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Data Communication CS601 Lecture No 8

Lecture Prepared By

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A Simple Periodic Analog Signal, A Sine Wave

A simple periodic analog signal, a sine wave, cannot be decomposed into simpler signals. A composite periodic analog signal is composed of multiple sine waves. A sine wave can be represented by three parameters: the peak amplitude, the frequency, and the phase. These three parameters fully describe a sine wave.

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Periodic Signal – Sine Wave

There are three main attribute of a Sine Wave

1. Amplitude **2. Period / Frequency** **3. Phase**

1. Amplitude (Key Attribute):

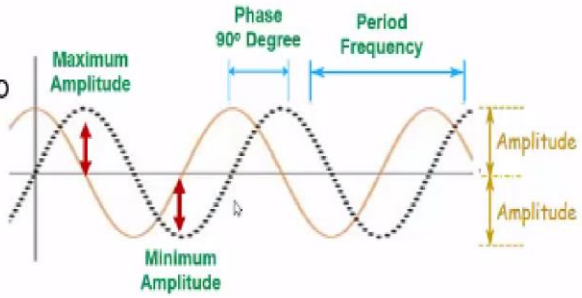
It is equal to the vertical distance from a given point on the wave form to the horizontal axis

2. Period / Frequency (Second Attribute):

Period: Amount of time (in seconds) a signal need to complete one cycle.

Frequency: Number of cycles completed in one second

Unit of Period: Period is expressed in seconds



Periodic Analog Signal

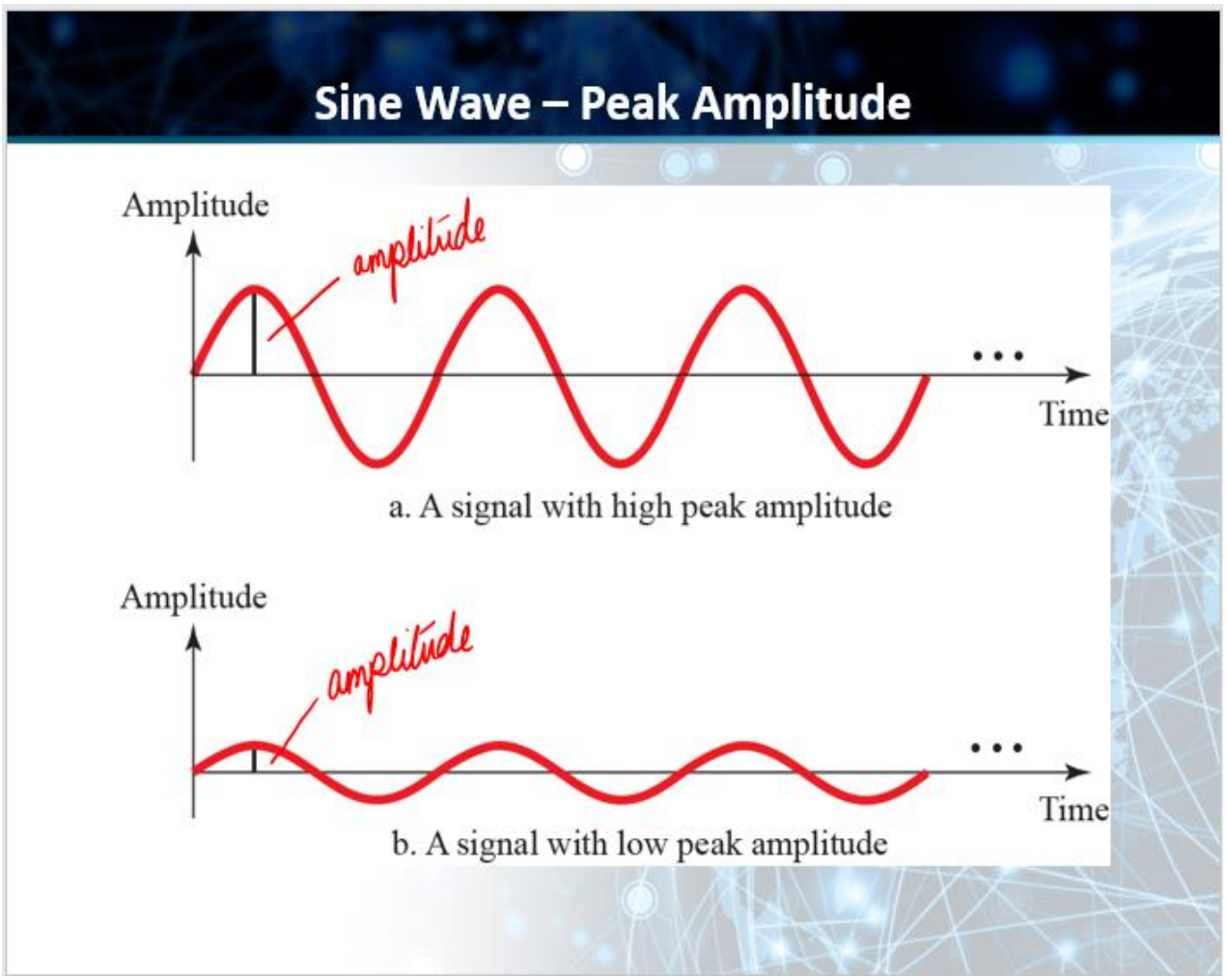
3. Phase

The Phase Shift is how far the function is shifted horizontally from the usual position.

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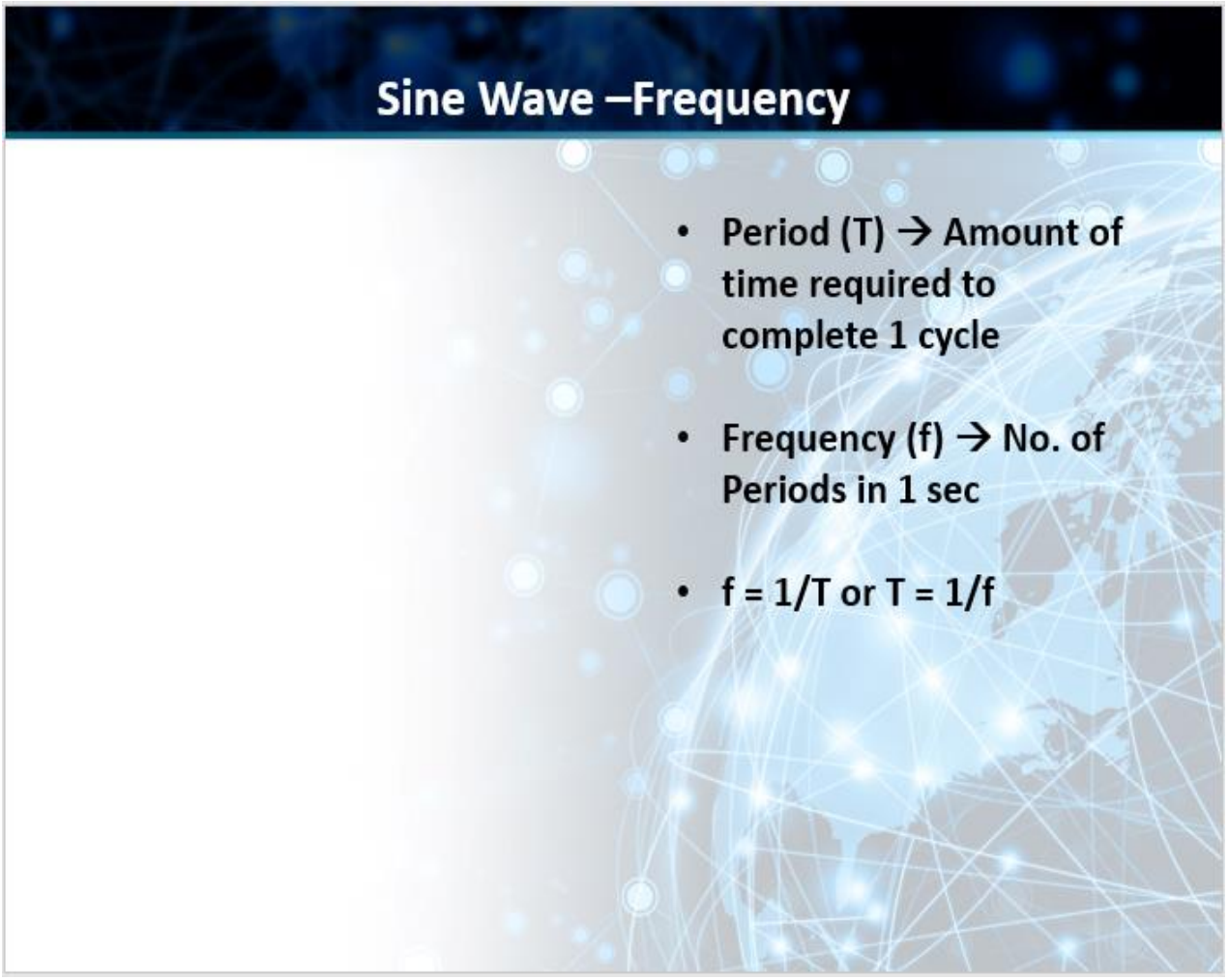
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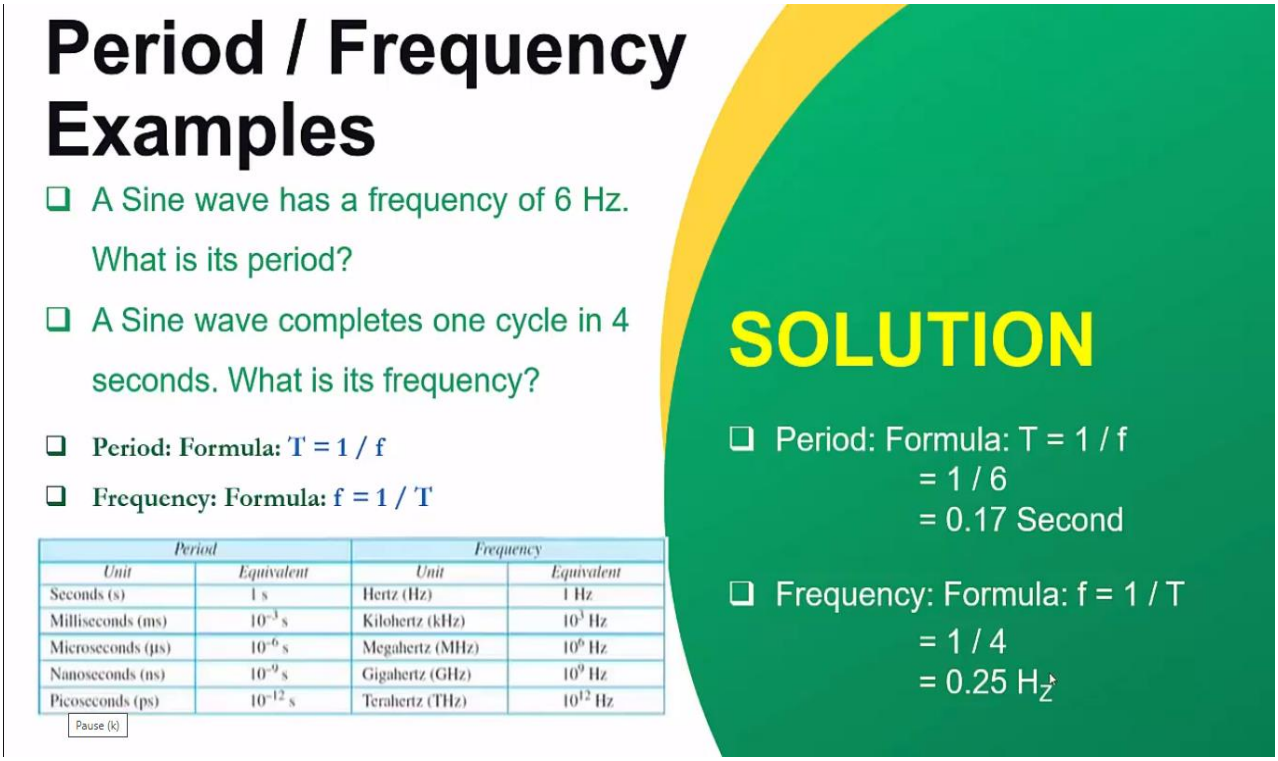
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Sine Wave –Frequency

Period		Frequency	
Unit	*Equivalent*	*Unit*	*Equivalent*
Seconds (s)	1 s	Hertz (Hz)	1 Hz
Milliseconds (ms)	10^{-3} s	Kilohertz (kHz)	10^{3} Hz
Microseconds (μs)	10^{-6} s	Megahertz (MHz)	10^{6} Hz
Nanoseconds (ns)	10^{-9} s	Gigahertz (GHz)	10^{9} Hz
Picoseconds (ps)	10^{-12} s	Terahertz (THz)	10^{12} Hz

Example

The power we use at home has a frequency of 60 Hz. The period of this sine wave can be determined as follows:

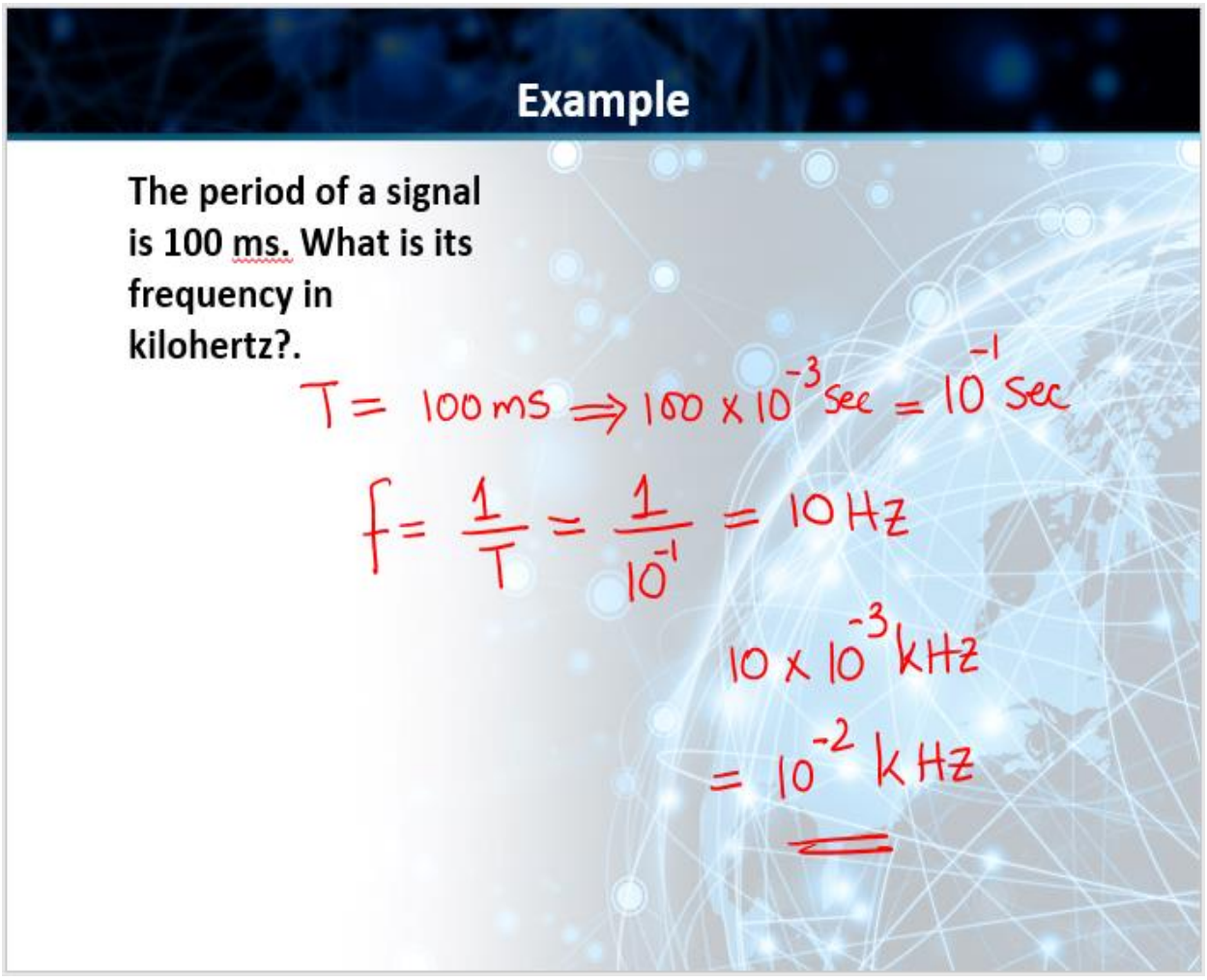
$$T = \frac{1}{f} = \frac{1}{60} = 0.0166 \text{ sec}$$

$$= 16.6 \text{ msec}$$

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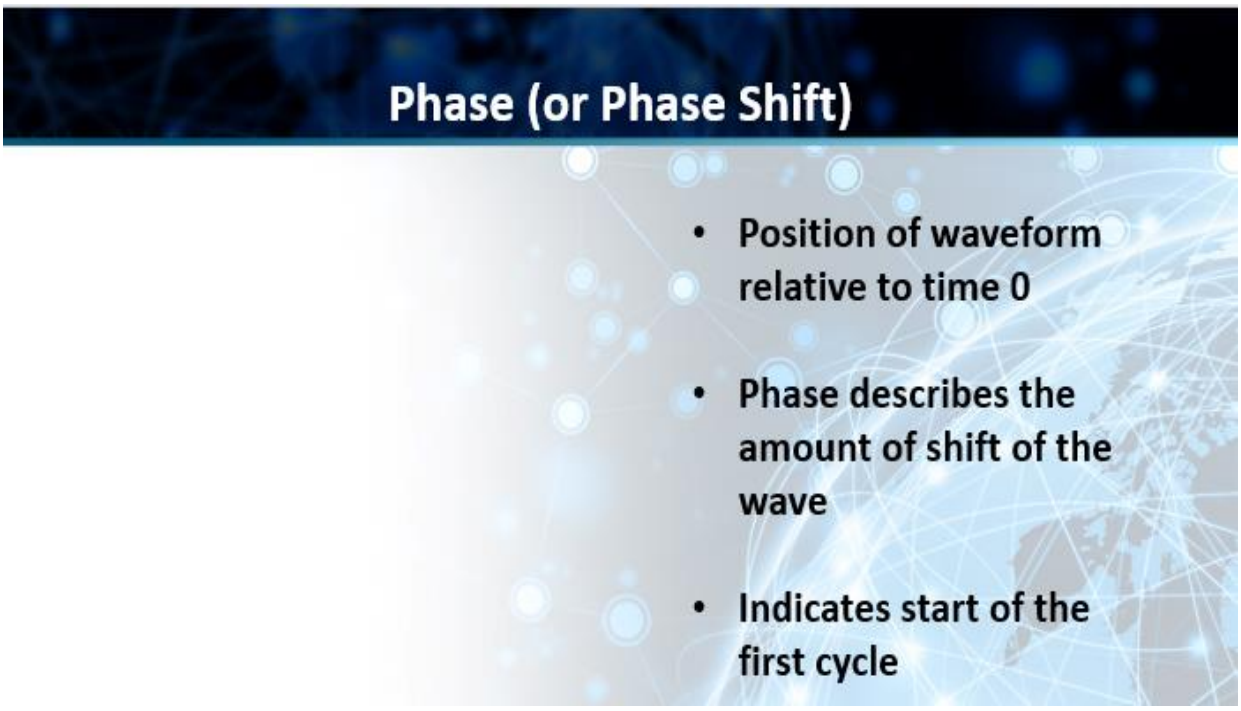
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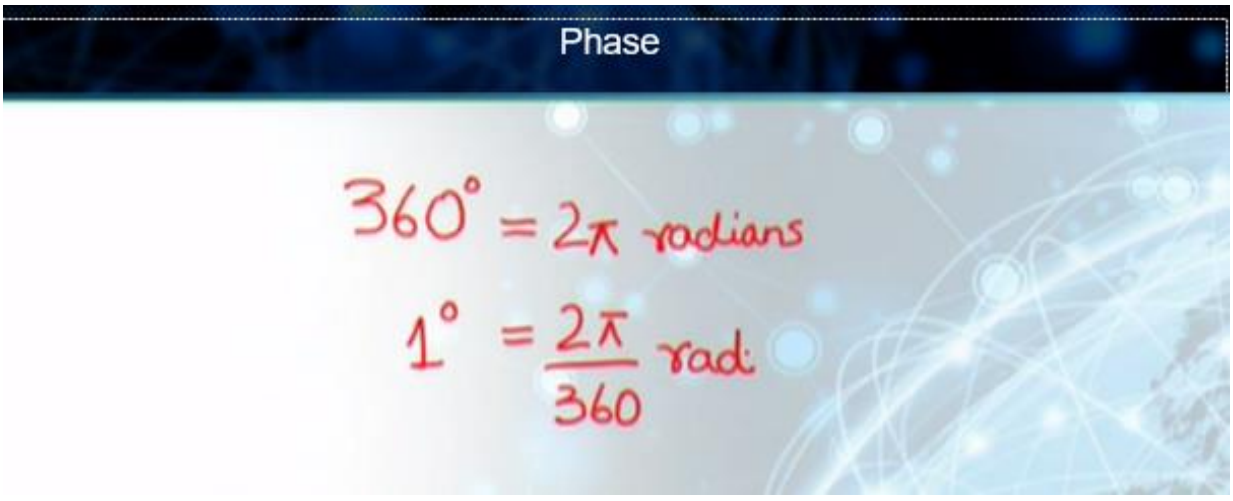


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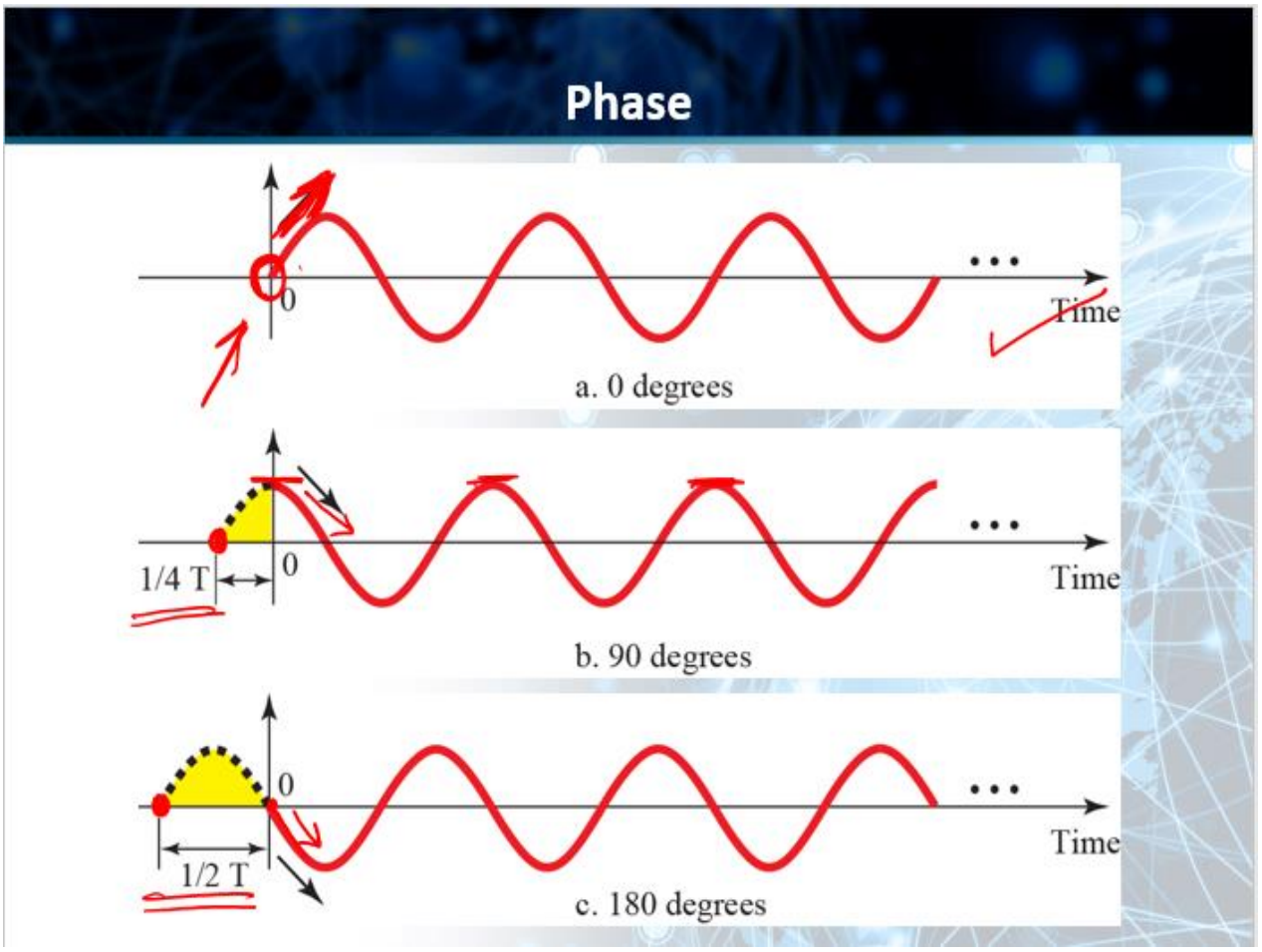




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SOLUTION

- Phase:

= 1 / 6 x 360

= 360 / 6

= 60^0 Degree

Phase Example

A sine wave is offset 1/6 of a cycle with respect to time zero. What is its phase in radius?

- One Cycle = 360 Degrees

($1^0 = 2\pi / 360^0$ radios)

$= 60 \times 2\pi / 360$

$= 60 \times (2 \times (3.146 / 360))$

$= 60 \times (2 \times 0.0087)$

$= 60 \times 0.0174$

= 1.04 Radius

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EXERECISE

- A Sine wave has a frequency of 60 Hz. What is its period?
- A Sine wave completes one cycle in 100 seconds. What is its frequency?
- A sine wave is offset 1/4 of a cycle with respect to time zero. What is its phase in radius?