Dan Hawb	PHYS 108	HW 6	Y4

1) 

$I = ?$
$V = 20E3\,V$
$R_b = 8.5E3\,\Omega$
$R_I = 2000\,\Omega$
$P = ?$
$I_{new} = ?$
$I_{new} = 0.85E{-}3\,A$

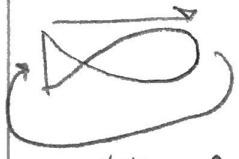
a) $V = IR_{eq}$ $\quad R_{eq} = R_b + R_I$

$I = V/(R_b + R_I) = 1.9\,A$

b) $P = I^2 R_b = 30846.7\,W$

c) $V = I_{new} R_{new}$

$R_{new} = V/I_{new} = 23.53\,M\Omega$

2) 

$880\,\Omega = R_o$

$V_{eq} = \Sigma V_{series}$

$V_{eq} = 6.15V \cdot 5000$

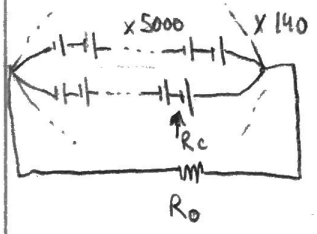
$V_{eq} = 750V$

$R_{eq} = R_o + R_{Rsh}$

$R_{Rsh} = (140(R_c \cdot 5000)^{-1})^{-1}$

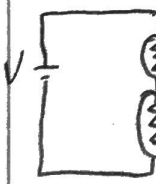
$R_{Rsh} = 8.93\,\Omega$

$R_{eq} = 880\,\Omega + 8.93\,\Omega = 888.93\,\Omega$

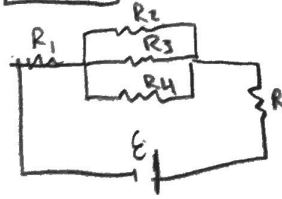


$V = IR$

$I = \frac{V_{eq}}{R_{eq}} = 0.84137A$

3) 

→ Glows brighter because it has a higher resistance and therefore displaces more energy through heat than the 50 W bulb

4) 

$R_1 = 11\,\Omega$
$R_2 = 15\,\Omega$
$R_3 = 89\,\Omega$
$R_4 = 25\,\Omega$
$R_5 = 35\,\Omega$
$\mathcal{E} = 5.5V$

a) $R_{234} = (R_2^{-1} + R_3^{-1} + R_4^{-1})^{-1}$

b) $R_{eq} = R_1 + R_{234} + R_5$
$= R_1 + (R_2^{-1} + R_3^{-1} + R_4^{-1})^{-1} + R_5$

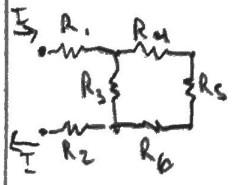
c) $R_{eq} = 54.48\,\Omega$

d) $I_1 = \mathcal{E}/R_{eq}$

e) $I_1 = 0.101$

f) $P_1 = I_1^2 R_1$

g) $P_1 = 0.1121\,W$

5) 

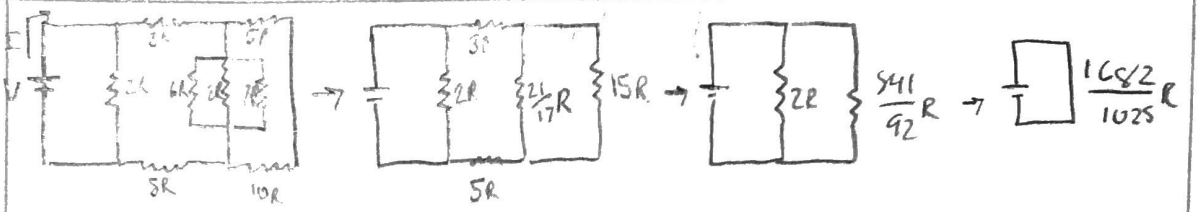
$I = 11A$
$R_1 = 21\,\Omega$ $\quad R_4 = 63\,\Omega$
$R_2 = 55\,\Omega$ $\quad R_5 = 93\,\Omega$
$R_3 = 47\,\Omega$ $\quad R_6 = 25\,\Omega$

$R_{eq} = R_1 + R_2 + (R_3^{-1} + (R_4 + R_5 + R_6)^{-1})^{-1}$

$R_{eq} = 113.311\,\Omega$

$V = IR = 1246.425\,V$

6)



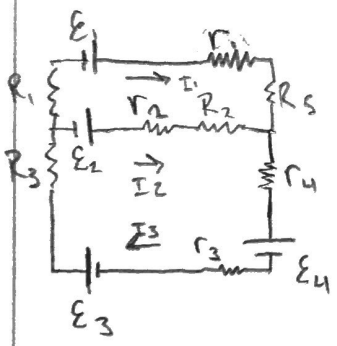
$I = 3.6A$
$R = 17\Omega$

$R_{eq} = 1.641R$

a) $V = I \cdot R_{eq}$
$V = 1.641IR$

b) $V = 100.4\,V$

7)



$I_2 = 45A$
$I_1 = ?$

a) Loop rule for top loop

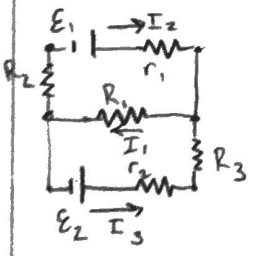
$0 = \mathcal{E}_3 - I_2 r_2 - I_2 R_2 + I_1 R_5 + I_1 r_1 - \mathcal{E}_4 + I_1 R_1$

$I_1 R_1 + I_1 R_5 + I_1 r_1 = \mathcal{E}_1 - \mathcal{E}_3 + I_2 R_2 + I_2 r_2$

$I_1 = \frac{\mathcal{E}_1 - \mathcal{E}_3 + I_2 R_2 + I_2 r_2}{R_1 + R_5 + r_1}$

$I_1 = 71.65A$

8)



$\mathcal{E}_1 = 21V$
$\mathcal{E}_2 = 41V$
$r_1 = 0.5\Omega$
$r_2 = 0.5\Omega$
$R_1 = 6\Omega$
$R_2 = 2.5\Omega$
$R_3 = 1.5\Omega$

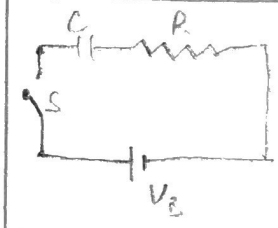
$I_1 = I_2 + I_3$, Top Loop: $0 = \mathcal{E}_1 - I_2 r_1 - I_1 R_1 - I_2 R_2$
Bottom Loop: $0 = \mathcal{E}_2 - I_3 r_2 - I_3 R_3 - I_1 R_1$

$I_1 - I_2 - I_3 = 0$
$I_1 R_1 + I_2(r_1 + R_2) = \mathcal{E}_1$
$I_1 R_1 + I_3(r_2 + R_3) = \mathcal{E}_2$

$$\left[\begin{array}{ccc|c} 1 & -1 & -1 & 0 \\ R_1 & (r_1+R_2) & 0 & \mathcal{E}_1 \\ R_1 & 0 & (r_2+R_3) & \mathcal{E}_2 \end{array}\right] \Rightarrow$$

a) $I_1 = 4.58\,A$
b) $I_2 = -2.17A$
c) $I_3 = 6.75\,A$

9)



$C = 9.5\,\mu F$
$R = 8.5\,k\Omega$
$V_B = 115\,V$

a) $\tau = RC$
$\tau = 0.08075\,s$

b) @ $t = \infty$, $V_c = V_B$

c) $Q = CV_B = 0.00109\,C$

d) @ $t = \infty$, $I = 0$

f) $q = CV_B(1 - e^{-t/\tau})$

$q = 7.283E\text{-}4\,C$

e) $I_0 = V_B/R$

$\frac{I_0}{3} = \frac{V_B}{R} e^{-t/\tau}$

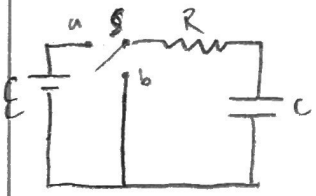
$\frac{V_B}{3R} = \frac{V_B}{R} e^{-t/\tau}$

$1/3 = e^{-t/\tau}$

$\ln(1/3) = -t/\tau$

$\tau \ln(3) = t \approx 0.0887\,s$

10)



$\mathcal{E} = 4.5\,V$
$R = 150\,k\Omega$
$C = 680\,pF$

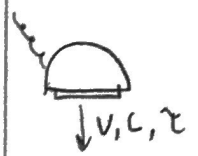
a) When the switch is connected to point a, the voltage across the capacitor will increase exponentially with time

b) $\tau = RC = 1.02E\text{-}4\,s$

c) $q(t) = C\mathcal{E}(1 - e^{-t/RC})$

d) $V_c = \mathcal{E}(1 - e^{-t/RC}) = 3.729\,V$

11)



$V = 10.5\,kV$
$C = 9.5\,\mu V$
$\tau = 9.5\,ms$
$V_b = 600\,V$

a) $\tau = RC$
$R = \tau/C$
$R = 1000\,\Omega = 1\,k\Omega$

b) $V_b = V \cdot e^{-t/\tau}$

$(V_b/V) = e^{-t/\tau}$

$\ln(V/V_b)\tau = t$

$t = 27.14\,ms$

12)

$\tau \leq 100\,ps$
$R = 1.05\,k\Omega$

$\tau = RC$
$C = \tau/R$
$C = 9.524E\text{-}8\,F$

13)

78 pulses/min = 1.3 pulses/s = frequency

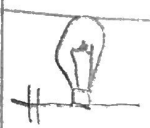
$\tau = \text{frequency}^{-1} = 0.769\,s$

$C = 21.5\,nF$

$R = \tau/C$

$R = 35.77\,M\Omega$

14)



$\tau = 0.29\,s$
$V = 2.75\,V$
$P = 35\,mW$

a) $E = P \cdot \tau$
$E = 0.01015\,J$

b) $q = I \cdot \tau$
$q = \frac{P}{V} \cdot \tau = 0.00369\,C$

c) $C = q/V$
$C = 0.00134\,F$

d) $P = V^2/R$
$R = V^2/P = 216.071\,\Omega$

15)

$\tau = 0.065\,\mu s$
$R_1 = 0.035\,\Omega$
$C = ?$
$R_2 = 775\,k\Omega$
$\tau_2 = ?$

a) $C = \tau/R_1$,
$C = 1.857\,\mu F$

b) $\tau_2 = R_2 \cdot C = 1.439\,s$

16)

$C = 6.2\,\mu F$
$\tau = 13.5\,ms$
$V_0 = 12.4\,kV$
$V = 586\,V$

a) $R = \tau/C$
$R = 2177.42\,\Omega$

b) $t = \tau \ln(V_0/V) = 0.0412\,s$
(See 11b for derivation)