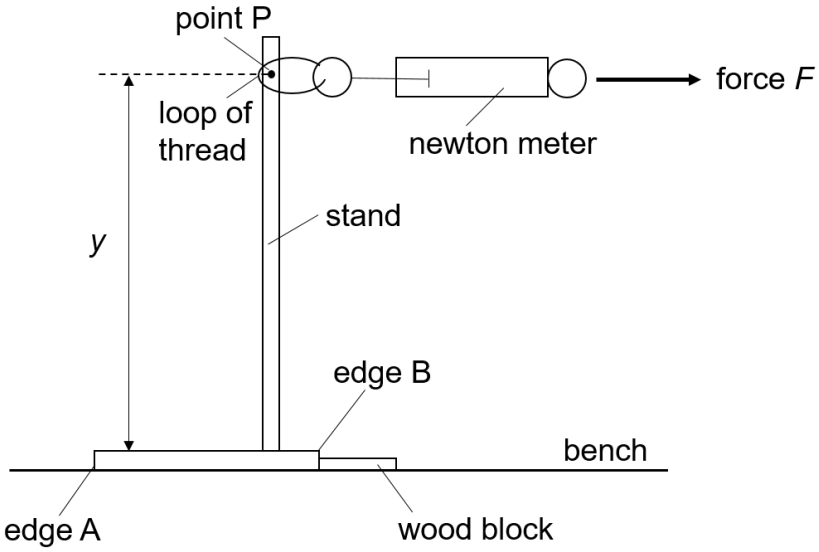

Fig. 1.1

(ii) Record the distance *y* as shown in Fig. 1.1.

y = ... [1]

(ii) Pull the newton meter horizontally until edge A of the stand just starts to rise. Record the force *F* required to just raise edge A.

F = ... [1]

(c) When edge A of the stand just starts to rise, the following equation applies,

$$W x = F y$$

where W is the weight of the stand that is given on the card, and

x is the horizontal distance of the centre of mass of the stand from edge B.

Using results from part **(a)** and the value of *W* that is given on the card, calculate a value for *x*. Show your working.

x = ... [2]

(d) Plan

The equation in part **(c)** may be re-written in the form

$$F=(W x)\cdot\frac{1}{y}$$

Describe how to extend the above experiment to obtain an accurate value for *x* from a line graph.

Your plan should include

- the quantities that you will keep constant,
- a description of how you will perform the experiment,
- a sketch of the graph you would plot,
- how you would determine *x* from the graph.

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