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MidTerm #2

① $R = 1000\,\Omega$

$\tau = RC < 100\,\mu s$

time, Resis, capacitance

$100 \times 10^{-6} = 1000(C)$

$\boxed{C = 1 \times 10^{-7}\ F}$

b) No, it wouldn't be difficult because there are capacitors smaller than that value

c) $V_c(t) = V_0(1 - e^{-t/\tau})$

$30 \times 10^{-3} = 60 \times 10^{-3}(1 - e^{-t/100\mu s})$

$\frac{1}{2} = 1 - e^{-t/100} \longrightarrow \frac{1}{2} = e^{-t/100} \longrightarrow \ln\frac{1}{2} = \ln e^{-t/100}$

$\ln\frac{1}{2} = \frac{-t}{100} \longrightarrow t = -100\ln\frac{1}{2} \longrightarrow \boxed{t = -100 \times 10^{-6}\ln(\tfrac{1}{2})}$

② $v(t) = V_0 \sin(2\pi f t + \phi)$ $\quad f = 60\ Hz$ $\quad V_0 = 120\ V$

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

$+k\frac{1}{120}$

$0 = V_0 \sin(2\pi f t)$

$0 = 120\sin(2\pi(60)t) \rightarrow 0 = 120\sin(120\pi t)$

$0 = \sin(120\pi t)$

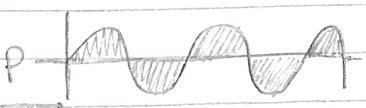
$\boxed{t = \frac{1}{120}\ sec}$

Wavelength $= \frac{2\pi}{120\pi} = \frac{1}{60} \cdot \frac{1}{2} = \frac{1}{120}$

b) $P = IV$ $\quad V = IR \rightarrow I = V/R$

$P_{MAX} = \frac{V_{MAX}^2}{R_{MAX}} = \frac{(120)^2}{1000\,\Omega} = \boxed{14.4\ W}$

c) $P \propto V$



Avg. power = 0 W

③ Fridge : 3A , 110 V
Lamp : 100W
Light : 60W
Random : 3 W

$.2 \frac{\text{dollars}}{\text{kWhr}} = .2 \frac{\text{dollars}}{1000\ \text{Whr}}$

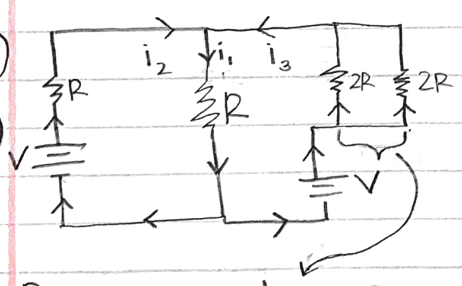
360 hrs $12 \frac{\text{hr}}{\text{day}}$ 1 month (30 days)

$P = IV = 3(110) = 330\ W$

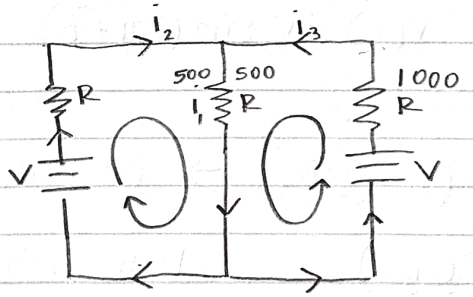
$P_{TOT} = 330 + 100 + 60 + 3 = 493\ W$

$\frac{.2}{1000} \frac{1}{\text{kWhr}} \cdot \frac{360\ \text{hr}}{1} \cdot \frac{493\ \text{W}}{1} = \boxed{\$35,496}$

④ a)



simplify →



$i_2 + i_3 = i_1$

$R_{TOT} = \frac{1}{2000} + \frac{1}{2000} = \frac{2}{2000} = 1000\ \Omega$

V = 12 V

$R_{TOT} = 1500\ \Omega$

$V = IR$

$\boxed{i_3 = 0.008\ A}$

$i_3 = \boxed{i_2 = 0.008\ A}$

$i_1 = 0.008 + 0.008 = \boxed{0.016\ A}$

$P = I^2 R$

$P_1 = (.008)^2 (1000) = 0.064\ W$

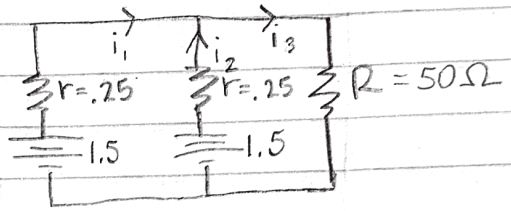
$P_2 = (.016)^2 (1000) = 0.256\ W$

$P_3 = (.008)^2 (1000) = 0.064\ W$

$P_{TOT} = P_1 + P_2 + P_3$

$\boxed{P_{TOT} = 0.384\ W}$

(5) R btwn. 1.4 - 2 V
$\mathcal{E} = 1.5\ V$
$r = 0.25\ \Omega$



$R_{TOT} = \frac{1}{.25} + \frac{1}{.25} = 0.125\ \Omega + 50\ \Omega = 50.125\ \Omega$

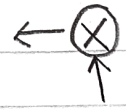
$V_{TOT} = 1.5\ V + 1.5\ V = 3\ V$

$V = IR \rightarrow I = \frac{V}{R} = \frac{3\ V}{50.125\ \Omega} = \boxed{0.06\ A}$

b) $q = 2.5\ A\,hr \qquad I = 0.06\ A$

$\frac{q}{I} = t = \frac{2.5\ A\,hr}{0.06\ A} = \boxed{41.7\ hr}$

(6) a) The particle is positive



Moving to left
Right hand rule

b) It is strange because the particle has the mass of an electron, yet it's positive not negative

c) $F = qv \times B = (1.6 \times 10^{-19})(10^6)(0.05)$

$\boxed{F = 8 \times 10^{-15}\ N}$ $\boxed{\text{Direction: moving to left (negative x-direction)}}$