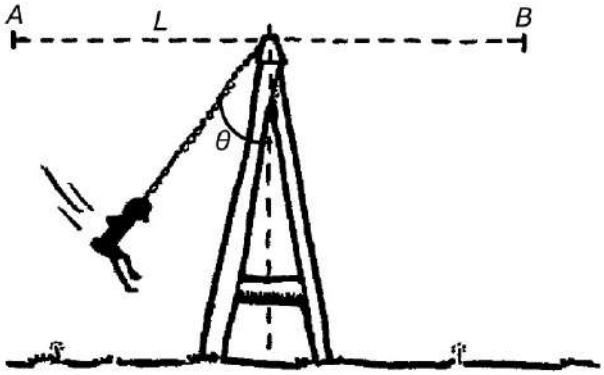
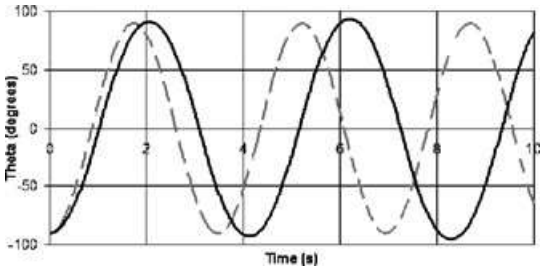
NAME _____ DATE _____

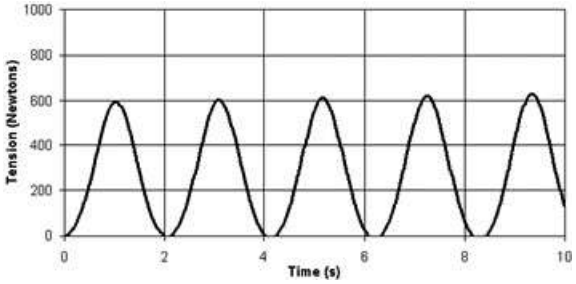
Scenario

A 20-kg child swings on a swing set. The chains supporting the swing are $L = 3$ m *long. At time* $t = 0$*, the child is at point* A*, where the angular displacement of the chains supporting the swing is* $\theta = -90°$*. The child swings between points* A *and* B*, that is between the angular displacements of* $-90°$ *and* $+90°$*.*

Angela uses force sensors and video analysis to measure the angular displacement of the chains (below left graph, solid line) and the tension in the chains (below right graph) as functions of time.







Data Analysis

PART A: The dashed line on the above left graph shows the angular displacement of the chains if the swing is modeled as a simple pendulum swinging with simple harmonic motion and having period $T = 2\pi\sqrt{L/g}$. Angela notices that the dashed (SHM model) and solid (collected data) lines are not aligned. Explain why this is the case.

Argumentation

PART B: Angela suggests that the tension in the chains is 200 N when the child swings through $\theta = 0°$. She reasons that this is because the child is neither speeding up nor slowing down, so the tension must balance the weight force according to Newton's second law. The graph above and to the right does NOT support her claim.

i. What aspects of Angela's claim and reasoning are correct? Explain.

ii. What aspects of Angela's claim and reasoning are incorrect? Explain.

iii. Why doesn't the graph above and to the right support Angela's claim?

iv. Explain why the tension in the chains is greater than 200 N when $\theta = 0°$. Cite specific physical principles.