6 **(a)** State what is meant by *simple harmonic motion*.

……

……

…….. [2]

(b) A small ball rests at point P on a curved track of radius r, as shown in Fig. 6.1.

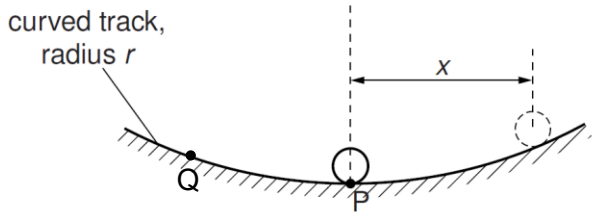

Fig. 6.1

The ball is moved a small distance of 2.0 cm to one side and is then released. The horizontal displacement *x* of the ball is related to its acceleration *a* towards P by the expression

$$a = -\frac{gx}{r}$$

where *g* is the acceleration of free fall.

(i) Explain how the equation above shows that the ball undergoes simple harmonic motion.

……

……

……

…… [2]

(ii) The radius *r* of curvature of the track is 28 cm.

Show that the period *T* of the oscillation is 1.1 s. [2]

(iii) Determine the time interval τ between the ball passing point P to point Q, where Q is 1.5 cm to the left of P.

τ = ... s [2]

(iv) On the axes of Fig. 6.2, sketch a graph to show the variation with displacement *x* of the velocity *v*.

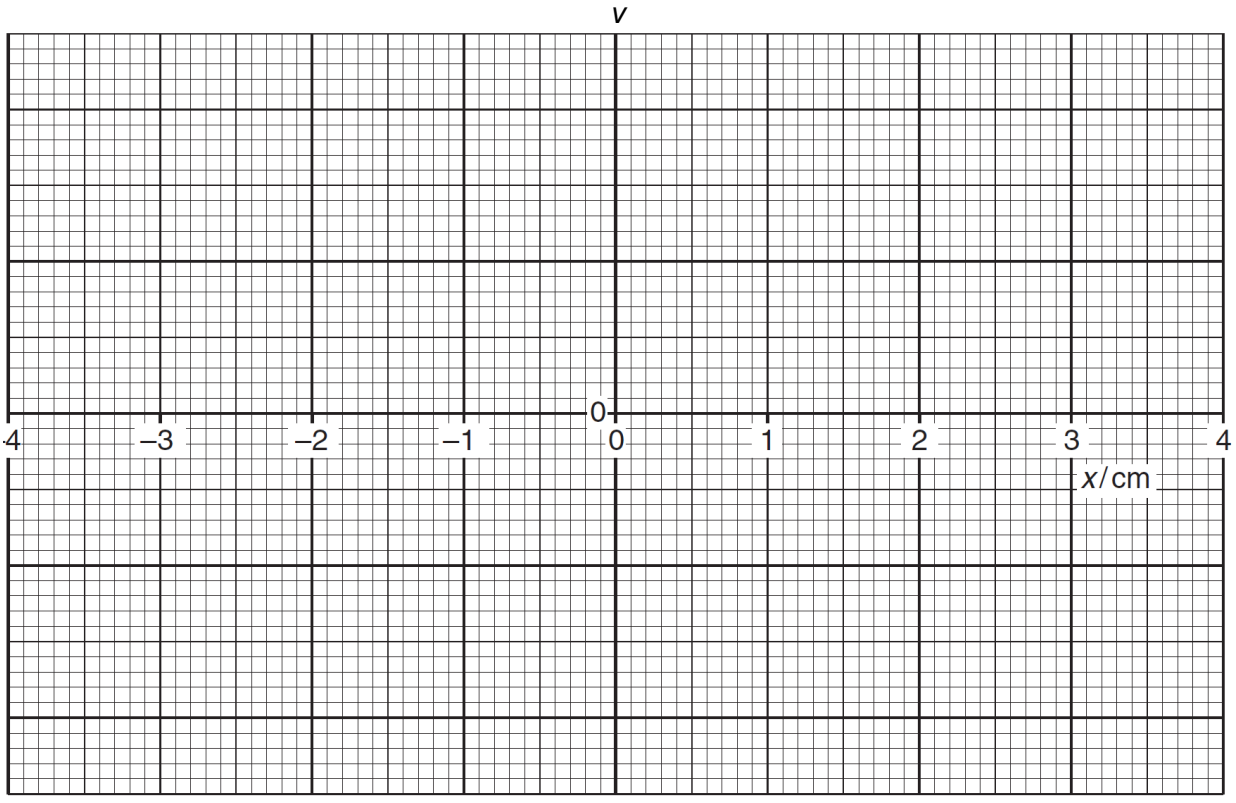

Fig. 6.2

[3]

(v) The mass of the ball is 0.10 kg. Calculate the total energy of the oscillation.

total energy = …….. mJ [3]

(vi) Hence, on the axes of Fig. 6.3, to show the variation with displacement *x* of

1. the total energy (label this TE)
2. the kinetic energy (label this KE)
3. the potential energy (label this PE)

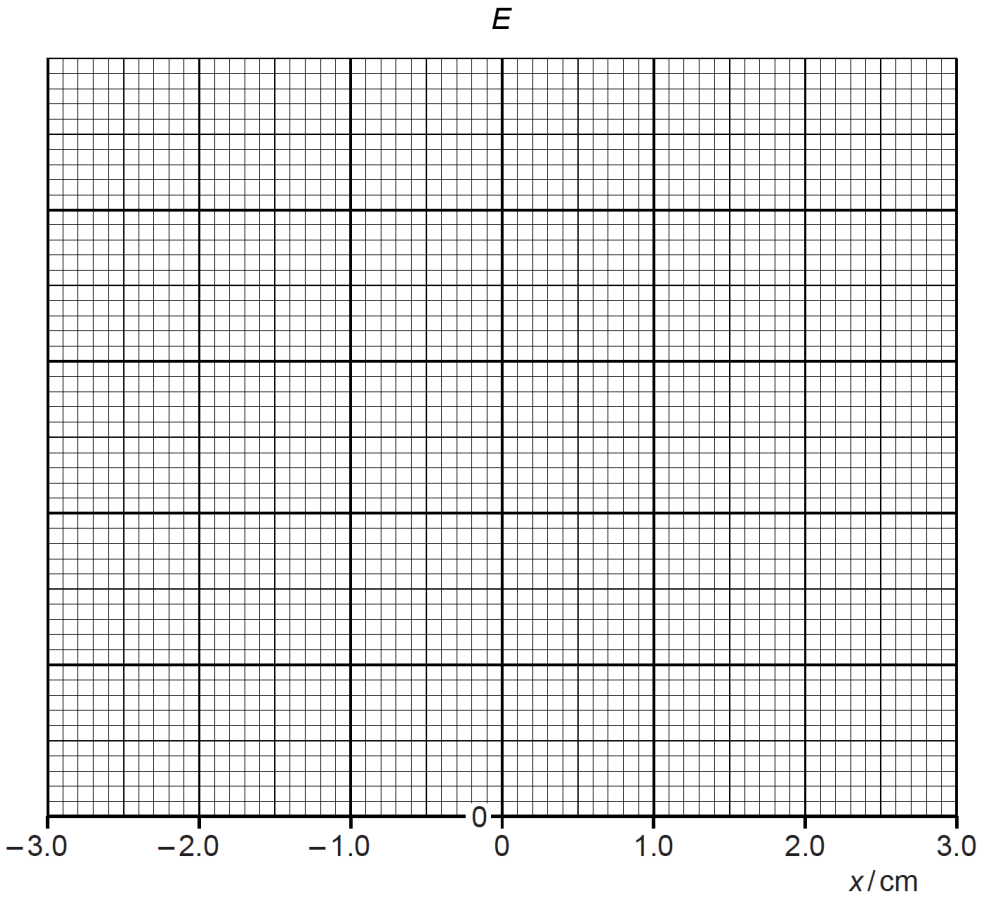

Fig. 6.3

[2]

(vii) An additional track with a radius of 29 cm is placed beside the track with a radius of 28 cm. One ball is placed on each track and released as shown in Fig. 6.4 so that the balls start to move in phase.

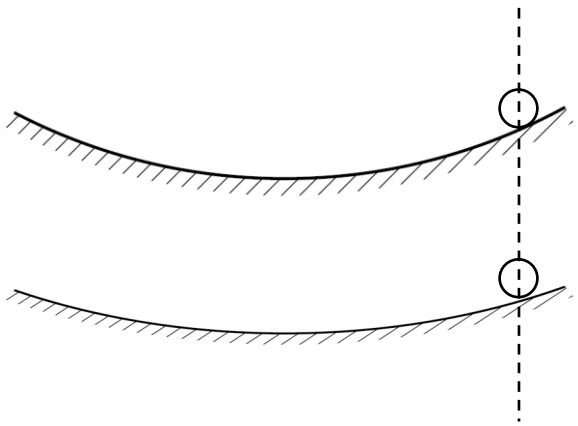

Fig. 6.4

The balls will start to move out of phase as they oscillate.

Determine the time it takes from the time of release till the next point in time when the balls are in phase again.

time = …… s [4]

[Total: 20]

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