

Problem 4.38 Given the electric field

$$\mathbf{E} = \hat{\mathbf{R}} \frac{18}{R^2} \quad (\text{V/m})$$

find the electric potential of point A with respect to point B where A is at $+2$ m and B at -4 m, both on the z -axis.

Solution:

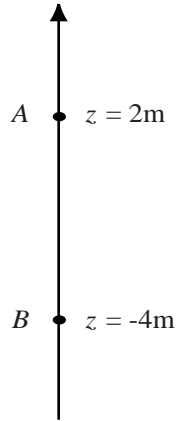


Figure P4.38: Potential between B and A .

$$V_{AB} = V_A - V_B = - \int_B^A \mathbf{E} \cdot d\mathbf{l}.$$

Along z -direction, $\hat{\mathbf{R}} = \hat{\mathbf{z}}$ and $\mathbf{E} = \hat{\mathbf{z}} \frac{18}{z^2}$ for $z \geq 0$, and $\hat{\mathbf{R}} = -\hat{\mathbf{z}}$ and $\mathbf{E} = -\hat{\mathbf{z}} \frac{18}{z^2}$ for $z \leq 0$. Hence,

$$V_{AB} = - \int_{-4}^2 \hat{\mathbf{R}} \frac{18}{z^2} \cdot \hat{\mathbf{z}} dz = - \left[\int_{-4}^0 -\hat{\mathbf{z}} \frac{18}{z^2} \cdot \hat{\mathbf{z}} dz + \int_0^2 \hat{\mathbf{z}} \frac{18}{z^2} \cdot \hat{\mathbf{z}} dz \right] = 4 \text{ V}.$$
