CHAPTER 9: CURRENT AND RESISTANCE

MIDTERM 2
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① (a) $\tau = R \times C \Rightarrow C = \tau / R = (100 \times 10^{-6} s)/(1.00 \times 10^{3} \Omega) = \boxed{1 \times 10^{-7} F = C_{max}}$

(b) NO it is not difficult in practice to limit the capacitance to less than $C_{max} = 1 \times 10^{-7} F$ because it is an ECG monitor and can measure at time constant less than $100 \mu s$

(c) $V = V_0 (1 - e^{-t/RC}) \Rightarrow 30 = 60 (1 - e^{-t/100 \times 10^{-6}})$

$\Rightarrow \frac{30}{60} = e^{-t/100 \times 10^{-6}} \Rightarrow \underset{\ln}{0.5} = \underset{\ln}{e}^{-t/100 \times 10^{-6}} = 0.6931 = \frac{t}{100 \times 10^{-6}} \Rightarrow \boxed{t = 6.93 \times 10^{-5} s}$

② (a) if $\phi = 0$ then $v(t) = V_0 \sin(2\pi f t)$

$\frac{\cancel{V_0} \sin(2\pi f t)}{\cancel{V_0}} = \frac{0}{V_0}$

$\sin(2\pi f t) = 0$

$\sin(2\pi f t) = \sin(\pi)$

$2\pi f t = \pi$

$t = \frac{\pi}{2\pi f} = \frac{\pi}{2\pi(60 Hz)} = 0.00833 = \boxed{8.33 \times 10^{-3} s = 8.33 ms}$

(b) $P_{max} = \frac{V_0^2}{R} = \frac{(120 V)^2}{10^3 \Omega} = \boxed{14.4 W}$

(c) $P_{avg} = \frac{V_0^2}{2R} = \frac{(120 V)^2}{2(10^3 \Omega)} = \boxed{7.2 W}$

③ $P = VI = 110 V \cdot 3.00 A = 330 W$ refrigerator

$P_{total} = (330 W + 100 W + 60 W + 3.0 W) = 493 W$

$493 W \times \frac{12 \text{ hours}}{1 \text{ day}} \times \frac{30 \text{ days}}{1 \text{ month}} = \frac{177480 \text{ watt-hours}}{10^3 W} = 177.48 \cancel{Kw}\text{-}\cancel{hr} \times \frac{\$0.2}{1 \cancel{Kw\text{-}hr}}$

$= 35.496 \approx \boxed{\$35.50}$

CHAPTER 10: DIRECT-CURRENT (DC) CIRCUITS

(1) $\frac{1}{R_{eq}} = \frac{1}{2R} + \frac{1}{2R} \Rightarrow R_{eq} = R$ where $R = 1k\Omega$

$V = 12V$

Junction rule $I_2 + I_3 = I_1$ $\Rightarrow I_3 = I_1 - I_2$

$12 - I_2R - IR = 0$

Loop1 - $12 = 1000I_1 + 1000I_2$

$12 - 1000I_3 - 1000I_1 = 0$

Loop 2 $12 = 1000I_1 + 1000I_3$

$12 = 1000I + 1000(I_1 - I_2)$

$12 = 2000I_1 - 1000I_2$

$12 = 1000I_1 + 1000I_2$

$12 = 2000I_1 - 1000I_2$

$24 = 3000I_1 \Rightarrow I_1 = \frac{24}{3000} = 0.008A = \boxed{8mA = I_1}$

$1000I_2 = 2000I_1 - 12$

$1000I_2 = 2000 \times 8 \times 10^{-3} - 12$

$\boxed{I_2 = 4mA}$

$I_3 = I_1 - I_2$

$= 8mA - 4mA = \boxed{4mA = I_3}$

Power: $P = I_1^2R + I_2^2R + I_3^2R$

$= [((8\times10^{-3})^2 \times 1000) + ((4\times10^{-3})^2 \times 1000) + ((4\times10^{-3})^2 \times 1000)]$ W

$= 0.096$ W $= \boxed{96\text{ mW} = \text{power consumed in resistors}}$

(2) (a) $\mathcal{E} - I_1r - (I_1 + I_2)R = 0$ where $\mathcal{E} = 1.5V$, $r = 0.25\Omega$, $R = 50\Omega$

$1.5V = 0.25\Omega I_1 + 50I_1 + 50I_2$

$\mathcal{E} - I_1r + I_2r - \mathcal{E} = 0$

$-I_1r + I_2r = 0$

$\cancel{r}(-I_1 + I_2) = 0$

$+\cancel{I_1} \quad + I_1$

$\Rightarrow I_2 = I_1 = I$

$1.5V = 0.25I + 100I$

$1.5V = 100.25I$

$I = \frac{1.5V}{100.25} = 0.01496\text{ A} \times 2 = 0.0299\text{ A} \approx \boxed{0.03\text{ A} = I}$

(b) $i = \frac{q}{t} \Rightarrow t = \frac{q}{i} = \frac{2(2.5\text{ A hrs})}{0.03\text{ A}} = 166.67\text{ hrs} \approx \boxed{167\text{ hrs} = 600{,}000\text{ secs}}$

$\times 3600$

total current + total charge.

CHAPTER 11: MAGNETIC FORCES AND FIELDS

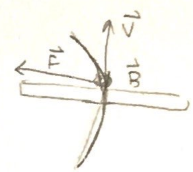
① (a) If the particle bends toward left then the velocity must point vertically upwa-
If $\vec{B}$ is into the page too and given the Lorentz equation ($\vec{F} = q(\vec{v} \times \vec{B})$),
the change q of the particle has to be $\boxed{\text{positive}}$ because $\vec{F}$ points left.

(b) If the particle had the mass of an electron what's strange is that an electron is negatively charged. with this negative change the particle should turn right when entering the magnetic field. Thus what's strange is that all though the same mass as an election the particle follows a different path because it is positively charged unlike an election.

(c) $|\vec{F}| = qvB\sin\theta$

$|\vec{F}| = qvB\sin 90$

$|\vec{F}| = (1.602 \times 10^{-19})(10^{6})(0.05) = \boxed{8.01 \times 10^{-15}\ N}$



If $\vec{v}$ is vertically upwards & $\vec{B}$ is into the page, by $\vec{F} = q(\vec{v} \times \vec{B})$ & that q is positive, $\vec{F}$ has to be horizontally leftwards after crossing the lead plate. (or $-x$ axis).