$y'' + 6y' + 13y = 0$

$y = e^{rt}$

$y' = re^{rt}$

$y'' = r^2 e^{rt}$

$e^{rt}(r^2 + 6r + 13) = 0$

$r^2 + 6r + 13 = 0$

$$r = \frac{-6 \pm \sqrt{36 - 52}}{2}$$

$\sqrt{-16}$

$4i$

$$= \frac{-6 \pm 4i}{2} = -3 \pm 2i$$

$$\boxed{y = e^{-3t}(C_1 \sin 2t + C_2 \cos 2t)}$$

$$\frac{dy}{dt} + 3y = 2\sin 5t$$

$$ye^{3t} = \int \square + C$$

$$+Ce^{\square}$$

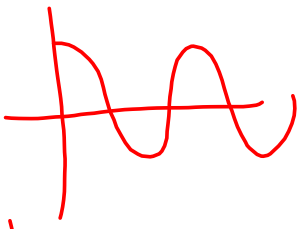
$$i = \underbrace{\frac{17}{5}e^{-3t}}_{\text{transient}} + \underbrace{\frac{1}{5}\sin t + \frac{3}{5}\cos t}_{\text{steady-state}}$$

$$my'' + \beta y' + ky = 0$$

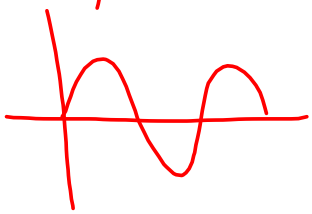
If $\beta = 0$ and $k > 0$, solution

$$y = C_1 \sin \omega t + C_2 \cos \omega t.$$

$y(0) = 1, y'(0) = 0$



$y(0) = 0, y'(0) = 1$



$$y = 3.1 \sin 1.4t - 0.2 \cos 1.4t$$

$$y = C \sin(\omega t + \phi)$$

$$e^{Ai+Bi} = e^{(A+B)i} = \cos(A+B)+i\sin(A+B)$$

$$e^{Ai}\,e^{Bi}$$

$$(\cos A+i\sin A)(\cos B+i\sin B)$$

$$\cos A\cos B+i\sin B\cos A+i\sin A\cos B-\sin A\sin B$$

$$\cos(A+B)=\cos A\cos B-\sin A\sin B$$

$$\sin(A+B)=\sin A\cos B+\sin B\cos A$$