Name:_____ Universal Gravitation Assignment

1. On Earth, two parts of a space probe weigh 12000N and 9900N These parts are separated by a center to center distance of 12m and may be treated as uniform spherical objects. Find the magnitude of the gravitational force that each exerts on the other out in space far from any other objects. (5 marks)

$m_1 = \frac{12000}{9.81} = 1223.2\ kg$ $\quad F_g = \frac{G m_1 m_2}{r^2}$

$m_2 = \frac{9900}{9.81} = 1009.2$ $\quad = \frac{(6.67\times10^{-11})(1223.2)(1009.2)}{12^2}$

$= 5.7\times10^{-7} N$

2. Calculate the acceleration due to gravity on Venus. (3 marks)

$g = \frac{Gm}{r^2} =$

$= \frac{(6.67\times10^{-11})(4.89\times10^{24})}{(6.05\times10^{6})^2}$

$= 8.91\ m/s^2$

3. A space monkey weighs 480N on Earth. What will the monkey weigh on another planet whose radius is 4 times that of Earth and whose mass is a quarter that of the Earth? (3 marks)

$F_g \propto \frac{G m_1 m_2}{r^2}$ $\quad F_g \propto \frac{1}{64}$

$\propto \frac{(1)(1)(\frac{1}{4})}{4^2}$ $\quad \frac{1}{64}(480) = 7.5\ N$

4. Iona Ford (m=75.0kg) feels like he weighs 641N, how far from the surface of the Earth is she? (4marks)

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

$\sqrt{r^2} = \sqrt{\frac{G m_1 m_2}{F_g}}$ $\quad r = \sqrt{\frac{(6.67\times10^{-11})(75)(5.98\times10^{24})}{641}}$

$= 693148 - r_e$

$= 4.51\times10^{5} m$

5. A distance of 3.50 mm separates two objects of equal mass. If the gravitational force between them is 0.2104 N, find the mass of each object. (3 marks)

$r = 3.5\text{ mm}$
$= 0.0035$

$m_1 = m$
$m_2 = m$

$F_g = 0.3104$

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

$F_g = \frac{G m m}{r^2}$

$F_g = \frac{G m^2}{r^2}$

$\frac{F_g r^2}{G} = \frac{G m^2}{G}$

$\sqrt{m^2} = \sqrt{\frac{F_g r^2}{G}}$

$m = \sqrt{\frac{F_g r^2}{G}}$

$m = 197\text{ Kg}$

6. If the gravitational field strength at the top of Mount Assisippi is 9.789 N/kg, approximately how tall is the mountain? (4 marks)

$g = \frac{Gm}{r^2}$

$\sqrt{r^2} = \sqrt{\frac{Gm}{g}}$

$r = \sqrt{\frac{(6.67\times10^{-11})(5.98\times10^{24})}{9.789}}$

$= 3287\text{ m}$

$- r_e$

7. If you dropped a ball while standing on the surface of Mercury, at what rate would it accelerate toward the ground? (2 marks)

$g = \frac{Gm}{r^2}$

$= \frac{(6.67\times10^{-11})(3.32\times10^{23})}{(2.44\times10^{6})^2} = 3.72\text{ m/s}^2$

8. A space probe lands on the surface of a spherical asteroid 603km in diameter and measures the strength of its gravitational field at that point to be 9.34×10^{-2} N/kg. What is the mass of the asteroid? (3 marks)

$d = 603000\text{ m}$
$r = 301500$

$r^2\left(g = \frac{Gm}{r^2}\right)r^2$

$\frac{gr^2}{G} = \frac{Gm}{G}$

$m = \frac{gr^2}{G}$

$m = \frac{(9.34\times10^{-2})(301500)^2}{6.67\times10^{-11}}$

$= 1.27\times10^{20}\text{ Kg}$