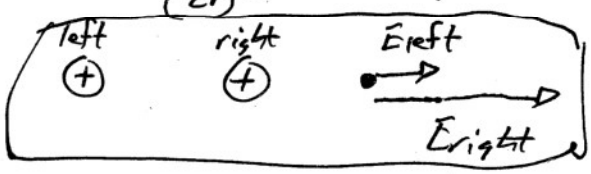
In Class Practice Problems
Electric Fields and Potential
SOLUTION KEY

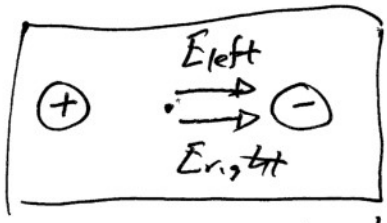
(1) Electric fields are vectors. So one must determine the electric field created by each of two point charges at the dot. Then add those electric field vectors together to get overall (net) electric field magnitude.

(A) $E_{left} = \frac{kq}{(2r)^2} \rightarrow \frac{1}{4}\frac{kq}{r^2}$ (to right) $\quad E_{right} = \frac{kq}{r^2}$ (to right)



$E_{net} = \frac{1}{4}\frac{kq}{r^2} + \frac{kq}{r^2} = \boxed{\frac{5}{4}\frac{kq}{r^2}}$

(B)

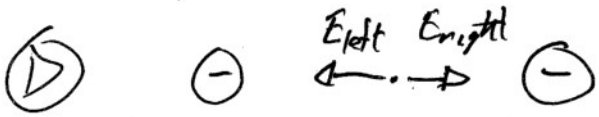


$|E_{left}| = |E_{right}| = \frac{kq}{r^2} \rightarrow E_{net} = \frac{kq}{r^2} + \frac{kq}{r^2} = \boxed{\frac{2kq}{r^2}}$

(C)

$E_{left} = \frac{kq}{(2r)^2} = \frac{1}{4}\frac{kq}{r^2}$ (to left) $\qquad E_{right} = \frac{kq}{r^2}$ (to right)

$E_{net} = E_{right} - E_{left} = \frac{kq}{r^2} - \frac{1}{4}\frac{kq}{r^2} = \boxed{\frac{3}{4}\frac{kq}{r^2}}$



$|E_{left}| = |E_{right}|$

$E_{net} = E_{left} - E_{right} = \boxed{\emptyset}$

RANKING

B	A	C	D
$2\frac{kq}{r^2}$	$\frac{5}{4}\frac{kq}{r^2}$	$\frac{3}{4}\frac{kq}{r^2}$	$\emptyset$

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(2) (a) $E = \frac{F}{q} = \frac{6.00\times10^{-4}\,N}{3.0\times10^{-6}\,C} = 200\,N/C$

$E = \frac{kq}{r^2} \rightarrow r^2 = \frac{kq}{E} = \frac{(8.99\times10^{9}\,N\cdot m^2C^{-2})(20\times10^{-9}\,C)}{200\,N/C}$

$r^2 = .899\,m^2 \rightarrow r = \sqrt{.899}$

$r = .95\,m$

(b) $E = \frac{F}{q} \rightarrow Eq = F$ $\left\{ F = (7.2\times10^{4}\,N/C)(4.0\times10^{-9}\,C) \right.$

$F = \cancel{1.8\times10^{-5}\,N}$ $2.88\times10^{-4}\,N$

$r^2 = \frac{kq}{E} = \frac{(8.99\times10^{9}\,N\cdot m^2C^{-2})(12\times10^{-6}\,C)}{7.2\times10^{4}\,N/C} = 1.498$

$r^2 = 1.498 \rightarrow r = \sqrt{1.498}$

$r = 1.2\,m$

(2) (c) $E = \frac{kq}{r^2} = \frac{(8.99\times10^9\ N\cdot m^2C^{-2})(2\times10^{-7}\ C)}{(3.8\ m)^2} = 125\ N/C$ or

$F = Eq = (125\ N/C)(1.6\times10^{-19}\ C) = 2\times10^{-17}\ N$

(d) $E = \frac{kq}{r^2} = \frac{(8.99\times10^9\ N\cdot m^2C^{-2})(3.2\times10^{-6}\ C)}{(0.8\ m)^2} = 4.50\times10^4\ N/C$

$F = Eq = (4.50\times10^4\ N/C)(1.60\times10^{-19}\ C) = 7.2\times10^{-15}\ N$

(3) (a) $22.0\ eV \times \frac{1.60\times10^{-19}\ J}{1\ eV} = 3.52\times10^{-18}\ J$

(b) $35.7\times10^6\ eV \times \frac{1.60\times10^{-19}\ J}{1\ eV} = 5.71\times10^{-12}\ J$

(c) $125\times10^9\ eV \times \frac{1.60\times10^{-19}\ J}{1\ eV} = 2.0\times10^{-8}\ J$

(4) (a) $3.2\times10^{-18}\ J \times \frac{1\ eV}{1.60\times10^{-19}\ J} = 20\ eV$

(b) $9.6\times10^{-15}\ J \times \frac{1\ eV}{1.60\times10^{-19}\ J} = 60{,}000\ eV$ or $60\ keV$

(5) (a) $V = \frac{E_P}{q} = \frac{48\times10^{-6}\ J}{12\times10^{-9}\ C} = 4000\ V$ (b) $V_q = E_P$

$(4000\ V)(6\times10^{-9}\ C) = 2.4\times10^{-5}\ J$