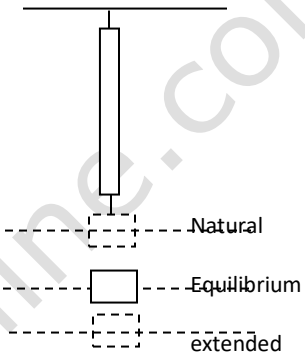
Q- A block is suspended by a vertical spring of constant 1800 N/m and makes 5.5 oscillations per second.
(a) Find the mass of the block.
(b) What is elongations in the spring if the block is at rest in equilibrium?
(c) If the block is pulled down by 2.5 cm from equilibrium position and released, write the equation of subsequent motion of the block.

For the vertical spring oscillations, the time period is given by the equation

$$T = 2\pi\sqrt{\frac{m}{K}}$$

Where K is the spring constant



As the frequency n is the inverse of time period T we have

$$n = \frac{1}{2\pi}\sqrt{\frac{K}{m}}$$

(a) Substituting the values, we get

$$5.5 = \frac{1}{2\pi}\sqrt{\frac{1800}{m}}$$

Or $$m = \frac{1800}{4*3.14^2*5.5^2} = 1.507 \text{ kg}$$

(b) In equilibrium, the spring stretched such that the weight of the mass is balanced and hence if the stretch is Δl, we have

$$\Delta l = \frac{F}{K} = \frac{mg}{K} = \frac{1.509*9.8}{1800} = 8.206*10^{-3} m = 0.82 \text{ cm.}$$

(c) The angular frequency ω is given by

$$\omega = 2\pi n = 2\pi*5.5 = 11\pi$$

The displacement amplitude of oscillation is A = 2.5 cm = 0.025 m

As the object is released at t =0, from the stretched position, at t = 0 the object is at maximum displacement position and hence the initial phase of oscillation is 90^0 and thus the expressions are written as

$$x = A\sin(\omega t + \varphi_0)$$
Or $$x = A\sin(\omega t + 90^0) \qquad \phi_0 = 90^0$$
Or $$x = A\cos\omega t$$
Or $$x = 0.025\cos(11\pi t)$$

This is the equation of the subsequent motion.