Wavelength, Frequency, and Wave Speed  \( v = f \times \lambda \)

What is the speed of the following waves?
1. A wave with a wavelength of 1 m and a frequency of 330 Hz.
2. A wave with a wavelength of 1,000 m and a frequency of 3,000,000 Hz (3x10^6).
3. A wave with a wavelength of 0.5 m and a frequency of 600,000,000 Hz (6x10^8).

What is the wavelength of the following waves?
4. A wave with a frequency of 5.0x10^{14} Hz, travelling at 3x10^8 m/s.
5. A wave with a frequency of 6.7x10^{14} Hz, travelling at 3x10^8 m/s.
6. A wave with a frequency of 3.0x10^{18} Hz, travelling at 3x10^8 m/s.

What is the frequency of the following waves?
7. A wave with a wavelength of 1000 m, travelling at 3.0x10^8 m/s.
8. A wave with a wavelength of 7.0x10^{-9} m, travelling at 3.0x10^8 m/s.
9. A wave with a wavelength of 4.5x10^{-12} m, travelling at 3.0x10^8 m/s.

Frequency  \( f = \frac{1}{T} \)

What is the frequency of the following waves?
1. A wave with a time period of 3 s.
2. A wave with a time period of 0.005 s.
3. A wave with a time period of 9.0x10^{-15} s.

What is the time period for a wave if the frequency is:
4. 450 Hz?
5. 19,500 Hz?
6. 0.01 Hz?

Refraction  \( n_1 \times \sin i = n_2 \times \sin r \)

What is the refractive index of the following materials? From air to the material:

What is the angle of refraction in the following situations?
4. Light entering glass (n = 1.5) with an angle of incidence of 15.0°.
5. Light entering diamond (n = 2.4) with an angle of incidence of 20.0°.
6. Light exiting water (n = 1.3) with an angle of incidence of 32.0°.

Critical Angle

What is the critical angle of...
1. Glass?
2. Water?
3. Diamond?
Solutions

Wavelength, Frequency, and Wave Speed

What is the speed of the following waves?
1. A wave with a wavelength of 1 m and a frequency of 330 Hz. \( 1 \times 330 = 330 \text{ m/s} \)
2. A wave with a wavelength of 1,000 m and a frequency of 3,000,000 Hz (3x10^6). \( 1,000 \times 3x10^6 = 3x10^8 \text{ m/s} \)
3. A wave with a wavelength of 0.5 m and a frequency of 600,000,000 Hz (6x10^8). \( 1 \times 330 = 330 \text{ m/s} \)
What is the wavelength of the following waves?
4. A wave with a frequency of 5.0x10^14 Hz, travelling at 3.0x10^8 m/s. \( 3.0x10^8/5.0x10^{14} = 6.0x10^{-7} \text{ m} \)
5. A wave with a frequency of 6.7x10^14 Hz, travelling at 3.0x10^8 m/s. \( 3.0x10^8/6.7x10^{14} = 4.5x10^{-7} \text{ m} \)
6. A wave with a frequency of 3.0x10^18 Hz, travelling at 3.0x10^8 m/s. \( 3.0x10^8/3.0x10^{18} = 1.0x10^{-10} \text{ m} \)

Frequency

What is the frequency of the following waves?
1. A wave with a time period of 3 s. \( 1/3 = 0.33 \text{ Hz} \)
2. A wave with a time period of 0.005 s. \( 1/0.005 = 200 \text{ Hz} \)
3. A wave with a time period of 9.0x10^{-15} s. \( 1/9.0x10^{-15} = 1.1x10^{14} \text{ Hz} \)
What is the time period for a wave if the frequency is...
4. 450 Hz? \( 1/450 = 2.0x10^{-3} \text{ s} \)
5. 19,500 Hz? \( 1/19,500 = 5.1x10^{-5} \text{ s} \)
6. 0.01 Hz? \( 1/0.01 = 100 \text{ s} \)

Refraction

What is the refractive index of the following materials?
1. Angle of incidence: 30.0°. Angle of refraction: 19.5°. \( \sin 30.0 / \sin 19.5 = 1.5 \)
2. Angle of incidence: 45.0°. Angle of refraction: 33.0°. \( \sin 45.0 / \sin 33.0 = 1.3 \)
3. Angle of incidence: 40.0°. Angle of refraction: 20.9°. \( \sin 40.0 / \sin 20.9 = 1.8 \)
What is the angle of refraction in the following situations?
4. Light entering glass (n = 1.5) with an angle of incidence of 15.0°. \( 1.5 \times \sin 15.0 = 0.39. \sin^{-1} 0.39 = 22.9° \)
5. Light entering diamond (n = 2.4) with an angle of incidence of 20.0°. \( 2.4 \times \sin 20.0 = 0.82. \sin^{-1} 0.82 = 55.2° \)
6. Light exiting water (n = 1.3) with an angle of incidence of 32.0°. \( 1.3 \times \sin 32.0 = 0.69. \sin^{-1} 0.69 = 43.5° \)

Critical Angle

What is the critical angle of...
1. Glass? \( 1/1.5 = 0.67. \sin^{-1} 0.67 = 42° \)
2. Water? \( 1/1.3 = 0.77. \sin^{-1} 0.77 = 50° \)
3. Diamond? \( 1/2.4 = 0.42. \sin^{-1} 0.42 = 25° \)