Quiz 3
Physics 220
Fall 2013

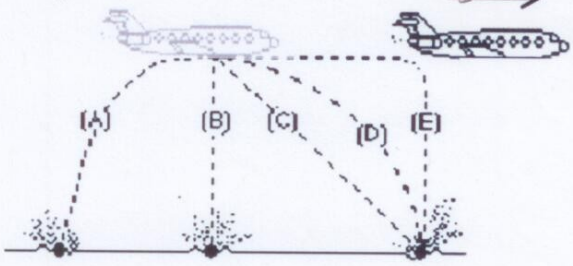
Name: Solution Group #: _____ 5 digit #: _____

1. Two metal balls are the same size but one weighs twice as much as the other. These balls are rolled off a horizontal table with the same speed. In this situation:
   a) both balls hit the floor at approximately the same horizontal distance from the base of the table.
   b) the heavier ball hits the floor at about half the horizontal distance from the base of the table than does the lighter ball.
   c) the lighter ball hits the floor at about half the horizontal distance from the base of the table than does the heavier ball.
   d) the heavier ball hits the floor considerably closer to the base of the table than the lighter ball, but not necessarily at half the horizontal distance.
   e) the lighter ball hits the floor considerably closer to the base of the table than the heavier ball, but not necessarily at half the horizontal distance.

   Explain Why:
   Each ball has the same initial speed. The time to fall is determined by how far they fall down and they each fall from the same height. So time & horizontal speed are the same making distance equal.

2. A bowling ball accidentally falls out of the cargo bay of an airliner as it flies along in a horizontal direction.

   Which path would the bowling ball most closely follow after leaving the airplane?



3. A projectile is launched with an initial speed of 30.0 m/s at an angle of 20° above the horizontal. The landscape is rolling hills and the projectile lands 3.00 seconds later. Neglect air resistance and use -9.8 m/s^2 for the acceleration due to Earth's gravity.
   a. What is its velocity just before it hits the ground?

30 m/s @ 20°

$x_i = 0m$ $y_i = 0m$
$x_f = ?$ $y_f = ?$
$v_{ix} = 28.19\ m/s$ $v_{iy} = 10.26\ m/s$
$V_{fx} = 28.19\ m/s$ $V_{fy} = ?$
$a_x = 0$ $a_y = -9.8\ m/s^2$
$\Delta t = ?$ $\Delta t = 3.00\ s$

$V_{yf} = V_{yi} + a_y \Delta t$

$V_{yf} = 10.26\ m/s + -9.8\ m/s^2 (3.00\ s) =$

$= -19.14\ m/s$

$V_{xf} = 28.19\ m/s$

$V_f^2 = V_{xf}^2 + V_{yf}^2 =$

$V_f = \sqrt{(28.19)^2 + (-19.14)^2}$

$= 34.07\ m/s = \boxed{34.1\ m/s}$ velocity requires speed and direction.

$\tan\theta = V_{fy}/V_{fx} = \frac{-19.14}{28.19} \Rightarrow \theta = \boxed{-34.2°}$

b. How far above or below the launch point must the landing site be?

$y_F = ?$ $\quad y_F = y_i + v_{y_i}\Delta t + \frac{1}{2} a \Delta t^2$ gives a quadratic :

$v_{yF}^2 = v_{yi}^2 + 2 a_y \Delta y$

$(19.14\,m/s)^2 = (10.2\,m/s)^2 + 2(-9.8\,m/s^2)\Delta y$

$261\,m^2/s^2 = -19.6\,m/s^2\,\Delta y$

$\boxed{-13.32\,m} = \Delta y = y_F - y_i^{\,0} = y_F$

4. A bus is moving at 15.0 m/s relative to the Earth. A passenger sitting in the front row throws a football to his friend in the back row. If the football is thrown with a horizontal velocity of -5.0 meters per second relative to the Earth, what is its velocity relative to the passengers in the bus? You must use relative motion notation in your work for full credit.

$V_{BE} = 15.0\,m/s$

$V_{FE} = -5.0\,m/s$

$V_{FB} = ?$

$V_{FB} = V_{FE} + V_{EB}$

$= -5.0\,m/s + -15.0\,m/s$

$= \boxed{-20.0\,m/s}$

$x_f = x_i + v_{xi}\Delta t + \frac{1}{2} a_x(\Delta t)^2$ $\qquad v_{xf} = v_{xi} + a_x \Delta t$ $\qquad v_{xf}^2 = v_{xi}^2 + 2a_x(\Delta x)$

$\sin\theta$ = opp/hyp $\qquad \cos\theta$ = adj/hyp $\qquad \tan\theta$ = opp/adj $\qquad a^2 + b^2 = c^2$