2 Electric Charge and Electric Fields

$\frac{19.5}{20}$

1. $E = \frac{kq}{r^2} \rightarrow 2\times10^{-3} = \frac{(8.9\times10^{9})q}{10^{-3}} \rightarrow 2\times10^{-9} = 8.9\times10^{9}(q)$

$\frac{2\times10^{-9}}{8.9\times10^{9}} = q \rightarrow q = 2.25\times10^{-19}$

$E = 2\times10^{-3}$ V/m
$r^2 = 1\times10^{-3}$
$q = 2.25\times10^{-19}$
$k = 8.9\times10^{9}$

excellent.

$E_c = \frac{(8.9\times10^{9})(2.25\times10^{-19})}{(5\times10^{-3})^2} \rightarrow \boxed{E_c = 8\times10^{-5} \text{ V/m}}$

B. $E = \frac{kq}{r^2}$ $8\times10^{-3} = \frac{(8.9\times10^{9})(1\times10^{-6})}{r^2} \rightarrow r^2 = \frac{(8.9\times10^{9})(1\times10^{-6})}{8\times10^{-3}}$

$r^2 = 1112500 \rightarrow r = 1054$

$E_1 = 8\times10^{-3}$
$r = 1054$
$q = 1\times10^{-6}$
$k = 8.9\times10^{9}$

$-\frac{1}{2}$ almost but there's some math error here

$E_2 = ?$
$r = 1054$
$q = 3\times10^{-6}$
$k = 8.9\times10^{9}$

$E = \frac{(8.9\times10^{9})(3\times10^{-6})}{1054^2} \rightarrow \boxed{E = 2.4\times10 \text{ V/m}}$

$2.4\times10^{?}$ V/m

2. $F = qe \rightarrow q = \frac{F}{e} \rightarrow q = \frac{4\times10^{-15}}{6131.25} \rightarrow q = 6.5\times10^{-19}$

$E_{field} = 6131.25$ N/C
$m = 4\times10^{-16}$
$F = 4\times10^{-15}$
$F = ma$

$\frac{6.5\times10^{-19}}{1.6\times10^{-19}} = 4.077$

2.25×10^{-16}

nice

$\boxed{\text{A. 4 electrons}}$

$F_c = qE \rightarrow (4.9\times10^{-19})6131.25 = 3\times10^{-15}$

$q = (6.5\times10^{-19}) - (1.6\times10^{-19}) = 4.9\times10^{-19}$

$E = 6131.25$

B. $a = \frac{F}{m}$

$\frac{10^{-15}}{4\times10^{-16}}$

$(4\times10^{-15}) - (3\times10^{-15}) = 10^{-15}$

$\boxed{\text{B. } A = 2.5 \text{ m/s}}$ 2.5 m/s^2

3 Potential Energy and Capacitors

1. A. $KE = qV$

$q_H = 1.6 \times 10^{-19}$
$q_{He} = 3.2 \times 10^{-19}$
$V = 4000V$

A) Hydrogen $= 6.4 \times 10^{-16}$
Helium $= 1.28 \times 10^{-15}$ $\rightarrow KE_{tot} = 1.92 \times 10^{-15}$

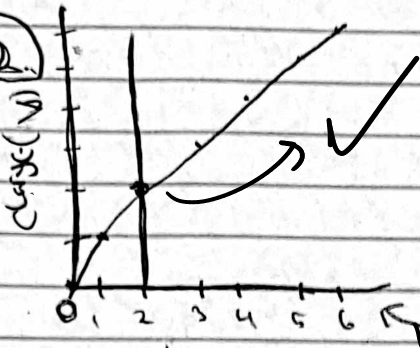
$\frac{1.92 \times 10^{-15}}{1.6 \times 10^{-19}} = \boxed{12000 eV}$

12,000 eV is the total (4 keV + 8 keV)

B $E = \frac{V}{x}$

$V = 4kV$
$E = ?$
$x = 5cm$

$\frac{4000V}{.05m} = \boxed{8 \times 10^4 V/m}$

2. 

1V/mm

$E_{field} = 1kV/m = 1V/mm$

Y intercept $= 0V$

3. $C = \frac{\varepsilon_0 A}{d} \rightarrow C = \frac{(8.85 \times 10^{-12})(10^{-4})}{2 \times 10^{-3}} = \boxed{4.4 \times 10^{-13} F}$

$C = 8.85 \times 10^{-12}$
$A = 1cm$
$d = 2mm$

B. $E = \frac{1}{2} \cdot C \cdot V^2 \rightarrow (4.4 \times 10^{-13}) \cdot .5 \cdot 25 = \boxed{5.5 \times 10^{-12} J}$

4. $\boxed{\text{Parallel}}$

4. Current Resistors and Circuits

1. A

$I = \frac{Emf_1 + Emf_2}{r_1 + r_2 + R_{load}} \rightarrow \frac{1.5+1.5}{2+2+50} = 5.5\times10^{-2}A$

$R=12$

$V=3$

$\varepsilon_1/\varepsilon_2 = 1.5V$

$R = 50\Omega$

$\frac{emf}{r_{int} + R_{load}} \rightarrow \frac{1.5}{.5+.5+50} = 3\times10^{-2}A$

A. Series $= 5.5\times10^{-2}A$
parallel $= 3\times10^{-2}A$

B $P=IV$

Series $\rightarrow P=(5.5\times10^{-2})3 \rightarrow P=1.6\times10^{-1}W$
parallel $\rightarrow P=(3\times10^{-2})1.5 \quad P=4.5\times10^{-2}W$

2.

A. 2 ms
B. 105 mV