Chapter 1 Answers

(1a) $\boxed{9.11\times10^{-31}kg}$ (b) $\boxed{3}$

(2) $\boxed{2.53\times10^{1}\,ft^{2}}$

(3a) Mantissa is > 10 (b) $\boxed{2.67\times10^{8}}$

(4a) $28.6\,lb = \boxed{29\,lb}$ (b) That's awfully large for a Rainbow trout

(5) $\bar{t} = \boxed{10.01s}$

(6) $m_n - m_p = 2.308\times10^{-30}kg = \boxed{2.31\times10^{-30}kg}$

(7a) 1320 has three, 1800 has two, 2302 has four (b) $avg = 1807.3 = \boxed{1800Cal}$

(8a) No, too many sig. figs. for this ruler – it's not precise enough. (b) $\boxed{187.83cm}$

(9a) Matt's (b) Jared's

(10a) accurate & imprecise (b) accurate & precise (c) inaccurate & imprecise
(d) precise & inaccurate

(11) $\boxed{\$0.85}$

(12a) $\boxed{381m}$ (b) $\boxed{381{,}000mm}$

(13) $218{,}907.36cm^{2} = \boxed{2.2\times10^{5}cm^{2}}$

(14) Yes, it can probably travel about $\boxed{82\,ft}$. This is about 1000 times the length of the ant.

(15a) Kurtz jumps $\boxed{567cm}$, Zimmerman jumps $\boxed{503cm}$ (b) $63.78cm = \boxed{63.8cm}$

(16a) $\overline{\Delta t} = 11.15s = \boxed{11.2s}$ (b) $\overline{speed} = 20.06mi/hr = \boxed{20.1mi/hr}$

(17a) $length = \boxed{74\,ft}$ (b) $area = \boxed{440\,ft^{2}}$

(18) $3{,}375{,}000 = \boxed{3.4\times10^{6}}$ beats

(19) About $\boxed{2.5\times10^{8}}$ tires

(20) About $\boxed{3.7\times10^{8}}$ breaths

(21) About $\boxed{100,000}$ cups

(22) Anywhere from $\boxed{100,000 - 150,000}$ hairs on the average human head

(23) Depends on the book (typically $\boxed{50,000 - 500,000}$ words)

Chapter 2 Answers

(1) $\Delta x = 4.5\,ft$

(2a) $\Delta x = 2.0\,ft$ (b) $d = 7.0\,ft$

(3a) $x = -11m$ (b) $\Delta x = -11m$ (c) $d = 53m$

(4a) $x_f = 7.5m$ (b) $\Delta x = -10.7m = \boxed{-11m}$ (c) $d = 16.2m = \boxed{16m}$

(5a) $\bar{v} = 0.077m/s$ (b) $\bar{v} = -0.025m/s$

(6) $\Delta x = 87.5mi$ west

(7a) $\Delta x = 760km$ west (b) $d = 1400km$ (c) $\bar{v} = 113km/hr$ west
(d) $\bar{v} = 207km/hr$

(8a) $0m/s$ any direction (b) No, we don't know the distance traveled.

(9a) $1.5m/s$ forward, $1.5m/s$ (b) at rest (c) $2.0m/s$ forward, $2.0m/s$
(d) $0.75m/s$ forward, $0.75m/s$ (e) $0.86m/s$ backward, $0.86m/s$
(f) $0.0m/s$ any direction, $1.1m/s$

(10a) $\bar{v} = 3.0m/s$ (b) $\bar{a} = 0.50m/s^2$ (c) $\bar{a} = -0.50m/s^2$
(d) $v = 2.0m/s$ (e) $\Delta x = 9.0m$ (f) $\Delta x = 6.0m$

(11) $\bar{a} = 3.63 = \boxed{3.6m/s^2}$

(12) $v = 15.416m/s = \boxed{15m/s}$

(13) $\Delta x = \boxed{-8.4m}$

(14a) $d = 430mi$ (b) $v = 61.4 = \boxed{61mph}$

(15) $v_i = 9.45 = \boxed{9.5m/s}$

(16a) $\bar{v} = 1.5m/s$ (b) $\bar{a} = \boxed{0.15m/s^2}$

(17a) $\bar{v} = 15.96 = \boxed{16m/s}$ forward (b) $\Delta x = 33.52 = \boxed{34m}$

(18) $\Delta t = 7.95 = \boxed{8hr}$

(19) $\bar{a} = 1.814 = \boxed{2m/s^2}$

(20a) $t = 21.93 = \boxed{22s}$ (b) $v_f = \boxed{1908m/s}$

(21a) $t = 1.11 = \boxed{1.1s}$ (b) $v_f = 10.8m/s = \boxed{11m/s}$

(22) $\Delta x = 20.65 = \boxed{21m}$ {above his mitt} (b) $\Delta t = \boxed{4.11s}$

(23) $v_i = 11.879 = \boxed{12m/s}$

(24) $x_f = 74.529 = \boxed{75m}$

(25) (a) $t = 0.525s$ (b) $x_f = 11.15 = \boxed{11.2m}$

(26) $v_i = 30.43 = \boxed{30m/s}$

(27) $x_{croc} - x_{Steve} = \boxed{15m}$

(28a) $\Delta x = 38.75 = \boxed{39m}$ (b) $\Delta x = 62.76 = \boxed{63m}$

(c) The difference is significant because it goes like the *square* of the velocity difference.

(29) $t = 12.38 = \boxed{12s}$ (b) $v_f = 80.47 = \boxed{80m/s}$

(30a) $0.3286 = \boxed{0.33hr}$ (b) $d = 15.47 = \boxed{15mi}$

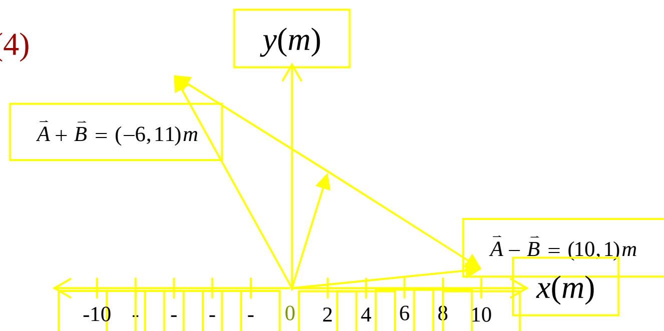
Chapter 3 Answers

(1) $|\vec{A}| = 6.32m \,@\, 71.6^\circ$, $|\vec{B}| = 9.43m \,@\, 148^\circ$, $|\vec{C}| = 10.6m \,@\, 229^\circ$, $|\vec{D}| = 8.94m \,@\, 297^\circ$

(2) $\vec{A}+\vec{B} = (-6,11)m$, $\vec{A}-\vec{B} = (10,1)m$, $\vec{C}+\vec{D} = (-3,-16)m$, $3\vec{A} = (6,18)m$,
$2\vec{A}-3\vec{B} = (28,-3)m$

(3) $|\vec{A}+\vec{B}| = 12.5m \,@\, 119^\circ$, $|\vec{A}-\vec{B}| = 10.0m \,@\, 5.71^\circ$, $|\vec{C}+\vec{D}| = 16.3m \,@\, 259^\circ$,
$|3\vec{A}| = 19.0m \,@\, 71.6^\circ$, $|2\vec{A}-3\vec{B}| = 28.2M \,@\, 354^\circ$

(4)



(5a) $\vec{R} = (-0.08, 15.96)km$ (b) $\text{distance} = 30km$ (c) $|\vec{R}| = 15.96km$
or $15.96km \,@\, 90.29^\circ$

(6a) $\text{distance} = 14.9 = \boxed{15km}$ (b) $\vec{R} = (-4.1, 14)km$ or $\vec{R} = 15km \,@\, 106^\circ$

(7) $v_x = 47.6mph\ W = \boxed{48mph\ W}$ $v_y = 27.5mph\ N = \boxed{28mph\ N}$

(8a) $\vec{R} = 206.1mi \,@\, 107^\circ$ (b) $\vec{v} = 31.7mph \,@\, 107^\circ$ (c) $speed = 58.5mph$
(d) $|\vec{R}| = 206.1mi$

(9a) $\vec{v} = 77.9m/s \,@\, 30^\circ\ S\ of\ E$ (b) $speed = 77.9m/s$ (c) $\vec{R} = 1597m \,@\, 30^\circ\ S\ of\ E$
(d) $|\vec{R}| = 1597m$

(10) Joe N. should stand $63m$ to the right of Joe N.

(11a) $y_f = 4.0m$ (b) $x_f = 1.4m$ (c) $v = 9.0m/s$

(12) $v_i = 5.0m/s$

(13) The ball crosses at a height of $12.32m$ or $40.43\,ft$. Thus it clears the post by $30.43\ ft$.
(14) $y_f = -0.142m$, i.e., $14cm$ below.

(15a) $y_i = 60m$ (b) $x_f = 52.5m = \boxed{52m}$

(16a) $h = 54.5m = \boxed{55m}$ (b) $\%\,error = 10.1\%$

(17) $v_i = 18.8m/s = \boxed{19m/s}$

(18a) $v_{pw} = 5.92m/s = \boxed{5.9m/s}$ (b) $v_{pl} = 4.22m/s = \boxed{4.2m/s}$ (c) $v_{sl} = \boxed{6.0m/s}$

(19) $v_{eg} = 2.2m/s$

(20a) $v_{kg} = 1.7m/s\ @\ 60^\circ$ (b) $y = 4.417m = \boxed{4.4m}$

(21) $v_{bh} = 40.375m/s = \boxed{90mph}$

(22) $v_{wg} = -3.9m/s$

(23a) $t = 566.6s = \boxed{570s}$ (b) $x_f = 283.3\,ft = \boxed{280\,ft}$ (c) $d = 896\,ft = \boxed{900\,ft}$

(24a) $v_{pw} = 167.7mph = \boxed{170mph}$ (b) $\theta = 26.57^\circ\ N\ of\ E = \boxed{27^\circ\ N\ of\ E}$

(25) $v_{wg} = 32.6mph\ E = \boxed{33mph\ E}$

(26) $a_c = 0.817m/s^2 = \boxed{0.82m/s^2}$

(27a) $s = 30\,ft$ (b) $v = 5.0\,ft/s$ (c) $a_c = 0.42\,ft/s^2$

(28) $a_c = 18.4m/s^2 = \boxed{18m/s^2}$

(29a) $v = 15.7m/s = \boxed{16m/s}$ (b) $a_c = 16.3m/s^2 = \boxed{16m/s^2}$

(30a) $v = 18.9m/s = \boxed{19m/s}$ (b) $a_c = 296.1m/s^2 = \boxed{300m/s^2}$

(31) $x_f = 8.49m$

Ch. 4 Answers

(1) No, it would be just as hard to accelerate the barbell on the moon, as it would be on earth. The inertia is the same (because the mass is the same) even though the weight is different.

(2a) $speed = \boxed{25mph}$ (b) $speed = \boxed{25mph}$

(3) The acceleration is tripled as well (acceleration is directly proportional to applied force).

(4a) $a = \boxed{11m/s^2}$ (b) $a = \boxed{5.5m/s^2}$ (the acceleration is inversely proportional to the mass).

(5) $F = \boxed{192.5N}$

(6) $m = \boxed{25kg}$

(7a) $43.3N\ east$ and $25N\ north$ – or more simply written as: $\vec{F} = \boxed{(43.3N, 25.0N)}$

(b) $0.157m/s^2\ east$ and $0.091m/s^2\ north$ – or: $\vec{a} = \boxed{(0.157m/s^2, 0.091m/s^2)}$

(c) $0.785m/s\ east$ and $0.455m/s\ north$ – or: $\vec{v} = \boxed{(0.785m/s, 0.455m/s)}$

(8) $\vec{F} = \sum_{i=1}^{3} \vec{F}_i = \boxed{(-70N, 10N)}$ or, $70.7N\ @\ 171.9^\circ$

(9a) $\vec{a} = \boxed{(-3.23, -8.52)m/s^2}$

(b) $\vec{v} = \vec{v}_i + \vec{a}t = (15,0)m/s + (-3.23,-8.52)m/s^2(3s) = \boxed{(5.31, -25.56)m/s}$

(c) $\vec{r}_f = \vec{r}_i + \vec{v}_i t + \tfrac{1}{2}\vec{a}t^2 = (0,5)m + (15m/s, 0m/s)(3s) + \tfrac{1}{2}(-3.23m/s^2, -8.52m/s^2)(3s)^2$

$\vec{r}_f = \boxed{(30.5m, -33.3m)}$

(10a) $a = \boxed{-15.9m/s^2}$ (b) $F = \boxed{-27843N}$ (c) $|x_f - x_i| = \boxed{38.5m}$

(11a) $speed = \boxed{30.15m/s}$ (b) $F = \boxed{14,300N}$ (c) $|x_f - x_i| = \boxed{58.8m}$

(12) $F_T = \boxed{14,125N}$

(13) $F_N = \boxed{485.7N}$

(14a) $a = \boxed{3.5m/s^2}$ (b) $F_T = \boxed{7600N}$

(15) $a_{\max} = \boxed{2.7 m/s^2}$

(16a) $a = \boxed{1.0 m/s^2}$ (b) $F_T = \boxed{20 N}$

(17a) $F_f = \boxed{-2940 N}$ (b) $a = \boxed{-1.96 m/s^2}$ (c) $|x_f - x_i| = \boxed{57.4 m}$, not quite
(d) $|x_f - x_i| = \boxed{7.66 m}$, antilock brakes help considerably.

(18) $t = \boxed{12.76 s}$

(19a) $\mu_K = \boxed{0.264}$

(20a) $a = \boxed{27778 m/s^2}$ (b) $speed = \boxed{41.7 m/s}$

(21a) $a = \boxed{4.91 m/s^2}$

(22a) $F = \boxed{1000 N}$ (b) $a = \boxed{3.92 m/s^2}$ (c) $|x_f - x_i| = \boxed{4.41 m}$

(23a) $F_N = \boxed{107.6 N}$ (b) $F_{f\_wagon} = \boxed{-16.14 N}$ (c) $a = \boxed{0.098 m/s^2}$
(d) $F_x = \boxed{-17.32 N}$ (e) $F_{f\_Susie} = \boxed{20.16 N}$

(24a) $a = \boxed{34.62 m/s^2}$ (b) $F_f = \boxed{51923 N}$ (c) $\mu = \boxed{3.53}$

(25) $F_{AB} = -F_{BA} = \boxed{\frac{5}{6} F_0}$ $F_{BC} = -F_{CB} = \boxed{\frac{1}{2} F_0}$

(26a) $F_f = \boxed{180 N}$ {on each} (b) $F_{1Bull} = \boxed{600 N}$ (c) $F_{21} = \boxed{400 N}$ (d) $F_{32} = \boxed{200 N}$

(27) $F_0 = \boxed{32.34 N}$

(28a) $\mu_S = \boxed{0.466}$ (b) $a = \boxed{1.21 m/s^2}$

(29a) $a = \boxed{6.07 m/s^2}$ (b) $F_T = \boxed{951 N}$

(30a) $a = \boxed{1.435 m/s^2}$ (b) $F_T = \boxed{83.65 N}$

(31) $m_2 \geq \boxed{86.6 kg}$

(32a) $F = \boxed{22N}$ (b) $F = \boxed{-22N}$ (c) $a_{Romeo} = \boxed{0.26m/s^2}$; $a_{Juliet} = \boxed{-0.44m/s^2}$
(d) $v_{Romeo} = \boxed{0.208m/s}$; $v_{Juliet} = \boxed{-0.352m/s}$

(33) $t = \boxed{186.6s}$

(34) $\theta = \boxed{39.7^\circ}$

(35a) $x_f - x_i = \boxed{0.617m}$ (b) $h = \boxed{0.309m}$

(36) $F_{Thrust} = \boxed{24,950N}$

(37a) $F_{tot} = \boxed{37.38N}$ (b) $a = \boxed{0.258m/s^2}$

(38a) $v_{term} = \boxed{10.9m/s}$ (b) $v_{term} = \boxed{4950m/s}$ …probably isn't too realistic!

(39a) $b = \boxed{13.7}$ (b) $v_{term} = \boxed{0.036m/s}$

(40) $t = \boxed{25.2s}$

Chapter 5 Answers

(1a) $F = \boxed{236.9N}$ {for both arms} (b) Same force, opposite direction
(c) Unlike an adult, a small child's arm may not be able to sustain such a force.

(2) $F_T = \boxed{201.7N}$

(3) $F_T = \boxed{3944N}$

(4) $v_{max} = \sqrt{\mu_s rg}$

(5a) $a_c = \boxed{8.17m/s^2}$ (b) $F_f = \boxed{12,255N}$ (c) $\mu_S = \boxed{0.834}$

(6a) $F_T = \boxed{51.52N}$ (b) $\theta = \boxed{1.09^\circ}$

(7a) $F_N = \boxed{292.6N}$ {top}, $F_N = \boxed{687.4N}$ {bottom} (b) $\omega = \boxed{0.99rad/s}$, $\omega = \boxed{0.158\,rev/s}$

(8a) $a_c = \boxed{70m/s^2}$ (b) $F_N = \boxed{6783N}$ (c) $\boxed{8.14\,g's}$

(9) $\mu_S = \boxed{0.33}$

(10) $\mu_S \boxed{0.783}$

(11) $v_{max} = \boxed{19.0m/s}$

(12a) $F_f = \boxed{-0.675N}$ (b) $\alpha = \boxed{-7.75rad/s^2}$ (c) $t = \boxed{292s}$
(d) $\theta_f - \theta_i = \boxed{52,565rev}$

(13a) $\omega = \boxed{3.85rad/s}$ (b) $a_c = \boxed{96.2m/s^2}$ (c) $N_{rev} = \boxed{9.18}$
(d) $F_{total} = \boxed{8654N}$

(14a) $\omega_f = \boxed{2.51rad/s}$ (b) $\alpha = \boxed{0.168rad/s^2}$ (c) $v = \boxed{10.54m/s}$
(d) $\Delta s = \boxed{79.4m}$

(15a) $\omega = \boxed{34.6 rad/s}$ (b) $a_c = \boxed{921.7 m/s^2}$ (c) $t = \boxed{43.25 s}$

(d) $N_{rev} = \boxed{119.1}$

(16) $R = \boxed{515.6 m}$

(17) $\theta = \boxed{60.3^\circ}$

(18a) $R = \boxed{11.08 m}$ (b) $v_{max} = \boxed{19.64 mph}$

(19) $v_{max} = \sqrt{Rg\left(\frac{\sin\theta + \mu_s \cos\theta}{\cos\theta - \mu_s \sin\theta}\right)} = \sqrt{Rg\left(\frac{0 + \mu_s \cdot 1}{1 - \mu_s \cdot 0}\right)} = \boxed{\sqrt{Rg\mu_s}}$

(20) $\tau = \boxed{11.0 N \cdot m}$

(21) $\theta = \boxed{66.4^\circ}, \boxed{114^\circ}$

(22) $I = MR^2$ so, $\alpha = \boxed{17.8 rad/s^2}$

(23a) $\alpha = \boxed{1.27 rad/s^2}$ (b) $\tau = \boxed{0.0337\ N \cdot m}$ (c) $\theta_f - \theta_i = \boxed{0.76\ rev}$

(24) $\tau_{human} = \boxed{5.92 N \cdot m}$ vs. $\tau_{chimp} = \boxed{21.7 N \cdot m}$

(25) $\tau = \boxed{13.5 N \cdot m}$ (b) $\alpha = \boxed{20 rad/s^2}$ (c) $v = \boxed{1.125 m/s}$

(26a) $a = \boxed{9.03 m/s^2}$ (b) $F_T = \boxed{76.78 N}$

(27a) $a = \boxed{2.33 m/s^2}$ (b) $F_T = \boxed{1152 N}$

(28a) $\tau_{motor} = \boxed{46.44 N \cdot m}$ (b) $\tau_{motor} = \boxed{39.69 N \cdot m}$

(29a) $\omega = \boxed{121 rad/s}$ (b) $\theta = \boxed{1260.5 rev}$

(30) $v = \boxed{134.1 mph}$

(31) $\mu_s = \boxed{0.043}$

(32a) $t = \boxed{1.34s}$ (b) $\Delta x = \boxed{6.33m}$

(33a) $\tau = \boxed{1.12N \cdot m}$ (b) $F_f = \boxed{10.25N}$ (c) $\Delta x = \boxed{2.23m}$ (d) $v = \boxed{4.5m/s}$

Chapter 6 Answers

(1) $W = \boxed{117.8J}$

(2a) $W_g = \boxed{0J}$ (b) $W_f = \boxed{-73.85J}$ (c) $W_{net} = \boxed{43.95J}$

(3a) $a = \boxed{-0.844m/s}$ (b) $F_f = \boxed{-21N}$ (c) $x_f - x_i = \boxed{8.55m}$

(4a) $F = \boxed{18,620N}$ (b) $W_c = \boxed{139,650J}$ (c) $W_g = \boxed{-139,650J}$

(5a) $W_g = \boxed{1057J}$ (b) $W_N = \boxed{0J}$

(6a) $W_f = \boxed{-59.14J}$ (b) $W_g = \boxed{1057J}$ (c) $W_{net} = \boxed{998J}$

(7) $W = \boxed{506J}$

(8a) $W = \boxed{5,145J}$ (b) $W_g = \boxed{-5,145J}$

(9a) $a = \boxed{584.1m/s^2}$ (b) $F = \boxed{262.8N}$ (c) $W_{on\,ball} = \boxed{431.8J}$

(d) $x_f - x_i = \boxed{1.64m}$ (e) $W_{on\,bat} = \boxed{-431.8J}$

(10a) $F_f = \boxed{-40N}$ (b) $W_G = \boxed{2250J}$ (c) $W_J = \boxed{-1650J}$

(d) $W_f = \boxed{-600J}$ (e) $W_{net} = \boxed{0J}$

(11a) $W_{net} = \boxed{4.55\times10^{-7}J}$ (b) $\Delta K = \boxed{4.55\times10^{-7}J}$ (c) $v = \boxed{0.095m/s}$

(12a) $\Delta K = \boxed{203J}$ (b) $F_{arrow} = \boxed{270N}$

(13) $x_f - x_i = \boxed{11.3m}$

(14a) $\Delta K = \boxed{15J}$ (b) $F_f = \boxed{-141.4N}$ (c) $\mu_K = \boxed{0.06}$

(15a) $W_{Buford} = \boxed{34J}$, $W_{Bertha} = \boxed{-34J}$ (b) $v_{Buford} = \boxed{0.77m/s}$, $v_{Bertha} = \boxed{-0.77m/s}$ {same force & speed, but opposite direction}

(16) $h = \boxed{2.5m}$

(17) $x_f - x_i = \boxed{78.67m}$

(18a) $h_1 = \boxed{57m}$ (b) $d = \boxed{178m}$

(19a) $\Delta U = \boxed{10.23J}$ (b) $v = \boxed{10.66m/s}$

(20) $v = \boxed{3.13m/s}$

(21) $v = \boxed{5.14m/s}$

(22) $v = \boxed{5.41m/s}$

(23) $v = \boxed{1.89m/s}$

(24) $\tau = \boxed{54.6N \cdot m}$

(25) $v = \boxed{2.97m/s}$

(26) $v = \boxed{4.44m/s}$

(27a) $W_{car} = \boxed{37,500,000J}$ (b) $W_{Loco} = \boxed{-37,500,000J}$ (c) $F_f = \boxed{-25,000N}$

(d) $\mu = \boxed{0.02}$

(28a) $t = \boxed{73.12s}$ (b) $\Delta\theta = \boxed{13,783rad}$ (c) $\Delta\theta = \boxed{2194rev}$

(29) $R = \boxed{31.25m}$

(30a) $v = \boxed{72\ m/s}$ (b) $v = \boxed{81.6\ m/s}$

(31) $E = \boxed{11.75MJ}$

(32) $\bar{P} = \boxed{385W}$

(33a) $P = \boxed{47.53W}$ (b) $d = \boxed{7.96m}$

(34a) $P = \boxed{83.46kW}$ (b) $F = \boxed{11,760N}$

(35) $F_f = \boxed{4,005N}$

(36a) $P = \boxed{367.5W}$ (b) $P = \boxed{704.9W}$ (c) $F = \boxed{469.9N}$

(37) $\bar{P} = \boxed{9,029W}$

(38) $v = \boxed{1.12m/s}$

(39a) $P = \boxed{71.74kW}$ (b) $P = \boxed{287kW}$

(40) $\Delta t = \boxed{514hr}$

Chapter 7 Answers

(1) $p = \boxed{2.295\times10^5 kg\cdot m/s}$

(2) $v = \boxed{1.2m/s}$

(3) $p_{car} = \boxed{68,800\ kg\cdot m/s}$ vs. $p_{train} = \boxed{8.72\times10^6 kg\cdot m/s}$

(4) $F = \boxed{-1.94\times10^5 N}$

(5a) $\Delta p = \boxed{-3.23\times10^7 kg\cdot m/s}$ (b) $F_f = \boxed{-3.80\times10^5 N}$

(6a) $\Delta p = \boxed{42,750kg\cdot m/s}$ (b) $v_f = \boxed{275.8m/s}$

(7a) $F = \boxed{-0.49N}$ (b) $t = \boxed{4.136s}$ (c) $\Delta p = \boxed{-2.03kg\cdot m/s}$
(d) $v = \boxed{40.5m/s}$

(8a) $\Delta p = \boxed{-438.3kg\cdot m/s}$ (b) $\Delta p_{total} = \boxed{0}$ (c) $\Delta p_{earth} = \boxed{+438.3kg\cdot m/s}$
(d) $\Delta v = \boxed{7.34\times10^{-23} m/s}$ (which isn't measurable!)

(9a) $\Delta p = \boxed{17.6kg\cdot m/s}$ (equal but opposite) (b) $\Delta p_{total} = \boxed{0}$
(c) $\sum F_{ext} = \boxed{0}$

(10a) $p_f = \boxed{19.1kg\cdot m/s}$ (b) $F = \boxed{23.9N}$ (c) $F_{ball} = \boxed{-478N}$

(11a) $v_{Amanda} = \boxed{0.095m/s}$ (b) $t = \boxed{179s}$

(12) $x_{cm} = \boxed{4.67m}$

(13) $x_{cm} = \boxed{1.0m}$; $y_{cm} = \boxed{1.0m}$

(14) $x_{cm} = \boxed{6.86cm}$; $y_{cm} = \boxed{6.29cm}$

(15a) $(x_{cm}, y_{cm}) = \boxed{(9.0cm, 7.8cm)}$ (b) $(v_{x\_cm}, v_{y\_cm}) = \boxed{(4.1cm/s, -1.1cm/s)}$

(16a) $x_{raft} = \boxed{0.5m}$ $x_{Roger} = \boxed{1.0m}$ {closer to the shore}

(17) $v_{Jacques} = \boxed{3.0 m/s}$

(18) Accidentally repeated question! Same as (8)…

(19a) $v_{rifle} = \boxed{0.57 m/s}$ (b) $p_{rifle} = \boxed{-2.68 kg \cdot m/s}$ (c) $F_{shoulder} = \boxed{-29.8 N}$

(20a) $p = \boxed{1.8 \times 10^6 kg \cdot m/s}$ (b) $v_{recoil} = \boxed{13.9 m/s}$

(21) $v = \boxed{0.625 m/s}$

(22) $v = \boxed{0.978 m/s}$

(23) $v = \boxed{0.273 m/s}$

(24) $v = \boxed{0.526 m/s}$

(25) The moving puck stops: $v = \boxed{0 m/s}$ and the target puck is now moving at $v = \boxed{0.5 m/s}$.

(26) $v = \boxed{116.7 m/s}$ {not possible, this is 261mph!}

(27) $v_{small} = \boxed{-1.0 m/s}$

(28) $L = \boxed{0.074 kg \cdot m^2/s}$

(29) You, holding the wheel, will begin rotating CCW (from above), at an angular speed that is much less than that of the bicycle wheel's original angular speed (since your moment of inertia with the wheel is much larger than the wheel by itself.)

(30a) $\omega_f = \boxed{7.15 rad/s}$ (b) $K_{lost} = \boxed{0.98 J}$

(31) $L = \boxed{16 kg \cdot m^2/s}$

(32) $v_{cm} = \boxed{0.548 m/s}$, $\omega = \boxed{3.84 rad/s}$. The pencil rotates about its center of mass while the center of mass moves in a straight at the given speed.

(33) This problem really belongs in a different chapter. Ignore…

Chapter 8 Answers

(1) $e = \boxed{0.2583}$

(2) $r_a = 1066AU = \boxed{1.594\times10^{14}m}$

(3) $d_{Jupiter} = \boxed{5.20AU}$

(4) $T_{Mercury} = \boxed{0.2436yr}$

(5) $F_g = \boxed{9.375lb}$

(6) $F_{g(Mars)} = \boxed{38.4lb}$ $F_{g(Pluto)} = \boxed{4.23lb}$

(7a) $F_g = \boxed{1.99\times10^{20}N}$ (b) $a_{Moon} = \boxed{2.70\times10^{-3}m/s^2}$ (c) $a_{Earth} = \boxed{3.32\times10^{-5}m/s^2}$

(d) They don't crash into each other because they have sufficient tangential speed so as to fall *around* each other rather than *into* each other.

(8) $F_{net} = 4.716\times10^{-7}N\ @\ 45^\circ$

(9) $F_{moon-Earth} = \boxed{1.99\times10^{20}N}$ $F_{Sun-Earth} = \boxed{3.678\times10^{22}N}$

Tides are caused primarily by the moon since they are due the *relative difference* in force on opposite sides of the Earth. That is to say that the relative difference in gravitational pull by the moon on the near side of the Earth compared to the far side is much larger than the same relative difference in gravitational pull for the Sun.

(10) At $x = 3.11\times10^8m$ from the Earth the net force on an object is zero. This is about 81% of the distance from Earth to Moon.

(11a) $F = \boxed{1.51\times10^{-4}N}$ (b) $a = \boxed{2.21\times10^{-6}m/s^2}$

(12a) $U_{Sun/Inner\ planets} = \boxed{-6.73\times10^{33}J}$ (b) $U_{Sun/Jupiter} = \boxed{-3.24\times10^{35}J}$ {50X as much!}

(13a) $E_{perihelion} = \frac{1}{2}m_H(100,000m/s)^2 - (3.9253\times10^9)m_H$

(b) $E_{aphelion} = \frac{1}{2}m_H v^2 - (8.4770\times10^5)m_H$

(c) $v = \boxed{46,380m/s}$

(14) $g = \boxed{8.9m/s^2}$ This is 90.8% of the value on the surface of the Earth!

(15) $d = \boxed{42,250km}$ {from Earth's center} *or* $35,880km$ above the surface.

(16) $v = \boxed{1680m/s}$ {that would be tough!}

(17a) $v_{escape(Earth)} = \boxed{11.2km/s}$ (b) $v_{escape(solar\ system)} = \boxed{42.1km/s}$

(18) $R_{Event} = \boxed{54.3m}$

(19a) No, it is relatively unchanged (since the Earth is about a billion times more massive than the asteroid). (b) …and for that reason, the orbit would not change by much – just very slightly larger.

(20) $K_{extra} = \boxed{8.58 \times 10^{13} J}$

(21) $M = 2.30 \times 10^{33} kg$ {about 1000 times the mass of our Sun}

(22) $r_{Earth-Moon} = \boxed{3.83 \times 10^{8} m}$

(23) The Space Shuttle can return to Earth by slowing down (firing rockets in the forward direction). As it slows down it will spiral down, falling out of orbit.

(24) $v = \boxed{8.06m/s}$ {This would be easily possible!}

(25) $\Delta K_{into\ the\ Sun} = \boxed{4.5 \times 10^{12} J}$ compared to: $\Delta K_{out\ of\ Solar\ System} = \boxed{4.745 \times 10^{12} J}$

Surprisingly, it requires about 5.4% more energy to send it straight into the sun rather than out of the Solar System. Either way, it requires an enormous amount of energy – too much to make it cost effective.

Ch. 9 Answers (assigned)

(1a) $F_T = \boxed{3{,}800\ N}$ (b) $\vec{F}_N = \boxed{(2{,}930\ N, 485\ N)}$

(2) $F_T = \boxed{309\ lb}$

(4a) $F_{T_1} = \boxed{1165\ N}$, $F_{T_2} = \boxed{955\ N}$, $F_{T_3} = \boxed{490\ N}$, (b) He pulls with $F_{T_2} = \boxed{955\ N}$

(5a) $x = \boxed{3.1\ m}$ (b) $F_{T_L} = \boxed{284\ N}$

(7) Left arm (angled): $F_T = \boxed{1550\ N}$; Right arm (straight): $F_T = \boxed{1240\ N}$

(8) Ignore…needs to be completely re-worded…

(10) The applied pressure is $4.3\times10^6\ Pa$, which is $\boxed{4.3\ MPa}$ thus it will likely break.

(11) $F_T = \boxed{63.6\ N}$

(12) $F_T = \boxed{3.85\times10^{-5}\ N}$

(17) $F = \boxed{3{,}560\ N}$

(19) $P_{elephant} = \boxed{33.2 lb/in^2}$ {per foot, assuming equal weight distribution}

$P_{spike\ heel} = \boxed{1{,}294 lb/in^2}$ {per foot, etc.}

(20a) $P = \boxed{1.1\times10^8\ Pa}$ (b) $P \sim \boxed{1100 atm}$

(22) They should breathe air at a pressure equal to the pressure at that depth. The pressure at that depth is $P = 6.03\times10^5\ Pa$ (just like we breath air at normal atmospheric pressure when we're not submerged).

(24) $h_{water} = \boxed{10.34 m}$

(25) $P = \boxed{9.757\times10^4\ Pa}$

(27) $F_b = \boxed{6{,}265 N}$

(29) $F_2 = \boxed{6,000 lb}$

(32) $V \sim 0.005 m^3 = \boxed{5L}$

(33) $v_{narrow} = \boxed{1.5 m/s}$

(35) $P_{in} - P_{out} = \boxed{725 Pa}$

(36) $F_{outward} = \boxed{2,474 N}$

Ch. 10 Answers (assigned)

(1) $\ell = \boxed{4.45m}$

(2) $k = \boxed{250N/m}$

(4) $m = \boxed{133g}$

(5a) $T = \boxed{1.75s}$ (b) $f = \boxed{0.571Hz}$; $\omega = \boxed{3.59rad/s}$ (c) $\ell = \boxed{0.76m}$

(7a) $T = \boxed{4s}$ (b) $\omega = \boxed{1.57rad/s}$ (c) $k = \boxed{185N/m}$ (d) $m = \boxed{0.93kg}$

(8) $T = \boxed{2.69s}$

(9) $g_{asteroid} = \boxed{0.39m/s^2}$

(10a) $k = \boxed{201.4N/m}$ (b) $m = \boxed{57.6kg}$; $weight = \boxed{127lb}$

(12a) $f = \boxed{1.25Hz}$ (b) $\omega = \boxed{7.85rad/s}$; $k = \boxed{3.08N/m}$

(c) $x(t) = \boxed{0.07\cos(7.85t)}$

(17) $x = \boxed{\pm 0.82A}$

(18) $v = \boxed{27.15m/s}$

(22) $\ell = \boxed{3.51m}$

(23a) $f = \boxed{6Hz}$ (b) period doubles to $0.167s$

Ch. 11 Answers (assigned)

(2a) $\lambda = \boxed{15cm}$ (b) $f = \boxed{1.67Hz}$

(4) $\mu = \boxed{0.082kg/m}$

(5) $B_{air} = \boxed{1.49 \times 10^5 N/m^2}$

(6) $E_{steel} = \boxed{1.875 \times 10^{11} N/m^2}$

(8a) $T = \boxed{0.5s}$; $f = \boxed{2Hz}$; $A = \boxed{12cm}$ (b) $\lambda = \boxed{48cm}$; $v = \boxed{96cm/s}$; $\mu = \boxed{3.9kg/m}$

(16a) $\lambda = \boxed{1.3m}$ (b) $f = \boxed{43.85Hz}$ (c) $F_T = \boxed{276.2N}$

(18a) $f_{1-5} = \boxed{48.3, 96.6, 145, 193, 242Hz}$ (b) $\lambda_{1-5} = \boxed{5.00, 2.50, 1.67, 1.25, 1.00m}$

(20) *Reduce* the tension by about 3.1%

(21a) $f_1 = \boxed{251.42Hz}$ (b) (b) $F_T = \boxed{2,203N}$

(22a) $f_1 = \boxed{41.56Hz}$ (b) $f_{new} = \boxed{58.77Hz}$

(27a) $\mu = \boxed{0.21g/m}$ (b) $v = \boxed{168m/s}$ (c) $\lambda = \boxed{0.933m}$ (d) $F_T = \boxed{3.33N}$

Chapter 12 Answers (assigned)

(3) $t = \boxed{0.083s}$

(4a) $r = \boxed{4.46m}$ (b) $\beta = \boxed{54.9dB}$

(6a) $\beta = \boxed{107dB}$ (b) $r = \boxed{7093\,ft}$

(7) $P = \boxed{3.89\times10^{-5}W}$

(8a) $P = \boxed{1.96\times10^{-19}W}$ (b) $E = \boxed{1.18\times10^{-17}J}$ (c) $E_{light\,bulb} = \boxed{60,000J}$

(11a) $f_{beat} = \boxed{2Hz}$ (b) $f_{avg} = \boxed{439Hz}$

(12a) $L = \boxed{0.41m}$ (b) $L = \boxed{0.69m}$

(14a) $f = \boxed{110Hz}$ (b) $f = \boxed{108.8Hz}$

(15) $\Delta L = \boxed{-0.13m}$

(16a) $f_{high} = \boxed{16,742Hz}$ (b) $L_{long} = \boxed{5.245m}$ (c) by half (d) $L_{short} = \boxed{0.01m}$

(18a) $L_{empty} = \boxed{0.325m}$ (b) skip this one, needs revision

(19) $\Delta f = \boxed{54Hz}$

(20) $v_s = \boxed{171.5m/s}$

(21) $\Delta f / f = \boxed{-0.097}$

(24) $\Delta f / f = \boxed{+0.0266}$

(26) $v_s = \boxed{22.4m/s}$

(28) $f' = \boxed{453Hz}$

(29a) $M = \boxed{1.82}$ (b) $\theta = \boxed{33.3^\circ}$ (c) $t = \boxed{0.73s}$

Chapter 13 Answers (assigned)

(1) $T_{LHe} = \boxed{-452^\circ F}$

(2) It has much lower boiling point; thus, it can be used below the freezing point of water.

(3) $T_f = \boxed{-170.2^\circ C}$

(4a) $T_f = \boxed{23.8^\circ C}$ (b) $T_f = \boxed{47.6^\circ C}$

(6) It needs to have an additional volume of $\boxed{109.2 gal}$

(8) $h_f = \boxed{3.273\, cm}$

(10) $T_f = \boxed{496.2^\circ C}$

(12) $T_f = \boxed{10.5\ ^\circ C}$

(13a) $\beta = 8.7\times10^{-5}(1/\ ^\circ C)$, so the material is Lead. (b) $D = \boxed{9.94 cm}$

(15a) $N = \boxed{3.3\times10^{25}\ molecules}$ (b) $\rho = \boxed{0.989\ g/cm^3}$

(16) $\Delta H / H = \boxed{0.0096\%}$, which amounts to about $2.9 cm$

(18) $T = \boxed{40^\circ C}$

(19a) $P = \boxed{1.362\times10^5 Pa}$ (b) $V = \boxed{0.059 m^3}$

(20a) $n = \boxed{28.56 mol}$ (b) $P = \boxed{3,040 Torr}$

(21a) $P = \boxed{39.6\, psi}$ (b) Need to add $\boxed{0.42 mol}$

(22) $n/V = 2.94\times10^{-11} mol/m^3$, which means there are still about 2.21×10^{11} particles in the chamber.

Chapter 14 Answers (assigned)

(4a) Yes. (b) $87.5cal$

(6) $Q_{fuel}/g = \boxed{1,200cal/g}$

(7) $Q_L = \boxed{2,789.5cal}$

(10) $T_f = \boxed{22.1^\circ C}$

(11a) $Q = \boxed{1.14\times10^{10}J}$ (b) About $\boxed{\$57}$

(12) $\Delta T_{body} = \boxed{-0.92^\circ C}$

(13a) $H = \boxed{7.33W}$ (b) $\Delta t = \boxed{4,550s}$

(16a) $T_{weld} = \boxed{122.7^\circ C}$ (b) $T_{Cu} = \boxed{173.0^\circ C}$

(17) $P_{body} \sim \boxed{190W}$

(18) $H \sim \boxed{75.7W}$

(20) $T = \boxed{363.5K}$

(21) $P_{elephant} = \boxed{3,150W}$; $P_{mouse} = \boxed{0.19W}$