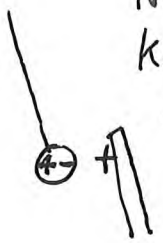
11.303 a)



Nei, de negative ladningene på kula kan flytte seg nærmere den positivt ladde staven slik at kreftene på den delen av kula nærmest staven blir større enn kreftene på de positive ladningene som ble igjen ettersom disse er lenger unna staven.

b) Ja, i det tilfellet er overskuddet av positiv ladning så stort at det ikke hjelper at de negative ladningene kan være nærmere staven.

11.307 $U = 15\,MV = 15 \cdot 10^6 V$

$Q = 30C$

a) $W = Q \cdot U = 30C \cdot 15 \cdot 10^6 V = \underline{4{,}5 \cdot 10^8 J}$

b) $W = \frac{1}{2} m v^2$

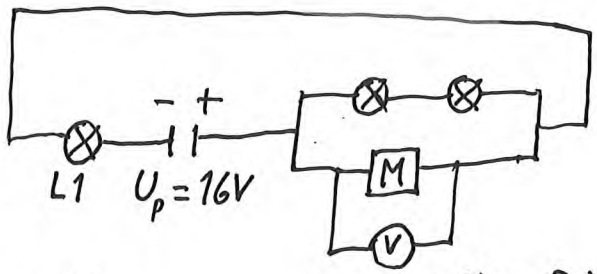
$2W = mv^2$

$\frac{2W}{m} = v^2$

$v = \sqrt{\frac{2W}{m}} = \sqrt{\frac{2 \cdot 4{,}5 \cdot 10^8 J}{700\,kg}} = 1133 \frac{m}{s}$

$= \underline{1{,}1 \frac{km}{s}}$

11.308+ a)



b) $U_p = U_M + U_{L1}$ $\qquad U_M = U_{II} = 5{,}0V$

$U_{L1} = U_p - U_M = 16V - 5{,}0V = \underline{11V}$

$U_{II} = 2 \cdot U_L \Rightarrow U_L = \frac{U_{II}}{2} = \frac{5{,}0V}{2} = \underline{2{,}5V}$ over hver av de to like lampene.

11.311 $Q = 1{,}4 \cdot 10^{-3}\,C$ $t = 2{,}0\,s$

a) $I = \frac{Q}{t} = \frac{1{,}4 \cdot 10^{-3}\,C}{2{,}0\,s} = 7{,}0 \cdot 10^{-4}\,C/s = \underline{0{,}70\,mA}$

b) $n = \frac{Q}{e} = \frac{-1{,}4 \cdot 10^{-3}\,C}{-1{,}60 \cdot 10^{-19}\,C} = \underline{8{,}8 \cdot 10^{15}}$

11.313 $U_p = 4{,}5\,V$ $N = 3{,}2 \cdot 10^{18}$ $t = 20\,s$

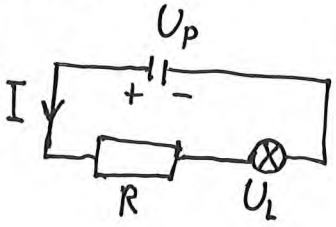
a) $I = \frac{Q}{t} = \frac{Ne}{t} = \frac{3{,}2 \cdot 10^{18} \cdot 1{,}60 \cdot 10^{-19}\,C}{20\,s} = 0{,}026\,A = \underline{26\,mA}$ $(0{,}0256\,A)$

b) $U = \frac{W}{Q}$

$W = QU = NeU_p = \text{osv.}$

$W = QU = ItU_p = 0{,}0256\,A \cdot 20\,s \cdot 4{,}5\,V = \underline{2{,}37}$

11.318 $U_p = 12{,}0\,V$ $R = 5{,}0\,\Omega$ $U_L = 8{,}0\,V$



a) $U_p = U_L + RI$

$U_p - U_L = RI$

$I = \frac{U_p - U_L}{R} = \frac{12{,}0\,V - 8{,}0\,V}{5{,}0\,\Omega} = \underline{0{,}80\,A}$

b) $U_L = R_L \cdot I$

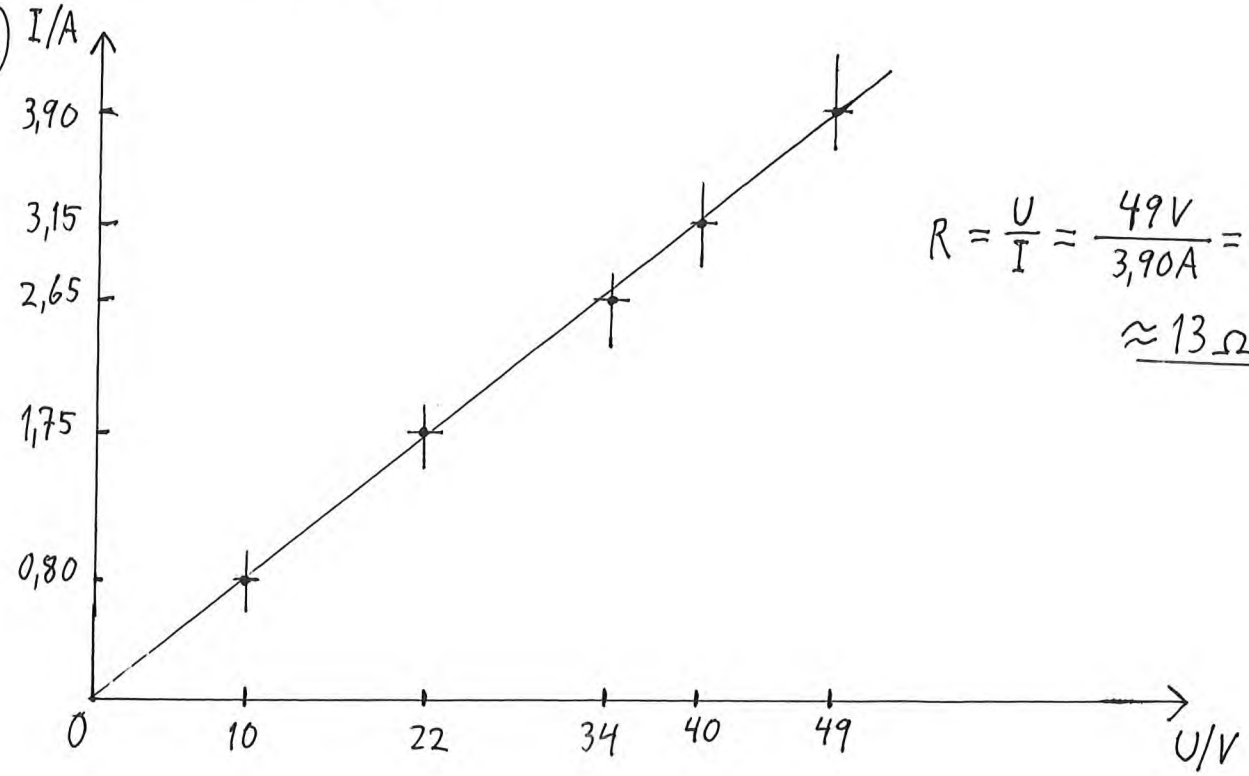
$R_L = \frac{U_L}{I} = \frac{8{,}0\,V}{0{,}80\,A} = \underline{10\,\Omega}$

11.320+

a) Resistansen i lederen er konstant når strømmen og spenningen varierer i ledere der Ohms lov er oppfylt $U = RI$ med R = konstant altså.

b) Kopling 2 fordi (V) må koples i parallell med M og i serie med (A).

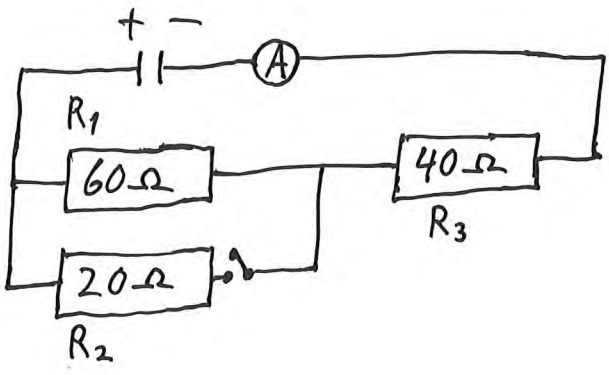
c)



$$R = \frac{U}{I} = \frac{49\,V}{3{,}90\,A} = 12{,}56\,\Omega$$

$$\approx \underline{13\,\Omega}$$

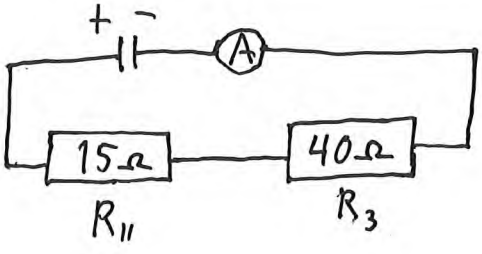
11.322+



$$\frac{1}{R_{II}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_{II}} = \frac{1}{60\,\Omega} + \frac{1}{20\,\Omega}$$

$$R_{II} = \frac{1\,\Omega}{\left(\frac{1}{60} + \frac{1}{20}\right)} = 15\,\Omega$$



$$R_y = R_{II} + R_3$$

$$= 15\,\Omega + 40\,\Omega = \underline{55\,\Omega}$$

dvs 2) er riktig.

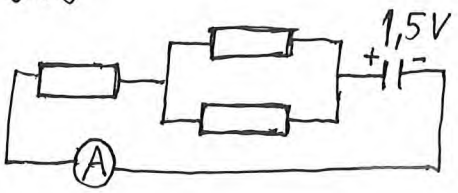
11.323+ $I = 1{,}0\,A$ $U = 1{,}5\,V$

$U = R\,I$

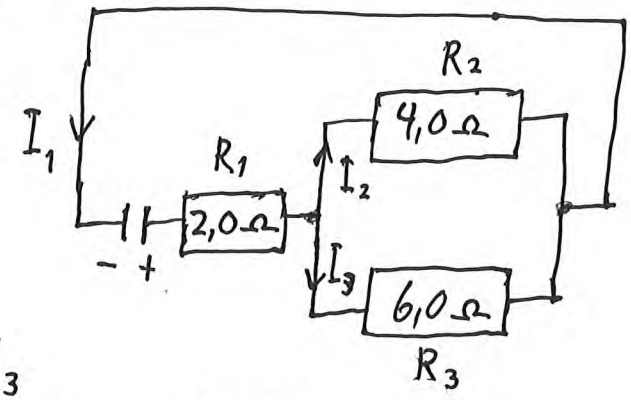
$R = \frac{U}{I} = \frac{1{,}5\,V}{1{,}0\,A} = 1{,}5\,\Omega = 1{,}0\,\Omega + 0{,}5\,\Omega$

$\frac{1}{R_{II}} = \frac{1}{1{,}0\,\Omega} + \frac{1}{1{,}0\,\Omega} \Rightarrow R_{II} = 0{,}5\,\Omega$ dvs

koplingen blir:



11.324 $I_3 = 1{,}2\,A$



a) $U_{II} = R_3 \cdot I_3$

$U_{II} = 6{,}0\,\Omega \cdot 1{,}2\,A = 7{,}2\,V$

$U_{II} = R_2 \cdot I_2$

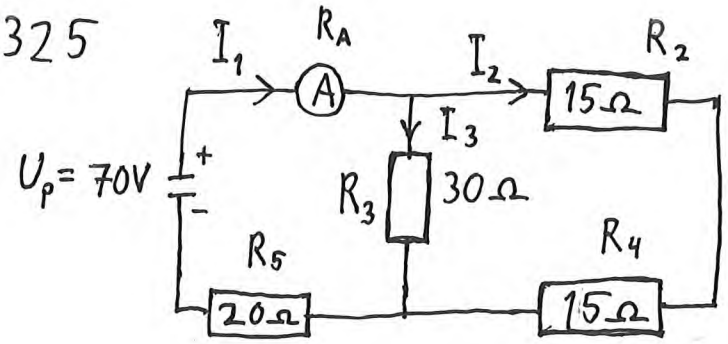
$I_2 = \frac{U_{II}}{R_2} = \frac{7{,}2\,V}{4{,}0\,\Omega} = \underline{1{,}8\,A}$ og $I_1 = I_2 + I_3 = 1{,}8\,A + 1{,}2\,A = \underline{3{,}0\,A}$

b) $U_{R2} = U_{R3} = U_{II} = \underline{7{,}2\,V}$

$U_{R1} = R_1 \cdot I_1 = 2{,}0\,\Omega \cdot 3{,}0\,A = \underline{6{,}0\,V}$

$U_p = U_{R2} + U_{R1} = 7{,}2\,V + 6{,}0\,V = 13{,}2\,V = \underline{13\,V}$

11.325



a) R_2 og R_4 er i serie.

$R_{24} = R_2 + R_4 = 15\Omega + 15\Omega$
$= 30\Omega$

R_3 er parallellkoblet med R_{24}.

$$\frac{1}{R_{II}} = \frac{1}{R_3} + \frac{1}{R_{24}}$$

$$\frac{1}{R_{II}} = \frac{1}{30\Omega} + \frac{1}{30\Omega} = \frac{2}{30\Omega}$$

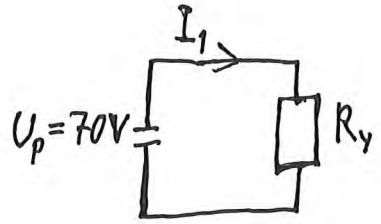
$$\frac{R_{II}}{1} = \frac{30\Omega}{2} = 15\Omega$$

$$R_{II} = 15\Omega$$

R_{II} er i serie med R_5 og $R_A \approx 0$

$R_y = R_{II} + R_5 = 15\Omega + 20\Omega = \underline{35\Omega}$

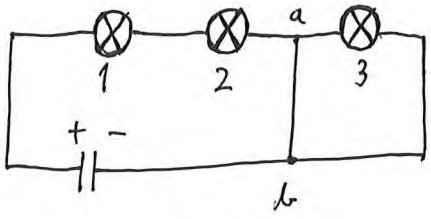
b) Kretsen kan forenkles til:



$U_p = R_y \cdot I_1$

$I_1 = \frac{U_p}{R_y} = \frac{70V}{35\Omega} = \underline{2{,}0A}$

11.326+



a) Lampe 3 vil slukne pga. kortslutningsledningen ab.

b) I vil øke fordi R_y avtar.

c) Lysstyrken vil øke når I øker.

d) Spenningen vil øke over gjenværende lamper hvis polspenningen er endret.

d) $P = UI$ Effekten vil øke for lampe 1 og 2 fordi både U og I øker.

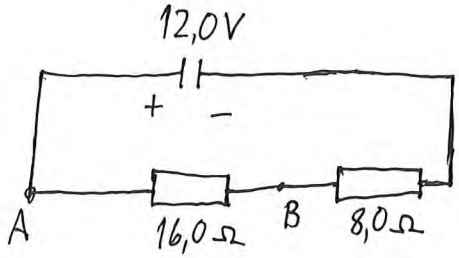
$P_{før} = 3 \cdot \frac{1}{3} U_p \cdot I_{før} = U_p \cdot I_{før}$

$P_{etter} = 2 \cdot \frac{1}{2} U_p \cdot I_{etter} = U_p \cdot I_{etter}$

} og ettersom $I_{etter} > I_{før}$ vil den samlede utstrålingen øke.

11.327+

a)

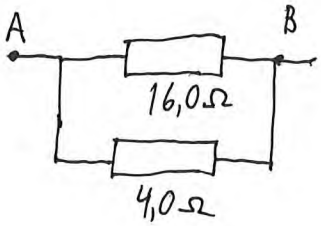


$R_y = (16,0 + 8,0)\Omega = 24,0\Omega$

$I = \frac{U}{R} = \frac{12,0V}{24,0\Omega} = 0,50A$

$U_{AB} = R_{AB} \cdot I = 16,\Omega \cdot 0,50A = \underline{8,0V}$

b)



$\frac{1}{R_{AB}} = \frac{1}{16,0\Omega} + \frac{1}{4,0\Omega}$

$R_{AB} = \frac{16,0}{5}\Omega$

$R_y = \frac{16,0}{5}\Omega + 8,0\Omega = 3,2\Omega + 8,0\Omega = 11,2\Omega$

$I = \frac{U}{R} = \frac{12,0V}{11,2\Omega} = 1,071A$ $\quad U_{AB} = R_{AB} \cdot I = \frac{16,0}{5}\Omega \cdot 1,071A = \underline{3,4V}$

11.328+ $U_L = 6,0V$ $\quad I_L = 0,50A$ $\quad U_p = 10V$ $\quad \frac{R_t}{l} = 40\frac{\Omega}{m}$

Vi må redusere spenningen med 4,0V fra 10V til 6,0V.
Spenningsfallet over tråden blir da

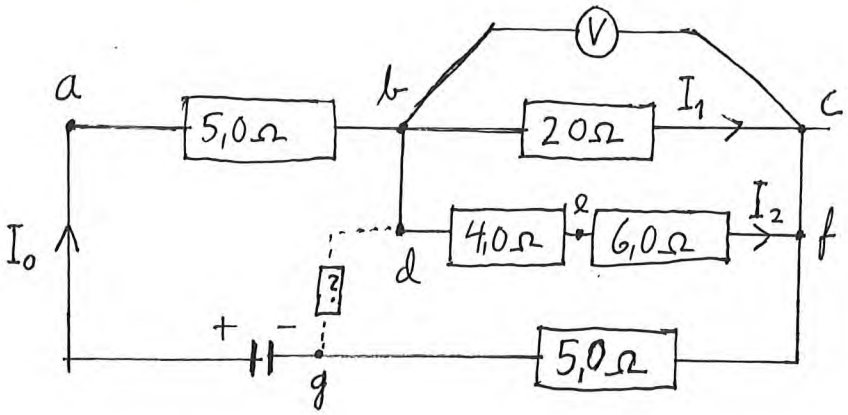
$U = R_t \cdot I = \frac{R_t}{l} \cdot x \cdot I$

$4,0V = 40\frac{\Omega}{m} \cdot x \cdot 0,50A$

$x = \frac{4,0V \cdot m}{20\Omega A} = \underline{0,20m}$

Vi må koble i serie for å redusere spenningen.

11.329+



$U_{bc} = 4{,}0\,V$

a) $U = RI \Rightarrow I_1 = \frac{U_{bc}}{R_{bc}} = \frac{4{,}0\,V}{20\,\Omega} = \underline{0{,}20\,A}$

$I_2 = \frac{U_{bc}}{R_{df}} = \frac{4{,}0\,V}{10{,}0\,\Omega} = \underline{0{,}40\,A}$

$I_0 = I_1 + I_2 = \underline{0{,}60\,A}$

b) $U_{de} = R_{de} \cdot I_2 = 4{,}0\,\Omega \cdot 0{,}40\,A = \underline{1{,}6\,V}$

$U_{ef} = R_{ef} \cdot I_2 = 6{,}0\,\Omega \cdot 0{,}40\,A = \underline{2{,}4\,V}$

$U_{bc} = \underline{4{,}0\,V}$

$U_{fg} = R_{fg} \cdot I_0 = 5{,}0\,\Omega \cdot 0{,}60\,A = \underline{3{,}0\,V}$

$U_{ab} = R_{ab} \cdot I_0 = 5{,}0\,\Omega \cdot 0{,}60\,A = \underline{3{,}0\,V}$

c) $U_p = U_{ab} + U_{bc} + U_{fg} = 3{,}0\,V + 4{,}0\,V + 3{,}0\,V = \underline{10\,V}$

d) U_p er uendret og $U_{bc} = 2{,}0\,V$

$I_1 = \frac{2{,}0\,V}{20\,\Omega} = 0{,}10\,A$

$I_2 = \frac{2{,}0\,V}{10\,\Omega} = 0{,}20\,A$

$U_{fg} = 5{,}0\,\Omega \cdot (0{,}10 + 0{,}20)\,A = 1{,}5\,V$

$U_{dg} = U_{bg} = U_{bc} + U_{fg} = 2{,}0\,V + 1{,}5\,V = 3{,}5\,V$

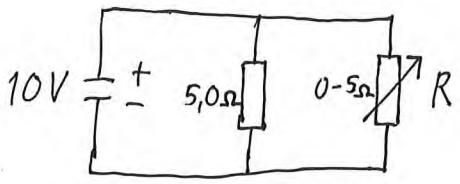
$U_p = U_{ab} + U_{dg}$

$U_{ab} = U_p - U_{dg} = 10\,V - 3{,}5\,V = 6{,}5\,V$

$I_0 = \frac{U_{ab}}{R_{ab}} = \frac{6{,}5\,V}{5{,}0\,\Omega} = 1{,}3\,A$ og $I_{dg} = I_0 - I_1 - I_2 = 1{,}3\,A - 0{,}10\,A - 0{,}20\,A = 1{,}0\,A$

$R_{dg} = \frac{U_{dg}}{I_{dg}} = \frac{3{,}5\,V}{1{,}0\,A} = \underline{3{,}5\,\Omega}$

11.330+



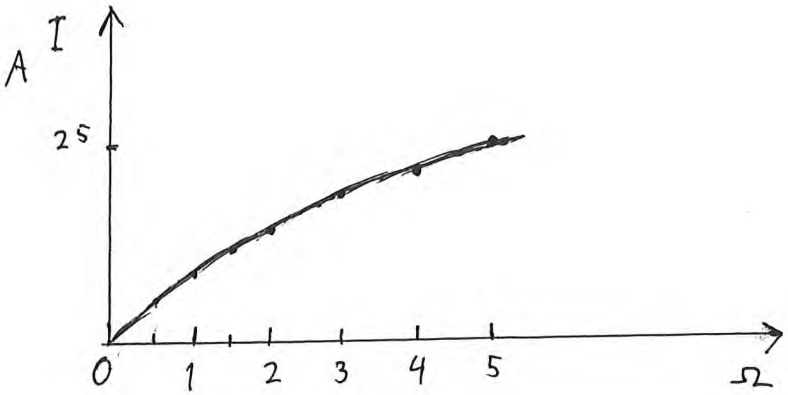
$$\frac{1}{R_{ty}} = \frac{1}{5{,}0\,\Omega} + \frac{1}{R_r}$$

$$1 = \left(\frac{1}{5{,}0} + \frac{1}{R_r}\right) \cdot R_y$$

$$R_y = \frac{1}{\left(\frac{1}{5{,}0} + \frac{1}{R_r}\right)}$$

$$U = R_y I$$

$$I = \frac{U}{R_y} = \frac{10\,V}{1/\left(\frac{1}{5{,}0\,\Omega} + \frac{1}{R_r}\right)}$$



X	0,52	1,03	1,51	2,02	3,01	4,01	5
Y	4,68	8,55	11,6	14,4	18,8	22,2	25

Kalkulator

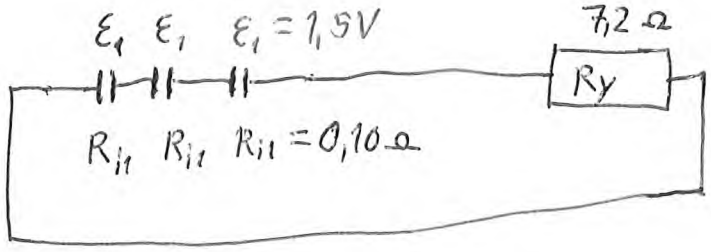
11.331 $\mathcal{E} = 6{,}0\,V$ $I = 4{,}0\,A$ $t = 8{,}0 \cdot 60\,s$

$U = \frac{W}{Q} \Rightarrow U \cdot Q = W$ elektrisk arbeid

$\mathcal{E} \cdot I \cdot t = W$

$W = 6{,}0\,V \cdot 4{,}0\,A \cdot 8{,}0 \cdot 60\,s = 11520\,J$ dvs ca 12 kJ

11.332



a) $\mathcal{E} = 3 \cdot \mathcal{E}_1 = 3 \cdot 1{,}5\,V = \underline{4{,}5\,V}$

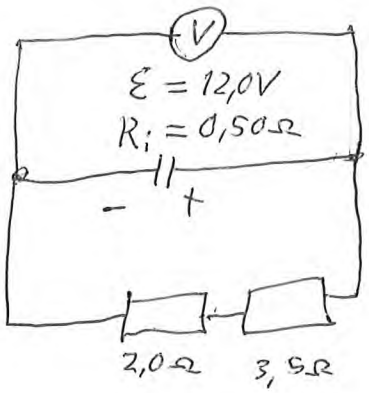
b) $\mathcal{E} = R_i I + R_y I = (R_i + R_y) \cdot I$

$4{,}5\,V = (3 \cdot 0{,}10\,\Omega + 7{,}2\,\Omega)\, I$

$\frac{4{,}5\,V}{7{,}5\,\Omega} = I \quad \Rightarrow \quad I = 0{,}60\,A$

$U_p = \mathcal{E} - R_i I = 4{,}5\,V - 0{,}30\,\Omega \cdot 0{,}60\,A = \underline{4{,}3\,V}$

11.333



$U_p = \mathcal{E} - R_i I$

$R_y = 2{,}0\,\Omega + 3{,}5\,\Omega = 5{,}5\,\Omega$

$U_p = R_y \cdot I$

$U_p = R_y \cdot I$

$= 5{,}5\,\Omega \cdot 2{,}0\,A = \underline{11\,V}$

$R_y \cdot I = \mathcal{E} - R_i I$

$R_y \cdot I + R_i I = \mathcal{E}$

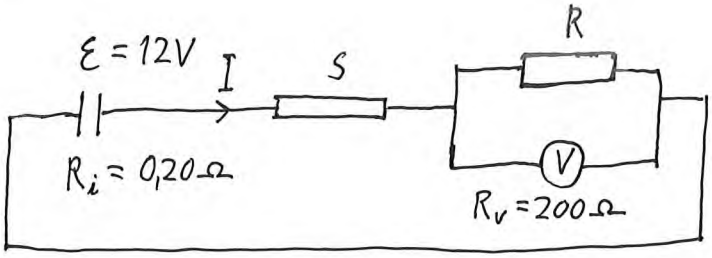
$I \cdot (R_y + R_i) = \mathcal{E}$

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

$I = \frac{12{,}0\,V}{(5{,}5 + 0{,}50)\,\Omega} = \frac{12{,}0}{6{,}0}\,A = 2{,}0\,A$

11.337+

a)



b) $I = 10A$ $\quad \varepsilon - R_i I = U_p$

$U_p = 12V - 0{,}20\Omega \cdot 10A = \underline{10V}$ som er det voltmeteret viser.

c) $I_V = \frac{U_V}{R_V} = \frac{10V}{200\Omega} = 0{,}050A$

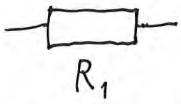
$I = I_V + I_R \Rightarrow I_R = I - I_V = 10A - 0{,}050A = 9{,}95A$

$R = \frac{U}{I_R} = \frac{10V}{9{,}95A} = \underline{1{,}0\Omega}$ $\quad (1{,}005\Omega)$

d) $I = 10A$ ettersom nesten ingen strøm går gjennom voltmeteret og R er like stor som før. Spenningen $U_V = 0V$ ettersom strømmen går nesten uhindret gjennom lederen S som er koplet i parallell.

11.344+

$R_1 = 54\Omega$ $\quad R_2 = 81\Omega$ $\quad U_n = 220V$

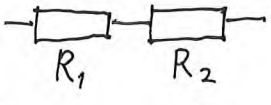


$P = UI = U \cdot \frac{U}{R_1}$

$= \frac{U^2}{R_1} = \frac{(220V)^2}{54\Omega}$

$= 896W$

$= \underline{0{,}90kW}$

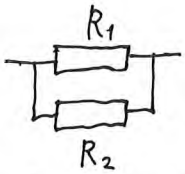


$P = \frac{U^2}{(R_1 + R_2)}$

$= \frac{(220V)^2}{135\Omega}$

$= 358{,}5W$

$= \underline{0{,}36kW}$



$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

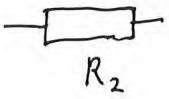
$R = \frac{1}{\left(\frac{1}{R_1} + \frac{1}{R_2}\right)}$

$P = \frac{U^2\left(\frac{1}{R_1} + \frac{1}{R_2}\right)}{1}$

$P = (220V)^2 \cdot \left(\frac{1}{54\Omega} + \frac{1}{81\Omega}\right)$

$= 1493{,}8W$

$= \underline{1{,}5kW}$



$P = \frac{U^2}{R_2}$

$= \frac{(220V)^2}{81\Omega}$

$= 597{,}5W$

$= \underline{0{,}60kW}$

11.345+ lampe1: 230V/40W lampe2: 6,0V/2,0A $U_n = 230V$

a) lampe 1, ikke lampe 2. Den 1 har riktig spenning, ikke 2.

b) $P = UI \Rightarrow I_1 = \frac{P_1}{U_1} = \frac{40W}{230V} = 0,17A$

Ved å kople i parallell vil lampe 2 få altfor høy spenning.

c) lampe 2 vil få altfor lav strøm. $R_1 = \frac{U^2}{P} = \frac{220^2}{40}\Omega = 1210\Omega$

Vi ser dette fordi $R_1 >> R_2$, noe som vil gi altfor liten strøm til R_2. $R_2 = \frac{U}{I} = \frac{6,0}{2,0}\Omega = 3,0\Omega$

11.346+

$R = 3,00\Omega$

a) $\frac{1}{R_{II}} = \frac{1}{3,00\Omega} + \frac{1}{3,00\Omega}$

$R_{II} = 1,50\Omega$ og $R_{tot} = 3 \cdot R_{II} = 3 \cdot 1,50\Omega = \underline{4,50\Omega}$

b) $U_p = 12,0V$

$P = UI = \frac{U^2}{R} = \frac{(12,0V)^2}{4,50\Omega} = \underline{32,0W}$

$U = RI$

$\frac{U}{R} = I$