Practice Quiz **Projectile Motion** **Name**_____ **Date** _____

For each problem, on separate lined paper, sketch a diagram with relevant data labeled.
You do not need to show detailed calculations, but show the formulas you use for each problem, and show the formulas with the values substituted.

Example: $d = v \cdot t$
$= (183 \text{ m/s})(24.5\text{s}) = 4483.5 \text{ m} = 4480 \text{ m}$

1. A steel ball is rolled horizontally off a high platform at 12.0 m/s. It falls and hits the ground 18.0 m below.
   a) How long does the ball stay in the air?

   b) How far from the base of the platform does the ball hit the ground?

2. A ball is launched into the air by a cannon angled 57.0º above the horizon, at a speed of 278 m/s.
   a) What is the horizontal component of the ball's velocity?

   b) At what time will the ball reach its maximum height?

3. A water balloon is fired across a street, exactly following the contours of a parabolic bridge. The balloon is fired from ground level, reaches a maximum height of 12.3 meters, and lands across the street, 19.2 meters away.
   a) What was the y-component of the velocity?

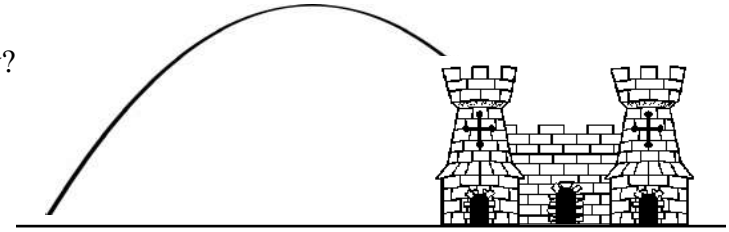
   b) How long was the balloon in the air? (Multiple ways to figure this out, but be careful.)

   c) What was the x-component of the velocity?

   d) At what speed and angle (above the horizontal) was the balloon launched?

4. The diagram below shows the trajectory of an arrow launched at a castle. The arrow leaves the bow at an initial velocity of 46.0 m/s, angled exactly 65 degrees above horizontal. It hits its target at the top of the castle, 36.2 meters above the point at which the arrow was fired.
   a) How long does the arrow spend in the air? (Pay attention to the diagram)

   b) How far has the arrow traveled horizontally?



5. (Bonus):
   A window washer is outside a tall skyscraper, moving downward at 3.70 meters per second. At the instant he reaches the height of 187 meters, a person on the ground fires a cannonball straight upwards at 66.0 m/s (aimed just to the side of the window washer, of course, not at him). At what times will the cannonball pass the window washer? (Make equations for the height of the window washer and the height of the ball.)

Solutions:

1a) $t=1.75$ s
1b) $d_x=21.0$m

2a) $v_x = v\cos\theta = 143$m/s
2b) $t = \Delta v/a = 18.1$s

3a) $v_{iy} = 16.8$m/s
3b) $t_{total} = 2\cdot t_{max\ ht} = 3.41$s
3c) $v_x = d_x/t = 5.04$s
3d) Use v_x and v_{iy} to calculate v_i; $v_i = 17.5$m/s@73° above horizontal

4a) Use quadratic formula to solve for t, or solve for both values of v_f, and then solve for both values of t.
t = 0.93s or **t=6.38s**
In this problem, the second time makes sense (for when the arrow is coming back down through that height, as shown in diagram).
4b) $d_x=v_xt = 127$m

5) position = $pos_i + v_it + \frac{1}{2}at^2$
Create an expression for the position of each object
(cannonball and window washer.)
Set the expressions equal to each other (to find when positions are equal)
Solve quadratic equation.
t = 2.82s or t =12.1s