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[ STUDENT > # Solve for current in an L/R circuit with suddenly
[             applied voltage V = sqrt(2)*Vln*cos(w*t-theta)
[
[ STUDENT >
[ STUDENT > restart;
[ STUDENT >
[ STUDENT > # We can write the steady state response by inspection
[             (based on known magnitude and angle of impedance)
[ STUDENT > ilss(t):=sqrt(2)*Vln/sqrt(R^2+w^2*L^2)*cos(w*t-theta-arctan(w*L/R));

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$$ilss(t) := \frac{\sqrt{2} Vln \cos\left(-w t + \theta + \arctan\left(\frac{w L}{R}\right)\right)}{\sqrt{R^2 + w^2 L^2}}$$

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[
[ STUDENT > # We can write the transient response by inspection in
[             terms of unknown constant C:
[ STUDENT > iltrans(t):=C*exp(-t*R/L);

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$$iltrans(t) := C e^{\left(-\frac{t R}{L}\right)}$$

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[ STUDENT > # Current il(t) is sum of SS and transient components
[ STUDENT > il(t):=ilss(t) + iltrans(t);

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$$il(t) := \frac{\sqrt{2} Vln \cos\left(-w t + \theta + \arctan\left(\frac{w L}{R}\right)\right)}{\sqrt{R^2 + w^2 L^2}} + C e^{\left(-\frac{t R}{L}\right)}$$

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[ STUDENT >
[ STUDENT > # We can solve for C using the initial condition il(t=0) =
[             0
[ STUDENT > Csolution:=solve(subs(t=0,il(t))=0,C);

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$$Csolution := -\frac{\sqrt{2} Vln \cos\left(\theta + \arctan\left(\frac{w L}{R}\right)\right)}{e^0 \sqrt{R^2 + w^2 L^2}}$$

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[ STUDENT >
[ STUDENT > # Plug solution for C back into the expression for i
[ STUDENT > il(t):=subs(C=Csolution,il(t));

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$$il(t) := \frac{\sqrt{2} Vln \cos\left(-w t + \theta + \arctan\left(\frac{w L}{R}\right)\right)}{\sqrt{R^2 + w^2 L^2}} - \frac{\sqrt{2} Vln \cos\left(\theta + \arctan\left(\frac{w L}{R}\right)\right) e^{\left(-\frac{t R}{L}\right)}}{\sqrt{R^2 + w^2 L^2}}$$

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[ STUDENT > # This gives results which are identical to previous
[             solution, but much easier form to derive and work with

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