

1)

$$\frac{X}{F} = \frac{1}{1000 - 100\omega^2 + j\omega}$$

ω	$\frac{X}{F}$	$ X $	$\angle X$ (rad)	$\angle X$ (deg)
$\frac{2\pi}{5}$	$1.187 \times 10^{-3} - 1.70 \times 10^{-6}j$	9.626×10^{-4}	3.140	179.9 $\sim \pi$ or 180°
$\frac{6\pi}{5}$	$-2.374 \times 10^{-3} - 2.125 \times 10^{-5}j$	2.138×10^{-4}	0.009	0.513 ~ 0
2π	$-3.892 \times 10^{-4} - 7.281 \times 10^{-7}j$	1.100×10^{-5}	0.002	0.122 ~ 0

$$x(t) = 9.626 \times 10^{-4} \cos\left(\frac{2\pi}{5}t + 3.14\right) + 2.138 \times 10^{-4} \cos\left(\frac{6\pi}{5}t + 0.009\right) + 1.100 \times 10^{-5} \cos(2\pi t + 0.002)$$

$$\begin{aligned}
 2) \quad 0 < t < 0.02 \quad & \int_0^t \sin \sqrt{10} (t - \tau) d\tau \\
 x(t) = \frac{1}{10\sqrt{10}} \quad & \\
 = \frac{1}{10\sqrt{10}} \frac{1}{\sqrt{10}} \cos \sqrt{10} (t - \tau) \Big|_0^t & \\
 = \frac{1}{100} (\cos 0 - \cos \sqrt{10} t) & \\
 = \frac{1}{100} (1 - \cos \sqrt{10} t) &
 \end{aligned}$$

$$\underline{0.02 < t}$$

$$\begin{aligned}
 x(t) &= \frac{1}{10\sqrt{10}} \int_0^{0.02} \sin \sqrt{10} (t - \tau) d\tau + 0 \\
 &= \frac{1}{100} (\cos \sqrt{10} (t - \tau)) \Big|_0^{0.02} \\
 &= \frac{1}{100} (\cos \sqrt{10} (t - 0.02) - \cos \sqrt{10} t)
 \end{aligned}$$

$$3) a) 300 \ddot{X} + C \dot{X} + 40000 X = 40000 y + C \dot{y}$$

$$\frac{X}{Y} = \frac{40000 + C j \omega}{40000 - 300 \omega^2 + C j \omega}$$

At resonance $\frac{X}{Y} = 40$, $\omega = \sqrt{\frac{40000}{300}} = 11.55 \text{ rad/s}$

$$\left| \frac{40000 - C j 11.55}{11.55 C j} \right| = 40$$

Let's be honest.

I solved this using the solver in my calculator.

$$\frac{40000^2 + C^2 133.3}{C^2 133.3} = 1600$$

For entry tangent, $40000^2 + C^2 133.3 = 1600 \cdot 133.3 C^2$

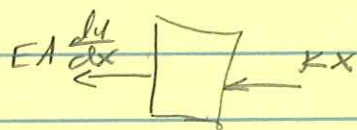
$$40000^2 = 1599.1333 C^2$$

$$C = 86.61 \text{ kg/s}$$

$$b) F_{\text{spring}} = \frac{40000}{K} |X - Y| = 40000 |0.1 e^{-1.5j} - 0.0025| = 4004 \text{ N}$$

$$F_{\text{dashpot}} = C \omega X = 86.61 \cdot 11.55 |X - Y| = 100.1 \text{ N}$$

4)



$$m \ddot{u}|_l = -K u|_l - EA \frac{du}{dx}|_l$$