Given a voltage represented by the phasor

\[ V = 10 - j10 \]

What is the derivative of the voltage in the time domain? The frequency is 10 Hz.

A \[ \frac{d}{dt} v(t) = 100\sqrt{2} \cos(10t + 45^\circ) \]

B \[ \frac{d}{dt} v(t) = 200\sqrt{2}\pi \cos(2\pi10t + 135^\circ) \]

C \[ \frac{d}{dt} v(t) = 200\pi \cos(2\pi10t + 45^\circ) \]

D \[ \frac{d}{dt} v(t) = 200\sqrt{2}\pi \cos(2\pi10t + 45^\circ) \]

E 0
First express phasor as magnitude and phase (polar form):

\[ V = 10 - j10 = 10\sqrt{2}e^{-j45^\circ} \]

Phasor representing derivative is then

\[ V_d = (j2\pi10)10\sqrt{2}e^{-j45^\circ} = 200\sqrt{2}\pi e^{j90^\circ} e^{-j45^\circ} = 200\sqrt{2}\pi e^{j45^\circ} \]

So time domain waveform is

\[ \frac{d}{dt} v(t) = 200\sqrt{2}\pi \cos(2\pi10t + 45^\circ) \]
Alternative solution based on in-class discussion. You want to be able to do this in the phasor domain, though!

First express phasor as magnitude and phase (polar form):

\[ V = 10 - j10 = 10\sqrt{2}e^{-j45^\circ} \]

Time-domain version of this voltage is then

\[ v(t) = 10\sqrt{2} \cos(2\pi 10t - 45^\circ) \]

Take the derivative in the time domain

\[ \frac{d}{dt} v(t) = -200\sqrt{2}\pi \sin(2\pi 10t - 45^\circ) \]

\[ = 200\sqrt{2}\pi \cos(2\pi 10t - 45^\circ + 90^\circ) \]

\[ = 200\sqrt{2}\pi \cos(2\pi 10t + 45^\circ) \] which is the same.