Physics 11 OKM

Name: _____ Date: _____

Block: ____

Projectile Motion

Objects Launched Horizontally

1. A stone is thrown horizontally at a speed of +5.0 m/s from the top of a cliff 78.4 m high.
   a. How long does it take the stone to reach the bottom of the cliff?

$d_y = \frac{1}{2}gt^2 \Rightarrow t = \sqrt{\frac{2d_y}{g}}$

$t = \sqrt{\frac{2(-78.4\,m)}{-9.80\,m/s^2}} = \boxed{4.0\,s}$

   b. How far from the base of the cliff does the stone strike the ground?

$d_x = v_{ox}t$

$= (5\,m/s)(4.0\,s) = \boxed{20\,m}$

   c. What are the horizontal and vertical components of the velocity of the stone just before it hits the ground?
      i. Horizontal $+5.0\,m/s$
      ii. Vertical

$v_y = gt = (-9.80\,m/s^2)(4.0\,s) = \boxed{-39\,m/s}$

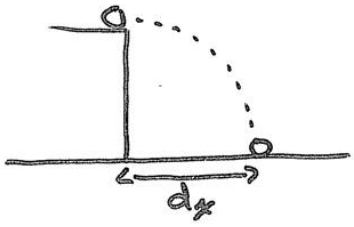
   d. What is the magnitude and direction of the velocity of the projectile upon impact with the ground? (Draw a diagram)

$v = \sqrt{v_{ox}^2 + v_{oy}^2} = \sqrt{(5.0\,m/s)^2 + (-39\,m/s)^2}$

$v = 39.3\,m/s = \boxed{39\,m/s}$

$\tan\theta = \frac{v_{ox}}{v_y} \rightarrow \theta = \tan^{-1}\left(\frac{5\,m/s}{39.3\,m/s}\right) = \boxed{7.3^\circ \text{ from vertical}}$

2. A steel ball rolls with constant velocity across a tabletop 0.950 m high. It rolls off and hits theground +0.352 m horizontally from the edge of the table. How fast was the ball rolling?



$d_y = \frac{1}{2}gt^2 \rightarrow t = \sqrt{\frac{2d_y}{g}}$

$t = \sqrt{\frac{2(-0.95\,m)}{-9.80\,m/s^2}} = \boxed{0.44\,s}$

$v_{ox} = \frac{d_x}{t} = \frac{0.352\,m}{0.44\,s} = \boxed{0.800\,m/s}$

Lachapelle From: Merril: Physics – Principles and Problems

3. An auto, moving too fast on a horizontal stretch of mountain road, slides off the road, falling into deep snow 43.9 m below the road and 87.7 m beyond the edge of the road.

   a. How long did the auto take to fall?

$$d_y = \frac{1}{2} g t^2 \rightarrow t = \sqrt{\frac{2 d_y}{g}} = \sqrt{\frac{2(-43.9\,m)}{-9.80\,m/s^2}} =$$

$$\boxed{t = 2.99\,s}$$

   b. How fast was it going when it left the road? (in m/s and km/h)

$$d_x = v_{ox} t \rightarrow v_{ox} = \frac{d_x}{t}$$

$$v_{ox} = \frac{87.7\,m}{2.99\,s} = \boxed{29.3\,m/s}$$

$$29.3\,\frac{m}{s}\left(\frac{1\,km}{1000\,m}\right)\left(\frac{3600\,s}{1\,h}\right) = \boxed{106\,km/h}$$

   c. What was it's acceleration 10 m below the edge of the road?

$$\boxed{g = -9.80\,m/s^2}$$

Lachapelle From: Merril: Physics – Principles and Problems