Honors Physics Circular motion and gravitational force Quiz review

Name Key

1) Gravity always points in what direction? What is the formula for universal gravitation?

Down, towards each other. $F_g = \frac{G M_1 M_2}{r^2}$

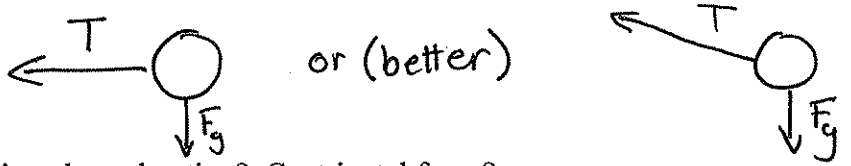
2) How do you find the circumference and area of a circle?

$C = 2\pi r = \pi d$ $\quad A = \pi r^2$

3) How do you determine 'g' for a planet?

$F_g = F_g \longrightarrow mg = \frac{GM_m}{r^2} \longrightarrow g = \frac{GM_p}{r_p^2}$

4) A ball is being twirled horizontally on a string. Draw the free body diagram for the ball.

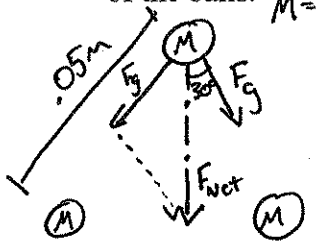


5) How do you find centripetal acceleration? Centripetal force?

$a_c = \frac{V^2}{R}$ $\quad F_c = \frac{mV^2}{R}$

6) Draw the path of a ball moving in a circle. At three points draw a vector representing the velocity of the ball. On a separate circle, draw the path the ball would follow if the string twirling it in a circle were suddenly to magically disappear.

7) Three spheres of mass 2,500 kg each are located at the corners of an equilateral triangle of side length 0.05 m out in space. Determine the magnitude and direction of the gravitational force on ONE of the balls.



$M = 2500$ kg

$F_g = \frac{GM_1M_2}{r^2} = \frac{(6.67\times10^{-11}\frac{Nm^2}{kg^2})(2500\,kg)(2500\,kg)}{(.05)^2} = 0.167N$

x directions cancel so

$F_{Net} = 2F_{gy} = 2F_g\cos 30 = 2(.167)\cos 30 = 0.290N$

Towards the center of the triangle.

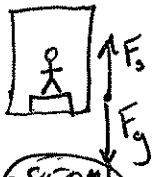
8) An 85 kg man stands on a scale in an elevator. The elevator can accelerate at 3 m/s^2. What is the reading on the scale when the elevator is stopped? When it is accelerating up? When it is moving up at a constant speed? When it is accelerating downward? When it is moving down at a constant speed?

- Not moving
- constant speed

$\Sigma F = ma$

$F_s - F_g = 0$

$F_s = mg = (85\,kg)(10\,m/s^2) = 850N$



Up $\Sigma F = ma$

$F_s - F_g = (85)(3)$

$F_s - 850 = 255$

$F_s = 1155N$

Down $F_s - F_g = ma$

$F_s - 850 = (85)(-3)$

$F_s = -255 + 850$

$= 595N$

9) A camel runs in a circle of radius 25 m at a constant speed of 100 m/s. The coefficient of static friction between the camel and the sand is 0.25 and she has a mass of 300 kg.

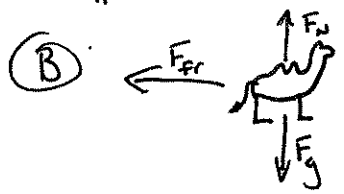
A) What is the maximum amount of friction available to the camel?

B) Draw a Free Body diagram of the camel.

C) Will the camel make it around the curve without slipping? How do you know?

A) $F_{fr} = \mu F_N \rightarrow (.25)(300\,kg \times 10\,m/s^2) = 750\,N$

B)



C) $\Sigma F_x = ma_r$

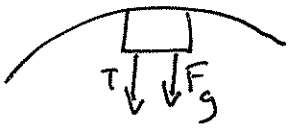
$F_{fr} \stackrel{?}{\geq} m\left(\frac{v^2}{R}\right)$

$750N \stackrel{?}{\geq} (300)\frac{(100)^2}{25}$

$750N \not\geq 1.2\times10^5 N$

so NO, it will slip. b/c $F_{fr} < F_c$

10) A bowling ball is swung in a vertical circle on a string. What is the minimum speed that the ball can have in order to make it around the circle without the string going slack?



$\Sigma F = ma$

$T + F_g = ma_c$

$0 + mg = m\left(\frac{v^2}{R}\right) \rightarrow g = \frac{v^2}{R} \rightarrow v = \sqrt{gR}$

11) Review your kinematics equations.

K1) $v = v_0 + at$

K2) $x - x_0 = v_0 t + \frac{1}{2}at^2$

K3) $v^2 = v_0^2 + 2a(x - x_0)$