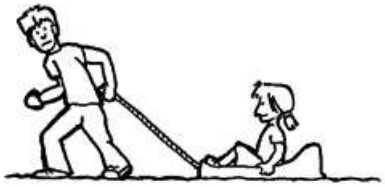
NAME _____ DATE _____

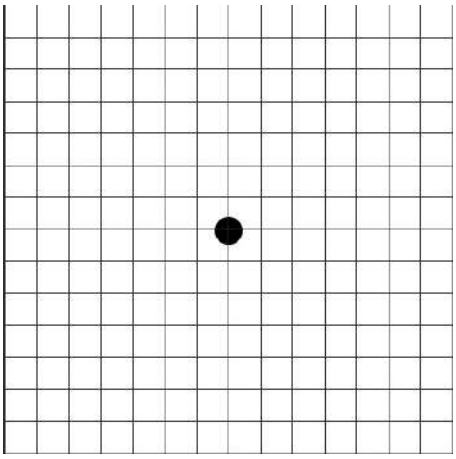
Scenario

Blake accelerates a sled carrying his little sister from rest. The sled and sister have a total mass m, the coefficient of kinetic friction between the sled and the ground is μ_k, and Blake causes the rope connected to the sled to have a constant tension force T that makes an angle θ with the horizontal. Any frictional forces between the sled and the snow are negligible.



Using Representations

PART A: The dot at right represents the sister and sled system. Draw a free-body diagram showing and labeling the forces (not components) exerted on the system. Draw the relative lengths of all vectors to reflect the relative magnitudes of all the forces. Each force must be represented by a distinct arrow starting on and pointing away from the dot.



Argumentation

PART B: Suppose that Blake increases the angle θ slightly but keeps the angle less than 90°. Angela and Carlos debate how this will change the magnitude of the sled's acceleration.

i. Angela suggests that increasing the angle will decrease the acceleration of the sled. Explain why this is possible in terms of the free-body diagram you drew above.	ii. Carlos suggests that increasing the angle will increase the acceleration of the sled. Explain why this is possible in terms of the free-body diagram you drew above.

Quantitative Analysis

PART C: Derive expressions for the following in terms of m, μ, F_p, and θ:

i. The force that the ground exerts on the system.	ii. The force of friction the ground exerts on the system.	iii. The acceleration of the system