proprep

Workbook

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Biot Savart Law

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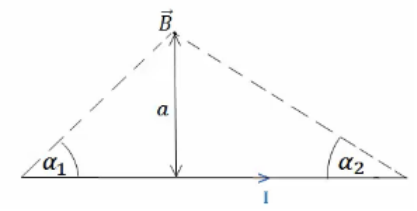
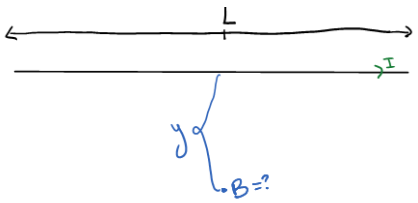
Questions

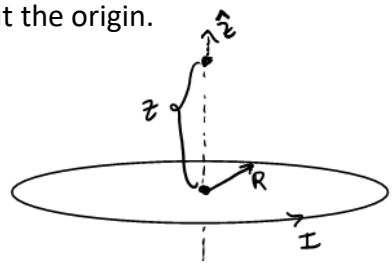
1) Show that the magnitude of the magnetic field caused by the current carrying wire, a distance a from the wire is: $B = \frac{\mu_0 I}{4\pi a}(cos\,\alpha_1 + cos\,\alpha_2)$



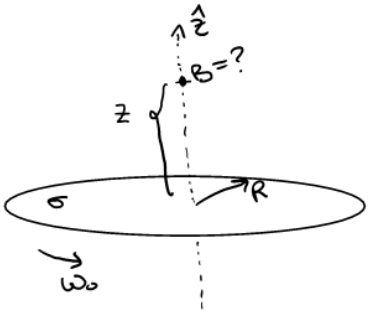
2) Calculate the magnetic field at point y below the middle of a current carrying wire of length L. The current is flowing in the x direction.



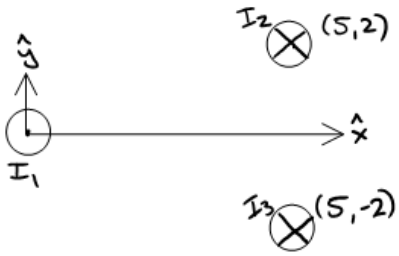
3) Calculate the magnetic field a distance z away from the center of a current carrying loop of radius R. The current is travelling in an anticlockwise direction about the origin.



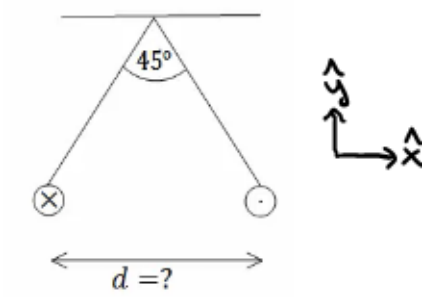
4) Calculate the magnetic field a distance z away from the center of a disk of radius R, charge density σ, and angular velocity ω_0 in the anticlockwise direction about the origin.



5) Three infinite wires are placed parallel to the z-axis.
Their positions are: $\overrightarrow{r_1} = (0,0)$, $\overrightarrow{r_2} = (5,2)$, $\overrightarrow{r_3} = (5,-2)$.
The direction of current in each wire is: $I_1 = 3A$ out of the page, $I_2 = 5A$ into the page, $I_3 = 4A$ into the page.
Where along the x-axis does the y component of the magnetic field equal zero?

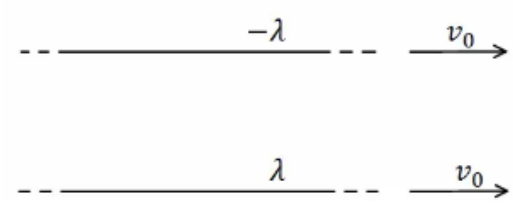


6) Two very long wires are hung from the ceiling via two strings of equal and unknown length. A current of $100A$ flows through each wire, in opposite directions. There is a $45°$ angle between the strings, and their mass per unit length is $= 2\frac{gr}{m}$.
Find the distance between the wires.



7) A current I flows through a regular n-sided polygon that is enclosed by a circle of radius R.
a. What is the magnetic field at the centre of the polygon?
b. What is the magnetic field at the center of the polygon when $n \to \infty$?

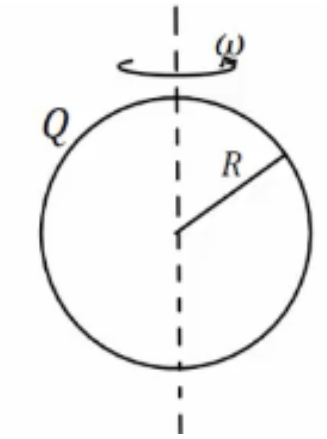
8) Two infinite wires are parallel to one another and have charge distribution λ and $-\lambda$. The wires are pulled in the rightwards direction at a constant velocity v_0.
Calculate the magnitude of the velocity such that the magnetic force will cancel out with the electric force.



9) Wire $ACDFG$ includes a circular section of radius R, and two infinitely long straight regions.
The continuation of line AC cuts through the center of the circle's radius.
A current I flows through the wire.

a. What is the magnetic field at the centre of the circular region?
b. A charged particle travels through the centre of the circular region.
The particle's trajectory changes due to the magnetic field. The trajectory appears in the diagram.
What is the particles charge?
c. In another experiment, a non-uniform magnetic field is present is the region $R < y < 2R$.
Part of the FG section of the wire is in the region with the non uniform magnetic field.
The magnetic field is $\vec{B} = (0,0,ay^2)$, where a is given. What magnetic force does this field apply to the wire?

10) A spherical shell of radius R has charge Q evenly distributed on the surface.
The shell rotates about its axis of symmetry at a constant angular velocity ω.
Calculate the magnetic field at the centre of the shell.
Assume that the rotation does not affect the charge distribution.



*For the solutions go see the vidoes