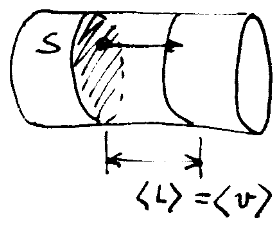
8.1



$$I = \frac{q}{t} = \frac{\overbrace{n\langle v\rangle S \cdot t}^{V} \cdot e}{t} =$$

$$= \underbrace{m \frac{N_A}{M_m} \cdot \frac{1}{V}}_{n} e S \langle v\rangle =$$

$$= \rho e S \langle v\rangle \frac{N_A}{M_m}$$

$$\langle v\rangle = \frac{I \cdot M_m}{\rho N_A e S} = \frac{6 \cdot 63{,}54 \cdot 10^{-3}}{8{,}9 \cdot 10^3 \cdot 6{,}022 \cdot 10^{23} \cdot 1{,}602 \cdot 10^{-19} \cdot 1 \cdot 10^{-6}} =$$

$$= \underline{4{,}440\,227\,1 \cdot 10^{-4}\,m\,s^{-1}}$$

8.2

$$j = ne\langle v\rangle,\ n = \frac{N}{V},\ \underbrace{N = m\frac{N_A}{M_m},\ m = \rho V}$$

$$\Downarrow \qquad\qquad N = \frac{\rho V N_A}{M_m}$$

$$\langle v\rangle = \frac{j}{e \cdot n} = \frac{jV}{e \cdot N}$$

$$\langle v\rangle = \frac{jV}{e\,\frac{\rho V N_A}{M_m}} = \frac{j M_m}{e N_A \rho} = \frac{1 \cdot 10^6 \cdot 27{,}0 \cdot 10^{-3}}{1{,}602 \cdot 10^{-19} \cdot 6{,}022 \cdot 10^{23} \cdot 2{,}7 \cdot 10^3} =$$

$$= 1{,}036\,565\,4 \cdot 10^{-4}\,m \cdot s^{-1}$$

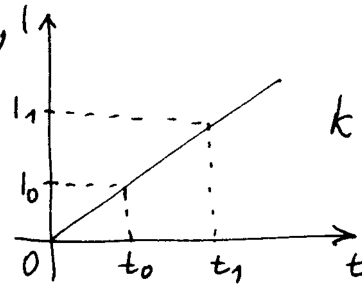
8.4

a) $I = \frac{dq}{dt}$, $dq = I\,dt$

$$q = \int I\,dt = I\int_0^{t_0} dt = I\cdot t_0$$

$$q = 5\cdot 10 = \underline{\underline{50\,C}}$$

b)



$$k = \frac{I_1 - I_0}{t_1 - t_0} = \frac{3}{10} = 0{,}3\ A\cdot s^{-1}$$

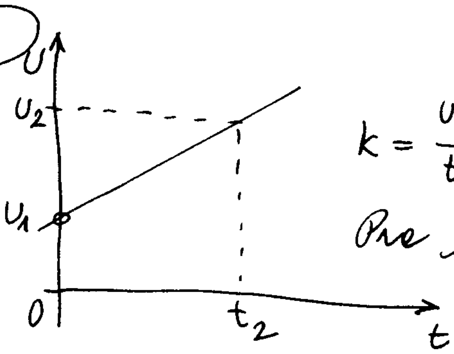
Keď $t_0 = \emptyset$ potom $I_0 = \emptyset$. Pre ľubovolné t bude platiť

$$k = \frac{I - \emptyset}{t - \emptyset} \Rightarrow I = kt.$$

$$dq = kt\,dt$$

$$q = \int_0^{t_0} kt\,dt = k\int_0^{t_0} t\,dt = k\left[\frac{t^2}{2}\right]_0^{t_0} = \frac{kt_0^2}{2} = 0{,}3\,\frac{10^2}{2} = \frac{30}{2} = \underline{\underline{15\,C}}$$

8.5



$$k = \frac{U_2 - U_1}{t - t_1} = \frac{7-3}{2} = 2\ V\cdot s^{-1}$$

Pre ľubovolné t platí:

$$k = \frac{U - U_1}{t} \Rightarrow kt = U - U_1$$

$$\boxed{U = U_1 + kt}$$

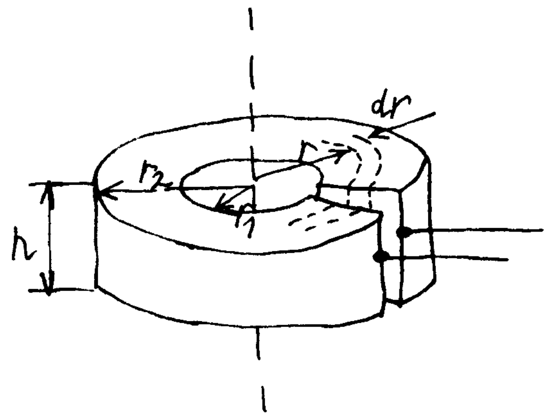
$$I = \frac{dq}{dt}$$

$$\frac{U}{R} = \frac{dq}{dt} \Rightarrow dq = \frac{U}{R}\,dt$$

$$q = \frac{1}{R}\int_0^{t_2} U\,dt = \frac{1}{R}\int_0^{t_2}(U_1 + kt)\,dt = \frac{1}{R}\left[U_1 t + k\frac{t^2}{2}\right]_0^{t_2} =$$

$$= \frac{1}{5}\left(3.2 + 2\cdot\frac{2^2}{2}\right) = \frac{1}{5}\left(6 + \frac{8}{2}\right) = \frac{10}{5} = \underline{\underline{2\,C}}$$

8.10



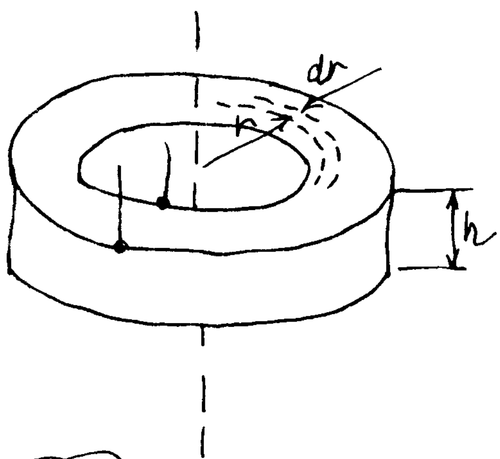
$$G = \frac{1}{R}$$

$$G = \int dG$$

$$dG = \frac{1}{dR} = \frac{1}{\rho \frac{2\pi r}{h\,dr}} = \frac{h\,dr}{\rho\, 2\pi r}$$

$$G = \frac{h}{2\pi\rho}\int_{r_1}^{r_2}\frac{dr}{r} = \frac{h}{2\pi\rho}\ln\left|\frac{r_2}{r_1}\right|$$

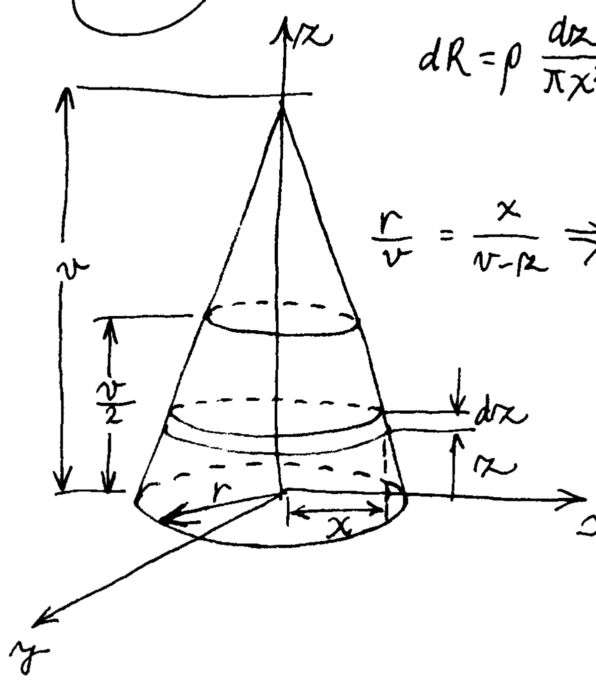
$$R = \frac{2\pi\rho}{h\ln\left|\frac{r_2}{r_1}\right|}$$



$$dR = \rho\frac{dr}{2\pi r h}$$

$$R = \frac{\rho}{2\pi h}\int_{r_1}^{r_2}\frac{dr}{r} = \frac{\rho}{2\pi h}\ln\left|\frac{r_2}{r_1}\right|$$

8.11



$$dR = \rho\frac{dz}{\pi x^2} = \rho\frac{dz}{\pi\frac{r^2}{v^2}(v-z)^2} = \frac{\rho v^2}{\pi r^2}\cdot\frac{dz}{(v-z)^2}$$

$$\frac{r}{v} = \frac{x}{v-z} \Rightarrow x = \frac{r}{v}(v-z)$$

$$R = \frac{\rho v^2}{\pi r^2}\int_0^{\left(\frac{v}{2}\right)}\frac{dz}{(v-z)^2} = \frac{\rho v^2}{\pi r^2}\left[\frac{1}{v-z}\right]_0^{\left(\frac{v}{2}\right)} =$$

$$= \frac{\rho v^2}{\pi r^2}\left[\frac{1}{v-\frac{v}{2}} - \frac{1}{v}\right] = \frac{\rho v}{\pi r^2}$$

$$R = R_1 + R_2$$

8.13

$$R_0 = R_{01} + R_{02}$$

$$R_0(1+\alpha\Delta T) = R_{01}(1+\alpha_1\Delta T) + R_{02}(1+\alpha_2\Delta T)$$

$$R_0 - (R_{01}+R_{02}) + R_0\alpha\Delta T = R_{01}\alpha_1\Delta T + R_{02}\alpha_2\Delta T$$

$$R_0\alpha\Delta T = R_{01}\alpha_1\Delta T + R_{02}\alpha_2\Delta T$$

$$\alpha = \frac{R_{01}\alpha_1 + R_{02}\alpha_2}{R_0} =$$

$$= \frac{3\cdot 4{,}2\cdot 10^{-3} + 2\cdot 6\cdot 10^{-3}}{3+2} = \frac{0{,}0246}{6} = \underline{\underline{4{,}1\cdot 10^{-3}\,K^{-1}}}$$

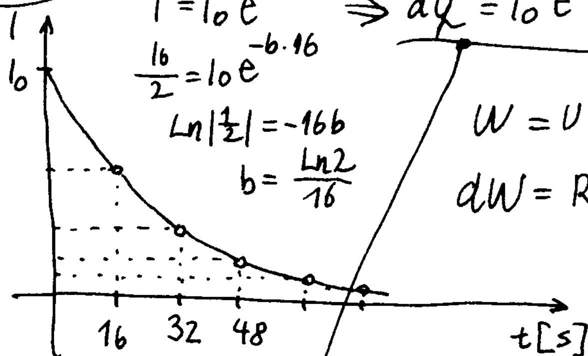
8.15

$$I = I_0 e^{-bt} \Rightarrow dq = I_0 e^{-bt}dt$$

$$\frac{I_0}{2} = I_0 e^{-b\cdot 16}$$

$$\ln\left|\tfrac{1}{2}\right| = -16b$$

$$b = \frac{\ln 2}{16}$$



$$W = UIt = RI^2t$$

$$dW = RI^2dt = RI_0^2e^{-2bt}dt$$

$$W = RI_0^2\int_0^\infty e^{-2bt}dt = RI_0^2\left[\frac{e^{-2bt}}{-2b}\right]_0^\infty = RI_0^2\left[\frac{e^{-2bt}}{-2b} - \frac{1}{-2b}\right] =$$

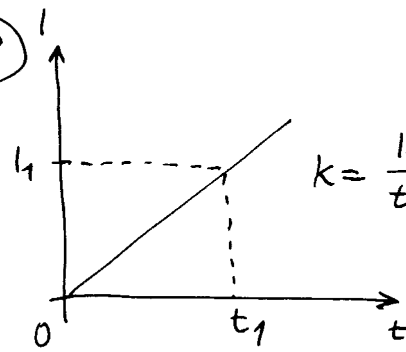
$$= \frac{RI_0^2}{2b}\left(1-e^{-2bt}\right)_{t\to\infty} = \frac{RI_0^2}{2b} = \frac{Rq^2b^2}{2b} = \frac{Rq^2}{2}b = \frac{Rq^2}{2}\cdot\frac{\ln 2}{16} =$$

$$q = I_0\int_0^\infty e^{-bt}dt = \frac{I_0}{b} \Rightarrow I_0 = qb$$

$$= Rq^2\frac{\ln 2}{32} = 5\cdot 40^2\cdot\frac{\ln 2}{32} =$$

$$= \underline{\underline{173{,}286795\,J}}$$

8.18



$$k = \frac{I_1 - 0}{t_1 - 0} \Rightarrow I_1 = k t_1 \Rightarrow I = kt$$

$$k = \frac{I_1}{t_1} = \frac{1{,}5}{3} = 0{,}5\,A\cdot s^{-1}$$

$$dW = UI\,dt = RI^2 dt = Rk^2 t^2 dt$$

$$W = Rk^2 \int_0^{t_1} t^2 dt = Rk^2\left(\frac{t_1^3}{3}\right) = 10 \cdot 0{,}5^2 \frac{3^3}{3} = \underline{\underline{22{,}5\,J}}$$

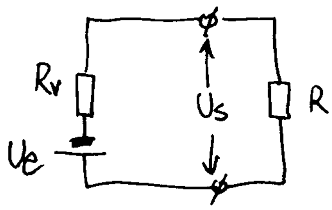
8.19

$$\eta \frac{U^2}{R} t = m c \Delta T$$

$$t = \frac{R m c \Delta T}{\eta U^2} = \frac{16 \cdot 0{,}6 \cdot 4186 \cdot 90}{0{,}6 \cdot 120^2} =$$

$$= 418{,}6\,s = 6{,}976\,666\,min \approx 7\,min$$

8.26



$$U_e = U_s + IR_v$$

$$U_s = U_e - IR_v$$

$$RI = U_e - IR_v \Rightarrow I = \frac{U_e}{R+R_v}$$

$$P = U_s \cdot I = (U_e - IR_v)I = \left(U_e - \frac{U_e}{R+R_v} \cdot R_v\right)\frac{U_e}{R+R_v} = \frac{(R+R_v)U_e^2 - U_e^2 R_v}{(R+R_v)^2}$$

$$\frac{dP}{dR} = 0$$

$$\frac{d}{dR}\left(\frac{U_e^2(R+R_v) - U_e^2 R_v}{(R+R_v)^2}\right) = \frac{U_e^2(R+R_v)^2 - U_e^2 R_v \cdot 2(R+R_v)}{(R+R_v)^4} = 0$$

$$U_e^2(R+R_v)^2 - U_e^2 R_v \cdot 2(R+R_v) = 0$$

$$(R+R_v) - 2R_v = 0$$

$$R - R_v = 0$$

$$\underline{\underline{R = R_v}}$$