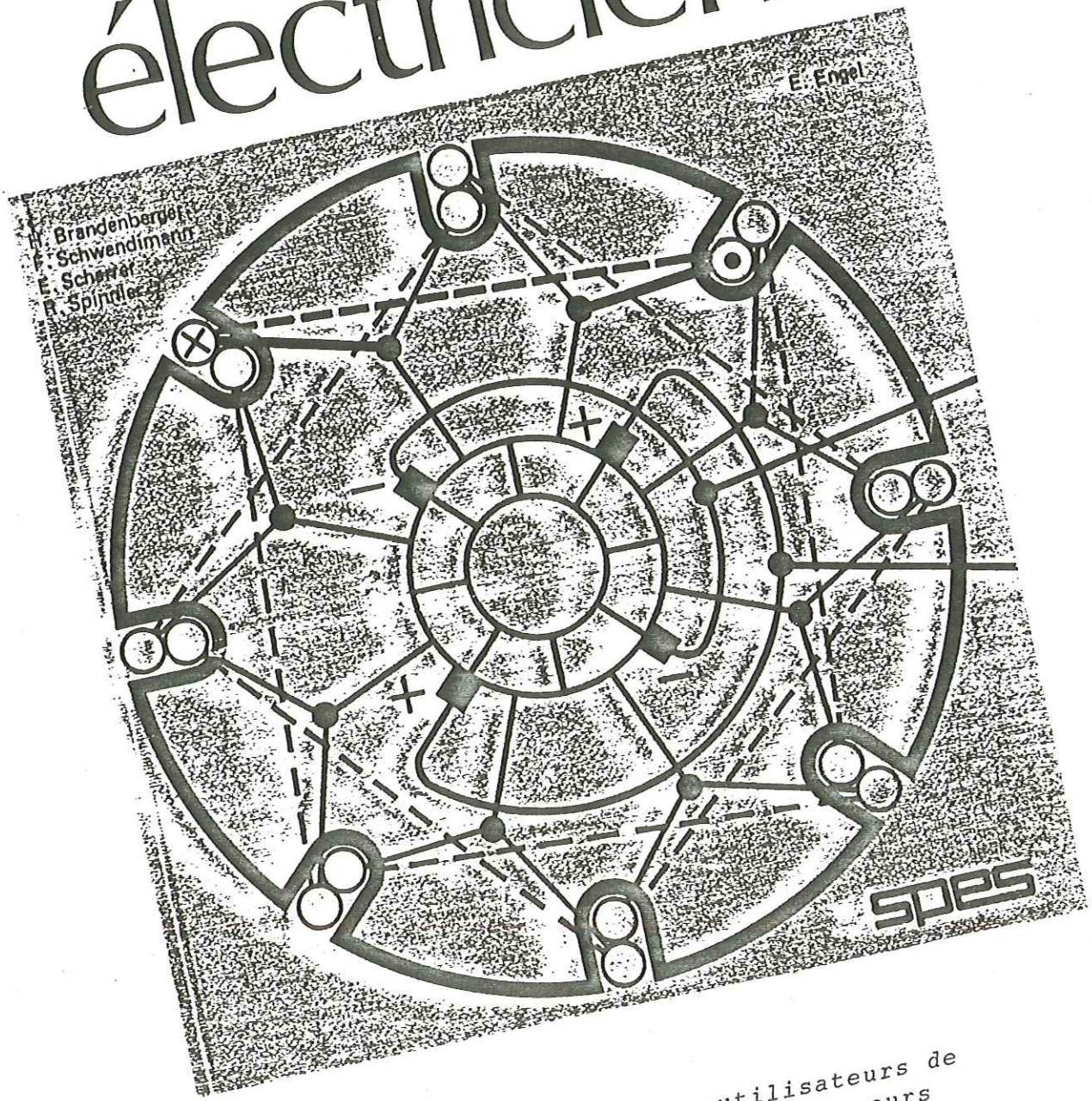
CORRIGE

BIBLIOTHÈQUE PROFESSIONNELLE

calcul pour électriciens



Je remercie, par anticipation, tous les utilisateurs de ce manuscrit, de bien vouloir me signaler les erreurs qu'ils y trouveront !

Joseph Abbet 027/38 39 07
Maître-électricien 1974 Arbaz

Centre de formation professionnelle de Sion

Calcul paur électricien solutions

N° 3.1.1

A en mm^2	I en A	J en $\frac{A}{mm^2}$
1	6	6
1.5	10	6,66
2,5	16	6,4
4	20	5
6	25	4,16
10	40	4
16	63	3,93

N° 3.1.2

$$J = \frac{I}{A} \Rightarrow A = \frac{I}{J} = \frac{82}{2,9} = 28,27 \Rightarrow 35\ \Phi$$

N° 3.1.3

$$J = \frac{I}{A} \Rightarrow I = J \cdot A = 18 \cdot 16 = 288\ A$$

N° 3.1.4

$$J = \frac{I}{A} = \frac{430}{35} = 12,28 A$$

N° 3.1.5

$$J = \frac{I}{A} \Rightarrow A = \frac{I}{J} = \frac{385}{12} \quad 23,75\ cm^2$$

N° 3.1.6

$$A = \phi^2 \cdot 0,786 = 2,5^2 \cdot 0,785 = 4,9\ mm^2$$

$$J = \frac{I}{A} \Rightarrow I = J \cdot A = 2,2 \cdot 4,9 = 10,79\ A.$$

№3. 1. 7

$$A = \phi^2 \cdot 0{,}785 = 0{,}1^2 \cdot 0{,}785 = 0{,}00785 \text{ mm}^2$$

a) $J = \frac{I}{A} = \frac{2{,}8}{0{,}00785} = \underline{\underline{356{,}68 \ \frac{A}{mm^2}}}$

b) $J = \frac{I}{A} = \frac{3{,}1}{0{,}00785} = \underline{\underline{394{,}9 \ \frac{A}{mm^2}}}$

c) $J = \frac{I}{A} = \frac{2{,}4}{0{,}00785} = \underline{\underline{305{,}73 \ \frac{A}{mm^2}}}$

№3. 1. 8

$J = \frac{I}{A} \Rightarrow I = J \cdot A = 35 \cdot 17{,}8 = \underline{\underline{623 \text{ A}}}$

$I = A \cdot J = 35 \cdot 20 = \underline{\underline{700 \text{ A}}}$

№3. 1. 9

$8{,}5 \ \frac{A}{cm^2} = 0{,}85 \ \frac{A}{mm^2}$

$J = \frac{I}{A} \Rightarrow A = \frac{I}{J} = \frac{32}{0{,}85} = \underline{37{,}64 \text{ mm}^2}$

$A = \phi^2 \cdot 0{,}785 \Rightarrow \phi = \sqrt{\frac{A}{0{,}785}} = \sqrt{\frac{37{,}64}{0{,}785}} = \underline{6{,}92 \text{ mm}}$

№ 3. 1. 10

$A = \phi^2 \cdot 0{,}785 = 4{,}8^2 \cdot 0{,}785 = 18{,}08 \text{ mm}^2$

$18{,}3 \text{ kA} = 18300 \text{ A}$

$J = \frac{I}{A} = \frac{18300}{18{,}08} = \underline{\underline{1011{,}81 \ \frac{A}{mm^2}}}$

№ 3. 1. 11

$A' = \phi^2 \cdot 0{,}785 = 40^2 \cdot 0{,}785 = 1256 \text{ mm}^2$

$A'' = \phi^2 \cdot 0{,}785 = 36^2 \cdot 0{,}785 = 1017{,}36 \text{ mm}^2$

$\Delta A = A' - A'' = 1256 - 1017{,}36 = 238{,}64 \text{ mm}^2$

$J = \frac{I}{A} \Rightarrow I = J \cdot A = 2{,}38 \cdot 238{,}64 = \underline{\underline{567{,}96 \text{ A}}}$

№ 3.1.12

$A = \phi^2 \cdot 0{,}785 = 0{,}12^2 \cdot 0{,}785 = 0{,}011 \ mm^2$

$J = \frac{I}{A} \Rightarrow I = J \cdot A = 3{,}4 \cdot 0{,}011304 = \underline{\underline{0{,}038 \ A}}$

№ 3.1.13

$J = \frac{I}{A} =$

a) $\frac{460}{95} = \underline{\underline{4{,}84 \ \frac{A}{mm^2}}}$

b) $\frac{335}{95} = \underline{\underline{3{,}52 \ \frac{A}{mm^2}}}$

c) $\frac{295}{95} = \underline{\underline{3{,}10 \ \frac{A}{mm^2}}}$

d) $\frac{295}{95} = \underline{\underline{3{,}10 \ \frac{A}{mm^2}}}$

№ 3.1.14

$A = \phi^2 \cdot 0{,}785 = 2{,}84^2 \cdot 0{,}785 = 6{,}33 \ mm^2$

$A \text{ totale} = A \cdot n = 6{,}33 \cdot 19 = 120{,}29 \ mm^2$

a) Cuivre : $J = \frac{I}{A} = \frac{840}{120{,}29} = \underline{\underline{3{,}82 \ \frac{A}{mm^2}}}$

b) Aluminium : $J = \frac{I}{A} = \frac{265}{120{,}29} = \underline{\underline{2{,}2 \ \frac{A}{mm^2}}}$

c) $\% = 100 - \left(\frac{265 \cdot 100}{840}\right) = \underline{\underline{22{,}05\ \%}}$

№ 3.2.1

$$I = \frac{U}{R} = \frac{220}{40,5} = 5,43\ A$$

№ 3.2.2

$$U = R \cdot I = 3,82 \cdot 16,5 = 63,03\ V$$

№ 3.2.3

$$R = \frac{U}{I} = \frac{8}{18} = 0,44\ \Omega$$

№ 3.2.4

$$I = \frac{U}{R} = \frac{4,12}{60} = 80,33\ mA$$

№ 3.2.5

$$U = R \cdot I = 165 \cdot 2,5 = 412,5\ V$$

№ 3.2.6

$$R = \frac{U}{I} = \frac{48}{62} = 0,77\ \Omega$$

№ 3.2.7

$$I = \frac{U}{R} = \frac{11,9}{2.8} = 4,85\ A$$

№ 3.2.8

$$U = R \cdot I = 0,043 \cdot 39.5 = 1,7\ A$$

№ 3.2.9

$$R = \frac{U}{I} = \frac{5,8}{3,15} = 1,84\ \Omega$$

№ 3.2.10

$$I = \frac{U}{R} = \frac{6,5}{0,424} = 15,33\ A$$

№ 3.2.11

$$I = \frac{U}{R} = \frac{185}{16} = 11,56\ mA$$

$\frac{\text{unité}}{k} \Rightarrow m$

№ 3.2.12

$$U = R \cdot I = 0{,}086 \cdot 12 = 1{,}032 \text{ V}$$

№ 3.2.13

$$R = \frac{U}{I} = \frac{12.9}{0{,}92} = \underline{\underline{14{,}02 \text{ k}\Omega}}$$

$\frac{\text{unité}}{\text{m}} \Rightarrow$ k

№ 3.2.14

$$I = \frac{U}{R} = \frac{287{,}5}{11{,}5} = \underline{\underline{25 \text{ mA}}}$$

$\frac{\text{unité}}{\text{k}} \Rightarrow$ m

№ 3.2.15

$$R = \frac{U}{I} = \frac{1.65}{6{,}6} = \underline{\underline{0{,}25 \text{ m}\Omega}}$$

$\frac{\text{Unité}}{\text{k}} \Rightarrow$ m

№ 3.2.16

$$U = R \cdot I = 9{,}2 \cdot 14{,}5 = \underline{\underline{133{,}4 \text{ V}}}$$

m . k $\Rightarrow$ Unité

№ 3.2.17

$$R = \frac{U}{I} = \frac{12}{0{,}107} = \underline{\underline{112{,}1 \Omega}}$$

№ 3.2.18

$$I = \frac{U}{R} = \frac{2{,}24}{1{,}26} = \underline{\underline{177{,}8 \ \mu\text{A}}}$$

$\frac{\text{unité}}{\text{M}} = \mu$

№ 3.2.19

$$U = R \cdot I = 2{,}6 \cdot 560 = \underline{\underline{1456 \text{ V}}}$$

M . $\mu \Rightarrow$ Unité

№ 3.2.20

$$R = \frac{U}{I} = \frac{10{,}2}{10{,}4} = \underline{\underline{0{,}98 \Omega}}$$

$\frac{\text{k}}{\text{k}} =$ unité

Nº 3.3.1

$It = I_1 + I_2 + I_3 + I_4 = 18,2 + 9,6 + 21,7 + 17,1 = \underline{66,6\ A}$

Sens : de gauche à droite.

Nº 3.3.2

$It = I_1 + I_2 + I_3 + I_4 + I_5 = 902 + 1027 + 189 + 503 + 992 = \underline{3513\ A}$

Nº 3.3.3

$It = I_1 + I_2 + (2 \cdot I_3) = 2,8 + 2,3 + (2 \cdot 1,25) = \underline{7,6\ A}$

Nº 3.3.4

$It = 2 \cdot I_1 + 2 \cdot I_2 + 4 \cdot I_3 + 4 \cdot I_5 + I_6 + I_7 =$

$2 : 3,33 + 2 \cdot 0,33 + 4 \cdot 0,4 + 4 \cdot 0,25 + 0,5 + 2,5 = \underline{12,93\ A}$

Nº 3.3.5

Sens du crt. = Entrant.

I'tot. sortant = 210 + 187 = 397 A

I'tot. Entrant = 120 + 178 = 298 A

$I_1 = \Delta I = I' - I'' = 397 - 298 = \underline{99\ A}$

Nº 3.3.6

I'tot. entrant = 12,1 + 9,3 + 48,2 = 69,6 A

I''tot. sortant = 76,1 + 17,8 = 93,9 A

I est entrant et égal à ΔI

$I = I' - I'' = 93,8 - 69,6 = \underline{24,3\ A}$

Nº 3.3.7

$I = I\ déb. - I\ uti. = 24,2 - (3,6 + 9,8 + 5,5) = \underline{5,3\ A}$

Nº 3.3.8

$I_1 = I\ tot. - I_3 = 8,21 - 5,67 = \underline{2,54\ A}$

$I_2 = I\ tot. = \underline{8,21\ A}$

№ 3.3.9

$I_1 = c \to d + c \to b = 83 + 72 = \underline{155\ A}$

$I_3 = 211 - 72 = \underline{139\ A}$

$I_2 = 920 - I_3 = 920 - 139 = \underline{781\ A}$

$I_4 = 83 + I_2 = 83 + 781 = \underline{864\ A}$

№ 3.3.10

$I_{tot.}'$ entrants $= 13,5 + 30,2 = 43,7\ A$

$I_{tot.}''$ sortants $= 14,8 + 12,4 = 27,2\ A$

$\Delta I = I' - I'' = 43,7 - 27,2 = \underline{16,5\ A}$

I est <u>sortant!</u>

№ 3.3.11

$I_1 = 168 + 77 = \underline{91\ mA}$

$I_3 = 301 + I_1 = 301 + 91 = \underline{392\ mA}$

$I_2 = 301 - 77 = \underline{224\ mA}$

I_1 va de droite à gauche!

I_2 est sortant!

I_3 est entrant!

№ 3.4.1

$$\gamma \cdot \varphi = \sim 1$$

$$\frac{\Omega \cdot mm^2}{m} \cdot \frac{m}{\Omega \cdot mm^2} = \frac{1}{1} \sim 1 \text{ (nombre Neutre)}$$

$0{,}0175 \cdot 57 = \underline{0{,}9975}$

$0{,}485 \cdot 2{,}06 = \underline{0{,}991}$

$1{,}08 \cdot 0{,}926 = \underline{1}$

№ 3.4.2

$$\gamma = \frac{1}{\varphi} = \frac{1}{1114} = 0{,}8977 \ \frac{m\,Sm}{mm^2}$$

№ 3.4.3

$$\varphi = \frac{1}{\gamma} = \frac{1}{0{,}0285} = 35{,}09 \ \frac{\Omega \cdot mm^2}{m}$$

№ 3.4.4

$$\gamma = \frac{1}{\varphi} = \frac{1}{0{,}0245} = 40{,}82 \ \frac{Sm}{mm^2}$$

№ 3.4.5

$$\varphi = \frac{1}{\gamma} = \frac{1}{3{,}21} = 0{,}3115 \ \frac{M\Omega \cdot mm^2}{m}$$

№ 3.4.6

$$\gamma = \frac{1}{\varphi} = \frac{1}{0{,}075} = 13{,}3 \ \frac{Sm}{mm^2}$$

№ 3.4.7

$$\gamma = \frac{1}{\varphi} = \frac{1}{55} = 18{,}18 \ \frac{m\,Sm}{mm^2}$$

№ 3.4.8

$$\gamma = \frac{1}{\varphi} = \frac{1}{0{,}0255} = 39{,}21 \ \frac{Sm}{mm^2}$$

№ 3.5.1

$$R = \frac{\varphi \cdot l}{A} = \frac{0{,}0175 \cdot 100}{16} = \underline{\underline{0{,}109\ \Omega}}$$

№ 3.5.2

$$A = \phi^2 \cdot 0{,}785 = 32^2 \cdot 0{,}785 = 803{,}84\ mm^2$$

$$l = 0{,}915\ m$$

$$R = \frac{\varphi \cdot l}{A} \Rightarrow \varphi = \frac{R \cdot A}{l} = \frac{1.05 \cdot 803{,}84}{0{,}915} = \underline{\underline{922{,}9\ \frac{\Omega \cdot mm^2}{m}}}$$

№ 3.5.3

$$R = \frac{\varphi \cdot l}{A} \Rightarrow l = \frac{R \cdot A}{\varphi} = \frac{0{,}42 \cdot 2{,}5}{0{,}0175} = \underline{\underline{60\ m}}$$

№ 3.5.4

$$R = \frac{\varphi \cdot l}{A} \Rightarrow A = \frac{\varphi \cdot l}{R} = \frac{0{,}0175 \cdot 52}{0{,}062} = \underline{\underline{14{,}68\ mm^2}}$$

A normalisé $\Rightarrow$ $\underline{\underline{16\ \Phi}}$

№ 3.5.5

$$A = \phi^2 \cdot 0{,}785 = 0{,}85^2 \cdot 0{,}785 = 0{,}5671\ mm^2$$

$$A = \phi^2 \cdot 0785 = 0{,}075^2 \cdot 0{,}785 = 0{,}0044\ mm^2$$

$$R = \frac{\varphi \cdot l}{A} = \frac{0{,}0175 \cdot 28{,}6}{0{,}56} = \underline{\underline{0{,}882\ \Omega}}$$

$$R = \frac{\varphi \cdot l}{A} = \frac{0{,}0175 \cdot 1780}{0{,}0044} = \underline{\underline{7051\ \Omega}}$$

№ 3.5.6

$$A = \phi^2 \cdot 0{,}785 = 0.7^2 \cdot 0{,}785 = 0{,}384\ mm^2$$

$$R = \frac{\varphi \cdot l}{A} \Rightarrow l = \frac{R \cdot A}{\varphi} = \frac{1{,}65 \cdot 0{,}384}{0{,}0175} = \underline{\underline{36{,}28\ m}}$$

№ 3.5.7

$$R = \frac{\varphi \cdot l}{A} \Rightarrow A = \frac{\varphi \cdot l}{R} = \frac{0{,}0175 \cdot 0{,}85^2}{0{,}000425} = \underline{\underline{\overset{29}{\cancel{35}}\ mm^2}}$$

N° 3.5.8 φ du Bronze = 0,0185 $\frac{\Omega \cdot mm^2}{m}$

$A = \phi^2 \cdot 0{,}785 = 3^2 \cdot 0{,}785 = 7{,}065\ mm^2$

$R = \frac{\varphi \cdot l \cdot 2}{A} = \frac{0{,}0185 \cdot 1820 \cdot 2}{7{,}065} = \underline{\underline{9{,}537\ \Omega}}$

N° 3.5.9

$0{,}527\ \Omega/km \Rightarrow 0{,}000527\ \frac{\Omega \cdot m}{35\ mm^2}$

$\varphi = A \cdot \Omega \cdot m = 0{,}000527 \cdot 35 = \underline{\underline{0{,}01845\ \frac{\Omega \cdot mm^2}{m}}}$

N° 3.5.10

$A = \phi^2 \cdot 0{,}785 = 1{,}8^2 \cdot 0{,}785 = 2{,}54\ mm^2$

$R = \frac{\varphi \cdot l}{A} \Rightarrow l = \frac{R \cdot A}{\varphi} = \frac{1{,}8 \cdot 2{,}54}{0{,}0175} = \underline{\underline{261{,}7\ m}}$

N° 3.5.11

$R = \frac{\varphi \cdot l \cdot 2}{A} \Rightarrow A = \frac{\varphi \cdot l \cdot 2}{R} = \frac{0{,}0175 \cdot 120 \cdot 2}{2{,}1} = \underline{\underline{2\ mm^2}}$

soit $\underline{\underline{2{,}5\ mm^2\ normalisé}}$

N° 3.5.12

$R = \frac{\varphi \cdot l}{A} = \frac{0{,}0175 \cdot 82}{16} = \underline{\underline{0{,}0896\ \Omega}}$

N° 3.5.13

$A = l \cdot L = 6 \cdot 6 = 36\ mm^2$

$R = \frac{\varphi \cdot l}{A} \Rightarrow \varphi = \frac{R \cdot A}{l} = \frac{1{,}05 \cdot 36}{0{,}6} = \underline{\underline{63\ \frac{\Omega \cdot mm^2}{m}}}$

N° 3.5.14

$A = \phi^2 \cdot 0{,}785 = 1{,}2^2 \cdot 0{,}785 = 1{,}13\ mm^2$

$R = \frac{\varphi \cdot l}{A} \Rightarrow l = \frac{R \cdot A}{\varphi} = \frac{44 \cdot 1{,}13}{0{,}91} = \underline{\underline{54{,}68\ m}}$

N° 3.5.15

$R = \frac{\varphi \cdot l}{A} \Rightarrow A = \frac{\varphi \cdot l}{R} = \frac{0{,}029 \cdot 12}{0{,}000375} = \underline{\underline{928\ mm^2}}$

№ 3.5.16

$$R = \frac{\varphi \cdot l}{A} = \frac{0{,}0328 \cdot 50'000}{600} = \underline{\underline{2{,}73\ \Omega}}$$

№ 3.5.17

$$A = \phi^2 \cdot 0{,}785 = 0{,}05^2 \cdot 0{,}785 = 0{,}0019\ mm^2$$

$$R = \frac{\varphi \cdot l}{A} \Rightarrow l = \frac{R \cdot A}{\varphi} = \frac{11200 \cdot 0{,}0019}{0{,}0175} = \underline{\underline{1257\ m}}$$

№ 3.5.18

$$A = \phi^2 \cdot 0{,}785 = 0{,}8^2 \cdot 0{,}785 = 0{,}502\ mm^2$$

Lacet : $R = \frac{\varphi \cdot l}{A} \cdot 2 = \frac{0{,}0175 \cdot 520 \cdot 2}{0{,}502} = \underline{\underline{36{,}25\ \Omega}}$

Fil : $R = \frac{\varphi \cdot l}{A} = \frac{0{,}0175 \cdot 520}{0{,}502} = \underline{\underline{18{,}125\ \Omega}}$

№ 3.5.19

$$A = \phi^2 \cdot 0{,}785 = 0{,}03^2 \cdot 0{,}785 = 0{,}0007\ mm^2$$

$$R = \frac{\varphi \cdot l}{A} \Rightarrow l = \frac{R \cdot A}{\varphi} = \frac{6250 \cdot 0{,}0007}{0{,}707} = \underline{\underline{6{,}248\ m}}$$

№ 3.5.20

$$R = \frac{\varphi \cdot l}{A} \Rightarrow \varphi = \frac{R \cdot A}{l} = \frac{0{,}1697 \cdot 1}{0{,}35} = \underline{\underline{0{,}4849\ \frac{\Omega \cdot mm^2}{m}}}$$

$$\gamma = \frac{1}{\varphi} = \frac{1}{0{,}484} = \underline{\underline{2{,}06\ \frac{S \cdot m}{mm^2}}}$$

№ 3.5.21

$$A = \phi^2 \cdot 0{,}785 = 0{,}65^2 \cdot 0{,}785 = 0{,}33\ mm^2$$

$$R = \frac{\varphi \cdot l}{A} \Rightarrow \varphi = \frac{R \cdot A}{l} = \frac{1{,}25 \cdot 0{,}33}{1} = \underline{\underline{0{,}4148\ \frac{\Omega \cdot mm^2}{m}}}$$

il s'agit de <u>Nickeline</u> !

№ 3.5.22

$$R = \frac{\varphi \cdot l}{A} = \frac{0{,}0175 \cdot 140}{25} = 0{,}098\ \Omega$$

$$R = \frac{\varphi \cdot l}{A} \Rightarrow A = \frac{\varphi \cdot l}{R} = \frac{0{,}029 \cdot 140}{0{,}098} = \underline{\underline{41{,}43\ mm^2}}$$ soit 50 ♯

№ 3.5.23

$A = \phi^2 \cdot 0{,}785 = 0{,}2^2 \cdot 0{,}785 = 0{,}0314 \text{ mm}^2$

$R = \frac{\varphi \cdot l}{A} = \frac{0{,}0175 \cdot 5}{0{,}0314} = \underline{2{,}786\ \Omega}$

$R_1 = \frac{R}{n} = \frac{2{,}786}{798} = \underline{3{,}492\ \text{m}\Omega}$

№ 3.5.24

$l = \phi \text{ moyen} \cdot \pi \cdot n = 0{,}085 \cdot 3{,}14 \cdot 2900 = 307{,}87 \text{ m}$

$A = \phi^2 \cdot 0{,}785 = 0{,}65^2 \cdot 0{,}785 = 0{,}3316 \text{ mm}^2$

$R = \frac{\varphi \cdot l}{A} = \frac{0{,}0175 \cdot 307{,}87}{0{,}3316} = \underline{16{,}24\ \Omega}$

№ 3.5.25

$A = \phi^2 \cdot 0{,}785 = 0{,}6^2 \cdot 0{,}785 = 0{,}2826 \text{ mm}^2$

$R = \frac{\varphi \cdot l}{A} \Rightarrow l = \frac{R \cdot A}{\varphi} = \frac{340 \cdot 0{,}2826}{0{,}0175} = 5490{,}5 \text{ m}$

$l = \frac{l}{2} = \frac{5490{,}5}{2} = \underline{2745{,}25 \text{ m}}$

№ 3.5.26

$A = \phi^2 \cdot 0{,}785 \cdot n = 0{,}15^2 \cdot 0{,}785 \cdot 42 = 0{,}74 \text{ mm}^2$

$R = \frac{\varphi \cdot l}{A} \cdot 2 = \frac{0{,}0175 \cdot 40}{0{,}741} \cdot 2 = \underline{1{,}88\ \Omega}$

№ 3.5.27

$A = \phi^2 \cdot 0{,}785 = 0{,}22^2 \cdot 0{,}795 = 0{,}037 \text{ mm}^2$

$R = \frac{\varphi \cdot l}{A} \Rightarrow l = \frac{R \cdot A}{\varphi} = \frac{32 \cdot 0{,}037}{0{,}0175} = \underline{69{,}47 \text{ m}}$

$l \text{ spire} = \phi \cdot \pi = 0{,}02 \cdot 3{,}14 = 0{,}0621 \text{ m}$

$n = \frac{l}{l.\text{spire}} = \frac{69{,}47}{0{,}0693} = \underline{1106 \text{ spires}}$

№ 3.6.1

$$y = \frac{1}{R} = \frac{1}{11,2} = 0,08929 \text{ S}$$

№ 3.6.2

$$R = \frac{1}{y} = \frac{1}{0,428} = 2,336 \ \Omega$$

№ 3.6.3

$$y = \frac{1}{R} = \frac{1}{1,17} = 0,1547 \text{ S}$$

№ 3.6.4

$$R = \frac{1}{y} = \frac{1}{2,33} = 0,4291 \ \Omega$$

№ 3.6.5

$$y = \frac{1}{R} = \frac{1}{0,084} = 11,904 \text{ S}$$

№ 3.6.6

$$R = \frac{1}{y} = \frac{1}{1680} = 0,5952 \text{ m}\Omega$$

№ 3.6.7

$$y = \frac{1}{R} = \frac{1}{6800} = 0,1471 \text{ m S}$$

№ 3.6.8

$$R = \frac{1}{y} = \frac{1}{4,35} = 229,88 \ \Omega$$

№ 3.6.9

$$y = \frac{1}{R} = \frac{1}{16000} = 0,0625 \text{ m S}$$

№ 3.6.10

$$y = \frac{1}{R} = \frac{1}{2,5} = 400 \text{ S}$$

№ 3.7.1

$$A = \phi^2 \cdot 0{,}785 = 0{,}4^2 \cdot 0{,}785 = 0{,}1256 \text{ mm}^2$$

$$\text{"} = 0{,}6^2 \cdot 0{,}785 = 0{,}2826 \text{ mm}^2$$

$$\text{"} = 0{,}8^2 \cdot 0{,}785 = 0{,}5024 \text{ mm}^2$$

$$\text{"} = 1^2 \cdot 0{,}785 = 0{,}785 \text{ mm}^2$$

$$\gamma = \left(\frac{\varphi \cdot l}{A}\right)^{-1} = \left(\frac{0{,}0175 \cdot 1000}{0{,}1256}\right)^{-1} = 7{,}16 \text{ mS}$$

$$\text{"} = \left(\frac{0{,}0175 \cdot 1000}{0{,}2826}\right)^{-1} = 16{,}12 \text{ mS}$$

$$\text{"} = \left(\frac{0{,}0175 \cdot 1000}{0{,}5024}\right)^{-1} = 28{,}65 \text{ mS}$$

$$\text{"} = \left(\frac{0{,}0175 \cdot 1000}{0{,}785}\right)^{-1} = 44{,}77 \text{ mS}$$

№ 3.7.2

$$R = \frac{1}{\gamma} = \frac{1}{24{,}5} = 0{,}0408\ \Omega$$

$$R = \frac{\varphi \cdot l}{A} \Rightarrow A = \frac{\varphi \cdot l \cdot 2}{R} = \frac{0{,}0175 \cdot 18{,}5 \cdot 2}{0{,}0408} = 15{,}86 \text{ mm}^2 \Rightarrow 16\,\text{Ø}$$

№ 3.7.3

$$R = \frac{\varphi \cdot l}{A} = \frac{0{,}033 \cdot 12200}{147} = 2{,}7387\ \Omega$$

$$\gamma = \frac{1}{R} = \frac{1}{2{,}7387} = 0{,}3651\ S$$

№ 3.7.4

$$R = \frac{1}{\gamma} = \frac{1}{0{,}147} = 6{,}802\ \Omega$$

$$A = \phi^2 \cdot 0{,}785 = 1^2 \cdot 0{,}785 = 0{,}785 \text{ mm}^2$$

$$R = \frac{\varphi \cdot l}{A} \Rightarrow l = \frac{R \cdot A}{\varphi} = \frac{6{,}802 \cdot 0{,}7853982}{0{,}43} = 12{,}42 \text{ m}$$

№ 3.7.5

$$\varphi = \frac{1}{\gamma} = \frac{1}{1.22} = 0{,}819 \quad \Omega \cdot \frac{mm^2}{m}$$

$$A = \phi^2 \cdot 0{,}785 = 0{,}7^2 \cdot 0{,}785 = 0{,}384 \ mm^2$$

$$R = \frac{\varphi \cdot l}{A} = \frac{0{,}81967 \cdot 22}{0{,}3848451} = 46{,}85 \ \Omega$$

$$\gamma = \frac{1}{R} = \frac{1}{46{,}85} = \underline{\underline{21{,}34 \ mS}}$$

№ 3.7.6

$$R = \frac{1}{\gamma} = \frac{1}{3{,}4} = 0{,}294 \ \Omega$$

$$R = \frac{\varphi \cdot l}{A} \Rightarrow \varphi = \frac{R \cdot A}{l} = \frac{0{,}294 \cdot 2{,}5}{42} = \underline{\underline{0{,}0175 \ \frac{\Omega \cdot mm^2}{m}}}$$

c'est du <u>cuivre</u> !

№ 3.7.7

$$R = \frac{1}{\gamma} = \frac{1}{0{,}07143} = 13{,}99972 \ \Omega$$

$$R = \frac{\varphi \cdot l}{A} \Rightarrow \varphi = \frac{R \cdot A}{l \cdot 2} = \frac{13{,}99 \cdot 0{,}75}{21 \cdot 2} = \underline{\underline{0{,}25 \ \frac{\Omega \cdot mm^2}{m}}}$$

№ 3.7.8

φ de l'aluminium $= 0{,}029 \ \frac{\Omega \cdot mm^2}{m}$

$$R = \frac{\varphi \cdot l}{A} = \frac{0{,}029 \cdot 85}{50} = 0{,}0493 \ \Omega$$

$$\gamma \ Alu = \frac{1}{R} = \frac{1}{0{,}0493} = \underline{\underline{20{,}28 \ S}}$$

$$\gamma \ Cu = \frac{1}{R} = \frac{1}{0{,}02875} = 33{,}61 \ S$$

$$\% = 100 - \frac{20{,}28 \cdot 100}{33{,}61} = \underline{\underline{41{,}66 \%}}$$

№ 3.8.1

$\Delta\theta = t_2 - t_1 = 85 - 20 = 65\ °C$

$R_2 = R_1 \cdot (1 + \alpha \cdot \Delta\theta) = 18 \cdot (1 + 0{,}004 \cdot 65) = \underline{22{,}68\ \Omega}$

$\Delta R = R_2 - R_1 = 22{,}68 - 18 = \underline{4{,}68\ \Omega}$

№ 3.8.2

3 - 20 = −17

$\Delta\theta = t_2 - t_1 = 20 - 3 = 17\ °C$

$R_2 = R_1 \cdot (1 - \alpha \cdot \Delta\theta) = 0{,}0184 \cdot (1 - 0{,}00804 \cdot 17) = \underline{0{,}01838\ \Omega}$

$R_1 \cdot (1 + \alpha \cdot 17)$;

№ 3.8.3

$\Delta\theta = t_2 - t_1 = 56 - 20 = 36\ °C$

$R_2 = R_1 \cdot (1 + \alpha \cdot \Delta\theta) = 0{,}0061 \cdot (1 + 0{,}0018 \cdot 36) = \underline{0{,}005704\ \Omega}$

$1 + 0{,}0018 \cdot 36$

№ 3.8.4

$\Delta\theta = t_2 - t_1 = 55 - 20 = 35\ °C$

$R_2 = R_1 \cdot (1 + \alpha \cdot \Delta\theta) \Rightarrow R_1 = \frac{R_2}{1 + \alpha \cdot \Delta\theta} = \frac{0{,}163}{1 + 0{,}004 \cdot 35} = \underline{0{,}14298\ \Omega}$

№ 3.8.5

$\Delta\theta = t_2 - t_1 = 71 - 20 = 51\ °C$

$\Delta R = R_2 - R_1 = 3{,}063 - 2{,}317 = 0{,}746\ \Omega$

$\Delta R = R_1 \cdot \alpha \cdot \Delta\theta \Rightarrow \alpha = \frac{\Delta R}{R_1 \cdot \Delta\theta} = \frac{0{,}746}{2{,}317 \cdot 51} = \underline{0{,}006313\ \frac{\Omega}{\Omega \cdot °C}}$

№ 3.8.6

$\Delta R = R_2 - R_1 = 9{,}847 - 7{,}64 = 2{,}207\ m\Omega$

$\Delta R = R_1 \cdot \alpha \cdot \Delta\theta \Rightarrow \Delta\theta = \frac{\Delta R}{R_1 \cdot \alpha} = \frac{2{,}207}{7{,}64 \cdot 0{,}004} = 72{,}21\ °C$

$\theta = \Delta\theta + 20 = 72{,}21 + 20 = \underline{92{,}21\ °C}$

№ 3.8.7

$\Delta\theta = t_2 - t_1 = 52 - 20 = 32\,°C$

$R_1 = \frac{R_2}{1-\alpha\cdot\Delta\theta}$ ~~$R_2 = R_1\cdot(1+\alpha\cdot\Delta\theta) = 9.89\cdot(1+0{,}004\cdot 5) = 10{,}078\ \Omega$~~

$R_2 = R_1\cdot(1+\alpha\cdot\Delta\theta) = 10{,}08\cdot(1+0{,}004\cdot 32) = \underline{11{,}379\ \Omega}$

№ 3.8.8

$\Delta\theta = t_2 - t_1 = 20 - -18 = 38\,°C$

$R_2 = R_1\cdot(1-\alpha\cdot\Delta\theta) = 0{,}442\cdot(1-0{,}004\cdot 38) = \underline{0{,}3748\ m\Omega}$

№ 3.8.9

$\Delta\theta = t_2 - t_1 = 20 - -10 = 30\,°C$

$R_2 = R_1\cdot(1-\alpha\cdot\Delta\theta) \Rightarrow R_1 = \frac{R_2}{1-\alpha\cdot\Delta\theta} = \frac{0{,}23}{1-0{,}004\cdot 30} = \underline{0{,}2618\ \Omega}$

№ 3.8.10

$\Delta R = R_2 - R_1 = 48{,}4 - 40{,}2 = 8{,}2\ \Omega$

$\Delta\theta = t_2 - t_1 = 950 - 20 = 930\,°C$

$\Delta R = R_1\cdot\alpha\cdot\Delta\theta \Rightarrow \alpha = \frac{\Delta R}{R_1\cdot\Delta\theta} = \frac{8{,}2}{40{,}2\cdot 930} = \underline{0{,}0002193\ \frac{\Omega}{\Omega\cdot°C}}$

№ 3.8.11

$\Delta R = R_2 - R_1 = 20{,}6 - 17 = 3{,}6\ \Omega$

$\Delta R = R_1\cdot\alpha\cdot\Delta\theta \Rightarrow \Delta\theta = \frac{\Delta R}{R_1\cdot\alpha} = \frac{3{,}6}{17\cdot 0{,}004} = 52{,}94\,°C$

$\theta = \Delta\theta + 20 = 52{,}94 + 20 = \underline{72{,}94\,°C}$

№ 3.8.12

$\Delta\theta = t_2 - t_1 = 1100 - 20 = 1080\,°C$

$R_2 = R_1\cdot(1+\alpha\cdot\Delta\theta) \Rightarrow R_1 = \frac{R_2}{1+\alpha\cdot\Delta\theta} = \frac{48}{1+0{,}00022\cdot 1080} = \underline{38{,}78\ \Omega}$

№ 3.8.13

$R_1 = 100\ \Omega$, $R_2 = 110\ \Omega$

$\Delta R = R_2 - R_1 = 110 - 100 = 10\ \Omega$

$\Delta R = R_1 \cdot \alpha \cdot \Delta\theta \Rightarrow \Delta\theta = \frac{\Delta R}{R_1 \cdot \alpha} = \frac{10}{100 \cdot 0{,}004} = \underline{25\,°C}$

№ 3.8.14

$\Delta\theta = t_2 - t_1 = 70 - 20 = 50\,°C$

$R_2 = R_1 \cdot (1 + \alpha \cdot \Delta\theta) \Rightarrow R_1 = \frac{R_2}{1 + \alpha \cdot \Delta\theta} = \frac{12{,}6}{1 + 0{,}004 \cdot 50} = \underline{10{,}5\,\Omega}$

№ 3.8.15

$\Delta R = R_2 - R_1 = 0{,}02 - 0{,}0175 = 0{,}0025\ \Omega$

$\Delta R = R_1 \cdot \alpha \cdot \Delta\theta \Rightarrow \Delta\theta = \frac{\Delta R}{R_1 \cdot \alpha} = \frac{0{,}0025}{0{,}0175 \cdot 0{,}004} = 35{,}71\,°C$

$\theta = \Delta\theta + 20 = 35{,}71 + 20 = \underline{55{,}71\,°C}$

№ 3.8.16

$\Delta\theta' = t_2 - t_1 = 55 - 20 = 35\,°C$

$\Delta\theta'' = t_2 - t_1 = 20 - -10 = 30\,°C$

$R = \frac{\varphi}{A} \cdot \frac{l}{300} = \frac{0{,}033 \cdot 1200}{300} = 1{,}32\ \Omega$

$R_2\ \tilde{a}\ (55°C) = R_1 \cdot (1 + \alpha \cdot \Delta\theta) = 1{,}32 \cdot (1 + 0{,}004 \cdot 35) = 1{,}5048\ \Omega$

$R_2\ \tilde{a}\ (-10°C) = R_1 \cdot (1 - \alpha \cdot \Delta\theta) = 1{,}32 \cdot (1 - 0{,}004 \cdot 30) = 1{,}144\ \Omega$

a) $\Delta R = R - R = 1{,}5048 - 1{,}144 = \underline{0{,}3608\ \Omega}$

b) $\% = 100 - \left(\frac{1{,}144 \cdot 100}{1{,}32}\right) = \underline{14\,\%}$

c) $\% = 100 - \left(\frac{1{,}32 \cdot 100}{1{,}5048}\right) = \underline{12\,\%}$

№ 3.8.17

$R = \frac{U}{I} = \frac{230}{0{,}43} = 534{,}88\ \Omega$

$\Delta R = R_2 - R_1 = 534{,}88 - 42 = 492{,}88\ \Omega$

$\Delta R = R_1 \cdot \alpha \cdot \Delta\theta \Rightarrow \Delta\theta = \frac{\Delta R}{R_1 \cdot \alpha} = \frac{492{,}88}{42 \cdot 0{,}00506} = \underline{2321\,°C + 2 = \theta}$

№ 3.8.18

$\Delta R = R_2 - R_1 = 95 - 57,3 = 37,7\ \Omega$

$\Delta\theta = t_2 - t_1 = 160 - 20 = 140°C$

$\Delta R = R_1 \cdot \alpha \cdot \Delta\theta \Rightarrow \alpha = \frac{\Delta R}{R_1 \cdot \Delta\theta} = \frac{37,7}{57,3 \cdot 140} = 0,0047\ \frac{\Omega}{\Omega \cdot °C}$

c'est du Fer

№ 3.8.19

$R_1 = \frac{U}{I} = \frac{220}{0,2} = 1100\ \Omega$

$R_2 = \frac{U}{I} = \frac{220}{0,15} = 1466,6^{-}\ \Omega$

$\Delta R = R_2 - R_1 = 1466,6 - 1100 = 366,6^{-}\ \Omega$

$\Delta R = R_1 \cdot \alpha \cdot \Delta\theta \Rightarrow \Delta\theta = \frac{\Delta R}{R_1 \cdot \alpha} = \frac{366,6^{-}}{1100 \cdot 0,004} = 83,33^{-}$

$\theta = \Delta\theta + 20 = 83,33 + 20 = 103,33^{-}°C$

№ 3.8.20

$\Delta\theta = t_2 - t_1 = 350 - 20 = 330°C$

a) $R_2 = R_1 \cdot (1 + \alpha \cdot \Delta\theta) = 50 \cdot (1 + 0,00001 \cdot 330) = 50,165\ \Omega$

b) $R_2 = R_1 \cdot (1 + \alpha \cdot \Delta\theta) = 50 \cdot (1 + 0,00506 \cdot 330) = 133,49\ \Omega$

c) 1) $\% = 100 - \left(\frac{50,165 \cdot 100}{50}\right) = 0,33\ \%$

2) $\% = 100 - \left(\frac{133,49 \cdot 100}{50}\right) = 166,98\ \%$

№ 3.9.1.1

$$R = R \cdot n = 242 \cdot 5 = \underline{1210\ \Omega}$$

№ 3.9.1.2

$$R = \frac{Re}{n} = \frac{13,26}{6} = \underline{2,21\ \Omega}$$

№ 3.9.1.3

$$n = \frac{Rt}{R} = \frac{145,6}{11,2} = \underline{13 \text{ pièces}}$$

№ 3.9.1.4

$$R = \frac{Rt}{n} = \frac{3260}{15} = \underline{217,33\ \Omega}$$

№ 3.9.1.5

$$Rt = R_1 + R_2 + R_3 + R_4 + R_5 = 16 + 2 + 7 + 8 + 20,3 = \underline{53,3\ \Omega}$$

№ 3.9.1.6

$$R_1 = Rt - (R_2 + R_3 + R_4) = 41,7 - (11,2 + 16,3 + 4,9) = \underline{9,3\ \Omega}$$

№ 3.9.1.7

$$Rt = R_1 + R_2 = 4800 + 78 = \underline{4878\ k\Omega}$$

№ 3.9.1.8

$$R = \frac{Rt - R}{2} = \frac{47,1 - 46,3}{2} = \underline{0,4\Omega}$$

№ 3.9.1.9

$$UR = R \cdot I = 200 \cdot 1,3 = 260\ V$$

$$U\ lpe = U - UR = 380 - 260 = \underline{120\ V}$$

№ 3.9.1.10

$$UR = R \cdot I = 5,55 \cdot 5,4 = 29,97\ V$$

$$U\ lpe = U - UR = 225 - 29,97 = \underline{195,03\ V}$$

№ 3.9.1.11

$I_{max.} = \frac{U}{R} = \frac{220}{268} = 0,82\ A$

a) $R_{add} = \frac{U - U_R}{I_{max}} = \frac{250-220}{0,82} = \underline{36,54\ \Omega}$

b) $R_t = R + R_{add.} = 268 + 36,54 = \underline{304,54\ \Omega}$

c) $I = \frac{U}{R} = \frac{250}{304,54} = \underline{0,82\ A}$

№ 3.9.1.12

Pour $0\ \Omega \rightarrow U = 220\ V$

Pour $20\ \Omega$: $I = \frac{U}{R_t} = \frac{220}{80} = 2,75\ A$

$U = R \cdot I = 80 \cdot 2,75 = \underline{165\ V}$

Pour $40\ \Omega$: $I = \frac{U}{R_t} = \frac{220}{100} = 2,2\ A$

$U = R \cdot I = 60 \cdot 2,2 = \underline{132\ V}$

Pour $60\ \Omega$: $I = \frac{U}{R_t} = \frac{220}{120} = 1,83\ A$

$U = R \cdot I = 60 \cdot 1,83 = \underline{110\ V}$

Pour $80\ \Omega$: $I = \frac{U}{R_t} = \frac{220}{140} = 1,57\ A$

$U = R \cdot I = 60 \cdot 1,57 = \underline{94,28\ V}$

Pour $100\ \Omega$: $I = \frac{U}{R_t} = \frac{220}{160} = 1,375\ A$

$U = R \cdot I = 60 \cdot 1,375 = \underline{82,5\ V}$

№ 3.9.1.13

a) $U_1 = R \cdot I = 4200 \cdot 0,018 = \underline{75,6\ V}$

b) $U_3 = R \cdot I = 1360 \cdot 0,018 = \underline{24,48\ V}$

c) $U = U_1 + U_2 + U_3 = 75,6 + 24 + 24,48 = \underline{124,08\ V}$

d) $I_1 = I = \underline{18\ mA}$

e) $I_1 = I = \underline{18\ mA}$

Nº 3.9.1.14

a) $Rt = R_1 + R_2 + R_3 + R_4 = 81 + 49 + 20 + 100 = 250\ \Omega$

c) $I = \frac{U}{R} = \frac{220}{250} = \underline{0,88\ A}$

b) $U_1 = R_1 \cdot I = 81 \cdot 0,88 = \underline{71,28\ V}$

$U_2 = R_2 \cdot I = 49 \cdot 0,88 = \underline{43,12\ V}$

$U_3 = R_3 \cdot I = 20 \cdot 0,88 = \underline{17,6\ V}$

$U_4 = R_4 \cdot I = 100 \cdot 0,88 = \underline{88\ V}$

Nº 3.9.1.15

$Rt = R_1 + R_2 + R_3 = 60 + 120 + 180 = 360\ \Omega$

a) $Ut = Rt \cdot I = 360 \cdot 0,025 = \underline{9\ V}$

b) $U_1 = R_1 \cdot I = 60 \cdot 0,025 = \underline{1,5\ V}$

$U_2 = R_2 \cdot I = 120 \cdot 0,025 = \underline{3\ V}$

$U_3 = R_3 \cdot I = 180 \cdot 0,025 = \underline{4,5\ V}$

c) 60, 120, 180, $\Rightarrow$ <u>1. 2. 3</u>

d) 1,5, 3, 4,5, $\Rightarrow$ <u>1. 2. 3</u>

e) U chute est proportionnel à R !

Nº 3.9.1.16

$R' = R_1 + R_2 + R_4 + R_5 = 12000 + 700 + 3200 + 4200 = 20,1\ k\Omega$

$U\ ch. = Ut - U_3 = 110 - 20,4 = 89,6\ V$

$I = \frac{U\ ch.}{R'} = \frac{89,6}{20,1} = 4,457\ mA$

$R_3 = \frac{U}{I} = \frac{20,4}{4,457} = \underline{4,577\ k\Omega}$

Nº 3.9.1.17

b) $Re = R_1 + R_2 + R_3 = 240 + 120 + 350 = \underline{710\ \Omega}$

c) $I = \frac{U}{R} = \frac{224}{710} = \underline{0,315\ A}$

%

№ 3.9.1.17 suite

2) $U_1 = R_1 \cdot I = 240 \cdot 0{,}315 = \underline{\underline{75{,}718\ V}}$

$U_2 = R_2 \cdot I = 120 \cdot 0{,}315 = \underline{\underline{37{,}859\ V}}$

$U_3 = R_3 \cdot I = 350 \cdot 0{,}315 = \underline{\underline{110{,}422\ V}}$

d) $Re = R_1 + R_3 = 240 + 350 = 590\ \Omega$

$I = \frac{U}{R} = \frac{224}{590} = 0{,}379\ A$

$U_1 = R_1 \cdot I = 240 \cdot 0{,}379 = \underline{\underline{91{,}118\ V}}$

$U_2 = R_2 \cdot I = 350 \cdot 0{,}379 = \underline{\underline{132{,}881\ V}}$

e) $Ut = U = \underline{\underline{224\ V}}$

№ 3.9.1.18

$Rt = \frac{U}{I} = \frac{120}{3{,}2} = 37{,}5\ \Omega$

$R = \frac{Rt}{n} = \frac{37{,}5}{4} = \underline{\underline{9{,}375\ \Omega}}$

№ 3.9.1.19

$R\,four = \frac{U}{I} = \frac{220}{6{,}75} = 32{,}592\ \Omega$

$Rl = \frac{\varphi \cdot l \cdot 2}{A} = \frac{0{,}0175 \cdot 57 \cdot 2}{1{,}5} = 1{,}33\ \Omega$

$Rt = R\,four + Rl = 32{,}592 + 1{,}33 = 33{,}922\ \Omega$

$I = \frac{U}{Rt} = \frac{224}{33{,}922} = 6{,}603\ A$

$U\,four = R_{four} \cdot I = 32{,}592 \cdot 6{,}603 = \underline{\underline{215{,}21\ V}}$

№ 3.9.2.1

$$R_e = \frac{R}{n} = \frac{80,6}{2} = \underline{40,3\ \Omega}$$

№ 3.9.2.2

$$R_e = \frac{R}{n} \Rightarrow R = R_e \cdot n = 58,2 \cdot 2 = 116,4\ \Omega$$

№ 3.9.2.3

$$R_e = \frac{R}{n} = \frac{242}{2} = \underline{121\ \Omega}$$

" $\frac{242}{3} = \underline{80,6\ \Omega}$

" $\frac{242}{4} = \underline{60,5\ \Omega}$

" $\frac{242}{5} = \underline{48,4\ \Omega}$

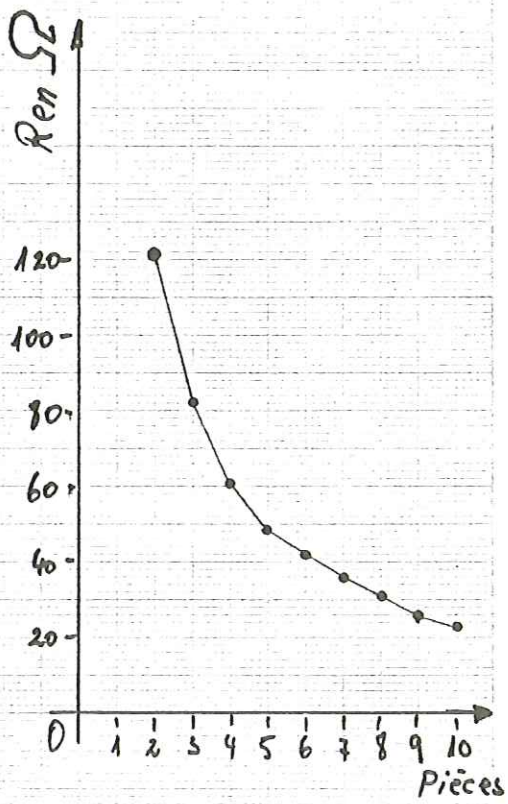
" $\frac{242}{6} = \underline{40,33\ \Omega}$

" $\frac{242}{7} = \underline{34,57\ \Omega}$

" $\frac{242}{8} = \underline{30,25\ \Omega}$

" $\frac{242}{9} = \underline{26,8\ \Omega}$

" $\frac{242}{10} = \underline{24,2\ \Omega}$



№ 3.9.2.4

$$R_e = \frac{R}{n} \Rightarrow R = R_e \cdot n = 27,4 \cdot 7 = \underline{191,8\ \Omega}$$

№ 3.9.2.5

$$R_e = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{1}{\frac{1}{21,7} + \frac{1}{200}} = \underline{19,57\ \Omega}$$

№ 3.9.2.6

$$R_e = \frac{R_1 \cdot R_2}{R_1 + R_2}$$

Nº 3.9.2.6 Suite

$$\Rightarrow R_e \cdot R_1 + R_2 = R_1 \cdot R_2$$

$$\Rightarrow R_e \cdot R_1 + R_e \cdot R_2 = R_1 \cdot R_2$$

$$\Rightarrow R_e \cdot R_1 = R_1 \cdot R_2 - R_e \cdot R_2$$

$$\Rightarrow R_e \cdot R_1 = R_2 \cdot R_1 - R_e$$

$$\Rightarrow R_2 = \frac{R_e \cdot R_1}{R_1 - R_e} = \frac{22 \cdot 18}{22 - 18} = \underline{99\ \Omega}$$

Nº 3.9.2.7

$$R_e = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}} = \frac{1}{\frac{1}{4,2} + \frac{1}{12,4} + \frac{1}{0,24} + \frac{1}{12,4}} = \underline{219\ \Omega}$$

Nº 3.9.2.7

$$R_e = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}} = \frac{1}{\frac{1}{4,2} + \frac{1}{12,4} + \frac{1}{0,24} + \frac{1}{12,4}} = \underline{219\ \Omega}$$

Nº 3.9.2.8

$$R_e' = \frac{R_1 \cdot R_2}{R_1 + R_2} = \frac{421 \cdot 320}{421 + 320} = 181,8\ \Omega$$

$R_x = (\text{idem } 3.9.2.6) \Rightarrow R_x = \frac{R_e \cdot R_e'}{R_e' - R_e} = \frac{62 \cdot 181,8}{181,8 - 62} = \underline{94,09\ \Omega}$

Nº 3.9.2.9

a) $R_e = \frac{R}{n} \quad \frac{40,2}{2} = \underline{20,1\ \Omega}$

b) $R = R = \underline{40,2\ \Omega}$

c) $I = \frac{U}{R} = \frac{220}{20,1} = \underline{10,94\ A}$

d) $I = \frac{U}{R} = \frac{220}{40,2} = \underline{5,47\ A}$

№ 3.9.2.10

a) $R_e = \frac{R}{n} = \frac{1210}{24} = \underline{\underline{50,41\ \Omega}}$

b) $I = \frac{P}{U} = \frac{40}{220} = \underline{\underline{0,1818\ A}}$

c) $I = \frac{P \cdot n}{U} = \frac{40 \cdot 24}{220} = \underline{\underline{4,36\ A}}$

№ 3.9.2.11

a) $I = \frac{P}{U} = \frac{100}{220}$ $\underline{\underline{0,454\ A}}$

b) $R = \frac{U^2}{P} = \frac{240^2}{100} = 484\ \Omega$

№ 3.9.2.12

a) $R_e = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{1}{\frac{1}{1,24} + \frac{1}{1,86}} = \underline{\underline{0,744\ m\Omega}}$

c) $U = R \cdot I = 0,744 \cdot 1,05 = \underline{\underline{0,7812\ V}}$

b) $I_1 = \frac{U}{R_1} = \frac{0,781}{1,24} = \underline{\underline{630\ A}}$

$I_2 = \frac{U}{R_2} = \frac{0,781}{1,86} = \underline{\underline{420\ A}}$

d) 1,5 fois plus soit $\underline{\underline{2 \div 3}}$

e) 1,5 fois moins soit $\underline{\underline{3 \div 2}}$

f) I inversément proportionnel à R

№ 3.9.2.13

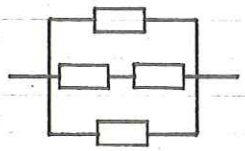
$I_1 = \frac{U}{R} = \frac{36}{36} = \underline{\underline{1\ A}}$

$I_2 = I_{tot} - I_1 = 1,6 - 1 = \underline{\underline{0,6\ A}}$

$R_2 = \frac{U}{I_2} = \frac{36}{0,6} = \underline{\underline{60\ \Omega}}$

Nº 3.9.3.2 Suite

h

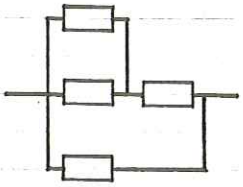


$Rt = R \cdot n = 200 \cdot 2 = 400\ \Omega$

$Re' = \frac{R}{n} = \frac{200}{2} = 100\ \Omega$

$Re = \frac{1}{\frac{1}{Re'} + \frac{1}{Rt}} = \frac{1}{\frac{1}{400} + \frac{1}{100}} = \underline{\underline{80\ \Omega}}$

i



$Re' = \frac{R}{n} = \frac{200}{2} = 100\ \Omega$

$Rt = Re' + R_3 = 100 + 200 = 300\ \Omega$

$Re = \frac{Rt \cdot R_4}{Rt + R_4} = \frac{300 \cdot 200}{300 + 200} = \underline{\underline{120\ \Omega}}$

Nº 3.9.3.3

a: $Rt_1 = R_1 + R_2 = 20 + 30 = 50\ \Omega$

$Rt_2 = R_3 + R_4 = 40 + 50 = 90\ \Omega$

$Re = \frac{Rt_1 \cdot Rt_2}{Rt_1 + Rt_2} = \frac{50 \cdot 90}{50 + 90} = \underline{\underline{32,14\ \Omega}}$

b: $Rt = R_1 + R_2 + R_3 = 20 + 30 + 40 = 90\ \Omega$

$Re = \frac{Rt \cdot R_4}{Rt + R_4} = \frac{90 \cdot 50}{90 + 50} = \underline{\underline{32,14\ \Omega}}$

c: $Re' = \frac{R_1 \cdot R_2}{R_1 + R_2} = \frac{20 \cdot 30}{20 + 30} = 12\ \Omega$

$Rt = Re' + R_3 + R_4 = 12 + 40 + 50 = \underline{\underline{102\ \Omega}}$

d: $Rt' = R_1 + R_2 = 20 + 30 = 50\ \Omega$

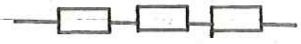
$Re = \frac{1}{\frac{1}{Rt'} + \frac{1}{R_3} + \frac{1}{R_4}} = \frac{1}{\frac{1}{50} + \frac{1}{40} + \frac{1}{50}} = \underline{\underline{15,38\ \Omega}}$

e: $Re' = \frac{R_1 \cdot R_2}{R_1 + R_2} = \frac{20 \cdot 40}{20 + 40} = 13,33\ \Omega$

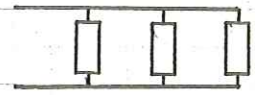
$Rt = Re' + R_3 = 13,33 + 30 = 43,33\ \Omega$

$Re = \frac{Rt \cdot R_4}{Rt + R_4} = \frac{43,33 \cdot 50}{43,33 + 50} = \underline{\underline{23,21\ \Omega}}$

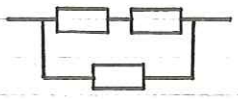
№ 3.9.3.1



$Rt = R_1 + R_2 + R_3 = 120 + 120 + 120 = \underline{360\ \Omega}$

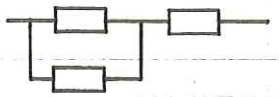


$Re = \frac{R}{n} = \frac{120}{3} = \underline{40\ \Omega}$



$Rt = R \cdot n = 120 \cdot 2 = 240\ \Omega$

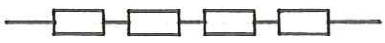
$Re = \frac{Rt \cdot R_3}{Rt + R_3} = \frac{240 \cdot 120}{240 + 120} = \underline{80\ \Omega}$



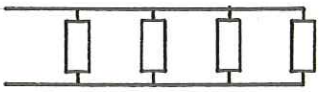
$Re = \frac{R_1 \cdot R_2}{R_1 + R_2} = \frac{120 \cdot 120}{120 + 120} = 60\ \Omega$

$Rt = Re + R_3 = 60 + 120 = \underline{180\ \Omega}$

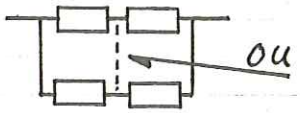
№ 3.9.3.2

1 a 

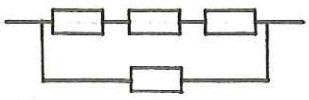
$Rt = R \cdot n = 200 \cdot 4 = \underline{800\ \Omega}$

2 b 

$Re = \frac{R}{n} = \frac{200}{4} = \underline{50\ \Omega}$

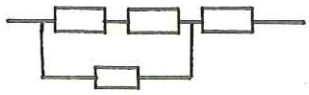
3 c 

$Rp = \frac{Rt_1 \cdot Rt_2}{Rt_1 + Rt_2} = \frac{400 \cdot 400}{400 + 400}$ $\underline{200\ \Omega}$

4 d 

$Rt = R \cdot n = 200 \cdot 3 = 600\ \Omega$

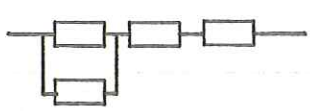
$Re = \frac{Rt \cdot R_4}{Rt + R_4} = \frac{600 \cdot 200}{600 + 200} = \underline{150\ \Omega}$

5 e 

$Rt = R_1 + R_2 = 200 + 200 = 400\ \Omega$

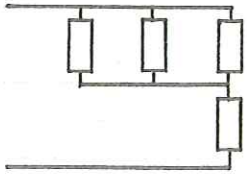
$Re = \frac{Rt \cdot R_3}{Rt + R_3} = \frac{400 \cdot 200}{400 + 200} = 133,3'\ \Omega$

$Rt = Re + R_4 = 133,5 + 200 = \underline{333,3'\ \Omega}$

6 f 

$Re = \frac{R}{n} = \frac{200}{2} = 100\ \Omega$

$Rt = Re + R_3 + R_4 = 100 + 200 + 200 = \underline{500\ \Omega}$

7 g 

$Re = \frac{R}{n} = \frac{200}{3} = 66,6'\ \Omega$

$Rt = Re + R_4 = 66,6 + 200 = \underline{266,6\ \Omega}$

№ 3.9.3.4

$$R_{e'} = \frac{R_1 \cdot R_2}{R_1 + R_2} = \frac{580 \cdot 120}{580 + 120} = 99{,}42\ \Omega$$

$$R_t = R_{e'} + R_3 = 99{,}42 + 33 = \underline{\underline{132{,}42\ \Omega}}$$

№ 3.9.3.5

$$R_{e'} \quad \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{1}{\frac{1}{18} + \frac{1}{60}} = 13{,}84\ \Omega$$

$$R_t = R_{e'} + R_3 + R_4 + R_5 = 13{,}84 + 7{,}5 + 1{,}4 + 32 = \underline{\underline{54{,}746\ \Omega}}$$

№ 3.9.3.6

$$R_e = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{1}{\frac{1}{24} + \frac{1}{20}} = 10{,}909\ \Omega$$

$$I_1 = \frac{U}{R} = \frac{38}{24} = \text{~~1,675 A~~ } 1{,}583$$

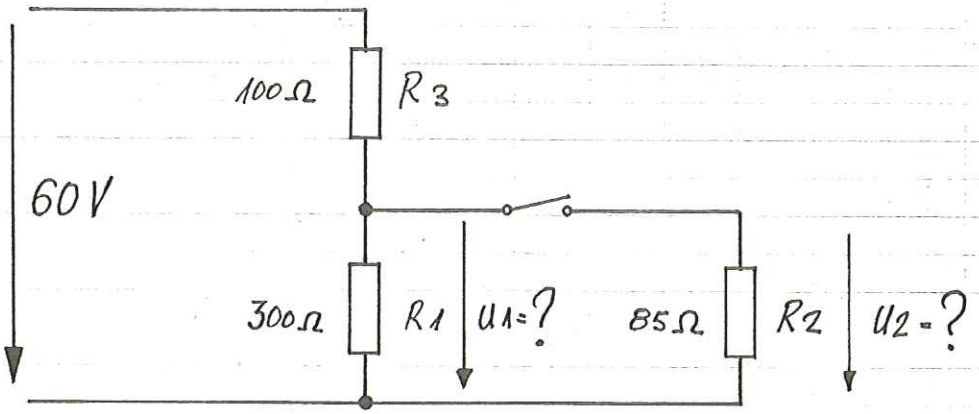
$$I_2 = \frac{U}{R} = \frac{38}{20} = 1.9\ A$$

$$I_t = I_1 + I_2 = 1{,}675 + 1{,}9 = 3{,}575\ A$$

$$U_3 = R_3 \cdot I_t = 6 \cdot 3{,}575 = \text{~~21,45 V~~ } 21{,}9$$

$$U_t = U_3 + U_1 = 21{,}46 + 38 = \text{~~59,45 V~~ } 58{,}9\ V$$

3.9.3 № 7



a) 

$R = R_1 + R_3 = 100 + 300 = 400\ \Omega$

$I = \frac{U}{R} = \frac{60}{400} = 0,15\ A$

$U_1 = R_1 \cdot I = 300 \cdot 0,15 = \underline{45\ V}$

$U_2 = \underline{0\ V}$ "pas de circuit"

b) 

$Re = \frac{R_1 \cdot R_2}{R_1 + R_2} = \frac{300 \cdot 85}{300 + 85} = 66,23\ \Omega$

$R = Re + R_1 = 66,23 + 100 = 166,23\ \Omega$

$I = \frac{U}{R} = \frac{60}{166,23} = 0,36\ A$ ← Ok.

$U_3 = R_3 \cdot I = 100 \cdot 0,36 = 36\ V$

$U_1 = U_2 = U - U_3 = 60 - 36 = \underline{24\ V}$

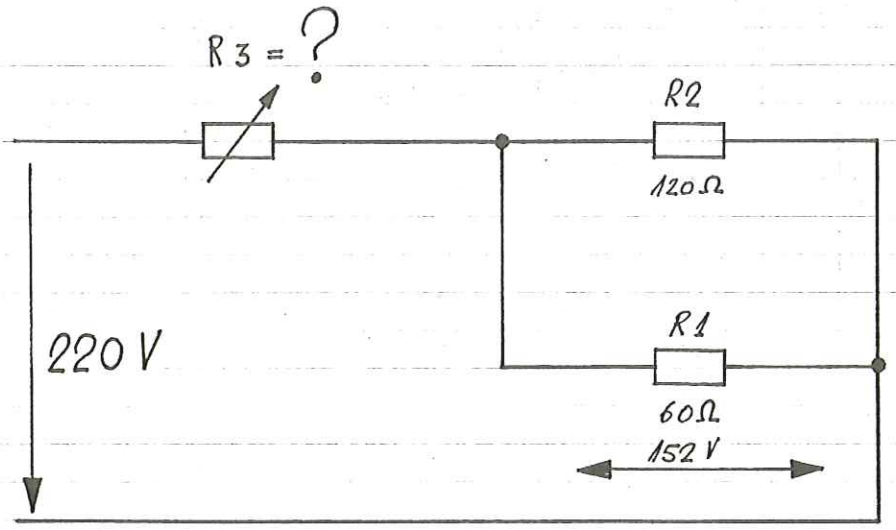
$I_1 = \frac{U_1}{R_1} = \frac{24}{300} = 0,08\ A$

Preuve:

$I_2 = \frac{U_2}{R_2} = \frac{24}{85} = 0,282$

$It = I_1 + I_2 = 0,08 + 0,282 = 0,36\ A$ →

3.9.3 № 8



$$I_1 = \frac{U_1}{R_1} = \frac{152}{60} = 2,53 \text{ A}$$

$$I_2 = \frac{U_2}{R_2} = \frac{152}{120} = 1,26 \text{ A}$$

$$I_t = I_1 + I_2 = 2,53 + 1,26 = 3,79 \text{ A} \quad \text{OK.}$$

$$U_3 = U - U_1 = 220 - 152 = 68 \text{ V}$$

$$R_3 = \frac{U_3}{I} = \frac{68}{3,79} = \underline{\underline{17,94 \ \Omega}}$$

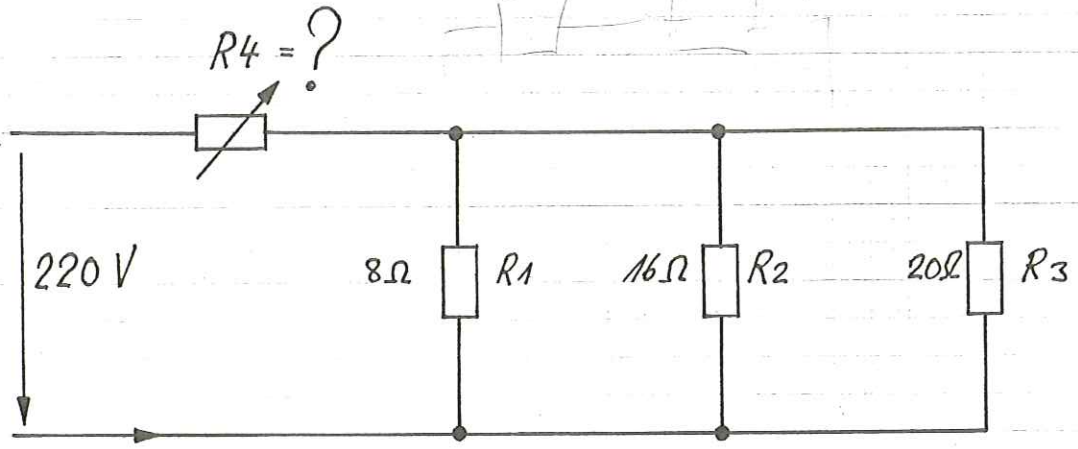
PREUVE :

$$R_e = \frac{R_1 \cdot R_2}{R_1 + R_2} = \frac{60 \cdot 120}{60 + 120} = 40 \ \Omega$$

$$R_t = R_e + R_3 = 40 + 17,94 = 57,94 \ \Omega$$

$$I = \frac{U}{R} = \frac{220}{57,94} = \underline{\underline{3,79 \text{ A}}}$$

3. 9. 3 № 9



6.2 A

$$Re = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}} = \frac{1}{\frac{1}{8} + \frac{1}{16} + \frac{1}{20}} = 4,21\ \Omega$$

$$Rt = \frac{U}{I} = \frac{220}{6,2} = 35,48\ \Omega$$

$$R4 = Rt - Re = 35,48 - 4,21 = \underline{31,27\ \Omega}$$

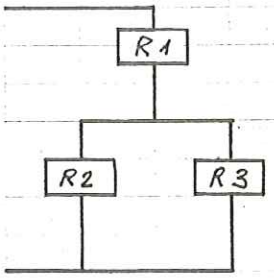
PREUVE:

$$U_1 = Re \cdot I = 4,21 \cdot 6,2 = 26,1\ V$$

$$U_4 = U - U_1 = 220 - 26,1 = 193,9\ V$$

$$I = \frac{U_4}{R_4} = \frac{193,9}{31,27} = 6,2\ A$$

№ 3.9.3.10



$$Re' = \frac{R_2 \cdot R_3}{R_2 + R_3} = \frac{3600 \cdot 1000}{3600 + 1000} = 782{,}6\,\Omega$$

a) $Rt = Re' + R_1 = 783 + 17{,}4 = \underline{800\,\Omega}$

b) $I_1 = It = \frac{U}{Rt} = \frac{36}{800} = \underline{45\,mA}$

e) $Uch = R_1 \cdot I = 17{,}4 \cdot 0{,}045 = \underline{0{,}783\,V}$

c) $U_2 = U_3 = U - Uch = 36 - 0{,}783 = \underline{35{,}217\,V}$

d) $I_3 = \frac{U_3}{R_3} = \frac{35{,}217}{3{,}6} = \underline{9{,}78\,mA}$

c) $I_2 = \frac{U_2}{R_2} = \frac{35{,}217}{1} = \underline{35{,}217\,mA}$

№ 3.9.3.11

a) $Re = \frac{R_1 \cdot R_2}{R_1 + R_2} \cdot 2 = \frac{10 \cdot 420}{10 + 420} \cdot 2 = \underline{19{,}53\,\Omega}$

b) $U = \frac{U}{2} = \frac{226}{2} = \underline{113\,V}$

c) $Re = \frac{R_1 \cdot R_2}{R_1 + R_2} + R_3 = \frac{10 \cdot 420}{10 + 420} + 420 = \underline{429{,}76\,\Omega}$

d) $I = \frac{U}{R} = \frac{226}{429{,}76} = 525\,mA$

$U_{R_3} = R_3 \cdot I = 420 \cdot 0{,}525 = \underline{220{,}86\,V}$

$U_{R_2} = U - U_{R_3} = 226 - 220{,}86 = \underline{5{,}14\,V}$

№ 3.9.3.12

$$R_1 \cdot R_3 = R_2 \cdot R_4$$

$$R_1 = \frac{R_2 \cdot R_4}{R_3} = \frac{1{,}8 \cdot 630}{3{,}2} = \underline{354{,}37\,\Omega}$$

№ 3.9.3.13

$$U_R = R \cdot I = 1 \cdot 12 = 12\ V$$

$$U_2 = U_{R_1} = U_t - U_R = 72 - 12 = 60\ V$$

$$I_{R_1} = I_t - I_2 = 12 - 8 = 4\ mA$$

$$R_1 = \frac{U}{I} = \frac{60}{4} = \underline{\underline{15\ k\Omega}}$$

№ 3.10.1

$18\ min = 18 \cdot 60 = 1080\ S$

$Q = I \cdot t = 25 \cdot 1080 = \underline{27000\ As}$

$Q = \frac{As}{3600} = \frac{27000}{3600} = \underline{7,5\ Ah}$

№ 3.10.2

$34\ min = 34 \cdot 60 = 1860\ S$

$2,2\ Ah = 2,2 \cdot 3600 = 7920\ As$

$Q = I \cdot t \Rightarrow I = \frac{Q}{t} = \frac{7920}{1860} = \underline{4,258\ A}$

№ 3.10.3

$150\ Ah = 150 \cdot 3600 = 540000 As$

$Q = I \cdot t \Rightarrow t = \frac{Q}{I} = \frac{540000}{180} = 3000\ s$

$t\ min = \frac{S}{60} = \frac{3000}{60} = \underline{50\ min}$

№ 3.10.4

$45\ kA = 0,045\ MA$

$Q = I \cdot t = 0,045 \cdot 24 = \underline{1,08\ MAh}$

№ 3.10.5

$11,62\ Ah = 11,62 \cdot 3600 = 41832\ As$

$10\ min = 10 \cdot 60 = 600\ S$

$I = \frac{Q}{t} = \frac{41832}{600} = \underline{69,72\ A}$

№ 3.10.6

$360\ mA = 0,36\ A$

$t = \frac{Q}{I} = \frac{86,4}{0,36} = \underline{240\ s = 4\ min.}$

№ 3.11.1

$$Q = I \cdot t = 40 \cdot 1 = 40\ Ah$$

a $m = Q \cdot C = 40 \cdot 1,0945 = \underline{43,78\ g}$

b $m = \frac{Q \cdot C \cdot 97}{100} = \frac{40 \cdot 1,0945 \cdot 97}{100} = \underline{42,46\ g}$

№ 3.11.2

$1t = 1'000'000\ g$

$$Q = \frac{m}{m/Ah} = \frac{1000000}{0,3354} = \underline{2,98\ MAh}$$

№ 3.11.3

$$42\ min = \frac{42}{60} = 0,7\ h$$

$$C_2 = \frac{C \cdot 80}{100} = \frac{2,3716 \cdot 80}{100} = 1,8973\ g/Ah$$

$$Q = \frac{m}{m/Ah} = \frac{1,4}{1,8973} = 4,427\ Ah$$

$$I = \frac{Q}{t} = \frac{4,427}{0,7} = \underline{6,324\ A}$$

№ 3.11.4

$$I = A \cdot I/dm^2 = 500 \cdot 0,14 = 70\ A\,dm^2$$

$$Q = \frac{m \cdot 3600}{60} = \frac{5,14 \cdot 3600}{60} = 308,4\ g$$

$$C = \frac{Q}{A} = \frac{308,4}{70} = \underline{4,406\ g\ Ah}$$

№ 3.11.5

$$3,2\ min = \frac{3,2}{60} = 0,053'\ h$$

$$m = I \cdot C \cdot t \cdot n = 60 \cdot 0,6468 \cdot 0,053' \cdot 0,15 = \underline{0,3105\ g}$$

№ 3.11.6

$36\ min = \frac{36}{60} = 0,6\ h$

$I = A/dm^2 \cdot dm^2 = 0,8 \cdot 5 = 4\ A$

$m = I \cdot C \cdot t \cdot n = 4 \cdot 2,2142 \cdot 0,6 \cdot 0,9 = \underline{4,7826\ g}$

№ 3.11.7.

$50\ cm^2 = 0,5\ dm^2$

$51,4\ mg = 0,0514\ g$

$I = A \cdot A/dm^2 = 0,5 \cdot 1,4 = 0,7\ A$

$m = I \cdot C \cdot t \Rightarrow t = \frac{m}{I \cdot C} = \frac{0,0514}{0,7 \cdot 4,024} = 0,018\ h$

$0,018\ h \cdot 60 = \underline{1,094\ min}$

№ 3.11.8

$90\ min = 1,5\ h$

$I = A/dm^2 \cdot dm^2 = 0,4 \cdot 450 = 180\ A$

$Q = I \cdot t = 180 \cdot 1,5 = 270\ Ah$

$m = C \cdot Q \cdot W = 1,0845 \cdot 270 \cdot 0,97 = \underline{286,65\ gr}$

№ 3.12.1.1

$$P = U \cdot I = 36 \cdot 6,8 = 244,8\ W$$

№ 3.12.1.2

$$I = \frac{P}{U} = \frac{450}{110} = 4,09\ A$$

№ 3.12.1.3

$$U = \frac{P}{I} = \frac{5,2}{35} = 148\ mV$$

№ 3.12.1.4

$$P = U \cdot I = 110 \cdot 0,16 = 28,8\ W$$

№ 3.12.1.5

$$I = \frac{P}{U} = \frac{102000}{615} = 165,85\ A$$

№ 3.12.1.6

$$U = \frac{P}{I} = \frac{720}{2,3} = 313,04\ V$$

№ 3.12.1.7

$$P = U \cdot I = 12,5 \cdot 6,5 = 81,25\ W$$

№ 3.12.1.8

$$I = \frac{P}{U} \cdot 2 = \frac{85}{12} \cdot 2 = 14,16\ A \Rightarrow 16\ A \text{ normalisé}$$

№ 3.12.1.9

$$P = U \cdot I = 11,2 \cdot 3,2 = 35,84\ MW$$

№ 3.12.1.10

$$I = \frac{P}{U} = \frac{0,2}{240} = 0,83\ mA$$

№ 3.12.1.11

$$U = \frac{P}{I} = \frac{5}{12} = 416,6\ V$$

Nº 3.12.1.12

$P = U \cdot I = 380 \cdot 0,6 = \underline{228 \text{ mW}}$

Nº 3.12.1.13

$I = \frac{P}{U} = \frac{20}{220} = \underline{90,9 \text{ mA}}$

Nº 3.12.1.14

$P = U \cdot I = 5,2 \cdot 152 = \underline{790,4 \text{ W}}$

Nº 3.12.1.15

$I = \frac{P}{U} = \frac{300}{13} = \underline{23,07 \text{ A}}$

Nº 3.12.1.16

$U = \frac{P}{I} = \frac{1,8}{35} = \underline{51,4 \text{ mV}}$

Nº 3.12.1.17

$P = U \cdot I = 1650 \cdot 930 = \underline{1,5345 \text{ MW}}$

Nº 3.12.1.18

$I = \frac{P}{U} = \frac{2000}{220} = \underline{9,09 \text{ A}}$

Nº 3.12.1.19

$I = \frac{P}{U} + I_1 = \frac{93}{12} + 6,2 = \underline{13,95 \text{ A}}$

Nº 3.12.1.20

$P_{tot} = (2 \cdot 45) + (2 \cdot 4) + (2 \cdot 35) + (4 \cdot 5) + (4 \cdot 3) + 20 = 220 \text{ W}$

$I = \frac{P}{U} = \frac{220}{12} = 18,33 \text{ A}$

$I_{Tot} = 2,5 + 4 = 6,5 \text{ A} + 18,33 = 24,833 \text{ A}$

$I = I - I_t = 25 - 24,833 = \underline{0,1667 \text{ A}}$

La batterie se <u>charge</u>

№ 3.12.2.1

$$R = \frac{U^2}{P} \Rightarrow P = \frac{U^2}{R} = \frac{110^2}{7300} = \underline{1,65\ W}$$

№ 3.12.2.2

$$R = \frac{U^2}{P} \Rightarrow U = \sqrt{P \cdot R} = \sqrt{2400 \cdot 60} = \underline{379,47\ V}$$

№ 3.12.2.3

$$R = \frac{U^2}{P} = \frac{220^2}{150} = \underline{322,6\ \Omega}$$

№ 3.12.2.4

$$R = \frac{U^2}{P} \Rightarrow P = \frac{U^2}{R} 4 = \frac{38,2^2}{12,2} \cdot 4 = \underline{478,43\ W}$$

№ 3.12.2.5

$$R = \frac{U^2}{P} \Rightarrow U = \sqrt{P \cdot R} = \sqrt{0,2 \cdot 800000} = \underline{400\ V}$$

№ 3.12.2.6

$$R = \frac{U^2}{P} = \frac{171^2}{6340} = \underline{4,61\ \Omega}$$

№ 3.12.2.7

$$R = \frac{U^2}{P} \Rightarrow P = \frac{U^2}{R} = \frac{240^2}{45000} = \underline{1,28\ W}$$

№ 3.12.2.8

$$R = \frac{U^2}{P} = \frac{220^2}{0,6} = \underline{80,666\ k\Omega}$$

№ 3.12.2.9

$$R = \frac{U^2}{P} \Rightarrow P = \frac{U^2}{R} = \frac{48,2^2}{380} = \underline{6,11\ W}$$

№ 3.12.2.10

$$R = \frac{U^2}{P} = \frac{163^2}{0,125} = \underline{212552\ \Omega}$$

№ 3.12.2.11

$$R = \frac{U^2}{P} \Rightarrow P = \frac{U^2}{R} = \frac{180^2}{1,5} = \underline{21,6\ mW}$$

№ 3.12.3.1

$$R = \frac{U^2}{P} = \frac{220^2}{35} = 1382{,}68\ \Omega$$

$$\text{Neue } P = \frac{U^2}{R} = \frac{212^2}{1382{,}68} = \underline{\underline{32{,}5\ W}}$$

№ 3.12.3.2

$$R = \frac{U^2}{P} = \frac{220^2}{1200} = 40{,}33\ \Omega$$

$$\text{Neue } U = \frac{220 \cdot 104}{100} = 228{,}8\ V$$

$$\text{Neue } P = \frac{\text{Neue } U^2}{R} = \frac{228{,}8^2}{40{,}33} = \underline{\underline{1297{,}92\ W}}$$

№ 3.12.3.3

$$R = \frac{U^2}{P} = \frac{220^2}{1500} = 32{,}26\ \Omega$$

$$\text{Neue } P = \frac{U^2}{R} = \frac{380^2}{32{,}26} = \underline{\underline{4475{,}3\ W}}$$

№ 3.12.3.4

$$R = \frac{U^2}{P} = \frac{380^2}{2400} = 60{,}16\ \Omega$$

$$\text{Neue } P = \frac{U^2}{R} = \frac{220^2}{60{,}16} = \underline{\underline{804{,}43\ W}}$$

№ 3.12.3.5

$$R = \frac{U^2}{P} = \frac{220^2}{1000} = 48{,}4\ \Omega$$

$$R = \frac{U^2}{P} \Rightarrow \text{Neue } U = \sqrt{P \cdot R} = \sqrt{926 \cdot 48{,}4} = \underline{\underline{211{,}7\ V}}$$

№ 3.12.3.6

$$R = \frac{U^2}{P} = \frac{220^2}{100} = 484\ \Omega$$

$$I = \frac{U}{R} = \frac{228}{484} = \underline{\underline{0{,}47\ A}}$$

N° 3.12.3.7

a) $R = \frac{U^2}{P} \Rightarrow P = \frac{U^2}{R} = \frac{100^2}{20000} = \underline{0,5\ W}$

b) $P = \frac{U^2}{R} = \frac{400^2}{20000} = \underline{8\ W}$

c) 200V÷ | 100V÷ | 400V⇒ — $\underline{2 \div 1 \div 4}$

d)

2	1	4	
2 W ÷	0,5 W ÷	8 W ⇒ · 2 ⇒	$\underline{4 \div 1 \div 16}$
4	1	16	

N° 3.12.3.8

Je suppose : 400 V

$R = \frac{U^2}{P} = \frac{400}{1800} = 88,88\ \Omega$

Nelle $P\bar{a} + 10\% = \frac{U + 10\%^2}{R} = \frac{400 + 10\%^2}{88,88} = \underline{2178\ W}$

Nelle $P\bar{a} - 10\% = \frac{U - 10\%^2}{R} = \frac{400 - 10\%^2}{88,88} = \underline{1458\ W}$

$\% = 100 + \left(\frac{100 \cdot 2178}{1800}\right) = \underline{21\ \%}$ $\quad 2,9^2 = 8,87$

$\% = 100 - \left(\frac{100 \cdot 1458}{1800}\right) = \underline{19\ \%}$ $\quad 1,1^2 = 1,21$

№ 3.13.1.1

$$P = R \cdot I^2 = 12 \cdot 4{,}5^2 = \underline{\underline{243\ W}}$$

№ 3.13.1.2

$$P = R \cdot I^2 \Rightarrow I = \sqrt{\frac{P}{R}} = \sqrt{\frac{820}{210}} = \underline{\underline{1{,}97\ A}}$$

№ 3.13.1.3

$$P = R \cdot I^2 \Rightarrow R = \frac{P}{I^2} = \frac{5{,}6}{40^2} = \underline{\underline{3{,}5\ m\Omega}}$$

№ 3.13.1.4

$$P = R \cdot I^2 = 0{,}00162 \cdot 600^2 = \underline{\underline{583{,}2\ W}}$$

№ 3.13.1.5

$$I = \sqrt{\frac{P}{R}} = \sqrt{\frac{5}{400000}} = \underline{\underline{3{,}536\ mA}}$$

№ 3.13.1.6

$$P = R \cdot I^2 \Rightarrow R = \frac{P}{I^2} = \frac{620}{3{,}4^2} = \underline{\underline{53{,}63\ \Omega}}$$

№ 3.13.1.7

$$P = R \cdot I^2 = 0{,}825 \cdot 32^2 = \underline{\underline{844{,}8\ W}}$$

№ 3.13.1.8

$$R = \frac{P}{I^2} = \frac{3{,}2}{12^2} = \underline{\underline{22{,}2\ m\Omega}}$$

№ 3.13.1.9

$$P = R \cdot I^2 = 0{,}00272 \cdot 45^2 = \underline{\underline{5{,}508\ W}}$$

№ 3.13.1.10

$$P = R \cdot I^2 = 15000 \cdot 0{,}025^2 = \underline{\underline{9{,}375\ W}}$$

№ 3.13.1.11

$$A = l \cdot L = 10 \cdot 100 = 1000\ mm^2$$

$$R = \frac{\rho \cdot l}{A} = \frac{0{,}0175 \cdot 1}{1000} = 0{,}0175\ m\Omega$$

3.13.1.11 Suite

$$P = R \cdot I^2 = 0{,}0000175 \cdot 5000^2 = \underline{\underline{437{,}5 \text{ W/m}}}$$

N° 3.13.1.12

$$A = l \cdot L = 3 \cdot 5 = 15 \text{ mm}^2$$

$$I = J \cdot A = 3 \cdot 15 = 45 \text{ A}$$

$$R = \frac{\varphi \cdot l}{A} = \frac{0{,}0175 \cdot 16{,}8}{15} = 0{,}0196 \ \Omega$$

$$P = R \cdot I^2 = 0{,}0196 \cdot 45^2 = \underline{\underline{39{,}69 \text{ W}}}$$

N° 3.13.1.13

$$R = \frac{\varphi \cdot l}{A} = \frac{0{,}0175 \cdot 1700}{16} = 1{,}859 \ \Omega$$

$$P = R \cdot I^2 \cdot 3 = 1{,}859 \cdot 110^2 \cdot 3 = \underline{\underline{67{,}495 \text{ kW}}}$$

№ 3.13.2.1

$P = R \cdot I^2 \Rightarrow R = \frac{P}{I^2} = \frac{2}{5^2} = 0,08\ \Omega$

a) $P = R \cdot I^2 = 0,08 \cdot 0^2 = \underline{0\ W}$

b) $P = 0,08 \cdot 1^2 = \underline{0,08\ W}$

c) $P = 0,08 \cdot 2^2 = \underline{0,32\ W}$

d) $P = 0,08 \cdot 3^2 = \underline{0,72\ W}$

e) $P = 0,08 \cdot 4^2 = \underline{1,28\ W}$

№ 3.13.2.2

$R = \frac{P}{I^2} = \frac{12800}{420^2} = 0,07256\ \Omega$

$I_1 = I - 10\% = 420 - 10\% = 378\ A$

$I_2 = I + 10\% = 420 + 10\% = 462\ A$

a) $P = R \cdot I^2 = 0,072 \cdot 378^2 = \underline{10,368\ kW}$

b) $P = R \cdot I^2 = 0,072 \cdot 462^2 = \underline{15,488\ kW}$

c) "a" $100 - \left(\frac{10368 \cdot 100}{12800}\right) = \underline{19\ \%}$

"b" $100 + \left(\frac{15488 \cdot 100}{12800}\right) = \underline{21\ \%}$

№ 3.13.2.3

$I\ nominal = 63\ A$

$R = \frac{\varphi \cdot l}{A} = \frac{0,0175 \cdot 100}{16} = 0,1093\ \Omega$

a) $P = 3 \cdot R \cdot I^2 = 3 \cdot 0,109 \cdot 63^2 = \underline{1,302\ kW}$

b) $I\ nominal = \frac{I}{2} = \frac{63}{2} = 31,5\ A$

$P = 3 \cdot R \cdot I^2 \cdot 2 = 3 \cdot 0,109 \cdot 31,5^2 \cdot 2 = \underline{651,16\ W}$

N° 3.14.1

$$n = \frac{P_2}{P_1} = \frac{306,2}{949} = \underline{0,322} \text{ ou } \underline{32,27\ \%}$$

N° 3.14.2

$$P_2 = P_1 \cdot n = 1240 \cdot 0,94 = \underline{1165,6\ kW}$$

N° 3.14.3

$$P_1 = \frac{P_2}{n} = \frac{3000}{0,91} = \underline{3296,7\ kW}$$

N° 3.14.4

$$P_1 = \frac{P_2}{n} = \frac{4000}{0,84} = 4761,9\ W$$

$$\text{Pertes} = P_1 - P_2 = 4761,9 - 4000 = \underline{761,9\ W}$$

N° 3.14.5

$$P_1 = U \cdot I = 24 \cdot 5,5 = 132\ W$$

$$n = \frac{P_2 \cdot 100}{P_1} = \frac{75 \cdot 100}{132} = \underline{56,82\ \%}$$

N° 3.14.6

$$P_2 = P_1 \cdot N = 46 \cdot 0,88 = \underline{40,48\ W}$$

N° 3.14.7

$$P_1 = \frac{P_2}{n} = \frac{5000}{0,79} = 6329,11\ W$$

$$I = \frac{P}{U} = \frac{6329,11}{220} = \underline{28,78\ A}$$

N° 3.14.8

$$P_2 = U \cdot I = 224 \cdot 68 = 15,232\ kW$$

$$\text{Pertes} = P_1 - P_2 = 18 - 15,232 = \underline{2,768\ kW}$$

$$\text{Pertes en \%} = \frac{2768 \cdot 100}{18000} = \underline{15,37\ \%}$$

N° 3.14.9

$$P_1 = U \cdot I = 800 \cdot 212 = 169600\ W$$

$$P_2 = U \cdot I = 762 \cdot 212 = 161544\ W$$

%

Nº 3.14.9. Suite

$$n = \frac{P_{2.100}}{P_1} = \frac{161544 \cdot 100}{169600} = \underline{95,25\ \%}$$

Nº 3.14.10

$$P_1 = U \cdot I = 228 \cdot 16,1 = 3670,8\ W$$

$$P_2 = P_1 \cdot n = 3670,8 \cdot 0,62 = \underline{2275,89\ W}$$

Nº 3.14.11

a) $P_1 = \frac{P_2}{n} = \frac{185}{0,92} = \underline{201,08\ kW}$

b) $I = \frac{P_2}{U_2} = \frac{185000}{480} = \underline{385,4\ A}$

c) $U_1 = \frac{P_1}{I} = \frac{201080}{385,4} = \underline{521,72\ V}$

Nº 3.14.12

a) $P_2 = U \cdot I = 218 \cdot 20 = \underline{4360\ W}$

b) $R_l = 2 \cdot R = 2 \cdot 0,25 = 0,5\ \Omega$

$P = R \cdot I^2 = 0,5 \cdot 20^2 = \underline{200\ W}$

c) $P_1 = P_2 + P = 4360 + 200 = \underline{4560\ W}$

d) $n = \frac{P_2}{P_1} \cdot 100 = \frac{4360}{4560} \cdot 100 = \underline{95,61\ \%}$

Nº 3.14.13

$$P_1 = \frac{P_2}{n} = \frac{8,7}{0,71} = \underline{12,25\ Wh}$$

№ 3.15.1

$7h\ 48min = 7,8\ h$

$W = P.t = 1,2 \cdot 7,8 = \underline{9,36\ kWh}$

№ 3.15.2

$t = \frac{W}{P} = \frac{1000}{25} = \underline{40\ h}$

$t = \frac{W}{P} = \frac{1000}{40} = \underline{25\ h}$

$t = \frac{W}{P} = \frac{1000}{75} = \underline{13,33\ h}$

$t = \frac{W}{P} = \frac{1000}{100} = \underline{10\ h}$

№ 3.15.3

$\Delta W = W_1 - W_2 = 1428 - 1250 = 178\ kWh$

$\Delta t = t_1 - t_2 = 11,45 - 6,45 = 5\ h$

$P = \frac{W}{t} = \frac{178}{5} = \underline{35,6\ kW}$

№ 3.15.4

$8\ h\ 12\ min = 8,2\ h$

$W = P.t = 92 \cdot 8,2 = \underline{754,4\ Wh}$

№ 3.15.5

$W = P.t \Rightarrow t = \frac{W}{P} = \frac{32}{4,2} = 7,619\ h$

$\underline{7,61\ h} = \underline{7h\ 37\ min\ 8\ sec.}$

№ 3.15.6

$W = P.t \Rightarrow P = \frac{W}{t} = \frac{7680}{24} = \underline{320\ kW}$

$\% = \frac{320 \cdot 100}{1840} = \underline{17,39\ \%}$

Nº 3.15.7

$$t = n \cdot 24 = 365 \cdot 24 = 8760\,h$$

$$W = P \cdot t = 0{,}01 \cdot 8760 = \underline{87{,}6\ kWh}$$

Nº 3.15.8

$$W = P \cdot t \Rightarrow t = \frac{W}{P} = \frac{253000}{62} = 4080\,h$$

a) $$Jours = \frac{t}{24} = \frac{4080}{24} = \underline{170\ Jours}$$

$$P_2 = P_1 \cdot n = 62 \cdot 0{,}65 = 40{,}3\ MW$$

$$W = P \cdot t \Rightarrow t = \frac{W}{P} = \frac{253000}{40{,}3} = 6277{,}9\,h$$

b) $$Jours = \frac{t}{24} = \frac{6277{,}9}{24} = \underline{261{,}57\ Jours}$$

Nº 3.15.9

$$P = \frac{W}{t} = \frac{120000}{24} = \underline{5'000\ kW}$$

Nº 3.15.10

$$P = P.\,\% = 2000 \cdot 0{,}54 = 1080\ kW$$

$$W = P \cdot t = 1080 \cdot 30 \cdot 24 = \underline{777{,}6\ MWh}$$

Nº 3.15.11

2 mois = 60 jours

$$W/Jour = \frac{W}{60} = \frac{83}{60} = \underline{1{,}383\ kWh}$$

$$W/personne = \frac{W/J}{2} = \frac{1{,}383}{2} = \underline{0{,}691\ kWh}$$

N° 3.16.1

Coût = W · ct = 14,5 · 5,5 = 79,75 ct.

N° 3.16.2

Prix = $\frac{4270,2}{66620}$ = 0,064 Fr = 6,41 ct/kWh

N° 3.16.3

W = $\frac{Fr}{Fr/kWh}$ = $\frac{52}{0,08}$ = 650 kWh

N° 3.16.4

W = P · t = 2 · 50 = 100 kWh

Coût = W · ct = 100 · 0,09 = 9 Fr.

N° 3.16.5

Prix = $\frac{985,20}{20920}$ = 4,709 ct/kWh

N° 3.16.6

W = $\frac{1}{0,11}$ = 9,09 kWh

t = $\frac{W}{P}$ = $\frac{9,09}{0,04}$ = 227,3 h

N° 3.16.7

1h 36 min = 1,6 h

W = P · t = 1,25 · 1,6 = 2 kWh

Coût = W · ct = 2 · 9 = 18 ct.

N° 3.16.8

t = 8h 40 m = 8,66 h

Coût = P · t · ct = 0,060 · 8,66 · 35 = 18,2 ct.

N° 3.16.9

a) haut = $\frac{94.15}{980}$ = 10,69 ct/kWh

bas = $\frac{43.20}{720}$ = 6 ct/kWh

Prix = $\frac{160,55}{1600}$ = 10,03 ct/kWh

№ 3.17.1

$1\,kWh = 3\,600\,000\,J$

$W = P \cdot t = 14200 \cdot 3600 = \underline{51\,120\ kJ}$

№ 3.17.2

$P = \frac{W}{t} = \frac{12\,000\,000}{3\,600\,000} = \underline{3,33\ kWh}$

№ 3.17.3

$W = P \cdot t = 4000 \cdot 3600 = \underline{14\,400\ kJh}$

№ 3.17.4

$P = \frac{W}{t} = \frac{90\,000\,000}{3\,600} = \underline{25\ kW}$

№ 3.17.5

$W = P \cdot t = 9 \cdot 3600 = \underline{32\,400\ J.}$

№ 3.17.6

$P = \frac{W}{t} = \frac{1\,000\,000\,000}{3\,600\,000} = \underline{277,8\ kW}$

№ 3.17.7

$Q = m \cdot c \cdot \Delta\theta = 250 \cdot 4190 \cdot 57 = \underline{59,707\ kJ}$

№ 3.17.8

$\Delta\theta = t_2 - t_1 = 132 - 20 = 112\ °C$

$Q = m \cdot c \cdot \Delta\theta = 16 \cdot 482 \cdot 112 = \underline{863,7\ kJ}$

№ 3.17.9

$\Delta\theta = t_2 - t_1 = 32 - 15 = 17\ °C$

$m = l \cdot \rho = 240 \cdot 0,93 = 223,2\ l$

$Q = m \cdot c \cdot \Delta\theta =$

$223,2 \cdot 1680 \cdot 17 = \underline{6375\ kJ}$

№ 3.17.10

$\Delta\theta = 66\,°C \qquad 1\,kWh = 3\,600\,000\,J$

$Q = m \cdot c \cdot \Delta\theta \Rightarrow m = \frac{Q}{c \cdot \Delta\theta} = \frac{3\,600\,000}{4190 \cdot 66} = \underline{13,02\ l}$

№ 3.17.11

$1\,kWh = 3'600'000\ J \qquad \Delta\theta = 1\,°C$

a) eau $m = l \cdot \rho = 1 \cdot 1 = 1\ kg$

$m = \frac{Q}{c \cdot \Delta\theta} = \frac{3600000}{4190 \cdot 1} = \underline{859,18\ l}$

b) huile $m = l \cdot \rho = 1 \cdot 0,93 = 0,93\ kg$

$m = \frac{Q}{c \cdot \Delta\theta} = \frac{3600000}{1670 \cdot 0,93} = \underline{2317,9\ l}$

c) Glycérine $m = l \cdot \rho = 1 \cdot 1,27 = 1,27\ kg$

$m = \frac{Q}{c \cdot \Delta\theta} = \frac{3600000}{2430 \cdot 1,27} = \underline{1166,5\ l}$

d) Mercure $m = l \cdot \rho = 1 \cdot 13,6 = 13,6\ kg$

$m = \frac{Q}{c \cdot \Delta\theta} = \frac{3600000}{138 \cdot 13,6} = \underline{1918\ l}$

№ 3.17.12

$m = l \cdot \rho = 520 \cdot 0,83 = 431,6\ kg$

$Q = m \cdot c \cdot \Delta\theta \Rightarrow \Delta\theta = \frac{Q}{m \cdot c} = \frac{65000000}{431,6 \cdot 2100} = 71,71\ °C$

$t_2 = t_1 + \Delta\theta = 18 + 71,71 = \underline{89,71\ °C}$

№ 3.17.13

$Q = m \cdot c \cdot \Delta\theta = 150 \cdot 4190 \cdot 12,3 = \underline{7730,5\ kJ}$

№ 3.17.14

$\Delta\theta = t_2 - t_1 = 58 - 16 = 42\ °C$

$Q_1 = m \cdot c \cdot \Delta\theta = 240 \cdot 4190 \cdot 42 = 42235,2\ kJ$

$Q_2 = \frac{Q_1}{\eta} = \frac{42235,2}{0,76} = \underline{55572,6\ kJ}$

$W = \frac{Q_2}{J/kWh} = \frac{55572,632}{3'600'000} = \underline{15,43\ kWh}$

№ 3.17.15

$Q = P \cdot t \cdot J/kWh = 2,5 \cdot 24 \cdot 3'600'000 = \underline{216\ MJ}$

№ 3.17.16

$m = 30 \cdot 1000 = 30000\ l = 30\,000\ kg$

$\Delta\theta = t_2 - t_1 = 22 - 15 = 7\,°C$

$Q = m \cdot c \cdot \Delta\theta = 30000 \cdot 4190 \cdot 7 = \underline{879,9\ MJ}$

$W = \frac{Q}{J/kWh} = \frac{879900000}{3600000} = 244,4\ kWh$

$P = \frac{W}{t} = \frac{244,4}{24} = \underline{10,18\ kW}$

№ 3.17.17

$\Delta\theta = t_2 - t_1 = 76 - 10 = 66\ °C$

$P_2 = P_1 \cdot n = 1800 \cdot 0,55 = 990\ W$

$Q = m \cdot c \cdot \Delta\theta = 3,2 \cdot 4190 \cdot 66 = 884928\ J$

$t = \frac{Q}{P_2} = \frac{884928}{990} = \underline{893,86\ sec = 14,9\ min}$

№ 3.17.18

$W = P \cdot t \cdot \eta = 1400 \cdot 5 \cdot 3600 \cdot 0,94 = 23688000\ J$

$Q = m \cdot c \cdot \Delta\theta \Rightarrow \Delta\theta = \frac{Q}{m \cdot c} = \frac{23688000}{75 \cdot 4190} = 75,37\ °C$

$t_1 = 5\,°C$

$t_2 = t_1 + \Delta\theta = 5 + 75,37 = \underline{80,37\ °C}$

№ 3.17.19

$\Delta\theta = t_2 - t_1 = 85 - 10 = 75\ °C$

$Q = m \cdot c \cdot \Delta\theta = 5 \cdot 4190 \cdot 75 = 1571,25\ kJ$

$0,5\ kWh = \frac{3600000}{2} = 1800000\ J$

$n = \frac{Q}{W} = \frac{1571250}{1800000} = \underline{0,8729 \text{ ou } 89,27\%}$

№ 3.17.20

$t = \frac{8}{60} = 0,13\ h$

$W = P \cdot t = 10 \cdot 0,13 = 1,33\ Wh$

$3600000 \cdot 0,00183 = 4800\ J$

№ 3.17.21

$m = l \cdot \rho = 4 \cdot 0{,}79 = 3{,}16\ l$

$\Delta\theta = t_2 - t_1 = 42 - 24 = 18\ °C$

$Q = m \cdot c \cdot \Delta\theta = 3{,}16 \cdot 2430 \cdot 18 = 138218{,}4\ J$

$12\ min = \frac{12}{60} = 0{,}2\ h$

$1\ kWh = 3600000\ J \Rightarrow 138218{,}4\ J = 0{,}03839\ kWh$

$W = P \cdot t \Rightarrow P = \frac{W}{t} = \frac{0{,}03839}{2} = 0{,}19197\ kW$

$P_1 = \frac{P_2}{\eta} = \frac{191{,}97}{0{,}9} = \underline{\underline{213{,}3\ W}}$

№ 3.17.22

$Q_1 = \frac{Q_2}{\eta} = \frac{200000}{0{,}92} = 217391{,}3\ J$

$W = P \cdot t = 250 \cdot 60 = 15000\ W/min$ ou J/min

$t = \frac{Q}{W/min} = \frac{217391{,}3}{15000} = \underline{\underline{14{,}49\ min}}$

№ 3.17.23

$18\ min = 1080\ sec \qquad m = 0{,}32\ kg$

$W = P \cdot t = 120 \cdot 1080 = 129600\ J$

$Q_2 = W \cdot \eta = 129600 \cdot 0{,}8 = 103680\ J$

$Q = m \cdot c \cdot \Delta\theta \Rightarrow \Delta\theta = \frac{Q}{m \cdot c} = \frac{103680}{0{,}32 \cdot 400} = 810\ °C$

$t_2 = t_1 + \Delta\theta = 810 + 20 = \underline{\underline{830\ °C}}$

№ 3.17.24

$25\ min = 1500\ sec$

$\Delta\theta = t_2 - t_1 = 85 - 15 = 70\ °C$

$Q = m \cdot c \cdot \Delta\theta = 8 \cdot 4190 \cdot 70 = 2\,346\,400\ J$

$W = P \cdot t = 2000 \cdot 1500 = 3\,000\,000\ J$

$\eta = \frac{Q}{W} = \frac{2346400}{3000000} = \underline{\underline{0{,}78 \text{ ou } 78{,}21\ \%}}$

№ 3.17.25

$m = 680\ kg \qquad \Delta\Theta = t_2 - t_1 = 68 - 12 = 56\ °C$

$6h\ 30\ min = 23400\ Sec.$

$Q = m \cdot c \cdot \Delta\Theta = 680 \cdot 4190 \cdot 56 = 1,5956 \cdot 10^8\ J$

$W = \frac{Q}{\eta} = \frac{1,5956}{0,92} = 1,7343 \cdot 10^8\ J$

$W = P \cdot t \Rightarrow P = \frac{W}{t} = \frac{1,7343 \cdot 10^8}{23400} = \underline{7,412\ kWh}$

№ 3.17.26

$\Delta\Theta = t_2 - t_1 = 360 - 20 = 340\ °C$

$Q = m \cdot c \cdot \Delta\Theta = 7,5 \cdot 380 \cdot 340 = 969000\ J$

$W = \frac{Q}{\eta} = \frac{969000}{0,78} = 1\,242\,307,7\ J$

$W = P \cdot t \Rightarrow t = \frac{W}{P} = \frac{1\,242\,307,7}{620} = \underline{2003,7\ sec = 33,4\ min}$

№ 3.17.27

$P = R \cdot I^2 = 0,52 \cdot 21^2 = 229,32\ W$

$W = P \cdot t = 229,32 \cdot 60 = \underline{1295\ kJ/h}$

№ 3.17.28

$P = R \cdot l = 29 \cdot 12,4 = 359,6\ W$

$W = P \cdot t = 359,6 \cdot 3600 = \underline{1295\ kJ/h}$

№ 3.17.29

$P = U \cdot I = 28,4 \cdot 28 = 795,2\ W$

$W = P \cdot t = 795,2 \cdot 24 \cdot 3600 = \underline{68,705\ MJ}$

№ 3.17.30

$R = \frac{\varphi \cdot l}{A} = \frac{0,0175 \cdot 100}{10} = 0,175\ \Omega$

$P = R \cdot I^2 = 0,175 \cdot 40^2 = 280\ W$

$W = P \cdot t = 280 \cdot 3600 = \underline{1,008\ MJ/h}$
