EMPossible

Electromagnetics:
Electromagnetic Field Theory

Example 5 – Magnetic Moment

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Example #5 – Magnetic Moment

Determine the magnetic dipole moment formed by the triangular loop show below.

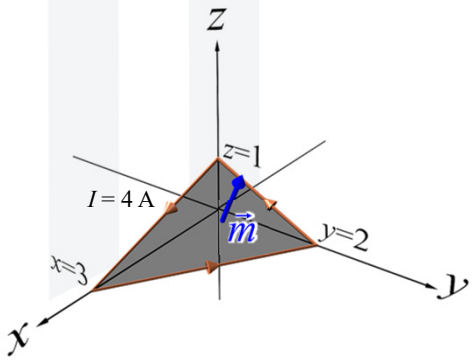
Solution

The magnetic dipole moment $\vec{m}$ is defined as

$$\vec{m} = IS\hat{a}_n$$

The current I is given in the figure to be

$$I = 4 \text{ A}$$



2

Example #5 – Magnetic Moment

Area S of the loop is calculated using the cross product.

$$S = \frac{1}{2}\left|\vec{b}\times\vec{a}\right| = \frac{1}{2}\left|(-3,2,0)\times(-3,0,1)\right| = \frac{1}{2}\left|(2,3,6)\right| = 3.5$$

$$\vec{a} = (0,0,1) - (3,0,0) = (-3,0,1)$$

$$\vec{b} = (0,2,0) - (3,0,0) = (-3,2,0)$$

Surface normal $\hat{a}_n$ is

$$\hat{a}_n = \frac{\vec{b}\times\vec{a}}{\left|\vec{b}\times\vec{a}\right|} = \frac{(2,3,6)}{\left|(2,3,6)\right|} = \left(\frac{2}{7},\frac{3}{7},\frac{6}{7}\right)$$

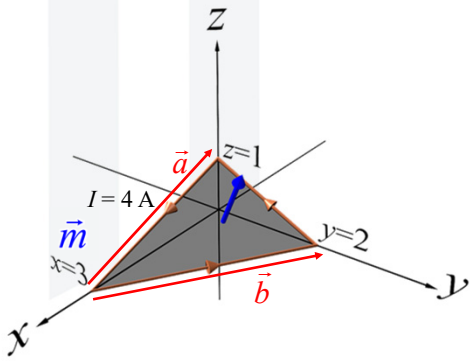
Altogether, $\vec{m}$ is

$$\vec{m} = IS\hat{a}_n$$

$$= (4\text{ A})(3.5\text{ m}^2)\left(\frac{2}{7},\frac{3}{7},\frac{6}{7}\right)$$

$$= (4,6,12)$$

$$\boxed{\vec{m} = 4\hat{a}_x + 6\hat{a}_y + 12\hat{a}_z \quad \text{A}\cdot\text{m}^2}$$



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