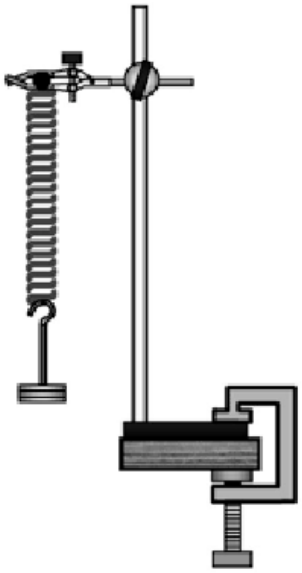
Question 1



(*a*) State Hooke's law. (4)

The elastic constant of a spring is 12 N m^{-1} and it has a length of 25 mm. An object of mass 20 g is attached to the spring.

What is the new length of the spring? (6)

The object is then pulled down until the spring's length is increased by a further 5 mm and is then released. The object oscillates with simple harmonic motion.

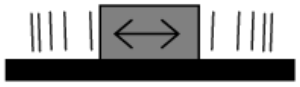
Sketch a velocity-time graph of the motion of the object. (9)

Calculate the period of oscillation of the object. (9)

(acceleration due to gravity, $g = 9.8$ m s^{-2})

Question 2

(*a*) State Hooke's law. (6)



A body of mass 250 g vibrates on a horizontal surface and its motion is described by the equation $a = -16s$, where s is the displacement of the body from its equilibrium position. The amplitude of each vibration is 5 cm.

Why does the body vibrate with simple harmonic motion? (6)

Calculate the frequency of vibration of the body? (9)

What is the magnitude of (i) the maximum force, (ii) the minimum force, which causes the body's motion? (7)

Question 3

3. A student investigated the variation of the fundamental frequency f of a stretched string with its tension T. The following is an extract of the student's account of the experiment.

> "I fixed the length of the string at 40 cm. I set a tuning fork of frequency 256 Hz vibrating and placed it by the string. I adjusted the tension of the string until resonance occurred. I recorded the tension in the string. I repeated the experiment using different tuning forks."

How was the tension measured? How did the student know that resonance occurred? (6)

The following data were recorded.

f/Hz	256	288	320	341	384	480	512
T/N	2.4	3.3	3.9	4.3	5.7	8.5	9.8

Draw a suitable graph to show the relationship between the fundamental frequency of a stretched string and its tension. State this relationship and explain how your graph verifies it. (21)

Use your graph to

(i) estimate the fundamental frequency of the string when its tension is 11 N;

(ii) calculate the mass per unit length of the string. (13)

Question 4

1. A student investigated the relationship between the period and the length of a simple pendulum.

The student measured the length l of the pendulum.

The pendulum was then allowed to swing through a small angle and the time t for 30 oscillations was measured.

This procedure was repeated for different values of the length of the pendulum.

The student recorded the following data.

l/cm	40.0	50.0	60.0	70.0	80.0	90.0	100.0
t/s	38.4	42.6	47.4	51.6	54.6	57.9	60.0

Why did the student measure the time for 30 oscillations instead of measuring the time for one?

How did the student ensure that the length of the pendulum remained constant when the pendulum was swinging? (9)

Using the recorded data draw a suitable graph to show the relationship between the period and the length of a simple pendulum. What is this relationship? (19)

Use your graph to calculate the acceleration due to gravity. (12)