

③ a) area = 1 cm^2

$$C = \frac{\epsilon_0 A}{d}$$

$$C = \frac{(8.85 \times 10^{-12}) (1 \times 10^{-4})}{(2 \times 10^{-3})}$$

$$C = 4.425 \times 10^{-13}$$

b) $E = \frac{1}{2} CV^2$

$$E = \frac{1}{2} (4.425 \times 10^{-13}) (5^2)$$

$$E = 5.531 \times 10^{-12} \text{ J}$$

④ We should connect an identical capacitor to the first in parallel because the capacitance gets added up. Therefore, storing more energy
ex. parallel = $C_1 + C_2 + C_3 \dots$

Current, Resistance, and DC circuits.

① $r_1 = r_2 = 2 \Omega$ $\epsilon_1 = \epsilon_2 = 1.5 \text{ V}$ $R = 50 \Omega$ Serial case = 3 V parallel case = 1.5

a) $-E_2 + I r_2 + I r_1 - E_1 + I R = 0$

$$-1.5 + I(r_2 + r_1 + R) - E_1 = 0$$

$$-3 \text{ V} + I(r_2 + r_1 + R) = 0$$

$$I = \frac{3 \text{ V}}{r_2 + r_1 + R}$$

$$= \frac{3 \text{ V}}{2 + 2 + 50}$$

$$I = 55.556 \text{ mA}$$

$$\frac{V_r - 1.5}{2} + \frac{V_r - 1.5}{2} + \frac{V_r}{50} = 0$$

$$\frac{25V_r - 87.5 + 25V_r - 37.5 + V_r}{50} = 0$$

$$51V_r = 125$$

$$V_r = 2.45 \text{ V}$$

$$I_1 = \frac{1.5 - 2.45}{2} = -15 \text{ mA}$$

$$I_2 = \frac{1.5 - 2.45}{2} = -15 \text{ mA}$$

$$I = I_1 + I_2$$

$$I = 30 \text{ mA}$$

b) Power Consumption

Serial

$$P_{\text{total}} = I^2 r_1 + I^2 r_2 + I^2 R$$

$$= (55.556)^2 (2) + (55.556)^2 (2) + (55.556)^2 (50)$$

$$= 6.173 + 6.173 + 154.3235$$

$$= 166.669 \text{ mW}$$

Parallel

$$P_{\text{total}} = (15 \text{ mA})^2 (2) + (15 \text{ mA})^2 (2) + (30 \text{ mA})^2 (50)$$

$$= 0.45 \text{ mW} + 0.45 \text{ mW} + 45 \text{ mW}$$

$$= 45.9 \text{ mW}$$

② a) 2 ms

Phys135B Midterm

① a) $E_c = 2.00 \times 10^{-3} \text{ V} @ 1 \text{ mm}$ $E_c = ? @ 5 \text{ mm}$
 $2.00 \times 10^{-3} = \frac{1}{4} \pi \epsilon_0 \left(\frac{q}{(1 \times 10^{-3})^2} \right)$ $E = \frac{1}{4} \pi \epsilon_0 \left(\frac{q}{(5 \times 10^{-3})^2} \right)$
 $2.00 \times 10^{-3} (1 \times 10^{-6}) = \frac{q}{4\pi \epsilon_0}$ $E = \frac{q}{4\pi \epsilon_0} \left(\frac{1}{25 \times 10^{-6}} \right)$
 $E = 2 \times 10^3 (1 \times 10^{-6}) \times \frac{1}{25 \times 10^{-6}}$
 $E = 0.00008 = 8 \times 10^{-5} \text{ V/m}$

b) $E_c = 8.00 \times 10^{-3} \text{ V/m} @ 1 \mu\text{C}$ $E_c = ? @ 3 \mu\text{C}$
 $\frac{8.00 \times 10^{-3}}{1 \mu\text{C}} = \frac{x}{3 \mu\text{C}}$
 $x = 3 (8 \times 10^{-3})$
 $E_c = 24 \times 10^{-3} \text{ V/m}$

② mass = $4 \times 10^{-16} \text{ kg}$ $E\text{-field} = 6131.25 \text{ N/C}$ downward

a) $q = \frac{(4 \times 10^{-16})(9.8)}{6131.25}$ $n = \frac{q}{1.6 \times 10^{-19}}$
 $q = 6.39348 \times 10^{-19}$ $n = 3.9959 \approx 4$
b) $q = q_e$ $F_e = q'E = 2.939 \times 10^{-15}$
 $q = 4.79348 \times 10^{-19}$ $F_g = m'g = 3.92 \times 10^{-15}$
 $a = \frac{F_g - F_e}{m}$ $m = 4.0 \times 10^{-16}$
 $a = \frac{3.92 \times 10^{-15} - 2.939 \times 10^{-15}}{4.0 \times 10^{-16}}$
 $a = 2.453 \text{ m/s}^2$

Potential Energy and Voltage, Capacitors

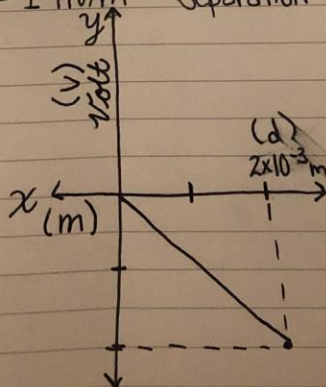
① a) $\Delta V = 4 \text{ kV}$ $H = +1q_e$ $He = +2q_e$

$KE = qv$
hydrogen = $KE = (+1)(1.6 \times 10^{-19})(4 \times 10^3) = 6.4 \times 10^{-16} \text{ J}$
helium = $KE = (+2)(1.6 \times 10^{-19})(4 \times 10^3) = 12.8 \times 10^{-16} \text{ J}$

b) $\Delta x = 5 \text{ cm}$

$E = \frac{\Delta V}{\Delta x} = \frac{4 \times 10^3}{5 \times 10^{-2}} = 8 \times 10^4 \text{ V/m}$

② $E = 1 \text{ kV/m}$ separation = 2 mm $E = -\Delta\phi/\Delta x$



y-intercept = (0,0)
starts @ origin