1.30 A vector field is given by $\mathbf{H} = 10yz^2\mathbf{a}_x - 8xyz\mathbf{a}_y + 12y^2\mathbf{a}_z$

(a) Evaluate $\mathbf{H}$ at P(−1, 2, 4)

(b) Find the component of $\mathbf{H}$ along $\mathbf{a}_x - \mathbf{a}_y$ at P.

a) $\bar{H}_P = 10(2)4^2\hat{a}_x - 8(-1)2(4)\hat{a}_y + 12(2)^2\hat{a}_z$

$$\underline{\underline{\bar{H}_P = 320\hat{a}_x + 64\hat{a}_y + 48\hat{a}_z}}$$

b) Find unit vector for $\bar{A} = \hat{a}_x - \hat{a}_y$

$$\hat{a}_A = \frac{\bar{A}}{|\bar{A}|} = \frac{\hat{a}_x - \hat{a}_y}{\sqrt{1^2+(-1)^2}} = \frac{1}{\sqrt{2}}\hat{a}_x - \frac{1}{\sqrt{2}}\hat{a}_y$$

$$\bar{H}_{A,P} = (\bar{H}_P \cdot \hat{a}_A)\,\hat{a}_A$$

$$= \left[(320\hat{a}_x + 64\hat{a}_y + 48\hat{a}_z)\cdot\left(\frac{\hat{a}_x}{\sqrt{2}} - \frac{\hat{a}_y}{\sqrt{2}}\right)\right]\left(\frac{\hat{a}_x}{\sqrt{2}} - \frac{\hat{a}_y}{\sqrt{2}}\right)$$

$$= \left[\frac{320}{\sqrt{2}} - \frac{64}{\sqrt{2}}\right]\left(\frac{\hat{a}_x}{\sqrt{2}} - \frac{\hat{a}_y}{\sqrt{2}}\right)$$

$$= \frac{256}{\sqrt{2}}\left(\frac{\hat{a}_x}{\sqrt{2}} - \frac{\hat{a}_y}{\sqrt{2}}\right)$$

$$\underline{\underline{\bar{H}_{A,P} = 128\hat{a}_x - 128\hat{a}_y}}$$