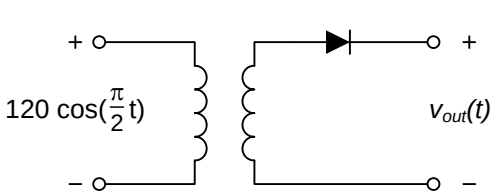
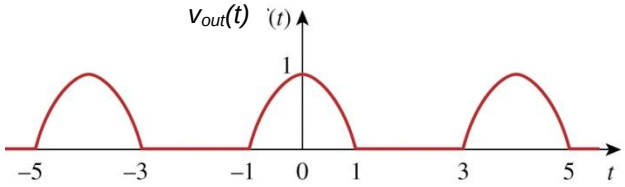
Given: When you measure a halfwave rectifier that you built (shown below) you find the given output voltage waveform.





Find: The DC (A_o) and the amplitude of the first harmonic (A_1) of $v_{out}(t)$. Check answers using intuition/estimation.

$f(t)$ even $\Rightarrow b_n = 0$

$\omega_0 = \frac{\pi}{2}$ (given). $T = \frac{2\pi}{\omega_0} = 4$

$a_0 = \frac{1}{T}\int_{\langle T \rangle} f(t)\,dt = \frac{1}{4}\int_{-1}^{1} \cos\left(\frac{\pi}{2}t\right)dt = \frac{1}{4}\left[\frac{2}{\pi}\sin\frac{\pi}{2}t\right]_{-1}^{1} = \frac{1}{2\pi}\left[\sin\frac{\pi}{2} - \sin\left(-\frac{\pi}{2}\right)\right] = \frac{1}{\pi}$

by inspection, I guess the average is between $\frac{1}{4}$ and $\frac{1}{2}$ ✓

$a_1 = \frac{2}{T}\int_{\langle T \rangle} f(t)\cos(n\omega_0 t)\,dt = \frac{2}{4}\int_{-1}^{1} \cos\left(\frac{\pi}{2}t\right)\cos\left(\frac{\pi}{2}t\right)dt = \frac{1}{2}\int_{-1}^{1}\frac{1}{2}\left[\cos(\pi t) + \cos(0)\right]dt$

$= \frac{1}{4}\int_{-1}^{1}\cos(\pi t) + 1\,dt = \frac{1}{4}\left[\frac{1}{\pi}\sin\pi t\Big|_{-1}^{1} + t\Big|_{-1}^{1}\right] = \frac{1}{4}\left[\frac{1}{\pi}\sin\pi - \frac{1}{\pi}\sin(-\pi) + 1 - -1\right] = \frac{1}{2}$

by inspection, I guess something between 1/4 and 1 ✓

$b_n = 0$ since even

$A_0 = a_0 = \boxed{\frac{1}{\pi}}$

$A_1 \angle\phi_1 = a_1 - jb_1 = \frac{1}{2} - j0 = \frac{1}{2}\angle 0° \Rightarrow \boxed{A_1 = \frac{1}{2}}$