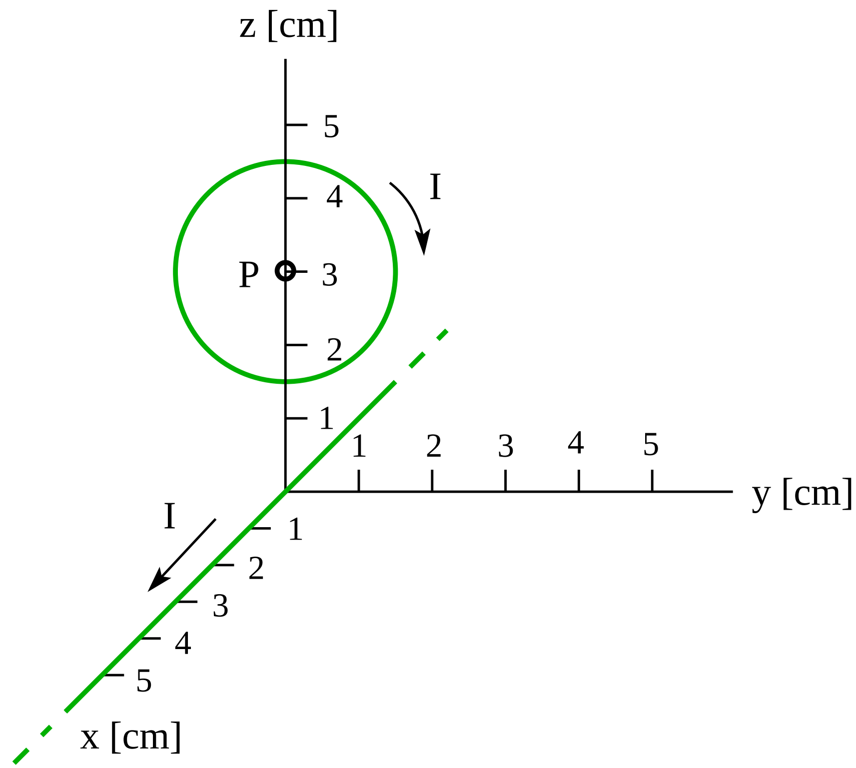
Unit Exam III: Problem #2 (Spring ’13)

A very long, straight wire is positioned along the x-axis and a circular wire of 1.5cm radius in the yz plane with its center P on the z-axis as shown. Both wires carry a current $I = 0.6$A in the directions shown.

(a) Find the magnetic field $\mathbf{B}_c$ (magnitude and direction) generated at point P by the current in the circular wire.

(b) Find the magnetic field $\mathbf{B}_s$ (magnitude and direction) generated at point P by the current in the straight wire.

(c) Find the magnetic moment $\vec{\mu}$ (magnitude and direction) of the circular current.



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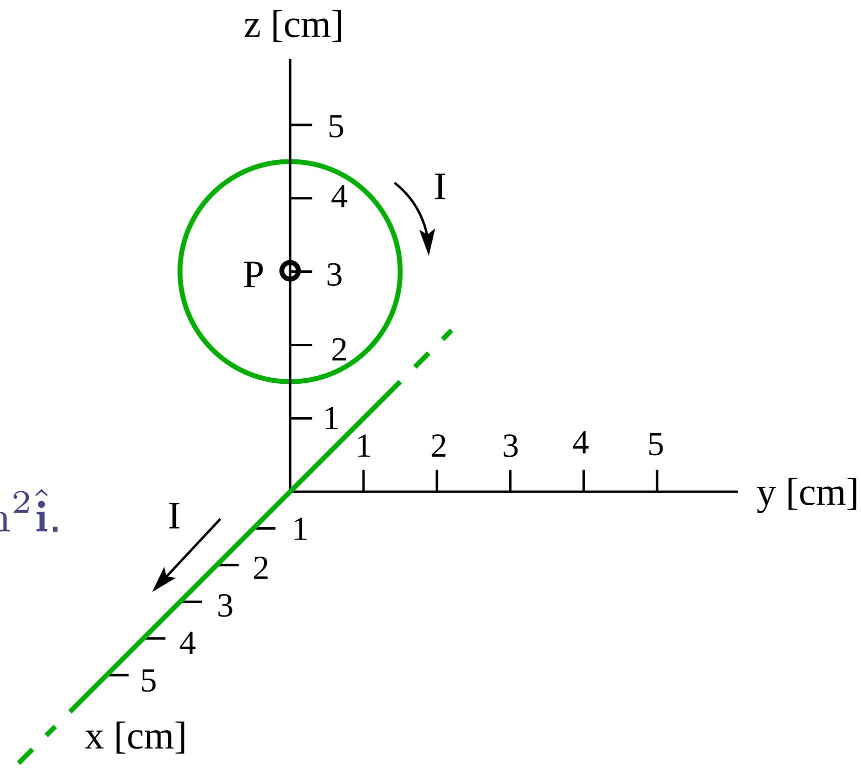


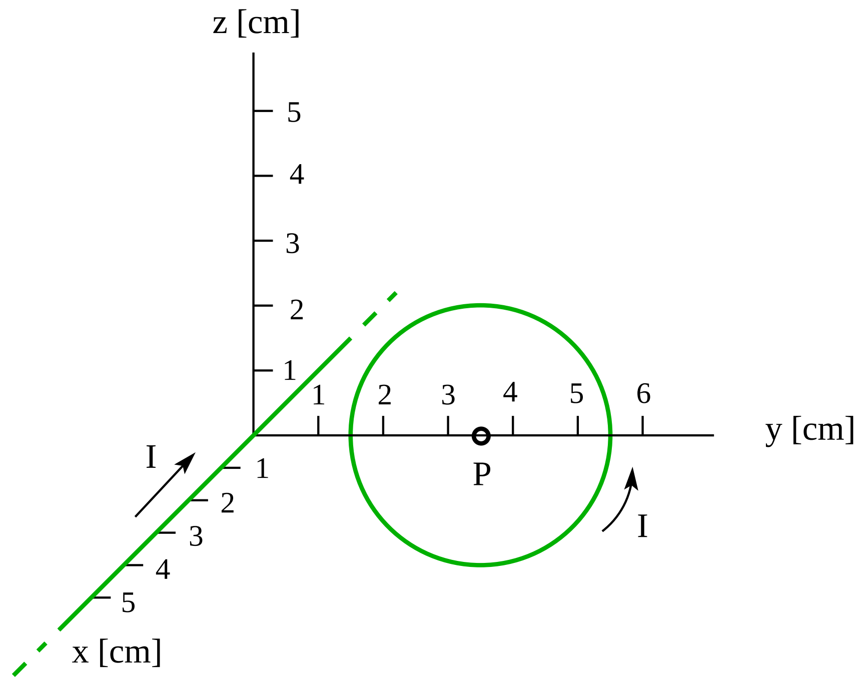
Solution:

(a) $\mathbf{B}_c = \dfrac{\mu_0(0.6\text{A})}{2(0.015\text{m})}(-\hat{\mathbf{i}}) = -2.51 \times 10^{-5}\text{T}\,\hat{\mathbf{i}}.$

(b) $\mathbf{B}_s = \dfrac{\mu_0(0.6\text{A})}{2\pi(0.03\text{m})}(-\hat{\mathbf{j}}) = -4.00 \times 10^{-6}\text{T}\,\hat{\mathbf{j}}.$

(c) $\vec{\mu} = \pi(0.015\text{mm})^2(0.6\text{A})(-\hat{\mathbf{i}}) = -4.24 \times 10^{-4}\text{Am}^2\hat{\mathbf{i}}.$

A very long straight wire is positioned along the x-axis and a circular wire of 2.0cm radius in the yz plane with its center P on the y-axis as shown. Both wires carry a current $I = 0.5$A in the directions shown.
(a) Find the magnetic field $\mathbf{B}_c$ (magnitude and direction) generated at point P by the current in the circular wire.
(b) Find the magnetic field $\mathbf{B}_s$ (magnitude and direction) generated at point P by the current in the straight wire.
(c) Find the magnetic moment $\vec{\mu}$ (magnitude and direction) of the circular current.



A very long straight wire is positioned along the x-axis and a circular wire of 2.0cm radius in the yz plane with its center P on the y-axis as shown. Both wires carry a current $I = 0.5$A in the directions shown.
(a) Find the magnetic field $\mathbf{B}_c$ (magnitude and direction) generated at point P by the current in the circular wire.
(b) Find the magnetic field $\mathbf{B}_s$ (magnitude and direction) generated at point P by the current in the straight wire.
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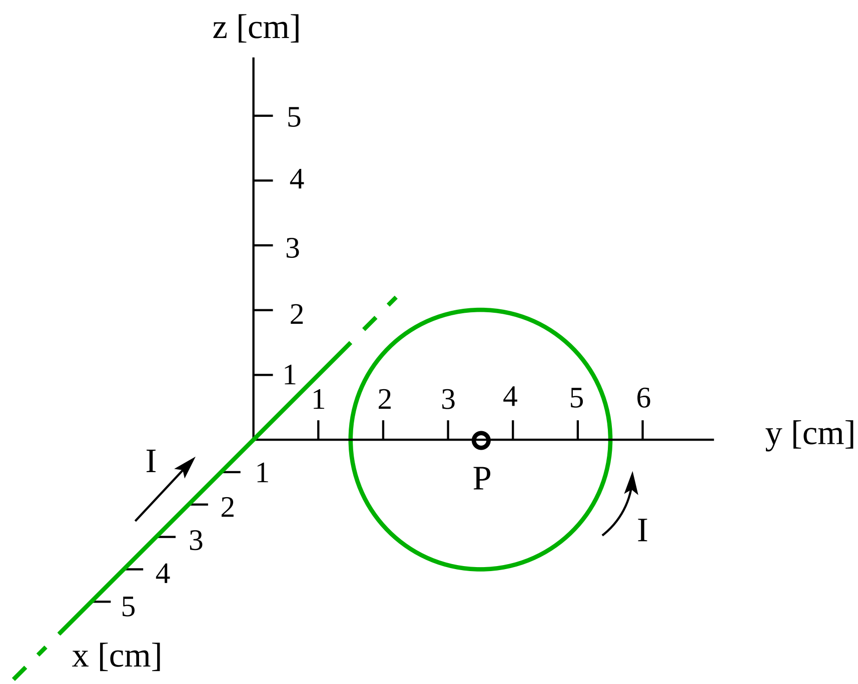

Solution:

(a) $\mathbf{B}_c = \frac{\mu_0(0.5\text{A})}{2(0.02\text{m})}\,\hat{\mathbf{i}} = 1.57 \times 10^{-5}\text{T}\,\hat{\mathbf{i}}.$

(b) $\mathbf{B}_s = \frac{\mu_0(0.5\text{A})}{2\pi(0.035\text{m})}(-\hat{\mathbf{k}}) = -2.86 \times 10^{-6}\text{T}\,\hat{\mathbf{k}}.$

(c) $\vec{\mu} = \pi(0.02\text{m})^2(0.5\text{A})\,\hat{\mathbf{i}} = 6.28 \times 10^{-4}\text{Am}^2\hat{\mathbf{i}}.$