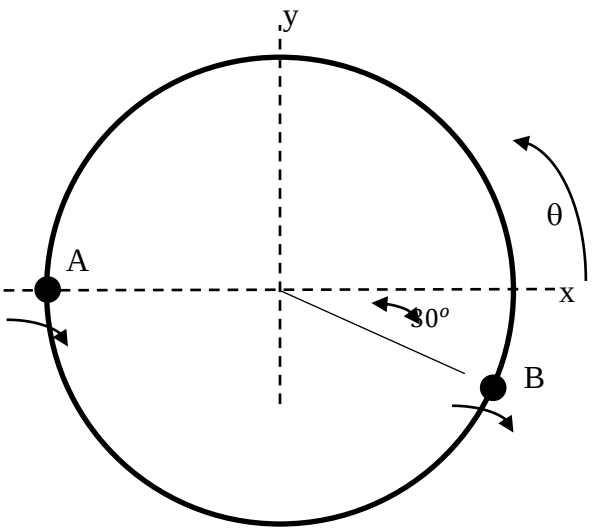
MIE100 Quiz – Jan 26, 2016

Allotted time: 75 minutes. Answer all questions

Answers to be placed in CrowdMark Booklets

1. The particles *A* and *B* both move in a circle of radius 40 meters around the origin in the directions shown. At time t = 0 seconds, the particles are at the position shown in the diagram. The speed of *A* is 5t and the speed of *B* is 2t, where the parameter "t" represents time in seconds. Angle θ is measured counter-clockwise from the positive x-axis, as shown.



5 (a) Determine the unit vector for the direction of the initial velocity particle *B* as soon as it starts to move. Express your answer in terms of its $\hat{\imath}$ and $\hat{\jmath}$ components, using the x-y rectangular coordinate system shown in the diagram.

10 (b) Determine $\dot{\theta}$ and $\ddot{\theta}$ of *B* at time t = 3 seconds.

5 (c) At what time t will $|a_n| = |a_t|$ for *A*?

10 (d) At what time t will particle *A* crash into *B*?

30 marks for question #1

2. The ground is sloped at 45^o as shown in the diagram. A cannon ball is shot from the origin into the air at time t = 0. Ignore air resistance. Initial velocity of the cannon ball is 57 m/s, at an angle of 60 degrees above the horizontal. Angle θ is measured counter-clockwise from the positive x-axis.

5 (a) Determine the position $\vec{r}(t)$ of the cannon ball as a function of time t measured in seconds. Express your answer in terms of its $\hat{\imath}$ and $\hat{\jmath}$ components, using the rectangular x-y coordinate system shown in the diagram.

10 (b) Find the radius of curvature of the cannon ball's path immediately after launch.

10 (c) Determine the velocity of the cannon ball in polar (r-θ) coordinates when it crosses the x-axis at point B.

5 (d) Determine the time at which the cannon ball hits the ground at point C.

30 marks for question #2