Name: _____ **Date:** _____

Centripetal Acceleration Activity – Accelerometer Worksheet – Answers

1) What is the equation used for determining centripetal force and describe all components of that equation?

The equation used for centripetal force is $F = m (V^2/ r)$, where M is the mass, V is the linear velocity and r is the radius of the curved path.

2) What is the equation used for determining centripetal acceleration and describe all components of that equation?

Centripetal acceleration is the acceleration directed towards the center of the circle. The equation used for centripetal acceleration is $a = \omega^2 r = V^2/r$, where $V = \omega r$ and $\omega = 2\pi/$ time per one revolution, where *a* is the centripetal acceleration, *V* is the linear velocity, *r* is the radius of the curved path and ω is he angular velocity.

3) How does the accelerometer work? Please use pictures to describe how it works (use the backside of this sheet for drawing)?

Source: http://mindstorms.lego.com/en-us/products/MS1040.aspx#MS1040

Acceleration is measured in the range of –2g to +2g, with scaling of approximately 200 counts per g. The Acceleration Sensor can also be used to measure tilt in three axes. This is possible because gravity is perceived as acceleration. When the sensor is stationary and in the normal horizontal position, the x and y axis will be near zero, because they are horizontal, while the z axis will be near 200, which represents one *g*. If you tilt the sensor, then gravity is detected on the other axis and the value for the z axis goes down. The microscopic crystal structures become stressed from accelerative forces and cause a change in voltage. Some of the accelerative forces may cause a change in capacitance, which gets converted into voltage. They may also measure the change in g-force (free fall reference frame relative to itself). They will be able to detect this change in three different directions as a vector quantity.

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4) A round basket ball with a circumference of 50 cm is balanced on the tip of a finger and is spinning at a rate of 15 rev/sec. What is the centripetal acceleration of a point of the basket ball?

a) 50 cm = 0.5 m

b) 15 rev/ sec = 94.25 rads/ sec

c) Area of a circle = πr^2, _____

d) 0.5 m = πr^2 so $\sqrt{(0.5\ m/\pi)} = r$, r = 0.3989 m

e) $a = \omega^2 r$

f) $a = (94.25\ rads/sec)^2(0.3989)$,

$a = 3534\ rads^2/sec^2\ m$

5) A half-kilogram around gum-ball has an area of 1.5 sqr. meters. In order to have a centripetal force of 100 Newtons, how many revolutions per second must the gum-ball make in rads/ sec?

a) 100 N=100 Kg(m/s^2)

b) Area of a circle = πr^2, 1.5 $m^2 = \pi r^2$, $\sqrt{(1.5\ m^2 / \pi)} = r$, r = 0.691m

c) $F = m\ (V^2/r)$, 100 Kg(m/s^2) = 0.5 Kg (V^2/0.691), $V = \sqrt{((100\ Kg(m/s^2)/\ 0.5\ Kg)(0.691m))}$

d) V = 11.74 m/s or 73.86 rads/ sec

6) If accelerometer is measuring all three axes, then would the change in g be the same across all three axes? Why or why not?

The change in g would not be the same across all three axes because when the sensor is stationary and in the normal horizontal position, the x and y axis will be near zero, because they are horizontal, while the z axis will be near 200, which represents one *g*. If you tilt the sensor, then gravity will also be detected on the other axis, and the value for the z axis will go down. Thus, the g value will not bet the same across all three axes.