# EE 381 Electric and Magnetic Fields Quiz #4 (Fall 2025)

**Name** **KEY A**

Instructions: Closed book & notes. Place answers in indicated spaces and show all work for credit.

Useful equations: $\bar{A}\bullet\bar{B} = |\bar{A}||\bar{B}|\cos\theta_{AB}$, $\bar{A}\times\bar{B} = |\bar{A}||\bar{B}|\sin\theta_{AB}\,\hat{a}_n$, $\bar{r}_{\text{position}} = x\,\hat{a}_x + y\,\hat{a}_y + z\,\hat{a}_z$

Given vectors $\bar{M} = -12\hat{a}_x - 8\hat{a}_y + 16\hat{a}_z$, $\bar{L} = 6\hat{a}_x + 9\hat{a}_y - 4\hat{a}_z$, & $\bar{N} = 6\hat{a}_x - 12\hat{a}_y - 9\hat{a}_z$ and the Cartesian points $A$(2, -8, 3), $B$(-3, 4, -3), and $C$(7, 4, 5), with units of meters, find:

a) The unit vector in the direction of $\bar{L}$.

$$|\bar{L}| = \sqrt{\bar{L}\bullet\bar{L}} = \sqrt{(6\hat{a}_x + 9\hat{a}_y - 4\hat{a}_z)\bullet(6\hat{a}_x + 9\hat{a}_y - 4\hat{a}_z)} = \sqrt{6^2 + 9^2 + (-4)^2} = \sqrt{133} = 11.53256$$

$$\hat{a}_L = \frac{\bar{L}}{|\bar{L}|} = \frac{6\hat{a}_x + 9\hat{a}_y - 4\hat{a}_z}{\sqrt{133}} = 0.520\hat{a}_x + 0.780\hat{a}_y - 0.347\hat{a}_z$$

$\hat{a}_L =$ $\underline{0.520\hat{a}_x + 0.780\hat{a}_y - 0.347\hat{a}_z}$

b) The smallest angle $\theta$ (in degrees) that $\bar{L}$ makes with the positive $z$-axis

Use scalar product-

$$\bar{L}\bullet\hat{a}_z = |\bar{L}|(1)\cos\theta$$

$$(6\hat{a}_x + 9\hat{a}_y - 4\hat{a}_z)\bullet\hat{a}_z = -4 = \sqrt{133}\cos\theta$$

$$\Rightarrow \theta = \cos^{-1}\left(\frac{-4}{\sqrt{133}}\right) = 110.2944°$$

$\theta =$ $\underline{110.2944°}$

c) The distance vector $\bar{d}_{AB}$ going from point $A$ to $B$

position vectors- $\bar{r}_A = 2\hat{a}_x - 8\hat{a}_y + 3\hat{a}_z$ (m) and $\bar{r}_B = -3\hat{a}_x + 4\hat{a}_y - 3\hat{a}_z$ (m)

distance vector-

$$\bar{d}_{AB} = \bar{r}_B - \bar{r}_A = (-3\hat{a}_x + 4\hat{a}_y - 3\hat{a}_z) - (2\hat{a}_x - 8\hat{a}_y + 3\hat{a}_z) = (-3-2)\hat{a}_x + (4+8)\hat{a}_y + (-3-3)\hat{a}_z$$
$$= -5\hat{a}_x + 12\hat{a}_y - 6\hat{a}_z \text{ (m)}$$

$\bar{d}_{AB} =$ $\underline{-5\hat{a}_x + 12\hat{a}_y - 6\hat{a}_z \text{ (m)}}$

d) The vector product of $\bar{L}$ with $\bar{N}$:

$$\bar{L}\times\bar{N} = (6\hat{a}_x + 9\hat{a}_y - 4\hat{a}_z)\times(6\hat{a}_x - 12\hat{a}_y - 9\hat{a}_z)$$
$$= [9(-9) - (-4)(-12)]\hat{a}_x + [-4(6) - 6(-9)]\hat{a}_y + [6(-12) - 9(6)]\hat{a}_z$$
$$= -129\hat{a}_x + 30\hat{a}_y - 126\hat{a}_z \text{ (m)}$$

vector product of $\bar{L}$ with $\bar{N} =$ $\underline{\bar{L}\times\bar{N} = -129\hat{a}_x + 30\hat{a}_y - 126\hat{a}_z}$

# EE 381 Electric and Magnetic Fields Quiz #4 (Fall 2025)

**Name** __KEY B__

Instructions: Closed book & notes. Place answers in indicated spaces and show all work for credit.

Useful equations: $\bar{A}\bullet\bar{B} = |\bar{A}||\bar{B}|\cos\theta_{AB}$, $\bar{A}\times\bar{B} = |\bar{A}||\bar{B}|\sin\theta_{AB}\,\hat{a}_n$, $\bar{r}_{\text{position}} = x\,\hat{a}_x + y\,\hat{a}_y + z\,\hat{a}_z$

Given vectors $\bar{M} = -12\hat{a}_x - 8\hat{a}_y + 16\hat{a}_z$, $\bar{L} = 6\hat{a}_x + 9\hat{a}_y - 4\hat{a}_z$, & $\bar{N} = 6\hat{a}_x - 12\hat{a}_y - 9\hat{a}_z$ and the Cartesian points $A(2, -8, 3)$, $B(-3, 4, -3)$, and $C(7, 4, 5)$, with units of meters, find:

a) The unit vector in the direction of $\bar{N}$.

$$|\bar{N}| = \sqrt{\bar{N}\bullet\bar{N}} = \sqrt{(6\hat{a}_x - 12\hat{a}_y - 9\hat{a}_z)\bullet(6\hat{a}_x - 12\hat{a}_y - 9\hat{a}_z)} = \sqrt{6^2 + (-12)^2 + (-9)^2} = \sqrt{261} = 16.1555$$

$$\hat{a}_N = \frac{\bar{N}}{|\bar{N}|} = \frac{6\hat{a}_x - 12\hat{a}_y - 9\hat{a}_z}{\sqrt{261}} = 0.371\hat{a}_x - 0.743\hat{a}_y - 0.557\hat{a}_z$$

$\hat{a}_N =$ __$0.371\hat{a}_x - 0.743\hat{a}_y - 0.557\hat{a}_z$__

b) The smallest angle $\theta$ (in degrees) that $\bar{N}$ makes with the positive $z$-axis

Use scalar product-

$$\bar{N}\bullet\hat{a}_z = |\bar{N}|(1)\cos\theta$$

$$(6\hat{a}_x - 12\hat{a}_y - 9\hat{a}_z)\bullet\hat{a}_z = -9 = \sqrt{261}\cos\theta$$

$$\Rightarrow \theta = \cos^{-1}\left(\frac{-9}{\sqrt{261}}\right) = 123.8545°$$

$\theta =$ __**123.8545°**__

c) The distance vector $\bar{d}_{AC}$ going from point $A$ to $C$

position vectors- $\bar{r}_A = 2\hat{a}_x - 8\hat{a}_y + 3\hat{a}_z$ (m) and $\bar{r}_C = 7\hat{a}_x + 4\hat{a}_y + 5\hat{a}_z$ (m)

distance vector-

$$\bar{d}_{AC} = \bar{r}_C - \bar{r}_A = (7\hat{a}_x + 4\hat{a}_y + 5\hat{a}_z) - (2\hat{a}_x - 8\hat{a}_y + 3\hat{a}_z) = (7-2)\hat{a}_x + [4-(-8)]\hat{a}_y + (5-3)\hat{a}_z$$

$$= 5\hat{a}_x + 12\hat{a}_y + 2\hat{a}_z \text{ (m)}$$

$\bar{d}_{AC} =$ __$5\hat{a}_x + 12\hat{a}_y + 2\hat{a}_z$ (m)__

d) The vector product of $\bar{L}$ with $\bar{M}$:

$$\bar{L}\times\bar{M} = (6\hat{a}_x + 9\hat{a}_y - 4\hat{a}_z)\times(-12\hat{a}_x - 8\hat{a}_y + 16\hat{a}_z)$$

$$= [9(16) - (-4)(-8)]\hat{a}_x + [-4(-12) - 6(16)]\hat{a}_y + [6(-8) - 9(-12)]\hat{a}_z$$

$$= 112\hat{a}_x - 48\hat{a}_y + 60\hat{a}_z \text{ (m)}$$

vector product of $\bar{L}$ with $\bar{M} =$ __$\bar{L}\times\bar{M} = 112\hat{a}_x - 48\hat{a}_y + 60\hat{a}_z$__