Circular Motion - 2023 A2 Physics 9702

1. Nov/2023/Paper_9702/42/No.1

(a) Define the radian.

.....

..... [1]

(b) The minute hand of a clock revolves at constant angular speed around the face of the clock, completing one revolution every hour. A small piece of modelling clay is attached to the hand with its centre of gravity at a distance L from the fixed end of the hand, as shown in Fig. 1.1.

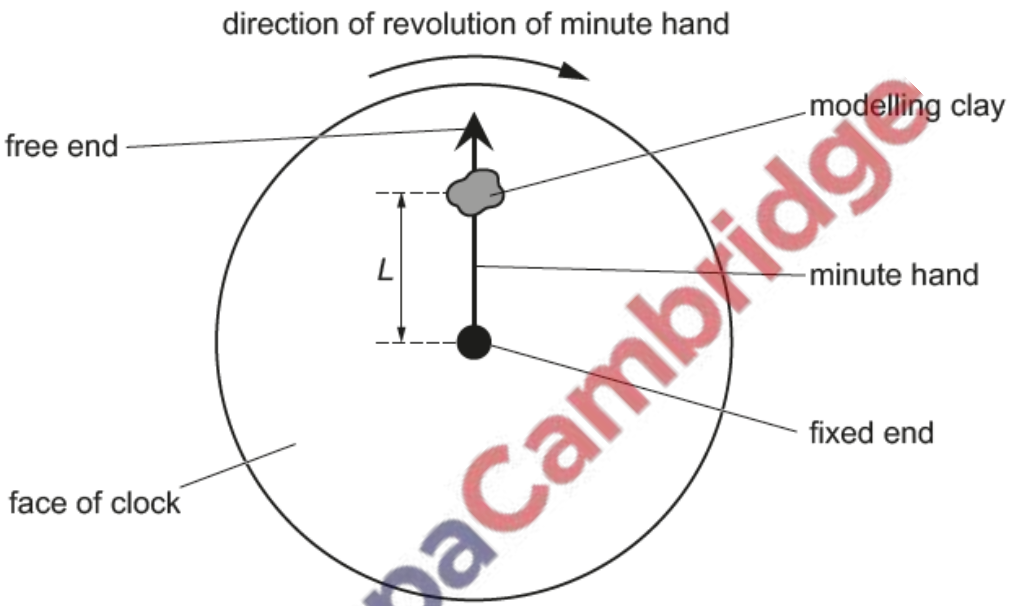

Fig. 1.1

Calculate the angular speed ω of the minute hand.

ω = ... rad s^{-1} [2]

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(c) During a time interval of 1400 s, the centre of gravity of the piece of modelling clay in Fig. 1.1 moves through a total distance of 0.44 m.

(i) Calculate the angle through which the minute hand moves in this time interval.

angle = ... rad [1]

(ii) Determine distance *L*.

L = ... m [2]

(iii) Calculate the magnitude of the centripetal acceleration of the piece of modelling clay.

centripetal acceleration = ... $m\,s^{-2}$ [2]

(d) Use your answer in **(c)(iii)** to explain why the variation with time of the magnitude of the force exerted by the minute hand on the piece of modelling clay is negligible as the minute hand undergoes one full revolution.

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..... [2]

[Total: 10]

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2. June/2023/Paper_9702/41/No.2

A steel sphere of mass 0.29 kg is suspended in equilibrium from a vertical spring. The centre of the sphere is 8.5 cm from the top of the spring, as shown in Fig. 2.1.

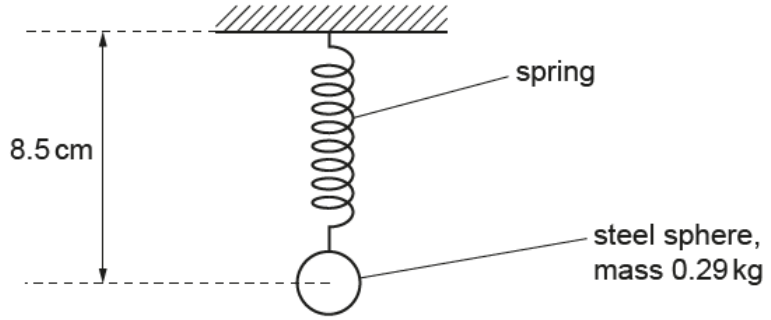

Fig. 2.1

The sphere is now set in motion so that it is moving in a horizontal circle at constant speed, as shown in Fig. 2.2.

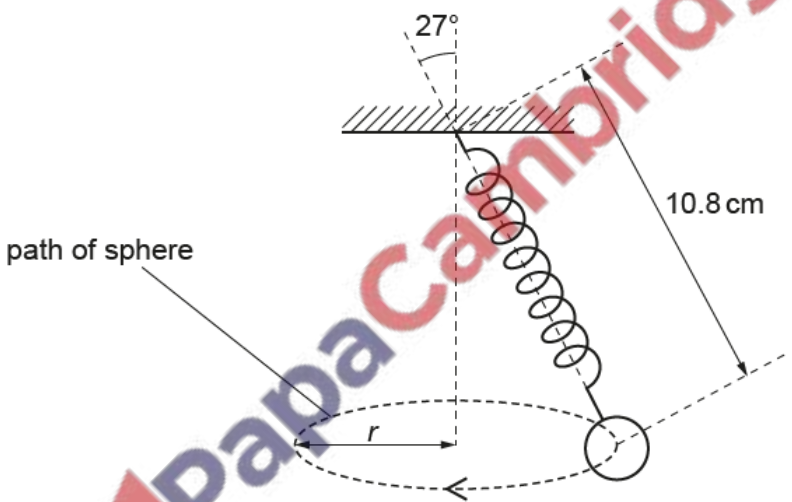

Fig. 2.2

The distance from the centre of the sphere to the top of the spring is now 10.8 cm.

(a) Explain, with reference to the forces acting on the sphere, why the length of the spring in Fig. 2.2 is greater than in Fig. 2.1.

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.....

..... [3]

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(b) The angle between the linear axis of the spring and the vertical is 27°.

(i) Show that the radius r of the circle is 4.9 cm.

[1]

(ii) Show that the tension in the spring is 3.2 N.

[2]

(iii) The spring obeys Hooke's law.

Calculate the spring constant, in $N\,cm^{-1}$, of the spring.

spring constant = ... $N\,cm^{-1}$ [2]

(c) **(i)** Use the information in **(b)** to determine the centripetal acceleration of the sphere.

centripetal acceleration = ... $m\,s^{-2}$ [2]

(ii) Calculate the period of the circular motion of the sphere.

period = ... s [2]

[Total: 12]

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