2008 **6.** **(a)** A particle of mass 5 kg is suspended from a fixed point by a light elastic string which hangs vertically. The elastic constant of the string is 500 N/m. The mass is pulled down a vertical distance of 20 cm from the equilibrium position and is then released from rest.

(i) Show that the particle moves with simple harmonic motion.
(ii) Find the speed and acceleration of the mass 0.1 seconds after it is released from rest.

(*i*) Equilibrium position :

$T_0 = kd$ and $T_0 = 5g$

$\Rightarrow d = \frac{5g}{k} = \frac{5g}{500}$ or $\frac{g}{100}$ — 5

Displaced position :

Force in dirn. of x inc. $= 5g - 500(d + x)$

$= 5g - 5g - 500x$

$= -500x$

Acceleration $= -\frac{500x}{5} = -100x$

$\Rightarrow$ S.H.M. about $x = 0$ with $\omega = 10$ — 5

(*ii*) amplitude $= 0.2$

$x = a\cos\omega t$

$= 0.2\cos 1 = 0.10806$ — 5

$v = \omega\sqrt{a^2 - x^2}$

$= 10\sqrt{0.2^2 - 0.10806^2}$

$= 1.68$ m/s — 5

acceleration $= \omega^2 x$

$= 100(0.10806)$

$= 10.8\ \text{m/s}^2$ — 5

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