AC Waveform Introduction

- Team Assignments
  - Sit together now, also in myCourses as teams
- AC Waveforms
  - Intro, various types
  - Sinusoids, intro and characteristics
  - ICP
- Sinusoids Continued
  - AC sources
  - Equations
  - Radians and degrees
  - ICP
  - Phase lead and lag
  - ICP

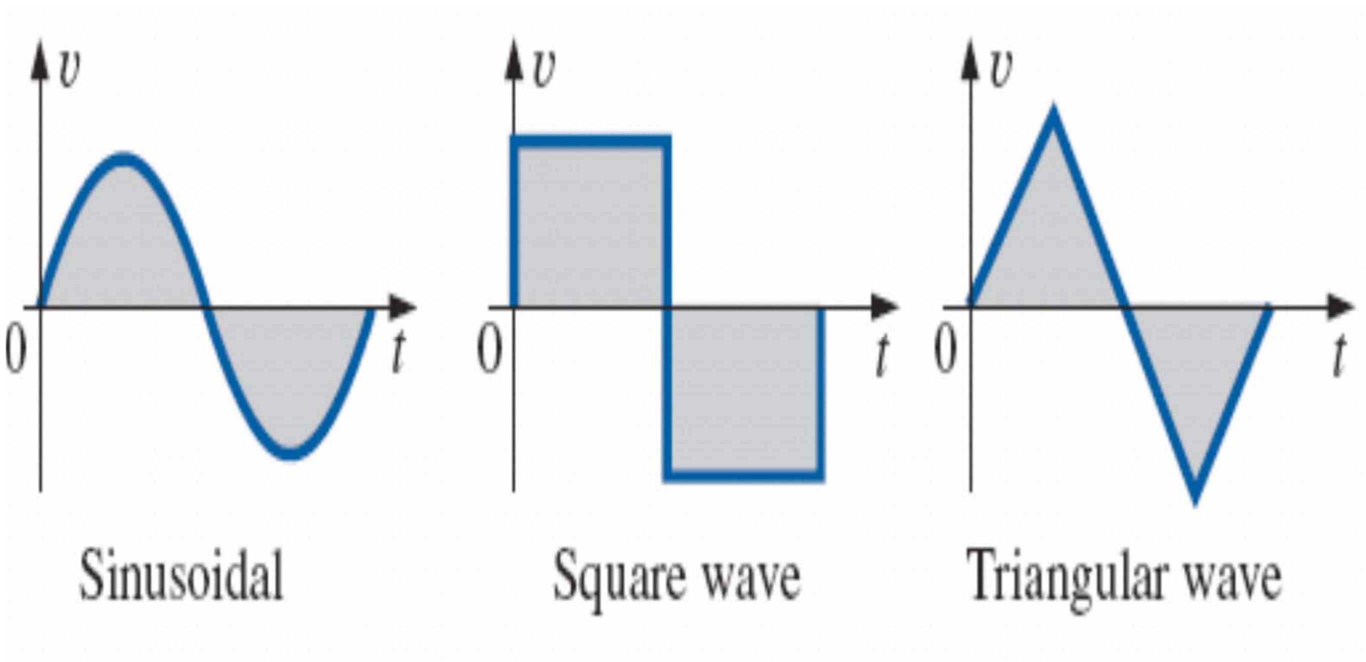


FIG. 13.1 *Alternating waveforms.*

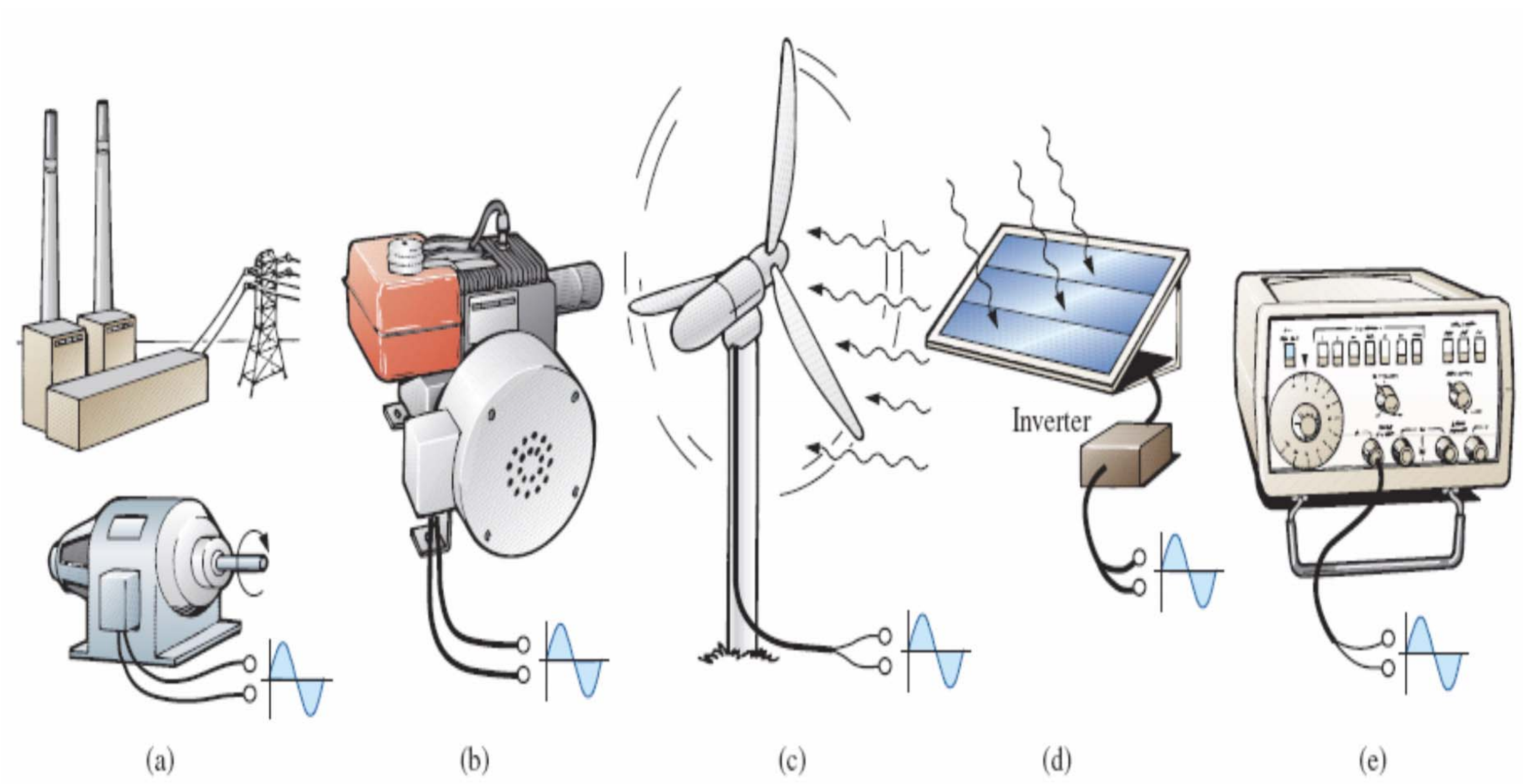


FIG. 13.2 *Various sources of ac power: (a) generating plant; (b) portable ac generator; (c) wind-power station; (d) solar panel; (e) function generator*

Note – Peak amplitude (Em) and Period (T)

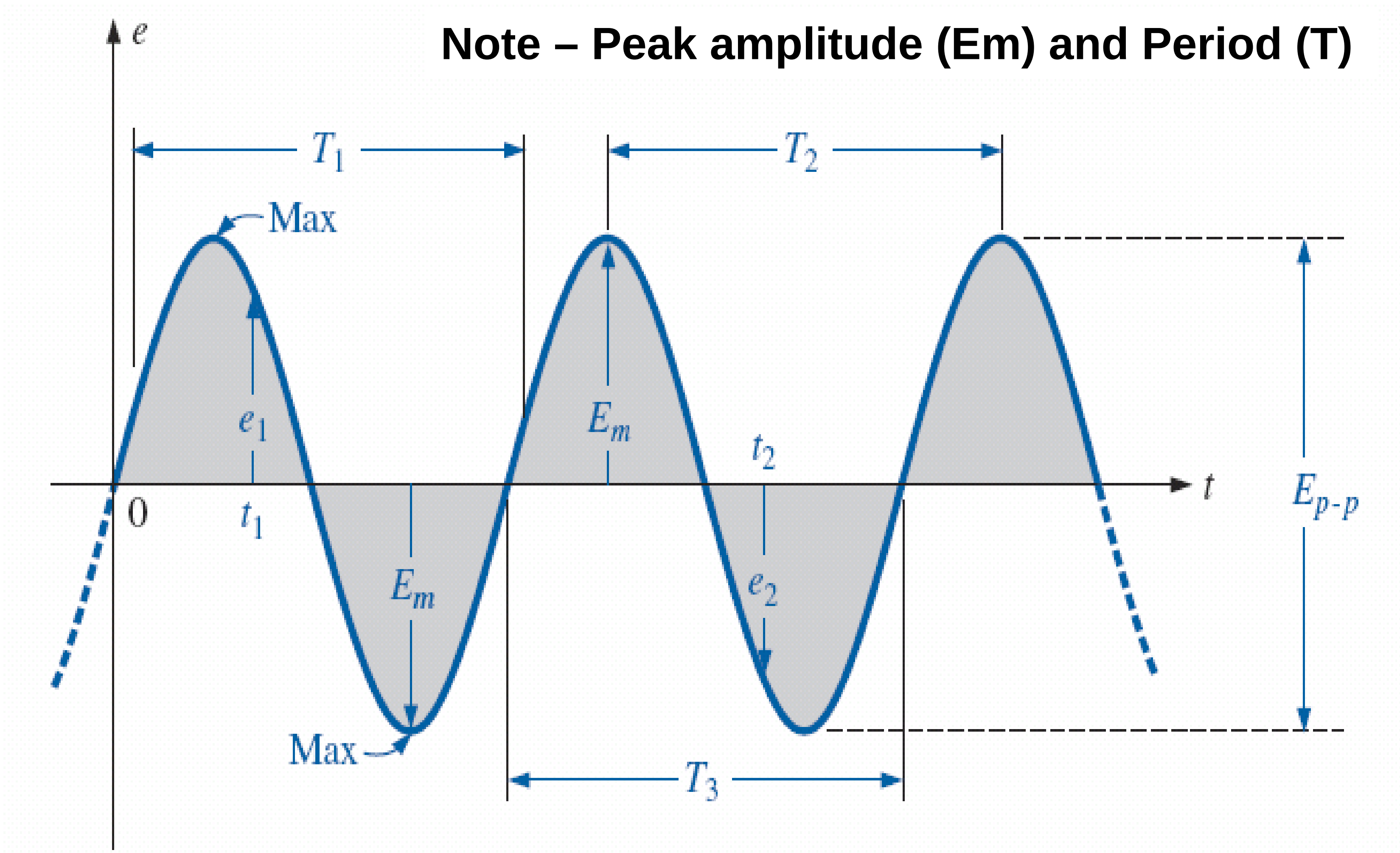


FIG. 13.3 *Important parameters for a sinusoidal voltage.*

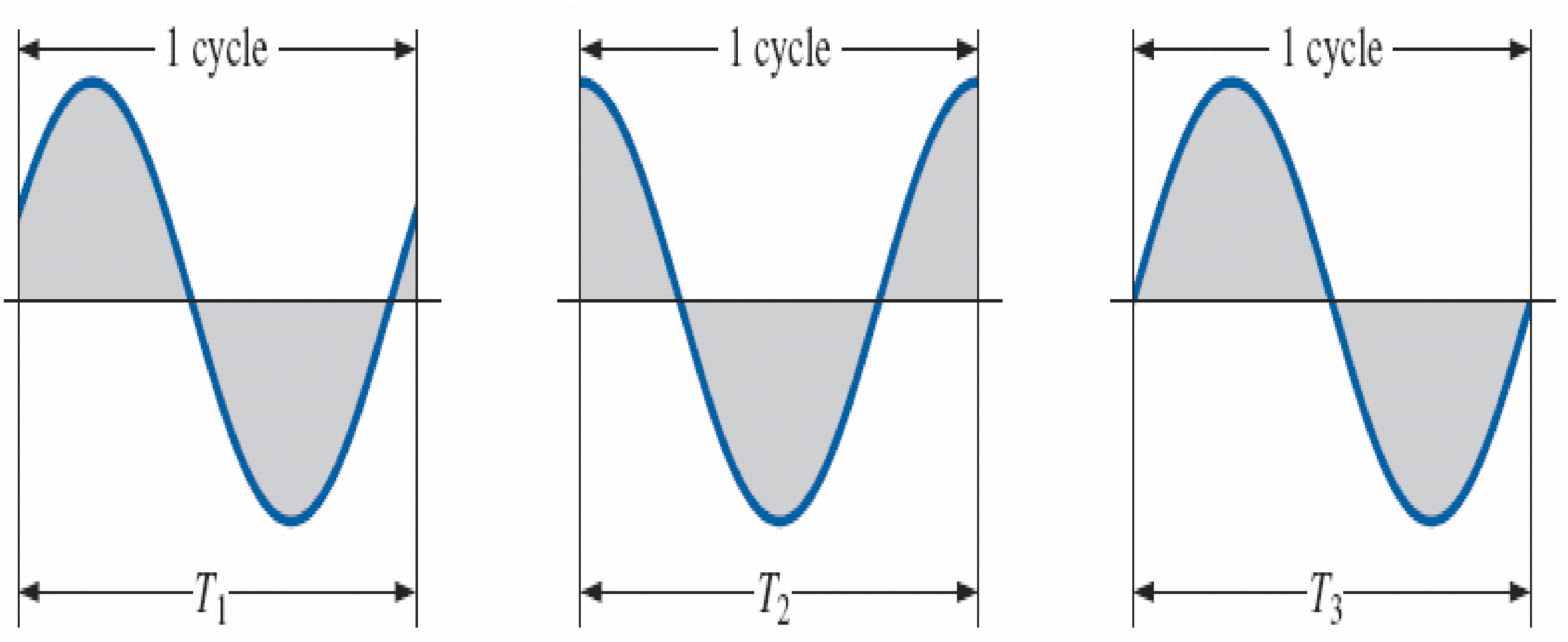
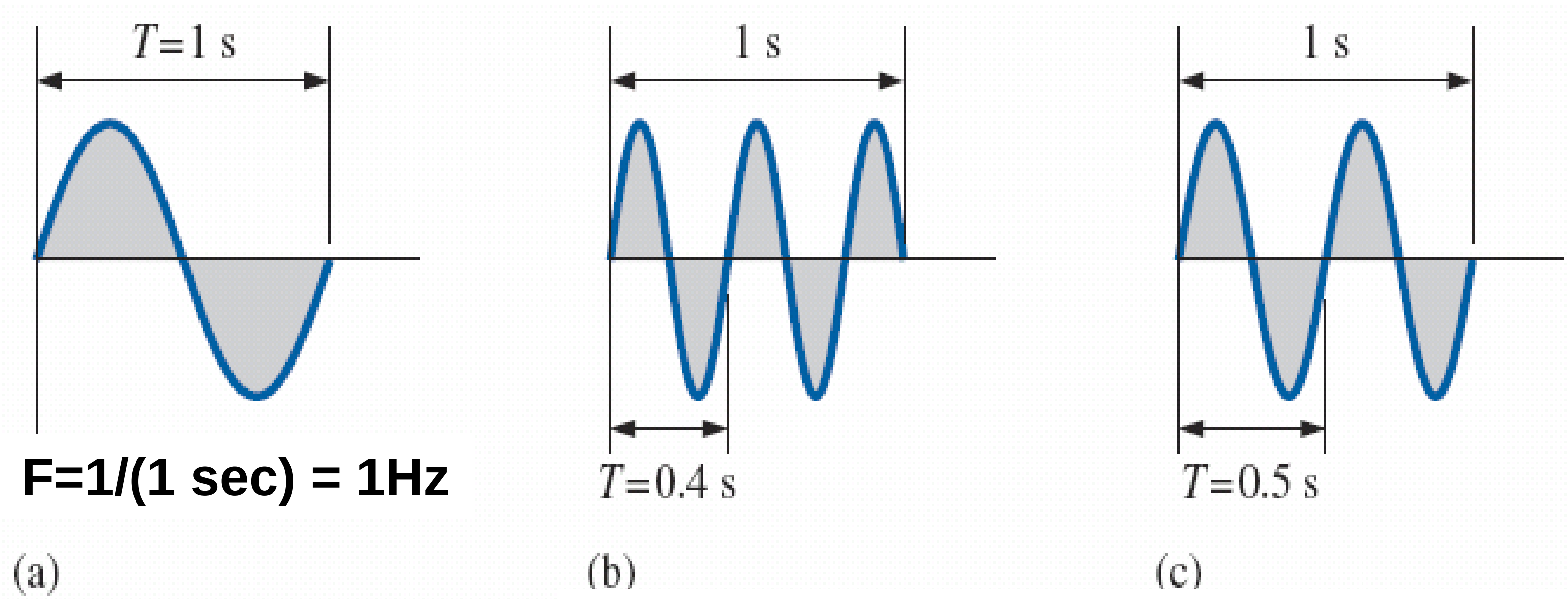


FIG. 13.4 *Defining the cycle and period of a sinusoidal waveform.*

Frequency (f in cycles/second or Hz) = 1/T



F=1/(1 sec) = 1Hz

F=1/(0.4 sec) = 2.5Hz   **F=1/(0.5 sec) = 2Hz**

FIG. 13.5 *Demonstrating the effect of a changing frequency on the period of a sinusoidal waveform.*

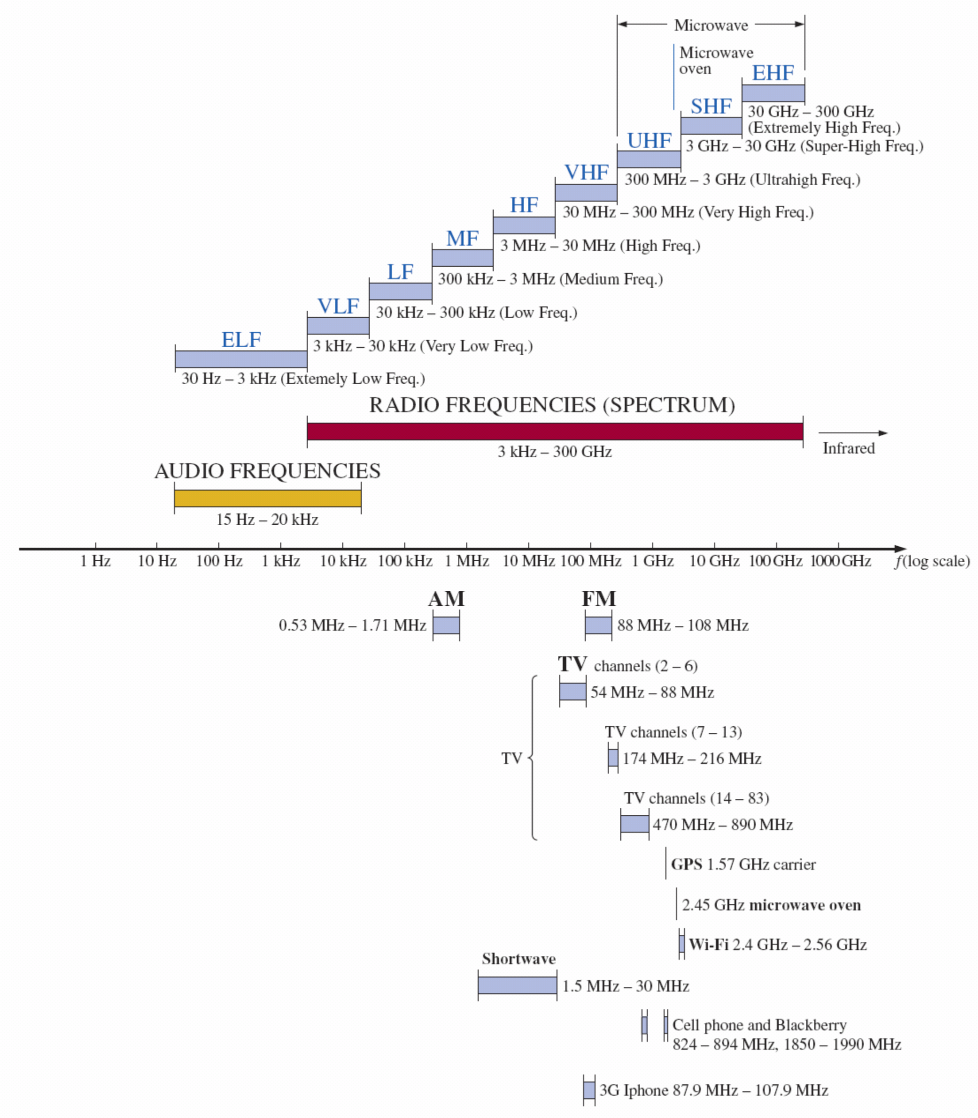


FIG. 13.8 *Areas of application for specific frequency bands.*

Find the period (T) and frequency (F)

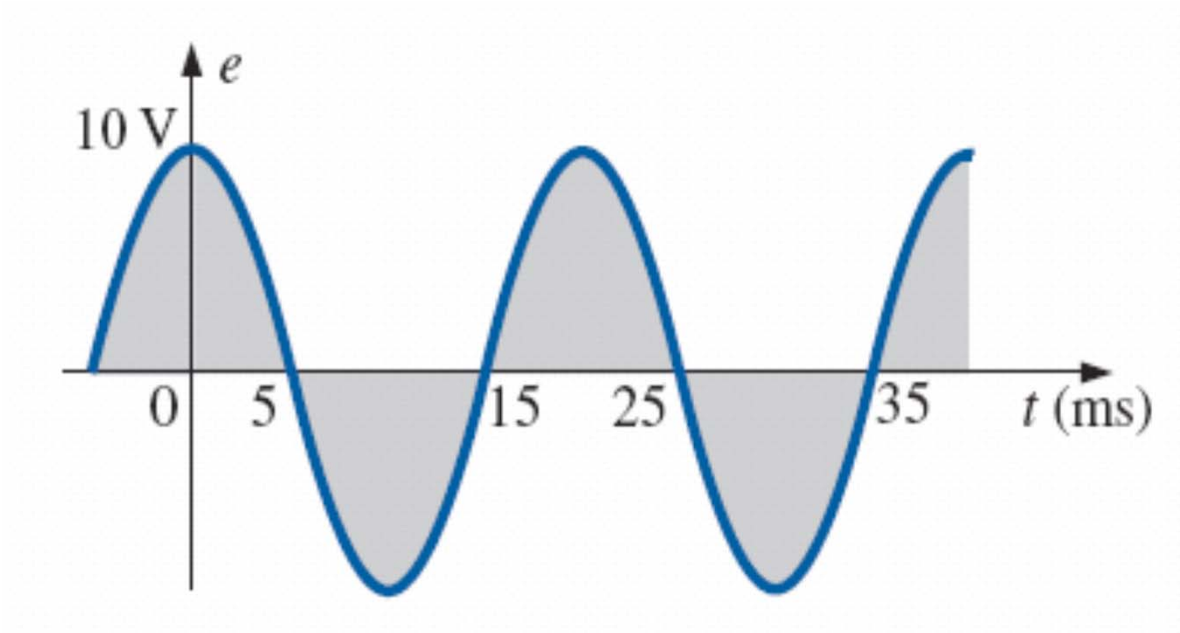
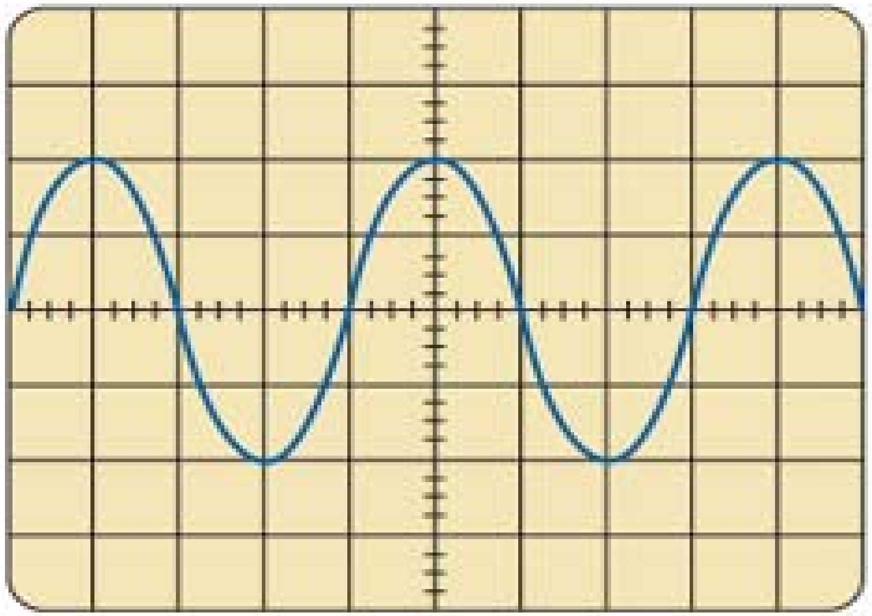


FIG. 13.9 *Example 13.3.*

ICP – Find T, f and Vpeak (O'Scope Screen)

Ground (0V) →



Vertical sensitivity = 0.1 V/div.
Horizontal sensitivity = 50 μs/div.

FIG. 13.38
Example 13.13.

Note – Lower Case Notation: e(t), i(t)…

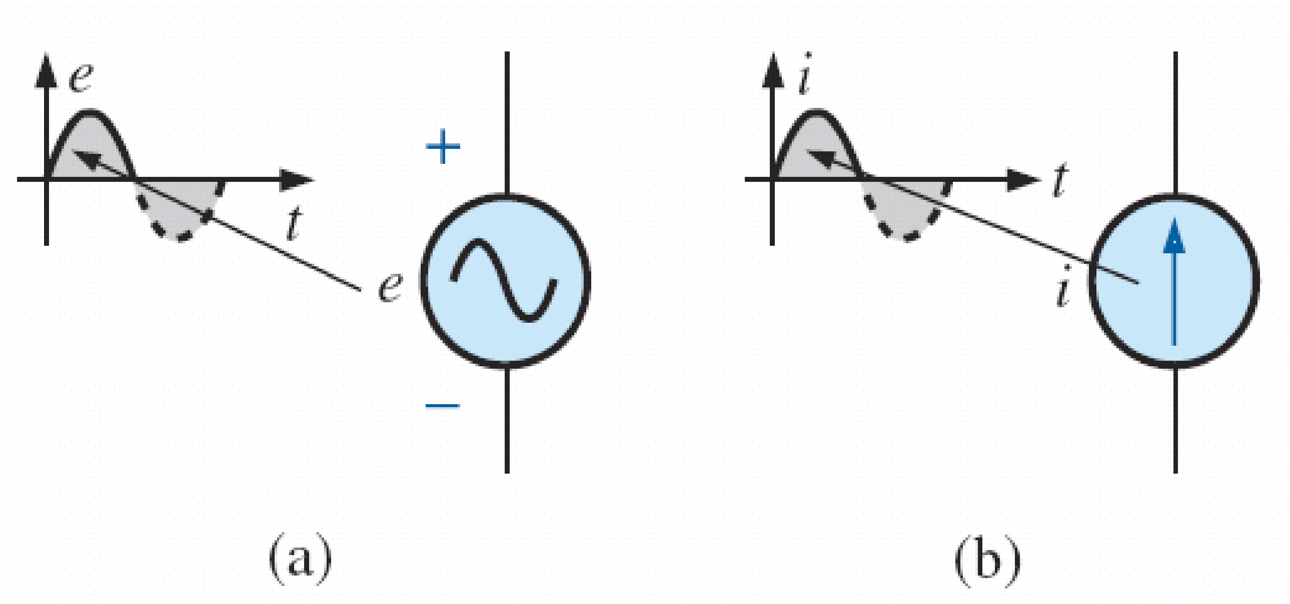


FIG. 13.11 *(a) Sinusoidal ac voltage sources; (b) sinusoidal current sources.*

e(t) = Em*sin(alpha)
or
i(t) = Im*sin(alpha)

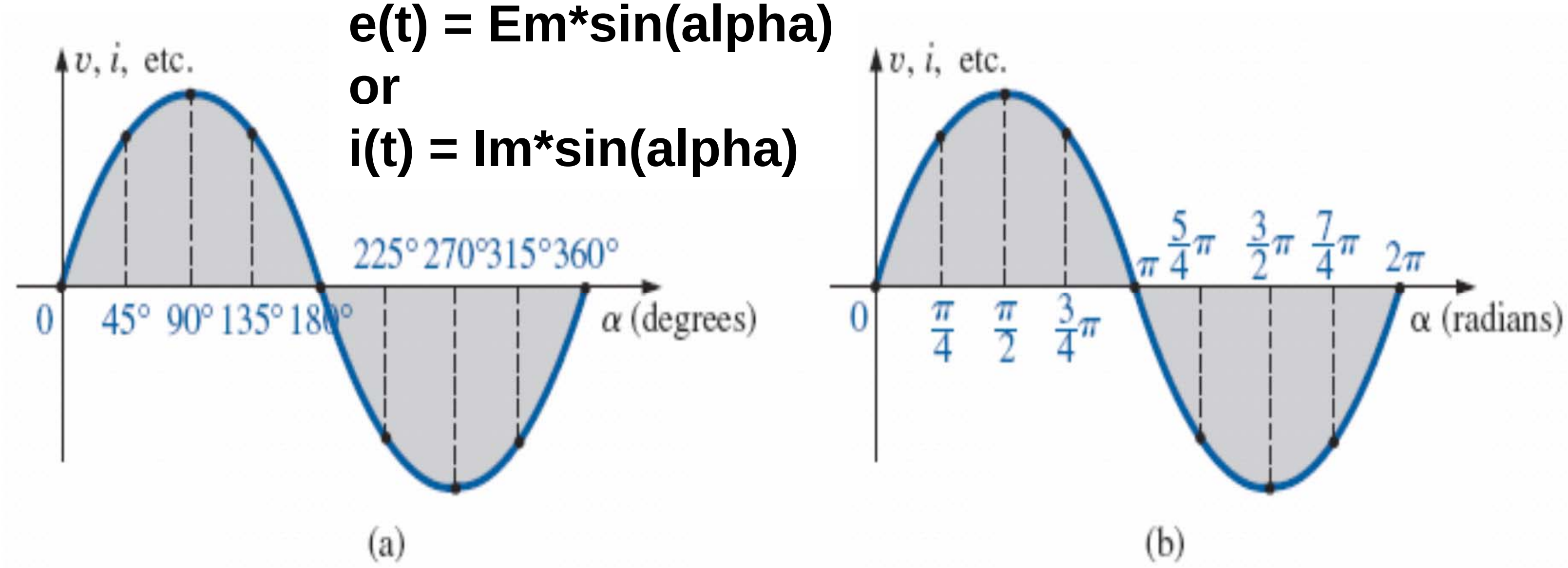


FIG. 13.15 *Plotting a sine wave versus (a) degrees and (b) radians.*

Make sure you:

- **Know how to use your calculator in degrees (DEG) and radian (RAD) modes**
- **Can convert between degrees and radians**

Note: Angular speed (omega, w) = angle/time or alpha/t
So Em*sin(alpha) = Em*sin(w*t)

Examples : Sharp EL-516 (calculator from DC Circuits)

6 [sin] [cos] [tan] [sin⁻¹] [cos⁻¹] [tan⁻¹] [π] [hyp] [arc hyp]
[ln] [log] [$\log_a x$] [e^x] [e] [10^x] [x^{-1}] [x^2] [x^3]
[$\sqrt{\ }$] [y^x] [$\sqrt[x]{\ }$] [$\sqrt[3]{\ }$] [n!] [nPr] [nCr] [%] [abs]

	[2ndF] [M-CLR] [0]	0.
sin 60 [°] =	[ON/C] [sin] 60 [=]	$\frac{\sqrt{3}}{2}$
	[CHANGE]	0.866025403
$\cos\frac{\pi}{4}$ [rad] =	[2ndF] [SET UP] [0] [1] [cos] [2ndF] [π] [a/b] 4 [=]	$\frac{\sqrt{2}}{2}$
	[CHANGE]	0.707106781

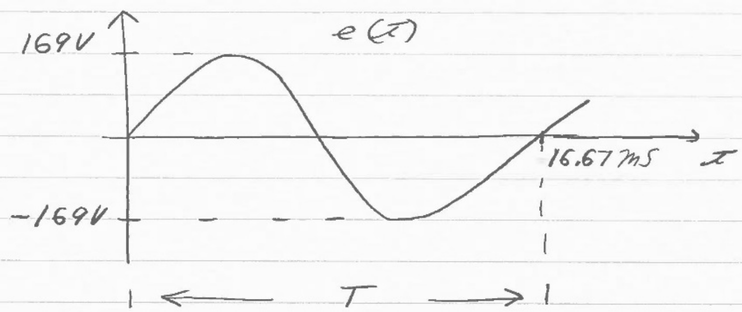
DEG = degree mode
RAD = radian mode (top of display)

(2ndF,SETUP,0 to select)

90° → [rad]	[ON/C] 90 [2ndF] [DRG▶]	$\frac{1}{2}\pi$
→ [g]	[2ndF] [DRG▶]	100.
→ [°]	[2ndF] [DRG▶]	90.

ICP

CONSIDER



FIND: f, ω, EQUATION

FIND: $e(t)$ AT $t = 5\,ms$, $10\,ms$
& t WHEN $e(t) = 169V$, $-169V$

169V:

-169V:

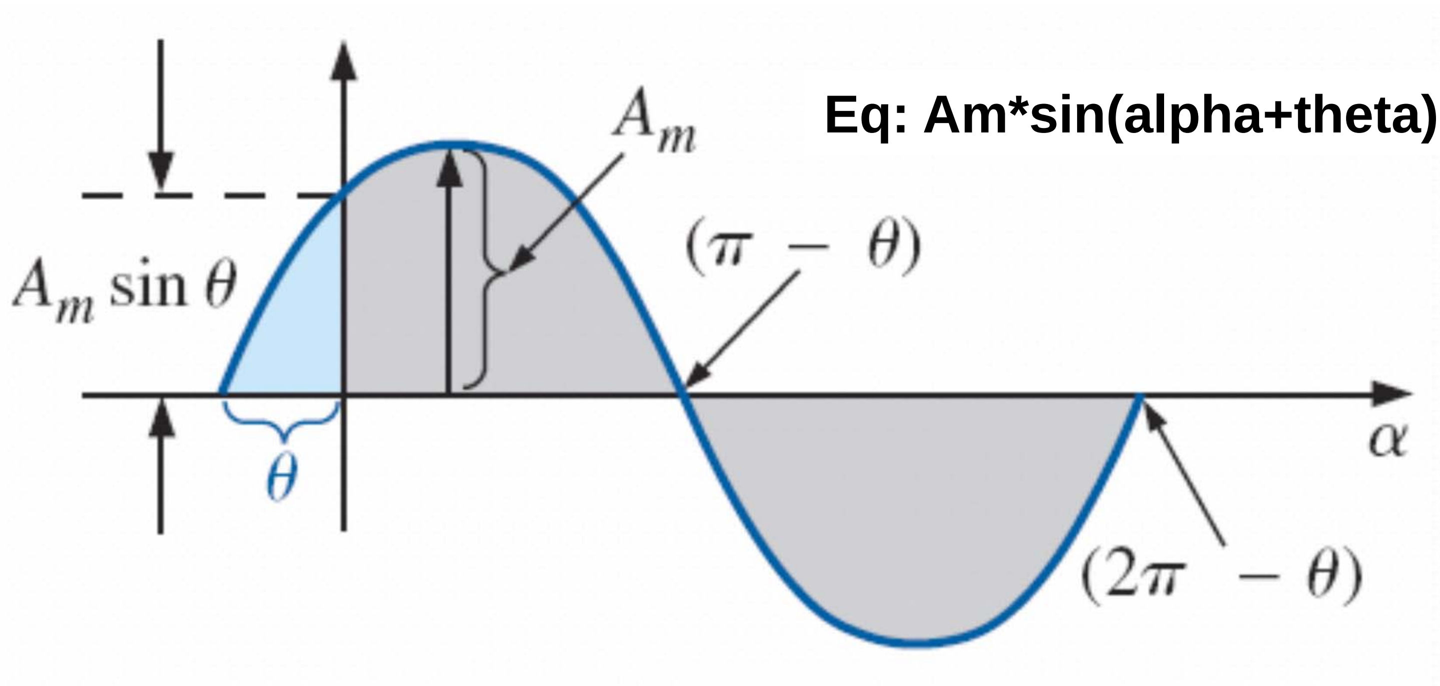


FIG. 13.27 *Defining the phase shift for a sinusoidal function that crosses the horizontal axis with a positive slope before 0°.*

Eq: Am*sin(alpha-theta)

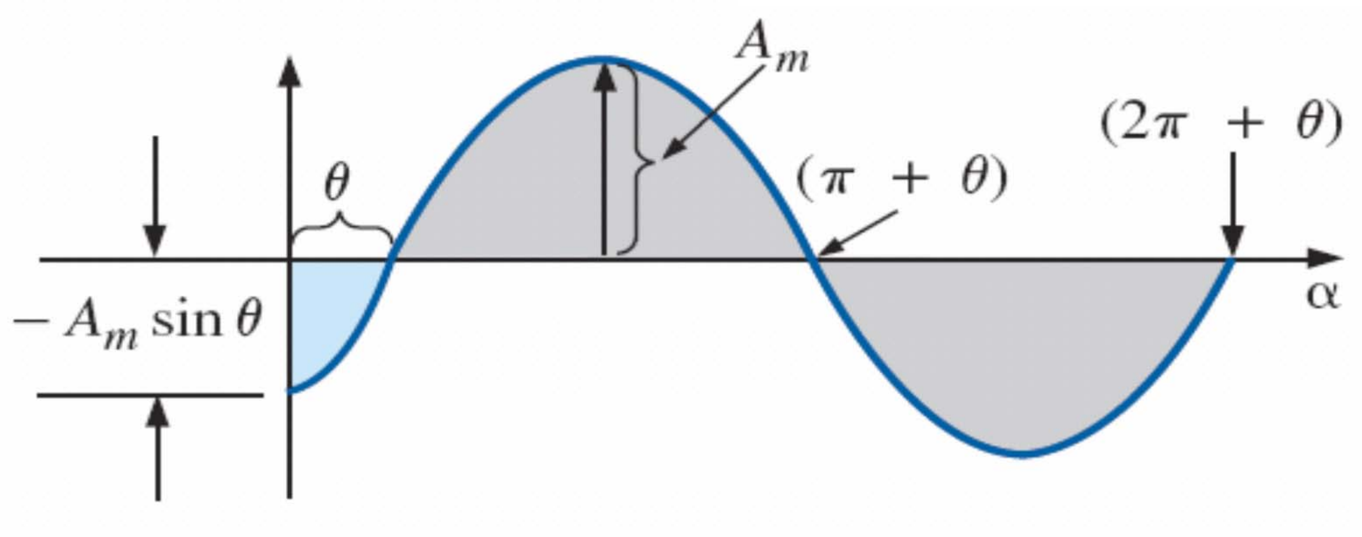
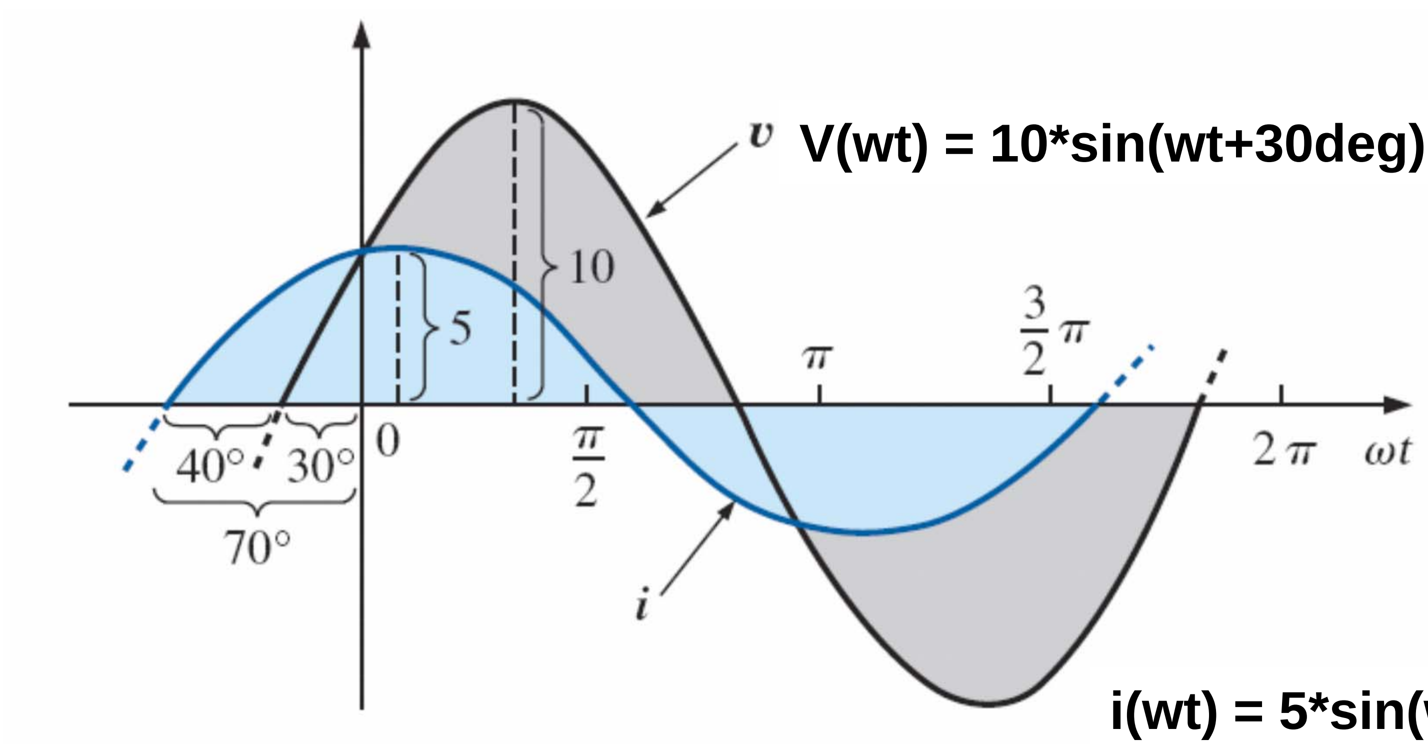


FIG. 13.28 *Defining the phase shift for a sinusoidal function that crosses the horizontal axis with a positive slope after 0°.*

Waveforms with the same period (and hence frequency) but different "starting points"



V(wt) = 10*sin(wt+30deg)

i(wt) = 5*sin(wt+70deg)

FIG. 13.31 *Example 13.12(a): i leads* y *by 40°.*

Or v(wt) LAGS i(wt) by 40 deg

ICP – Find The Relationship Between i(t) and e(t)

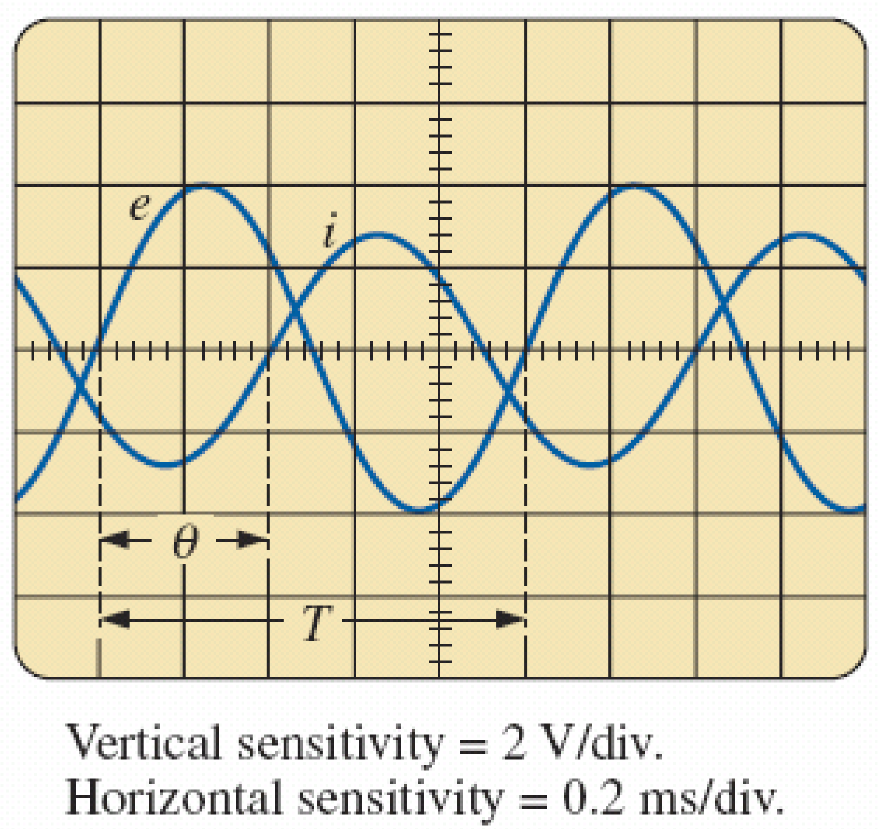


FIG. 13.39 *Finding the phase angle between waveforms using a dual-trace oscilloscope.*