

W2.04

Projectile Motion Problems – KEY

- 1) What are the accelerations in both the y-direction and the x-direction for all projectile motion problems?

$$a_x = 0 \text{ m/s}^2 \quad a_y = -10 \text{ m/s}^2$$

- 2) A projectile has the least speed at what point in its path?

At its peak

- 3) The maximum range of a projectile occurs when it is aimed at 45° if air resistance is neglected. Is this true with air resistance? Why or why not? Would you expect the maximum range with air resistance to be at an angle higher or lower than 45° ? Why?

NO. Approx. 39° -less time in air = less decrease of horizontal velocity.

- 4) Assuming both start at the same distance above the ground, which would take longer to hit the ground: a bullet that is dropped from rest or a bullet that is fired with a horizontal velocity of 250 meter per second? Why?

SAME TIME! "Y" motion is identical for both!

- 5) A ball rolls off a table, with an initial horizontal velocity of 0.75 meters per second. The table is 0.90 meters tall. How far from the base of the table does the ball hit?

$$t = 0.424 \text{ sec} \quad \Delta s_x = 0.318 \text{ m}$$

- 6) A marksman fires a rifle horizontally at a target. The bullet leaves the gun at 250 meters per second. How much does the bullet drop in flight after it traveled 50 meters?

$$t = 0.2 \text{ sec} \quad \Delta s_y = -0.2 \text{ m}$$

- 7) An airplane flying horizontally at a speed of 150 meters per second drops a box from an elevation of 2,500 meters. (A) How much time is required for the box to reach the ground? (B) How far does it travel horizontally while falling? (C) Find the horizontal and vertical components of its velocity when it strikes the ground.

$$(A) t = 22.36 \text{ sec} \quad (B) \Delta s_x = 3,354.1 \text{ m} \quad (C) v_y = -223.6 \text{ m/s}$$

- 8) A ball is shot on a level surface with an initial speed of 15 meters per second. (A) Calculate the horizontal displacement if it is shot at 36.87° above the horizontal. (B) Calculate the horizontal displacement if it is shot at 53.13° above the horizontal. (C) How do your answers compare? (D) If the ball had been thrown at 40° , what other angle would allow it to have the same horizontal displacement?

$$(A) \Delta s_x = 12 \text{ m/s}(1.8 \text{ s}) = 21.6 \text{ m} \quad (B) \Delta s_x = 9 \text{ m/s}(2.4 \text{ s}) = 21.6 \text{ m} \quad (C) \text{ see A \& B} \quad (D) 50^\circ$$

- 9) A football is kicked, at ground level, with a speed of 20.0 meters per second at an angle of 36.87° above the horizontal. (A) How high does the ball travel? (B) How long is the ball in the air? (C) How far has it traveled when it strikes the ground?

$$(A) \Delta s_y = 6 \text{ m/s}(1.2 \text{ s}) = 7.2 \text{ m} \quad (B) 2.4 \text{ sec} \quad (C) 38.4 \text{ m}$$

- 10) A car is parked on top of hill by a cliff. Unfortunately, the car is parked in neutral, and it begins to roll down the hill. The hill has an incline of 13.0° below the horizontal, and the car is traveling at 13 meters per second by the time it reaches the edge of the cliff and begins falling. The cliff is 16.0 meters high. How far from the base of the cliff does the car strike?

$$[V_{0x} = 12.66 \text{ m/s} \ \& \ v_{0y} = -2.924 \text{ m/s}] \quad v_y = -18.126 \text{ m/s} \quad t = 1.52 \text{ s} \quad \Delta s_x = 19.25 \text{ m}$$