

Quiz 3
Physics 220
Spring 2014

Name: Solution Group # _____

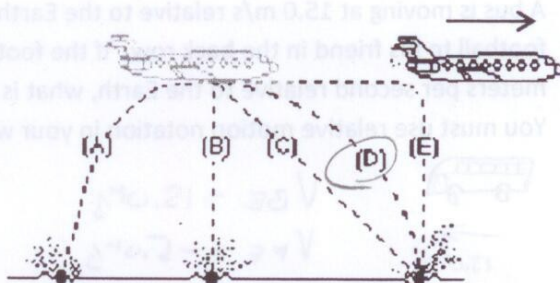
1. Two metal balls are the same size but one weighs twice as much as the other. These balls are rolled off a horizontal table with the same speed. In this situation:
- a) both balls hit the floor at approximately the same horizontal distance from the base of the table.
 - b) the heavier ball hits the 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:

The weight of the ball does not affect how far it travels or how long it takes to fall unless air resistance is involved. Metal balls rolling off a table do not experience much air resistance.

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?



Ball leaves the plane at the same speed the plane is traveling. It continues to travel at this speed and slows some as it falls due to air resistance.

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 13.0 meters below the launch point. Neglect air resistance and use -9.8 m/s² for the acceleration due to Earth's gravity. Find the velocity of the projectile just before it hits the ground.

$x_i = 0\text{m}$ $y_i = 0\text{m}$
 $x_f = ?$ $y_f = 13.0\text{m}$
 $v_{ix} = 28.2\text{m/s}$ $v_{iy} = 10.3\text{m/s}$
 $v_{fx} = 28.2\text{m/s}$ $v_{fy} = ?$
 $a_x = 0\text{m/s}^2$ $a_y = -9.8\text{m/s}^2$
 $\Delta t = ?$ $\Delta t = ?$

$v_x = 30.0\text{m/s} \cos 20^\circ = 28.2\text{m/s}$
 $v_y = 30.0\text{m/s} \sin 20^\circ = 10.3\text{m/s}$

Need v_{yf} then can combine v_{xf} & v_{yf} to get \vec{v}_f

$$v_{yf}^2 = v_{yi}^2 + 2a\Delta y$$

$$v_{yf}^2 = (10.3\text{m/s})^2 + 2(-9.8\text{m/s}^2)(13.0\text{m})$$

$$= 105.28\text{m}^2/\text{s}^2 + 254.8\text{m}^2/\text{s}^2$$

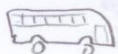
$$v_{yf} = 18.98\text{m/s}$$

$$v_f = \sqrt{v_{xf}^2 + v_{yf}^2} = \sqrt{(28.2\text{m/s})^2 + (18.98\text{m/s})^2} = 33.99\text{m/s}$$

$$\text{Direction } \tan \theta = v_y/v_x \quad \theta = \tan^{-1} v_y/v_x = \tan^{-1} \frac{18.98\text{m/s}}{28.2\text{m/s}} = 33.9^\circ$$

$$\boxed{34.0\text{m/s} @ -33.9^\circ}$$

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.



$$\rightarrow 15.0\text{m/s}$$

$$\leftarrow 5.0\text{m/s}$$

$$v_{BE} = 15.0\text{m/s}$$

$$v_{FE} = -5.0\text{m/s}$$

$$v_{FB} = ?$$

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

$$= -5.0\text{m/s} + -15.0\text{m/s}$$

$$\boxed{v_{FB} = -20\text{m/s}}$$

$$B = \text{Bus} \quad E = \text{Earth} \quad F = \text{Football}$$

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

$$\sin \theta = \text{opp/hyp}$$

$$\cos \theta = \text{adj/hyp}$$

$$\tan \theta = \text{opp/adj}$$

$$a^2 + b^2 = c^2$$