Name Key Hour _____

# Review for the Circular Motion and Gravity Test

**Make sure you understand all the information on:**

- Flying Pigs Assignment
- Gravity Notes
- Level 1 and Level 2 Problems
- Pendulum Lab
- Summary of circular motion and gravity
- Book assignment

**Circular Motion and Centripetal Force.**

1. Explain the difference between "Δt" and "T."

Δt = change in time  T = period = time to make 1 revolution

2. Explain the difference between centripetal force and centrifugal force.

force required to move in a circle  ~ inertia

3. Calculate the speed in **miles per hour** that we travel around the sun if the average radius is $1.5 \times 10^{11}$ m. *(ans. about 66,870 mph) (Yes you do know T!)* **Assume circular path at constant speed**

$365d \times \frac{24hr}{1d} \times \frac{3600s}{1hr} = 31536000$  $V = \frac{2\pi r}{T} = \frac{2\pi(1.5\times10^{11}m)}{31536000} = 29886\frac{m}{sec} \times \frac{1mi}{1609m} \times \frac{3600s}{1hr} =$ 66,867 mph

4. Calculate the centripetal force acting on you (mass 60 kg) if you are driving in a circle with a radius of 6.37 meters and it takes you 47 seconds to drive around that circle 10 times. *(ans. 683 N )*

① $V = \frac{2\pi r}{T}$

② $F_c = \frac{mV^2}{r}$

5. You (mass 65kg) are at a NASA training center preparing to handle g-forces in space. You get inside a capsule with a radius of 3 meters that spins in a plane that is parallel to the floor. If you spin at 35 **miles per hour**, how many g's will you experience? *(ans. 8.3 g's)*

m = 65kg
v = 15.64
r = 3

~15.64 m/s

$F_c = \frac{mv^2}{r} = \frac{65(15.64^2)}{3} = 5300N$  $g's = \frac{5300N}{65(9.8)} = 8.3g's$

**Gravitation**

6. Calculate the gravitational force between the earth and the moon. (The earth and the moon are at an average distance of $3.8 \times 10^8$ m apart. The distance includes the radius already! The mass of the moon is on your equation sheet) *(ans. $2.03 \times 10^{20}$ N)*

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

7. What happens to the acceleration due to gravity as you go further away from the earth? ↓
8. Calculate the acceleration due to gravity on the **moon**. (1.62 m/s²)

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

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9. What 2 variables does gravitational force depend on? mass & distance
10. What are the units of: Fg, g, G, and Fc?

N $m/s^2$ $N \cdot m^2/kg^2$ N

11. In order for an object to stay in a consistent orbit, what 2 forces must be equal? _____

12. Calculate the velocity a satellite must have in order to maintain an altitude of 1,500,000 m above the **earth's surface**. *(ans. 7,119 m/s)*

$r = 6.37\times10^6 + 1{,}500{,}000 = 7.87\times10^6 m$

① $g = \frac{Gm}{r^2}$ $(6.44 \frac{m}{s^2})$

② $g = \frac{v^2}{r}$

13. Calculate your **weight in Newtons** and **how many g's** you would feel (compared to weight on Earth) if you were 804,500 m above the surface of **Jupiter** (mass $1.9 \times 10^{27}$ kg, radius 71,492,000 m). You can assume your mass is 65 kg. *(ans. 1,576 N, 2.47 g's)*

$r = 71{,}492{,}000 + 804{,}500 = 7.2297\times10^7 m$

① $g = \frac{Gm}{r^2} = \frac{G(1.9\times10^{27})}{(7.2297\times10^7)^2} = 24.2 \frac{m}{s^2}$

② $Fg = m \cdot g$ (1576N)

③ $g's = \frac{1576}{65(9.8)} = 2.47 g's$

14. Calculate the height of a satellite from the center of the Earth (r) if it is moving around the earth at 6928 m/s and the gravity there is 5.78 m/sec$^2$. *(about $8.3 \times 10^6$ m)*

$v = 6928 \frac{m}{s}$

$g = 5.78 \frac{m}{s^2}$

① $g = \frac{v^2}{r}$

**Pendulums**

15. What variable(s) (length, mass, gravity) affect(s) the period of a pendulum? Explain how the equation for a pendulum backs up your answer.

Length - not mass - ↑ length, ↑ period

$T^2 = \frac{4\pi^2 L}{g}$ ← no MASS!

16. A friend bets you that you can't make a pendulum with a period of exactly one second. What length would you make it and how much mass would you attach to the end of it? Show your calculations. *(ans. 0.25 m, doesn't matter)*

mass doesn't matter!

$T^2 = \frac{4\pi^2 L}{g}$

17. Find the length of a pendulum on the MOON (g=1.62 m/s$^2$) that has a period of 2.15 sec.

$T^2 = \frac{4\pi^2 L}{g}$ $2.15^2 = \frac{4\pi^2 L}{1.62}$ $L = 0.19m$