Name _____ Period _____ Date _____

Example Problems

12.1 Universal Gravity

E1. Doc Fizzix, whose mass is 65.0 kg, is doing a physics demonstration at the front of the classroom. How much gravitational force does Doc Fizzix exert on 55 kg Rob who is sitting in the front row 1.00 meters away from Doc Fizzix?

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$F =$

$m_1 =$

$m_2 =$

$d =$

$G = 6.67 \times 10^{-11}\ \mathrm{Nm^2/kg^2}$

a) _____ ← units

E2. From the previous problem, Rob has moved back and is now 4 meters from Doc Fizzix, calculate the new force gravitational force exerts on Rob by Doc Fizzix.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

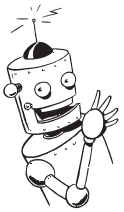
$F =$

$m_1 =$

$m_2 =$

$d =$

$G = 6.67 \times 10^{-11}\ \mathrm{Nm^2/kg^2}$



a) _____ ← units

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Chapter 12 Universal Gravity

E3. Doc Fizzix once told his wife that the reason she married him was because of the strong gravitational attraction he exerts on her. If Doc Fizzix has a mass of 65 kg and his wife has a mass of 45 kg, calculate the gravitational force between the two of them when they are 0.5 m apart.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$F =$

$m_1 =$

$m_2 =$

$d =$

$G = 6.67 \times 10^{-11}\ \mathrm{Nm^2/kg^2}$

a) _____ ← units

E4. The planet Mars has a mass of 6.4169×10^{23} kg and a radius of 3,397,000 meters. Calculate the weight of a 70.0 kg astronaut standing on the surface of Mars.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

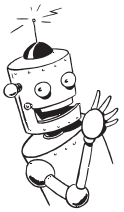
$F =$

$m_1 =$

$m_2 =$

$d =$

$G = 6.67 \times 10^{-11}\ \mathrm{Nm^2/kg^2}$



a) _____ ← units

Name _____ Period _____ Date _____

Chapter 12 Universal Gravity

E5. An 80,000 kg space shuttle is in orbit 500 km above the earth's surface. Calculate the gravitational force holding the shuttle in orbit. [Earth's radius is 6,371,000 meters]

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

g_p =

M_p =

r_p =

G = 6.67 x 10^{-11} Nm^2/kg^2

a) _____ ◄—— units

E6. A neutron star, mass 2 x 10^{30} kg, is a very compact star having a mass comparable to the sun but a radius of only a few kilometers (10 km). Calculate the acceleration of gravity on the surface of this neutron star and calculate your weigh if you could stand on the surface of the neutron star. (Assume your mass is 55 kg)

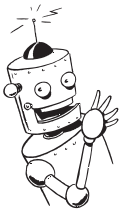
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

g_p =

M_p =

r_p =

G = 6.67 x 10^{-11} Nm^2/kg^2



a) _____ ◄—— units b) _____ ◄—— units

Name _____ Period _____ Date _____

Chapter 12 Universal Gravity

E7. A satellite is placed into an orbit 16,090,000 meters above the Earth's Surface. Calculate how fast the satellite need to travel in order to remain in orbit at this altitude.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

v =

M_p =

r_p =

$G = 6.67 \times 10^{-11}\ \mathrm{Nm^2/kg^2}$

a) _____ ← units

E8. A space ship is to orbit a planet with a mass of 8×10^{20} kg. How far from the plant's center must the space ship travel so that its velocity is 10,000 m/s?

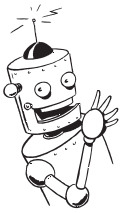
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

v =

M_p =

r_p =

$G = 6.67 \times 10^{-11}\ \mathrm{Nm^2/kg^2}$



a) _____ ← units

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Chapter 12 Universal Gravity

Student Problems

12.1 Universal Gravity

1. A monkey is sitting next to you on a park bench. Lets assume that your mass is 60.0 kg and the mass of the monkey is 45.0 kg. If the distance between your centers is 0.75 m, calculate the gravitational force of attraction between you and the monkey.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$F =$

$m_1 =$

$m_2 =$

$d =$

$G = 6.67 \times 10^{-11}\ \mathrm{Nm^2/kg^2}$

a) _____ ← units

2. A large gorilla whose mass is 87.0 kg is doing a physics demonstration in the front of the classroom. Calculate the gravitational force the gorilla exert on a monkey (45.0 kg) sitting in the second row 2.50 meters away from the gorilla.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

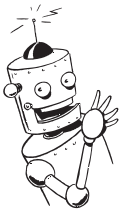
$F =$

$m_1 =$

$m_2 =$

$d =$

$G = 6.67 \times 10^{-11}\ \mathrm{Nm^2/kg^2}$



a) _____ ← units

Chapter 12 Universal Gravity

3. The planet Jupiter has a mass of 1.898 x 10^{27} kg and a radius of 6.99 x 10^{7} meters. Calculate the weight of a 70.0 kg astronaut standing on the surface of Jupiter.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

F =

m_1 =

m_2 =

d =

G = 6.67 x 10^{-11} Nm^2/kg^2

a) _____ ← units

4. Find the gravitational force of attraction between the Earth and the Moon. The moon has a mass of 7.35 x 10^{22} kg, the Earth has a mass of 5.98 x 10^{24} kg, and the distance between the two is 3.84 x 10^{8} m.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

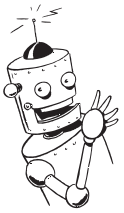
F =

m_1 =

m_2 =

d =

G = 6.67 x 10^{-11} Nm^2/kg^2



a) _____ ← units

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Chapter 12 Universal Gravity

5. The gravitational force of attraction between two monkeys sitting at their desks in their physics classroom is 3.20×10^{-8} N. If one monkey has a mass of 53.0 kg and the other monkey has a mass of 68.0 kg, how far apart are the two monkeys sitting?

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$F =$

$m_1 =$

$m_2 =$

$d =$

$G = 6.67 \times 10^{-11}\ \text{Nm}^2/\text{kg}^2$

a) _____ ← units

6. Your secret admirer is sitting near you in the classroom right now as you read this problem. Not only are they attracted to you because of your good looks but there is also a gravitational force of 7.94×10^{-7} N between the two of you. If you have a mass of 62.0 kg and the person you are attracted to has a mass of 48.0 kg, how far away is your secret admirer? Who do you think it is based on your calculations.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

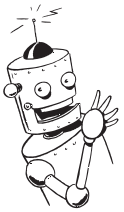
$F =$

$m_1 =$

$m_2 =$

$d =$

$G = 6.67 \times 10^{-11}\ \text{Nm}^2/\text{kg}^2$



a) _____ ← units b) _____ ← units

Chapter 12 Universal Gravity

7. How high above the surface of the Earth would you have to lift a 1.0 kg mass so that the gravitational force of attraction between the mass and the Earth was 1 N? [Hint: subtract the distance to the Earth's center from your answer. Distance to Earth's center is 6,380,000 meters]

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$F =$

$m_1 =$

$m_2 =$

$d =$

$G = 6.67 \times 10^{-11}\ \text{Nm}^2/\text{kg}^2$

a) _____ ⟵ units

8. The Planet of Apes has a radius 2.5 times that of the Earth's radius but has the same mass as the Earth. Calculate the acceleration of gravity on the surface of the Planet of the Apes and calculate the weight of a 65.0 kg man standing on the surface. [The Earth has a radius 6,380,000 meters and a mass of 5.98×10^{24} kg]

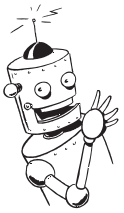
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$g_p =$

$M_p =$

$r_p =$

$G = 6.67 \times 10^{-11}\ \text{Nm}^2/\text{kg}^2$



a) _____ ⟵ units b) _____ ⟵ units

Chapter 12 Universal Gravity

9. The Hubble Telescope orbits the Earth 6,978,000 above the surface of the Earth's center. How fast is the Hubble Telescope traveling to stay in orbit at this location.

Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

v =

M_p =

r_p =

G = 6.67 x 10^{-11} Nm^2/kg^2

a) _____ ← units

10. A communications satellite stays in the same spot in the sky above the Earth's surface. It completes a single orbit in 24 hours. This orbit is unique and called a "geosynchonous orbit." How high above the Earth's surface is the satellite orbiting? [The Earth has a radius 6,380,000 meters]

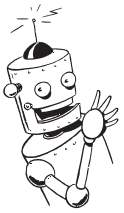
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

v =

M_p =

r_p =

G = 6.67 x 10^{-11} Nm^2/kg^2



a) _____ ← units

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