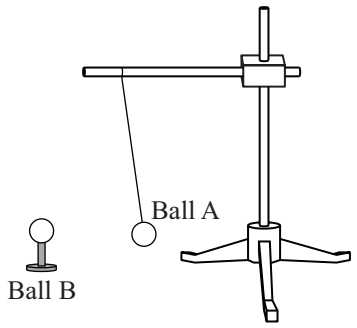
Name _____***Student ID*** _____ ***Score***_____

last ***first***

IV. [20 pts total]

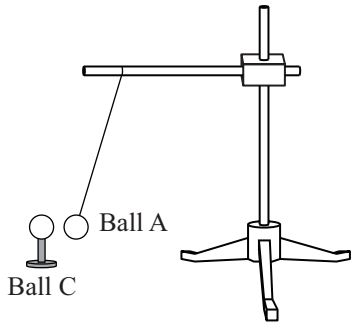
A. When ball B is placed near ball A, ball A is repelled by ball B as shown at right. If instead, ball C is placed near ball A, ball A is attracted to ball C as shown below right. All three balls are made of a solid conducting material. Ball A is hanging from an insulating thread, and balls B and C are on insulating stands.



i. [5 pts] Is it *possible* that the net charge on ball C is *zero?* Explain.

Because balls A and B repel, they must both be charged (and the signs of the net charges on balls A & B must be the same). In tutorial, neutral objects were observed to attract charged objects, so ball C could be neutral.

ii. [5 pts] Is it *possible* that the sign of the net charge on ball C is *the same as* the sign of the net charge on ball B? Explain.



Consider the situation in part i above. If a small amount of charge with the same sign as that on ball A were placed on ball C, there would be a slight repulsive force on ball A due to this additional charge. This repulsive force could be smaller in magnitude than the attractive force discussed in part i above. The net interaction between balls C and A could then be attractive, as is the case in the diagram. Therefore it is possible for the net charge on balls A and C to have the same sign, meaning the net charge on balls B and C could have the same sign.

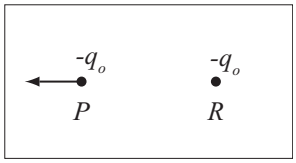
iii. [5 pts] Is it *possible* that the sign of the net charge on ball C is *opposite* the sign of the net charge on ball B? Explain.

If the sign of the net charge on ball C is the opposite of that on ball B, it is also the opposite of that on ball A. Opposite charges attract, so this situation would produce the effects shown in the diagram. It is possible for the net charge on ball C to be opposite to that on ball B.

B. Two identical negative charges are held in place at points P and R as shown.

i. [2 pts] On the diagram at right, draw an arrow to represent the direction of the electric *force* on the charge at point P by the charge at point R. Explain briefly.

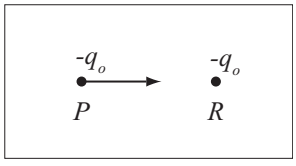
Force on charge at *P*



Charges with the same sign repel, so the force on the charge at point P will point away from the charge at point R.

ii. [3 pts] On the diagram at right, draw an arrow to represent the direction of the electric *field* at point P due to the charge at point R. Explain.

Electric field at *P*



Consider the charge at point P to be a test charge for the electric field produced by the charge at point R. Because the test charge is negative, and $\vec{E} \equiv \vec{F}/q$*, the electric field at point P must point in the opposite direction of the force on the charge at point P.*

OR: The electric field due to a negative point charge points directly toward the charge.