

Answer Key  
ASTR 1040

Problem Set #1  
W. Cash

$$1. \frac{200 \times 10^{34} + 40 \times 10^{34}}{1.2 \times 10^{12}} = \frac{2.4 \times 10^{36}}{1.2 \times 10^{12}} = 2 \times 10^{24}$$

$$2. \left( \frac{6 \times 2 \times 10^5}{0.15 \times 10^{16}} \right)^{1/2} = \left( \frac{12}{15} \times \frac{10^5}{10^{15}} \right)^{1/2} = \sqrt{8 \times 10^{-10}} = 2.8 \times 10^{-5}$$

$$3a \quad r_p = 5.9 \times 10^{12} \text{ m} \quad (40 \text{ AU})$$
$$\text{ratio} = \frac{5.9 \times 10^{12} \text{ m}}{0.2 \text{ m}} = 3 \times 10^{13} = \frac{1}{3 \times 10^{-14}}$$

$$b \text{ i} \quad 2 \text{ m} \times 3 \times 10^{-14} = 6 \times 10^{-14} \text{ m}$$

$$\text{ii} \quad 6.4 \times 10^6 \text{ m} \times 3 \times 10^{-14} = 2 \times 10^{-7} \text{ m}$$

$$\text{iii} \quad 1.5 \times 10^{14} \times 3 \times 10^{-14} = 4 \times 10^{-3} \text{ m} = 4 \text{ mm}$$

$$\text{iv} \quad 269,000 \text{ AU} \times 4 \times 10^{-3} \text{ m/AU} = 1000 \text{ m} \sim 1 \text{ km}$$

$$\text{v} \quad 780,000 \text{ pc} \times 3 \times 10^{16} \text{ m/pc} \times 3 \times 10^{-14} = 8 \times 10^8 \text{ m} = 800,000 \text{ km}$$

$$\text{vi} \quad R_U = 14 \times 10^9 \text{ pc} \Rightarrow 14 \times 10^9 \times 3 \times 10^{16} = 4 \times 10^{26} \text{ m}$$

$$d = 4 \times 10^{26} \times 3 \times 10^{-14} = 1 \times 10^{13} \approx 6 \text{ AU}$$

$$4 \quad v = \frac{6 \times 10^{12} \text{ m}}{7 \times 3.15 \times 10^8 \text{ s}} \approx 3 \times 10^4 \text{ m/s} = 30 \text{ km/s}$$

$$5 \quad a = 40 \text{ m/s}^2 \quad m = 10^6 \text{ kg}$$

$$F = ma = 4 \times 10^7 \text{ N}$$

$$6 \quad F = 10 \text{ N} = ma$$

$$a_L = 10/100 = .1 \text{ m/s}^2 \quad a_S = 10/50 = .2 \text{ m/s}^2$$

$$v_L = .1 \text{ s} \times .1 \text{ m/s}^2 = 1 \text{ cm/s} \quad v_S = .1 \text{ s} \times .2 \text{ m/s}^2 = 2 \text{ cm/s}$$

$$7 \quad M = 10^{32} \text{ kg} \quad R = 1.5 \times 10^{11} \text{ m}$$

$$P = 6.28 \left( \frac{(1.5 \times 10^{13})^3}{6.7 \times 10^{-8} \times 10^{25}} \right)^{1/2} = 6 \sqrt{40 \times 10^{10}} =$$

$$= 3.6 \times 10^6 \text{ s} \approx 1.5 \text{ months}$$

$$8. \quad V_e = \sqrt{\frac{26M}{R}} = \left( \frac{2 \times 6.7 \times 10^{-11} \times 2 \times 10^{30}}{1.5 \times 10^{11}} \right)^{1/2}$$

$$= \left( \frac{25}{1.5} \times 10^9 \right)^{1/2} = 6 \times 10^4 \text{ m/s} = 60 \text{ km/s}$$