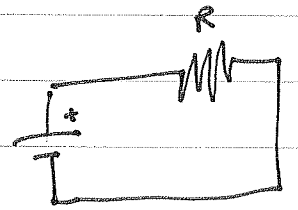
Physiss 152 Practice Exam 2 Sol'ns

1)



a) current is the rate of charge flow $i = \frac{dq}{dt}$, how much charge passes through a wire in a given amount of time.

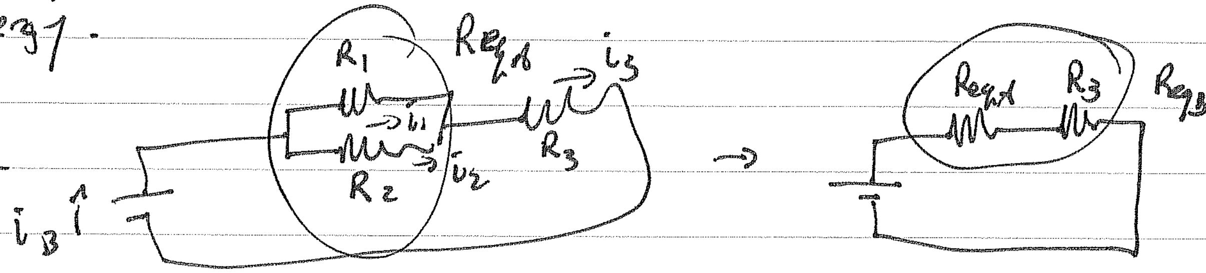
b) current flows through wires, resistors, batteries

c) The potential energy difference between the two ends of the battery cause the current to flow. The wires provide an easy path for the charges to move from high PE to low PE.

d) A switch or a broken wire will cause the current to stop flowing

2) qV = Potential energy, if you move around in a loop you must return to the same level of potential energy.

3 a



$$Req_A = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

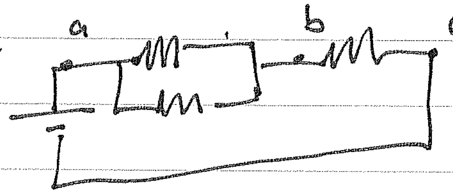
$$Req_B = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} + R_3$$

$$= \frac{1}{\frac{1}{30} + \frac{1}{20\times10^3}} + 100\ \Omega$$

$$= \left(\frac{60}{2 + \frac{3}{1000}} + 100\right)\Omega = 129.96\ \Omega$$

b) $i_B = \frac{V_3}{R_{eq}} = \frac{10V}{130\Omega} = 77 mA$

c)



$V_{a\to b} + V_{b\to c} + V_{c\to a} = 0$

$-i_2 R_2 - i_3 R_3 + 10V = 0$

~~$-i_2 (2\times10^4\Omega) - 77mA \times 100\Omega + 10V = 0$~~ ~~$.77mA$~~ ~~$10^{-3}$~~

$i_2 R_2 = 10V - i_3 R_3$

$i_2 = \frac{10V - i_3 R_3}{R_2}$

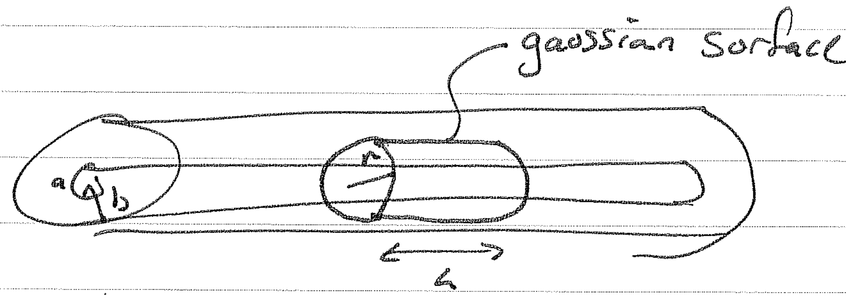
$= \frac{10V - 77\times10^{-3}\times100}{2\times10^4}$

$= \frac{2.3}{2\times10^4} = 1.15\times10^{-4}$

$= 0.115 mA$

d) If you remove R_2 there are fewer paths for the current to take, the current will decrease through R_3. Alternatively the equivalent resistance through $R_{eq A}$ is less than R_1 so less current will flow.

cyl



$$\Phi_E = \oint_{\text{gaussian surface}} \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\epsilon_0}$$

$$\Phi_E = \oint_{\text{caps}} \vec{E} \cdot d\vec{A} \; (\to 0) + \oint_{\text{edge}} \vec{E} \cdot d\vec{A}$$

$$= \oint \|\vec{E}\| \, \|d\vec{A}\| = \|\vec{E}\| \oint \|d\vec{A}\|$$

$$= \|\vec{E}\| \, 2\pi r L = \frac{q_{enc}}{\epsilon_0}$$

$$\|\vec{E}\| = \frac{q_{enc}}{2\pi r L \epsilon_0}$$

$$V = \int \vec{E} \cdot d\vec{r} = \int_a^b \frac{q_{enc}}{2\pi r L \epsilon_0} \, dr = \frac{q_{enc}}{2\pi L \epsilon_0} \int_a^b \frac{dr}{r}$$

$$= \frac{q_{enc}}{2\pi L \epsilon_0} \ln b/a$$

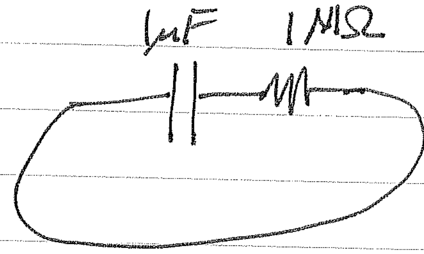
$$C = \frac{Q}{V} = \frac{Q_{encl}}{\frac{1}{2\pi L \epsilon_0} Q_{encl} \ln b/a} =$$

$$= \frac{2\pi L \epsilon_0}{\ln b/a}$$

So capacitance per unit length is

$$\frac{2\pi \epsilon_0}{\ln b/a}$$

5



a) $Q = CV = 10^{-6}F \, 5V = 5 \times 10^{-6} C = 5 \mu C$

b) $V = 5V e^{-t/RC} = 5V e^{-t/1s}$

so

$V(3s) = 5V e^{-3s/1s} = 0.25 V$

c) at 3s the voltage drop across the resistor is 0.25V

$P = iV$ and $V = iR \Rightarrow i = V/R$

so

$$P = V^2/R = \frac{(0.25V)^2}{10^6 \Omega} = 6.2 \times 10^{-8} W$$

d) $PE = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2} V^2 C$

$= \frac{1}{2} (0.25V)^2 \times 10^{-6} F = 3.1 \times 10^{-8} J$