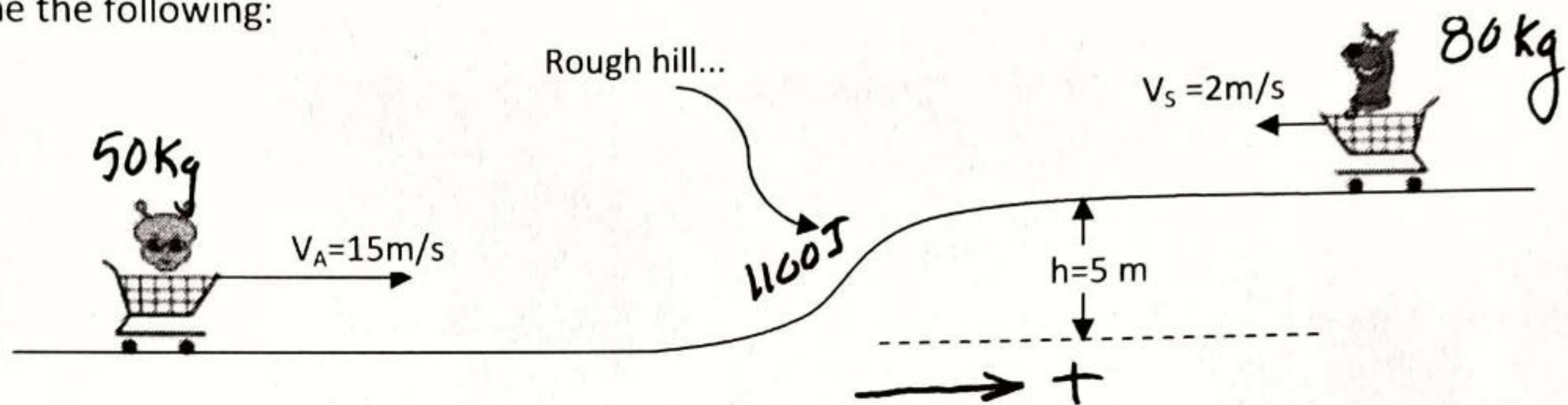


Problem Solving Using Mechanical Energy and Momentum

Name: _____ Date: _____

1. A 50kg cart with an alien in it is moving at a constant speed of 15 m/s across a frictionless track. It moves up a 5 m high hill which unlike the track has a rough surface which, through friction, generates 1100 J of heat. When this cart collides with the other 80kg cart (at the top of the hill), with Scooby Doo inside, that is moving to the left at 2 m/s (frictionless). The collision is inelastic. Determine the following:



- a) The final speed of the two combined carts (including the direction).

ALIEN:

$$E_k = \frac{mv^2}{2} = \frac{(50)(15)^2}{2} = 5625 \text{ J @ bottom. } \left. \vphantom{E_k} \right\} \text{ TOTAL ENERGY!! } E_T$$

$$E_g = mgh = (50)(9.8)(5) = 2450 \text{ J @ top.}$$

$$\text{@ top: } E_k = E_T - 2450 - 1100$$

$$= 5625 - 2450 - 1100$$

$$E_k = 2075 \text{ J} \rightarrow E_k = \frac{Mv^2}{2} \Rightarrow v = \sqrt{\frac{2E_k}{M}}$$

$$v = 9.11 \text{ m/s}$$

COLLISION PROBLEM:

$$P_{Ti} = P_{Tf}$$

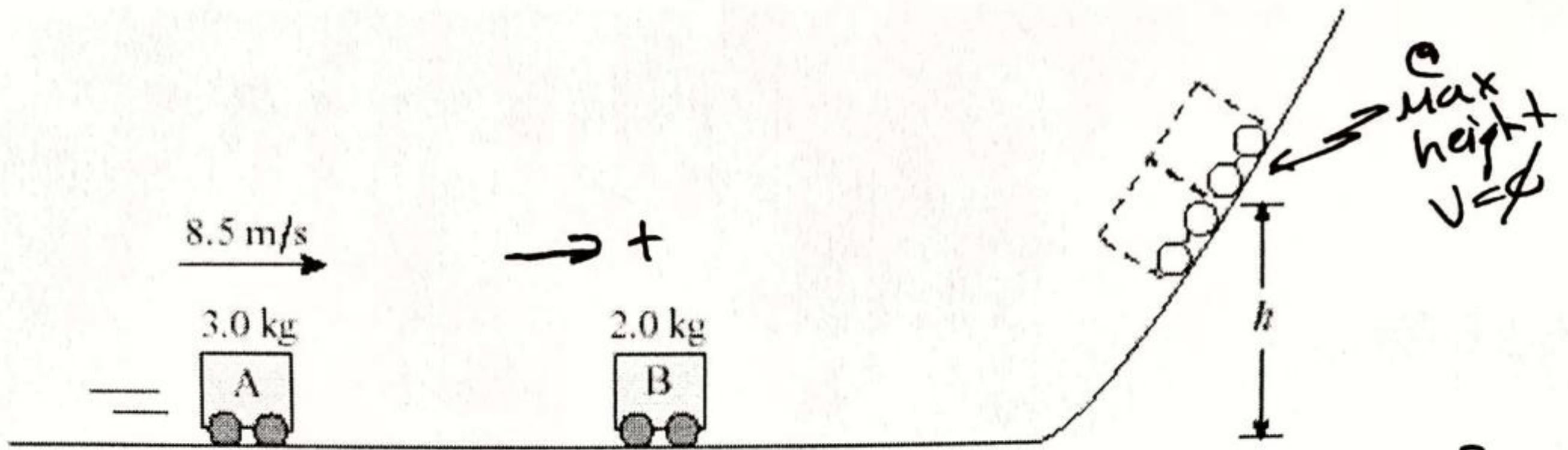
$$M_1 v_{1i} + M_2 v_{2i} = M_1 v_{1f} + M_2 v_{2f} \quad (v_{1f} = v_{2f} = v_f)$$

$$= v_f (M_1 + M_2)$$

$$v_f = \frac{M_1 v_{1i} + M_2 v_{2i}}{(M_1 + M_2)} = \frac{(50)(9.11) + (80)(-2)}{(130)}$$

$$v_f = 2.27 \text{ m/s [right]}$$

2. A 3.0kg cart collides with a 2.0 kg cart based on the diagram you see below. The collision is inelastic.



- a) To what height, h , will the combined carts rise?

$$M_A V_{Ai} + M_B V_{Bi} = M_A V_{Af} + M_B V_{Bf}$$

$$= V_f (M_A + M_B)$$

$$V_f = \frac{(3)(8.5) + (2)(0)}{(5)}$$

$$V_f = 5.1 \text{ m/s}$$

$$E_k = \frac{(M_A + M_B) V_f^2}{2}$$

$$E_k = \frac{(5)(5.1)^2}{2} = 65.025 \text{ J}$$

all the E_k becomes E_g

$$E_g = E_k = mgh = 65.025$$

$$h = \frac{65.025}{(5)(9.8)}$$

- b) The slope of the ramp is changed. See the figure below. The carts will reach i) a greater height ii) the same height iii) a lesser height

$$h = 1.33 \text{ m}$$

- c) Use physics principles to explain your answer to part b).

