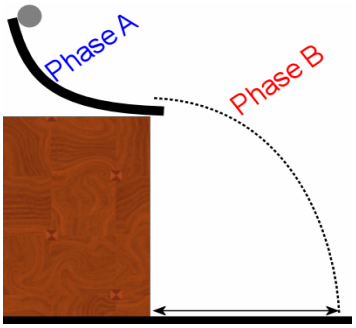
Question: Where will the ball land?



Make sure you understand each of the steps below. Make notes if you don't understand a step or its rationale.

Record all your steps on a blank sheet of paper. If a step includes the symbol (✍?), explain *why* you can do what you do.

1. To determine **where** (x_f) the ball will land, you need to use the equation $x_f = \frac{1}{2}at^2 + v_{xi}t + x_i$, since this tells us how far an object moves with respect to time, acceleration, and initial velocity. The Phase that answers this question is **Phase B** (✍?).
2. The "a" term can be crossed out (✍?).
3. The x_i can be crossed out (✍?).
4. Now all you need to know is *how much time the ball will fall* and *how fast* (velocity) it is going (in the x direction).

Determine the time the ball will fall in Phase B.

5. Again, start with $y_f = \frac{1}{2}at^2 + v_{yi}t + y_i$ (in this case you'll be using the y-axis).
6. Enter zero for velocity term (✍?).
7. Measure how high the ball will fall. Which term(s) is this?
8. What is the acceleration in the y-direction? (✍?). Write it in.
9. Solve the equation for time.

Next step: Determine how fast the ball will be traveling as it enters Phase B.

(See next column)

10. The velocity at the end of **Phase A** will be the same as the velocity at the start of **Phase B** (✍?).
11. The original *"How fast?"* question can be answered using the equation on the right, so you need to know *how much time* the ball falls in **Phase A**, as well as the *acceleration* (✍?). $a = \frac{v_f - v_i}{t}$
12. To calculate the time, you can use $y_f = \frac{1}{2}at^2 + v_{yi}t + y_i$.
13. You can cross off the v_i term (✍?).
14. What is the value for a? (✍?).
15. What is the value for y_f and y_i? (✍?).
16. Solve for "t" for **Phase A**.
17. Plug that value into the equation from Step 11.

Now you know both how fast the ball is moving as it enters Phase B, and how long it will fall.

18. Calculate how far the ball will travel using $x_f = \frac{1}{2}at^2 + v_{xi}t + x_i$
19. With this experiment, there is an "energy loss factor" of 25% (i.e. 25% of the velocity will be lost to friction and rotational forces), so you'll need to adjust your answer from Step 18.

Carefully measure out the location where your ball will fall. Place the target with the bulls-eye on the location of your prediction, being careful to check that you have it lined up properly left to right as well as up and down.