

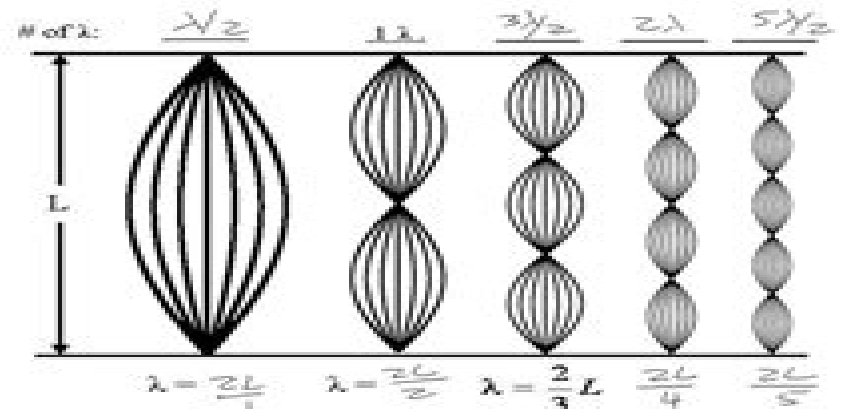
Harmonics on Strings and in Pipes

We will use the Socratic Method to derive equations for harmonics on strings and in pipes. "Sit and learn, Aristotle."

Harmonics on Strings

- 1) Fill in the equation at the right for how many antinodes (AN) equals 1 λ .
- 2) How many AN does the fundamental have?
- 3) Above the diagram, write how many wavelength each harmonic is (H_1 is already done).
- 4) So, how many L's is the wavelength of the fundamental?
- 5) Under each harmonic, write its wavelength in terms of "L". (H_1 is already done).
- 6) You probably have the wavelength of the fundamental as a whole number, not a fraction. Make it a fraction, over 1.
- 7) Notice the denominators of harmonics 1, 3, and 5. You should see a pattern. Change the fractions of the other harmonics (2 and 4) so that the pattern is the same for all of them.
- 8) So, these changing denominators are the number of:
- 9) Calling the denominator "n" (the number of antinodes). Now write a formula for finding the wavelength of a particular harmonic on a fixed string of length "L".

$$\underline{2} \text{ AN} = \lambda$$



$$\lambda_{\text{string}} = 2L$$

- 10) * On a 2.5 m string, what is the wavelength of the 8th harmonic?
 $\lambda_1 = 2.5(2) = 5\text{m}$
 $\text{so } \lambda_8 = \frac{5}{8} = .625\text{m}$ or $\lambda_8 = \frac{2L}{n} = \frac{2(2.5)}{8} = .625\text{m}$
- 11) If a mechanical vibrator is vibrating 460 times per second to produce the 8th harmonic you just found, find the speed of the wave in the string.
 $v = f\lambda$
 $= 460(.625) = 287.5\text{ m/s}$

One other thing to notice: on a string it is possible to have every harmonic. There are no "missing harmonics".

Transfer of Waves Between Mediums

The speed of the wave is different in different mediums, so the speed of the wave is different in the string than in air.

- 12) The speed of sound in air varies between 330 Hz and 444 Hz. Let's use $v_{\text{sound}} = 340\text{ m/s}$.
- 13) If you tighten the string, will the wavelength of the harmonics change (is the string longer)? No
- 14) * When I tighten a string on my guitar what does change (music-wise)? pitch or note
- 15) When the string vibrates, it beats against the air, making the air molecules vibrate, too. Every time the string pushes, the air moves, too. So, what is the same in air as in a string: the wavelength of the vibration or the frequency of the vibration?
 $v = f\lambda$
- 16) What frequency sound will we hear from the string in Q11?
- 17) Is this audible to us (see "Sound" notes)? yes audible: 20 Hz $\rightarrow$ 20,000 Hz
- 18) What would be the wavelength of that sound in air? (You have speed and frequency...)

$$v = f\lambda$$

$$340 = 460\lambda \quad \lambda = .739\text{m}$$

Notice in Q10: wavelength on string was 0.625m and $v = 287.5\text{ m/s}$. f is same, but v is faster (340m/s), so wavelength increased: 0.739m

Answer To Stephen Murray Magnetic Chapter 1

Jianjun Gao



Answer To Stephen Murray Magnetic Chapter 1:

Peripheral and Spinal Mechanisms in the Neural Control of Movement M.D. Binder, 1999-12-17 In the last decade we have witnessed a striking maturation of our understanding of how neurons in the spinal cord control muscular activity and movement Paradoxically a host of new findings have revealed an unexpected versatility in the behavior of these well studied neural elements and circuits In this volume the world s leading experts review the current state of our knowledge of motor control outline their latest results and developments and delineate the seminal unresolved questions in this vibrant field of research The volume begins with a commentary and overview of our current understanding of the peripheral and spinal basis of motor control The remainder of the volume is divided into seven sections each focused on a different problem The first chapter in each section provides some historical review and presages the experimental findings and hypotheses that are discussed in subsequent chapters Topics include the biomechanics of neuromuscular systems the properties of motoneurons and the muscle units they control spinal interneurons pattern generating circuits locomotion descending control of spinal circuits comparative physiology of motor systems and motor systems neurophysiology studied in man The book serves as a unique reference volume and should be essential reading for anyone interested in motor systems Moreover the volume s comprehensive coverage of a wide range of topics make it an effective textbook for graduate level courses in motor control neurobiology kinesiology physical therapy and rehabilitation medicine

A New English Dictionary on Historical Principles: part 1. A (1888) James Augustus Henry Murray, 1888 A New English Dictionary on Historical Principles: part 1. D (1897) James Augustus Henry Murray, 1897 *Understanding Computers* Grace Murray Hopper, Steven L. Mandell, 1984 **Nature**, 1895 **Nature** Sir Norman Lockyer, 1894 *International Aerospace Abstracts*, 1993
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Monthly Bulletin of the New York Free Circulating Library New York Free Circulating Library, 1895 The Electrical World, 1884 *Tools in Fluvial Geomorphology* G. Mathias Kondolf, Hervé Piégay, 2016-06-13 Fluvial Geomorphology studies the biophysical processes acting in rivers and the sediment patterns and landforms resulting from them It is a discipline of synthesis with roots in geology geography and river engineering and with strong interactions with allied fields such as ecology engineering and landscape architecture This book comprehensively reviews tools used in fluvial geomorphology at a level suitable to guide the selection of research methods for a given question Presenting an integrated approach to the interdisciplinary nature of the subject it provides guidance for researchers and professionals on the tools available to answer questions on river restoration and management Thoroughly updated since the first edition in 2003 by experts in their subfields the book presents state of the art tools that have revolutionized fluvial geomorphology in recent decades such as

physical and numerical modelling remote sensing and GIS new field techniques advances in dating tracking and sourcing statistical approaches as well as more traditional methods such as the systems framework stratigraphic analysis form and flow characterisation and historical analysis This book Covers five main types of geomorphological questions and their associated tools historical framework spatial framework chemical physical and biological methods analysis of processes and forms and future understanding framework Provides guidance on advantages and limitations of different tools for different applications data sources equipment and supplies needed and case studies illustrating their application in an integrated perspective It is an essential resource for researchers and professional geomorphologists hydrologists geologists engineers planners and ecologists concerned with river management conservation and restoration It is a useful supplementary textbook for upper level undergraduate and graduate courses in Geography Geology Environmental Science Civil and Environmental Engineering and interdisciplinary courses in river management and restoration **Harpers Weekly** John Bonner, George William Curtis, Henry Mills Alden, Samuel Stillman Conant, Montgomery Schuyler, John Foord, Richard Harding Davis, Carl Schurz, Henry Loomis Nelson, John Kendrick Bangs, George Brinton McClellan Harvey, Norman Hapgood, 1871

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