Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Q1.

(a) The equation that describes simple harmonic motion is

$$a = -\omega^2 x.$$

State the meaning of the symbol ω in this equation and go on to explain the significance of the negative sign.

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(2)

(b) **Figure 1a** shows a demonstration used in teaching simple harmonic motion. A sphere rotates in a horizontal plane on a turntable. A lamp produces a shadow of the sphere. This shadow moves with approximate simple harmonic motion on the vertical screen.

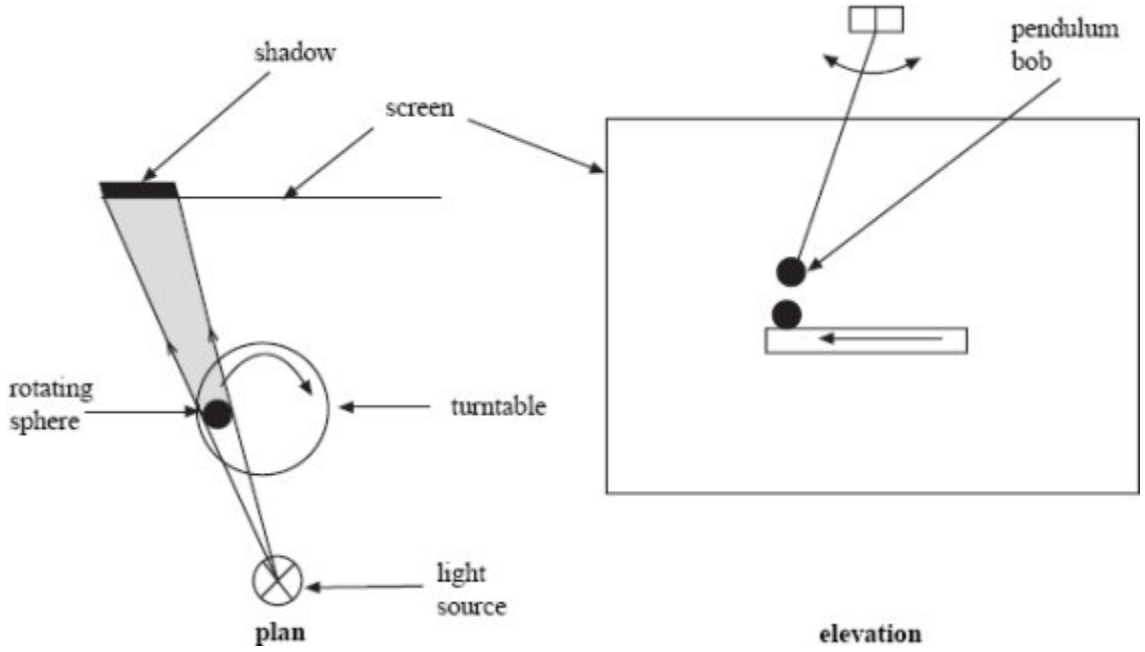


Figure 1a **Figure 1b**

(i) The turntable has a radius of 0.13 m and the teacher wishes the time taken for one cycle of the motion to be 2.2 s. The mass of the sphere is 0.050 kg.

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Calculate the magnitude of the horizontal force acting on the sphere.

(2)

(ii) State the direction in which the force acts.

_____

(1)

(c) **Figure 1b** shows how the demonstration might be extended. A simple pendulum is mounted above the turntable so that the shadows of the sphere and the pendulum bob can be seen to move in a similar way and with the same period.

(i) Calculate the required length of the pendulum.

acceleration due to gravity = 9.8 m s^{-2}

(1)

(ii) Calculate the maximum acceleration of the pendulum bob when its motion has an amplitude of 0.13 m.

(2)

(d) **Figure 2** includes a graph of displacement against time for the pendulum. Sketch, on the axes below, graphs of

(i) acceleration against time for the bob, and

(ii) kinetic energy against time for the bob.

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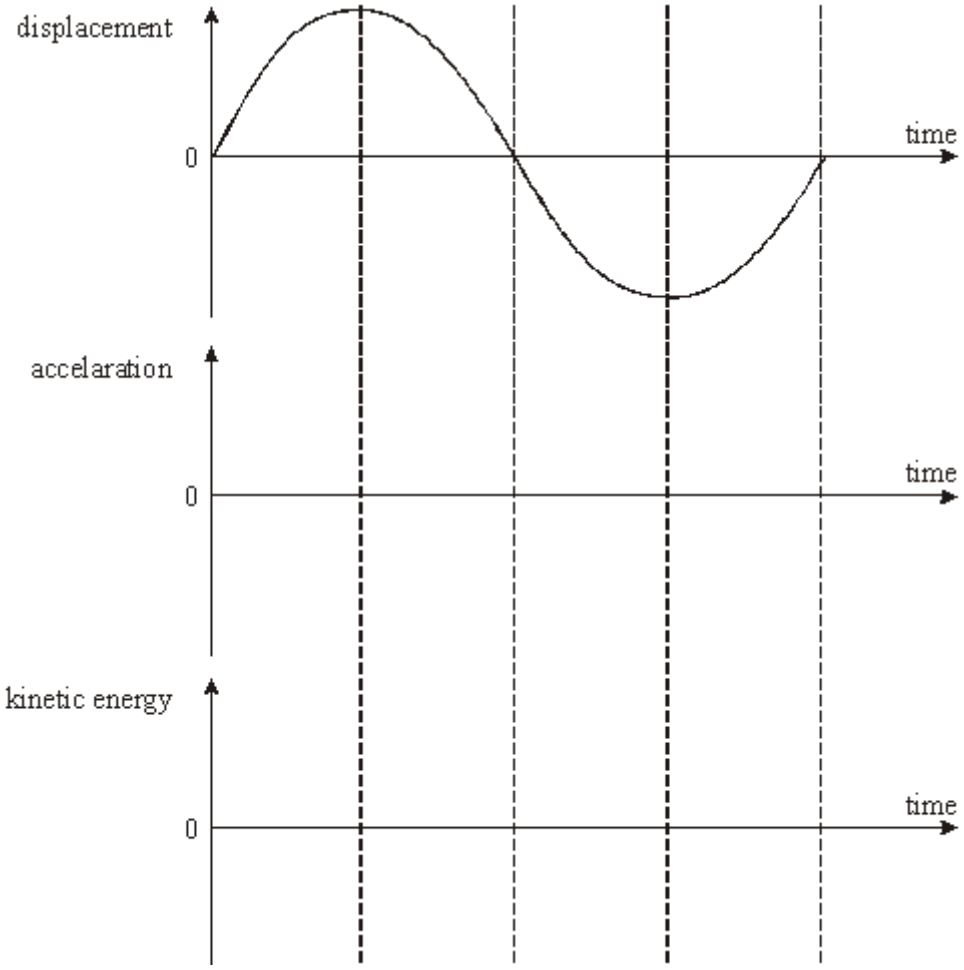


Figure 2

(4)

(Total 12 marks)

Q2.

Figure 1 shows one cycle of the displacement-time graphs for two mass-spring systems **X** and **Y** that are performing simple harmonic motion.

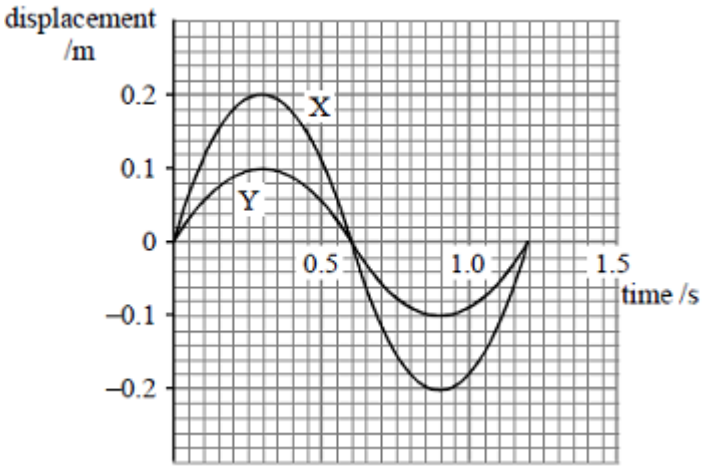


Figure 1

(a) (i) Determine the frequency of the oscillations.

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(2)

(ii) The springs used in oscillators **X** and **Y** have the same spring constant. Using information from **Figure 1**, show that the mass used in oscillator **Y** is equal to that in oscillator **X**.

_____

_____

_____

_____

(2)

(iii) Explain briefly how would you use one of the graphs in **Figure 1** to confirm that the motion is simple harmonic

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(2)

(b) **Figure 2** shows how the potential energy of oscillator **X** varies with displacement.

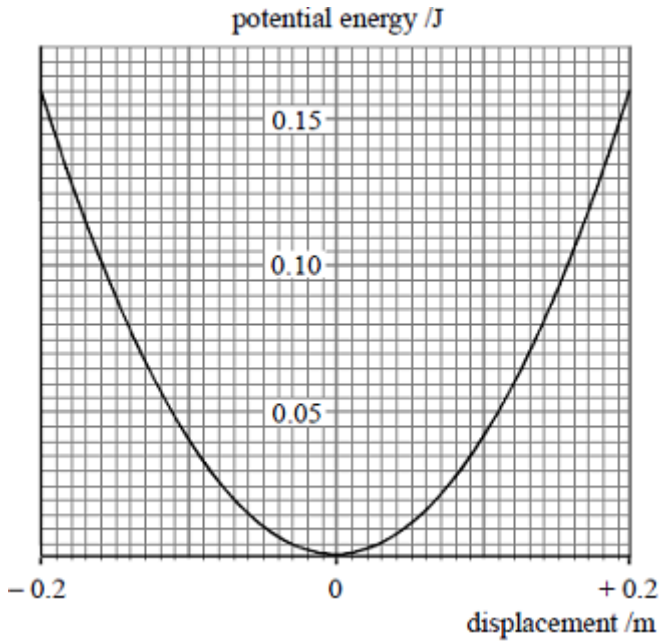


Figure 2

(i) Draw on **Figure 2** a graph to show how the kinetic energy of the mass used in oscillator **X** varies with its displacement. Label this **A**.

(1)

(ii) Draw on **Figure 2** a graph to show how the kinetic energy of the mass used in oscillator **Y** varies with its displacement. Label this **B**.

(2)

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(c) Use data from the graphs to determine the spring constant of the springs used.

(3)
(Total 12 marks)

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