

Kinematics in 2-dimensions

Syll. Statements 9.1.1-9.1.4 due on Friday, 9/23/2011
 Reading Reference: 67-79 (vector component review)
 pp. 80-81 (horizontally launched projectiles)
 pp. 82-88 (projectiles launched at an angle)

- The following slides are preliminary questions to see what you are thinking as we enter this section of our mechanics unit.
- Choose the answer that you believe to be correct.
- You will have limited time to select your choice.
- Ready? ☺

First...a little clicker action

- A small cart is rolling at **constant** velocity on a flat track. It fires a ball straight up into the air as it moves. After it is fired, what happens to the ball?
 - **A.** It depends on how fast the cart is moving
 - **B.** It falls behind the cart
 - **C.** It falls in front of the cart
 - **D.** It falls right back into the cart

Pre-question 1

- Now the cart is being pulled along a horizontal track by an external force (a weight hanging over the table edge). It fires a ball straight out of the cannon as it moves. After it is fired, what happens to the ball?

- **A.** It depends on the size of the weight
- **B.** It falls behind the cart
- **C.** It falls in front of the cart
- **D.** It falls right back into the cart

Pre-question 2

- The same small cart is now rolling down an inclined track and accelerating. It fires a ball straight out of the cannon as it moves. After it is fired, what happens to the ball?

- **A.** It depends upon how much the track is tilted
- **B.** It falls behind the cart
- **C.** It falls in front of the cart
- **D.** It falls right back into the cart

Pre-question 3

- You drop a package from a plane flying at constant speed in a straight line. Without air resistance, the package will:

- **A.** Quickly lag behind the plane while falling
- **B.** Remain vertically under the plane while falling
- **C.** Move ahead of the plane while falling
- **D.** Not fall at all

Pre-question 4

- From the **same height** (and at the **same time**), one ball is **dropped** and another ball is **fired horizontally**. Which one will hit the ground first?

- **A.** The dropped ball
- **B.** The fired ball
- **C.** It depends on the initial height
- **D.** It depends on how fast the ball was fired
- **E.** They both hit at the same time

Pre-question 5

- In the previous problem, which ball has the greater velocity at ground level?

- **A.** The dropped ball
- **B.** The fired ball
- **C.** Neither—they both have the same velocity on impact
- **D.** It depends on how hard the ball was thrown

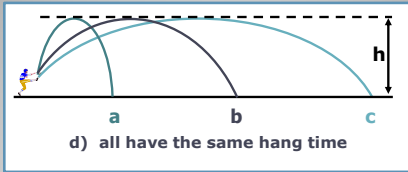
Pre-question 6

- A projectile is launched from the ground at an angle of 30° . At what point in its trajectory does this projectile have the **least** speed?

- **A.** Just after it is launched
- **B.** Just when it hits the ground
- **C.** At the highest point in its flight
- **D.** Halfway between the ground & the highest point
- **E.** Its speed is always constant

Pre-question 7

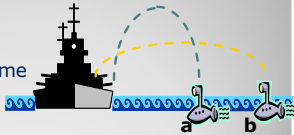
- Which of the three punts has the longest hang-time?



Pre-question 8

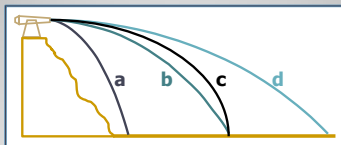
- A battleship simultaneously fires two shells at two enemy submarines. The shells are launched with the **same initial velocity**. If the shells follow the trajectories shown, which submarine gets hit **first**?

- A. Submarine **a**
- B. Submarine **b**
- C. Both at the same time



Pre-question 9

- For a cannon on **Earth**, the cannonball would follow **path b**. If the same cannon were on the **Moon**, which path would the cannonball take in the same situation?



Pre-question 10

- You are trying to hit a friend with a water balloon. He is sitting in the window of his dorm room directly across the street. You aim straight at him and shoot (with enough speed to cover the distance to the building). Just when you shoot, he falls out of the window! Does the water balloon hit him?
 - **A.** Yes, it hits him
 - **B.** Maybe, depending on the speed of the shot
 - **C.** No, it misses him

Pre-question 11

- You're on the street, trying to hit a friend with a water balloon. He sits on a tree branch across the street and above your position. You aim straight at him and shoot. Just when you shoot, he drops off the branch. Does the water balloon hit him?
 - **A.** Yes, it hits him
 - **B.** Maybe, depending on the speed of the shot
 - **C.** No, it misses him

Pre-question 12

- You're on the street trying to hit your friend with a water balloon. He's back up in the tree branch, and is now aiming a water balloon directly at your balloon. You aim straight at him and shoot at the same instant he does the same. **Do the water balloons hit each other?**
 - **A.** Yes, they hit each other
 - **B.** Maybe, depending on the speed of the shots
 - **C.** No, they miss each other completely

Pre-question 13

Gravitational Field Strength

- Review—what is it?
- Assumption near Earth's surface:
 - It's **UNIFORM**
- *Which means...*
 - A constant force will be exerted on masses moving vertically (in the direction of the field)
- *Which means...*
 - We can safely assume Constant Acceleration for objects that are under the influence of the gravitational field

What is that constant acceleration?

- Acceleration due to the gravitational field
- **$g=9.81 \text{ m/s}^2$**
- In what direction is this acceleration directed?

Target time...

- Who thinks they have great aim? I need some volunteers!
- Human kinematics cart: your goal—drop the cue ball so that it hits the bull's-eye of the target on the ground
 - (but you need to drop it from above your head...as you're being pulled at a constant speed!)

On your whiteboards...

- 1. Draw what the path of the ball would have looked like to someone looking:
 - **From the top view**
 - **From the front view**
 - **From the side view**
- 2. Add 5 dots to the path to indicate your prediction for the position of the ball at 5 equally spaced time intervals from the beginning to the end of the path.

Post-activity discussion

- Describe specifically what you needed to do in order to hit the target.

WHY?

Tomorrow:

- Bring a USB drive—we'll be doing some video analysis, and you may want to save the file.
- WA homework—due Thursday
