yellow

Name Key Hour _____

Practice TEST for Circular Motion/Gravity/Pendulums

1. A pilot (72 kg) is flying a small plane in a circular path with a radius of 50 m. If it takes him 15.7 sec to make 1 circle, calculate the centripetal force acting on him.

① $v = \frac{2\pi r}{T}$ $\frac{2(\pi)(50)}{15.7} = 20\frac{m}{s}$ ② $F_c = \frac{mv^2}{r}$ $\frac{72(20^2)}{50} =$ **576 N**

2. Calculate the force of attraction between the Earth and the moon if the distance from center to center is **3.84×10^8 m**.

$F_g = \frac{Gm_1 m_2}{r^2} = \frac{G(5.98\times10^{24}\,kg)(7.35\times10^{22}\,kg)}{(3.84\times10^8)^2} =$ **1.99×10^{20} N**

3. How far away from the center of the earth **(r)** would you (100 kg) need to go in order for the acceleration due to gravity to be equal to 2.9 m/s²? What would your **weight** be there? How **many g's** would you feel?

① $g = \frac{Gm}{r^2}$ $2.9\frac{m}{s^2} = \frac{G(5.98\times10^{24})}{r^2}$

$r = 1.17\times10^7$ m

② $w = m \cdot g$ $(100)(2.9\frac{m}{s^2}) =$ **290 N**

③ $g's = \left|\frac{290\,N}{100(9.8)}\right| =$ **0.296 g's**

4. A satellite for AT&T is orbiting at 450,000 m above the surface of the earth. Calculate how fast it is traveling in **mph.**

$r = 450{,}000 + 6.37\times10^6 = 6{,}820{,}000$ m

① $g = \frac{GM}{r^2} = \frac{G(5.98\times10^{24})}{6{,}820{,}000^2} = 8.575\frac{m}{s^2}$

② $g = \frac{v^2}{r}$ $8.575 = \frac{v^2}{6820{,}000}$

$v = 7648\frac{m}{s} \times \frac{1\,mi}{1609\,m} \times \frac{3600\,sec}{1\,hr} =$ **17110 mph**

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5. What are the **definitions and units** for the following items: gravitational force, centripetal force, centrifugal force, mass, G, period

gravitational force (F_g) - Force of attraction between 2 objects (N)
centripetal force (F_c) - Force needed to keep an object moving in a circle (N)
centrifugal force - inertia
mass - amount of matter (kg)
G - universal gravitation constant ($6.67 \times 10^{-11}\ N \cdot \frac{m^2}{kg^2}$)
period - time to make 1 revolution (sec)

6. How many meters long should a pendulum on earth be to have a period of 1.5 sec if the mass is 3.5 kg?

$T^2 = \frac{4\pi^2 L}{g}$ $\quad 1.5^2 = \frac{4\pi^2 L}{9.8}$ $\quad L = 0.559m$ or $55.9cm$

7. What affect does mass have on the period of a pendulum?

NONE!

8. What affect does length have on the period of a pendulum?

Longer length = longer period

9. Find the period (T) of a pendulum with a length of 0.84 m on the International Space Station which is 344,000 m above the surface of the Earth. $r = 6.37 \times 10^6 + 344{,}000 = 6{,}714{,}000$

① $g = \frac{Gm}{r^2} = \frac{G(5.98 \times 10^{24})}{(6{,}714{,}000)^2} = 8.85\ m/s^2$

② $T^2 = \frac{4\pi^2 L}{g} = \frac{4\pi^2(.84)}{8.85} = \sqrt{T^2} = \sqrt{3.75}$

$T = 1.94\ sec$