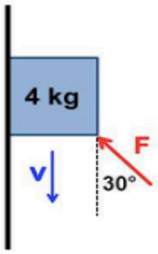
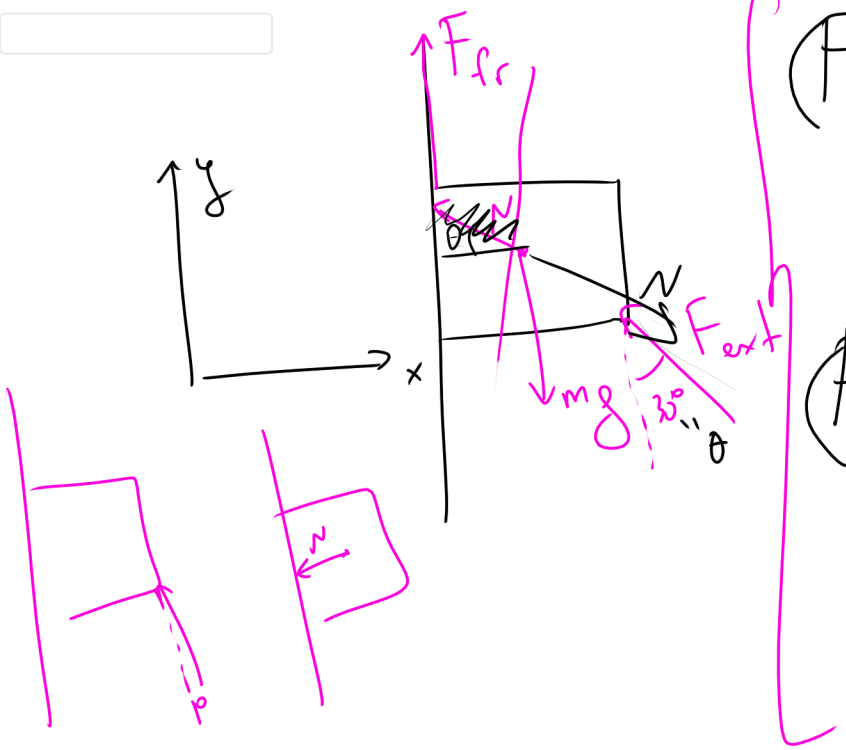
QUESTION 4

4 kg block is sliding down a vertical wall while being pushed by an external force as shown in the figure.



What is the magnitude of the acceleration of the block (in m/s^2) if the coefficient of kinetic friction between the wall and the block is μ_k = 0.2 and the magnitude of the external force is 20 N?



$$(F_{net})_x = F_{ext}\sin\theta - N\mu_k\cos\theta = ma_x$$

$$(F_{net})_y = mg - F_{ext}\cos\theta - N\mu_k\sin\theta = ma_y$$

But $a_x = 0 \Rightarrow (F_{net})_x = 0$

$$\Rightarrow F_{ext}\sin\theta = -N\mu_k\cos\theta$$

$$mg - F_{ext}\cos\theta - N\mu_k\sin\theta = ma_y$$

$$\Rightarrow \begin{cases} N = \dfrac{F_{ext}\sin\theta}{\mu_k\cos\theta} \\ a_y = g - \dfrac{F_{ext}\cos\theta}{m} - \dfrac{F_{ext}\sin\theta\,\mu_k}{\mu_k\cos\theta\, m} \end{cases}$$

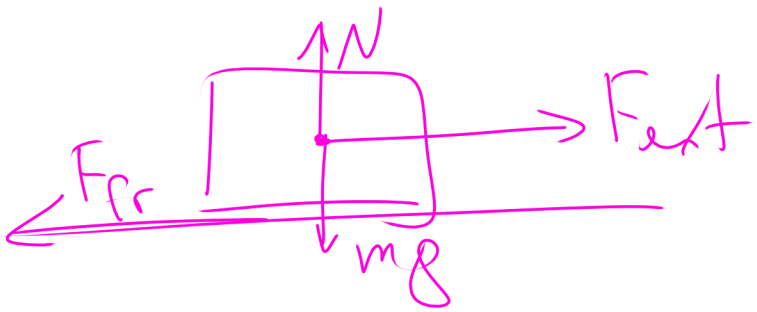
$\approx 2.58\,ms^{-2}$

$\mu_k = 0.2$

(2)

what's the acceleration?

Solution



$$\begin{cases} (F_{net})_x = F_{ext} - F_{fr} = m a_x \\ \Rightarrow m a_x = F_{ext} - \mu_k N \\ (F_{net})_y = N - mg = m a_y = 0 \\ \Rightarrow N = mg \end{cases}$$

$$a_x = \frac{F_{ext}}{m} - \frac{\mu_k}{m} \cdot mg$$

$$= \frac{10}{4} - 0.2 \cdot 9.8 = 0.54\,ms^{-2}$$

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