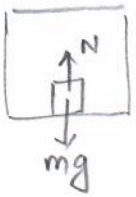
Solution PHYS-205A (Midterm Exam 01) Spring 2021

Problem 1



$\downarrow a = g$

$$-ma = -mg + N$$

$$N = mg - ma \qquad (a = g)$$

$$= mg - mg$$

$$= 0$$

Scale reads 0.

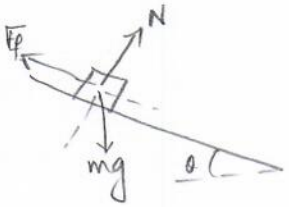
Problem 2

The accelerations will be identical. The tension in the ropes are the same at the ends because of the assumption that they are massless.

Problem 3

No, they are not. Action and reaction forces never act on the same mass.

Problem 4



Since the mass is at rest we have

$$F_f = mg \sin\theta$$

$$= (10.0)(9.8) \sin 30$$

$$= 49 \text{ Newtons}$$

Problem 5

$$g_{planet} = \frac{G M_p}{R_p^2}$$

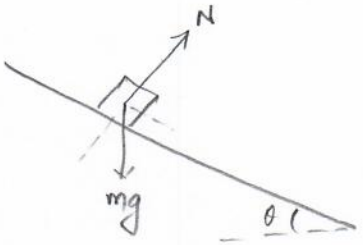
$M_p = 100\, M_E$

$R_p = 10\, R_E$

$$= \frac{G\, 100\, M_E}{(10 R_E)^2}$$

$$= \frac{G M_E}{R_E^2} = g = 9.8 \frac{m}{s^2}$$

Problem 6



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

$$ma = mg \sin\theta$$

$$a = g \sin\theta$$

$$= (9.8) \sin 30$$

$$= 4.9 \frac{m}{s^2}$$

$$N = mg \cos\theta$$

$$= (75)(9.8) \cos 30$$

$$= 637 \text{ Newtons}$$

(a) $N = mg \cos\theta = 637$ Newtons.

(b) $a = g \sin\theta = 4.9 \frac{m}{s^2}$.

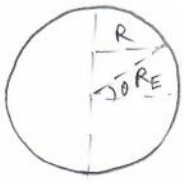
(c) $\Delta x = 6.0$ m, $\Delta t = ?$, $v_i = 0$, $a = 4.9 \frac{m}{s^2}$, $v_f =$

$$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$6.0 = 0 + \frac{1}{2} 4.9\, \Delta t^2$$

$$\Delta t = 1.6 \frac{m}{s^2}$$

Problem 7



$$a_c = \omega^2 R = \omega^2 R_E \cos\theta$$

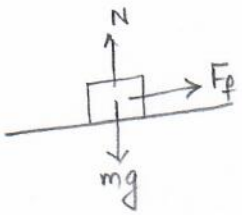
$$= \frac{4\pi^2}{T^2} R_E \cos\theta$$

$$= \frac{4\pi^2 (6.4\times10^6)}{(24\times60\times60)^2} \cos 30$$

$$= 0.034 \cos 30 = 0.029 \ \frac{m}{s^2}$$

direction: towards the axis.

Problem 8



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

x-dir

$$ma = F_f$$

y-dir

$$N = mg$$

$$F_f \leq \mu_s N$$

$$ma \leq \mu_s mg$$

$$a \leq \mu_s g = (0.5)(9.8) = 4.9 \ \frac{m}{s^2}.$$

maximum acceleration is $4.9 \ \frac{m}{s^2}$.