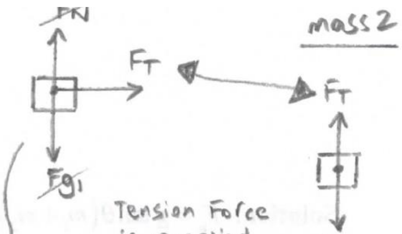
Errata Nelson Physics 12 Chapter 3

Section 3.1 – Review #8 – pg. 113 (explanation for answer)

* you can ignore adding m_2 since it is hanging off a pulley and is not physically in contact with the system



Tension Force is supplied by F_{g2}

$F_{g2} = m_2 g$

8. (a) Given: m_1 = 1.8 kg; m_2 = 1.2 kg; m_2 = 1.2 kg; F_N = 70.0 N
Required: F_a

Analysis: Since mass 1 does not slide, the acceleration due to the horizontal force must balance the acceleration due to the tension, which equals m_2g. Use $F = ma$ to determine the acceleration.

$$\frac{F_a}{m_1 + m_2 + m_3} = \frac{F_T}{m_1}$$

$$\frac{F_a}{m_1 + m_2 + m_3} = \frac{m_2 g}{m_1}$$

$$F_a = \frac{m_2 g}{m_1}(m_1 + m_2 + m_3)$$

Solution: $F_a = \frac{m_2 g}{m_1}(m_1 + m_2 + m_3)$

$$= \frac{(1.2\ \text{kg})(9.8\ \text{m/s}^2)}{(1.8\ \text{kg})}(1.8\ \text{kg} + 1.2\ \text{kg} + 3.0\ \text{kg})$$

$$F_a = 39\ \text{N}$$

Statement: The applied force is 39 N.

mass 1

$F_{NET} = F_T$

$m_1 \vec{a} = F_T$

$\vec{a} = \frac{F_T}{m_1}$

$\vec{a} = \frac{m_2 g}{m_1}$

as a system

$F_{NET} = m_T \vec{a}$

$F_a = (m_1 + m_2 + m_3)\vec{a}$

$\vec{a} = \frac{F_a}{(m_1 + m_2 + m_3)}$

equate

Section 3.3 – Review #11 – pg. 119 (strange answer)

11. (a) Given: $a_c = 711\ \text{m/s}^2$; $r = 1.21$ m
Required: v

Analysis: $a_c = \dfrac{v^2}{r}$; $v = \sqrt{a_c r}$

Solution: $v = \sqrt{a_c r}$

$= \sqrt{(711\ \text{m/s}^2)(1.21\ \text{m})}$

$v = 29.3$ m/s $\longrightarrow V_i = 29.33\text{m/s}$

Statement: The speed of the hammer is 29.3 m/s.

(b) Given: $\Delta d = -2.0$ m; $v_i = 29.3$ m/s; $\theta = 42°$
Required: Δd_x
Analysis: Use $v_f^2 = v_i^2 + 2a\Delta d$ to calculate the y-component of the final speed, then calculate the time of flight $v_f = v_i + a\Delta t$. Finally, calculate the range using $\Delta d = v\Delta t$.
Solution: Determine the y-component of the final speed:

$v_f^2 = v_i^2 + 2a\Delta d$

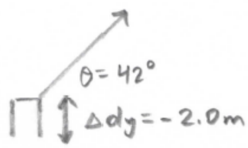
$v_{fy}^2 = v_{iy}^2 + 2g\Delta d$

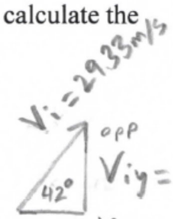
$v_{fy} = \sqrt{v_{iy}^2 + 2g\Delta d}$

$= \sqrt{((29.3\ \text{m/s})(\sin 42°))^2 + 2(9.8\ \text{m/s}^2)(-2.0\ \text{m})}$

$= 18.58$ m/s (two extra digits carried)

$v_{fy} = 19$ m/s $\longrightarrow V_{fy} = 18.60\text{m/s}$





$V_{iy} = V_i \cdot \sin\theta$

$V_{iy} = (29.33)\sin 42$

$V_{iy} = 19.62\text{m/s}$

Determine the time of flight:

$v_{fy} = v_{iy} + a\Delta t$

$\Delta t = \dfrac{v_{fy} - v_{iy}}{a}$

$= \dfrac{18.58\ \frac{\cancel{m}}{s} - \left(-29.3\ \frac{\cancel{m}}{s}\right)(\sin 42°)}{9.8\ \frac{\cancel{m}}{s^2}}$

$\Delta t = 3.896$ s (two extra digits carried)

Determine the range of the ball:

using projectile motion equation as done in class:

$\Delta y = V_{iy}\Delta t + \frac{1}{2} a_y \Delta t^2$

$-2 = (19.62)\Delta t + \frac{1}{2}(-9.8)\Delta t^2$

$0 = -4.9\Delta t^2 + 19.62\Delta t + 2$

$x_1 = -0.099$ sec ✗

$x_2 = 4.10$ sec ✓

$\Delta d_x = v_x \Delta t$

$= v_i \Delta t \cos\theta$

$= \left(29.3\ \frac{\text{m}}{\cancel{s}}\right)(3.896\ \cancel{s})(\cos 42°)$

$\Delta d_x = 85$ m

$\Delta d_x = V_{ix} \cdot \Delta t$

$\Delta d_x = (29.33\cos 42)(4.10)$

$\boxed{\Delta d_x = 89.36\text{m}}$

Statement: The range of the ball is $\boxed{\text{85 m.}}$

answer is strange, the record distance is 87m, calculating one method breaks the record while the other method does not

Section 3.3 – Review #1 – pg. 124 (correct steps)

Section 3.3 Questions, page 124

1. Given: $d = 24$ m or $r = 12$ m; $F_{net} = \dfrac{1}{3}F_g$

Required: v

Analysis: $F_c = \dfrac{mv^2}{r}$; $F_g = mg$; $F_{net} = F_c + F_g$

$$F_{net} = \frac{1}{3}F_g$$

$$F_c + F_g = \frac{1}{3}F_g$$

$$F_c = -\frac{2}{3}F_g$$

$$\frac{mv^2}{r} = -\frac{2}{3}mg$$

$$v^2 = -\frac{2}{3}\frac{\cancel{m}gr}{\cancel{m}}$$

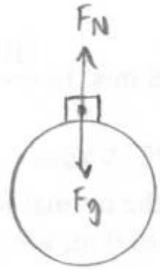
$$v = \sqrt{-\frac{2}{3}gr}$$

Solution: $v = \sqrt{-\dfrac{2}{3}gr}$

$$= \sqrt{-\frac{2}{3}(-9.8\ \text{m/s}^2)(12\ \text{m})}$$

$$v = 8.9\ \text{m/s}$$

Statement: The speed of the roller coaster is 8.9 m/s.



$$F_c = F_g - F_N$$

$$F_c = mg - \frac{1}{3}mg$$

$$F_c = \frac{2}{3}mg$$

$$\frac{\cancel{m}v^2}{r} = \frac{2}{3}\cancel{m}g$$

$$v = \sqrt{\frac{2}{3}g \cdot r}$$

Section 3.3 – Review #2 (b) – pg. 124 (incorrect answer)

(b) Given: $m = 1000.0$ kg; $r = 40.0$ m; $v = 15$ m/s
Required: F_N

Analysis: $F_\text{c} = \dfrac{mv^2}{r}$; $F_\text{g} = mg$;

$F_\text{N} = F_\text{g} + F_\text{c}$

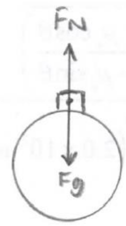
$F_\text{N} = mg + \dfrac{mv^2}{r}$

Solution: $F_\text{N} = mg + \dfrac{mv^2}{r}$

$= (1000.0\text{ kg})(9.8\text{ m/s}^2) + \dfrac{(1000.0\text{ kg})(15\text{ m/s})^2}{(40.0\text{ m})}$

$F_\text{N} = 1.5 \times 10^4\text{ N} = 15{,}000\text{N}$

Statement: The magnitude of the normal force is 1.5×10^4 N.



$F_c = F_g - F_N$

$F_N = F_g - F_c$

$F_N = mg - \dfrac{mv^2}{r}$

$F_N = (1000)(9.8) - \dfrac{(1000)(15)}{(40)}$

$F_N = 4175\text{N}$

feel lighter at the top

(c) Given: $m = 1000.0$ kg; $r = 40.0$ m; $v = 15$ m/s; $F_\text{net} = 0$
Required: v

Analysis: $F_\text{c} = \dfrac{mv^2}{r}$; $F_\text{g} = mg$

$F_\text{net} = F_\text{g} + F_\text{c}$

$0 = mg + \dfrac{mv^2}{r}$

$0 = g + \dfrac{v^2}{r}$

$v = \sqrt{-gr}$

Solution: $v = \sqrt{-gr}$

$= \sqrt{-(-9.8\text{ m/s}^2)(40.0\text{ m})}$

$v = 20$ m/s

Statement: The speed required to make the driver feel weightless is 20 m/s.

$F_c = F_g - \cancel{F_N}$

$F_N = 0$ (weightless)

$F_c = F_g$

$\dfrac{\cancel{m}v^2}{r} = \cancel{m}g$

$\dfrac{v^2}{r} = g$

$V = \sqrt{g \cdot r}$

Section 3.4 – Practice #3 – pg.129 (alternate solution shown below)

3. Given: $g = 10.00\ \text{m/s}^2$; $a_{\text{net}} = 9.70\ \text{m/s}^2$; $r = 6.2 \times 10^6\ \text{m}$

Required: T

Analysis: $a_c = \dfrac{4\pi^2 r}{T^2}$; the centripetal acceleration is the difference between the acceleration due to gravity and the net acceleration experienced by a falling object.

$$a_c = \frac{4\pi^2 r}{T^2}$$

$$g - a_{\text{net}} = \frac{4\pi^2 r}{T^2}$$

$$T = \sqrt{\frac{4\pi^2 r}{g - a_{\text{net}}}}$$

Solution: $T = \sqrt{\dfrac{4\pi^2 r}{g - a_{\text{net}}}}$

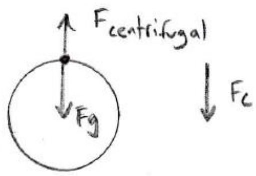
$$= \sqrt{\frac{4\pi^2 (6.2\times 10^6\ \cancel{\text{m}})}{\left(10.00\ \frac{\cancel{\text{m}}}{\text{s}^2} - 9.70\ \frac{\cancel{\text{m}}}{\text{s}^2}\right)}}$$

$$= 2.856\times 10^4\ \cancel{\text{s}} \times \frac{1\ \cancel{\text{min}}}{60\ \cancel{\text{s}}} \times \frac{1\ \text{h}}{60\ \cancel{\text{min}}}$$

$$T = 7.9\ \text{h}$$

Statement: The length of the day, or period of the planet, is 7.9 h.

Similar to question #4 pg. 130



$F_c = F_g - F_{centrifugal}$

$\cancel{m}a_c = \cancel{m}g - F_{centrifugal}$

$\dfrac{4\pi^2 r}{T^2} = g - \underbrace{F_{centrifugal}}_{\to\ a_{net}}$

$4\pi^2 r = (g - a_{net})T^2$

$\sqrt{\dfrac{4\pi^2 r}{g - a_{net}}} = T$

actual $\vec{a}$ experienced $= 9.70\ \text{m/s}^2$

planets acceleration $= 10.00\ \text{m/s}^2$

acceleration of an object at the equator is the difference between the acceleration due to gravity and the centrifugal acceleration

planets gravity

$a_{equator} = g - a_c \to$ centrifugal acceleration $\to a_c = \dfrac{4\pi^2 r}{T^2}$

$9.70 = 10.00 - a_c$

$9.70 - 10.00 = -a_c$

$-0.30 = -a_c$

$0.30 = a_c$

$0.30 = \dfrac{4\pi^2 r}{T^2}$

$T^2 = \dfrac{4\pi^2 r}{0.30}$

$T = \sqrt{\dfrac{4\pi^2 (6.2\times 10^6)}{0.30}}$

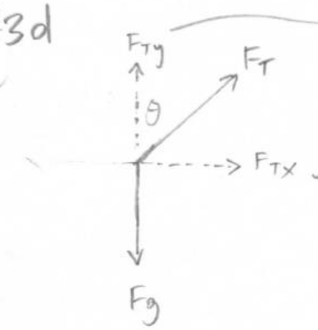
$T = 28{,}563.74\ \text{sec} \quad \div 3600$

$T = 7.93$ hours

Section 3.4 – Review #3 (d) – pg. 130 (full steps)

3.4 - Rotating Frames of Reference
pg. 126

#3d



$F_{Ty} = F_T \cos\theta$

$F_{Tx} = F_T \sin\theta$

* Earth's frame of Reference

x-component

$\Sigma F_x = F_{Tx}$

$F_c = F_T \sin\theta$

$\frac{F_c}{\sin\theta} = F_T$

y-component

$\Sigma F_y = F_{Ty} - F_g$

$0 = F_T\cos\theta - F_g$

$F_g = F_T \cos\theta$

$\frac{F_g}{\cos\theta} = F_T$

equate

$$\frac{F_c}{\sin\theta} = \frac{F_g}{\cos\theta}$$

$$\frac{F_c}{F_g} = \frac{\sin\theta}{\cos\theta}$$

$$\frac{F_c}{F_g} = \tan\theta$$

$$\theta = \tan^{-1}\left(\frac{\frac{\cancel{m}v^2}{r}}{\cancel{m}g}\right)$$

$$\theta = \tan^{-1}\left(\frac{v^2}{rg}\right)$$

$v = \frac{2\pi r}{T}$

Chapter 3 – Review #44 – pg. 143 (some textbooks are missing the radius values)

String A radius = 4.00 m

String B radius = 2.00 m

44. Two masses are tied together by strings as shown in **Figure 7** and swung around in a horizontal circle with a period of 2.00 s on a frictionless surface. Mass 1 is 3.00 kg, and mass 2 is 5.00 kg. Determine the tension in each string. (3.3) K/U T/I

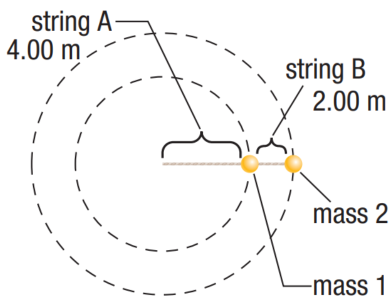


Figure 7