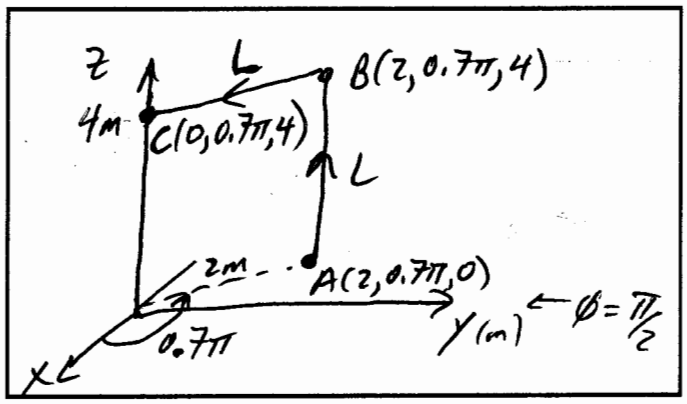
EE 381 Electric and Magnetic Fields Quiz #5 (Fall 2026)

Name Key A

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

The path L goes vertically from the cylindrical point $A(2, 0.7\pi, 0)$ to $B(2, 0.7\pi, 4)$, and then radially from $B(2, 0.7\pi, 4)$ to $C(0, 0.7\pi, 4)$. The points have angles in radians and distances in meters.

a) Sketch, with labels, the path L in box.



b) Compute $\bar{E}\cdot d\bar{l}$ given $\bar{E} = 10\rho z^2 \hat{a}_\rho - 5z\tan\phi\,\hat{a}_\phi + 9\rho z^2 \hat{a}_z$ (V/m).

$\bar{E}\cdot d\bar{l} = (10\rho z^2 \hat{a}_\rho - 5z\tan\phi\,\hat{a}_\phi + 9\rho z^2 \hat{a}_z)\cdot(d\rho\,\hat{a}_\rho + \rho\,d\phi\,\hat{a}_\phi + dz\,\hat{a}_z)$ (V/m, d m)

$\bar{E}\cdot d\bar{l} =$ $10\rho z^2 d\rho - 5\rho z\tan\phi\, d\phi + 9\rho z^2 dz$ (V)

c) Determine $\int \bar{E}\cdot d\bar{l}$ on the portion of L going from A to B.

$\phi = 0.7\pi \Rightarrow d\phi = 0$ + $\rho = 2m \Rightarrow d\rho = 0$

$$\int_A^B \bar{E}\cdot d\bar{l} = \int_{z=0}^{4} 10\rho z^2 \underbrace{d\rho}_{\to 0} - 5\rho z\tan\phi \underbrace{d\phi}_{\to 0} + 9\rho\int_0^2 z^2 dz$$

$$= 9(2)\left.\frac{z^3}{3}\right|_0^4 = \frac{18}{3}(4^3 - 0)$$

$\int_A^B \bar{E}\cdot d\bar{l} =$ 384 (V)

d) Determine $\int \bar{E}\cdot d\bar{l}$ on the portion of L going from B to C.

$\phi = 0.7\pi \Rightarrow d\phi = 0$, $z = 4_m \Rightarrow dz = 0$

$$\int_B^C \bar{E}\cdot d\bar{l} = \int_{\rho=2}^{0} 10\rho \underbrace{z^2}_{4^2} d\rho - 5\rho z\tan\phi \underbrace{d\phi}_{\to 0} + 9\rho z^2 \underbrace{dz}_{\to 0}$$

$$= 10(4^2)\left.\frac{\rho^2}{2}\right|_2^0 = \frac{160}{2}(0 - 2^2)$$

$\int_B^C \bar{E}\cdot d\bar{l} =$ −320 (V)

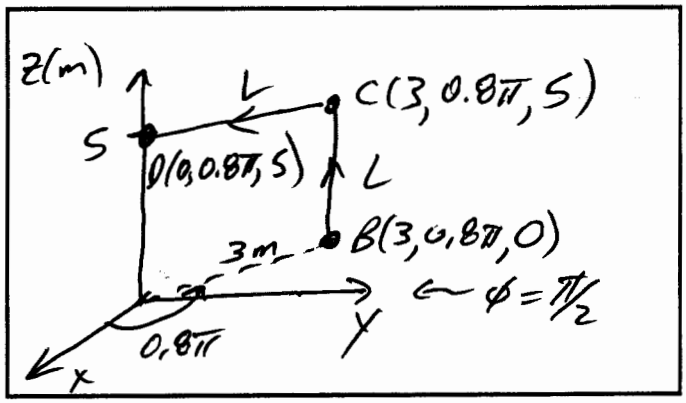
EE 381 Electric and Magnetic Fields Quiz #5 (Fall 2026)

Name Key B

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

The path L goes vertically from the cylindrical point $B(3, 0.8\pi, 0)$ to $C(3, 0.8\pi, 5)$, and then radially from $C(3, 0.8\pi, 5)$ to $D(0, 0.8\pi, 5)$. The points have angles in radians and distances in meters.

a) Sketch, with labels, the path L in box.



b) Compute $\bar{E}\cdot d\bar{l}$ given $\bar{E} = 12\rho z^2 \hat{a}_\rho - 15z\tan\phi\,\hat{a}_\phi + 9\rho z^2 \hat{a}_z$ (V/m).

$\bar{E}\cdot d\bar{\ell} = (12\rho z^2 \hat{a}_\rho - 15z\tan\phi\,\hat{a}_\phi + 9\rho z^2 \hat{a}_z)\cdot(d\rho\,\hat{a}_\rho + \rho\, d\phi\,\hat{a}_\phi + dz\,\hat{a}_z)$ (V/m; m)

$\bar{E}\cdot d\bar{l} =$ $12\rho z^2 d\rho - 15\rho z\tan\phi\, d\phi + 9\rho z^2 dz$ (V)

c) Determine $\int \bar{E}\cdot d\bar{l}$ on the portion of L going from B to C.

$\phi = 0.8\pi \Rightarrow d\phi = 0 \quad \rho = 3m \Rightarrow d\rho = 0$

$$\int_B^C \bar{E}\cdot d\bar{\ell} = \int_{z=0}^{5} 12\rho z^2 \cancel{d\rho}^{\,0} - 15\rho z\tan\phi \cancel{d\phi}^{\,0} + 9\cancel{\rho}^{\,3} z^2 dz$$

$$= 9(3)\left.\frac{z^3}{3}\right|_{z=0}^{5} = 9(5^3 - 0)$$

$\int_B^C \bar{E}\cdot d\bar{l} =$ 1125 (V)

d) Determine $\int \bar{E}\cdot d\bar{l}$ on the portion of L going from C to D.

$\phi = 0.8\pi \Rightarrow d\phi = 0 \quad z = 5m \Rightarrow dz = 0$

$$\int_C^D \bar{E}\cdot d\bar{\ell} = \int_{\rho=3}^{0} 12\rho \cancel{z^2}^{\,5^2} d\rho - 15\rho z\tan\phi \cancel{d\phi}^{\,0} + 9\rho z^2 \cancel{dz}^{\,0}$$

$$= 12(5^2)\left.\frac{\rho^2}{2}\right|_{\rho=3}^{0} = 300(0 - 3^2/2)$$

$\int_C^D \bar{E}\cdot d\bar{l} =$ −1350 (V)