WORKSHEET – Law of Universal Gravitation

mass of: **radius of:**

Earth → 5.98×10^{24} kg   Earth → 6.38×10^{6} m
Jupiter → 1.91×10^{27} kg   Jupiter → 7.14×10^{7} m
Mars → 6.43×10^{23} kg   Mars → 3.40×10^{6} m
Mercury → 3.32×10^{23} kg   Mercury → 2.44×10^{6} m
moon → 7.36×10^{22} kg   Neptune → 2.43×10^{7} m
Neptune → 1.03×10^{26} kg   sun → 7.00×10^{8} m
Saturn → 5.68×10^{26} kg   Uranus → 2.61×10^{7} m
sun → 1.99×10^{30} kg   Venus → 6.05×10^{6} m
Uranus → 8.74×10^{25} kg
Venus → 4.89×10^{24} kg

distance from Earth to the sun → 1.50×10^{11} m   **distance from Saturn to the sun → 1.43×10^{12} m**
distance from Earth to the moon → 3.84×10^{8} m

1 pound = 4.545 newtons   **1 meter = 3.28 feet**   **1 mile = 1609 meters**

1) How much would a 70.0-kg person weigh on Mercury?

2) How much would your 20.0-kg dog weigh on Neptune?

3) If Pete (mass = 90.0 kg) weighs himself and finds that he weighs 30.0 pounds, how far away from the surface of the earth is he?

4) Captain Kirk (80.0 kg) beams down to a planet that is the same size as Uranus and finds that he weighs 1250 N. What is the mass of that planet?

5) Which is greater, the force exerted by Saturn on the sun, or the force exerted by the earth on the Sun? How much greater?

6) A distance of 2.00 mm separates two objects of equal mass. If the gravitational force between them is 0.0104 N, find the mass of each object.

7) Calculate the gravitational field strength (g) on the surface of Jupiter.

8) If the gravitational field strength at the top of Mount Everest is 9.772 N/kg, approximately how tall (in feet) is the mountain?

9) If you dropped a ball while standing on the surface of Mars, at what rate would it accelerate toward the ground?

10) A space probe lands on the surface of a spherical asteroid 250 miles in diameter and measures the strength of its gravitational field at that point to be 4.95×10^{-11} N/kg. What is the mass of the asteroid?

11) Determine the force the sun exerts on an object with a mass of 80.0 kg if that object is on the earth. What is the force exerted by the moon on the same object? What is the force the earth exerts on it?

12) If a person weighs 882 N on the surface of the earth, at what altitude above the earth's surface must they be for their weight to drop to 800 N?

13) If a 50.0-kg mass weighs 554 N on the planet Saturn, calculate Saturn's radius.

14) Calculate the distance between the center of the earth and the center of the moon at which the gravitational force exerted by the earth on an object is equal in magnitude to the force exerted by the moon on the object.

ANSWERS:
1. 260. N   2. 233 N   3. 9.85 x 10^6 m   4. 1.60 x 10^{26} kg
5. $F_{Saturn - sun}$ = 3.69 x 10^{22} N $F_{earth – sun}$ = 3.53 x 10^{22} N ΔF = 1.60 x 10^{21} N   6. 25.0 kg   7. 25.0 N/kg
8. 28980 ft   9. 3.71 m/s²   10. 3.00 x 10^{10} kg
11. $F_{sun – object}$ = 0.472 N $F_{moon – object}$ = 0.00266 N $F_{earth-object}$ = 784 N   12. 3.19 x 10^5 m
13. 5.85 x 10^7 m   14. 3.46 x 10^8 m