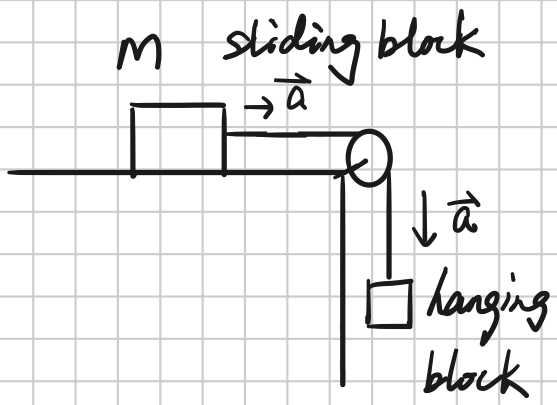
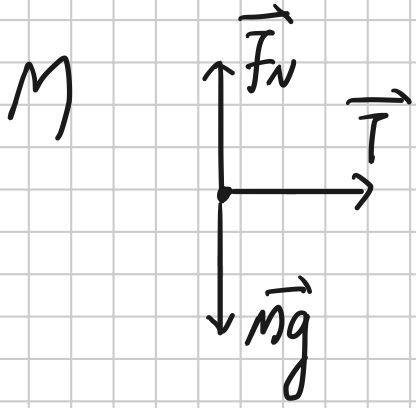
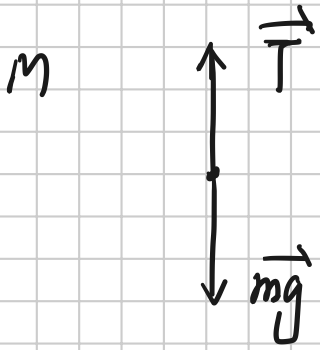




$$T = Ma \quad ①$$



$$mg - T = ma \quad ②$$

① → ②
$$a = \frac{m}{m+M} g \quad ③$$

③ → ①
$$T = \frac{Mm}{M+m} g \quad ④$$

4 special cases:

① $m = 0$, $a = 0$, $T = 0$

② $M = 0$, $a = g$, $T = 0$

③ $M \to \infty$, $a = \lim_{M\to\infty} \frac{m}{m+M} g = 0$

$$T = \lim_{M\to\infty} \frac{Mm}{M+m} g = mg$$

(divide numerator and denominator by M)

④ $m \to \infty$, $a = \lim_{m\to\infty} \frac{m}{m+M} g = g$

(divide numerator and denominator by m)

$$T = \lim_{m\to\infty} \frac{M}{\frac{M}{m}+1} g = Mg$$

Question $t = ?$ $f_k = \gamma_0 v$

$$-f_k = ma$$

$$-\gamma_0 v = m\frac{dv}{dt}$$

$$\int_0^t -\frac{\gamma_0}{m}\,dt = \int_{v_i}^{v_f} \frac{1}{v}\,dv$$

$$-\frac{\gamma_0}{m}t = \ln\frac{v_f}{v_i} = \ln\frac{1}{2} \Rightarrow t = -\frac{m}{\gamma_0}\ln\frac{1}{2} = 9.9\,s$$

$$\int \frac{1}{x}\,dx = \ln x + C$$

$$v(t) = v_0 e^{-\frac{\gamma_0}{m}t}$$