1 In this experiment, you will investigate the oscillation of masses on springs.

You have been provided with masses and springs.

Set up the apparatus as shown in Fig. 1.1.

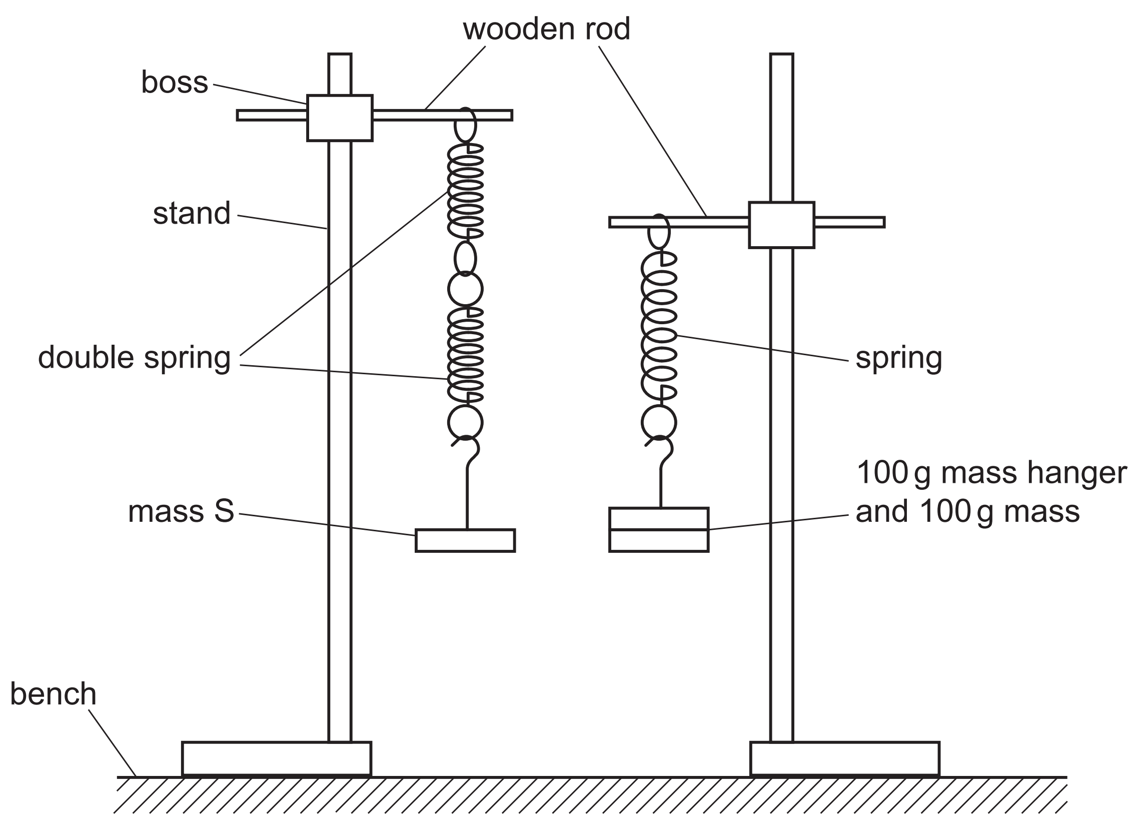

Fig. 1.1

(a)
- Ensure the bottoms of both masses are at the same level.
- Pull both masses down through a short distance and release them at the same time.
- Watch the oscillations of the masses. The masses initially oscillate in phase, then out of phase and then back in phase.
- The number of oscillations of mass S from release until the masses are back in phase for the first time is n_0.

Determine and record n_0.

n_0 = ... [2]

(b) (i)
- Add a mass of 30 g to mass S. The added mass is *M*.
- Record *M*.

M = ...

- Repeat **(a)**. The number of oscillations of mass S from release until the masses are back in phase for the first time is *n*.
- Determine and record *n*.

n = ...
[1]

(ii) Calculate *N*, where

$$N = n_0 - n.$$

N = ... [1]

(c) Vary *M* by changing the number of 10 g masses added to mass S and determine *n*. Do **not** use *M* = 0.

Repeat until you have five sets of values of *M* and *n*.

Record your results in a table. Include values of *N*. Also include values of N^3 to three significant figures.

[8]

(d) (i) Plot a graph of N^3 on the *y*-axis against *M* on the *x*-axis. [3]

(ii) Draw the straight line of best fit. [1]

(iii) Determine the gradient and *y*-intercept of this line.

gradient = ...

y-intercept = ...
[2]

(e) It is suggested that the quantities *N* and *M* are related by the equation

$$N^3 = PM + Q$$

where *P* and *Q* are constants.

Using your answers in **(d)(iii)**, determine the values of *P* and *Q*.
Give appropriate units.

P = ...

Q = ...
[2]

[Total: 20]

You may not need to use all of the materials provided.