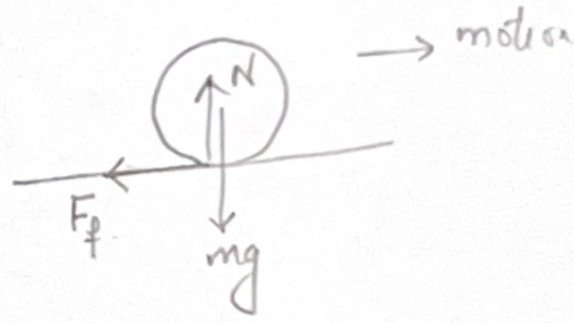
Solutions

PHYS-205A-002 (Midterm Exam 02) Fall 2023

## Problem 1

Based on the demonstration in quiz problem, helium balloon effectively moves in the opposite direction of a typical mass. So, helium balloon will more radially inward.

## Problem 2




$m\vec{a} = m\vec{g} + \vec{N} + \vec{F}_f$

x: $ma = -F_f$

$= -\mu_s N$ (became at verge of sliding)

$= -\mu_s mg$

$a = -\mu_s g$

$= -(1.1)(9.8)$

$= -11\ m/s^2$

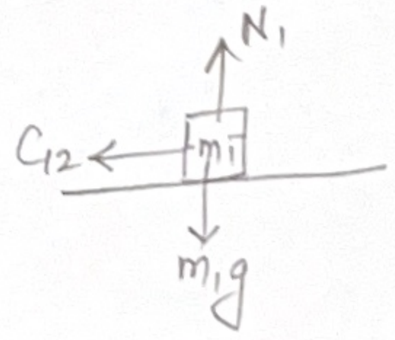
y: $N = mg$

$\Delta x = \frac{v_f^2 - v_i^2}{2a}$

$= \frac{0^2 - (30)^2}{2(-11)}$

$= 41\ m$

## Problem 3




$m_1 g$ – gravity

$N_1$ – normal force

$C_{12}$ – contact force from $m_2$ on $m_1$.

## Problem 4

uniform circular motion $\Rightarrow$ radially inward acceleration

$\Rightarrow$ total force has to be radially inward.

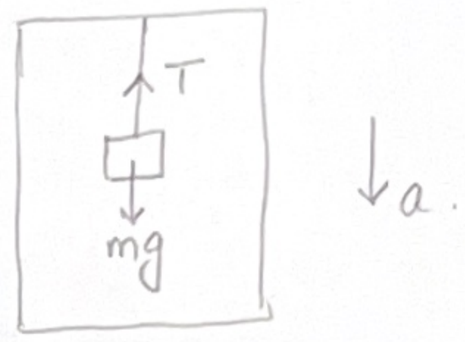
## Problem 5

$$m\vec{a} = m\vec{g} + \vec{T}$$

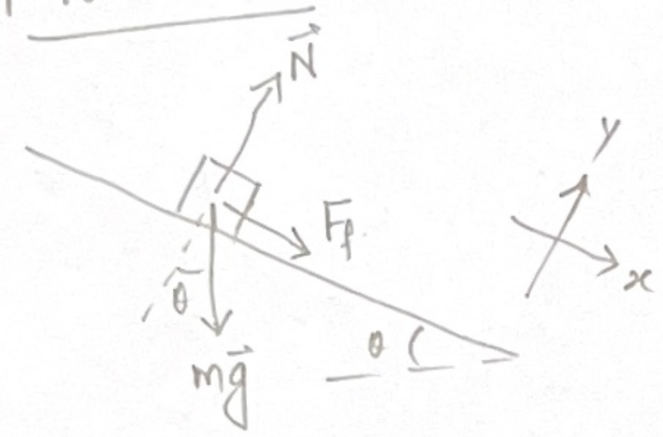
$$-ma = -mg + T$$

$$T = m(g-a)$$

$$= (1.0)(9.8-2.0) = 7.8 \text{ Newtons}$$




## Problem 6




$$m\vec{a} = m\vec{g} + \vec{N} + \vec{F_f}$$

x: $ma = mg\sin\theta + F_f$

$ma = mg\sin\theta + \mu_k N$

$ma = mg\sin\theta + \mu_k mg\cos\theta$

$a = g(\sin\theta + \mu_k\cos\theta)$

$= 9.8(\sin 30 + 0.60\cos 30)$ → evaluates to 1.02 = 1.0

$= 9.8 \frac{m}{s^2}$ (downward along incline)

y: $0 = -mg\cos\theta + N + 0$

$N = mg\cos\theta$

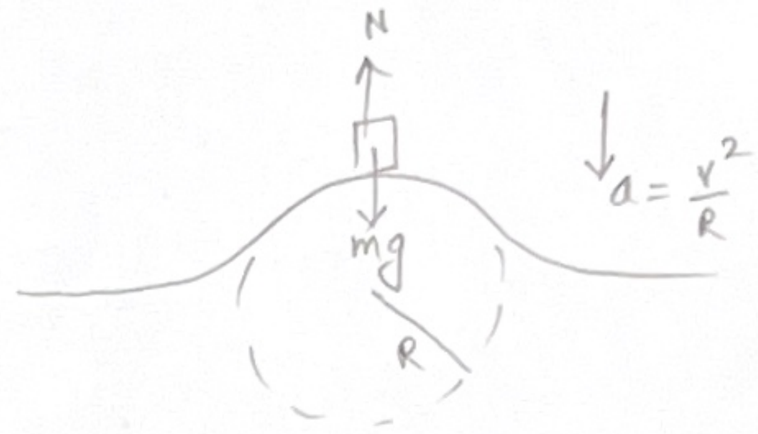
$2a\Delta x = V_f^2 - V_i^2$

$2(9.8)\Delta x = 0 - 15^2$

$\Delta x = -\frac{15^2}{2(9.8)}$

$= -12\text{ m}$ (12 m upward along the incline).

## Problem 7




$$m\vec{a} = m\vec{g} + \vec{N}$$

$$-m\frac{v^2}{R} = -mg + N$$

loses contact when $N = 0$

$$-\cancel{m}\frac{v^2}{R} = -\cancel{m}g + 0$$

$$v = \sqrt{gR} = \sqrt{(9.8)(2.0)} = 4.4\ \frac{m}{s} \quad \left(= 9.9\ \frac{\text{miles}}{\text{hour}}\right)$$