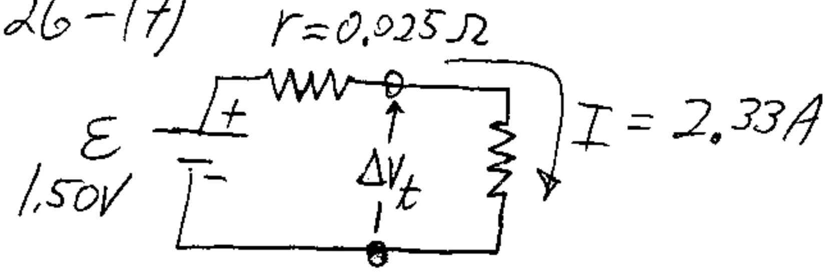
Phys 230

Solutions - Prob. Set 5

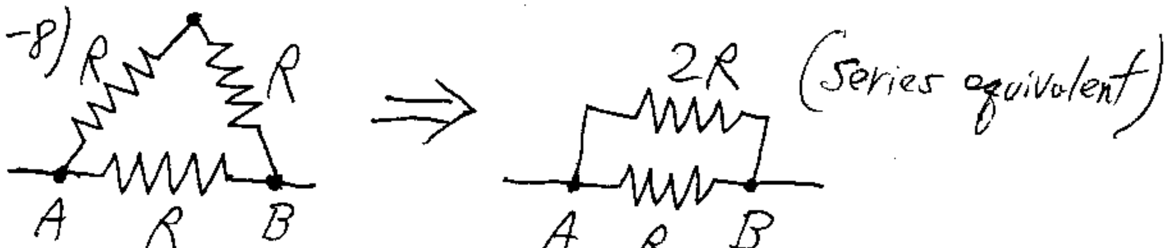
1. (26-14) $I = \frac{dQ}{dt} = \frac{25C}{0.19s} = \boxed{130A}$

2. (26-17)



$\Delta V_t = \mathcal{E} - Ir = 1.50V - (2.33A)(0.025\Omega) = \boxed{1.44V}$

3. (26-8)



Now $\frac{1}{R_{||}} = \frac{1}{R} + \frac{1}{2R} = \frac{3}{2R} \Rightarrow R_{||} = \boxed{\frac{2R}{3}}$

4. (26-24) Use $R = \frac{\rho l}{A}$ and $\rho = \rho_0[1 + (T - T_0)\alpha]$

Doubling diameter gives $A' = 4A \rightarrow R' = R/4$

Doubling l gives $R' = 2R$

Raising T by 300K gives $R' = R[1 + (300°C)\alpha]$

Largest α for metals (Table 26.1) is $5.0 \times 10^{-3}/°C$

Thus $R' = 2.5R$ maximum ($R' = 1.003R$ min.)

→ Greatest Change: Changing diameter by X2, $\boxed{d}$ (on line)

→ Least Change: $\boxed{\text{Depends on metal}}$

5. (26-26) #18 wire has $d = 1.024$ mm ; $r = 0.512 \times 10^{-3}$ m

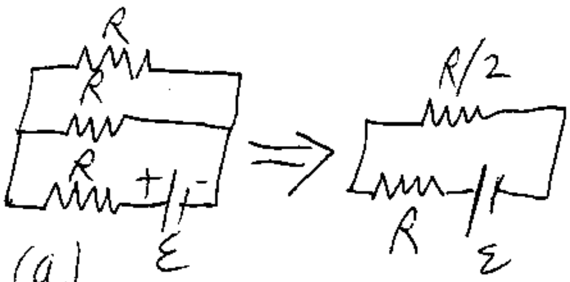
Thus $j_{MAX} = \frac{I_{MAX}}{A} = \frac{5A}{\pi(.512\times10^{-3}m)^2} = \boxed{6\times10^{6}\,A/m^2}$

Also $j = \sigma E$ so $E = \frac{1}{\sigma} j = \rho j$

$= (1.7\times10^{-8}\,\Omega\cdot m)(6\times10^{6}\,A/m^2)$

$= \boxed{0.1\ V/m}$

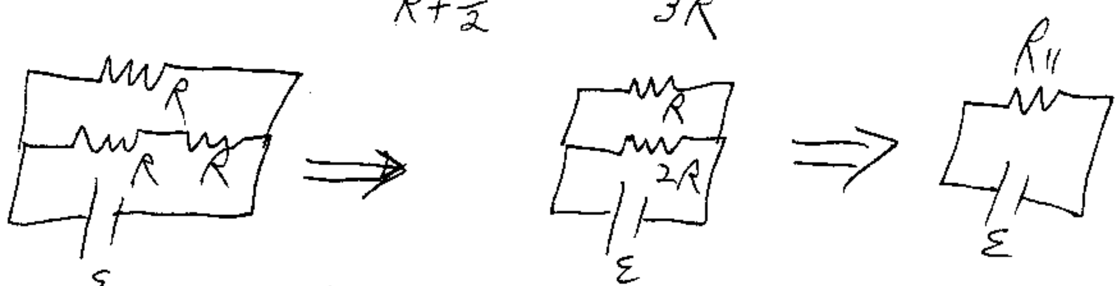
6. (26-39)



(a)

$$I = \frac{\varepsilon}{R+\frac{R}{2}} = \frac{2\varepsilon}{3R}$$

b)



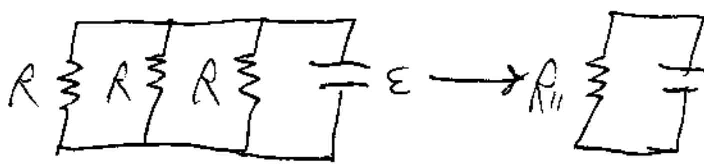
$$\frac{1}{R_{\parallel}} = \frac{1}{R} + \frac{1}{2R} = \frac{3}{2R}$$

$$R_{\parallel} = \frac{2R}{3} \ ; \ I = \frac{3\varepsilon}{2R}$$

c)

$$I = \frac{\varepsilon}{3R} = \frac{10.0V}{3(5.0\Omega)} = \boxed{0.67A;\ \text{least}}$$

d)

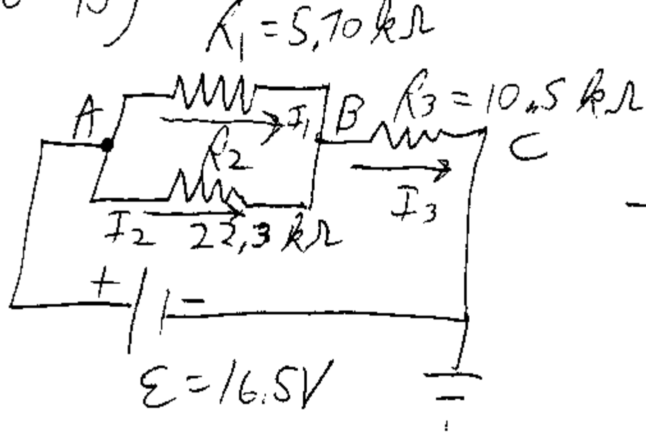


$$\frac{1}{R_{\parallel}} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R}$$

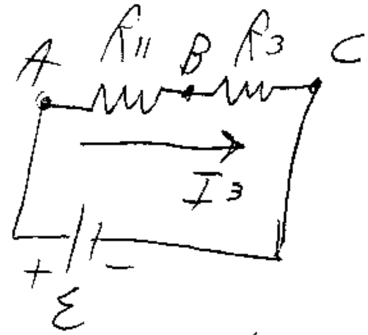
$$R_{\parallel} = R/3$$

$$I = \frac{3\varepsilon}{R} = \frac{3(10.0V)}{5.00\Omega} = \boxed{6.00A}$$ greatest

7. (26-43)



$\longrightarrow$



$$\frac{1}{R_{11}} = \frac{1}{5.70k\Omega} + \frac{1}{22.3\,k\Omega}$$

$$R_{11} = 4.54\,k\Omega$$

Then $I_3 = \dfrac{\mathcal{E}}{R_{11}+R_3} = \dfrac{16.5V}{15.0k\Omega} = \boxed{1.10\,mA}$

Now $\boxed{V_c = 0}$

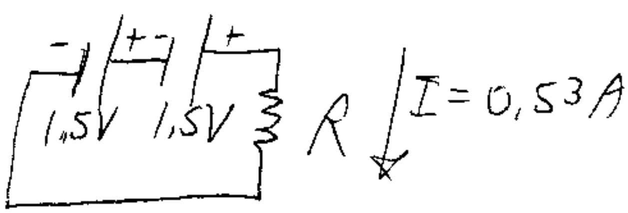
$V_B = V_c + I_3 R_3 = \boxed{11.5V}$

$V_A = V_B + I_3 R_{11} = 11.5V + (1.10\,mA)(4.54\,k\Omega) = \boxed{16.5V}$

Also $I_1 = \dfrac{V_A - V_B}{5.70k\Omega} = \dfrac{5V}{5.70k\Omega} = \boxed{0.877\,mA}$

$I_2 = \dfrac{V_A - V_B}{22.3\,k\Omega} = \dfrac{5V}{22.3\,k\Omega} = \boxed{0.224\,mA}$

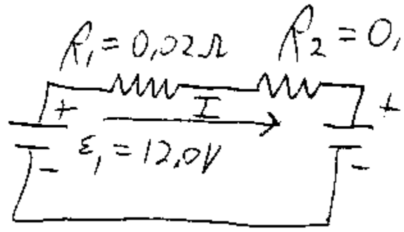
8. (26-50)



$R = \dfrac{\Delta V}{I} = \dfrac{3.0V}{0.53A} = \boxed{5.7\,\Omega}$

$P = I\Delta V = (0.53A)(3.0V) = \boxed{1.6W}$

9. (26-51)

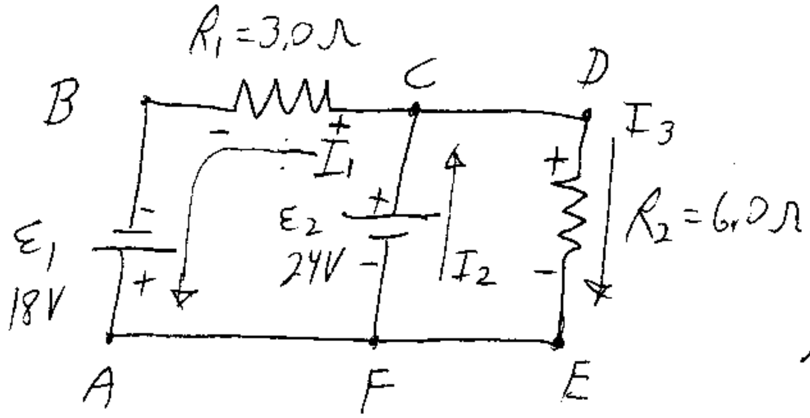


$\varepsilon_2 = 10.5V$

Kirchhoff loop equation gives $\varepsilon_1 - I(R_1) - IR_2 - \varepsilon_2 = 0$

$$I = \frac{\varepsilon_1 - \varepsilon_2}{R_1 + R_2} = \frac{1.5V}{0.17\Omega} = \boxed{8.8A}$$

10. (26-53)



Junction equation at C:

$I_2 = I_1 + I_3$

Loop equation for ABCFA:

$-\varepsilon_1 + I_1R_1 - \varepsilon_2 = 0$

$$I_1 = \frac{\varepsilon_1 + \varepsilon_2}{R_1} = \frac{42V}{3.0\Omega} = \boxed{14A}$$

Loop eqn for ABCDEFA

$-\varepsilon_1 + I_1R_1 - I_3R_3 = 0$

$$I_3 = \frac{I_1R_1 - \varepsilon_1}{R_3} = \frac{14A(3.0\Omega) -}{6.0\Omega} = \boxed{4A}$$

from junction eqn $I_2 = I_1 + I_3 = \boxed{18A}$