Problems for Circuit Analysis with Sinusoidal Sources

After AC1b Sine Characterization

1. If a voltage is a cosine function with an amplitude of 12 V, a frequency of 10 rad/s and a phase of 30^o, when does the voltage first cross through zero after $t = 0$? (Answer: 33 ms)

2. What is the period (in seconds) of a voltage with a frequency of 60 Hz, an amplitude of 170 V and a 45^o phase shift? (Answer: 16.7 ms)

3. If a voltage source, when characterized as a cosine wave, is specified as having a peak amplitude of 15 V, a frequency of 1 kHz and zero phase shift, what is the value of the source when $t = 250$ μs? (Answer: 10.6 V)

After AC3d Impedance 2

1. The impedance of a capacitor increases with frequency.

   True. (Answer: Wrong)

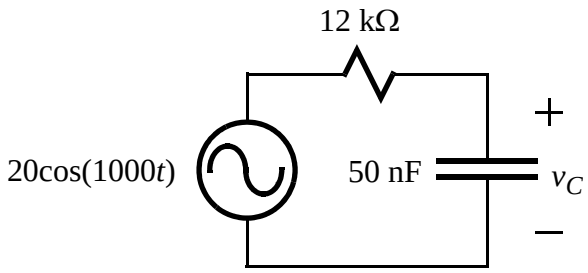
   False. (Answer: Correct)

2. At what frequency is the magnitude of a 2.5 mH inductor's impedance equal to the impedance of a 10 kΩ resistor? (Answer: 637 kHz)

3. If a capacitor is found to have an impedance of $-j\,4\ \Omega$ at 25 kHz, what is the value of the capacitor? (Answer: 1.59 μF)

After AC3e Example:

1. Use Phasor analysis to determine the voltage across the capacitor in the circuit shown below. (Answer: $17.2\cos(1000t + 31^o)$)



Problems for Power Calculations in Sinusoidally Driven Circuits

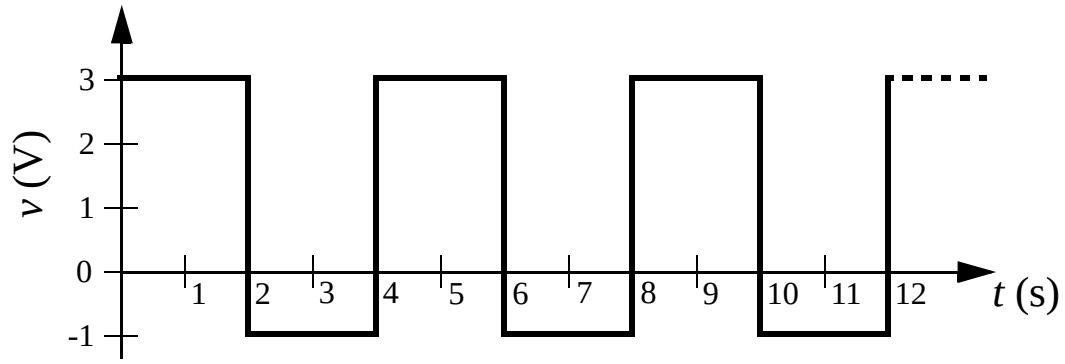
After PW1b Example: (Instantaneous power)

1. If a current, $i(t) = 3\cos(10\pi t)$ mA flows through a 1 kΩ resistor, what is the instantaneous power delivered to the resistor when $t = 0.333$ s? (Answer: 2.3 mW)

2. If a current, $i(t) = 6\cos(12\pi t)$ mA flows through a 10 μH Inductor, what is the instantaneous power delivered to the inductor when $t = 0.25$ s? (Answer: 0 W)

After PW1d Example: (Average of a periodic waveform)

1. Calculate the average value of the voltage shown below. (Answer: 1 V)



After PW1e Sin Average: (Average power in sinusoidally driven circuits)

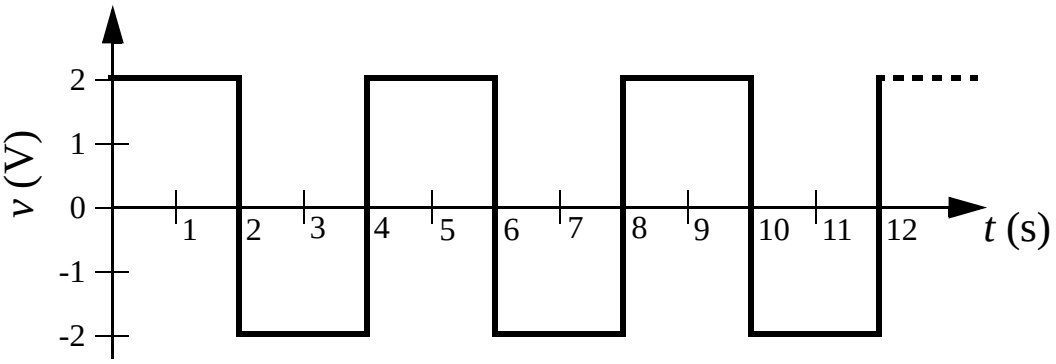
1. If the voltage and current supplied to a circuit are know to be 90^o out of phase, what can we say about the power delivered to the circuit?

   a. Power is being delivered to the circuit. (Answer: Wrong, $\cos(90^o) = 0$ so power = 0)
   b. No power is transferred. (Answer: Correct)
   c. Power is being supplied by the circuit. (Answer: Wrong, $\cos(90^o) = 0$ so power = 0)

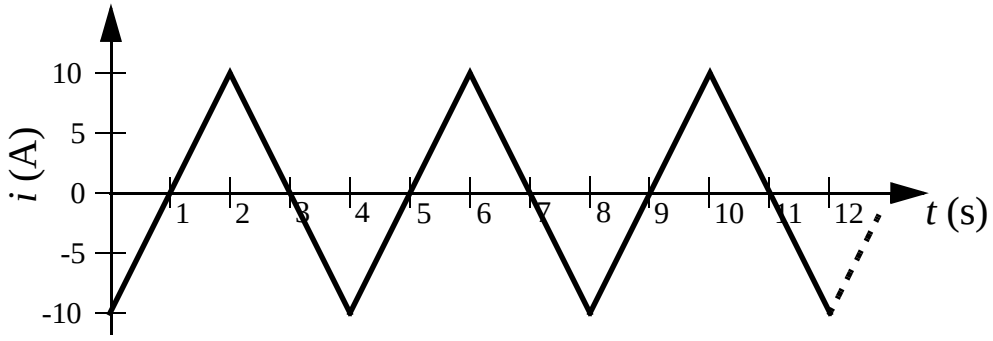
2. Measurements of a circuit have found that the current is given by $i(t) = 2\cos(60\pi t + 15^o)$ A and the voltage is given by $v(t) = 170\cos(60\pi t + -15^o)$ V. What is teh averag power delivered to the circuit? (Answer: 52.5 W)

After PW2b Example: (Calculating the effective value)

1. Calculate the effective value of the voltage shown below. (Answer: 2 V_{RMS})



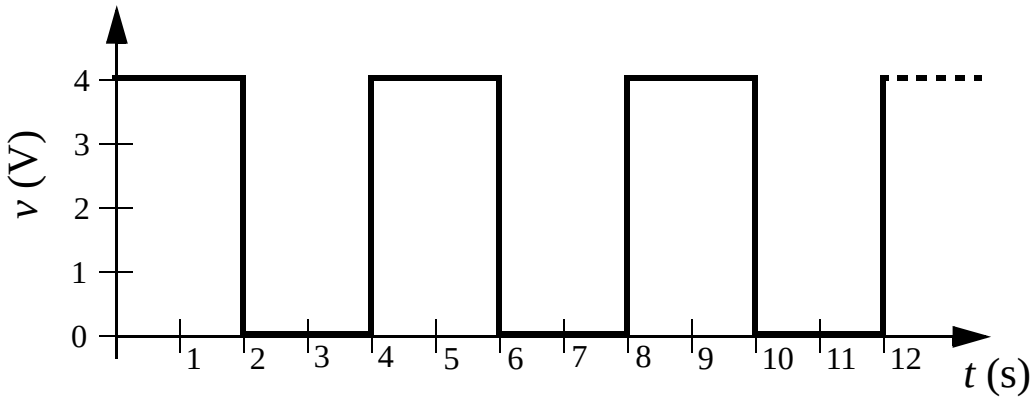
2. Calculate the effective value of the current shown below. (Answer: 5.77 A_{RMS})



After PW2e Example 2 sines: (Calculating the effective value of combinations of signals)

1. Using the equations developed in the previous video, determine the effective value of a signal composed of three sinusoidal signals with amplitudes of 2 V, 3 V and 5 V. (Answer: 4.36 V_{RMS}).

2. Calculate the effective value of the waveform shown below by considering it to be composed of a dc offset and a square wave with a zero dc average. (Answer: 2.828 V_{RMS})



After PW3c Example: (Calculating complex power and power factors)

1. A leading PF occurs when the complex power leads the real power;
   - True. (Answer: Wrong)
   - False (Answer: Correct)

2. The PF of a load composed entirely of resistors and capacitors will;
   a. Always be leading. (Answer: correct)
   b. Depend on the phase of the applied voltage. (Answer: wrong)
   c. Always be lagging. (Answer: wrong)

3. If a circuit is operating at a power factor of 0.5 lagging and the voltage has a phase of 15^o, what is the phase angle of the current? (answer: -45^o)

After PW3e Example: (Using the power triangle)

1. If a load is specified as 2.5 kW, with a leading PF of 0.866, what is the value of the reactive power? (Answer: -1.44 kVAR)

2. A load is found to be operating at a lagging PF of 0.5 and drawing 1.6 kVAR, what is the real power supplied to the load? (Answer: 924 W)

After PW3g PF Example: (Power factor correction)

1. If the complex power delivered to a load from a 60 Hz, 120 V_{RMS} source is found to be 1.414 kVA (lagging) and it is required to increase the PF to 0.9, what is the minimum value of capacitance required to be connected in parallel with the load? (Answer: 11 mF)