Half-Atwood Lab: Acceleration, Tension, and Friction

Name: ________________________________ **Date:** ______________________

Grading. Worth **50 points**: 25 for completion, 25 for effort. Effort means readable work, a labeled sketch where one belongs, and a real attempt on every part, not a correct final number. Point values are marked next to each part. Record every reading exactly as the panel gives it, units included, and describe what you actually saw rather than what you expected to see. Follow the assignment etiquette posted on the Assignment Center before you submit.

The simulation is on the lab page, `physicsatsteds.com/ap-physics-1-2/half-atwood-lab/`, and you can type your answers straight into it if you would rather not write on paper. Take g as 9.80 m/s^2 and take the two coefficients of friction as equal. Read every number exactly as the panel gives it, units included, and say what you actually saw rather than what you expected to see.

1. Warm-up: release it and watch [5 pts]

Set the cart to 2.00 kg, the hanging mass to 0.50 kg and the friction to zero. Press Release and watch the cart, the hanging mass and the panel.

Simulation: *"A cart on a table, pulled by a hanging mass over a pulley."*

Draw a free-body diagram for the cart and one for the hanging mass, then write **one sentence** saying how you know the two objects have accelerations of the same size even though they move in different directions. [5 pts]

2. Change the hanging mass [15 pts]

Leave the cart at **2.00 kg** and the friction at **zero** for the whole of this part. Change the hanging mass only.

Simulation: *"The same machine as Part 1."*

(a) Move the hanging mass slider from end to end. Say what happens to the acceleration and to the tension as the hanging mass grows, and compare the tension with the weight of the hanging mass at every setting you try. [7 pts]

(b) Fill the table in. Then explain why the tension is always smaller than the weight of the hanging mass while the system is accelerating, and say what would have to be true for the two to be equal. [8 pts]

Hanging mass	Acceleration (m/s²)	Tension (N)	Weight of the hanging mass (N)
0.20 kg			
0.40 kg			
0.60 kg			
1.00 kg			

3. Change the cart instead [15 pts]

Now leave the hanging mass at **0.50 kg** and the friction at **zero**, and change the cart.

Simulation: *"The same machine again."*

(a) Move the cart slider from end to end. Say what happens to the acceleration as the cart gets heavier, and say what number the acceleration climbs toward as the cart is made lighter and lighter. Name the situation that number belongs to. [7 pts]

(b) Fill the table in. The tension goes the other way from the acceleration. Say what value the tension climbs toward as the cart is made heavier and heavier, and explain why it can never quite reach it. [8 pts]

Mass of the cart	Acceleration (m/s^2)	Tension (N)
0.50 kg		
1.00 kg		
2.00 kg		
3.00 kg		

4. Put friction under the cart [15 pts]

Set the cart back to **2.00 kg** and the hanging mass to **0.50 kg**, and use the friction slider.

Simulation: *"The same machine, with the friction slider in play."*

(a) Raise the friction a step at a time, pressing Release each time, until the cart stops moving at all. Say the setting at which it stops, and name the two numbers in the panel that decide whether it moves or not. [7 pts]

(b) Fill the table in. Then look at the row where nothing moves and say what the tension is in that row, why it is that value, and what has become of the friction force there. [8 pts]

Friction setting	Largest friction the table can give (N)	Acceleration (m/s^2)	Tension (N)
0			
0.10			
0.20			
0.30			