

Even Answers for Tipler 6<sup>th</sup> edition. The odd answers in the back of your text. **All units are mks unless noted otherwise.**

Please let me know of any errors you find ☺.

### Chapter 1:

32.  $4050 \text{ m}^2$

34. a)  $0.5 \text{ ft}^3$  , b)  $0.014 \text{ m}^3$  , c) 14 l

38.  $\frac{\text{m}^3}{\text{kg} \cdot \text{s}^2}$

62.  $62.1 \text{ mi/h}$

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### Chapter 2:

14. a) B    b) B & D    c) E    d) A

16b.

curve *a*:  $\text{speed}(t_2) < \text{speed}(t_1)$

curve *b*:  $\text{speed}(t_2) = \text{speed}(t_1)$

curve *c*:  $\text{speed}(t_2) < \text{speed}(t_1)$

curve *d*:  $\text{speed}(t_2) > \text{speed}(t_1)$

24. a) 4D    b)  $4D/t$

42. a) 4.0 ns,    b) 67 min

66. 50 m

72. a) 26 m    b) 23

74. 94 m

80. 18 m

90. 1.5 km

94. 0.022g

110. a)  $x(t) = \frac{1}{6}bt^3$     b) 38 m/s and 63m    c) 38 m/s

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### Ch 3:

24.

(a) The speed is greatest at A and E.

(b) The speed is least at point C.

(c) The speed is the same at A and E. No. The horizontal components are equal at these points but the vertical components are oppositely directed.

50. a)  $(10 \text{ m/s})\hat{i} + (-3.0 \text{ m/s})\hat{j}$     b)  $(44 \text{ m})\hat{i} + (-9.0 \text{ m})\hat{j}$ ,  $45\text{m}, -12^\circ$

56. a) 0.8    b) 1.8    c)  $30^\circ$

72. 1.1 m

74. 42 m/s

76.  $76^\circ$

80. a) 49s    b) 12km    c) 12 km

82. a) 2.3km    b) 43 s    c) 9.2 km

84. 0.41 km

86. a) 2.8 m/s    b) falling

104. a) hit the brakes!    b) 14 m/s (50 km/h)

### Ch 4:

36. a) 0.0514,    b) 6.49

50.  $T_{\text{hor}} = 83.9$ ,  $T_{50} = 130.5$

52. a)  $T_1 = 60$ ,  $T_2 = 52$ ,  $m = 5.3$     b)  $T_1 = 46$ ,  $T_2 = 46$ ,  $m = 4.7$

c)  $T_1 = 34$ ,  $T_2 = 58.9$ ,  $m = 3.5$

64. 5.19

74.  $T = 47.2\text{kN}$      $F(\text{lift}) = 224\text{kN}$

76.  $m = 48$ ,     $T = 0.42\text{kN}$

82. Done in class notes

86. a)  $a = g \tan(\theta)$     b)  $9.3^\circ$

92. a) 17    b) An acceleration of the wedge greater than  $g \cot 30^\circ$  would require that the normal force exerted on the body by the wedge be greater than that given in Part (a); that is,  $F_n > mg/\sin 30^\circ$ . Under this condition, there would be a net force in the y direction and the block would accelerate up the wedge.

## Ch 5:

36. 0.417  
40. a) 65N b) 4.3, downward  
42. a) Method 2 is preferable because it reduces  $F_n$  and, therefore,  $f_s$ .  
b)  $F_1 (30^\circ) = 0.52\text{kN}$ ,  $F_2 (30^\circ) = 0.25\text{kN}$ ,  $F_1 (0^\circ) = 0.29\text{kN}$ ,  $F_2 (0^\circ) = 0.29\text{kN}$   
50. a) 16, b) 20N, c) 20N d) Because  $a_{\min,x} = g/\mu_s$ , the box will not fall if  $a \geq g/\mu_s$ .  
56. a) 80N b)  $F_{\text{net}} = 600\text{N}$ ,  $F = 680\text{N}$  c) 6.8  
84. a)  $9.6^\circ$  b) 0.58s  
86. a) 2.6N, b) 1.2 m/s  
94. a) 8.3kN b) 1.6kN c) 0.19  
122. a) 10.7 b) 8.1

## Ch 6:

4. Doubling the speed of a particle and halving its mass doubles its kinetic energy.  
24. a) 0.24kJ b) -0.18kJ c) 0.06 kJ  
30. a)  $\text{N/m}^3$  b) -9.5J c) 11.5, no  
32. a)  $W_g = 76.5\text{ J}$   $W_n = 0$  b)  $W_{\text{tot}} = 76.5\text{ J}$  c) 5.05 d) 5.43  
34. proof  
56.  $v_i = \sqrt{2(0.80)(9.81\text{ m/s}^2)(25\text{ m})}$ , which is 44 mph  
 $= 19.81\text{ m/s}$   
58. a) 706MJ b) 59MW  
66. a) 8.695J b) -22W

## Ch 7:

20. 0.88GW

28. a)  $6x(x-1)$  b)  $x=0, 1$  c)  $\left. \frac{d^2U}{dx^2} \right|_{x=0} = 6 > 0$   
 $\Rightarrow$ 

stable equilibrium at $x = 0$
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$\left. \frac{d^2U}{dx^2} \right|_{x=1\text{m}} = 6 - 12 < 0$   
 $\Rightarrow$ 

unstable equilibrium at $x = 1\text{ m}$
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38. 3.9 m  
40.  $v = 9.95\text{ m/s}$ , your call  $h = 5.05\text{m}$   
42. 1.4 m/s  
54. a) 3.5 m/s b) 7.9J c) 25N d)  $49^\circ$   
62. a)  $6.3 \times 10^5\text{ J}$ , b) 0.53

68. a.  $(3/8)mv_0^2$  b)  $\mu_k = \frac{\Delta E_{\text{therm}}}{2\pi mgr} = \frac{\frac{3}{8}mv_0^2}{2\pi mgr} = \frac{3v_0^2}{16\pi gr}$  c) one-third

### Ch 8 (starting with Ch5):

5-102. 79.5cm

5-114. 4 east

5-116. a) yes b)  $\vec{a}_{cm} = -\frac{mg}{M+m}\hat{j}$  c) Mg

### Ch 8:

20. A will travel farther. Both peas are acted on by the same force, but pea A is acted on by that force for a longer time. By the impulse-momentum theorem, its momentum (and, hence, speed) will be higher than pea B's speed on leaving the shooter.

34. 1.8 , opposite direction

44. a) 3.8 Ns b) 2900

46. a) 6, b) 4615

54. 3.1

60. a)  $v_m = \sqrt{2gh}$   $v_M = \sqrt{2gH}$  b)  $v_{mi} = \sqrt{2gh + \frac{M}{m}\sqrt{2gH}}$  c) before:

$$E_i = \frac{1}{2}mv_{mi}^2$$

$$= mg \left[ h + \frac{2M}{m}\sqrt{hH} + \left(\frac{M}{m}\right)^2 H \right] , \text{ after: } E_f = mgh + MgH = g(mh + MH)$$

d)  $gMH \left[ 2\sqrt{\frac{h}{H} + \frac{M}{m}} - 1 \right]$

70. 3.9m

108. 36

### Ch9:

30. a) -0.13 b) 1.7 c) 7.2

32. a) 0.23 b) 2.8 c) 0.65

34. 73  $\mu$ rad/s

44. 7/5 MR<sup>2</sup>

46. a)  $I = \sum_i m_i r_i^2 = m_1 x^2 + m_2 (L-x)^2$  b)

$x = \frac{m_2 L}{m_1 + m_2}$  is, by definition, the distance of the center of mass from  $m$ .

48. a) Corey 0.04 kgm<sup>2</sup> , You 0.0415 3.6%

b) The rotational inertia would increase because  $I_{\text{cm}}$  of a hollow sphere is greater than  $I_{\text{cm}}$  of a solid sphere.

58. a) -2.45 b) 0.0133

64. a) 0.4, 0.8 , 1.1J B) 0.56 kgm<sup>2</sup> , 1.1J

72. a) 3.9 b) 49

78. a) 0.0948 b)  $T_1 = 4.9524\text{N}$   $T_2 = 4.9548\text{N}$  0.0024N c)  $a = 0.0971$  ,  $T_1 = T_2 = 4.95\text{N}$

80. a) Mg, b) 2g/R c) 2g

84. a) 71.4 b) 66.7 c) 50

86.  $T = 1/3 Mg$

112.  $h_2 = 1/7 (5h_1 + 2R)$

## Chapter 10:

6.  $\vec{L}$  does not change in time.

22. 0.55s

24. a) 
$$\omega_a = 7.15 \times 10^8 \left( \frac{1 \text{ rev}}{25 \text{ d}} \right) = 2.86 \text{ rev/d}$$
$$= \boxed{2.9 \times 10^7 \text{ rev/d}}$$

b) The rotational kinetic energy *increases* by a factor of approximately  $7 \times 10^8$ . The additional rotational kinetic energy comes at the expense of gravitational potential energy, which decreases as the Sun gets smaller.

38. a)  $L = \boxed{28 \text{ kg} \cdot \text{m}^2/\text{s}, \text{ away from you}}$  b)  $I = (2.0 \text{ kg})(4.0 \text{ m})^2 = \boxed{32 \text{ kg} \cdot \text{m}^2}$

c) 
$$\omega = \frac{28 \text{ kg} \cdot \text{m}^2/\text{s}}{32 \text{ kg} \cdot \text{m}^2} = \boxed{0.88 \text{ rad/s}}$$

52. a) 
$$\omega_f = \frac{2mr^2 - \frac{1}{2}mr^2}{2mr^2 + \frac{1}{2}mr^2} \omega_0 = \boxed{\frac{3}{5} \omega_0}$$
 b)  $\Delta K = \boxed{-\frac{16}{25} K_i}$

64. 7.7 m/s

$$66. \text{ a) } L_0 = \boxed{m_p v_0 b} \quad \text{b. } \omega = \boxed{\frac{2m_p v_0 b}{(M + 2m_p)R^2}} \quad \text{c. } = \boxed{\frac{(m_p v_0 b)^2}{(M + 2m_p)R^2}}$$

$$\text{d. } = \boxed{-\frac{1}{2}m_p v_0^2 \left[ 1 - \frac{2m_p b^2}{(M + 2m_p)R^2} \right]}$$

$$76. \quad \omega_f = \frac{\frac{1}{10}ML^2 + \frac{1}{2}m(r^2 + \ell^2)}{\frac{1}{10}ML^2 + \frac{1}{2}m(r^2 + L^2)} \omega \quad K_i = \frac{1}{2} \left[ \frac{1}{10}ML^2 + \frac{1}{2}m(r^2 + \ell^2) \right] \omega^2$$

$$= \boxed{\frac{ML^2 + 5m(r^2 + \ell^2)}{ML^2 + 5m(r^2 + L^2)} \omega} \quad = \boxed{\left[ \frac{1}{20}ML^2 + \frac{1}{4}m(r^2 + \ell^2) \right] \omega^2}$$

$$K_f = \frac{1}{2} \left[ \frac{1}{10}ML^2 + \frac{1}{2}m(r^2 + L^2) \right] \left( \frac{ML^2 + 5m(r^2 + \ell^2)}{ML^2 + 5m(r^2 + L^2)} \omega \right)^2$$

$$= \boxed{\frac{1}{20} \left[ \frac{[ML^2 + 5m(r^2 + \ell^2)]^2}{ML^2 + 5m(r^2 + L^2)} \right] \omega^2}$$

## Chapter 14:

$$30. \text{ a) } \delta = \cos^{-1}(0) = \boxed{\frac{\pi}{2}, \frac{3\pi}{2}}, \text{ b) } \delta = \cos^{-1}(-1) = \boxed{\pi}, \text{ c) } 0, \text{ d) } \boxed{\frac{\pi}{3}}$$

$$32. \text{ a) } 1.3 \quad \text{b) } 25 \quad \text{c) } 0.25$$

$$36. 13 \text{ Hz}$$

$$40. \text{ a) } 31 \text{ cm/s} \quad \text{b) } \boxed{\frac{2\pi}{3} \text{ rad/s}} \quad \text{c) } x = \boxed{(15 \text{ cm}) \cos \left( \left( \frac{2\pi}{3} \text{ s}^{-1} \right) t + \pi \right)}$$

$$68. 2.0$$

$$72. \text{ a) } 24 \text{ cm} \quad \text{b) } d = \boxed{\frac{R}{\sqrt{2}}} \quad 2.1 \text{ s}$$