Planetary Motion

Kepler's Laws of Planetary Motion

&

Newton's Law of Universal Gravitation

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Kepler's Three Laws of Planetary Motion

◆ 1st Law
  ■ All planets move in _____ orbits with the sun at one focus
◆ 2nd Law
  ■ A line joining the planet to the sun sweeps out _____ area in _____ time.
    ● Planets move faster when closer to the sun
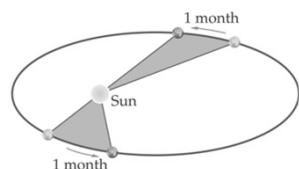
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Kepler's Three Laws of Planetary Motion

- 3rd Law
  - For any objects orbiting the same planet or star:

$$\left(\frac{T_1}{T_2}\right)^2 = \left(\frac{r_1}{r_2}\right)^3$$

Earth's Period around the sun= _____ days or _____ year

Average distance from the sun to the Earth = 1.5×10^{11} m or 1 AU

List of distances can be found in Table 8 – 1 on page 178

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Example Problem

- A small unnamed planet was discovered 1.2×10^{12} m from the sun. How long would it take this unnamed planet to orbit the sun?

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Example Problem #2

◆ If it takes 686.95 days for Mars to revolve around the sun, what is distance of Mars from the sun?

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Newton's Law of Gravity

◆ States that there is an attractive force between all masses.

For Earth,
= 9.8 m/s^2 (g)

$$F = G\frac{m_1 m_2}{d^2}$$

G = 6.67 x 10^{-11}

m_1 and m_2 = mass in kg

d = distance between objects

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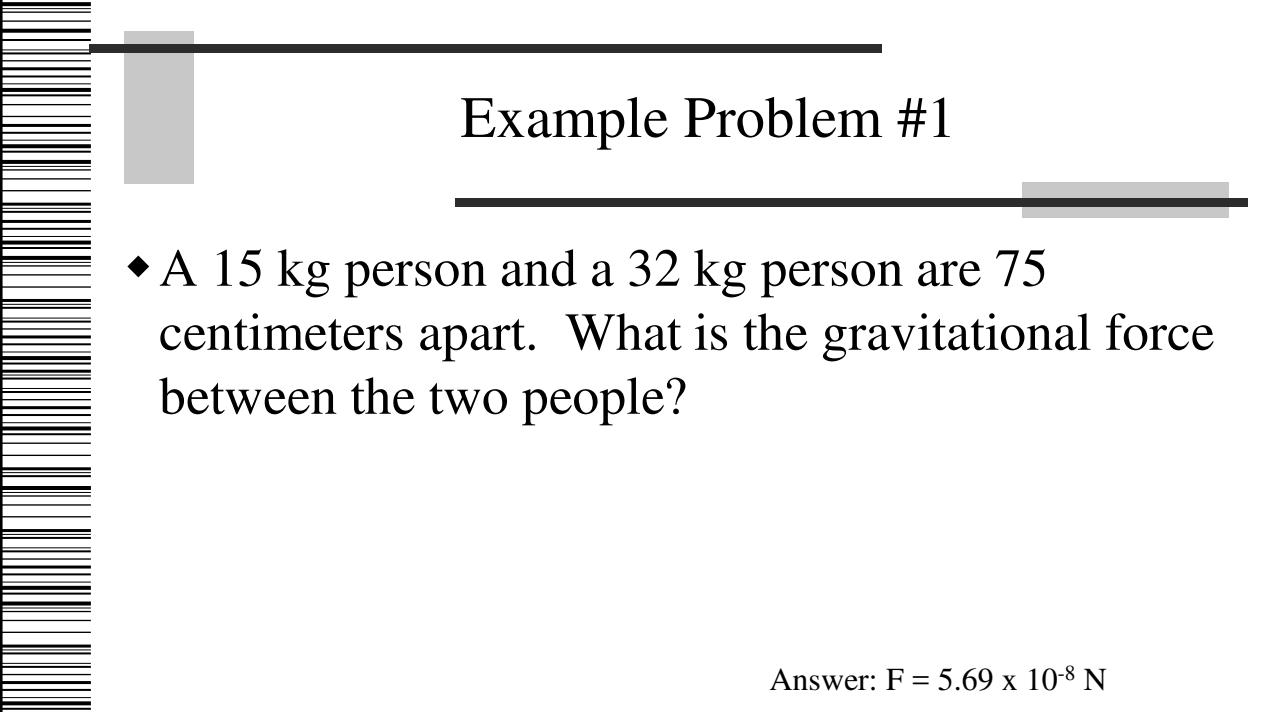
Example Problem #1

◆ A 15 kg person and a 32 kg person are 75 centimeters apart. What is the gravitational force between the two people?

Answer: $F = 5.69 \times 10^{-8}$ N

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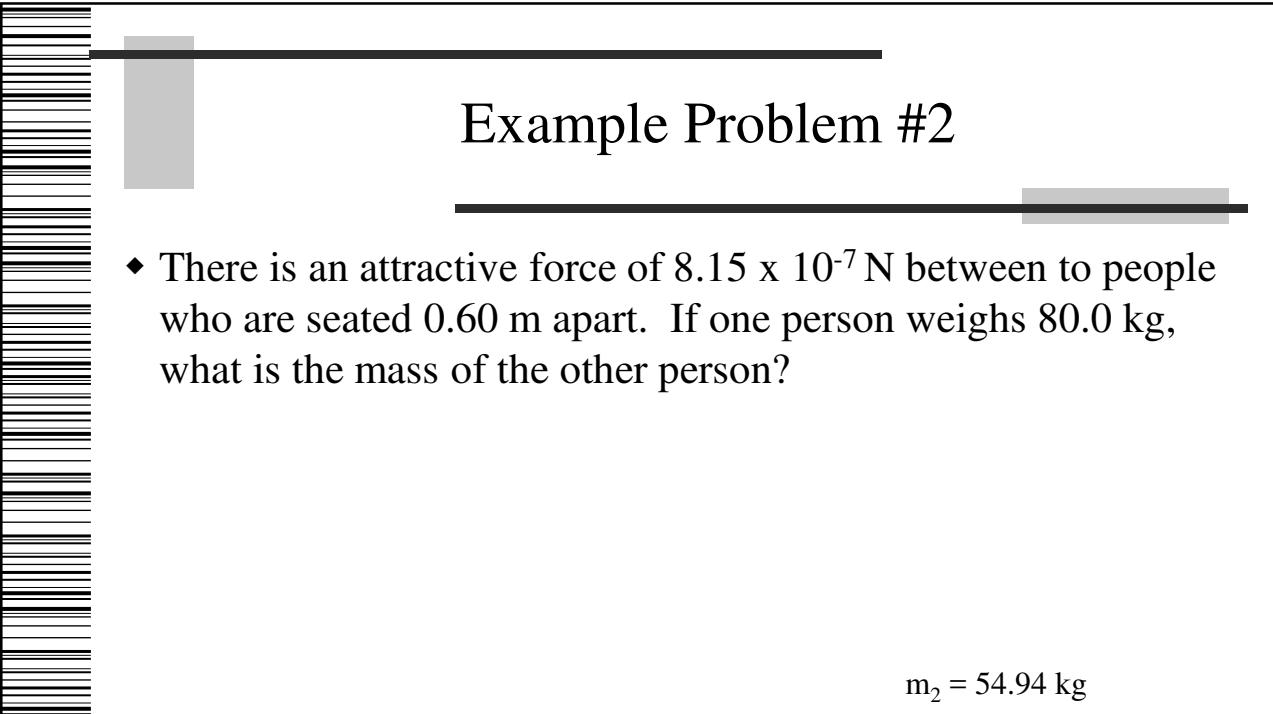
Example Problem #2

◆ There is an attractive force of 8.15×10^{-7} N between to people who are seated 0.60 m apart. If one person weighs 80.0 kg, what is the mass of the other person?

$m_2 = 54.94$ kg

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