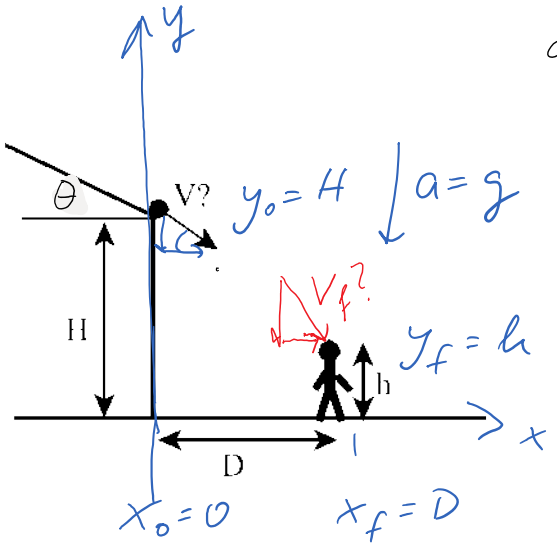
T prep HW 1: kinematics




a) $x = \cancel{x_0}^{0} + v_{0x}t + \frac{1}{2}\cancel{a_x}^{0}t^2$

$D = v_0 \cos\theta \, t \longrightarrow t = \frac{D}{v_0 \cos\theta}$

$y = y_0 + v_{0y}t + \frac{1}{2}a_y t^2$

$h = H + (-v_0 \sin\theta)t + \frac{1}{2}(-g)t^2$

$h = H - v_0 \sin\theta\left(\frac{D}{v_0 \cos\theta}\right) - \frac{1}{2}g\left(\frac{D}{v_0 \cos\theta}\right)^2$

$h = H - D\tan\theta - \frac{1}{2}g\frac{D^2}{v_0^2 \cos^2\theta}$

$\frac{1}{2}g\frac{D^2}{v_0^2\cos^2\theta} = H - h - D\tan\theta$

$$V = \sqrt{\frac{D^2 g}{2\cos^2\theta(H - h - D\tan\theta)}}$$

b) $v_x = v_{0x} + \cancel{a_x}^{0}t$

$v_x = V\cos\theta$

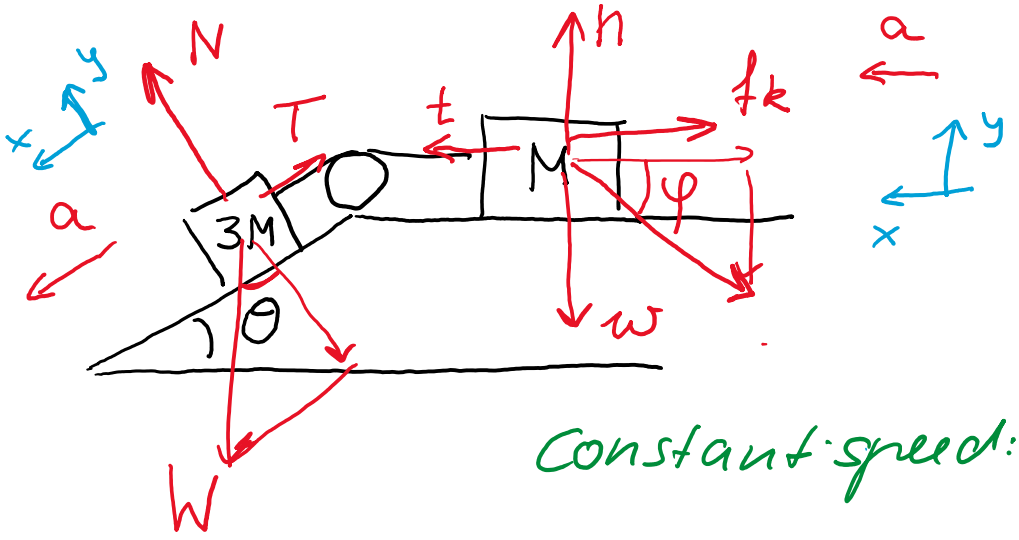
$v_y^2 = v_{0y}^2 + 2a_y(y - y_0)$

$v_y^2 = (-V\sin\theta)^2 + 2(-g)(h - H)$

$v = \sqrt{v_x^2 + v_y^2} = \sqrt{\underbrace{(V\cos\theta)^2 + (V\sin\theta)^2}_{V^2} + 2g(H - h)}$

$$v = \sqrt{V^2 + 2gH}$$

# T Prep HW 1: Forces




Constant speed: $a = 0$

Block 3M:

$$\sum F_x = N_x + T_x + W_x = 3Ma_x^{\,0}$$

$$-T + 3Mg\sin\theta = 0 \Rightarrow \boxed{T = 3Mg\sin\theta}$$

Block M:

$$\sum F_x = n_x^{\,0} + t_x + P_x + f_{kx} + w_x^{\,0} = Ma_x^{\,0}$$

$$t - P\cos\varphi - f_k = 0$$

$$3Mg\sin\theta - P\cos\varphi - f_k = 0$$

$$f_k = 3Mg\sin\theta - P\cos\varphi$$

$f_k = \mu n$

$$\sum F_y = n_y + t_y + P_y + f_{ky}^{\,0} + w_y = Ma_y^{\,0}$$

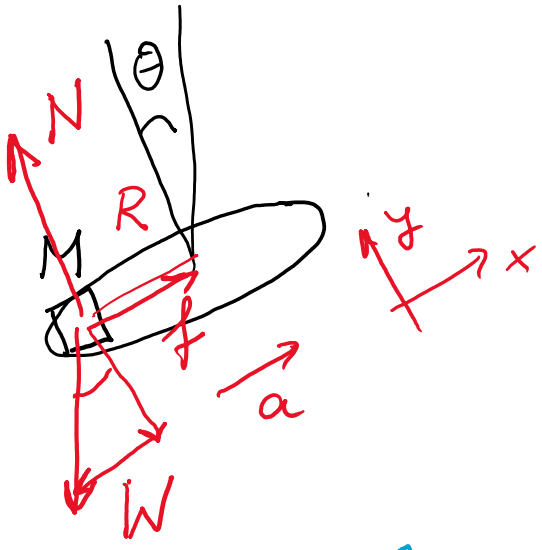
$$n - P\sin\varphi - Mg = 0$$

$$n = Mg + P\sin\varphi$$

$$\mu = \frac{f_k}{} = \frac{3Mg\sin\theta - P\cos\varphi}{}$$

$$\mu = \frac{f_k}{n} = \frac{3Mg\sin\theta - P\cos\varphi}{Mg + P\sin\varphi}$$

# T Prep HW 1: Circular




$$\Sigma F_x = \cancel{N_x}^{0} + f_x + W_x = Ma_x$$

$$f - Mg\sin\theta = M\frac{v^2}{R}$$

min. $v$: $f_s = f_{s\,max} = \mu N$

$$\Sigma F_y = N_y + \cancel{f_y}^{0} + W_y = \cancel{Ma_y}^{0}$$

$$N - Mg\cos\theta = 0$$

$$N = Mg\cos\theta$$

$$\mu Mg\cos\theta - Mg\sin\theta = M\frac{v^2}{R}$$

$$v = \sqrt{gR(\mu\cos\theta - \sin\theta)}$$