Circular Motion & Gravity Practice Test - Pre-AP Physics Name: Answers

Gravitate to an A in a round about way!

Short Answer

1. What does the word *centripetal* mean?

inward

2. For an object in uniform circular motion, there must be a *centripetally* / *centrifugally* (circle one) directed force acting on the object.

3. The acceleration of an object in uniform circular motion depends on two things. List the two.

Speed & radius

4. For the following examples, name the force responsible for uniform circular motion:

An electron orbiting a positive atomic nucleus electric force

A satellite orbiting the Earth gravity

A car turning on a flat road friction (static we hope!)

A stopper spinning in the String in the Glass Tube Lab tension

A person in a roller coaster loop-the-loop normal

5. Some physics students casually refer to these three using the same word (gravity), but what's the difference between $\mathbf{F_g}$, $\mathbf{G}$, and $\mathbf{g}$?

F_g → force of gravity

G → universal gravitational constant

g → accel. due to gravity (or gravitational field)

6. Suppose the distance between two students on the gym floor is suddenly increased to 3 times its original value. What happens to the gravitational force between the two?

Increase / *decrease* / *stays the same?* (circle one)

If it changes, by how much? → 1/9 original force

Would the two students notice? → no. (too small anyway)

7. Which of Kepler's 3 Laws of Planetary Motion overthrew the ancient idea that planets traveled in circles? *1st, 2nd, or 3rd?* (circle one--if you can't remember the number and would rather summarize the law, that's fine to do instead)

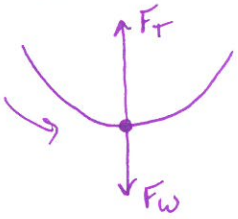
1st → planets travel in ellipses with Sun at one focus of the ellipse

8. Which of Kepler's 3 Laws of Planetary Motion overthrew the ancient idea that planets traveled at constant speeds in their orbits? *1st, 2nd, or 3rd* (circle one--if you can't remember the number and would rather summarize the law, that's fine to do instead)

2nd → ... sweeps out equal areas in equal times (so speed faster when closer)

9. Tarzan (m = 87 kg) swings on a 10.0 meter long vine in a circular arc. At the bottom of the swing the tension in the vine is 1200 N. Draw a free body diagram and use it to help calculate the speed of Tarzan at the bottom of his swing.

F.B.D.:



$\Sigma F = ma$

$F_T - F_W = m a_c$

$F_T - mg = m\frac{v_T^2}{r}$

6.319

$1200N - (87kg)(9.8m/s^2) = (87kg)\frac{(v_T^2)}{10m}$

Speed = 6.3 m/s

10. Brian swings a bucket full of water around in vertical circle. The distance from his shoulder socket to the center of mass of the bucket is 1.25 m. Starting with a free-body diagram and Newton's 2nd Law, determine the minimum speed he must swing the bucket at the top of its path in order to complete the circular path.

F.B.D.:

at v_{min}, F_T approaches zero

so

$\Sigma F = ma$

$F_W = m a_c$

$mg = m\frac{v_T^2}{r}$

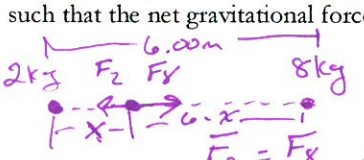
$g = \frac{v_T^2}{r}$

$9.8 = \frac{v_T^2}{1.25}$

3.5

Speed = 3.50 m/s

11. A 2.00 kg mass and an 8.00 kg mass are positioned 6.00 meters apart. Find the position one could place a 3rd mass in-between them such that the net gravitational force on it is zero. (Must be closer to 2kg mass...)



$F_2 = F_8$

$\frac{G(2)(m)}{x^2} = \frac{G(8)(m)}{(6-x)^2}$

$\frac{1}{x^2} = \frac{4}{(6-x)^2}$

$4x^2 = (6-x)^2$

$4x^2 = 36 - 12x + x^2$

$3x^2 + 12x - 36 = 0$

$x^2 + 4x - 12 = 0$

$(x+6)(x-2)$

$x = -6$ or $x = +2$ ✓

Distance from smaller mass: 2.00 M

12. Europa, a moon of Jupiter, apparently has liquid water under its icy surface. What value of **g** would an "Europan" life-form experience near the surface of Europa if the mass of the moon is 4.8 x 10^{22} kg and its radius is 1,561 km. (for comparison, g for Earth's Moon is 1.6 m/s^2)

↳ 1,561,000 m

$g = \frac{GM_p}{r_p^2}$

$g = \frac{(6.67E{-}11)(4.8E22)}{(1,561,000)^2}$

$g = 1.313896$

g = 1.3 m/s²

13. The dwarf planet Pluto's largest moon is named Charon. If Charon orbits in a radius of 17,536 km and with a period of 6.387 days, determine the mass of Pluto.

17,536,000 m

6.4 x 86,400 s/day = 551,836.8 s

$T^2 = \frac{4\pi^2}{GM} r^3$

$M = \frac{4\pi^2 r^3}{GT^2}$

$M = \frac{4\pi^2 (17,536,000)^3}{(6.67E{-}11)(551,836.8)^2}$

$M = 1.048E22$

Mass = 1.048 E22 kg