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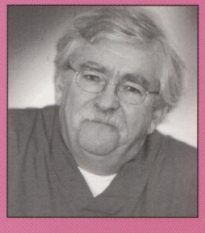

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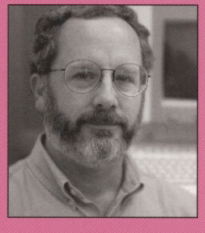

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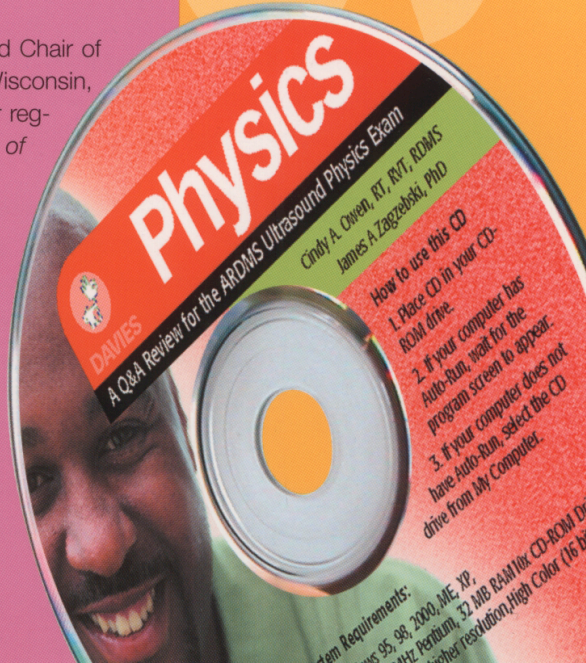

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Vascular Physics

A QUESTION / ANSWER / REFERENCE REVIEW FOR THE
VASCULAR PHYSICAL PRINCIPLES &
INSTRUMENTATION EXAM

2011

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We dedicate this work to
Dr. Eugene Bernstein.
His untimely death has stilled a giant in our field.

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PART I

Ultrasound Physics

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DOPPLER SIGNAL PROCESSING
DOPPLER INSTRUMENTS

DEFINITION OF SOUND

Sound versus ultrasound
Propagation velocity
Frequency
Wavelength
Frequency versus depth
Frequency ranges

1.1 Sound wave frequency is determined by:
A. The medium through which sound travels.
B. The propagation speed.
C. The sound source.
D. The boundary layer.
E. The number of reflections.

1.2 Sound wave variables include all the following EXCEPT:
A. Frequency.
B. Amplitude.
C. Perpendicular incidence.
D. Period.
E. Propagation speed.

1.3 As the frequency of the sound wave increases, the wavelength:

A. Decreases.
B. Increases.
C. Stays the same.
D. Wavelength is not related to frequency changes.
E. Doubles.

1.4 The term "period" is related to frequency by the fact that it:

A. Equals frequency.
B. Increases as frequency increases.
C. Is one tenth of frequency.
D. Is the reciprocal of frequency.
E. Equals frequency squared.

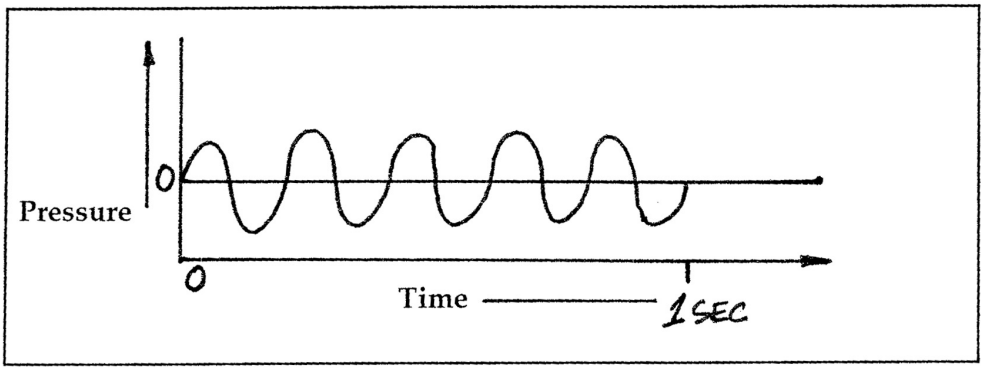

Figure 1.
See Question 1.5—What is the frequency?

1.5 What is the frequency of the sound wave in Figure 1?

A. 10 Hertz.
B. 7 Hertz.
C. 5 Hertz.
D. 2.5 Hertz.
E. 16 Hertz.

1.6 What is the period of the signal in Figure 1?

A. 0.5 seconds.
B. 0.25 seconds.
C. 2.0 seconds.
D. 0.20 seconds.
E. 0.02 seconds.

1.7 Wavelength may be measured in:

A. Hertz.
B. Microseconds.
C. Millimeters.
D. Newtons.
E. Rayls.

1.8 With an ultrasound frequency of 10 MHz the period is:

A. 1.00 microseconds.
B. 1.00 seconds.
C. 0.13 microseconds.
D. 0.20 microseconds.
E. 0.10 microseconds.

1.9 Which of the following ultrasound frequencies would result in the shallowest penetration depth?

A. 2 MHz.
B. 20 MHz.
C. 8 MHz.
D. 10 MHz.
E. 4 MHz.

1.10 To be classified as ultrasound, the frequency of the sound wave must be:

A. Less than 20 Hz.
B. Greater than 20 Hz.
C. Less than 20 kHz.
D. Greater than 20 kHz.
E. Greater than 20 MHz.

1.11 Which of the following is NOT true regarding frequency?

A. It is defined as the number of complete cycles per unit of time.
B. 1 cycle per second equals 1 hertz.
C. 1000 cycles per second equals 1 kilohertz.
D. It is the inverse of period.
E. It is measured in units of time (seconds).

1.12 Which ONE of the following cannot travel through a vacuum:

A. Radio waves.
B. Sound.
C. Light.
D. X-rays.
E. Infrared light.

1.13 Which of the following terms refers to regions of decreased particle density:

A. Attenuation.
B. Transmission.
C. Compression.
D. Rarefaction.
E. Reverberation.

1.14 Hertz is a unit of measure used to quantify the _____ of a sound wave:

A. Frequency.
B. Amplitude.
C. Power.
D. Intensity.
E. Half wave height.

1.15 Units of measure used to quantify intensity are:

A. Hertz.
B. Milliwatts.
C. Watts/meter^2.
D. Meters/second.
E. Megahertz.

1.16 A decrease in sound beam intensity in a fixed area is accompanied by _____ in pressure amplitude:

A. A decrease.
B. An increase.
C. No change.
D. A doubling.
E. A tripling.

1.17 10^{-3} = _____ :

A. +1000.
B. -1000.
C. +1/1000.
D. -1/1000.
E. +10000.

1.18 If the intensity of one sound wave is 1000 times as great as the intensity of a second sound wave, the ratio of the two intensities can be expressed as _____ decibels:

A. 3.
B. 30.
C. 3000.
D. 10,000.
E. 2^{10}.

1.19 The number 1215 can be expressed in scientific notation as:

A. 0.1215.
B. 0.1215×10^{3}.
C. 1215×10^{1}.
D. 1215×10^{-1}.
E. 1.215×10^{3}.

1.20 One Megahertz = _____ hertz:

A. 10^3.
B. 10^{-3}.
C. 10^6.
D. 10^{-6}.
E. 10^{10}.

1.21 Ultrasound used for medical diagnosis falls within which of the following frequency ranges:

A. <20 kHz.
B. 20 kHz to 2 MHz.
C. 2 to 20 MHz.
D. 500 to 20,000 Hz.
E. 1 to 20 kHz.

1.22 For a sinusoidal ultrasound wave:

A. Frequency is proportional to period.
B. Period is proportional to frequency.
C. Frequency and period are unrelated.
D. Frequency divided by period is equal to 1.
E. Frequency multiplied by period is equal to 1.

1.23 The strength of a sound beam is best described by:

A. Amplitude and impedance
B. Amplitude and wavelength.
C. Amplitude and intensity.
D. Intensity and impedance.
E. Frequency and wavelength.