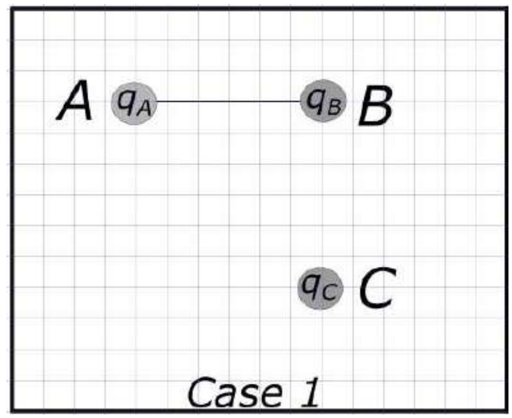
NAME ______________________ DATE ______________

Scenario

Identical pucks A and B are connected by a nonconducting rigid rod and given positive charges q_A and q_B. The pucks are set on a smooth (negligible friction) table along with a fixed puck C, which has a negative charge of magnitude q_C.



Using Representations

PART A: In Case 1, $q_B = 1.4q_A$, and the A-B-rod system is not fixed and is free to rotate and translate.

In the Case 1 diagram to the right, draw arrows representing only the electric forces exerted on A and B. It is not necessary to label the vectors, but it is necessary that each vector be a distinct arrow that starts on and points away from its point of application and the grid be used to show correct direction and relative magnitudes of forces.

Argumentation

PART B: In which direction does the center of the rod accelerate at the instant shown in the diagram? Does the rod rotate clockwise or counterclockwise, if at all? Justify your answers using the forces you drew.

Acceleration is:

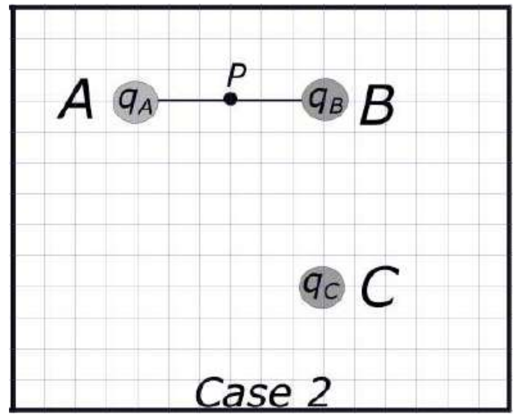
________ Left ________ Right ________ Up ________ Down

Rotation is:

________ Counterclockwise ________ Clockwise

Scenario

In Case 2, the rod is fixed to the table at point P. The magnitude of q_B is also decreased so that the A-B-rod system is both in translational and rotational equilibrium.



Using Representations

PART C: In the Case 2 diagram shown at right, draw arrows representing only the external forces exerted on the A-B-rod system (For this case, do not draw the normal force and weight, as they are perpendicular to the page). It is not necessary to label the vectors, but it is necessary that each vector be a distinct arrow that starts on and points away from its point of application and the grid be used to show correct direction and relative magnitudes of forces. The forces you draw in the Case 2 diagram do NOT need to be to the same scale as the forces you drew in the Case 1 diagram.

Quantitative Analysis

PART D: Derive an expression for the magnitude of charge q_B in terms of charge q_A. Verbally explain the physical principles you are using as you perform the steps of your derivation.