Answer on Question #41779, Physics, Other

A uniform electric field exists in x-y plane. The potential of points A(2m, 2m), B(–2m, 2m) and C(2m, 4m) are 4V, 16 V and 12 V respectively. The electric field is:

(1) (4î + 5ĵ) V/m

(2) (3î + 4ĵ) V/m

(3) – (3î + 4ĵ) V/m

(4) (3î – 4ĵ) V/m

Solution:

For a uniform field, the relationship between electric field (E), potential difference between points A and B (Δ), and distance between points A and B (d) is:

$$E = -\frac{\Delta \hat{V}}{d}$$

In x direction $\Delta V_{BA} = V_A - V_B = 4 - 16 = -12$ V is the potential difference between A and B.

In y direction $\Delta V_{AC} = V_C - V_A = 12 - 4 = 8$ V is the potential difference between A and C.

The distance between A and B is

$$d_{BA} = \sqrt{(x_A - x_B)^2 + (y_A - y_B)^2} = \sqrt{(2+2)^2 + (2-2)^2} = 4$$

The distance between A and C is

$$d_{AC} = \sqrt{(x_A - x_C)^2 + (y_A - y_C)^2} = \sqrt{(2-2)^2 + (2-4)^2} = 2$$

Thus,

$$E_x = -\frac{\Delta V_{BA}}{d_{BA}} = \frac{12}{4} = 3 \text{ V/m}$$

$$E_y = -\frac{\Delta V_{AC}}{d_{AC}} = -\frac{8}{2} = -4 \text{ V/m}$$

So,

$$E = E_x \hat{\imath} + E_y \hat{\jmath} = 3\hat{\imath} - 4\hat{\jmath} \text{ V/m}$$

Answer. (4) (3î – 4ĵ) V/m