2007 **6.** **(a)** A particle of mass m kg is suspended from a fixed point p by a light elastic string.
The extension of the string is d when the particle is in equilibrium.
The particle is then displaced vertically from the equilibrium position a distance not greater than d and is then released from rest.

(i) Show that the motion of the particle is simple harmonic.

(ii) Find, in terms of d, the period of the motion.

(*i*) Equilibrium position :

$$T_0 = kd \quad \Rightarrow \quad mg = kd$$ — 5

Displaced position :

Force in dirn. of x inc. $= mg - k(d + x)$

$= mg - kd - kx$

$= -kx$ — 5

Acceleration $= -\dfrac{kx}{m}$

$\Rightarrow$ S.H.M. about $x = 0$ with $\omega = \sqrt{\dfrac{k}{m}}$ — 5

(*ii*) Period $= \dfrac{2\pi}{\omega}$

$= 2\pi\sqrt{\dfrac{m}{k}}$ — 5

$= 2\pi\sqrt{\dfrac{d}{g}}$ — 5 — 25