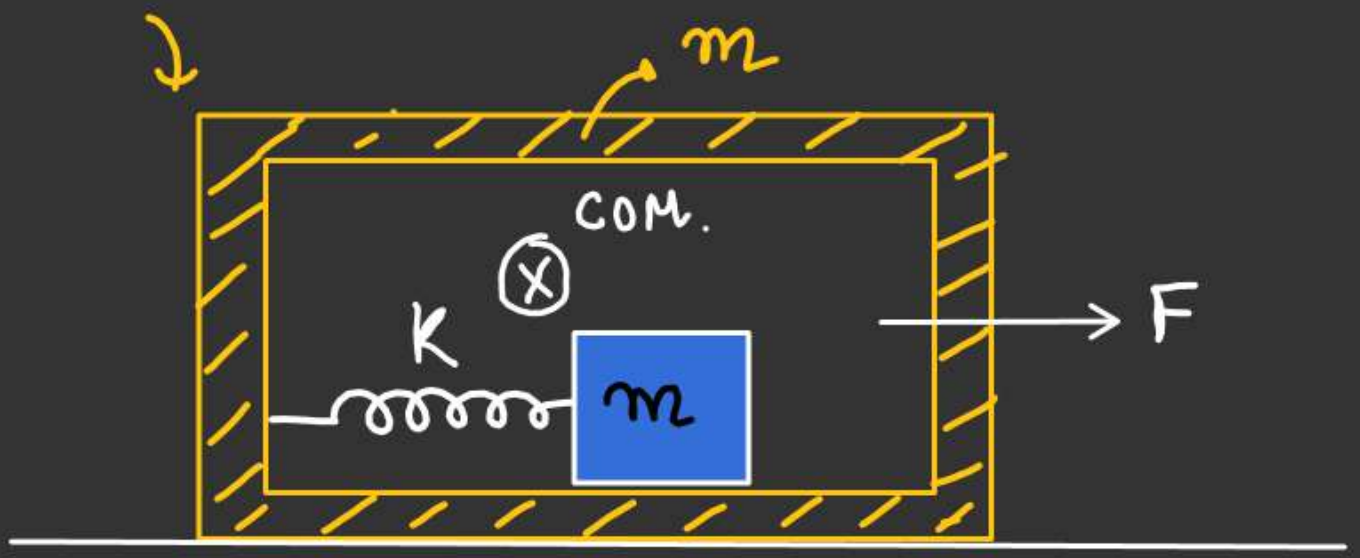
S.H.M

Cart pulled by constant force F.

a) Find Time Period of Cart

2) velocity of the Cart at the instant 'B' when compression in the spring is maximum

Cart.



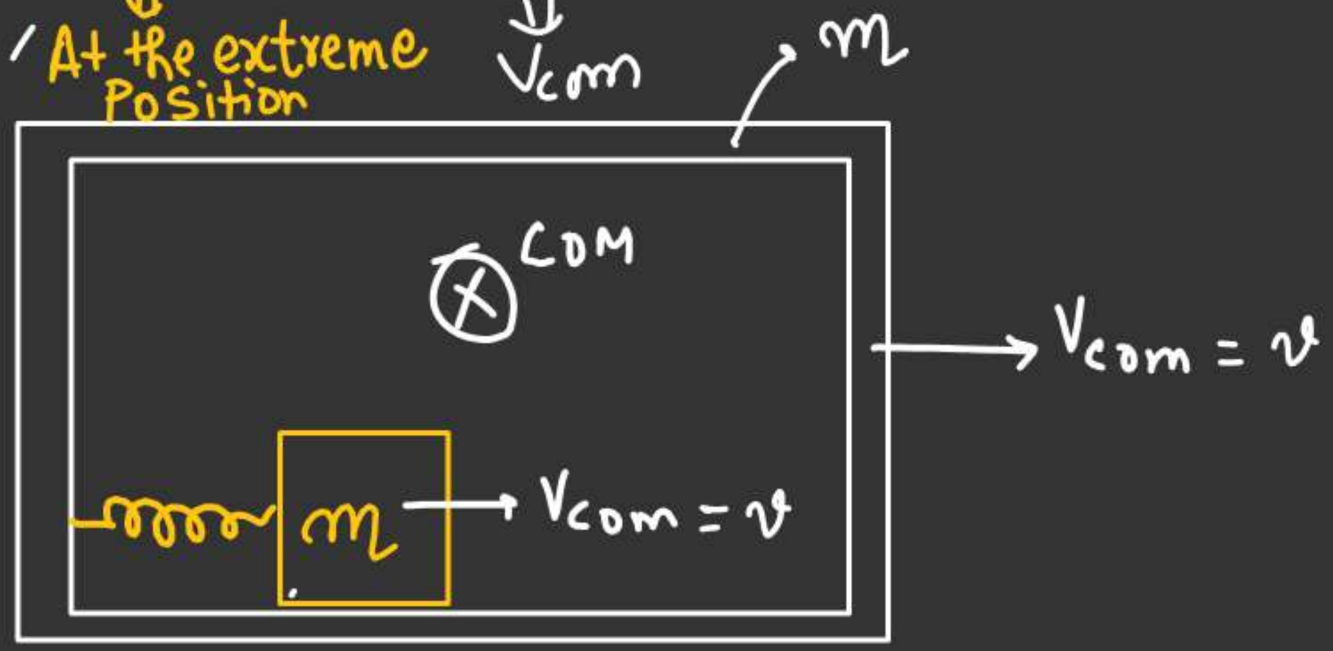
$$A_{com} = \left(\frac{F}{2m}\right)$$

W.r.t COM, only S.H.M. W.r.t earth (S.H.M + translational)

$$T = 2\pi\sqrt{\frac{\mu}{K}} \qquad \mu = \frac{m \cdot m}{m+m} = \frac{m}{2}$$

$$\left(T = 2\pi\sqrt{\frac{m}{2k}}\right)$$

$$\vec{v}_{block/g} = \underbrace{\cancel{\vec{v}_{block/com}}}_{\text{At the extreme position}}^{\;0} + \underbrace{\vec{v}_{com/g}}_{V_{com}}$$



$$V_{com} = \frac{mv + mv}{m + m} = v$$

$$v_{com} = A_{com} \cdot t$$

$$= \left(\frac{F}{2m}\right)\left(\frac{T}{4}\right)$$

$$v_{com} = \frac{F}{\cancel{2}m} \times \frac{1}{4} \times \cancel{2}\pi\sqrt{\frac{m}{2K}}$$

$$= \frac{F\pi}{4m}\sqrt{\frac{m}{2K}}$$

$$= \frac{\pi F}{\sqrt{32mK}}$$

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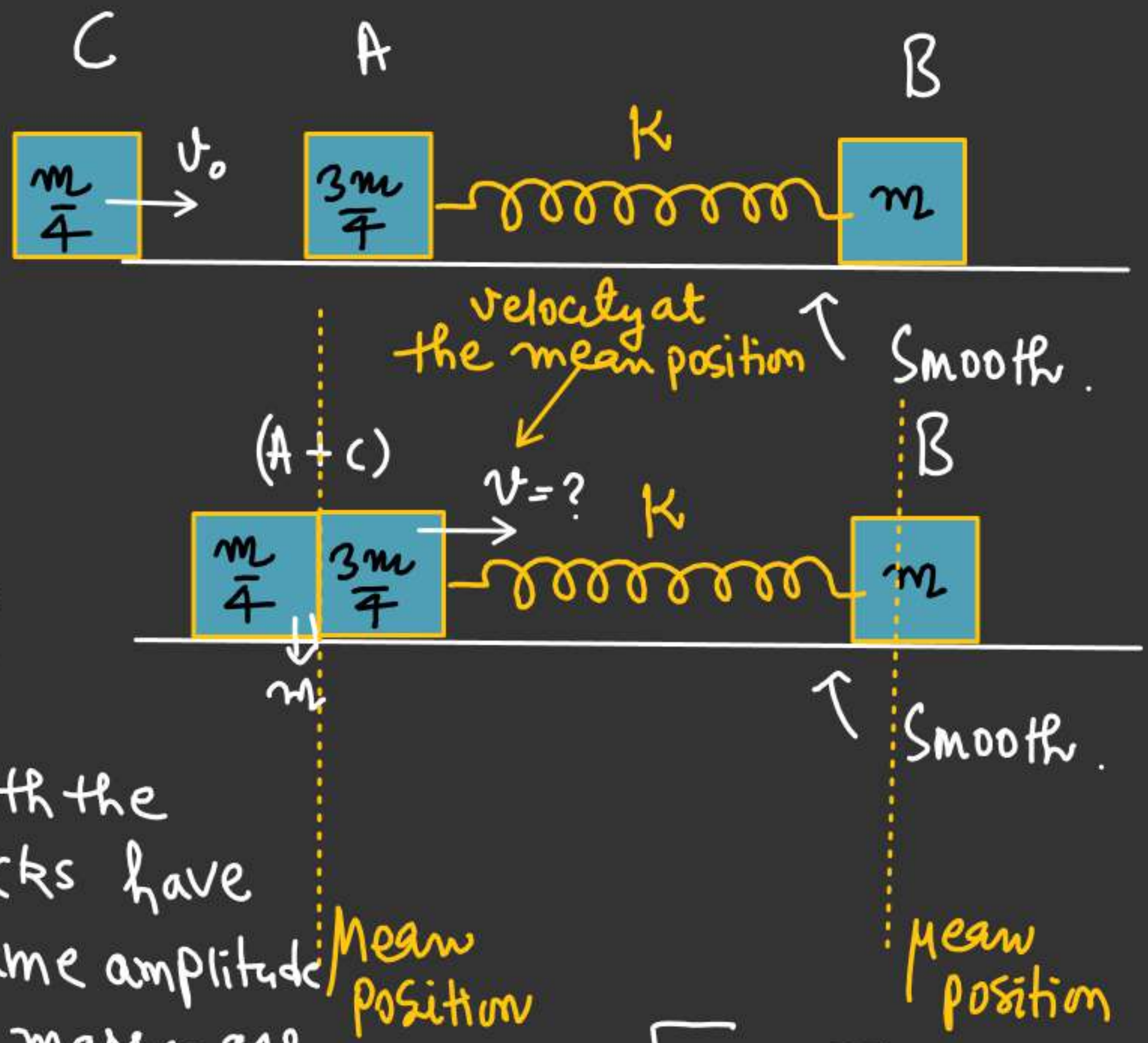
Collision b/w A & C is perfectly inelastic



① Find time period of the system after collision.

② Find amplitude of oscillation after collision.

L.M.C

$$\frac{m}{4}v_0 = mv \;,\qquad T = 2\pi\sqrt{\frac{\mu}{K}} \qquad \mu = \frac{m}{2}$$

$$v = \left(\frac{v_0}{4}\right)$$

① $\left(T = 2\pi\sqrt{\frac{m}{2K}}\right)$

Both the blocks have same amplitude as masses are same

② $v_{max} = A\omega$

$$v = A\omega$$

$$\omega = \sqrt{\frac{K}{\mu}} = \sqrt{\frac{2K}{m}}$$

$$A = \frac{v}{\omega} = \left(v\sqrt{\frac{m}{2K}}\right) = \frac{v_0}{4}\sqrt{\frac{m}{2K}} = v_0\sqrt{\frac{m}{32K}}$$

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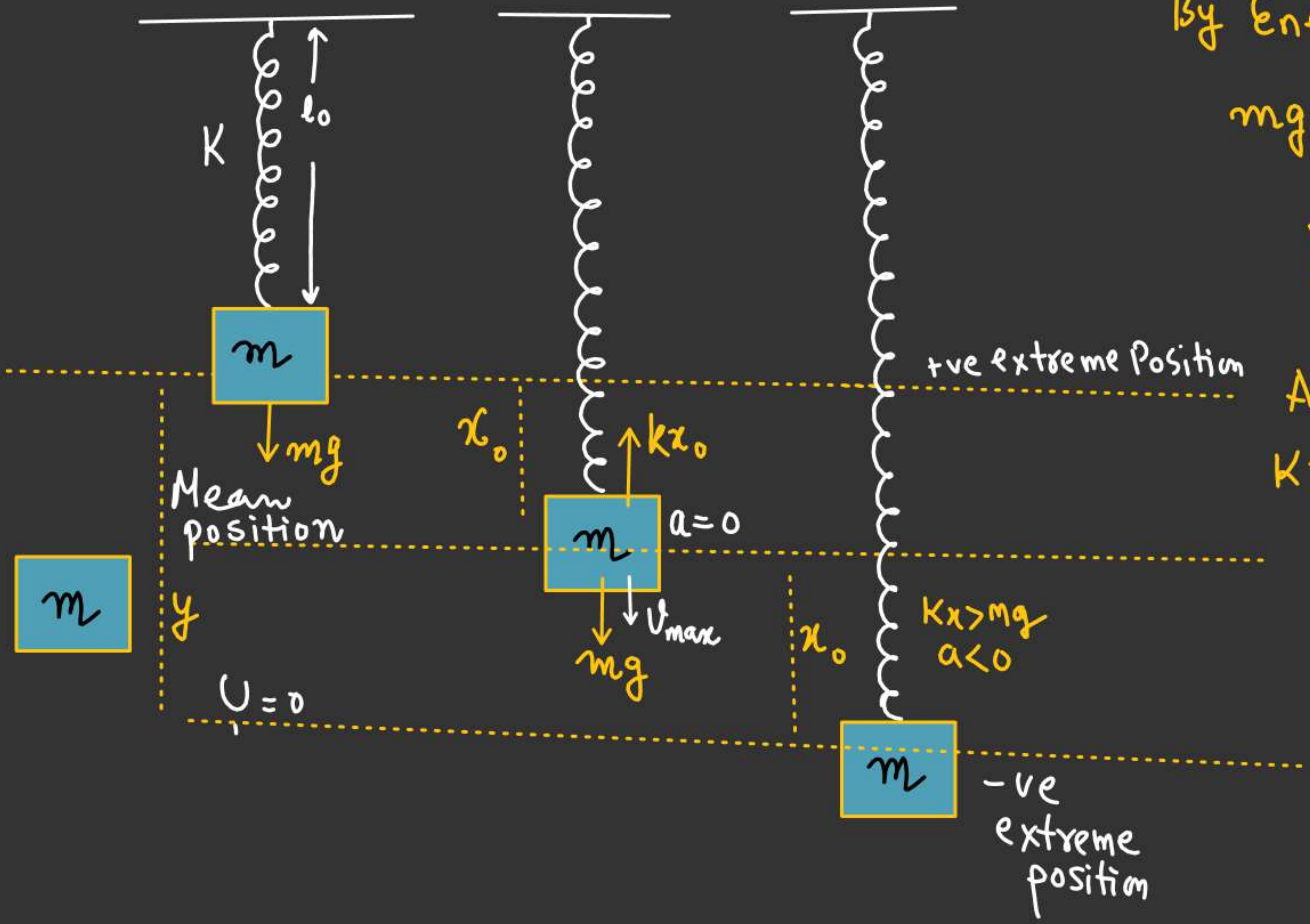
Case of Vertical Spring – block System.



By Energy Conservation

$$mgy = \frac{1}{2}Ky^2$$

$$y = \left(\frac{2mg}{K}\right)$$

At Mean position

$$Kx_0 = mg$$

$$x_0 = \left(\frac{mg}{K}\right)$$

$$y = 2x_0$$

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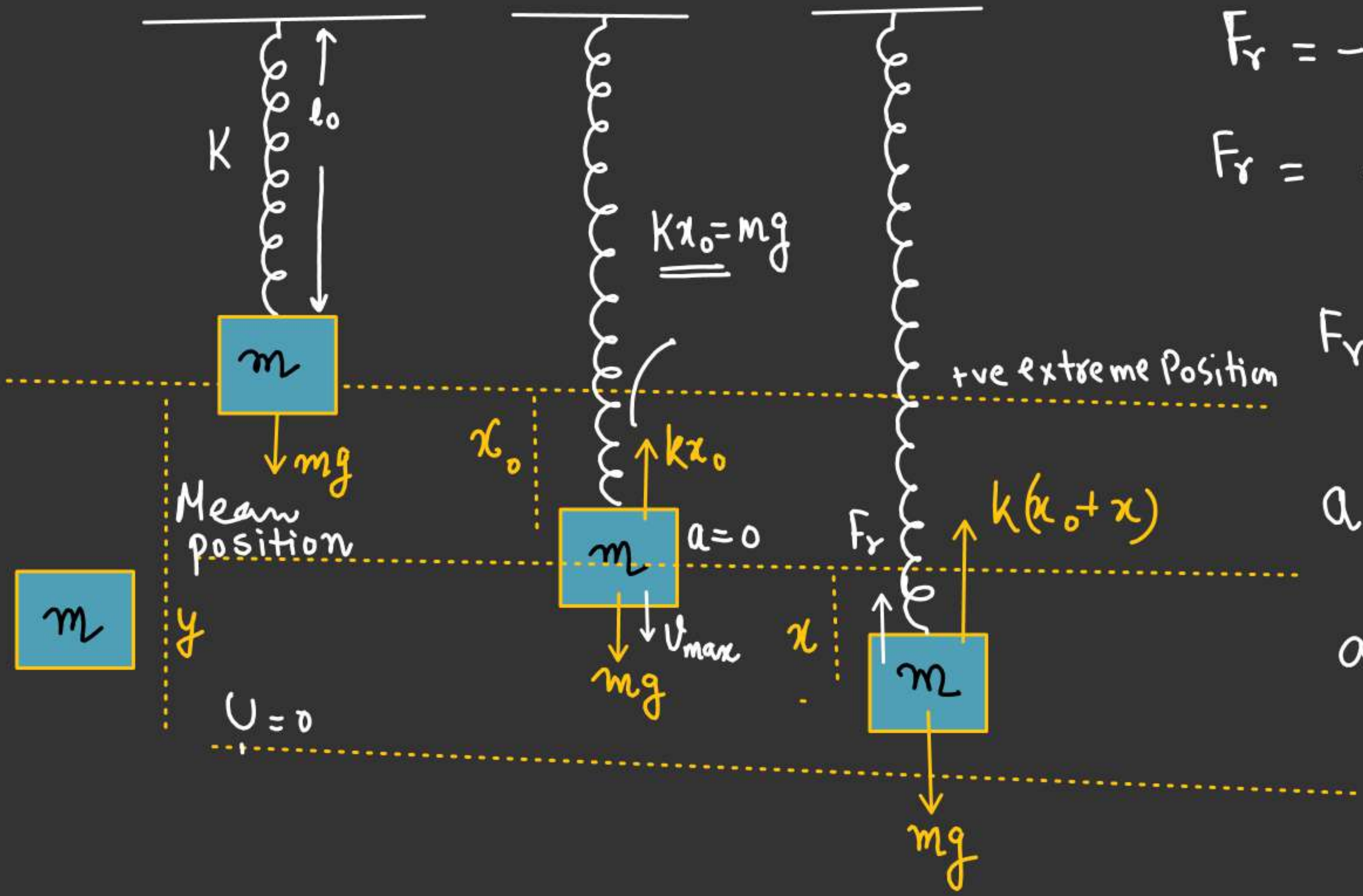
Case of Vertical Spring-block System. (Time period)



$$F_r = -\left[K(x_0+x) - mg\right]$$

$$F_r = -\left[\cancel{Kx_0} + Kx - \cancel{mg}\right]$$

$$F_r = -\left[\underbrace{Kx}\right]$$

↳ Extra Spring force responsible for restoring.

$$a = -\frac{K}{m}x$$

$$a = -\omega^2 x$$

$$\omega = \sqrt{\frac{K}{m}}, \quad \boxed{T = 2\pi\sqrt{\frac{m}{K}}}$$

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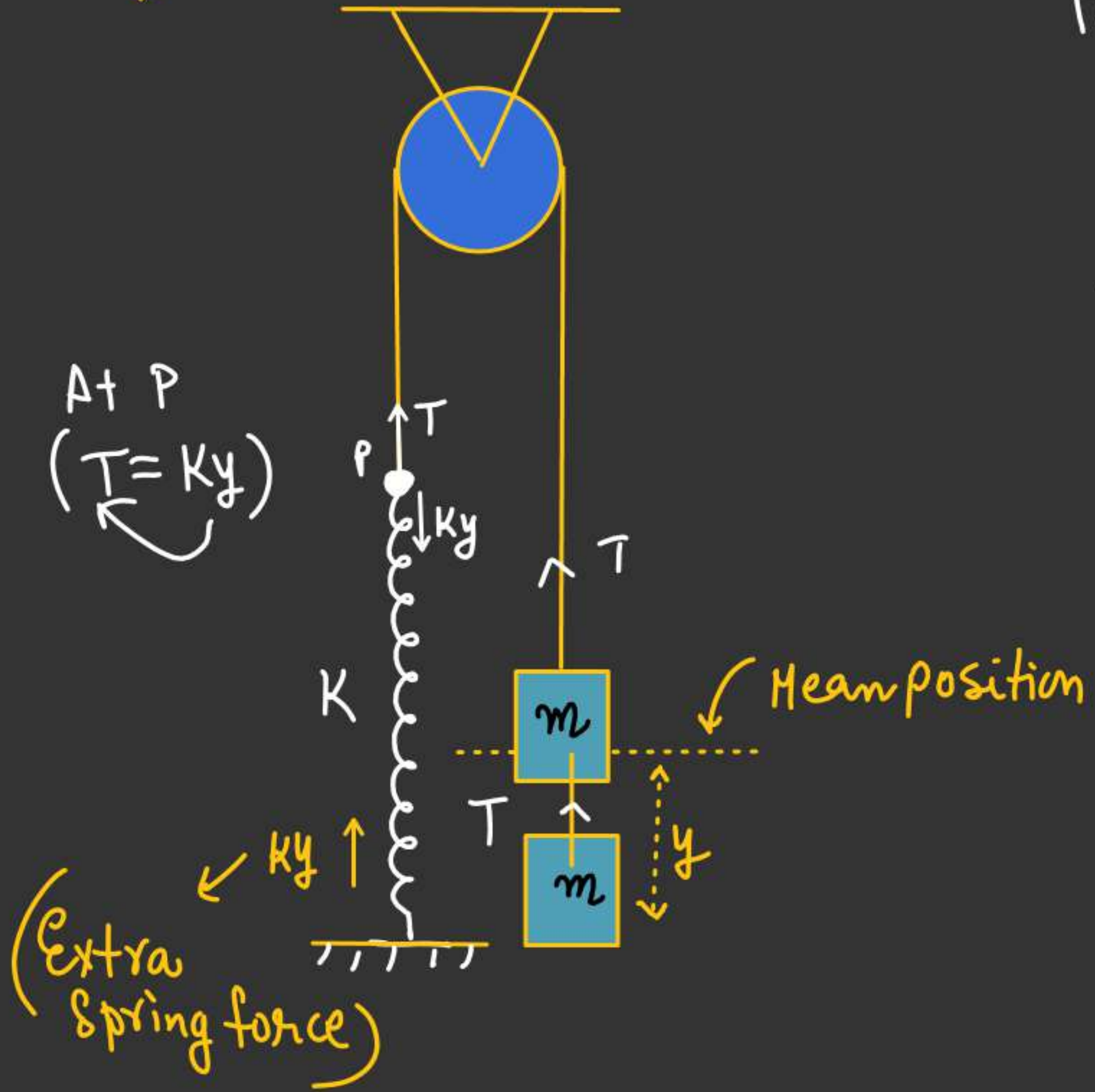

Tension T is restoring

$$F_r = T = Ky$$

$$T = -Ky$$

$$a = -\frac{K}{m} y$$

$$a = -\omega^2 y$$

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

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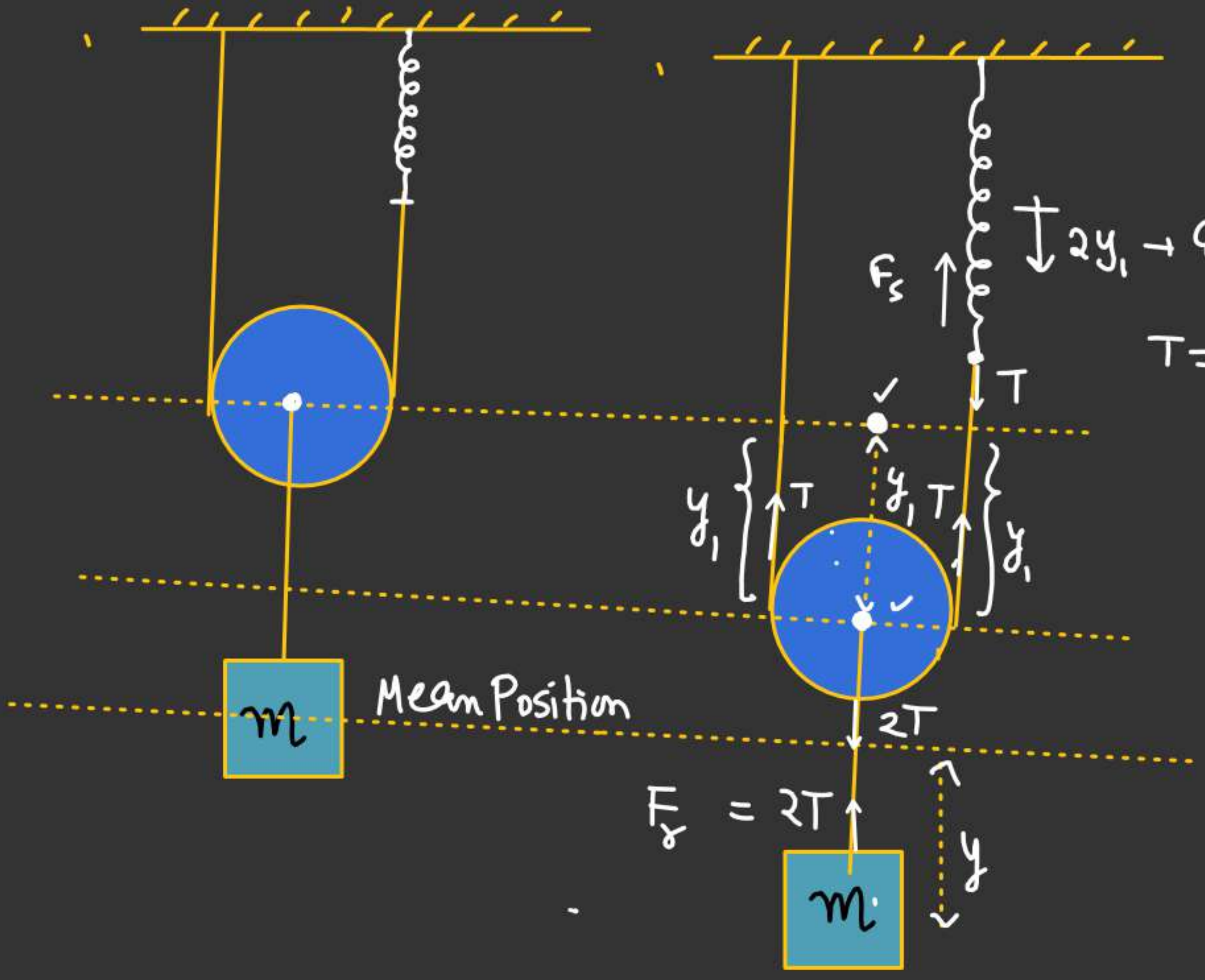
Time period of block



$\updownarrow 2y_1 \rightarrow$ Elongation

$T = F_s = 2Ky_1$

($y = y_1$ as pully and block directly connected)

$F_r = -2T$

$F_r = -2(2Ky_1)$

$F_r = -4Ky_1$

$F_r = -4Ky$

$a = -\frac{4K}{m} y$

$a = -\frac{4K}{m} y$ ✓

$a = -\omega^2 y$

$T = 2\pi \sqrt{\frac{m}{4K}}$

$T = \pi \sqrt{\frac{m}{K}}$ ✓

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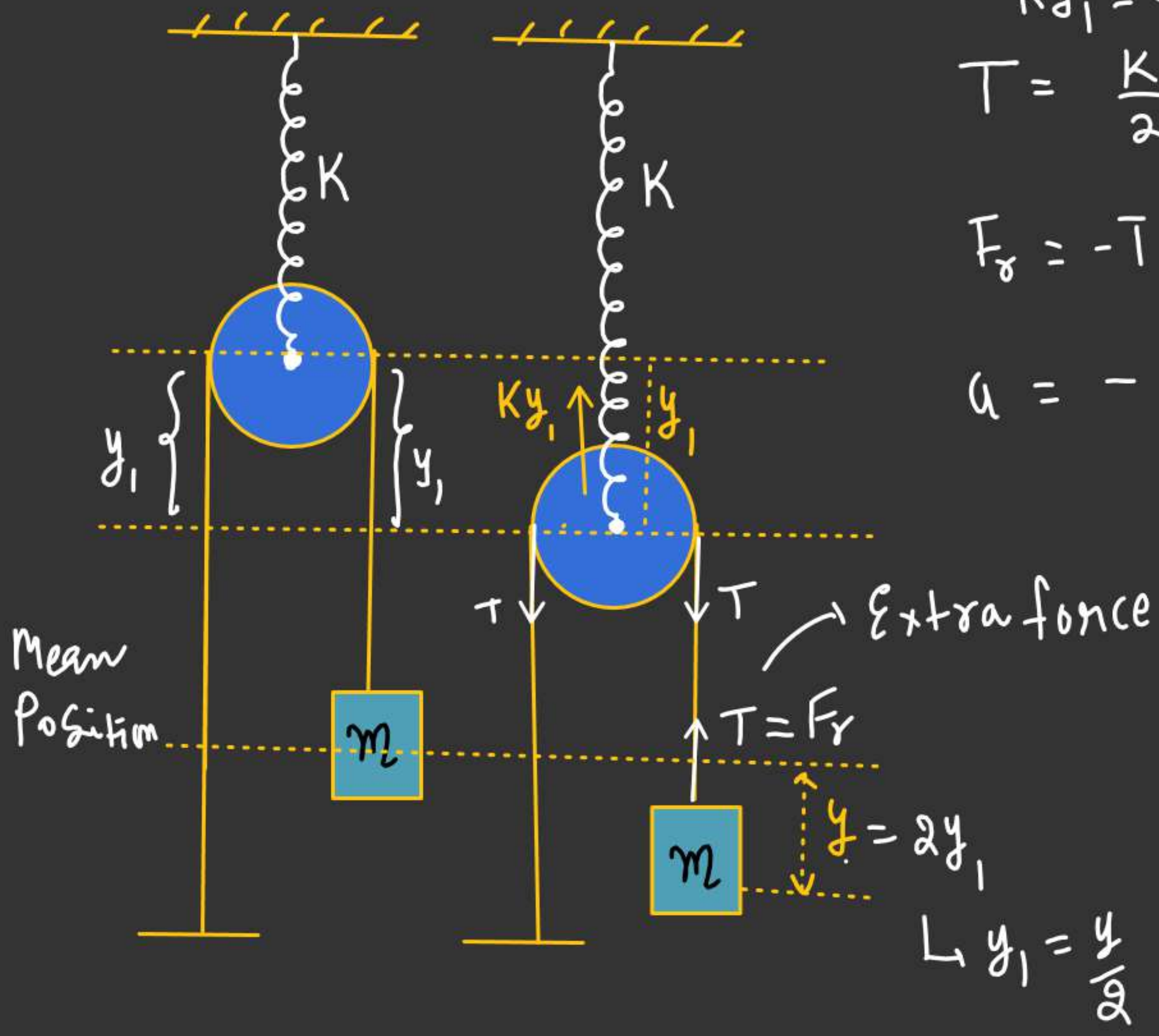
Find $T = ??$



Force balance on massless pully

$$Ky_1 = 2T$$

$$T = \frac{K}{2}y_1 = \frac{K}{2}\left(\frac{y}{2}\right) = \frac{K}{4}y$$

$$F_r = -T = -\frac{K}{4}y$$

$$a = -\frac{K}{4m}y \Rightarrow a = -\omega^2 y$$

$$\omega = \sqrt{\frac{K}{4m}}$$

$$T = 2\pi\sqrt{\frac{4m}{K}}$$

$$T = 4\pi\sqrt{\frac{m}{K}}$$

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Time period of block = ??

H.W :