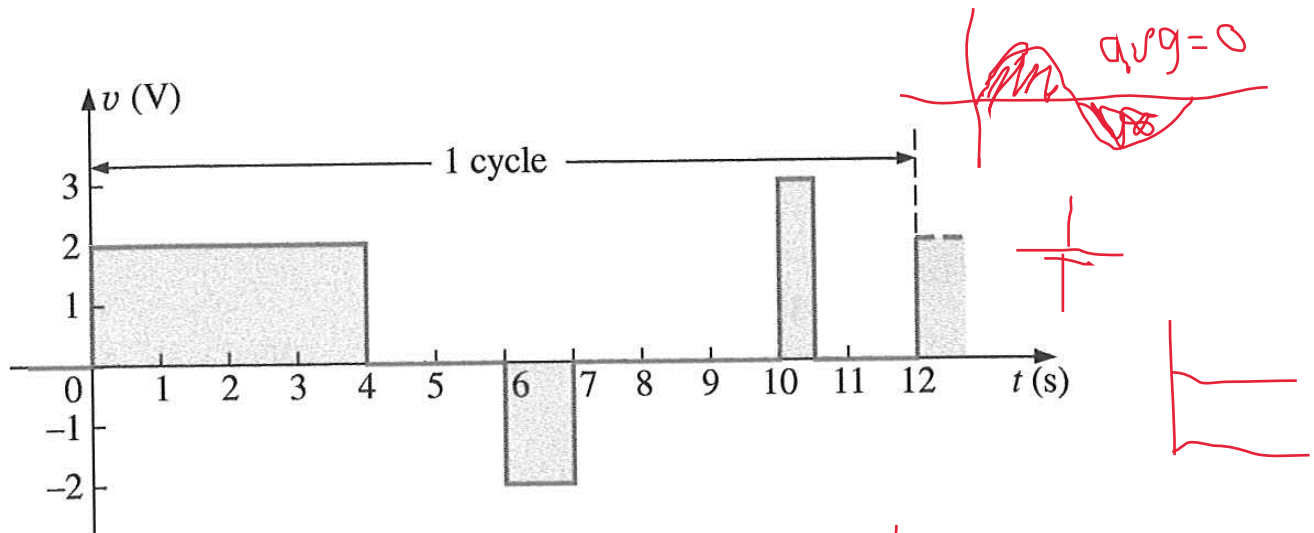


ENGG104 Tutorial 8 Class Questions

Team Name: _____

Question 1 [typical exam question]



- (a) Determine the average voltage V_{ave} for the waveform above

$$V_{ave} = \frac{2 \times 4 - 2 \times 1 + 3 \times 0.5}{12} = 0.625V$$

- (b) Determine the RMS voltage V_{rms} for the same waveform

$$V_{rms} = \sqrt{\frac{(2V)^2(4s) + (-2V)^2(1s) + (3V)^2\left(\frac{1}{2}s\right)}{12s}} = 1.43V$$

Handwritten red notes for RMS calculation:

$$V_{rms} = \frac{V_p}{\sqrt{2}}$$

RMS

$$\sqrt{\frac{(a^2 + \dots + b^2)}{T}}$$

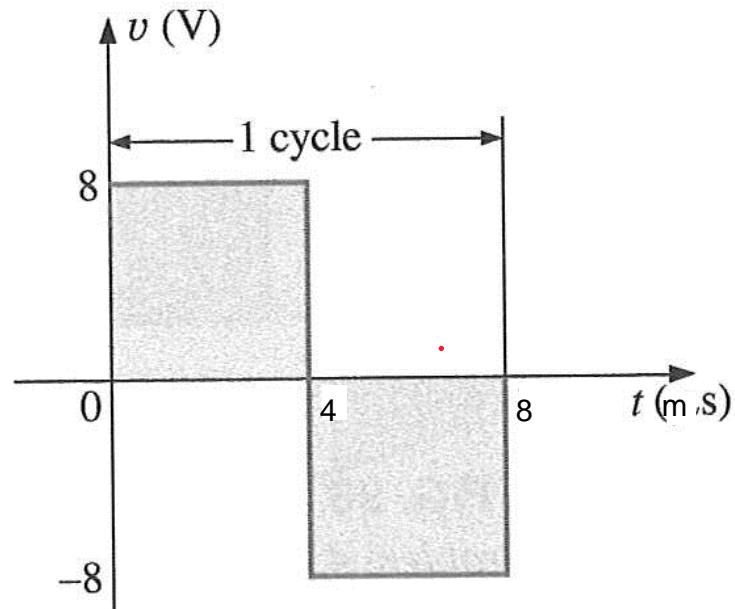
please note that square root is for the whole number not just the numerator.

- (c) Describe the difference between average and RMS values?

The average provides the average or the actual DC value of the waveform. While the RMS provides the **equivalent DC** value that will deliver the same **power**

Question 2 [typical exam question]

Repeat parts (a) and (b) for the following typical (communications) waveform:



$$G = \frac{(8 \text{ V})(4 \text{ ms}) - (8 \text{ V})(4 \text{ ms})}{8 \text{ ms}} = \frac{0}{8 \text{ ms}} = 0 \text{ V}$$

$$V_{\text{rms}} = \sqrt{\frac{(8 \text{ V})^2(4 \text{ ms}) + (-8 \text{ V})^2(4 \text{ ms})}{8 \text{ ms}}} = 8 \text{ V}$$

Question 3

The voltage across a $3\ \Omega$ resistor is as indicated. Find the sinusoidal expression for the current. In addition, sketch the v and i sinusoidal waveforms on the same axis.

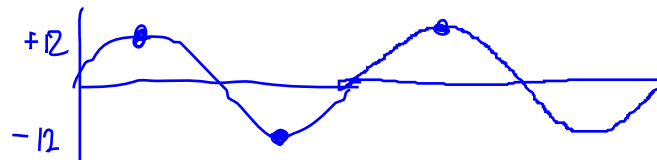
- a. $150 \sin 200t$
- b. $30 \sin(377t + 20^\circ)$
- c. $6 \cos(\omega t + 10^\circ)$
- d. $-12 \sin(\omega t + 40^\circ)$
 $12 \sin(\omega t + ?)$

what is the phase relationship between cosine and sine

$$\cos(\omega t + 10) = \sin(\omega t + 10 + 90) = \sin(\omega t + 100)$$

$-12\sin(\omega t + 40)$ can also be expressed as

- a. $I_m = V_m/R = 150\text{ V}/3\ \Omega = 50\text{ A}, i = 50 \sin 200t$
- b. $I_m = V_m/R = 30\text{ V}/3\ \Omega = 10\text{ A}, i = 10 \sin(377t + 20^\circ)$
- c. $I_m = V_m/R = 6\text{ V}/3\ \Omega = 2\text{ A}, i = 2 \sin(\omega t + 100^\circ)$
- d. $I_m = V_m/R = 12\text{ V}/3\ \Omega = 4\text{ A}, i = 4 \sin(\omega t + 220^\circ)$



Question 4

please note that the value for L is 2H and not 2 mH.

Determine the inductive reactance (in ohms) of a 2 H coil for

- a. dc
- and for the following frequencies:
- b. 60 Hz
- c. 4 kHz
- d. 1.2 MHz

$$X_L = j\omega L$$

$$= j2\pi f(L)$$

a. 0Ω

b. $X_L = 12.56f = 12.56(60 \text{ Hz}) = 753.6 \Omega$ ✓
 $2\pi fL$

c. $X_L = 12.56f = 12.56(4 \text{ kHz}) = 50.24 \text{ k}\Omega$ ✓
 $2\pi fL$

d. $X_L = 12.56f = 12.56(1.2 \text{ MHz}) = 15.07 \text{ M}\Omega$ ✓
 $2\pi fL$

Question 5

The current through a 20Ω inductive reactance is given. What is the sinusoidal expression for the voltage? Sketch the v and i sinusoidal waveforms on the same axis.

a. $i = 5 \sin \omega t$

b. $i = 40 \times 10^{-3} \sin(\omega t + 60^\circ)$

c. $i = -6 \sin(\omega t - 30^\circ)$

what is the phase relationship between current and voltage for an inductor

a. $V_m = I_m X_L = (5 \text{ A})(20 \Omega) = 100 \text{ V}$
 $v = 100 \sin(\omega t + 90^\circ)$

b. $V_m = I_m X_L = (40 \times 10^{-3} \text{ A})(20 \Omega) = 0.8 \text{ V}$
 $v = 0.8 \sin(\omega t + 150^\circ)$

c. $i = 6 \sin(\omega t + 150^\circ)$, $V_m = I_m X_L = (6 \text{ A})(20 \Omega) = 120 \text{ V}$
 $v = 120 \sin(\omega t + 240^\circ) = 120 \sin(\omega t - 120^\circ)$

Question 6

The voltage across a 2.5Ω capacitive reactance is given. What is the sinusoidal expression for the current? Sketch the v and i sinusoidal waveforms on the same set of axes.

a. $120 \sin \omega t$

b. $4 \times 10^{-3} \sin(\omega t + 40^\circ)$

For a capacitor, what is the phase relationship between current and voltage

a. $I_m = V_m/X_C = 120 \text{ V}/2.5 \text{ } \Omega = 48 \text{ A}$
 $i = 48 \sin(\omega t + 90^\circ)$

b. $I_m = V_m/X_C = 4 \times 10^{-3} \text{ V}/2.5 \text{ } \Omega = 0.16 \text{ A}$
 $i = 1.6 \times 10^{-3} \sin(\omega t + 130^\circ)$