

## Holt Physics

**Problem 14A****ELECTROMAGNETIC WAVES****PROBLEM**

The atoms in an  $\text{HCl}$  molecule vibrate (like two charged balls attached to the ends of a spring). If the wavelength of the emitted electromagnetic wave is  $3.75 \mu\text{m}$ , what is the frequency of the vibrations?

**SOLUTION**

Given  $\lambda = 3.75 \times 10^{-6} \text{ m}$   
 $v = 3.00 \times 10^8 \text{ m/s}$

Unknown  $f = ?$

Use the wave-speed equation, and solve for  $\lambda$ .

$$c = f\lambda$$

$$f = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \text{ m/s}}{3.75 \times 10^{-6} \text{ m}} = \boxed{8.00 \times 10^{13} \text{ Hz}}$$

**ADDITIONAL PRACTICE**

1. New-generation cordless phones use a  $9.00 \times 10^2 \text{ MHz}$  frequency and can be operated up to 60.0 m from their base. How many wavelengths of the electromagnetic waves can fit between your car and a base 60.0 m away?
2. The highest directly measured frequency is  $3.28 \times 10^{14} \text{ Hz}$ , corresponding to one of the transitions in cadmium-112. How many wavelengths of electromagnetic waves with this frequency could fit across a dot on a book page? Assume the dot is  $2.80 \times 10^{-3} \text{ m}$  in diameter.
3. Commercial trucks cause about 18 000 lane-change and merging accidents per year in the United States. To prevent many of them, a warning system covering blind spots is being developed. The system uses electromagnetic waves of frequency  $2.40 \times 10^{10} \text{ Hz}$ . What is the wavelength of these waves?
4. A typical compact disc stores information in tiny pits on the disc's surface. A typical pit size is 1.2  $\mu\text{m}$ . What is the frequency of electromagnetic waves that have a wavelength equal to the typical CD pit size?
5. A new architectural technique detects the differences in electromagnetic waves emitted by humans and by weapons made of metal, plastic, or ceramic. One possible range of wavelengths used with this technique is from 2.0 mm to 3.0 mm. Calculate the associated range of frequencies.
6. The U.S. Army's heaviest landspike is almost 17 m across and is transported on a special trailer. The sound is produced by an electromagnetic coil that can generate a minimum frequency of 30.8 Hz. What is the wavelength of these electromagnetic waves?

# Holt Physics Problem 19b Answers

**M Mosston**



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Holt Physics Raymond A. Serway, 2002      *Holt Physics*, 2001      *Modern Physics* Paul Allen Tipler, Ralph Llewellyn, 2003  
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guides students through the foundations and wide ranging applications of modern physics with the utmost clarity without  
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**The Cumulative Book Index**, 1900 A world list of books in the English language      The Publishers Weekly, 1886

*A.L.A. Catalog* American Library Association, 1923      Catalogue of Title Entries of Books and Other Articles, 1899

**Books in Print Supplement**, 2002      **Final Causality in Nature and Human Affairs** Richard F. Hassing, 2018-03-02  
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fundamental yet controversial themes in the history of philosophy Are there ends in nonhuman nature Does human history have a goal Do humanly unintended events of great significance express some sort of purpose Do human beings have ends prior to choice The essays in this volume address the abiding questions of final causality The chapters are arranged in historical order from Aristotle through Hegel to contemporary anthropic principle cosmology James Van Allen Abigail Foerstner, 2009-06 Astrophysicist and space pioneer James Van Allen 1914-2006 for whom the Van Allen radiation belts were named was among the principal scientific investigators for twenty-four space missions including Explorer I in 1958 the first successful U.S. satellite Mariner 2's 1962 flyby of Venus the first successful mission to another planet and the 1970s Pioneer 10 and Pioneer 11 missions that surveyed Jupiter and Saturn Although he retired as a University of Iowa professor of physics and astronomy in 1985 he remained an active researcher using his campus office to monitor data from Pioneer 10 on course to reach the edge of the solar system when its signal was lost in 2003 until a short time before his death at the age of ninety-one Now Abigail Foerstner blends space science drama military agendas cold war politics and the events of Van Allen's lengthy career to create the first biography of this highly influential physicist Drawing on Van Allen's correspondence and publications years of interviews with him as well as with more than a hundred other people and declassified documents from such archives as the Jet Propulsion Laboratory the Kennedy Space Center and the Applied Physics Laboratory Foerstner describes Van Allen's life from his Iowa childhood to his first experiments at White Sands to the years of Explorer I until his death in 2006 Often called the father of space science James Van Allen led the way to mapping a new solar system based on the solar wind massive solar storms and cosmic rays Pioneer 10 alone sent him more than thirty years of readings that helped push our recognition of the boundary of the solar system billions of miles past Pluto Abigail Foerstner's compelling biography charts the eventful life and time of this trailblazing physicist

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