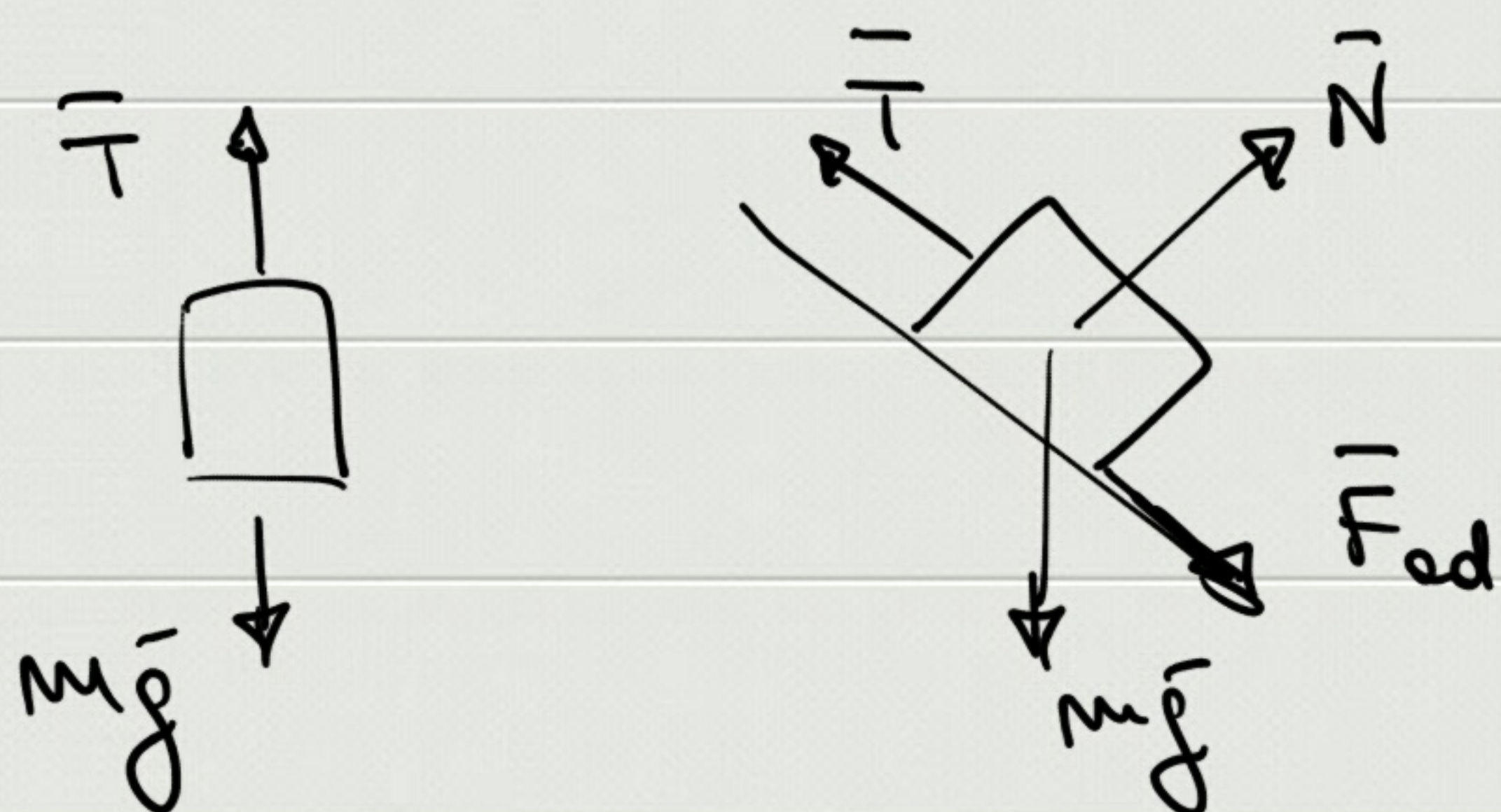$$\theta = 30°$$
$$\mu_d = 0.4$$
$$h = 1 \ m$$
$$v_{01} = v_{02} = 0$$

$$\Rightarrow a$$
$$\Rightarrow v^2 = 2ah$$

$$\frac{1}{2} m v^2 = mgh$$

$$\frac{1}{2} m v^2 + mgh \sin\theta = 0$$

$$m v^2 + mgh \sin\theta = mgh$$

$$-\mu mg \cos\theta \ h = m v^2 + mgh \sin\theta - mgh \qquad *$$

$$W_{nc} = \Delta E_m$$

$$v^2 = gh(1 - \sin\theta - \mu\cos\theta)$$
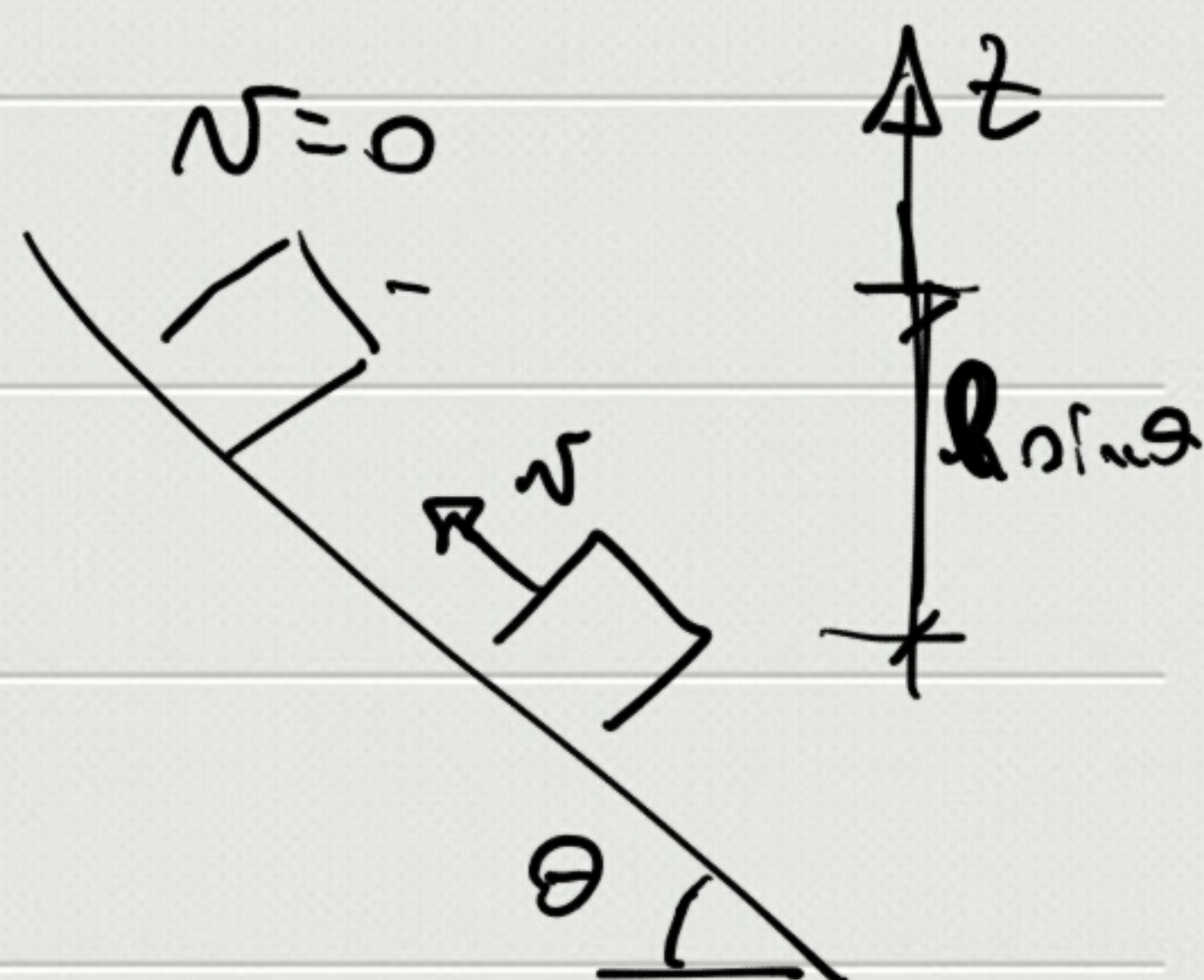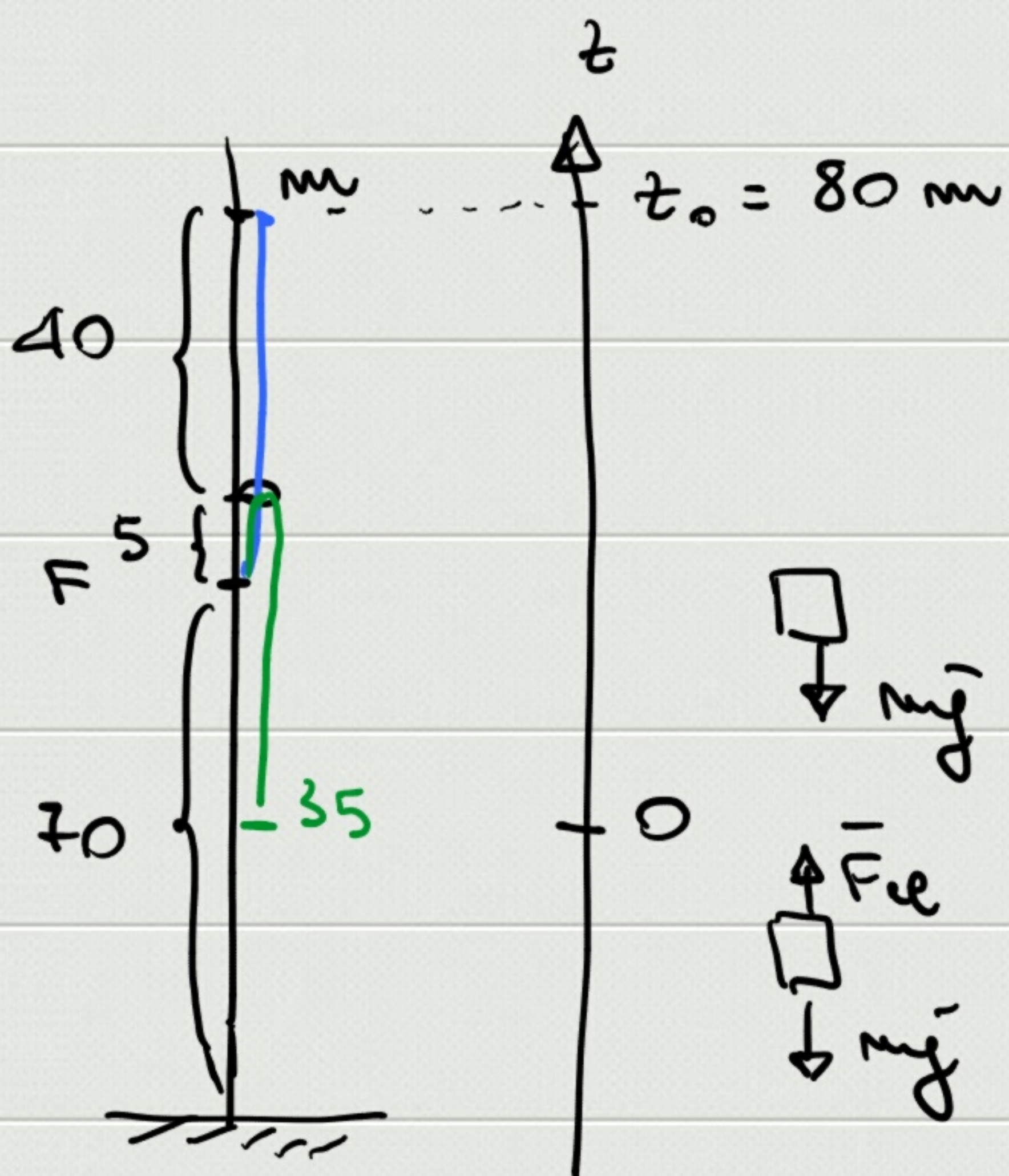$$\Rightarrow v = 1.23 \ m/s$$

$$W_{NC} = \Delta E_m$$

$$\downarrow$$

$$-\mu_d \cancel{m}g\cos\theta \cdot \ell = \cancel{m}g\ell\sin\theta - \frac{1}{2}\cancel{m}v^2$$

$$\ell = \frac{v^2}{2g(\sin\theta + \mu\cos\theta)} = 0.091 \text{ m}$$

$$m = 80 \text{ kg}$$

$$k = 520 \text{ N/m}$$

$$\Delta z_{max} = ?$$

$$v_{max} = ? \quad z(v_{max}) = ?$$

$z \geq 0 \qquad mg\,z_0 = \dfrac{1}{2} m v^2(z) + mg\,z$

$z < 0 \qquad mg\,z_0 = \dfrac{1}{2} m v^2(z) + mg\,z + \dfrac{1}{2} k z^2 \qquad \circledast$

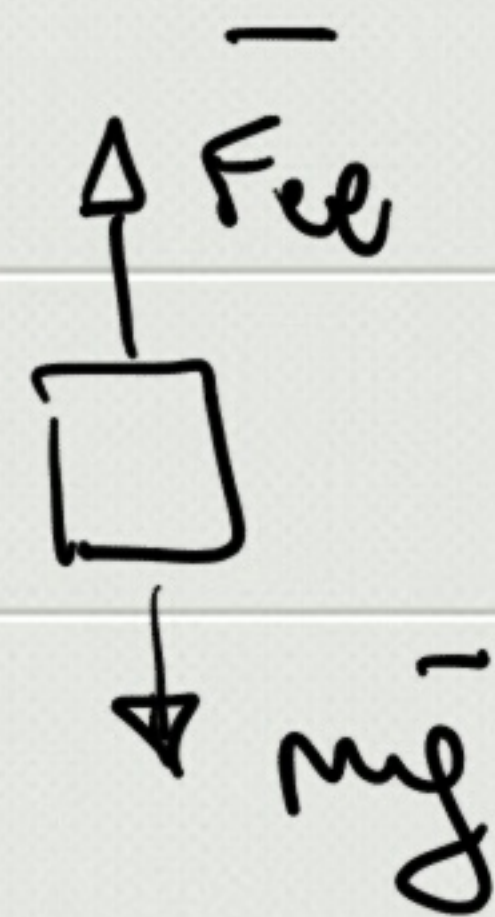$z_{max}: \quad v(z_{max}) = 0 \implies z^2 + \dfrac{2mg}{k} z - \dfrac{2mg}{k} z_0 = 0$

$z = -\dfrac{mg}{k} \pm \sqrt{\left(\dfrac{mg}{k}\right)^2 + \dfrac{2mg}{k} z_0} = -17.1 \text{ m}$

$\cancel{z < 0}$
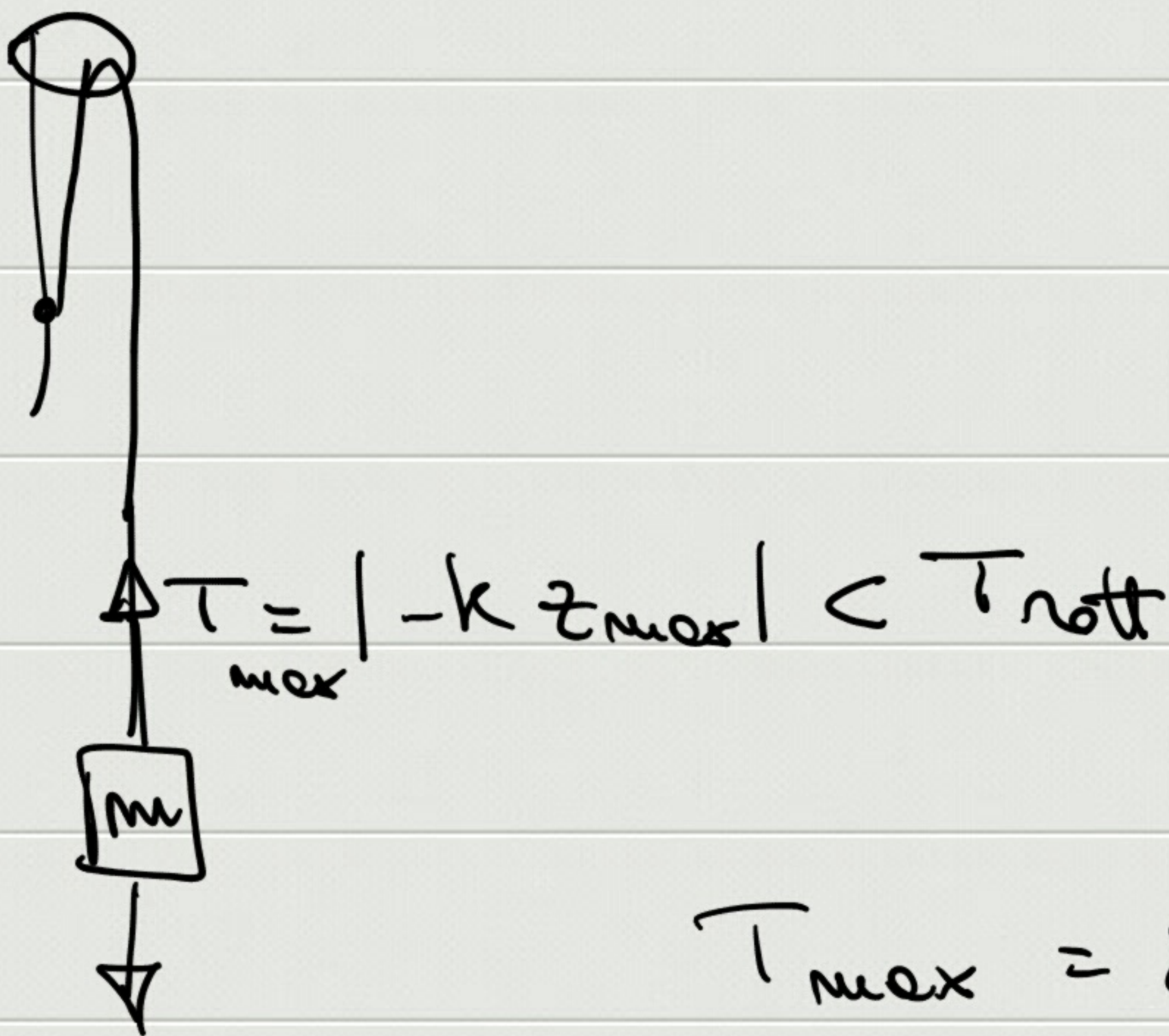
$-mg - kz = 0 \qquad * \implies \boxed{z = -\dfrac{mg}{k}}$

$\dfrac{d}{dz}\left(mg\,z_0 - mg\,z - \dfrac{1}{2} k z^2\right) = 0$

$\cancel{mg - 2kz = 0}$

$\searrow \dfrac{1}{2} m v^2$

$$T_{rott, fune} = 1.9 \cdot 10^4 \; N$$

$$T_{rott, muscly} = 2.2 \cdot 10^4 \; N$$

$T_{max} = |-k \, z_{max}| < T_{rott}$

$$T_{max} = 8892 \; N$$

$$T_{muscly, max} = 2 \, T_{max} \sim 1.8 \cdot 10^4 \; N$$