Class 5: What is a wave?

How do we describe one mathematically?

What is a wave function?

Demos get at some properties
The Handout.

Physics 123 Course Schedule, Spring Semester, 2011

draft: 21 Apr.

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<tr>
<th>Date</th>
<th>Read/topic</th>
<th>Quizze: 7th/(6th) Ed</th>
<th>Homework Due</th>
<th>Labs</th>
<th>Exams</th>
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<tbody>
<tr>
<td>#</td>
<td>5th Ed</td>
<td>7th/(6th) Ed</td>
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<tr>
<td>1 Wed. April 27</td>
<td>15.1–3</td>
<td>14.1–3</td>
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<td>2 Wed. April 27</td>
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<td>14.5–6</td>
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<td>4 Fri. Apr. 29</td>
<td>16.1–7</td>
<td>16.1–6</td>
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<td>17.1–3</td>
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<td>11 Mon. May 9</td>
<td>Review</td>
<td>10</td>
<td>8</td>
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<td>14 Wed. May 1</td>
<td>20.6–7;</td>
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<td>18 Mon. May 16</td>
<td>22.2–3.5–7</td>
<td>22.2–4.6–7</td>
<td>17</td>
<td>14</td>
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Remember: the **online** schedule has precedence.
3-1. Did you do 70% of the reading assignment?
A. yes  B. no

Today: Introduction to WAVES
• How do we describe one mathematically?
• What is a wave function?
• Demos get at some properties

Lab 1 due at 2200 in the marked 123 (homework) slot near the TA lab. If you put it in the wrong place??
What can be said about the height of the water in each vertical tube?

A. All are the same

B. The one on the narrow part is higher than the rest.

C. The one on the narrow part is lower than the rest.
Have you registered your clicker? pp
A. Yes
B. No I have not found the right spot
C. No I have not had time, but will

Class 5  Objective: To understand:
What is a wave? How does it differ from a baseball?

What are the varieties of waves?
Can a pulse be a wave?

Periodic waves sine waves

How to describe mathematically?

Reflection of waves- If we have time

A note for HW 4-2 SN is entered with e rather than \(^\). See instructions in packet. Computer is very dull.
What is a mechanical wave?

- Spring demo.
- What is being transmitted? Mass? Like a baseball?
Figure 16.5

Wave motion

Crest

Trough
What kind of wave is sound in air?

A. longitudinal
B. transverse
C. torsional
D. two of the above
What kind of wave is sound in **water**?

1. longitudinal
2. transverse
3. torsional
4. two of the above
Can a pulse be a wave?
Serway, Physics for Scientists and Engineers, 5/e
Figure 16.6

(a) Pulse at $t = 0$

(b) Pulse at time $t$
Figure 16.7

(a) $y(x, 0)$ at $t = 0$ with a maximum value of $y = 2.0$ cm and a speed of $3.0$ cm/s.

(b) $y(x, 1.0)$ at $t = 1.0$ s with a maximum value of $y = 2.0$ cm and a speed of $3.0$ cm/s.

(c) $y(x, 2.0)$ at $t = 2.0$ s with a maximum value of $y = 2.0$ cm and a speed of $3.0$ cm/s.
Online animation allows us to define some properties of sine waves.
What kind of function does this?

• A function linear in time and space
  – $f(kx \pm \omega t + \phi)$
  – $A \sin(kx \pm \omega t + \phi)$ ?
  – $A e^{f(kx \pm \omega t + \phi)}$ ?
  – $A e^{(kx \pm \omega t + \phi)^2}$ ?

• Some properties of most waves:
  – Amplitude, phase, velocity, duration?

• Some properties of periodic waves:
  – $\lambda$, $\omega$, $k$, $f$, $T$?

• Harmonic waves?
Velocity

• \( v = \sqrt{\text{(what?)}} \)
• \( \frac{T}{\mu} \)?
  – Where \( T \) is the tension on a string and \( \mu \) is mass/ unit length
• \( v = \sqrt{\text{(Restoring Force/ mass)}} \)
• Sound \( v = \sqrt{\frac{B}{\rho}} \) \( B \) is bulk modulus.
Figure 16.9

(a) \( y_1 \) \( y_2 \)

(b) \( y_1 \) \( y_2 \)

(c) \( y_1 + y_2 \)

(d) \( y_2 \) \( y_1 \)

(e) \( y_2 \) \( y_1 \)
Superposition

• Be prepared (in 2 chapters) to add together 2 waves like:

• $A_1 \sin(k_1 x \pm \omega_1 t + \varphi_1) + A_2 \sin(k_2 x \pm \omega_2 t + \varphi_2)$

  – Though usually I will give you: $k_1 = k_2 \& \omega_1 = \omega_2$ but $\varphi_1 \neq \varphi_2$. 
Reflections
Serway, Physics for Scientists and Engineers, 5/e
Figure 16.15

(a) Incident pulse

(b) Transmitted pulse

Reflected pulse