Ch 14 odd Problems

1) $I = \frac{dQ}{dt} = \frac{(10^6)(1.602\times10^{-19} C)}{1 s} = \boxed{1.602\times10^{-13} A}$

5) $\langle v \rangle = \frac{I}{qnA} = \frac{1.50 A}{(1.602\times10^{-19} C)(10.5\times10^{3} \frac{kg}{m^3})(\frac{1}{0.108 kg/mol})\cdot N_{Avo}\,(3.31 mm^2)(\frac{1 m}{1000 mm})(\frac{1 m}{1000 mm})}$

$= 4.83\times10^{-5} \frac{m}{s}$

$t = \frac{\Delta x}{v} = 2.07\times10^{4} s \times \frac{1 min}{60 s}\cdot\frac{1 hr}{60 min}$

$= \boxed{5.75 \text{ hrs}}$

9) $R = \frac{\rho l}{A} = \frac{(2.44e{-8}\,\Omega\cdot m)(400e{-6} m)}{(1e{-6} m)(10e{-6} m)}$

$= \boxed{6.1\times10^{6}\,\Omega}$

13) $R = \frac{(1.60\times10^{-7}\,\Omega\cdot m)(1.27\times10^{4} m)}{\pi(1.20 m)^2 - \pi(1.14 m)^2}$

$= \boxed{3.04\,\Omega}$

17) $\langle v \rangle = \frac{I}{qnA}$ $\quad A = \pi r^2$

$= \frac{I}{qn\pi r^2}$

smaller dia. larger drift speed, by 4x

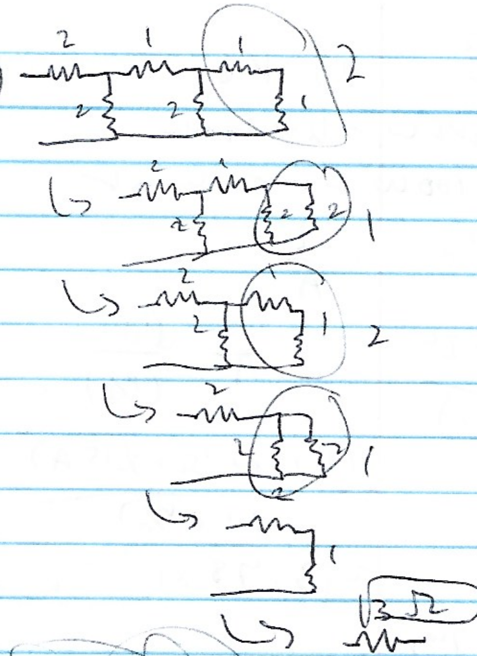
21) $R = \frac{\rho l}{A}$ $\quad \frac{A\cdot l}{m} = \rho_{mass}$

$A = \frac{\rho_{mass}\, m}{l}$

$R = \frac{\rho l^2}{\rho_{mass}\, m}$

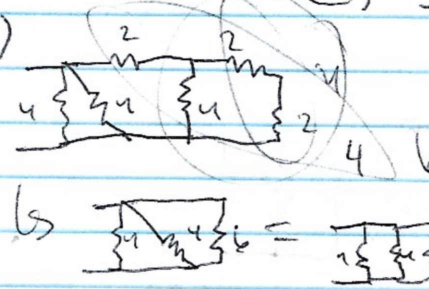
$K = \frac{\rho l^2}{\rho_{mass}}$

25) a)



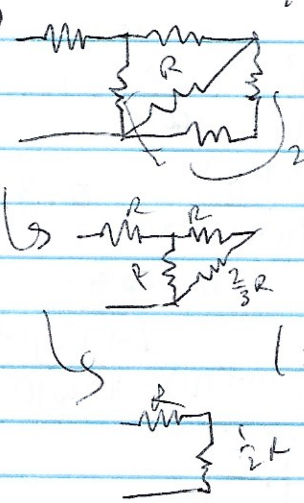
$\boxed{3\,\Omega}$

b)



$R_{eq} = \left(\frac{1}{4}+\frac{1}{4}+\frac{1}{6}\right)^{-1} = \boxed{1.5\,\Omega}$

c)

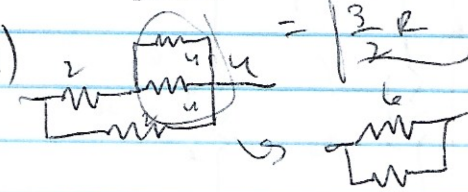


$\left(\frac{1}{2R}+\frac{1}{R}\right)^{-1} = \left(\frac{3}{2R}\right)^{-1} = \frac{2}{3}R$

$\left(\frac{1}{2R}+\frac{3}{2R}\right)^{-1} = \frac{1}{2}R$

$= \boxed{\frac{3}{2}R}$

d)



$\left(\frac{1}{6}+\frac{1}{2}\right)^{-1} = \boxed{1.5\,\Omega}$

29) $P = \frac{V^2}{R}$ $R\uparrow$ $P\downarrow$

200 W - less resistance

100 W - more resistance

33) $P = I^2R = I^2\frac{\rho l}{A}$

a)

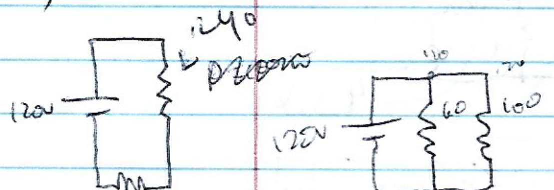
$\frac{P}{l} = \frac{\rho I^2}{A}$ $A = \frac{\rho I^2}{(P/l)}$

$= \frac{(1.77\times10^{-8}\,\Omega\cdot m)(15\,A)^2}{(1.0\,W/m)}$

$= \boxed{3.98\times10^{-6}\,m}$

b) 12 gauge

37)



$R_{60} = \frac{V^2}{P} = \frac{(120V)^2}{60W}$

$= 240\,\Omega$

$R_{100} = \frac{V^2}{P} = \frac{(120)^2}{100W} = 144\,\Omega$

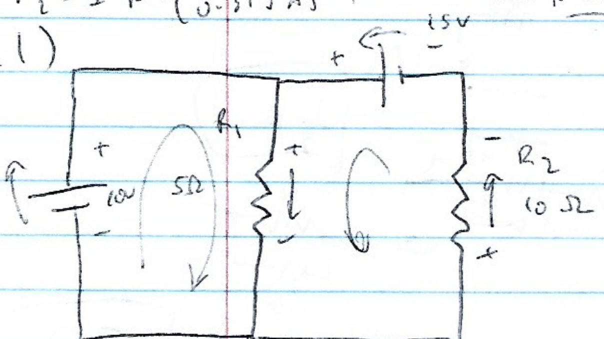
$I_{total} = \frac{\Delta V}{R_{eq}} = \frac{(120V)}{(144+240\,\Omega)} = 0.313\,A$

$P_1 = I^2R = (0.313A)^2(240)\,\Omega =$ ~~23.5~~

$\boxed{24\,W}$ (60W)

$P_2 = I^2R = (0.313A)^2(144\,\Omega) = \boxed{14W}$ (100W)

41)



$V_1 = I_1R_1 = V_{B_1} = 10V$

$I_1 - I_2 - I_{B_1} = 0$

~~$-I_1 + I_2 + I_{B_1} = 0$~~

$V_2 + V_1 = 15V$

$I_2R_2 + I_1R_1 = 15V$

$I_2R_2 = 5V$

$I_2 = \frac{5V}{10\Omega} = \boxed{0.500A}$

$I_1 = \frac{10V}{R_1} = \frac{10V}{5\Omega} = \boxed{2.00A}$

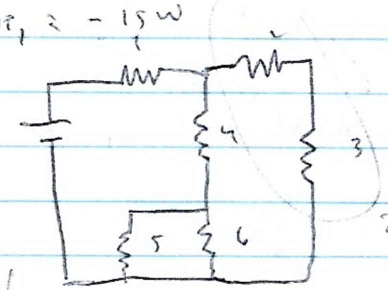
d) $P_1 = I_1^2R_1 = (2.00A)^2(5\Omega) = \boxed{20W}$

$P_2 = I_2^2R_2 = (0.500A)^2(10\Omega) = \boxed{2.5W}$

e) $P_{15} = I_2V_{B5} = (15V)(0.500A) = 7.5\,W$

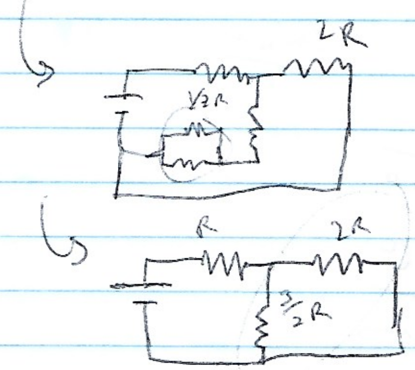
$P_{B_1} = -15W$

45)



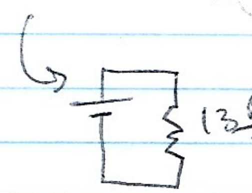
All resistors R

$R_{eq} = 13.0\,\Omega$



$\left(\frac{1}{2R} + \frac{2}{3R}\right)^{-1}$

$= \frac{6R}{7}$



$\frac{13R}{7} = 13\,\Omega$

$\boxed{R = 7\,\Omega}$

45) b) 5 and 6 , 2 and 3

c) $I_1 = I_{total} = \frac{V}{R_{eq}} = \frac{13V}{13\Omega} = 1.0A$

$\cancel{I_2 = I_3 = \frac{V}{2R} = \frac{13V}{14\Omega} = 0.93A}$

$I_4 =$ $\Delta V_1 = I_1 R_1 = 1.0A(7\Omega) = 7V$

$I_2 = I_3 = \frac{6V}{2R} = \frac{6V}{14\Omega} = 0.43A$

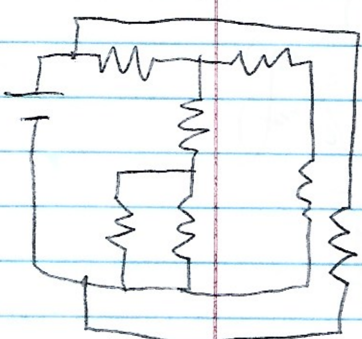
$I_4 = \frac{6V}{(\frac{3}{2}\cdot 7\Omega)} = 0.57A$

$\Delta V_4 = I_4 R_4 = (0.57A)(7\Omega) = 4V$

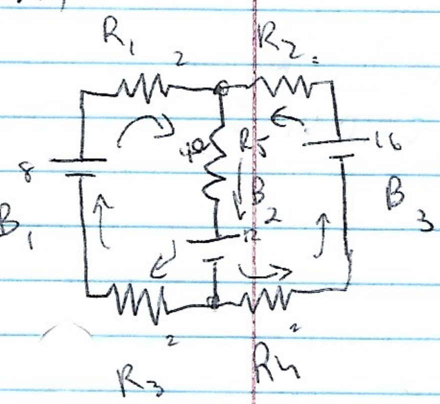
$\Delta V_5 = \Delta V_6 = 3V$

$I_6 = I_5 = \frac{V}{R} = \frac{3V}{7\Omega} = 0.43A$

$I_2 = I_3 = I_6 = I_5 = 0.43A$



49)



$4V = V_4 + V_2 + V_5$ $-4V = V_1 + V_5 + V_3$

$I_3 + I_4 - I_5 = 0$

$-I_1 - I_2 + I_5 = 0$

$V_1 = I_1 R_1$ $V_2 = I_2 R_2$ $V_3 = I_3 R_3$ $V_4 = I_4 R_4$

$V_5 = I_5 R_5$

$4V = I_4 R_4 + I_2 R_2 + I_5 R_5$

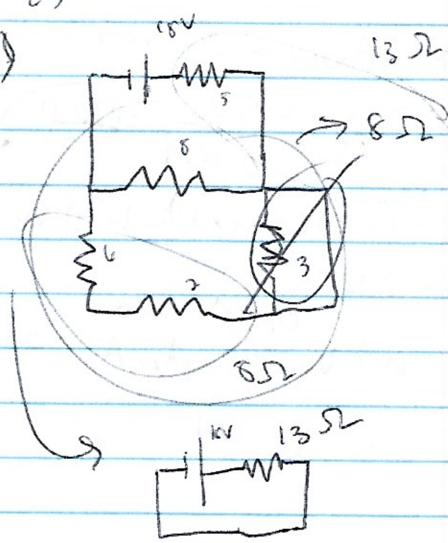
$-4V = I_1 R_1 + I_5 R_5 + I_3 R_3$

$I_5 = I_1 + I_2$

a) ? b) $V = 12V$ c) even though there's no current, there's still a battery there.

d) i)

53)



b) $I_{total} = \frac{\Delta V}{R_{eq}} = \frac{18V}{13\Omega} = 1.38A$

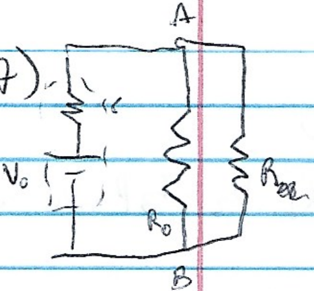
$V_5 = IR = 1.38A \cdot 5\Omega = 6.92V$

$V_{8\Omega} = (18 - 6.92V)$

c) $P = \frac{V^2}{R} = \frac{(18-6.92V)^2}{(8\Omega)} = 15.3W$

d) $P = IV = (1.38A)(18V) = 24.8W$

57)



a) $R = \infty$ (i) $\Delta V = I R_0$

$I = \frac{V_0}{R_0 + r}$ $\quad \Delta V = \frac{V_0 R_0}{r + R_0}$

(ii) $P = IV = \frac{V_0^2}{R_0 + r}$

b) $R = 0$ $\quad \Delta V_{R_0} = I R_0$ $\quad I = 0$

$\Delta V = 0$

(ii) $I = \frac{\Delta V}{R} = \frac{V_0}{r}$

61) $V_0 = 5\text{ V}$ $\quad A_{total} = 0.250\text{ A}$

$R = \frac{V}{I} = \frac{5\text{V}}{0.250\text{A}} = 20\,\Omega$

c) $P = IV = (5\text{ V})(0.250\text{A}) = 1.25\text{ W}$

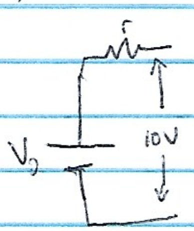
d) emf $= 5\text{V}$

65)

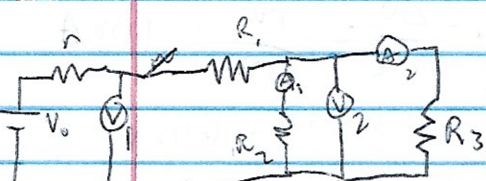
open switch

a) $V_2 = 0$, $A_1, A_2 = 0$

$V_0 = 10\text{V}$



b)



$V_1 = 8\text{V}$ $\quad V_2 = 6\text{V}$

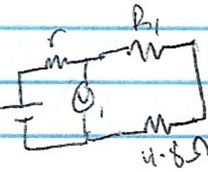
$A_1 = 0.50\text{A}$ $\quad A_2 = 0.75\text{A}$

$\Delta V = IR$

$\Delta V_2 = 2\text{V}$ $\quad R_3 = \frac{6\text{V}}{0.75\text{A}} = 8\,\Omega$

$R_2 = \frac{\Delta V}{I} = \frac{6\text{V}}{0.5\text{A}} = 12\,\Omega$

$R_1 = \frac{\Delta V}{I}$



$I = \frac{\Delta V}{R} = \frac{8\text{V}}{R_1 + 4.8\Omega} = \frac{10\text{V}}{R_1 + r + 4.8\Omega} = \frac{2\text{V}}{r}$

$\Delta V_r = 2\text{V}$ $\quad \Delta V = IR$

$I = \frac{\Delta V_r}{r}$

$(10\text{V})r = (2\text{V})(R_1 + r + 4.8\Omega)$

$(8\text{V})r = 2\text{V}(R_1 + 4.8\Omega)$

69) ~~$Q = Q_0 e^{-t/RC}$~~

$q(t) = V_0 C(1 - e^{-t/RC})$

$= Q_0(1 - e^{-t/RC})$

$\frac{1}{2}Q_0 = Q_0(1 - e^{-t/RC})$

~~$\ln(\frac{1}{2}) = \ln(1 - e^{-t/RC})$~~

~~$-\ln 2 = \ln(1 - e^{-t/RC})$~~

~~$1 - e^{-t/RC} = -2$~~

~~$3 = e^{-t/RC}$~~

~~$\ln 3 = -\frac{t}{RC}$~~

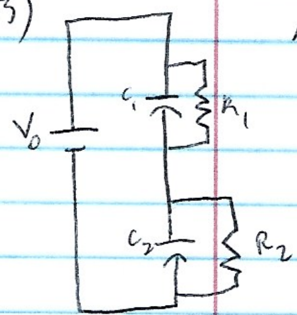
~~$-t$~~

$-\frac{1}{2} = -e^{-t/RC}$

$\ln(\frac{1}{2}) = -\frac{t}{RC}$

$t = 0.693\tau$

73)



After a while,

$V_{C_1} = V_0$

$V_{C_2} = V_0$