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General Physics- II, Quiz 2s
PHYS10000AA, Fall Semester-107
2019-04-18

St. ID:_____, Name:_____

Note: You can use pencil or any pen in answering the problems. Dictionary, calculators and mathematics tables are allowed. Please hand in both solution and this problem sheet.
ABSOLUTELY NO CHEATING!

Problems (total 3 problems, 100%)

1. Figure P24.22 represents a graph of the electric potential in a region of space versus position *x*, where the electric field is parallel to the *x* axis. Draw a graph of the *x* component of the electric field versus *x* in this region. (30%)

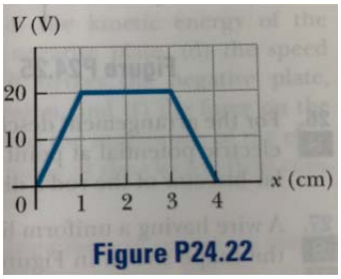


Figure P24.22

Ans:

$$E_x = -\frac{\partial V}{\partial x} \quad \rightarrow \quad E_x = -\frac{\Delta V}{\Delta x} = -\,(\text{slope of line})$$

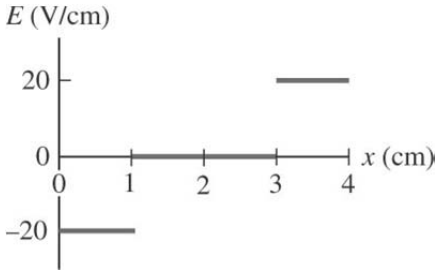
The sign indicates the direction of the *x* component of the field.

$x = 0$ to 1 cm

$$E_x = -\frac{\Delta V}{\Delta x} = -\frac{20\text{ V} - 0}{1\text{ cm}} = -20\text{ V/cm}$$

$x = 1$ to 3 cm: $E_x = -\dfrac{\Delta V}{\Delta x} = -\dfrac{0}{2\text{ cm}} = 0\text{ V/m}$

$x = 3$ to 4 cm: $E_x = -\dfrac{\Delta V}{\Delta x} = -\dfrac{0 - 20\text{ V}}{1\text{ cm}} = +20\text{ V/cm}$



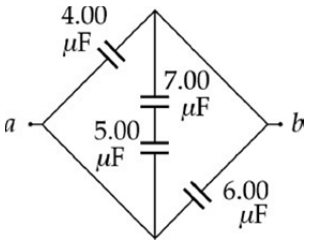
ANS. FIG. P24.22

2. Find the equivalent capacitance between points *a* and *b* in the combination of capacitors shown in Figure P25.13. (30%)

Ans:

$$C_s = \left(\frac{1}{5.00} + \frac{1}{7.00}\right)^{-1} = 2.92\ \mu\text{F}$$

$$C_p = 2.92 + 4.00 + 6.00 = \boxed{12.9\ \mu\text{F}}$$



ANS. FIG. P25.13

3. The quantity of charge q (in coulombs) that has passed through a surface of area 2.00 cm^2 varies with time according to the equation $q = 4t^3 + 5t + 6$, where t is in seconds. (a) What is the instantaneous current through the surface at t =1.00 s? (20%) (b) What is the value of the current density? (20%)

Ans:

We are given $q = 4t^3 + 5t + 6$. The area is

$$A = \left(2.00\ \text{cm}^2\right)\left(\frac{1.00\ \text{m}}{100\ \text{cm}}\right)^2 = 2.00\times10^{-4}\ \text{m}^2$$

(a) $$I(1.00\ \text{s}) = \left.\frac{dq}{dt}\right|_{t=1.00\ \text{s}} = \left.\left(12t^2+5\right)\right|_{t=1.00\ \text{s}} = \boxed{17.0\ \text{A}}$$

(b) $$J = \frac{I}{A} = \frac{17.0\ \text{A}}{2.00\times10^{-4}\ \text{m}^2} = \boxed{85.0\ \text{kA/m}^2}$$