Something to Think About

Recently a man with a protective suit dropped out of a module held by a balloon miles up in the atmosphere. If he dropped with zero vertical velocity, how long did it take him to reach 343 meters/sec? In air, this is the velocity of sound at 20°C. Note at high altitudes, the velocity of sound would be different due to the lower pressure and temperature. Show the units also. Note, 343 m/sec is the sound speed in air at 20°C.

Note from the Editor

Please send us items for future newsletters and share your teaching experiences with a note to us, (you can use e-mail to stumpf@ohio.edu.). If you know of anyone who would like to read the Newsletters, please inform them about the web address below. Your comments or suggestions are also welcome. Hard copies are no longer available. You can see the Newsletter on the web at www.phy.ohiou.edu/stnl. Look for it in September and January. It is listed in the Ohio University Department of Physics and Astronomy home page.

Why don’t you write or e-mail Burt Stumpf and tell me if these newsletters are helpful and how you use them? Any comments are welcome! Please let me know if you wish a previous newsletter.

Announcements

- The 2014 Southeast Ohio District Science Day will be held on Saturday, March 15, 2014. It will be held at Ohio University in Athens, Ohio. Judges are needed. Would you volunteer? Let Dr. Elizabeth Gierlowski-Kordesch know if you can help. Her email is gierlows@ohio.edu. The web address is www ohio.edu/scifair/
The 2014 State Science Fair will be held at Ohio State University in Columbus, Ohio, on Saturday, May 10, 2014.

The International Science and Engineering Fair will be held in May 2014.

The AMERICAN ASSOCIATION OF PHYSICS TEACHERS APPALACHIAN SECTION (Southeast Ohio, West Virginia and Western Maryland), will hold a FALL 2013 MEETING at Marshall University in Huntington, West Virginia. All school and college physical science and physics teachers are welcome. Why don’t you consider joining this AAPT Section or the Ohio Section or the Southern Ohio Section? There are contributed and invited papers, tours, demonstrations, etc. that are included in the meeting. The meetings are an opportunity to meet colleagues (network) and to learn about new developments in physics and physics teaching.

Teaching Materials Available

Books and Publications


The Physics Teacher has these helpful sections: Figuring Physics, You-Tube Physics, Web Sites, Book Reviews, and other items.

Particle or Wave: the Evolution of the Concept of Matter in Modern Physics, the book provides insight into how matter was defined. The Higgs Boson is discussed. Princeton University Press, 2008 is the publisher. The author is Charis Gvastopoulous and the price is $37.50.

Acoustic Resonators is the title of an article in the Physics Teacher for November 2012. See page 485. It discusses the tuning fork mounted on a resonant box. The low-
frequency resonant boxes are quarter wavelength boxes. There are half wavelength boxes for higher frequencies. The end corrections are necessary also to discuss these cases. The author is Thomas Greenslade Jr.

- **Used Math** is a book by Clifford Swartz. It is a text for teachers on the math needed for the first 2 years of university physics. Approximations are presented. The price is $34 for non-members and $27 for AAPT members. Use www.aapt.org/store.

**Demonstrations, Equipment, Software, Conferences, Tours, etc.**

- For professional development for teachers of physics and physical science, AAPT developed the Physics Teacher Resource Agent (PTRA) program. This should be helpful for new teachers since it provides an experienced and successful teacher to mentor them.

- AAPT has the Physics Store, which supplies books and other items at www.aapt.org/store. AAPT and the Center for the History of Physics are located at One Physics Ellipse in College Park, MD. Use 301-209-3333.

- Are you familiar with the online physics library called ComPadre? It has support for K-12 teachers. Also included are open source physics, tutorials, information on careers, and others. Use www.compadre.org. College faculty would find it helpful also.

- **Tours for Middle and High School Students** are offered by The Department of Physics and Astronomy at Ohio University in Athens. Use Wayne Chiasson at chaisson@ohio.edu. We have experimental research facilities that include surface physics, nuclear physics, optical physics, and biophysics. You can phone 740-593-1712.

- **PASCO** has downloads of Free experiments with PASCO Capstone Workbook Files. These involve mechanics, waves, optics, thermodynamics, and electromagnetism. There is data collection and analysis software. Use 1-800-772-8700 or www.pasco.com.

- **Arbor Scientific** offers lab and demonstration equipment for physics. The items offered in their catalog are for use in instruction in the following areas of physics: optics, holography,
mechanics, waves and sound, electrostatics, electricity, magnetism, thermodynamics, measurement, etc. There are items for conceptual physics and chemistry. For information use www.arborsci.com or 1-800-367-6695.

- **Physics for the 21st Century** is a multimedia course in modern physics for high school physics teachers. It has 11 units with a video and web site. Among the topics are: interactions, gravity, string theory, quantum physics, biophysics, dark matter, dark energy, and other topics. Use www.learner.org or 1-800-532-7637. The supplier is Annenberg Learner.

- If you are looking for a job or wanting to hire, AAPT has a career center. Use http://careers.aapt.org.

**New Developments in Science and Science Education**

- **Hooke’s Law and the Stiffness of a Plastic Spoon** is the title of an article in the Physics Teacher November, 2012 on pages 470-471. A linear curve of force versus displacement was observed. Complications were discussed as were the use of the finite element model.

- **Formulas in Physics have a “Standard” Form** is the title of an article in the Physics Teacher November 2012 on pages 472 and 473. This article points out that physics textbooks in most cases use the following form for equations.

  
  \[(\text{constants}) \times \text{(parameter)} \times \text{(variables)}\]

  For example, the electric field for a point charge at a distance \( r \) is

  \[E = \frac{kQ}{r^2}\]

  Here \( k = \text{a constant}, \ Q = \text{a parameter}, \ \text{and} \ r = \text{the variable} \]

- **You Tube Physics** is a section in the Physics Teacher. This would be a good introduction of physics phenomena presented in this way. In this section, there is a list of available items.
Killing the Computer to Save It is the title of an article in the New York Times on page D1 for Tuesday Oct 30, 2012. Computer security is leading some to consider starting from the basics again to design a simpler computer. It is known that complex systems fail in complex ways, which makes it difficult to detect problems in the systems and know that these systems are secure.

Peacocks are recently known to produce sounds below 20 hertz. This is the frequency limit for humans. The males make this sound when they open their feathers. The sound carries for meters. Read the story about this in Science News July 28, 2012 on page 8.

AAPT has several programs to improve physics education. These are:

1. A Two-Year College New Faculty Experience program and a workshop program for Experienced faculty.

2. An Undergraduate Physics Task Force to study the status of undergraduate physics programs.

3. An endowment fund to give money to members to develop and apply new teaching products. For information use: www.aapt.org or phone at 301-209-3311. There are other programs as well.

Feature Article

Addition of Sound Levels From Several Uncorrelated Noise Sources

This article was written by Dr. F.B. Stumpf, an emeritus professor of physics at Ohio University in Athens. He is an active member of the Acoustical Society of America and the Appalachian Section of the AAPT. He graduated from North Canton H.S. in North Canton, Ohio. His B.S. is from Kent State, M.S. from Michigan, and Ph.D. from the Illinois Institute of Technology. Dr. Stumpf taught undergraduate and graduate courses in physics. He also wrote the text Analytical Acoustics, published by Ann Arbor Science.
This article first appeared in the Newsletter 85 for September 2006. However, this material is still useful and interesting today. In the enclosed spaces or rooms in plants and offices, for example, several sound sources may contribute to overall noise level in a room. Therefore, it is necessary to know how to add the noise levels from several uncorrelated sources. Correlated sound sources occur rarely in plant or office environments. A rough rule for addition of uncorrelated sources is [1,2]:

<table>
<thead>
<tr>
<th>Difference Between Sound Levels (dB)</th>
<th>Corrections to be Added to Higher Sound Level (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 or 1</td>
<td>3</td>
</tr>
<tr>
<td>2 or 3</td>
<td>2</td>
</tr>
<tr>
<td>4 to 8</td>
<td>1</td>
</tr>
<tr>
<td>9 or greater</td>
<td>0</td>
</tr>
</tbody>
</table>

As an example, let us find the resulting sound level from sources of 76,48,86,90,87,86 dB. The sources may be grouped in pairs as shown (different groupings will give nearly the same result):

\[ 76 + 48 = 76\text{dB} \]
\[ 86 + 90 = 91\text{dB} \quad \text{then} \quad 91 + 90 = 94 \text{dB} \]
\[ 87 + 86 = 90\text{dB} \]

The total sound level for the 6 uncorrelated sound sources is 94dB.

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[3] The decibel (dB) is defined as

\[ \text{dB} = 10\log_{10} \frac{I}{I_0} = 20\log_{10} \frac{P}{P_0}, \]

Here \( I \) is the intensity in \( \frac{\text{watts}}{\text{m}^2} \) and \( I_0 \) in \( \frac{\text{watts}}{\text{m}^2} \), a reference intensity for air. \( P = \) sound pressure and \( P_0 = \) reference sound pressure in air = 0.00002 \( \frac{\text{Newton}}{\text{m}^2} \). These are effective pressures.
**Answer to Something to Think About**

We need here an expression for velocity as a function of time for the constant acceleration of gravity \(a = 9.8 \text{ m/sec}^2\)

Use \(v = v_0 + at\)

Here \(v\) is the velocity at time \(t\), \(v_0\) is the velocity at time \(t=0\) and \(a = g = 9.8 \text{ m/sec}^2\).

Solving for \(t\) when \(v_0 = 0\) gives

\[ t = \frac{v}{a} \]

Here \(v\) is the speed of sound in air at 20°C. Substituting values gives

\[ t = \frac{343 \text{ m}}{9.8 \text{ m/sec}^2} \]

\[ t = 35 \text{ seconds} \]

thus the drop time to reach the speed of sound or Mach 1 is near a half a minute.

Note: this is an approximate value. The speed of sound varies as the altitude increases because of decreasing air density and decreasing temperature. The acceleration of gravity also decreases with increasing altitude.