11.03 $N = 5{,}0 \cdot 10^{10}$

a) $Q = N \cdot e = 5{,}0 \cdot 10^{10} \cdot 1{,}60 \cdot 10^{-19}\,C = \underline{8{,}0 \cdot 10^{-9}\,C}$

b) $Q = -1\,C$

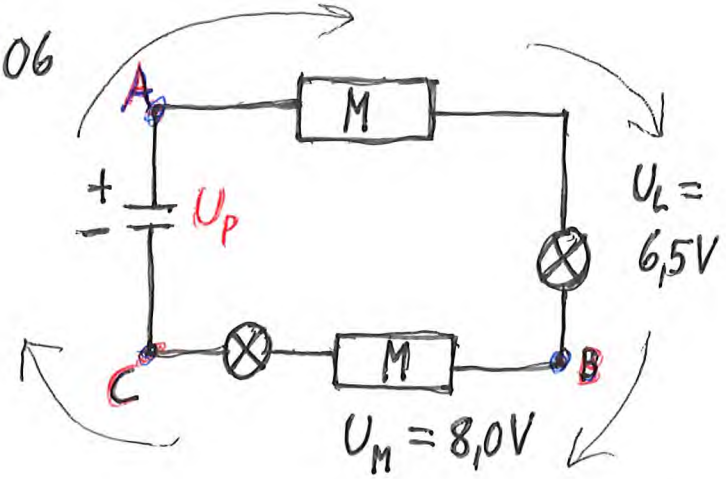
$Q = N(-e)$

$N = \frac{Q}{-e}$

$N = \frac{-1\,C}{-1{,}60 \cdot 10^{-19}\,C} = \frac{1}{1{,}60} \cdot 10^{19} = 6{,}25 \cdot 10^{18}$

$\approx \underline{6 \cdot 10^{18}}$

11.06



a) $U_L + U_M + U_L + U_M = 6{,}5V + 8{,}0V + 6{,}5V + 8{,}0V$

$= \underline{29V}$

b) $U_{BC} = U_M + U_L = 8{,}0V + 6{,}5V = 14{,}5V \approx \underline{15V}$

$U_{AB} = U_M + U_L \approx 15V$

$U_{AC} = 2U_M + 2U_L = 2 \cdot 8{,}0V + 2 \cdot 6{,}5V = \underline{29V}$

11.09 $Q = 34\,Ah$

$I = 2{,}0\,A$

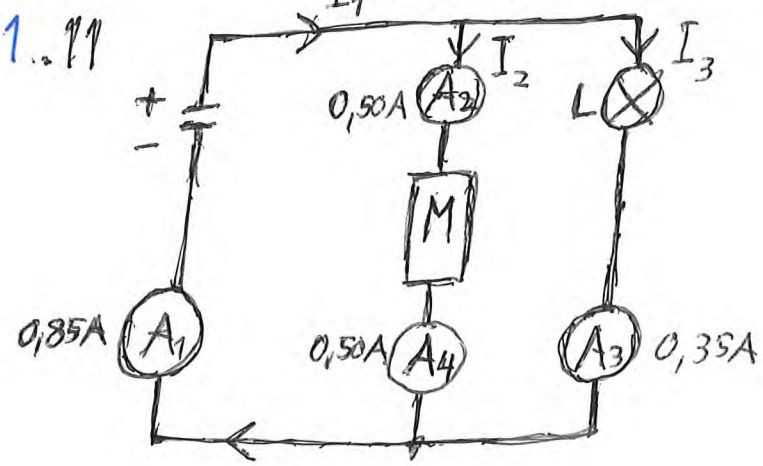
$t = ?$

$Q = I \cdot t \Leftarrow I = \frac{Q}{t}$

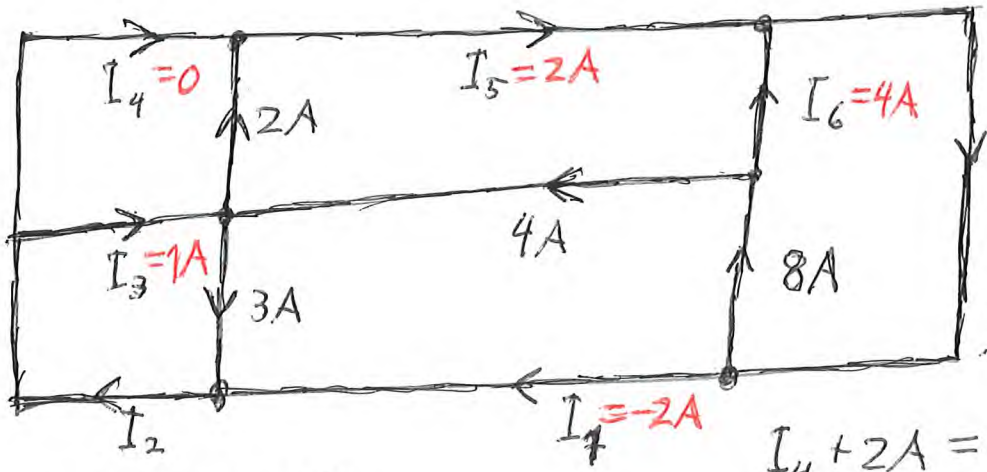
$\frac{Q}{I} = t$

$t = \frac{34\,Ah}{2{,}0\,A} = 17\,h$

11.11 $I_1 = I_2 + I_3 = 0{,}50\,A + 0{,}35\,A = 0{,}85\,A$



11.13



$I_1 + 3A = I_2$

$-2A + 3A = I_2$

$I_2 = 1A$

$6A = 8A + I_1$

$-2A = I_1$

$8A = 4A + I_6$

$8A - 4A = I_6$

$I_6 = 4A$

$I_4 + 2A = 2A$

$I_4 = 0$

$I_3 + 4A = 2A + 3A$

$I_3 = 5A - 4A$

$I_3 = 1A$

$4A + I_5 = 6A$

I_6

$I_5 = 6A - 4A = 2A$

11.15

U / V	10	0,30	0,62
I / A	10	0,096	0,11
R / Ω	1,0	3,1	5,4

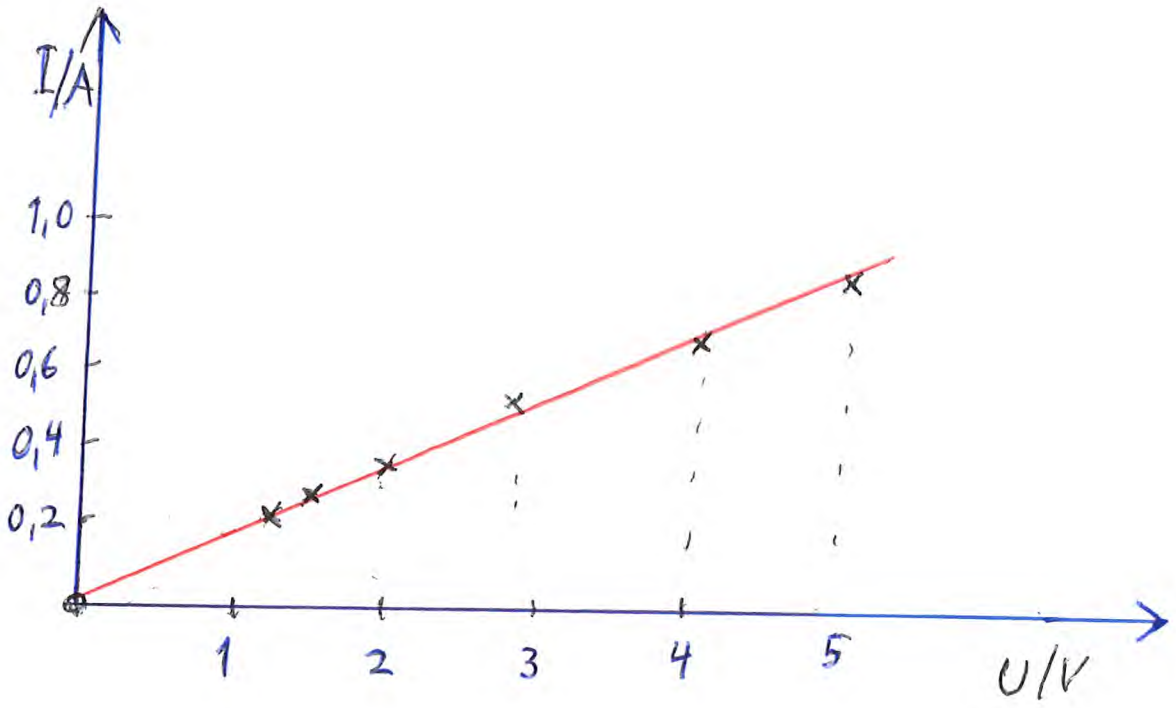
$$R = \frac{U}{I} = \frac{10V}{10A} = \underline{1,0\,\Omega}$$

$$\frac{U}{I} = \frac{0,30V}{0,096A} = 3,125\,\Omega = \underline{3,1\,\Omega}$$

$$U = RI$$

$$\frac{U}{R} = I \Rightarrow I = \frac{0,62V}{5,4\,\Omega} = 0,11A$$

11.16



$U = 5,0V$

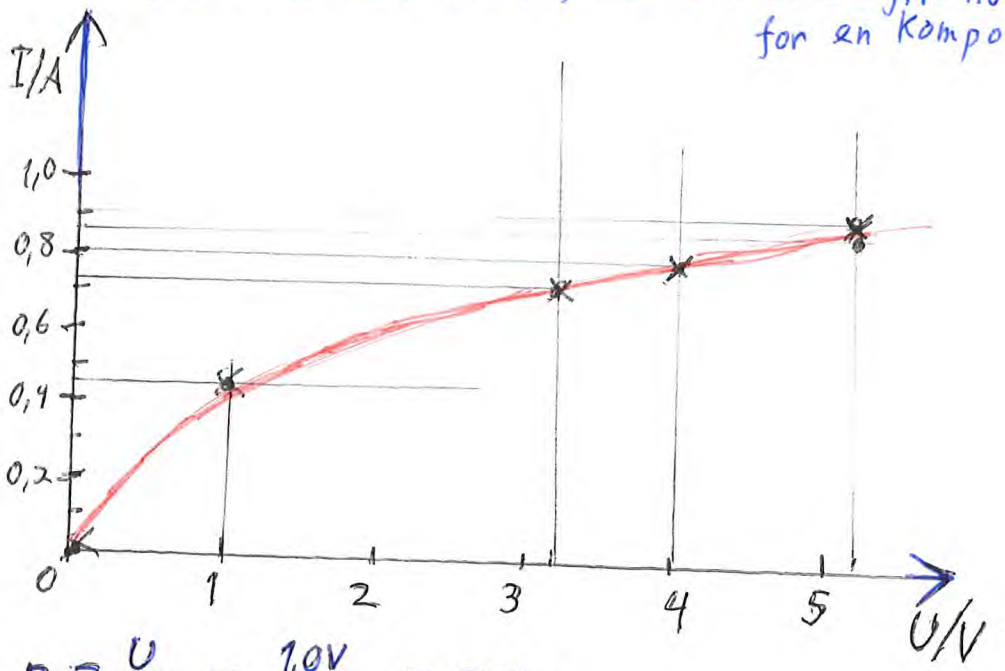
$I = 0,85A$

$$R = \frac{U}{I} = \frac{5,0V}{0,85A} = \underline{5,9\,\Omega}$$

$\left(\frac{5,0V}{0,83V} = 6,0\,\Omega\right)$

11,17 a) Kan ta med (0,0) fordi null strøm gir null spenning for en komponent.

1.



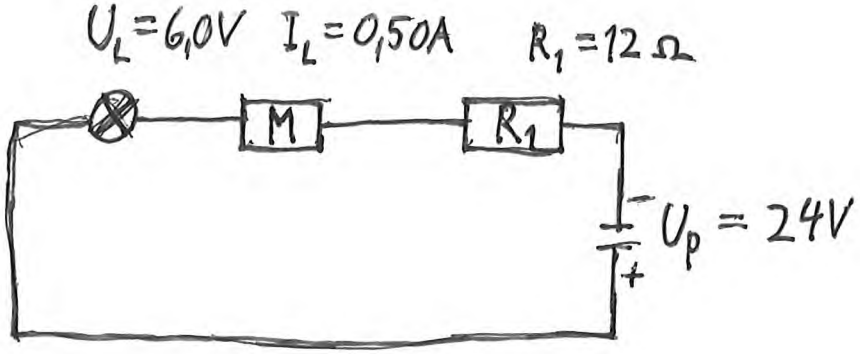
b) $R = \frac{U}{I} = \frac{1,0V}{0,44A} = \underline{2,3\Omega}$

$R = \frac{3,2V}{0,72A} = \underline{4,4\Omega}$

osv.

c) R endrer seg mye med spenningen. Dvs. R er ikke konstant og Ohms lov er ikke en god modell for 1,

11,18 a)



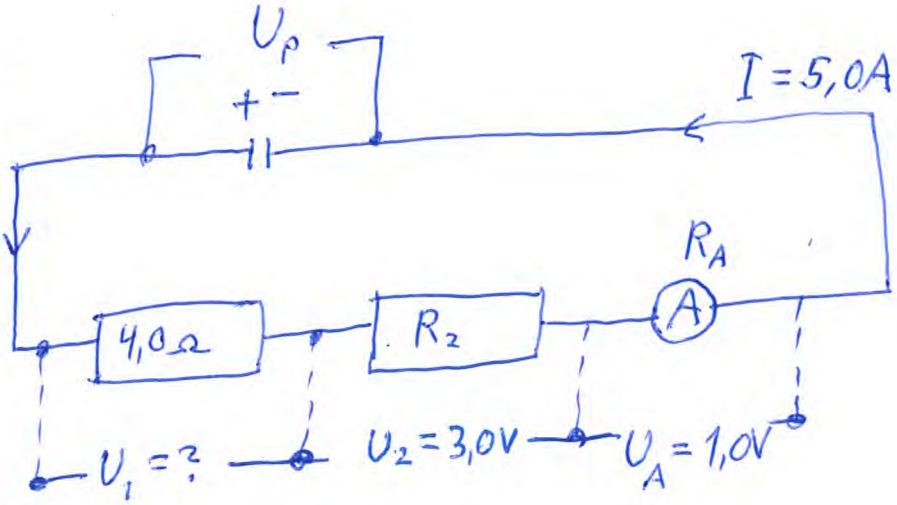
b) $U_1 = R_1 \cdot I_L = 12\Omega \cdot 0,50A = \underline{6,0V}$

$U_p = U_L + U_M + U_1$

$U_p - U_L - U_1 = U_M$

$U_M = 24V - 6,0V - 6,0V = \underline{12V}$

11.19



$U = R\,I$

$U_1 = R_1 \cdot I_1 = 4{,}0\,\Omega \cdot 5{,}0\,A = \underline{20\,V}$

$U = R\,I$

$U_2 = R_2 \cdot I_2$

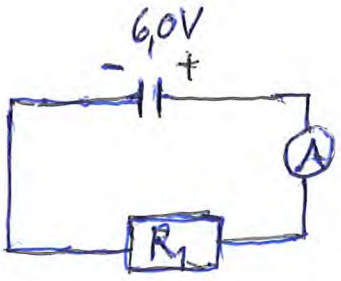
$\frac{U_2}{I_2} = R_2 \qquad R_2 = \frac{3{,}0\,V}{5{,}0\,A} = \underline{0{,}60\,\Omega}$

$R_A = \frac{U_A}{I_A} = \frac{1{,}0\,V}{5{,}0\,A} = \underline{0{,}20\,\Omega}$

$U_p = U_1 + U_2 + U_A$

$= 20\,V + 3{,}0\,V + 1{,}0\,V = \underline{24\,V}$

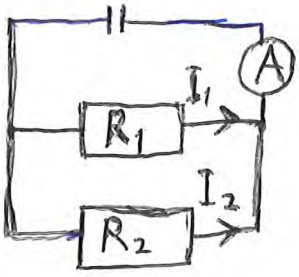
11.20



$U = R\,I$

$R_1 = \frac{U}{I} = \frac{6{,}0\,V}{2{,}3 \cdot 10^{-3}\,A} = 2608\,\Omega$

$\underline{R_1 = 2{,}6\,k\Omega}$



$I = I_1 + I_2$

$I_2 = I - I_1 = (4{,}3 - 2{,}3) \cdot 10^{-3}\,A = 2{,}0 \cdot 10^{-3}\,A$

$R_2 = \frac{U}{I_2} = \frac{6{,}0\,V}{2{,}0 \cdot 10^{-3}\,A} = \underline{3{,}0\,k\Omega}$

11.22 a) $R_A = 20\,\Omega$ og $R_{tot} = 25\,\Omega$

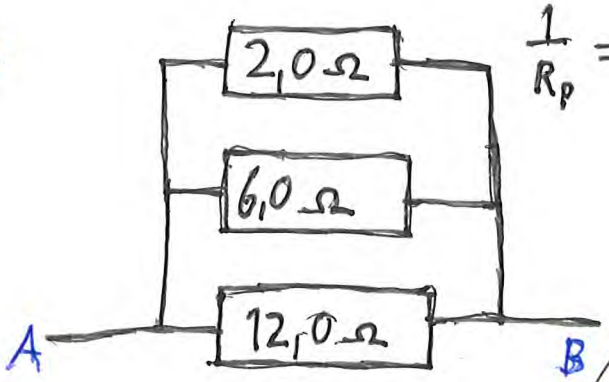
$$R_A + R_B = 25\,\Omega$$
$$20\,\Omega + R_B = 25\,\Omega$$
$$\underline{R_B = 5\,\Omega}$$

b) $15\,\Omega < 20\,\Omega$

$$\frac{1}{R_{tot}} = \frac{1}{R_A} + \frac{1}{R_B}$$
$$\frac{1}{15\,\Omega} = \frac{1}{20\,\Omega} + \frac{1}{R_B}$$
$$\left(\frac{1}{15\,\Omega} - \frac{1}{20\,\Omega}\right) = \frac{1}{R_B}$$
$$R_B \cdot \left(\frac{1}{15\,\Omega} - \frac{1}{20\,\Omega}\right) = 1$$
$$R_B = \frac{1\,\Omega}{\left(\frac{1}{15} - \frac{1}{20}\right)} = \underline{60\,\Omega}$$

c) $0\,\Omega$ kun ved kortslutning

11.23



$$\frac{1}{R_p} = \frac{1}{2{,}0\,\Omega} + \frac{1}{6{,}0\,\Omega} + \frac{1}{12{,}0\,\Omega} = 0{,}75\,\Omega^{-1}$$

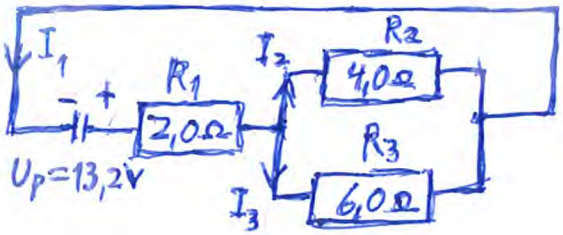
$$R_p = \frac{1}{0{,}75\,\Omega^{-1}} = \underline{1{,}3\,\Omega}$$

$$\frac{1}{R_p} = 0{,}75\,\Omega^{-1} \quad | \cdot R_p$$
$$1 = R_p \cdot 0{,}75\,\Omega^{-1} \quad | : 0{,}75\,\Omega^{-1}$$
$$\frac{1}{0{,}75\,\Omega^{-1}} = R_p$$

11.24 a) $\frac{1}{R_{II}} = \frac{1}{4{,}0\,\Omega} + \frac{1}{6{,}0\,\Omega}$

$\frac{1}{R_{II}} = 0{,}4166\ldots\,\Omega^{-1}$

$R_{II} = \frac{1\,\Omega}{0{,}4166\ldots} = \underline{2{,}4\,\Omega}$



b) $R_S = 2{,}0\,\Omega + 2{,}4\,\Omega$

$R_S = \underline{4{,}4\,\Omega}$

c) $U_p = R_S \cdot I_1 \Rightarrow \frac{U_p}{R_S} = I_1$

$I_1 = \frac{13{,}2\,V}{4{,}4\,\Omega} = \underline{3{,}0\,A}$

d) $R = 2{,}0\,\Omega$

$U_1 = R I_1 = 2{,}0\,\Omega \cdot 3{,}0\,A = \underline{6{,}0\,V}$

$U_p = U_1 + U_{II}$

$U_p - U_1 = U_{II}$

$U_{II} = 13{,}2\,V - 6{,}0\,V = \underline{7{,}2\,V}$

e) $U_{II} = R_2 I_2$

$\frac{U_{II}}{R_2} = I_2$

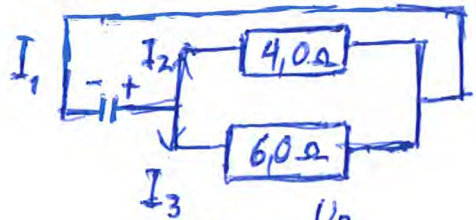
$I_2 = \frac{7{,}2\,V}{4{,}0\,\Omega} = \underline{1{,}8\,A}$

$I_1 = I_2 + I_3$

$I_1 - I_2 = I_3$

$I_3 = 3{,}0\,A - 1{,}8\,A = \underline{1{,}2\,A}$

f) Kortslutning av 2,0 Ω-motstand



$I_2 = \frac{U_p}{R_2}$

$I_2 = \frac{13{,}2\,V}{4{,}0\,\Omega} = \underline{3{,}3\,A}$

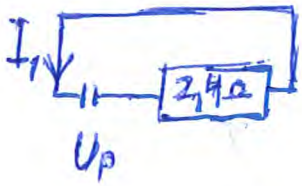
$U_p = 13{,}2\,V$

$R_{II} = 2{,}4\,\Omega$

$U_p = R_{II} \cdot I_1$

$\frac{U_p}{R_{II}} = I_1$

$I_1 = \frac{13{,}2\,V}{2{,}4\,\Omega} = \underline{5{,}5\,A}$

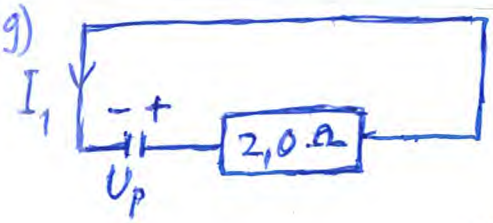


$I_2 + I_3 = I_1$

$I_3 = I_1 - I_2$

$I_3 = (5{,}5 - 3{,}3)\,A = \underline{2{,}2\,A}$

g)



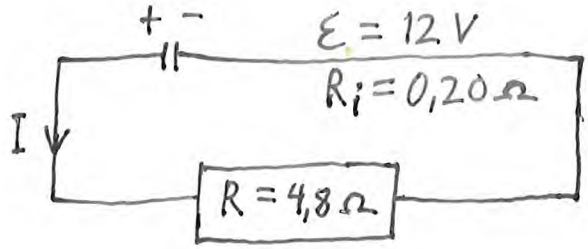
$R_1 \cdot I_1 = U_p$

$I_1 = \frac{U_p}{R_1} = \frac{13{,}2\,V}{2{,}0\,\Omega} = \underline{6{,}6\,A}$

$I_2 = \underline{0}$ $I_3 = \underline{0}$

h) Samme svar som i g)

11.25



$$\varepsilon = R_i I + R_y I$$

$$\varepsilon = (R_i + R_y) \cdot I$$

$$I = \frac{\varepsilon}{(R_i + R_y)}$$

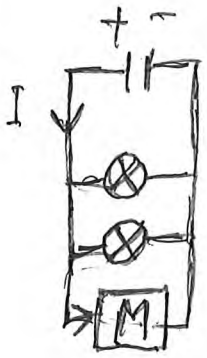
$$I = \frac{12\,V}{(0{,}20 + 4{,}8)\,\Omega} = \underline{2{,}4\,A}$$

11.26 a) $\varepsilon = 12\,V \quad I = 160\,A \quad R_i = 0{,}020\,\Omega$

$$\varepsilon = R_i I + U_p$$

$$U_p = \varepsilon - R_i I = 12\,V - 0{,}020\,\Omega \cdot 160\,A = \underline{8{,}8\,V}$$

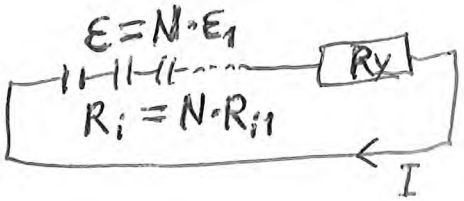
b)



11.27 $I = 2{,}0\,A \quad R_y = 10\,\Omega \quad U_p = R_y \cdot I = 10\,\Omega \cdot 2{,}0\,A = 20\,V$

$\varepsilon_1 = 1{,}5\,V \quad R_{i1} = 0{,}25\,\Omega$

N = antall elementer



$$\varepsilon = R_i I + U_p$$

$$N \cdot \varepsilon_1 = N \cdot R_{i1} \cdot I + U_p$$

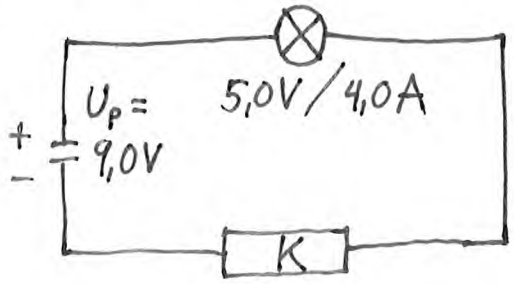
$$N \cdot (\varepsilon_1 - R_{i1} I) = U_p$$

$$N = \frac{U_p}{(\varepsilon_1 - R_{i1} I)}$$

$$N = \frac{20\,V}{(1{,}5\,V - 0{,}25\,\Omega \cdot 2{,}0\,A)}$$

$$= \frac{20}{1} = \underline{20}$$

11.29



a) $U_p = U_L + U_K$

$U_K = U_p - U_L$

$U_K = 9{,}0V - 5{,}0V = \underline{4{,}0V}$

b) $W_K = U_K I t = 4{,}0V \cdot 4{,}0A \cdot 10 \cdot 60s$

$= 9600J = \underline{9{,}6kJ}$

11.31 $W = 552 \cdot 10^3 J$

$U = RI$ og $I = \frac{Q}{t} \Rightarrow Q = It$

og $U = \frac{W}{Q}$

$W = QU = It \cdot RI$

$W = RI^2 t$

$[J = \Omega A^2 s]$

a) $I = 8{,}0A \quad R = 30\Omega$

$W = UIt = RI \cdot I \cdot t = RI^2 t$

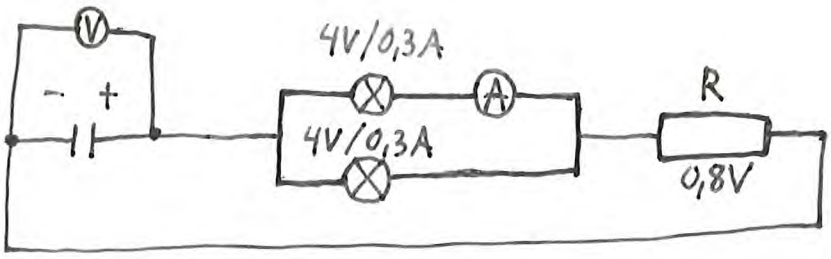
$\frac{W}{RI^2} = t$

$t = \frac{552 \cdot 10^3 J}{30\Omega \cdot (8{,}0A)^2} = 287{,}5s = \underline{4min \text{ og } 48s}$

b) $I = 4{,}0A \quad t = ?$ Antar $R = 30\Omega$ som før

$t = \frac{W}{RI^2} = \frac{552 \cdot 10^3}{30 \cdot 4{,}0^2} s = 1150s = \underline{19min \text{ og } 10s}$

11.32



a) $U_p = U_L + U_R = 4V + 0,8V = 4,8V \approx \underline{5V}$

b) $I_A = I_L = \underline{0,3A}$

c) $P_L = U_L I_L = 4V \cdot 0,3A = 1,2W \approx \underline{1W}$

Samme for den andre lampa.

$P_R = U_R I_R = 0,8V \cdot 2 \cdot I_L = 0,8V \cdot 2 \cdot 0,3A = 0,48W \approx \underline{0,5W}$

11.33 $E_k = 2 \cdot \frac{1}{2} m v^2 = m v^2 = 1000kg \cdot (30 \frac{m}{s})^2$

$= 900 \cdot 10^3 J$

$P = 1000W$

$E = P \cdot t = 1000 \frac{J}{s} \cdot 3600s = 3600 \cdot 10^3 J > E_k$