Name SOLUTIONS Date _____

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Universal Gravitation and More

$w=mg$ $F=Gm_1m_2/r^2$

$G = 6.67 \times 10^{-11}$ mass of the earth = 5.98×10^{24} kg radius of the earth = 6.38×10^{6} m

1) A 70 kg mass is 20 m from a 50 kg mass. What is the gravitational attraction between them?

$m_1 = 70\text{kg}$
$r = 20\text{m}$
$m_2 = 50\text{kg}$
$F = ?$

$$F = \frac{Gm_1m_2}{r^2}$$

$$F = \frac{(6.67\times10^{-11})(70)(50)}{20^2} = \boxed{5.84\times10^{-10}\text{N}}$$

2) Mars is 2.3×10^{11} m from the sun. Its mass is 6.4×10^{23} kg. The sun's mass is 1.99×10^{30} kg. What is the gravitational attraction between Mars and the Sun?

$r = 2.3\times10^{11}\text{m}$
$m_1 = 6.4\times10^{23}\text{kg}$
$m_2 = 1.99\times10^{30}\text{kg}$
$F = ?$

$$F = \frac{Gm_1m_2}{r^2}$$

$$F = \frac{(6.67\times10^{-11})(6.4\times10^{23})(1.99\times10^{30})}{(2.3\times10^{11})^2}$$

$$F = \boxed{1.61\times10^{21}\text{N}}$$

3) The radius of Neptune is 2.27×10^{7} m. Its mass is 1.03×10^{26} kg. What is the gravitational force or weight felt by a 70 kg person on Neptune?

$r = 2.27\times10^{7}\text{m}$
$m_1 = 1.03\times10^{26}\text{kg}$
$m_2 = 70\text{kg}$
$F = ?$

$$F = \frac{Gm_1m_2}{r^2}$$

$$F = \frac{(6.67\times10^{-11})(1.03\times10^{26})(70)}{(2.27\times10^{7})^2}$$

$$F = \boxed{933.27\text{N}}$$

Answers: 1) 5.84×10^{-10} N 2) 1.61×10^{21} N 3) 933.27 N

4) What is the acceleration due to gravity on Neptune? Hint:use information from problem 4

$g = ?$

$W = 933.27\,N$

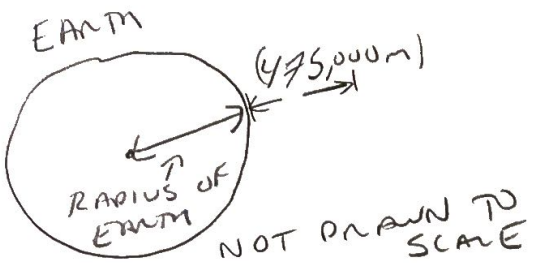
$m = 70\,kg$

$W = mg$

$933.27 = 70g$

$\frac{933.27}{70} = g = \boxed{13.33\,m/s^2}$

5) What is the orbital radius of a satellite of earth, when the satellite is 475,000 m above the earth's surface?



ORBITAL RADIUS = RADIUS OF EARTH + 475,000M

$r = 6.38 \times 10^6 + 475,000 = 6,855,000\,m$

$r = \boxed{6,855,000\,m}$ or $\boxed{6.86 \times 10^6\,m}$

6) A 500 N force is applied to a 70 kg object. If its acceleration is 5 m/s^2, what was *u*?

$APPLIED = 500N$

$m = 70kg$

$a = 5m/s^2$

$u = ?$

$F = ma$ = NET FORCE

$F = (70)(5) = 350N$

NET = APPLIED − FRICTION

$350 = 500 - FRICTION$

$FRICTION + 350 = 500$

$FRICTION = 500 - 350$

$FRICTION = 150N$

FRICTION = (NORMAL)(u)

$150 = NORMAL\,(u)$

$150 = (weight)(u)$

$150 = (mg)\,u$

$150 = (70)(9.8)\,u$

$150 = 686\,u$

$\frac{150}{686} = u = \boxed{.22}$

Answers: 4) 13.33 m/s² 5) 78.4 cm 6) 0.22