Last Name: First Name: Q01

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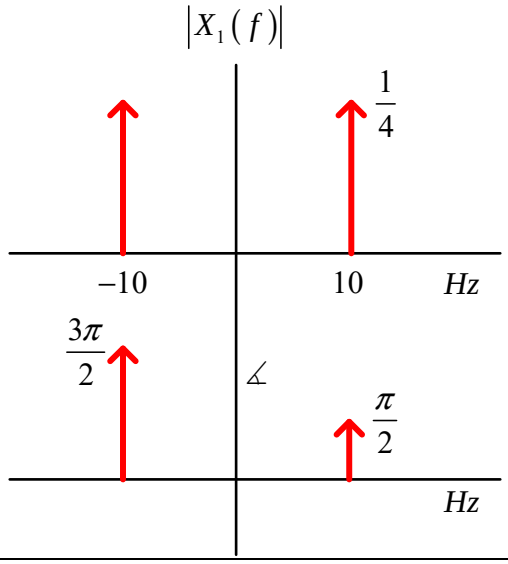
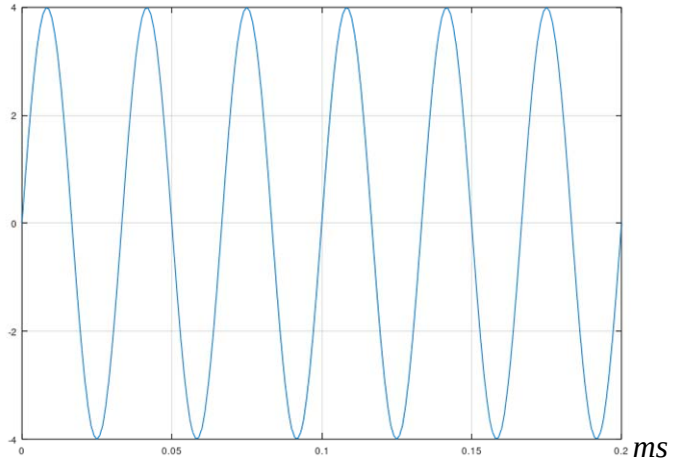
Two functions are shown, $X_1(f)$ in frequency (magnitude & phase) and $x_2(t)$ in time domain.

Note: $x_2(t)$ is written in from 0 to 0.2 ms (millisecond) in time and amplitude is 4. In this quiz, the amplitude of sinusoid is in peak values (not in RMS)

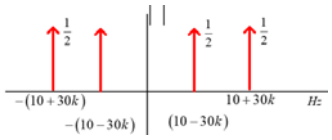




a) Write two signals in time domain.

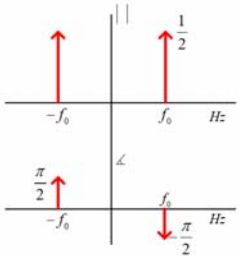
b) Find $\left[X(f)=F\{x_1(t)\cdot x_2(t)\}\right]$ (frequency response of multiplication of two functions)

c) Plot part b) in frequency domain

a)	$x_1(t)=-\frac{1}{2}\sin(2\pi\cdot 10\cdot t)$	$x_2(t)=4\sin(2\pi\cdot 30\cdot t)$
b)	$X(f)=\frac{1}{2}\left[\delta(f-(10+30k))+\delta(f+(10+30k))\right]$ $-\frac{1}{2}\left[\delta(f-(10-30k))+\delta(f+(10-30k))\right]$	
c)	Magnitude plot $\lvert X(f)\rvert$ 	Phase plot $\measuredangle X(f)$ 

a) From the Euler's equation,

$$\begin{cases} F\{A\sin(2\pi f_0 t)\}=\frac{1}{2j}\left[\delta(f-f_0)-\delta(f+f_0)\right] \\ @\ f=f_0:\left|\frac{1}{2j}\right|e^{j\left(-\frac{\pi}{2}\right)} \quad \& \quad f=-f_0:\left|-\frac{1}{2j}\right|e^{j\left(\frac{\pi}{2}\right)} \end{cases}$$



So

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	$x_1(t) = -\frac{1}{2}\sin(2\pi \cdot 10 \cdot t)$ and $x_2(t) = 4\sin(2\pi \cdot 30k \cdot t)$
b)	$X(f) = F\{x_1(t) \cdot x_2(t)\}$ $= \left(-\frac{1}{2}\sin(2\pi \cdot 10 \cdot t)\right) \cdot \left(4\sin(2\pi \cdot 30k \cdot t)\right)$ *where* $[x = 2\pi \cdot 10 \cdot t \ \ \& \ \ y = 2\pi \cdot 30k \cdot t]$ $= \left(-\frac{1}{2}\right) \cdot (4) \left[\left(\frac{e^{jx} - e^{-jx}}{j2}\right)\left(\frac{e^{jy} - e^{-jy}}{j2}\right)\right]$ $= \left(-\frac{1}{2}\right) \cdot (4) \cdot \left(\frac{1}{2j}\right) \cdot \left(\frac{1}{2j}\right)\left[\left(e^{jx} - e^{-jx}\right)\left(e^{jy} - e^{-jy}\right)\right]$ $= \left(-\frac{1}{2}\right) \cdot (4) \cdot \left(\frac{1}{2j}\right) \cdot \left(\frac{1}{2j}\right)\left[\left(e^{j(x+y)} - e^{j(x-y)} - e^{-j(x-y)} + e^{-j(x+y)}\right)\right]$ $= \left(\frac{1}{2}\right) \cdot (4) \cdot \left(\frac{1}{2}\right)\left[\frac{e^{j(x+y)} + e^{-j(x+y)}}{2} - \left(\frac{e^{j(x-y)} + e^{-j(x-y)}}{2}\right)\right]$ $= \cos(x+y) - \cos(x-y)$ $= \cos(2\pi \cdot (10+30k) \cdot t) - \cos(2\pi \cdot (10-30k) \cdot t)$
c)	$F\{\cos(2\pi \cdot (10+30k) \cdot t) - \cos(2\pi \cdot (10-30k) \cdot t)\}$ $= \frac{1}{2}[\delta(f - (10+30k)) + \delta(f + (10+30k))] - \frac{1}{2}[\delta(f - (10-30k)) + \delta(f + (10-30k))]$