Solutions

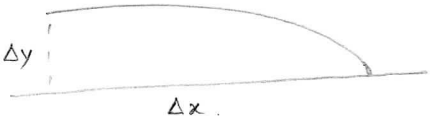
PHYS-203A-002 (Midterm Exam 02) Fall 2017

Prob. 1

$\Delta x = 20.0\,m$ $\quad$ $\Delta y = ?$ $\quad$ $V_{yi} = 0$

$V_x = 30.0\,\frac{m}{s}$ $\quad$ $\Delta t =$ $\quad$ $V_{yf} =$

$\Delta t =$ $\quad$ $a = -9.8\,\frac{m}{s^2}$



$$\Delta t = \frac{\Delta x}{V_x} = \frac{20.0}{30.0} = 0.667\,s$$

$$\Delta y = V_{yi}\,\Delta t + \frac{1}{2} a\,\Delta t^2$$

$$= 0 + \frac{1}{2}(-9.8)(0.667)^2$$

$$= -2.18\,m$$

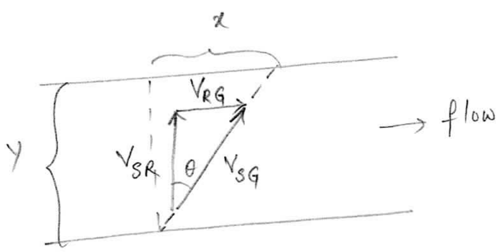
Vertical height : 2.18 m.

Prob. 2

S - Swimmer

R - River

G - Ground



$$\vec{V}_{SG} = \vec{V}_{SR} + \vec{V}_{RG}$$

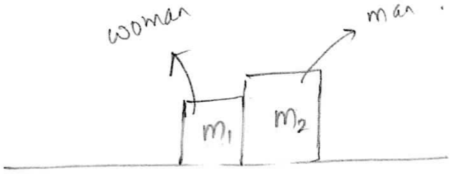
$$\tan\theta = \frac{|\vec{V}_{RG}|}{|\vec{V}_{SR}|} = \frac{x}{y}$$

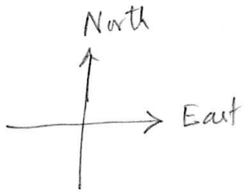
$$\frac{1.00\,m/s}{1.6\,m/s} = \frac{x}{1.2\,km}$$

$$x = \frac{1.00}{1.6}\;1.2\,km$$

$$= 0.75\,km = 750\,m.$$

Prob. 3





$|\vec{F}_{12}| = |\vec{F}_{21}|$ (using Newton's 3rd law).

x-component of Force on woman

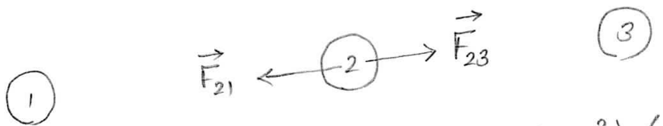
$$-F_{12} = m_1 a_1$$

$$a_1 = -\frac{F_{12}}{m_1} = -\frac{F_{21}}{m_1} = -\frac{65\text{ N}}{66\text{ kg}} = -0.99\ \frac{\text{m}}{\text{s}^2}$$

direction : West

magnitude : $0.99\ \frac{\text{m}}{\text{s}^2}$.

Prob. 4



$$\vec{F}_{23} = +\hat{i}\ \frac{G m_2 m_3}{r_{23}^2} = +\hat{i}\ \frac{\left(6.7\times10^{-11}\ \frac{\text{N m}^2}{\text{kg}^2}\right)(500\text{kg})(200\text{kg})}{(25\text{m})^2}$$

$$= +\hat{i}\ 1.07\times10^{-8}\ \text{N}$$

$$\vec{F}_{21} = -\hat{i}\ \frac{G m_2 m_1}{r_{12}^2} = -\hat{i}\ \frac{(6.7\times10^{-11})(500)(300)}{(50.0)^2}$$

$$= -\hat{i}\ 0.40\times10^{-8}\ \text{N}$$

Total force on m_2 $= +\hat{i}\ (1.07 - 0.40)\times10^{-8}\ \text{N}$

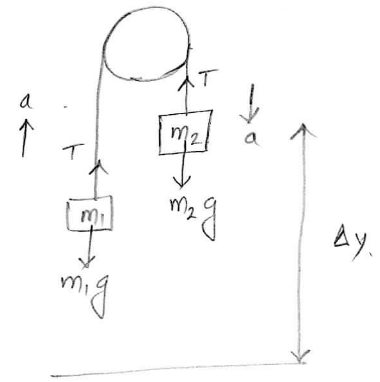
$$= +\hat{i}\ 6.7\times10^{-9}\ \text{N}$$

Prob. 5

(a) $30\,kg = m_1$: $-m_1 g + T = m_1 a$

$36\,kg = m_2$: $\ominus\ \ -m_2 g + T = -m_2 a$

$$-m_1 g + m_2 g = m_1 a + m_2 a$$



$$a = \left(\frac{m_2 - m_1}{m_2 + m_1}\right) g$$

$$= \left(\frac{36.0 - 30.0}{36.0 + 30.0}\right) 9.8 = 0.89\ \frac{m}{s^2}$$

(b) $\Delta y = -3.0\,m$ $V_i = 0$ $a = -0.89\ \frac{m}{s^2}$

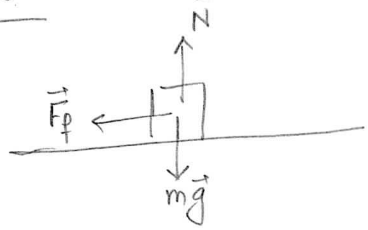
$\Delta t = ?$ $V_f =$

$$\Delta y = V_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$-3.0 = 0 + \frac{1}{2}(-0.89)\ \Delta t^2$$

$$\Delta t = \sqrt{\frac{(3.0)(2)}{(0.89)}} = 2.60 \text{ seconds}$$

Prob. 6



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

$x:\ 0 + 0 - \mu_k N = ma$

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

$F_f = \mu_k N$

(a) $y:\ N = mg$

$x:\ ma = -\mu_k N$

$ma = -\mu_k mg$

$$a = -\mu_k g = -(0.50)(9.8) = -4.9\ \frac{m}{s^2}$$

(b) $\Delta x =$ $V_i = ?$ $a = -4.9\ \frac{m}{s^2}$

$\Delta t = 1.5\,s$ $V_f = 0$

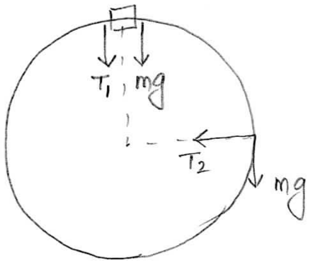
$V_f = V_i + a\Delta t$

$0 = V_i + (-4.9)(1.5)$

$V_i = 7.35\ \frac{m}{s}$

$= 7.4\ \frac{m}{s}$

Prob. 7



Given: $T_2 = \frac{mv^2}{R} = 15\text{ N}$

12 o'clock position

$$\vec{T_1} + m\vec{g} = m\vec{a}$$

$$-T_1 - mg = -\frac{mv^2}{R}$$

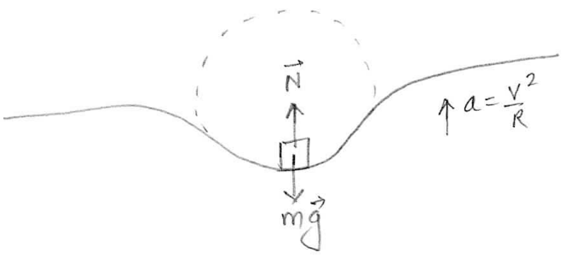
$$T_1 + mg = \frac{mv^2}{R}$$

$$T_1 + mg = 15\text{N}$$

$$T_1 = 15\text{N} - (0.250\text{kg})(9.8\tfrac{\text{m}}{\text{s}^2})$$

$$= 12.6\text{ Newtons}$$

Prob. 8



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

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

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

$$= (75)(9.8) + 75\frac{(30)^2}{150}$$

$$= 735\text{ N} + 450\text{ N}$$

$$= 1190\text{ Newtons.}$$