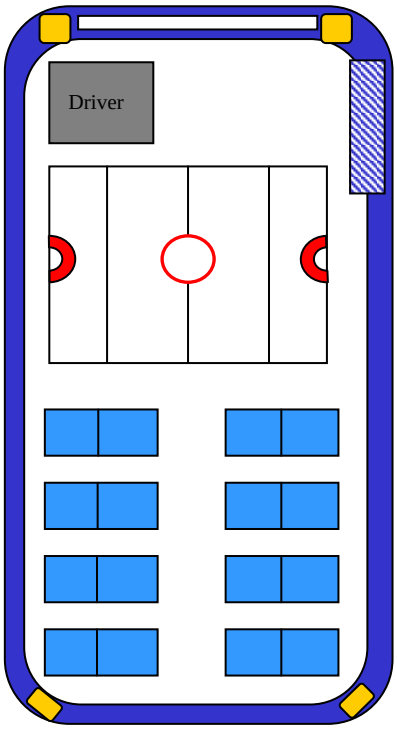
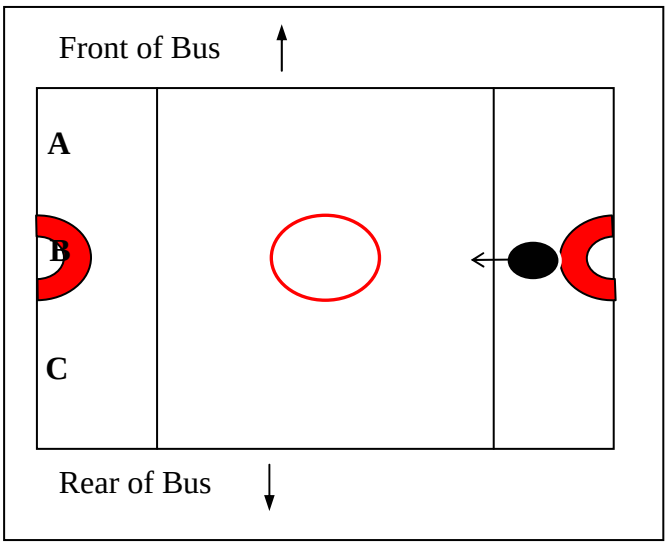
Group Tutorial: Air Hockey Table on a Metro Bus Date:_____
Group:_____ Name:_____



You and your roommate are traveling across campus on a very strange Madison Metro bus that happens to have an air hockey table set up with the long side of the table perpendicular to the length of the bus. Available

Answer the following questions and be prepared to discuss your answers with the class.

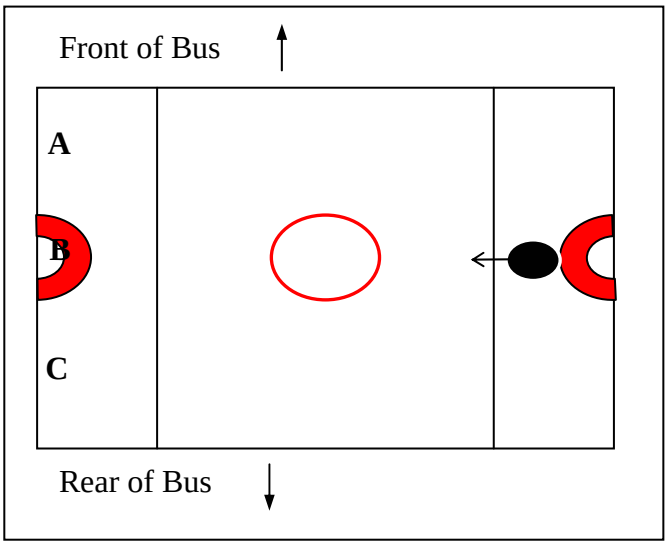
1) While the bus is stopped at a light you and your friend begin to lightly pass the puck back and forth aiming for each other's goals. Just as you release the puck (aimed at the goal) the bus begins to accelerate straight forward. Draw the motion of your puck on the table diagram below (assume your roommate doesn't block the puck).



Does the puck end up at position A, B, or C?

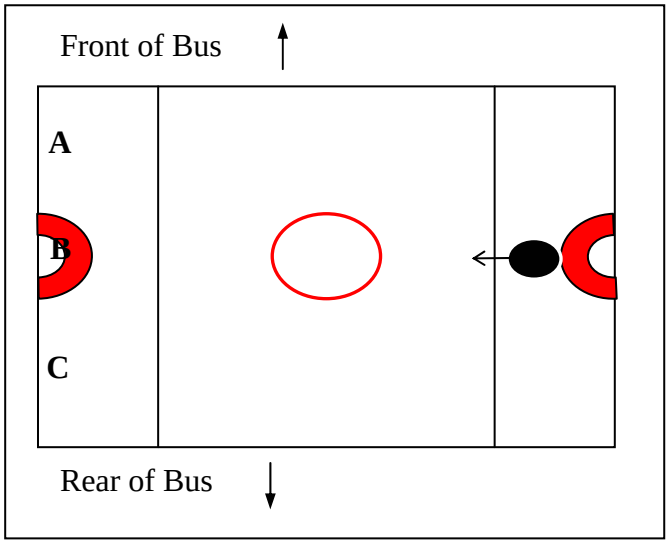
Group Tutorial: Air Hockey Table on a Metro Bus Date:_____
Group:_____ Name:_____

2) As the bus is traveling through campus you continue gently passing the puck back and forth with your roommate. Again, the bus alters its speed just as you release your puck. However, this time it decelerates in order to slow down to stop for a light (keeping a straight path). Draw the motion of your puck on the table diagram below (again assume that your roommate doesn't block the shot).



Does the puck end up at position A, B, or C?

3) What would the path of the puck look like if you lightly passed the puck aimed at your roommate's goal as the bus was traveling at a constant velocity forward in a straight line? Draw the motion of your puck on the table diagram below (again assume that your roommate doesn't block the shot).



Does the puck end up at position A, B, or C?

Discuss your group's reasoning for each situation with the whole class.

Group Tutorial: Air Hockey Table on a Metro Bus Date:_____
Group:_____ Name:_____

From what frame of reference were we considering for questions 1,2,and 3?

What are all the possible frames of reference for the problem? List as many as you can. Don't be afraid to possibly repeat some frames that may be the same mathematically but have different names. Be prepared to compare your frames with the whole class.

List the Frames:

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

Compile a list of frames of reference with the whole class.

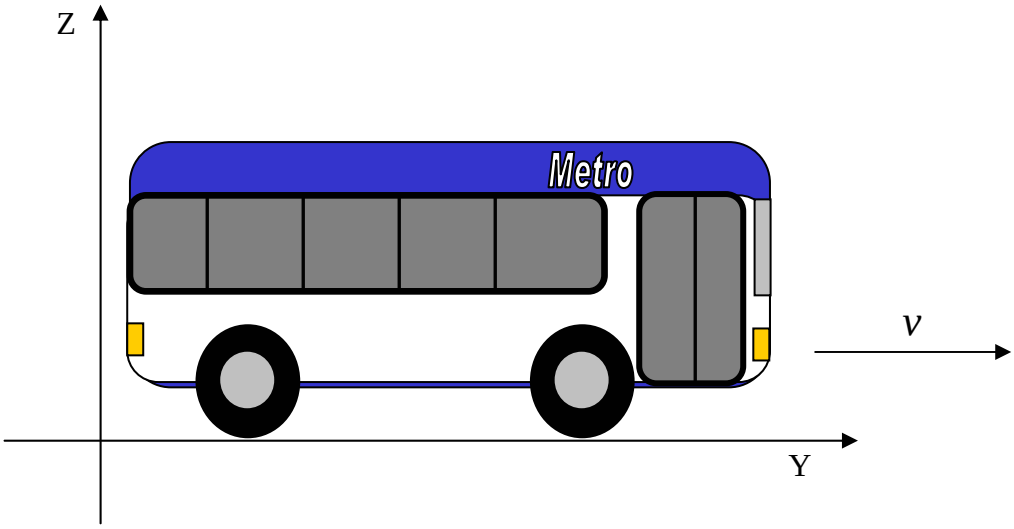
Fill in the frames of reference that you group may not have gotten on the lines below.

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

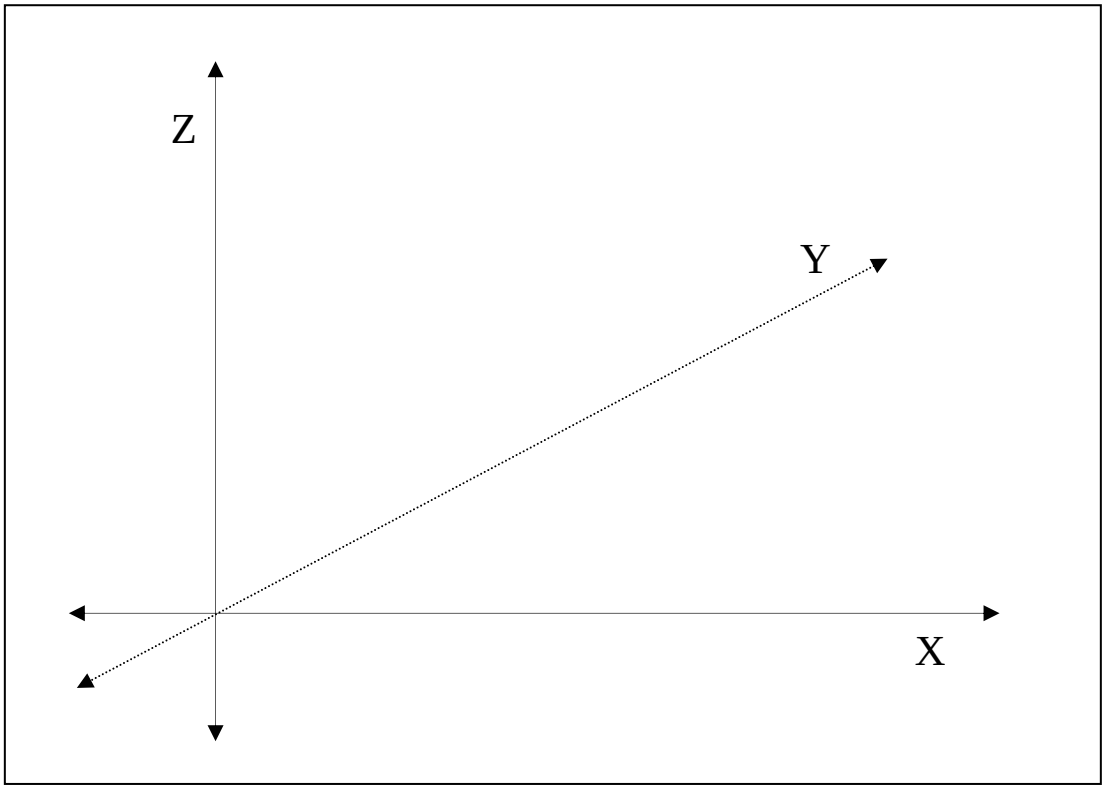
If someone were standing outside of the bus observing its motion, what would be his or her frame of reference?

_____

Group Tutorial: Air Hockey Table on a Metro Bus Date:_____
Group:_____ Name:_____



Draw a velocity vector below for the motion of the bus if it is traveling at constant velocity (*v*) of 25 miles/hour in a straight line in the frame of reference of someone standing outside of the bus on the ground.



Group Tutorial: Air Hockey Table on a Metro Bus Date:_____
Group:_____ Name:_____

Discuss with your group a reasonable speed for the air hockey puck to be traveling across the table if it where pushed gently (assume a constant velocity across the table).

Approximate length of an air hockey table: _____

How long would it take (estimate) a slow moving puck to travel the length above?
Time:_____

Puck Velocity: _____ (Distance/Time)

Bus Velocity converted to the same units as above _____

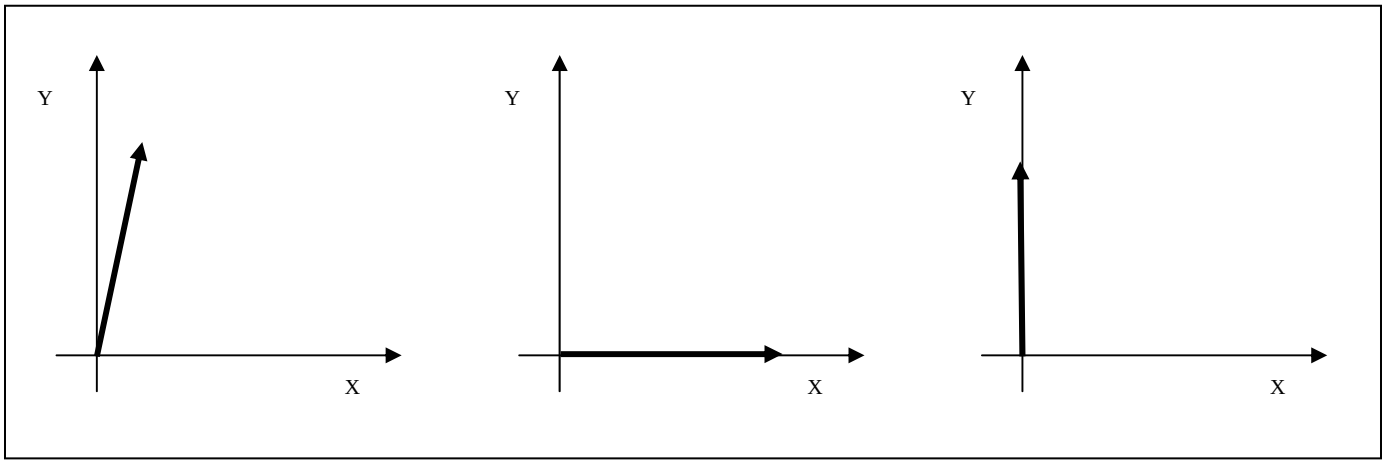
If we want to describe the path of the puck in the frame of reference of someone standing on the ground outside of the bus, what reference frames would be important?

_____ _____

In the reference frame of someone standing outside the bus, which of these paths (diagramed below) most accurately represent the path of the puck over the period of time it takes for the puck to travel the length of the air hockey table (path starting just after release of puck).

Relevant info: bus is traveling at a constant velocity in the positive Y direction and the puck is traveling at the velocity calculated above in the positive x direction.

Circle the best one and explain why you think that.



EXPLAIN:

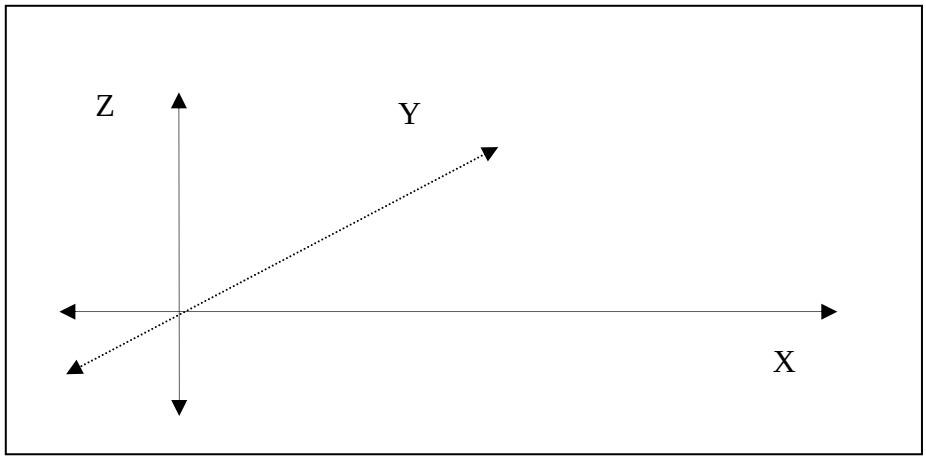
Group Tutorial: Air Hockey Table on a Metro Bus Date:_____
Group:_____ Name:_____

Try using superposition to reason through your answer.

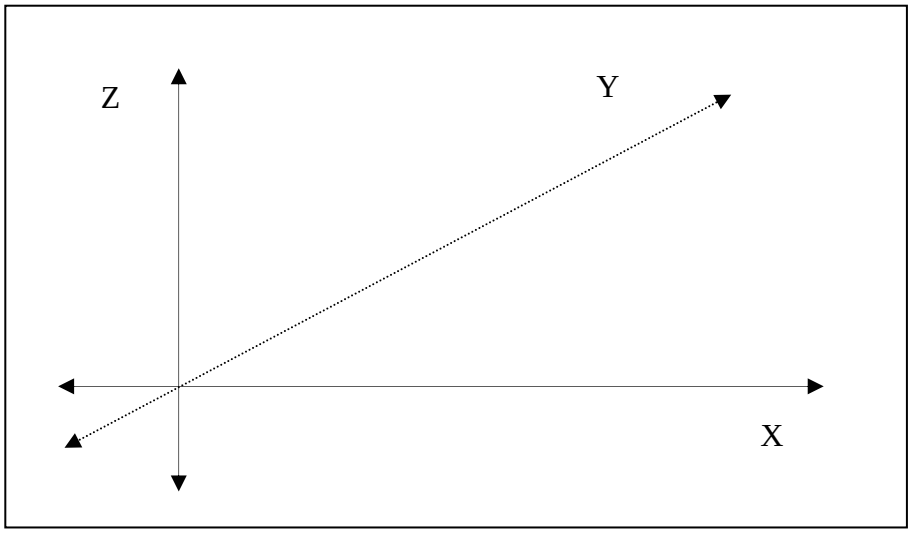
Using superposition means to divide the problem into parts then add them to get a complete description of the motion. Here we will describe the motion of the puck in the reference frame of the hockey table and then we will add (mathematically link the two frames) this motion to the motion of the bus.

Think about the bus frame of reference.

Draw the puck's path (x axis) across the table when the bus is traveling at a constant velocity. Remember this is from the bus reference frame (draw a scale on the x axis)

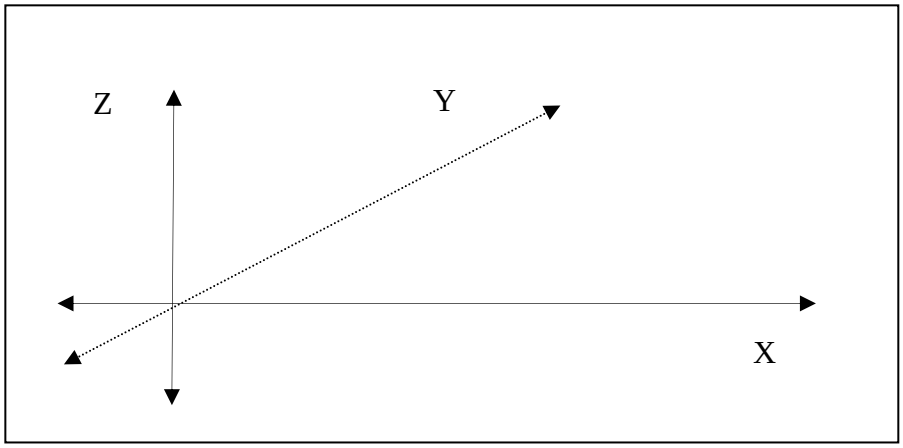


Now consider the motion of the just the bus in the ground reference frame. Draw how far the bus would travel in the amount of time it takes for the puck to travel the length of the table (draw a scale on the y axis).



Group Tutorial: Air Hockey Table on a Metro Bus Date:_____
Group:_____ Name:_____

Now to describe the motion of the puck in the ground reference frame combine the bus frame motion and the ground frame motion using vector addition. Put yourself in the bus frame of reference first by drawing the puck motion inside the bus. Then move yourself outside of the bus by adding the bus motion to the puck motion (tip-to-tail).



Draw the resulting motion (the vector that was created by vector addition) using a different color of ink.

Be prepared to share your results with the class.