DO NOT TURN THIS PAGE!!!!!

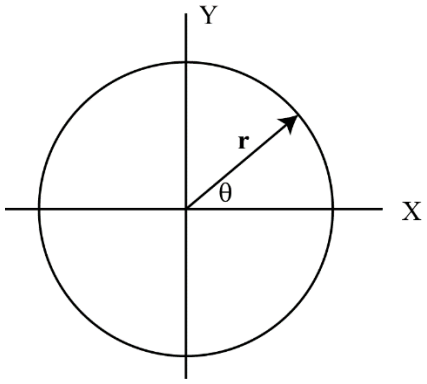
NAME: _____

PHYSICS 4A
WINTER 2018
EXAM 1

PARTIAL CREDIT will be given so do what you can and make sure that you show all work for each problem. **No credit will be given if no work is shown**. The point value of each question is indicated.

1. Just as you throw a package from the top of a 20 m high building with initial speed V_o at an angle of 30^o with the horizontal, your friend, who is running toward the building at speed 0.8Vo, is 22 m away. (15 pts)
   a) Calculate V_o in order for your friend to catch the packaqe.
   b) How far from the building does the friend catch the package.
   c) Calculate the speed at which the friend catches the package.
   d) Calculate the velocity vector in unit-vector notation of package relative to friend when it is caught.

2. Consider a particle moving in uniform circular motion (UCM) in the counter-clockwise direction along a circular path of radius **r** as shown below. At the instant shown below the position vector r makes an angle θ with the horizontal. (10 pts)



a) Obtain the position vector in unit-vector notation.
b) Obtain the velocity vector in unit vector notation.
c) Obtain the acceleration vector in unit vector notation.
d) Prove that the magnitude of the acceleration vector is $\frac{v^2}{r}$ and it's direction is radially inward.
e) Prove that the position vector is perpendicular to the velocity vector.

3. Suppose that the clock on our lecture room has a minute-hand length of 10 cm. (Use a coordinate system with the origin at center of clock and +x axis along the 3PM direction and the +y direction along the 12PM direction). From the 12 to 8 mark, for the tip of the minute hand: (15pts)

    a) Sketch a vector diagram labeling $\mathbf{r_i}$, $\mathbf{r_f}$, $\mathbf{\Delta r}$, $\mathbf{v_i}$, $\mathbf{v_f}$, and $\mathbf{\Delta v}$.
    b) Calculate the displacement vector in unit-vector notation.
    c) Calculate the average velocity vector in unit-vector notation.
    d) Calculate the average acceleration vector in unit-vector notation.
    e) Calculate magnitude and direction of the average acceleration vector.
    f) Calculate the magnitude and direction of the total acceleration of the tip of the minute hand at the 6 mark.

4. A rock dropped from a cliff falls one-fourth of its total distance to the ground in the last second of its fall. Determine the height of the cliff. (10 pts)

5. The acceleration of a particle moving through a fluid is given by $a = 5\sqrt{t}$ (m/s^2). (10 pts).

    a) If the particle enters the fluid moving at 0.5 m/s, calculate the velocity at 3 s later.
    b) Calculate the position of the particle 3.0 s after it enters the fluid. Assume that it enter the fluid at x = 0.