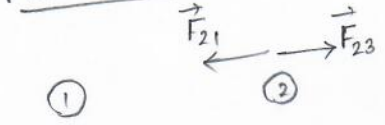
Solutions

Final Exam (PHYS-203A) Fall 2020

Problem 1

$$4.3\ \frac{g}{cm^3} = 4.3\ \frac{(10^{-3}\,kg)}{(10^{-2}\,m)^3} = 4.3\times 10^3\ \frac{kg}{m^3}$$

Problem 2



$$|\vec{F}_{21}| = \frac{G m_1 m_2}{r_{12}^2} = \frac{(6.7\times 10^{-11})(300)(500)}{(50)^2}$$

$$= 4\times 10^{-9}\ N$$

$$|\vec{F}_{23}| = \frac{G m_2 m_3}{r_{23}^2} = \frac{(6.7\times 10^{-11})(500)(200)}{(25)^2}$$

$$= 10\times 10^{-9}\ N$$

$$\vec{F} = (+F_{23} - F_{21})\,\hat{i} \rightarrow \text{towards 3}$$

$$= 6\times 10^{-9}\ N\ \hat{i}$$

Problem 3

$$g = \frac{GM}{(R+h)^2} = \frac{(6.7\times 10^{-11})(6.0\times 10^{24})}{(6.4\times 10^6)^2}$$

$$= 9.8\ \frac{m}{s^2}$$

$$R+h = 6400\,km + 3\,km$$

$$= 6403\,km$$

$$= 6.4\times 10^6\,m \quad (2\ \text{sig. digits})$$

$$= R$$

Problem 4

(a) $\Delta K = 0 - \frac{1}{2} m v_B^2 = -mgh = -(10.0)(9.8)(1.0) = -98\ J$

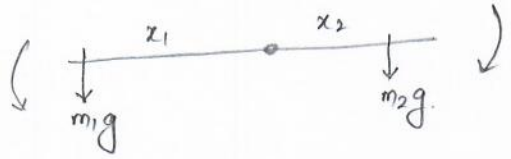
(b) $\Delta U^g = mgh_C - mgh_A = 0$

(c) $\Delta U^s = \frac{1}{2} k x_C^2 - 0 = +98\ J$

Problem 5

$$m_1 g x_1 = m_2 g x_2$$

$$\frac{x_1}{x_2} = \frac{m_2}{m_1} = \frac{2.0}{1.0} = 2.0.$$



Problem 6

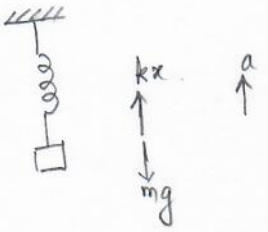
$$I = m_1 r_1^2 + m_2 r_2^2 + m_3 r_3^2 + m_4 r_4^2 + m_5 r_5^2$$

$$= m b^2 + 2m a^2 + 3m b^2 + 4m a^2 + 5m 0^2$$

$$= 6m a^2 + 4m b^2$$

$$\Rightarrow \quad \alpha = 6 \qquad \beta = 4.$$

Problem 7



$$kx - mg = ma.$$

$$x = \frac{m(g+a)}{k}$$

$$= \frac{(10.0)}{(1500)} (9.8 + 1.00)$$

$$= 0.072 \text{ m} = 7.2 \text{ cm}$$

Problem 8

$$T = 2\pi \sqrt{\frac{l}{g}} = 2\pi \sqrt{\frac{1.0}{4 \times (9.8)}}$$

$$= 1.0 \text{ s}$$