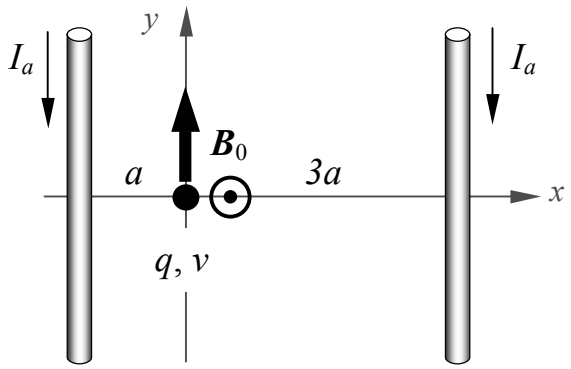
Name: _____ Sec. _____ **P212: Quiz 1, Week 8**

Two very long wires are oriented parallel to the *y* axis and carry identical but *unknown* currents I_a in the *same* direction. The wires cross the *x*-axis at positions $x = -a$ and $+3a$. The wires produce a magnetic field at the origin with known magnitude B_0 and direction $+z$ (*i.e.*, out of the page). Finally, a particle of charge *q* passes through the origin, with velocity *v* in the $+y$ direction.



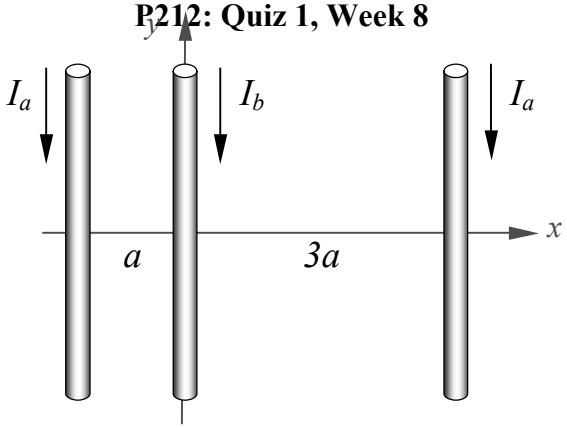
$a = 2$ cm
$B_0 = 5 \times 10^{-7}$ T
$q = 30$ mC
$v = 5 \times 10^7$ m/s
$I_a = ?$

NOTE: Whenever you are asked for a **vector** quantity, give **both** its magnitude **and** direction.

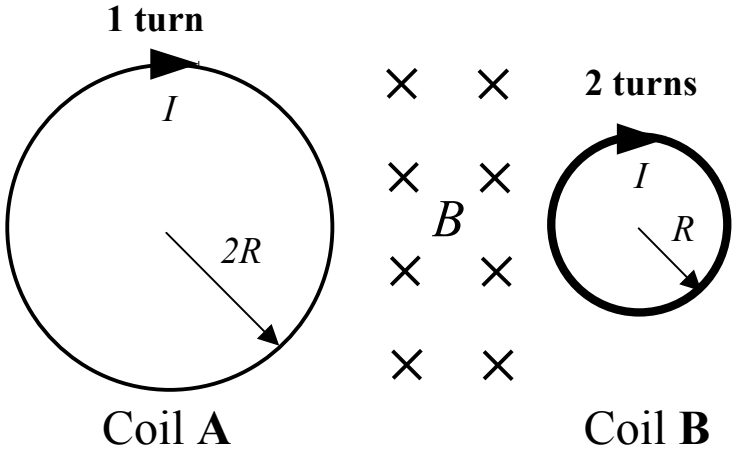
1) Using the given magnitude and direction of the magnetic field $\boldsymbol{B}_0$ at the origin, determine the current I_a. Bear in mind that I_a might be *negative*, indicating directions opposite to those shown in the figure. **[6]**

2) What is the force $\boldsymbol{F}$ on the charged particle as it crosses the origin? **[4]**

3) Now, a third wire is placed at the origin instead of the charged particle. This wire is also parallel to the *y*-axis, and carries current $I_b = 0.5$ A in the negative *y* direction. What is the force ***F*** exerted on a segment of length $L = 4$ cm of the third wire by the first two? **[4]**



4) Two circular coils, **A** of radius *2R*, and **B** of radius *R*, are situated in a region of constant magnetic field *B* directed into the page as shown in the figure below. Coil **A** has 1 turn while coil **B** has 2 turns. Identical currents *I* flow in each coil, both in the clockwise direction. Compare the magnitude of potential energies U_A and U_B of coils **A** and **B**. Provide a brief but clear explanation of your answer. **[6]**



a) $|U_A| < |U_B|$ b) $|U_A| = |U_B|$ c) $|U_A| > |U_B|$