Test 2

Jackson Diamond

1) $\tau = RC \quad V_c(t) = \varepsilon_1(1 - e^{-t/\tau})$

a) $C = \frac{1 \cdot 10^{-4}\,s}{1 \cdot 10^{3}\,\Omega} = \boxed{1 \cdot 10^{-7}\,F}$

b) Yes, if limited to a smaller amount then the resistance would increase the time constant past 100 μs.

c) $V_c(t) = emf(1 - e^{-t/\tau_1})$

$V_c(t) = .06(1 - e^{-x/1 \cdot 10^{-4}})$

$\boxed{\tau = 6.9315 \cdot 10^{-5}}$ @ .03 V

$\tau < 100\,\mu s$ ✓

2) a) $V(t) = V_0 \sin(2\pi f t + \phi)$

$V(t) = 0 \quad t = \{0, .108, 1.816, 2.575, 3.5606, \ldots\}$

It's a sin function so δV is passed instantly times $\delta x = .7$ between periods

b) $P = V^2/R \quad \delta V = I R$

$V = IR$

$I = .12$ amp $\quad P = (120\,V)^2/(1 \cdot 10^3\,\Omega) = \boxed{14.4\,W}$

c) $P(t) = I V(t) \rightarrow \int_0^v \frac{I V(t)\,dt}{t} = P_{avg}$

$P_{avg} = \frac{1}{2} I V = \boxed{0\,W}$

sin curve integrates to zero after one period

3) Month = 30 days · 12 hrs = 360 hrs

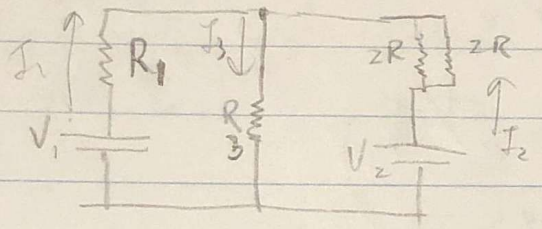
$P = IV$

330 W + 100 W + 60 W + 3W = 493 W

493 W = .493 KW → .493 · 360 = 177.48 · .2

= 35.496 $

4)



$P = IV$ $\Delta V = IR$

$R = 1K\Omega$

$V = 12V$

$\frac{1}{2K\Omega} + \frac{1}{2K\Omega} = \left(\frac{2}{2K\Omega}\right)^{-1} = 1000 = 1K\Omega$

$12V - R_1 I_1 - R_3 I_3 = 0$ $\quad R_1 = R_2 = R_3$

$12V - R_2 I_2 - R_3 I_3 = 0$ $\quad I_1 + I_2 = I_3$

$I_1 = .004$ amp $\quad I_2 = .004$ amp $\quad I_3 = .008$ amp

$R_1 = 1K\Omega \cdot .004 = 4V$

$R_3 = 1K\Omega \cdot .008 = 8V$

$2K\Omega \cdot .002 = 4V$

$P_{R_1} = 4V \cdot .004_a = .016\,W$

$P_{R_3} = 8V \cdot .008_a = .064\,W$

$P_{2R} = 4V \cdot .004_a = .016\,W$

5) $1.5V - I_1(.25\Omega) - I(50\Omega) = 0$

$1.5V - I_2(.25\Omega) - I(50\Omega) = 0$

$\Delta V = 1.5V \quad I_1 = \frac{1.5}{50.25} \quad I_2 = \frac{1.5}{50.25}$

a) $I_1 + I_2 = .0597$ amps

b) $\frac{2.5A}{.0597} = 41.875 \cdot 2 \geq 83.75$ hrs

2 batteries or about 84 hours

6) a) the charge is positive, goes with right hand rule.

b) it is uncommon to find a particle with the mass of an electron with a positive charge.

c) $F = q\vec{v} \times \vec{B} \quad \vec{v} = v_x\hat{i} + v_y\hat{j}$

$(v_x\hat{i} + v_y\hat{j}) \times -k\vec{B} \quad 10^6 \cdot .05 = 5 \cdot 10^4 N$

$\cancel{\hat{i} \times -k} + -\hat{i}v_yB \quad v \cdot B$

$= \cancel{0} \quad = \boxed{-\hat{i}\,5 \cdot 10^{-4} N}$

$-\hat{i} = -y$ direction