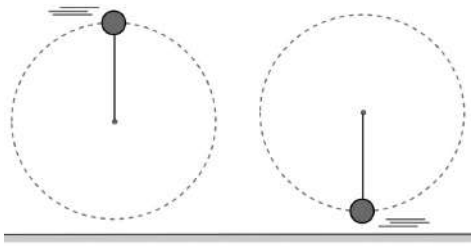
NAME _____ DATE _____

Scenario

A ball whose weight is 2 N *is attached to the end of a cord of length* 2 m *as shown. The ball is whirled in a vertical circle clockwise. The tension in the cord at the top of the circle is* 7 N*, and the tension at the bottom is* 15 N*. Two students discuss the net force on the ball at the top of the circle.*



Dominique: "The net force on the ball at the top position is 7 N since the net force is the same as the tension."

Carlos: "No, the net force on the ball includes the centripetal force, tension, and weight. The tension and the weight are acting downward and have to be added. Then you need to figure out the centripetal force $\left(\frac{mv^2}{r}\right)$ and include it in the net force."

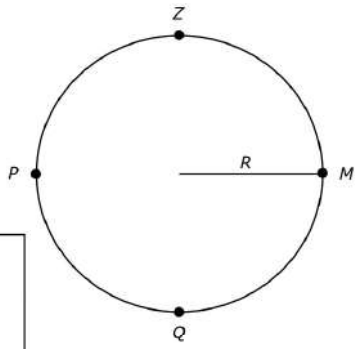
Analyze Data

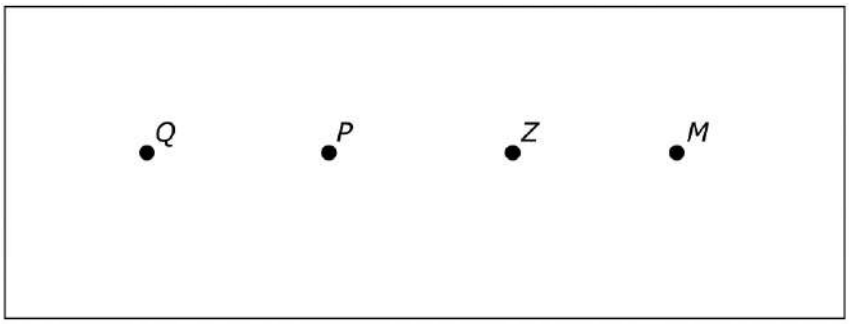
PART A: Cross out the incorrect statements for each student's argument.

PART B: In a few short sentences, state the net force on the ball at the top of the circle and support your claim with evidence.

Using Representations

PART C: The diagram at right shows the circular path of the ball from Part A. The dots below represent the ball at the marked locations on the circular path. Draw free-body diagrams showing and labeling the forces (not components) exerted on the ball at each point. Draw the relative lengths of all vectors to reflect the relative magnitudes of all the forces.





Quantitative Analysis

PART D: Derive an expression for the minimum speed the ball can have at point Z without leaving the circular path. For each line in the derivation, explain what was done mathematically. The first line is completed for you as an example.

$\sum F = ma_c$	The sum of the force is equal to ma, and since the ball is in circular motion, *a* is the centripetal acceleration.

PART E: Suppose the string breaks at point P. Describe the motion of the ball after the string breaks. (When describing the motion of an object, you need to discuss what is happening to the position, velocity, and the acceleration of the object.) Tell the story of the motion of the ball from the time the string breaks until the ball reaches the ground.

Position:

Velocity:

Acceleration: