Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Block: \_\_\_\_\_

 **Instructions:** You will be using what you know about Work and the Conservation of Energy to figure out how friction brings a moving cart to rest. To do this, you will be using the “Stopping Distance Interactive” that can be found here: <https://tinyurl.com/stoppingsim>

For the lab, assume the mass of the cart is 5kg.

**Part 1) 30cm Drop**

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| **Step 1)** Select the icon in the upper lefthand corner of the simulation to make it full screen, and press the “begin” button. Then, select the “30cm” drop button. |
| **Step 2)** Use the table below to identify and calculate the types of energy that the car has while it is at rest at the top of the ramp. Also determine its total energy at this location. [**BE SURE TO CONVERT FROM CM TO M**](https://www.google.com/search?client=ubuntu&hs=fyI&ei=usRfWp6WNo6KtQXn2pj4BQ&q=how+to+convert+cm+to+m&oq=how+to+con&gs_l=psy-ab.1.0.0i67k1j0j0i131k1j0l7.3633.6794.0.8195.34.20.2.0.0.0.180.2057.4j13.18.0....0...1.1.64.psy-ab..19.14.1492.0..0i13k1j0i13i30k1j0i13i10i30k1j33i13i21k1j33i160k1.322.wiKFSFrHTFo)

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| **Energy at the Top of the Ramp**  |
| Kinetic Energy? (Yes / No ) | Potential Energy due to Gravity? (Yes / No)  |
| K = ½ mv2 = \_\_\_\_\_\_\_\_  | Ug = mg∆y = \_\_\_\_\_\_\_\_\_\_ |
| Total Energy at Top of Ramp = K + Ug = \_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_ =  |

 |
| **Step 3)** Press the “Release” button, and watch the simulation. For now, let’s focus on when the cart passes the photogate (velocity meter) at the bottom of the ramp. Use the table below to identify and calculate the types of energy that the car has at the exact moment it passes the photogate at the bottom of the ramp. Also determine its total energy at this location.

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| **Energy at the Bottom of the Ramp** |
| Kinetic Energy? (Yes / No ) | Potential Energy due to Gravity? (Yes / No)  |
| K = ½ mv2 = \_\_\_\_\_\_\_\_  | Ug = mg∆y = \_\_\_\_\_\_\_\_\_\_ |
| Total Energy at Bottom of the Ramp = K + Ug = \_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_ =  |

 |
| **Step 4)** How does the Total Energy at the top of the ramp compare to the total energy at the bottom of the ramp? Does this make sense according to conservation of energy? Has any external force (from outside the cart-ramp-earth system) done any work on the cart, and how do you know? |
| **Step 5)** When the cart hits the box, the friction between the box and the floor gradually brings the cart to a stop. Use the critical thinking steps below to answer the following question: **“What is the average frictional force between the moving box and the floor?”****Critical Thinking Step 1)** Is there any work being done to/by the box as it slides across the floor? What evidence is there to support your claim using conservation of energy?**Critical Thinking Step 2)** How much energy will the cart have to lose in order for it to come to a rest? (this should be a number) Why must it lose exactly this much?**Critical Thinking Step 3)** What must be doing the work to bring the cart to a rest? **Critical Thinking Step 3)** Using the equation for work W=Fdcos(θ) , can you figure out how big the force needs to be in order to bring the cart to stop over the distance shown in the simulation? (clarification: Each large box in the simulation is 10cm) |

**Part 2: Does Height Affect the Stopping Force**

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| **Instructions:** Using Part 1 as a guide, repeat the process for the cart being dropped from 50cm and from 70cm in order to answer the following essential question:“**Does the height the cart is dropped from affect the size of the frictional force that stops it?”** |
| **Work for Determining Frictional Force when dropped from 50cm:** |
| **Work for Determining Frictional Force when dropped from 50cm:** |
| **Conclusion:**Based on the findings above, what can you conclude about the effect of the dropping height on the size of the frictional force needed to stop it? Why do you think this is the case?  |
| **Bonus Question:** Does the Total Energy increase as the drop height increases? What does that mean about how much work is needed to stop the cart? How is this increase in work accomplished? |