

# rechnung\_betragundphase\_umkehrintegrator

## Student Group

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\$\;\$ \$\;\$	$U_A = -\frac{1}{R \cdot C} \int_{t_0}^{t_1} U_E(t) dt + U_{A0}$
\$\;\$ \$\;\$	insert sine function: $U_E(t) = \hat{U}_E \cdot \sin(\omega \cdot t)$
\$\;\$ \$\;\$	$U_A = -\frac{1}{R \cdot C} \int_{t_0}^{t_1} \hat{U}_E \cdot \sin(\omega \cdot t) dt + U_{A0}$
\$\;\$ \$\;\$	insert root function with limits $\int_{x_0}^{x_1} \sin(a \cdot x) dx = [-\frac{1}{a} \cdot \cos(a \cdot x)]_{x_0}^{x_1}$
\$\;\$ \$\;\$	$U_A = -\frac{1}{R \cdot C} \cdot [-\frac{\hat{U}_E}{\omega} \cdot \cos(\omega \cdot t)]_{t_0}^{t_1} + U_{A0}$
\$\;\$ \$\;\$	put constant before integral
\$\;\$ \$\;\$	$U_A = \frac{1}{R \cdot C} \cdot \frac{\hat{U}_E}{\omega} \cdot [\cos(\omega \cdot t)]_{t_0}^{t_1} + U_{A0}$
\$\;\$ \$\;\$	insert limits: $t_0=0, t_1=t$
\$\;\$ \$\;\$	$U_A = \frac{\hat{U}_E}{\omega \cdot R \cdot C} \cdot (\cos(\omega \cdot t) - \cos(0)) + U_{A0}$
\$\;\$ \$\;\$	$\cos(0) = 1$
\$\;\$ \$\;\$	$U_A = \frac{\hat{U}_E}{\omega \cdot R \cdot C} \cdot (\cos(\omega \cdot t) - 1) + U_{A0}$
\$\;\$ \$\;\$	multiply
\$\;\$ \$\;\$	$U_A = \frac{\hat{U}_E}{\omega \cdot R \cdot C} \cdot \cos(\omega \cdot t) - \frac{\hat{U}_E}{\omega \cdot R \cdot C} + U_{A0}$
\$\;\$ \$\;\$	consider the non-cosine terms: The blue part is independent in time. We assume purely sinusoidal quantities!
\$\;\$ \$\;\$	$U_A = \frac{\hat{U}_E}{\omega \cdot R \cdot C} \cdot \cos(\omega \cdot t) - \frac{\hat{U}_E}{\omega \cdot R \cdot C} + U_{A0}$
\$\;\$ \$\;\$	Therefore, the initial voltage of the capacitor must be: $U_{C0} = U_{A0} = \frac{\hat{U}_E}{\omega \cdot R \cdot C}$
\$\;\$ \$\;\$	$U_A = \frac{\hat{U}_E}{\omega \cdot R \cdot C} \cdot \cos(\omega \cdot t)$
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