SAMPLE PROBLEM C

Gravitational Force

PROBLEM

Find the distance between a 0.300 kg billiard ball and a 0.400 kg billiard ball if the magnitude of the gravitational force between them is 8.92×10^{-11} N.

SOLUTION

Given: $m_1 = 0.300 \text{ kg}$ $m_2 = 0.400 \text{ kg}$ $F_g = 8.92 \times 10^{-11} \text{ N}$

Unknown: $r = ?$

Use the equation for Newton's law of universal gravitation, and solve for r.

$$F_g = G\frac{m_1 m_2}{r^2}$$

$$r = \sqrt{G\frac{m_1 m_2}{F_g}}$$

$$r = \sqrt{\left(6.673 \times 10^{-11} \frac{\text{N} \cdot \text{m}^2}{\text{kg}^2}\right) \times \frac{(0.300 \text{ kg})(0.400 \text{ kg})}{8.92 \times 10^{-11} \text{ N}}}$$

$$\boxed{r = 3.00 \times 10^{-1} \text{ m}}$$

PRACTICE C

Gravitational Force

1. What must be the distance between two 0.800 kg balls if the magnitude of the gravitational force between them is equal to that in Sample Problem C?
2. Mars has a mass of about 6.4×10^{23} kg, and its moon Phobos has a mass of about 9.6×10^{15} kg. If the magnitude of the gravitational force between the two bodies is 4.6×10^{15} N, how far apart are Mars and Phobos?
3. Find the magnitude of the gravitational force a 66.5 kg person would experience while standing on the surface of each of the following bodies:

Celestial Body	Mass	Radius
a. Earth	5.97×10^{24} kg	6.38×10^{6} m
b. Mars	6.42×10^{23} kg	3.40×10^{6} m
c. Pluto	1.25×10^{22} kg	1.20×10^{6} m