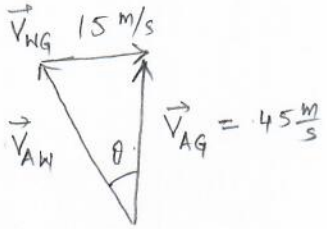
Solutions

PHYS-205A-001 (Midterm Exam 02) Spring 2024

Problem 1

G-Ground
W-Wind
A-Aeroplane



$\tan\theta = \frac{15}{45}$

$\theta = 18^\circ$ W of North

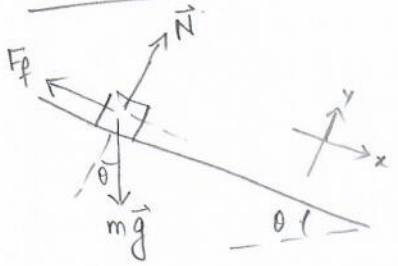
Problem 2

Radially inward, towards the center of circle.

Problem 3

No. Action reaction pairs do not act on the same body.

Problem 4



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

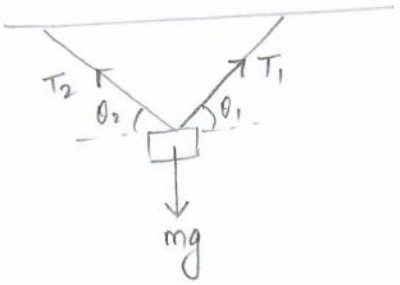
y: $0 = -mg\cos\theta + N + 0$

$N = mg\cos\theta$

$= (24)(9.8)\cos(60.0)$

$= 120$ Newtons

Problem 5



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

x: $\quad 0 = 0 - T_2 \cos\theta_2 + T_1 \cos\theta_1 \Rightarrow T_1 = T_2$.

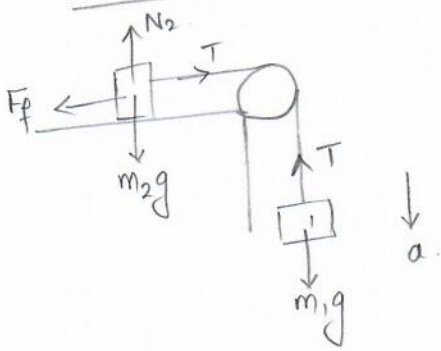
y: $\quad 0 = -mg + T_1 \sin\theta_1 + T_2 \sin\theta_2$

$$\Rightarrow 2T \sin\theta_1 = mg.$$

$$T = \frac{mg}{2\sin\theta_1} = \frac{(20.0)(9.8)}{2\sin 30.0}$$

$$= 196\ \text{N} = 2.0 \times 10^2\ \text{N}.$$

Problem 6



m_2: $\quad N_2 = m_2 g$ — (i)

$$T - F_f = m_2 a \quad \text{— (ii)}$$

$$m_1 g - T = m_1 a \quad \text{— (iii)}$$

$$m_1 g = (1.0)(9.8) = 9.8\ \text{N}$$

$$\mu_s N_2 = \mu_s m_2 g = (0.50)(2.0)(9.8) = 9.8\ \text{N}$$

Adding (ii) and (iii) we have.

$$m_1 g - F_f = (m_1 + m_2)\, a.$$

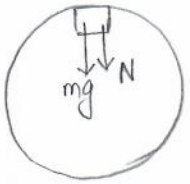
$$9.8 - 9.8 = 0$$

$\Rightarrow$ the masses will not accelerate.

$$F_f \le \mu_s m_2 g = 9.8\ \text{N}$$

$$m_1 g \le F_f \le \mu_s N_2$$

Problem 7



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

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

minimum speed — when $N = 0$.

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

$$v = \sqrt{gR}$$

$$= \sqrt{(9.8)(30.0)}$$

$$= 17\ \frac{m}{s}$$