Worksheet for Exploration 6.5: Circular Motion and Work

Time: 4.52 Force: Gravity

vx (m/s)	vy (m/s)	KE (J)
-3.04	+3.90	+12.23
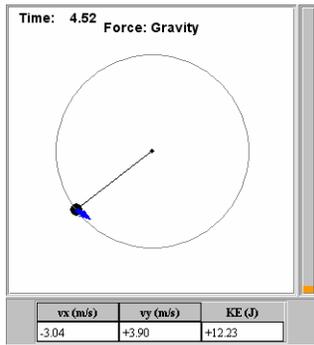
A 1-kg black ball is constrained to move in a circle as shown in the animation **(position is given in meters, time is given in seconds, and energy on the bar graph is given in joules)**. In the animation the wire is vertical and the ball is subjected to gravity (downward as usual), as well as the force of the wire. You may set the initial velocity and then play the animation. The blue arrow represents the net force acting on the mass, while the bar graph displays its kinetic energy in joules. Restart.

a. Set the speed fast enough to get the ball over the top. Then restart and examine forces at positions near say -45° and 45° (very roughly). (hanging straight down is –90°). Label your forces as F_g (gravity), F_{wire}, and F_{net}.

   i. Sketch a free body diagram and then a head to tail vector diagram indicating the two forces acting on the ball. Near -45° (Measure the position x=_____, y=_____)

   ii. Again. Near 45°.

   iii. Do again for –90°, 0° angles.

b. Given your force diagrams there are positions where the speed of the ball is changing more rapidly than others. Take each of the positions you considered and rank them from highest tangential acceleration to lowest.

Rank: _____ _____ _____ _____

i. Discuss what must happen for the ball to speed up or slow down.

c. Assume that the ball can get to y =10 m. How much kinetic energy does the ball lose in going from y = -10 m to y = 10 m? Is this independent of v_{0x} initial?

i. KE_{-10}=_____, KE_{+10}=_____

ΔKE=_____

d. What is the work done by gravity when the ball goes from y= -10 m to y = 10 m?
   i. To calculate the work done by gravity first show using symbols only, then determine a numerical value (ie plug numbers into your formula).

W_g=_____ (symbols)

W_g =_____ (number)

ii. How does your answer for work relate to the change in kinetic energy.

e. Determine the minimum speed that the ball must have (initially at the bottom) to go over the top. Once you have an answer check it using the animation.

$V_{bottom\ min}$=_____