PHYS 223 University Physics III
Exam 2

February 12, 2020

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1. Over a certain region of space, the electric potential is $V = x - y^2z + 5z^2$. Find expressions for the x, y, and z components of the electric field over this region. What is the magnitude of the field at the point *P* that has coordinates (-3.00, 1.00, 2.00) m?

a. E_x -1

b. E_y $2yz$

c. E_z $y^2 - 10z$

d. Magnitude of *E* 19.1 V/m

GRADES

92

90, 90

87

84

79

$$V = x + y^2z + 5z^2$$

$$E_x = -\frac{\partial V}{\partial x} = -1$$

$$E_y = -\frac{\partial V}{\partial y} = 2yz$$

$$E_z = -\frac{\partial V}{\partial z} = y^2 - 10z$$

$$\vec{E} = -\hat{x} + 2yz\,\hat{y} + (y^2 - 10z)\,\hat{z}$$

at $x = -3$, $y = 1$, $z = 2$

$$\vec{E} = -\hat{x} + 2\hat{y} - 19\hat{z}$$

$$|E| = \sqrt{1 + 4 + (19)^2} = 19.1 \text{ V/m}$$

$$= \sqrt{366} = 19.1 \text{ V/m}$$

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2. A charge Q is uniformily distributed on a thin wire. The wire is bent into a circular arc and two straight sections as shown in Figure 2.

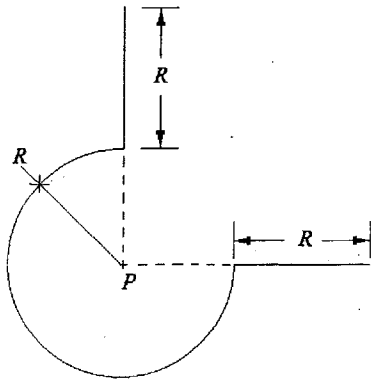

Figure 2

What is the electric potential at the point P at the center of the arc? _____

ONE STRAIGHT Section

$V_1 = K\int \frac{dq}{r}$

$dq = \lambda\, dx \qquad r = x$

$V_1 = K\lambda \int_R^{2R} \frac{dx}{x} = \lambda K \ln(2)$

ARC $\qquad V_2 = K\int \frac{dq}{r}$

$dq = \lambda r\, d\theta$

$V_2 = K\lambda \int_{\pi/2}^{2\pi} \frac{r\, d\theta}{r} = K\lambda\left[2\pi - \frac{\pi}{2}\right] = K\lambda\frac{3\pi}{2}$

$V = 2V_1 + V_2 = K\lambda\left[2\ln(2) + \frac{3\pi}{2}\right]$

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3. What is the capacitance between the points ***a*** and ***b*** in Figure 3? _____

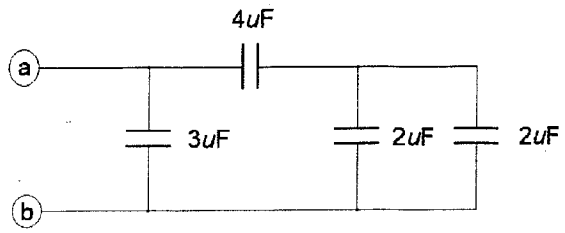
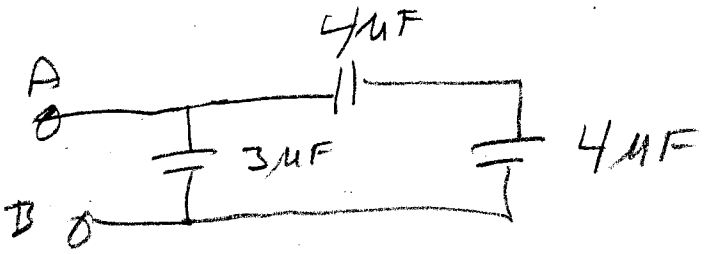


Figure 3



$$\frac{1}{C_{eq}} = \frac{1}{4} + \frac{1}{4}$$

$$= \frac{1}{2}$$