Aufladen eines Kondensators - Leistung und Energie - Theorie - Lösung

1.a)

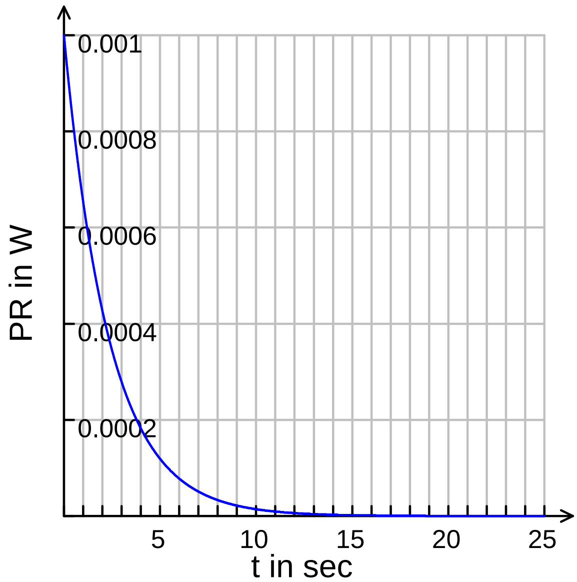
$I(t) := I0 \cdot \exp\left(\frac{-1}{R \cdot C} \cdot t\right)$ "Done" $I0 := \frac{-U0}{R}$ $\frac{-u0}{r}$

$\mathrm{UR}(t) := R \cdot I(t)$ "Done" $\mathrm{UR}(t)$ $-u0 \cdot e^{-t/(c \cdot r)}$

$\mathrm{PR}(t) := \mathrm{UR}(t) \cdot I(t)$ "Done" $\mathrm{PR}(t)$ $\frac{u0^2 \cdot e^{(-2 \cdot t)/(c \cdot r)}}{r}$

b)

$R := 1E5$ 100000. $C := 4.7E-5$ .000047 $U0 := -10$ -10



delvar(R) "Done" delvar(C) "Done" delvar($U0$) "Done"

c)

$\int_0^{t0} (\mathrm{PR}(t))\, dt$ $\frac{c \cdot u0^2 \cdot e^{(-2 \cdot t0)/(c \cdot r)} \cdot \left(e^{(2 \cdot t0)/(c \cdot r)} - 1\right)}{2}$

$\mathrm{expand}\left(\frac{c \cdot u0^2 \cdot e^{(-2 \cdot t0)/(c \cdot r)} \cdot \left(e^{(2 \cdot t0)/(c \cdot r)} - 1\right)}{2}\right)$ $\frac{c \cdot u0^2}{2} - \frac{c \cdot u0^2}{2 \cdot \left(e^{t0/(c \cdot r)}\right)^2}$

$\lim_{t0 \to \infty} (\mathrm{WR}(t)) = \frac{1}{2} \cdot C \cdot U0^2$

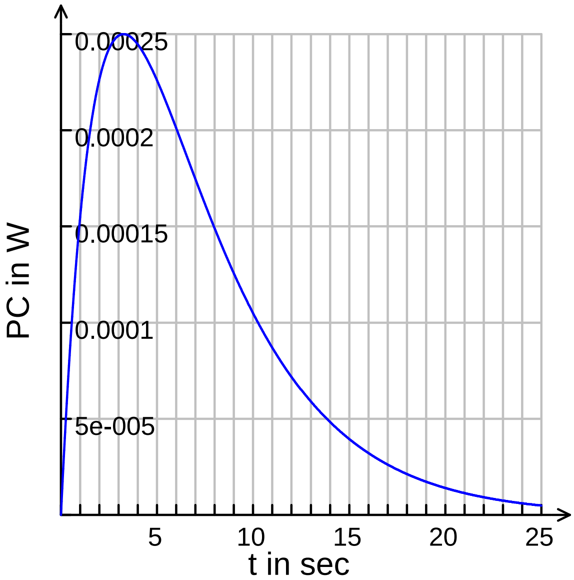
2.a)

$\mathrm{UC}(t) := -U0\cdot\left(1-\exp\left(\frac{-1}{R\cdot C}\cdot t\right)\right)$ "Done" $\mathrm{UC}(t)$ $-u0\cdot\left(e^{t/(c\cdot r)}-1\right)\cdot e^{-t/(c\cdot r)}$

$\mathrm{PC}(t) := \mathrm{UC}(t)\cdot I(t)$ "Done" $\mathrm{PC}(t)$ $\frac{u0^2\cdot\left(e^{t/(c\cdot r)}-1\right)\cdot e^{(-2\cdot t)/(c\cdot r)}}{r}$

b)

$R := 1E5$ 100000. $C := 4.7E-5$ .000047 $U0 := -10$ -10



delvar(R) "Done" delvar(C) "Done" delvar$(U0)$ "Done"

c)

$\mathrm{solve}\left(\frac{d}{dt}(\mathrm{PC}(t))=0,t\right)$ $t=c\cdot\ln(2)\cdot r$ or $\frac{u0^2}{c\cdot r^2}=0$

$\mathrm{PC}(R\cdot C\cdot\ln(2))$ $\frac{u0^2}{4\cdot r}$

d)

$\int_0^{t0}(\mathrm{PC}(t))\,dt$ $\frac{c\cdot u0^2\cdot e^{(-2\cdot t0)/(c\cdot r)}\cdot\left(e^{(2\cdot t0)/(c\cdot r)}-2\cdot e^{t0/(c\cdot r)}+1\right)}{2}$

$\mathrm{expand}\left(\frac{c\cdot u0^2\cdot e^{(-2\cdot t0)/(c\cdot r)}\cdot\left(e^{(2\cdot t0)/(c\cdot r)}-2\cdot e^{t0/(c\cdot r)}+1\right)}{2}\right)$ $\frac{-c\cdot u0^2}{e^{t0/(c\cdot r)}}+\frac{c\cdot u0^2}{2\cdot\left(e^{t0/(c\cdot r)}\right)^2}+\frac{c\cdot u0^2}{2}$

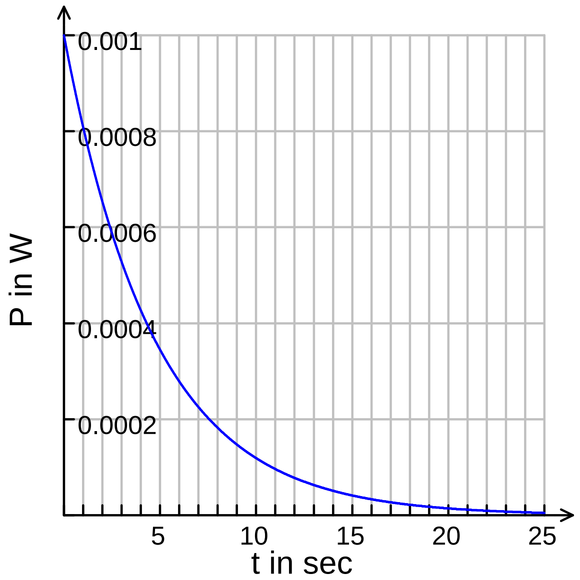
$\lim_{t0\to\infty}(\mathrm{WC}(t))=\frac{1}{2}\cdot C\cdot U0^2$

3.a)

$P(t) := \mathrm{PR}(t) + \mathrm{PC}(t)$ "Done" $P(t)$ $\dfrac{u0^2 \cdot e^{-t/(c \cdot r)}}{r}$

b)

$R := 1E5$ 100000. $C := 4.7E\text{-}5$ .000047 $U0 := -10$ -10



delvar(R) "Done" delvar(C) "Done" delvar$(U0)$ "Done"

c)

$\lim_{t0 \to \infty} (W(t)) = C \cdot U0^2$