Honors Physics – Ch 7 Practice Answers

1) $v_t = 465 \text{ m/s}$

$a_c = 3.4 \times 10^{-2} \text{ m/s}^2$

$$r = \frac{v_t^2}{a_c} = \frac{(465 \text{ m/s})^2}{3.4 \times 10^{-2} \text{ m/s}^2} = \boxed{6.4 \times 10^6 \text{ m}}$$

2) $m = 30.0 \text{ g}$

$r = 2.4 \text{ m}$

$F_T = 0.393 \text{ N}$

$g = 9.81 \text{ m/s}^2$

$$F_T = F_g + F_c = mg + m\frac{v_t^2}{r}$$

$$v_t = \sqrt{\frac{r(F_T - mg)}{m}} = \sqrt{\frac{(2.4 \text{ m})[0.393 \text{ N} - (30.0 \times 10^{-3} \text{ kg})(9.81 \text{ m/s}^2)]}{30.0 \times 10^{-3} \text{ kg}}}$$

$$v_t = \sqrt{\frac{(2.4 \text{ m})(0.393 \text{ N} - 0.294 \text{ N})}{30.0 \times 10^{-3} \text{ kg}}} = \frac{(2.4 \text{ m})(0.099 \text{ N})}{30.0 \times 10^{-3} \text{ kg}}$$

$v_t = \boxed{2.8 \text{ m/s}}$

3) $m = 75.0 \text{ kg}$

$r = 446 \text{ m}$

$v_t = 12 \text{ m/s}$

$g = 9.81 \text{ m/s}^2$

$$F_c = \frac{mv_t^2}{r} = \frac{(75.0 \text{ kg})(12 \text{ m/s})^2}{446 \text{ m}} = \boxed{24 \text{ N}}$$

$$F_T = F_c + mg = 24 \text{ N} + (75.0 \text{ kg})(9.81 \text{ m/s}^2)$$

$$F_T = 24 \text{ N} + 736 \text{ N} = \boxed{7.60 \times 10^2 \text{ N}}$$

4) $m_1 = m_2 = 1.0 \times 10^8 \text{ kg}$

$F_g = 1.0 \times 10^{-3} \text{ N}$

$G = 6.673 \times 10^{-11} \dfrac{\text{N} \cdot \text{m}^2}{\text{kg}^2}$

$$r = \sqrt{\frac{Gm_1m_2}{F_g}}$$

$$r = \sqrt{\frac{(6.673 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2)(1.0 \times 10^8 \text{ kg})^2}{1.0 \times 10^{-3} \text{ N}}}$$

$r = 2.6 \times 10^4 \text{ m} = \boxed{26 \text{ km}}$

5) $m_1 = 318 m_E$

$m_2 = 50.0 \text{ kg}$

$V_J = 1323 V_E$

$m_E = 5.98 \times 10^{24} \text{ kg}$

$r_E = 6.37 \times 10^6 \text{ m}$

$G = 6.673 \times 10^{-11} \dfrac{\text{N} \cdot \text{m}^2}{\text{kg}^2}$

If $V_J = 1323 \ V_E$, then $r_J = \sqrt[3]{1323}\, r_E$.

$$F_g = \frac{Gm_1m_2}{r_J^2} = \frac{(6.673 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2)(318)(5.98 \times 10^{24} \text{ kg})(50.0 \text{ kg})}{[(\sqrt[3]{1323})(6.37 \times 10^6 \text{ m})]^2}$$

$F_g = \boxed{1.30 \times 10^3 \text{ N}}$

6)

$T = 88\,643 \text{ s}$

$m = 6.42 \times 10^{23} \text{ kg}$

$r_m = 3.40 \times 10^{6} \text{ m}$

$$r = \sqrt[3]{\frac{GmT^2}{4\pi^2}} = \sqrt[3]{\frac{\left(6.673 \times 10^{-11} \frac{\text{N}\bullet\text{m}^2}{\text{kg}^2}\right)(6.42 \times 10^{23} \text{ kg})(88\,643 \text{ s})^2}{4\pi^2}}$$

$$r = 2.04 \times 10^{7} \text{ m}$$

$$r_s = r - r_m = 2.04 \times 10^{7} \text{ m} - 3.40 \times 10^{6} \text{ m} = \boxed{1.70 \times 10^{7} \text{ m}}$$

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7)

$r = 2.30 \times 10^{10} \text{ m}$

$T = 5.59 \times 10^{5} \text{ s}$

$m_s = 1.99 \times 10^{30} \text{ kg}$

$$m = 4\pi^2 \frac{r^3}{GT^2} = 4\pi^2 \frac{(2.30 \times 10^{10} \text{ m})^3}{\left(6.673 \times 10^{-11} \frac{\text{N}\bullet\text{m}^2}{\text{kg}^2}\right)(5.59 \times 10^{5} \text{ s})^2} = \boxed{2.30 \times 10^{31} \text{ kg}}$$

$$\frac{m}{m_s} = \frac{2.30 \times 10^{31} \text{ kg}}{1.99 \times 10^{30} \text{ kg}} = \boxed{11.6}$$

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8)

$\tau_{net} = 56.0 \text{ N}\bullet\text{m}$

$m_1 = 3.9 \text{ kg}$

$m_2 = 9.1 \text{ kg}$

$d_1 = 1.000 \text{ m} - 0.700 \text{ m} = 0.300 \text{ m}$

$g = 9.81 \text{ m/s}^2$

$\tau_{net} = \tau_1 + \tau_2 = F_1 d_1 (\sin \theta_1) + F_2 d_2 (\sin \theta_2)$

$\theta_1 = \theta_2 = 90°$, so

$\tau_{net} = F_1 d_1 + F_2 d_2 = m_1 g d_1 + m_2 g (1.000 \text{ m} - x)$

$$x = 1.000 \text{ m} - \frac{\tau_{net} - m_1 g d_1}{m_2 g}$$

$$x = 1.000 \text{ m} - \frac{56.0 \text{ N}\bullet\text{m} - (3.9 \text{ kg})(9.81 \text{ m/s}^2)(0.300 \text{ m})}{(9.1 \text{ kg})(9.81 \text{ m/s}^2)}$$

$$x = \frac{56.0 \text{ N}\bullet\text{m} - 11 \text{ N}\bullet\text{m}}{(9.1 \text{ kg})(9.81 \text{ m/s}^2)} = \frac{45 \text{ N}\bullet\text{m}}{(9.1 \text{ kg})(9.81 \text{ m/s}^2)} = 1.000 \text{ m} - 0.50 \text{ m}$$

$$x = \boxed{0.50 \text{ m} = 5.0 \times 10^{1} \text{ cm}}$$

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9)

$m = 5.00 \times 10^{2} \text{ kg}$

$d_1 = 5.00 \text{ m}$

$\tau = 6.25 \times 10^{5} \text{ N}\bullet\text{m}$

$g = 9.81 \text{ m/s}^2$

$\theta_1 = 90.0° - 10.0° = 80.0°$

$d_2 = 4.00 \text{ m}$

$\theta_2 = 90°$

a. $\tau' = F d (\sin \theta) = m g d_1 (\sin \theta_1)$

$\tau' = (5.00 \times 10^{2} \text{ kg})(9.81 \text{ m/s}^2)(5.00 \text{ m})(\sin 80.0°)$

$\tau' = \boxed{2.42 \times 10^{4} \text{ N}\bullet\text{m}}$

b. $\tau_{net} = F d_2 (\sin \theta_2) - \tau' = F d_2 (\sin \theta_2) - m g d_1 (\sin \theta_1)$

$$F = \frac{\tau_{net} + m g d_1 (\sin \theta_1)}{d_2 (\sin \theta_2)}$$

$$F = \frac{6.25 \times 10^{5} \text{ N}\bullet\text{m} + 2.42 \times 10^{4} \text{ N}\bullet\text{m}}{4.00 \text{ m} (\sin 90°)} = \frac{6.49 \times 10^{5} \text{ N}\bullet\text{m}}{4.00 \text{ m}}$$

$$F = \boxed{1.62 \times 10^{5} \text{ N}}$$
