Sheet 8

1 Given $\bar{E} = 2x\bar{a}_x - 4y\bar{a}_y$ V/m, find the work done in moving point charge $+2$ C

(a) from (2,0,0)m to(0,0,0) and then from (0,0,0) to(0,2,0)

(b) from(2,0,0) to(0,2,0) along the straight line joining the two points

(c) show the conservative property

$$[\mathbf{W = 24\ \mu J}]$$

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2 For a line charge $\rho_L = 0.5 \times 10^{-9}$ C/m on the z-axis, find V_{AB} where A is (2m,π/2,0) and B is (4m,π,5m)

$$[\boldsymbol{V_{AB} = 6.23\ V}]$$

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3 40 nC of charge is uniformly distributed around a circular ring of radius $r = 2$ m .find the potential at a point on the axis 5 m from the plane of the ring. Compare with the result where all charge is at the origin in the form of a point charge

$$\begin{bmatrix} \boldsymbol{V = 66.9\ V} \\ \boldsymbol{V = 72\ V} \end{bmatrix}$$

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4 For problem 3 show that $V = \dfrac{\rho_L\, r}{2\,\epsilon\,\sqrt{z^2 + r^2}}$ and then find an expression for the electric field

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5 If $V = \dfrac{\sin\theta}{r^2}$ V , Find (a) $\bar{\mathrm{E}}$ (b) ρ_v

$$\begin{bmatrix} \boldsymbol{\bar{E} = \dfrac{2\ \sin\theta}{r^3}\bar{a}_r - \dfrac{\cos\theta}{r^3}\bar{a}_\theta} \\ \boldsymbol{\rho_v = \dfrac{-\epsilon}{r^4 \sin\theta}\ \mathrm{C/m^3}} \end{bmatrix}$$

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6 If $\bar{D} = \dfrac{5}{r^2}\bar{a}_r - r^2\phi\sin\theta\,\bar{a}_\phi$ C/m^2 for a sphere or radius a . What is ρ_v in the sphere

$$[\boldsymbol{\rho_v = -r\ C/m3}]$$

7 A spherical conducting shell of radius a , centered at the origin , has a potential field :

$$V = \begin{cases} V_o & r \leq a \\ V_o \dfrac{a}{r} & r > a \end{cases}$$

with the zero reference at infinity .Find the stored energy.

$$\left[\boldsymbol{W_E = 2\pi\epsilon\, V_o{}^2\, a}\right]$$

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8 Determine the energy stored in the cube of 2 m side and at centre lies on the origin and $V = 8x + 6y$ V

$$[\boldsymbol{W_E = 3.54 \times 10^{-9}\ J}]$$