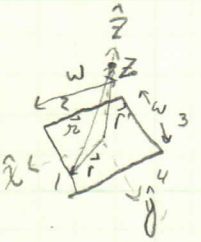
5.36




$$\vec{B} = \frac{\mu_0 I}{4\pi s}(\sin\theta_2 - \sin\theta_1)\,\hat{s} \qquad \text{Here } \theta_2 = -\theta_1 \text{ and } \vec{s}_{13} = \mp\frac{w}{2}\hat{x} + z\hat{z}$$

or $\vec{s}_{24} = \mp\frac{w}{2}\hat{y} + z\hat{z}$ depending on the segment

$$\text{So, } \sin\theta_1 = \frac{\text{opposite}}{\text{hypotenuse}} = \frac{\frac{w}{2}}{\sqrt{\frac{w^2}{4} + z_0^2}} = \frac{w/2}{s}$$

$$\vec{B}_i = -\frac{2\mu_0 I}{4\pi s^2}\sin\theta_1\,\vec{s}_i = \frac{\mu_0 I w}{4\pi s^3}\,\vec{s}_i$$

so

$$\vec{B} = \sum_{i=1}^{4}\vec{B}_i = \frac{\mu_0 I w}{4\pi s^3}\left[-\frac{w}{2}\hat{x} + z_0\hat{z} - \frac{w}{2}\hat{y} + z_0\hat{z} + \frac{w}{2}\hat{x} + z_0\hat{z} + \frac{w}{2}\hat{y} + z_0\hat{z}\right]$$

$$\vec{B} = \frac{\mu_0 I w}{\pi s^3} = \frac{\mu_0 I w}{\pi\left(\sqrt{\frac{w^2}{4} + z_0^2}\right)^3}\,4z_0\hat{z} = \frac{4\mu_0 I w z_0}{\pi\left(\frac{w^2}{4} + z_0^2\right)^{3/2}}\hat{z}$$

$$\vec{m} = I w^2 \hat{z}$$

$$\vec{B}_{dip}(z_0\hat{z}) = \frac{\mu_0}{4\pi}\frac{1}{z_0^3}\left[3(Iw^2)\hat{z} - Iw^2\hat{z}\right] = \frac{\mu_0 I w^2}{2\pi z_0^3}\hat{z}$$