Physics 20 - Speed of a Wave Assignment Answer Key

Assignment:
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Answers - Page 293 #1-4

(these answers are also in the back of the textbook)

1. Information from question: distance = 515 m, time = 1.50s
   a. want to find speed.
      speed = (distance)/(time)
      speed = 515m ÷ 1.50 s
      speed = 343 m/s
   b. frequency = 436 Hz. find period.
      T = 1/f
      T = 1/436 Hz
      T = 0.00229 s
   c. want to know wavelength.
      use speed equation $v = f \lambda$
      solve for λ
      $\lambda = v/f$
      $\lambda = 343$ m/s ÷ 436 Hz
      $\lambda = 0.787$ m
2. Information from question: distance = 2 x 685 m = 1370m (because it is an echo the wave must travel to the cliff AND back) time = 4.00 s
   a. speed = (distance)/(time)
      speed = 1370 m ÷ 4.00s
      speed = 343 m/s
   b. wavelength = 0.750 m. find frequency.
      $v = f \lambda$
      solve for f
      $f = v/\lambda$
      f = 343 m/s ÷ 0.750 m
      f = 457 Hz
   c. find period. T = 1/f
      T = 1/457 Hz
      T = 0.00219 s
3. Information from question: frequency is 99.5 x 10^6 Hz. Find wavelength.
   use speed equation $v = f \lambda$
   we know f, we want λ but we don't know v!!
   → The question said it was a **electromagnetic wave**. this means it travels at the speed of light. We can look up the speed of light. v = 3.00 x 10^8 m/s
   NOW we can use the speed equation and solve for wavelength: $\lambda = v/f$
   λ = 3.00 x 10^8 m/s ÷ 99.5 x 10^6 Hz
   $\lambda = 3.02$ m

4. Information from question: wavelength = 580 nm
   a. find wavelength in metres
      580 nm = 1m / 1 000 000 000nm = 0.000 000 58 m or 5.8×10^{-7} m
   b. find frequency. use speed equation $v = f \lambda$
      ➞ Hey! this is the same as question 3. We don't know what v is. BUT we do know that we are working with light again. SO we use the speed of light again.
      $f = v/\lambda$
      $f = 3.00 \times 10^{8}$ m/s ÷ 5.8×10^{-7} m
      $f = 5.2 \times 10^{14}$ Hz

Answers - Page 304 #2-10

(these answers are NOT in the back of the textbook)

2. Information from question: length = 10.0 m, time = 2.0s
   a. want to find speed.
      speed = (distance)/(time)
      speed = 10.0 m ÷ 2.0 s
      speed = 5.0 m/s
3. Information from question: wavelength = 6.0 m, frequency = 4.8 Hz
   a. want to find speed. use wave speed equation
      $v = f \lambda$
      v = (4.8 Hz)(6.0m)
      v = 29 m/s
   b. find period.
      T = 1/f
      T = 1 / 4.8 Hz
      T = 0.21 s
4. Information from question: distance = 4.4 m; time = 1.8 s; period = 1.2 s
   a. find speed
      speed = (distance)/(time)
      speed = 4.4m ÷ 1.8 s
      speed = 2.4 m/s
   b. find wavelength
      $v = f \lambda$
      solve for λ
      $\lambda = v/f$
            but what is f? f = 1/T
            f = 1/ 1.2 s
            f = 0.83 Hz
      λ = 2.4 m/s ÷ 0.83 Hz
      λ = 2.89 m
5. Information from question: frequency = 5.0×10^{14} Hz.
   want to find wavelength. use wave speed equation.
   $v = f \lambda$
   we have to use the speed of light again!
   solve for λ

$\lambda = v/f$
$\lambda = 3.00 \times 10^{8}$ m/s ÷ 5.0×10^{14} Hz
$\lambda = 6.0 \times 10^{-7}$ m

6. Information from question: wavelength = 2 x 3.0m (3.0 m separated a trough and crest, wavelength is crest to crest - troughs occur halfway between so multiply by 2)
solve for frequency: 14 crests in 20 s
frequency is cycles per second
f = 14/20s
f = 0.7Hz
now find speed using wave speed equation
$v = f \lambda$
v = (0.7Hz)(6.0m)
v = 4.2 m/s

7. Information from question: v = 3.00×10^{8} m/s f = 550 kHz and 1600 kHz
convert to Hz
550 kHz = 1000 Hz / 1 kHz = 550 000 Hz ; → 1 600 000 Hz
a. find wavelength. use wave velocity equation
$v = f \lambda$
solve for λ
$\lambda = v/f$
$\lambda = 3.00 \times 10^{8}$ m/s ÷ 550 000 Hz
$\lambda = 550$ m
$\lambda = v/f$
$\lambda = 3.00 \times 10^{8}$ m/s ÷ 1 600 000 Hz
$\lambda = 190$ m
b. f = 88 MHz and 108 MHz
convert to Hz
88 MHz = 1000 000 Hz / 1 kHz = 88 000 000 Hz ; → 108 000 000 Hz
$\lambda = v/f$
$\lambda = 3.00 \times 10^{8}$ m/s ÷ 88 000 000 Hz
$\lambda = 3.4$ m
$\lambda = v/f$
$\lambda = 3.00 \times 10^{8}$ m/s ÷ 108 000 000 Hz
$\lambda = 2.78$ m

8. Information from question: f = 1.00×10^{6} Hz; λ = 1.50 mm
convert to m
1.50 mm x 1m / 1000 mm = 0.00150 m
a. find speed. use wave speed equation
$v = f \lambda$
v = (1.00×10^{6} Hz)(0.00150 m)
v = 1500 m/s or 1.50×10^{3} m/s
b. find period.
T = 1/f
T = 1/1.00×10^{6} Hz
T = 0.00000100 or 1.00×10^{-6} Hz

9. Information from question: $\lambda = 0.70$ m $v = 330$ m/s and time elapsed is 0.50s
   a. find frequency. use wave speed equation
      $v = f\lambda$
      solve for f
      $f = v/\lambda$
      $f = 330$ m/s ÷ 0.70 m
      $f = 470$ Hz
   b. find cycles. frequency is cycles per second.
      f = (cycles) ÷ (time)
      solve for cycles
      cycles = f(time)
      cycles = (470Hz)(0.50s)
      cycles = 240 cycles
   c. find distance. speed = distance ÷ time.
      v = d/t
      solve for d
      d = vt
      d = (330m/s)(0.50s)
      d = 165 m
10. Information from question: v = 1498 m/s; time elapsed is 1.80s
      v = d/t
      solve for d
      d = vt
      d = (1498m/s)(1.80s)
      d = 2700 m or 2.70×10^3 m

Answers - Page 698 #1-10 Chapter 14 Questions

(these answers are NOT in the back of the textbook)

1. Information from question: f = 10.0 Hz; distance = 2.50 m
   distance from trough to trough is wavelength. distance given is from crest to trough. wavelength is twice the distance given. 2 x 2.50 m = 5.00 m
2. Information from question: 16.0 pulses in 4.00 s
   a. T = time ÷ cycles
      T = 4.00s ÷ 16.0
      T = 0.24 s
   b. f = cycles/second
      f = 16.0 ÷ 4.00s
      f = 4.00 Hz
3. Information from question: 22.5 pulses in 5.50 s
   a. T = time ÷ cycles
      T = 5.50s ÷ 22.5
      T = 0.244 s
   b. f = cycles/second
      f = 22.5 ÷ 5.50s
      f = 4.09 Hz

4. Information from the question: f = 2.50 Hz; λ = 0.600m
   find speed. use wave speed equation
   v = f λ
   v = (2.50 Hz)(0.600m)
   v = 1.50 m/s
5. Information from question: one pulse per 0.100s; λ = 3.30 cm
   frequency is cycles per second = 1/0.100s = 10.0 Hz
   convert cm to m
   3.30 cm x 1m / 100cm = 0.0330 m
   find speed. use wave speed equation.
   v = f λ
   v = (10Hz)(0.0330m)
   v = 0.330 m/s
6. Information from question: 5 pulses in 0.100s; λ = 1.20 cm
   frequency = 5 ÷ 0.100s = 50.0 Hz
   1.20 cm = 0.0120 m
   find speed. use wave speed equation
   v = f λ
   v = (50.0Hz)(0.0120m)
   v = 0.600 m/s
7. Information from question: f = 20.0 Hz; λ = 0.400 m
   find speed. use wave speed equation
   v = f λ
   v = (20.0Hz)(0.400m)
   v = 8.00 m/s
8. Information from question: f = 2.50 Hz; v = 4.0 m/s
   find wavelength. use wave speed equation
   v = f λ
   solve for λ
   λ = v/f
   λ = (4.0m/s) ÷ (2.50 Hz)
   λ = 1.6 m
9. Information from question: v = 15.0 m/s; f = 5.00 Hz
   find wavelength. use wave speed equation
   v = f λ
   solve for λ
   λ = v/f
   λ = (15.0m/s) ÷ (5.00 Hz)
   λ = 3.00 m
10. Information from question: v = 15.0 m/s; λ = 1.25 m
    find frequency. use wave speed equation
    v = f λ
    solve for f
    f = v/λ
    f = (15.0m/s) ÷ (1.25)
    f = 12.0 Hz