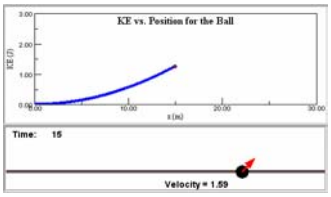
Worksheet for Exploration 6.4: Change the Direction of the Force Applied



A 20-kg ball has a hole with a rod passing through. The rod exerts a force as needed that constrains the ball to move along the rod. An applied force is now added (the "pulling" force) so the ball is pulled as shown **(position is given in meters and time is given in seconds)**. The pulling force vector is shown as a red arrow, and makes an angle θ with the horizontal. The velocity is given in meters/second. You may adjust the angle and/or the magnitude of the pulling force (F < 7 N). Restart.

a. How does the work done by the applied (pulling) force change as you vary the pulling force for a constant angle?
   i. Select a force magnitude and angle.

$|F_{pull}|$=_____

θ=_____

   ii. Make a sketch indicating the forces acting on the ball (vectors) and the direction of motion.

   iii. Calculate the work done by the F_{pull} from 0 to say 20m. Make sure your calculation agrees with the measurements made using the animation.

   iv. Now try changing the magnitude of the pulling force and repeat i,ii, and iii.

$|F_{pull}|$=_____

θ=_____

v. Consider your vector sketch with other force vectors on it (gravitational or the rod). Why didn't we need to consider those forces?

b. How does the work done by the applied force change as you vary the angle for a constant pulling force?
   i. Select a force, angle and displacement, then calculate the work done by the pulling force.

$|F_{pull}|$=_____ θ=_____ Δx=_____

W_{pull}=_____

   ii. Select a new angle then calculate the work done by the pulling force.

$|F_{pull}|$=_____ θ=_____ Δx=_____

W_{pull}=_____

c. Combine your answers above to a general mathematical formula for the work done on the ball due to an arbitrary applied force.

d. Determine the general mathematical formula for the work done by the normal force the rod exerts on the ball when an arbitrary force is applied to the ball.