Max Kiene

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Problem 8

$$F = \frac{(6.67 \times 10^{-11})(0.342)(0.816)}{(10.20)^2} \approx 1.79 \times 10^{-13} \, \text{N}$$

$$\Delta F = \sqrt{\left(\frac{\partial F}{\partial m_1}\Delta m_1\right)^2 + \left(\frac{\partial F}{\partial m_2}\Delta m_2\right)^2 + \left(\frac{\partial F}{\partial R}\Delta R\right)^2}.$$

$$\frac{\partial F}{\partial m_1} = \frac{G\,m_2}{R^2} \approx 5.235 \times 10^{-13} \, \text{N/kg}$$

$$\frac{\partial F}{\partial m_2} = \frac{G\,m_1}{R^2} \approx 2.193 \times 10^{-13} \, \text{N/kg}$$

$$\frac{\partial F}{\partial R} = -\frac{2G\,m_1\,m_2}{R^3} \approx -3.504 \times 10^{-14} \, \text{N/m}.$$

$$\Delta F = \sqrt{(5.235 \times 10^{-14})^2 + (9.212 \times 10^{-14})^2 + (4.240 \times 10^{-14})^2}.$$

$$(5.235 \times 10^{-14})^2 \approx 2.74 \times 10^{-27}$$

$$(9.212 \times 10^{-14})^2 \approx 8.49 \times 10^{-27}$$

$$(4.240 \times 10^{-14})^2 \approx 1.80 \times 10^{-27}.$$

$$2.74 + 8.49 + 1.80 = 13.03 \times 10^{-27} = 1.303 \times 10^{-26} \, \text{N}^2.$$

$$\Delta F \approx \sqrt{1.303 \times 10^{-26}} \approx 1.14 \times 10^{-13} \, \text{N}.$$

$$F_{\text{m}} = (1.79 \pm 1.14) \times 10^{-13} \, \text{N}.$$