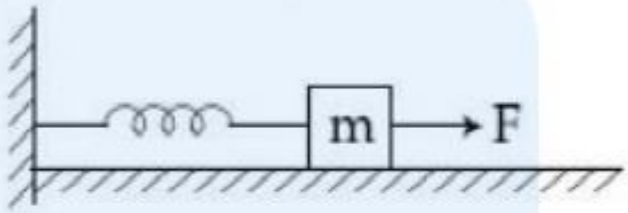
8. A block of mass m, lying on a smooth horizontal surface, is attached to a spring (of negligible mass) of spring constant k. The other end of the spring is fixed, as shown in the figure. The block is initially at rest in a equilibrium position. If now the block is pulled with a constant force F, the maximum speed of the block is



(A) $\frac{2F}{\sqrt{mk}}$

(B) $\frac{F}{\pi\sqrt{mk}}$

(C) $\frac{\pi F}{\sqrt{mk}}$

(D) $\frac{F}{\sqrt{mk}}$

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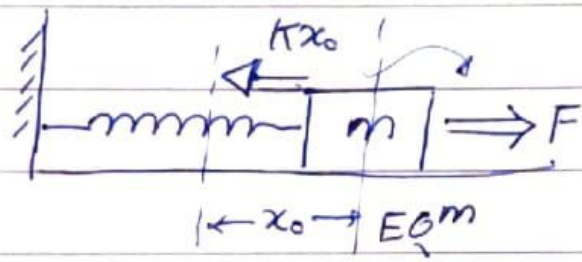
SOLUTION:

We need to find the maximum speed of block.

We have seen that maximum speed occurs when the mass is at equilibrium point, so let us find the eq^m point



So, we have $F = Kx_0$ at equilibrium

$$\text{So, } \boxed{x_0 = \frac{F}{K}}$$

now for finding speed lets use energy conservation. (b/w initial & eq^m point)

$$W_{done\ by\ all\ forces} = \Delta KE$$

$$W_{spring} = -\frac{1}{2}K(x_0)^2 \ ; \ W_{Force\ F} = Fx_0$$

$$\Delta KE = KE_f - KE_i = \frac{1}{2}mv^2 - 0 = \frac{1}{2}mv^2$$

So,

$$-\frac{1}{2}Kx_0^2 + Fx_0 = \frac{1}{2}mv^2 \Rightarrow -\frac{KF^2}{K^2} + \frac{2F^2}{K} = mv^2$$

$$\Rightarrow \frac{F^2}{Km} = v^2 \Rightarrow \boxed{v = \frac{F}{\sqrt{mK}}}$$