**Egg Drop Tutorial (*Drop vs. Stop)***

***As you journey through each step of this tutorial ask yourself one question: Is my egg dropping at this point or stopping?***

Mass of egg = **0.060 kg (60 grams)**

Average time of stopwatches = _____? s (get this from your teacher)

**Before you start this tutorial, remind yourselves of how vt-graphs work and why they are important. What kinds of shapes do we usually see on them? What physics concepts do the parts of each shape represent? This tutorial serves as a great review for the Fall Final Exam!!!!!!!!!**

**Assume no air resistance in this tutorial!!**

1. Draw a vt-graph of the motion of the egg as it fell (dropped).
2. On the **same** vt-graph above add the motion of the egg stopping. (continue from where you left off on the previous question).
3. At this point you should have 2 triangles on your vt-graph. Make a simple data table that allows you to record all the similarities and differences between all the parts of the 2 triangles.
4. Give a detailed description of the acceleration difference between **drop** and **stop.** Use the vt-graph as your guide. Calculate the acceleration for DROP and STOP based on the slopes in your v-t graph.
5. Calculate the velocity of the egg just before it landed. You did this the beginning of class today.
6. Showing all work, calculate the distance the egg fell. (Use the vt-graph as your guide. You should know the base and the height of your DROP triangle now.)
7. What is the product of velocity and mass called in Physics?
8. Calculate the final momentum, $\mathbf{v_f m}$**,** of the egg just before it began to stop ($\mathbf{v_f m}$ of the DROP). You did this the beginning of class today.
9. How much change in momentum, **Δvm** $[m(v_f - v_i)]$, did the egg undergo **only while it was dropping?** You did this the beginning of class today.
10. What causes a change in momentum? What is the formula for this other concept? (In other words, what is **Δvm** also equal to**?)**
11. Calculate the change in momentum, **Δvm,** of the egg **while it was stopping?** How does the answer to #11 compare to your answer in #9? How does the direction compare to #9?
12. Draw a labeled graph of **vm** on the **y axis** and **t** on the **x axis** of the egg stopping inside your device. Use your calculation that you did the beginning of class to label your data points on the y-axis only. (You drew this graph the beginning of class today.)
13. Draw a similar graph of just an egg **alone** being stopped by the concrete. (no device to protect it) You did this the beginning of class today.
14. What things are similar or different in each graph? (Compare the triangles again. Record your answers like in #3)
15. How does the change in momentum, **Δvm,** for each situation compare? So then, how does the impulse for each situation compare?
16. So since the impulse is the same for each situation:
    a. Which has a greater time interval—with device or without it?
    b. Therefore, which must have the least impact force?
17. Answer this Question: Do eggs without devices break because they have different amounts of Impulse than eggs inside devices? Why or Why Not?
18. What does the **slope** of graphs 12 and 13 represent? You answered this question in class today.
19. Which graph has a steeper slope?
20. What are your thoughts on the difference between the egg being stopped by your device and the egg being stopped by the concrete? Why does the egg break in one situation and not the other (Hopefully). **Be specific!! Be sure to mention the *slopes* on the momentum-time graphs in your explanation.**
21. Calculate the time it takes the egg to stop. In order to do this you must **estimate the distance** you think your egg moved in the device when it was stopping. *(You did this at the beginning of class today.)* (Show all Work).
22. Calculate the acceleration of the STOP. (Slope Equation from vt-graph #2) You did this the beginning of class today.
23. Calculate the amount of force necessary to STOP the egg. (Show all Work - use graph #12 and your response to #18 as a guide).
24. Calculate the **Dropping Force**. (Don't over-think this). Hint: Make a graph of vm versus t for the DROP. This is a similar calculation to #23. You drew your graph in class today. Now, do the required calculation.

Now, complete this table.

| Drop Information | | | | Stop Information | | | |
|---|---|---|---|---|---|---|---|
| **Quantity** | Magnitude | Direction + or - | How did you obtain your answer? | **Quantity** | Magnitude | Direction + or - | How did you obtain your answer? |
| $\mathbf{v_i}$ | | | | $\mathbf{v_i}$ | | | |
| $\mathbf{v_f}$ | | | | $\mathbf{v_f}$ | | | |
| **a** | | | | **a** | | | |
| **Δx** | | | | **Δx** | | | |
| **t** | | | | **t** | | | |
| $\mathbf{v_i m}$ | | | | $\mathbf{v_i m}$ | | | |
| $\mathbf{v_f m}$ | | | | $\mathbf{v_f m}$ | | | |
| **Δvm** | | | | **Δvm** | | | |
| **F** | | | | **F** | | | |