3 **(a)** An object is placed upon a platform that can oscillate up and down, as shown in Fig. 3.1.

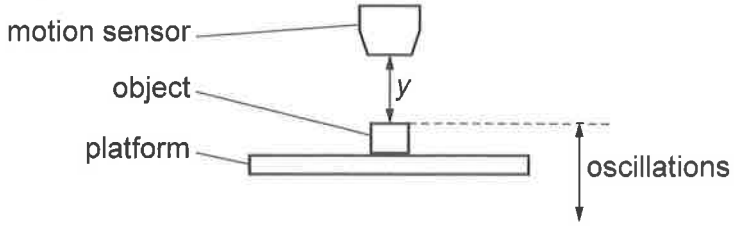

Fig. 3.1 (not to scale)

The object and the platform oscillate vertically with simple harmonic motion. A motion sensor is used to record the motion of the object. The vertical displacement of the object below the sensor is y. Fig. 3.2 shows the variation of y with time t.

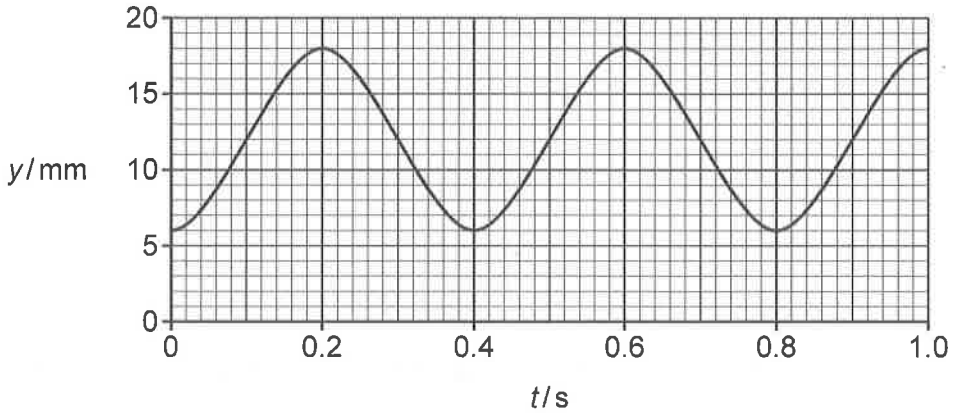

Fig. 3.2

(i) Show that the angular frequency ω of the oscillations of the object is 16 rad s^{-1}.

[1]

(ii) Determine the magnitude of the maximum acceleration of the object.

maximum acceleration = ... m s^{-2} [2]

(iii) Determine the magnitude of the maximum velocity of the object.

maximum velocity = ... m s^{-1} [1]

(iv) On Fig. 3.3, sketch a line to show the variation of the velocity v of the object with y.

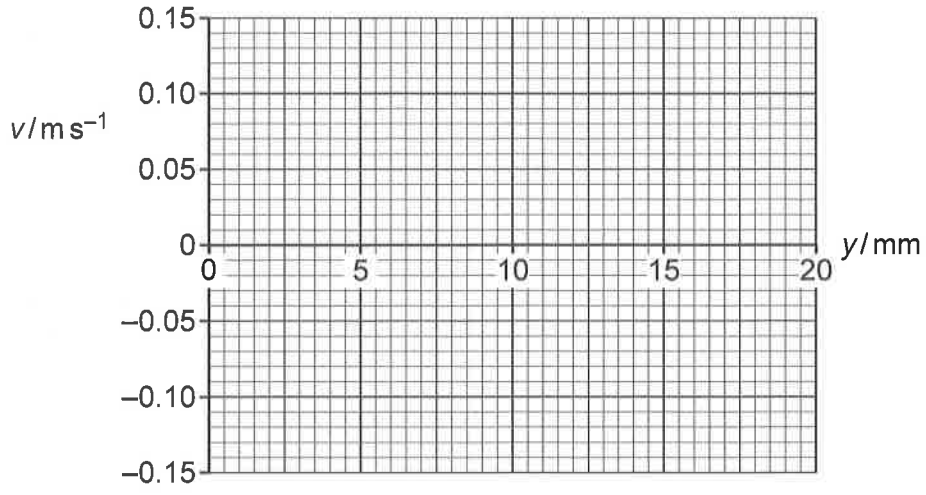

Fig. 3.3

[3]

(v) The angular frequency of the oscillations is kept constant. The amplitude of the oscillations is gradually increased. At an amplitude of A_0, the object just loses contact with the platform.

Determine A_0.

A_0 = ... m [2]

(b) (i) State what is meant by critical damping.

.....

.....

..... [1]

(ii) Explain, with reference to energy, why critical damping is important in car suspension systems.

.....

.....

..... [1]

[Total: 11]