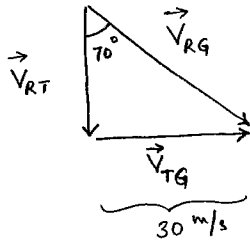


Solutions

(Midterm Exam 02, Fall 2015, PHYS 205A)

Prob. 1

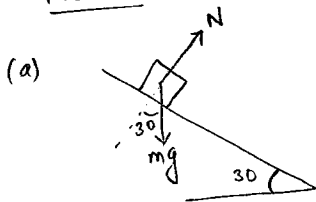


$$\vec{V}_{RG} = \vec{V}_{RT} + \vec{V}_{TG}$$

T - Train
G - Ground
R - Rain.

$$\frac{V_{TG}}{V_{RG}} = \sin 70 \quad \Rightarrow \quad V_{RG} = \frac{V_{TG}}{\sin 70} = \frac{30}{\sin 70} = 31.9 \text{ m/s}$$

Prob. 2



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

$$mg \sin \theta = ma$$

$$a = g \sin \theta$$

$$= 9.80 \sin 30$$

$$= 4.90 \text{ m/s}^2$$

(b)

$$V_f^2 = V_i^2 + 2a\Delta x$$

$$V_f^2 = 0^2 + 2(-4.90)(-3.0)$$

$$V_f = 5.42 \text{ m/s}$$

Prob. 3

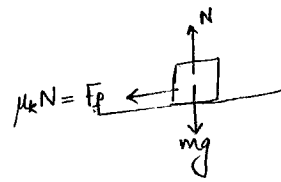
$$ma = -\mu_k mg$$

$$a = -\mu_k g$$

$$a = -0.60 \times 9.80 = -5.88 \text{ m/s}^2$$

$$\Delta x = \frac{V_f^2 - V_i^2}{2a}$$

$$= \frac{0 - 30^2}{-2 \times 5.88} = 76.6 \text{ m}$$



Prob. 4

$$m\vec{g} + \vec{T}_1 + \vec{T}_2 = 0$$

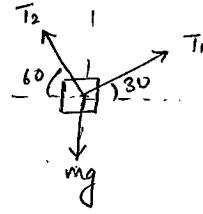
x: $T_1 \cos \theta_1 = T_2 \cos \theta_2$

y: $T_1 \sin \theta_1 + T_2 \sin \theta_2 = mg$

$$\begin{aligned} T_1 \cos 30 - T_2 \cos 60 &= 0 \\ T_1 \sin 30 + T_2 \sin 60 &= 450 \end{aligned}$$

\Rightarrow

$$\begin{aligned} T_1 &= 225 \text{ N} \\ T_2 &= 390 \text{ N} \end{aligned}$$



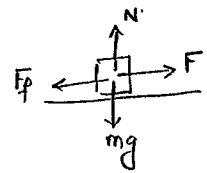
Prob. 5

(a) $F \geq F_f \geq \mu_s N = \mu_s mg = 0.40 \times 220 \text{ N}$

$\Rightarrow F_{\text{minimum}} = 88 \text{ N}$

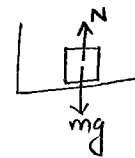
(b) $F = F_f = \mu_k N = \mu_k mg = 0.30 \times 220 \text{ N} = 66 \text{ N}$

(c) $F - F_f = ma$
 $88 - 66 = \left(\frac{220}{9.8}\right) a \Rightarrow a = 0.98 \text{ m/s}^2$



Prob. 6

$$\begin{aligned} N - mg &= -ma \\ N &= mg - ma \\ &= m(g - a) \\ &= 85(9.8 - 5.0) \\ &= 408 \text{ N} \end{aligned}$$



$a = \frac{v_f - v_i}{t} = \frac{0 - 15}{3.0} = -5.0 \text{ m/s}^2$

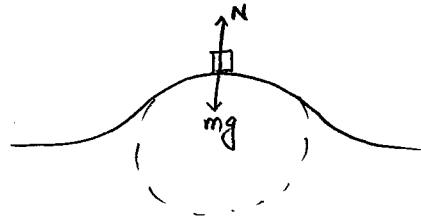
Prob. 7

$$mg - N = \frac{mv^2}{R}$$

greatest speed implies $N=0$.

$$mg = \frac{mv^2}{R}$$

$$v = \sqrt{gR} = \sqrt{9.8 \times 250} = 49 \text{ m/s.}$$



Prob. 8

$$N = mg$$

$$F_f = \frac{mv^2}{R}$$

$$= \frac{85.0 \times 9.00^2}{25.0}$$

$$= 275 \text{ N}$$

