Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Q1.

The photograph shows an example of a Foucault pendulum.

This is a pendulum that consists of a massive sphere, suspended by a long wire from a high ceiling. Over time the vertical plane through which the pendulum swings appears to rotate because of the rotation of the Earth.

mass of sphere = 28.0 kg

During refurbishment, the pendulum is taken down and the wire is replaced.

Steel wires of the following diameters are available:

0.71 mm 0.91 mm 1.22 mm 1.63 mm 2.03 mm

(i) Explain which of these wires is the thinnest that could be used to support the sphere safely.

breaking stress of steel = 3.10×10^8 N m^{-2}

(3)

.....

.....

.....

.....

.....

.....

(ii) The wire identified in part (i) is used for the pendulum, the unstretched length of the new wire is 11.2 m.

Calculate the extension of the new wire when the sphere is attached.
Young Modulus for steel = 200 GPa

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

Extension = ...

(Total for question = 6 marks)

Q2.

Genuine crystal balls are made from clarified quartz rather than glass. A student was given a small crystal ball and wanted to know whether it was genuine.

The student measured the diameter of the crystal ball using vernier calipers with a resolution of 0.01 cm. She measured the mass of the crystal ball using a balance with a resolution of 1 g.

The table gives the densities of clarified quartz and glass.

Material	Density / kg m^{-3}
Clarified quartz	2650
Glass	2590

Determine whether the crystal ball was genuine.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

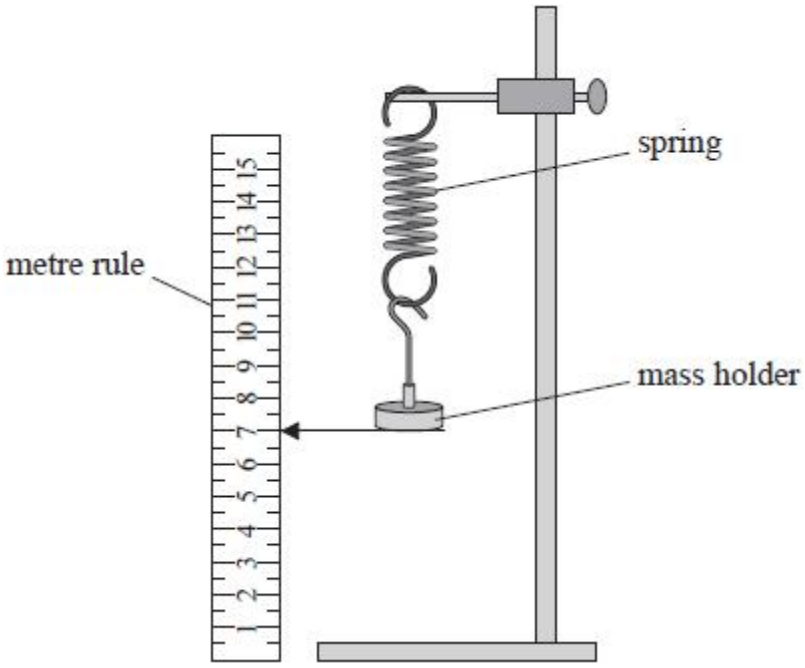
.....

.....

(Total for question = 6 marks)

Q3.

A student investigated the behaviour of a spring under tension. The spring was hung vertically with a mass holder attached.

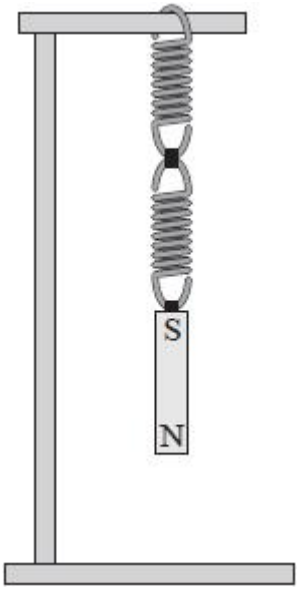


The position of the bottom of the mass holder was recorded. The spring was stretched by adding masses to the mass holder and the new positions were recorded. The extension of the spring each time was calculated.

The student produced the following table.

Mass added / g	Extension / cm	Stretching force / N
50	1.9	0.49
70	3	0.69
90	3.5	0.9
110	4.5	1.08
130	5.3	1.28
150	5.8	1.47

Two identical springs are joined in series and a bar magnet is hung from one end as shown.



The bar magnet is displaced a small distance vertically from its equilibrium position and released.

Calculate the frequency at which the system oscillates.

mass of magnet = 120 g
spring constant of each spring = 22 N m^{-1}

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Frequency = ...

(Total for question = 4 marks)

Q4.

A student carries out an experiment to determine the viscosity of glycerol. She does this by determining the terminal velocity of a steel sphere falling through glycerol.

(i) The student drops a steel sphere with a radius of 4.0 mm into a cylinder of glycerol.

The sphere reaches terminal velocity and takes 3.9 s to fall 0.50 m.
Calculate the viscosity of glycerol.
density of steel = 7800 kg m^{-3}
density of glycerol =1300 kg m^{-3}

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Viscosity of glycerol = ...

(ii) There are two cylinders available for the student to use. One cylinder has a diameter of 1.5 cm and the other has a diameter of 5.0 cm.

State and justify which cylinder the student should use in order to gain a more accurate value for the viscosity of glycerol.

(2)

.....

.....

.....

.....

(Total for question = 6 marks)