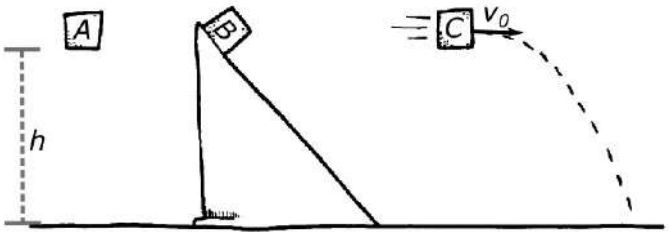
NAME _____ DATE _____

Scenario

Three identical blocks are released simultaneously from height h. *Block A is dropped from rest, Block B slides from rest down an incline (where friction may be neglected), and Block C is launched horizontally with speed* v_0.



Argumentation

Dominique and Carlos are trying to determine which block will have the fastest speed just before hitting the ground and which block will reach the ground first.

Dominique states, "They will all have the same speed before hitting the ground. Remember that we saw this demonstration in class, and it didn't matter how the blocks were dropped, they all landed at the same time. The speed will be the same because of conservation of energy. All blocks have the same gravitational potential energy to start with. This is the total energy and converts into kinetic energy."

Carlos states, "I think you're mixing up time and speed. They won't have the same speed at the end because Block C has an initial velocity. They will all land at the same time, though."

PART A: i. Which aspects of Dominique's reasoning, if any, are correct? Explain your answer.

ii. Which aspects of Carlos's reasoning, if any, are correct? Explain your answer.

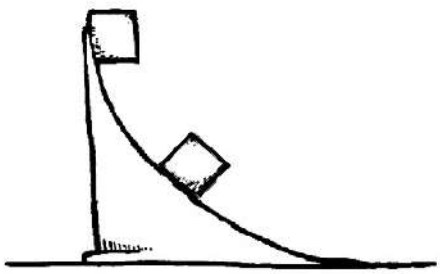
iii. Which parts of Dominique's reasoning are incorrect? Explain how you know.

iv. Which parts of Carlos's reasoning are incorrect? Explain how you know.

Using Representations

PART B: A fourth identical block is now released from rest at the top of a curved track of radius R.

Draw free-body diagrams showing and labeling the forces (not components) exerted on the block at each of the two positions shown at right. Draw the relative lengths of all vectors to reflect the relative magnitudes of all the forces.



Quantitative Analysis

PART C: Blake comes up with the following equation for the work done by the normal force during the slide:

$W_{normal} = \frac{\pi}{2} Rmg\cos\theta$, where R is the radius of curvature of the ramp, and θ is the angle through which the box has traveled.

i. Angela suggests that the equation could be incorrect. Does the equation make physical sense?

_____ Yes _____ No

Briefly explain your reasoning.

ii. Dominique says that $W_{\text{normal}} = 0$ regardless of the physical situation. Explain why this claim makes physical sense.