WELCOME TO PERIOD 25

Homework Exercise #24 is due today.

CAUTION: Keep your phones, tablets, calculators, watches, etc. off of the tables.

Watch video 6, Empire of the Air, for class discussion on Nov 29 or 30.

Final review session: Mon, Dec 10, 6:30 in 2005 SM

Final drop-in session: Tues, Dec 11, 3:00-5:15 in 2005 SM
Physics 1103 final exam

The final is Tuesday, **Dec 11, 6:00 – 7:45 pm**.

- Jim Bihari’s sections in 1005 Smith
- Mary Wildermuth’s sections in 1009 Smith
- Bill Davis’ sections in 113 Dreese Lab

The final has 50 multiple choice questions.

  About \(\frac{1}{2}\) of the questions are over Per 18 – 26.
  About \(\frac{1}{2}\) are over Per 1 – 17.
  One question each on Videos 5 and 6.

Review session: **Monday, Dec 10, 6:30 pm in 2005 Smith**

Drop-in session: **Tues, Dec 11, 3:30 – 5:30 pm in 2005 Smith**

**NO EARLY finals are given.**
How is information transferred?
How do loudspeakers and microphones work?
How can a signal be broadcast?

Put away your phones and electronics. The large magnets will damage them.
Radiant energy (electromagnetic radiation)

Radiant energy results from vibrations of charges.

As the charges vibrate, they produce waves of energy.

Waves of electromagnetic radiation travel at a speed of $3 \times 10^8$ (300,000,000) meters/second in a vacuum.
Wavelength, period, and frequency

- The wave’s period is the time it takes to complete one cycle.
- The wave’s frequency is how often it completes a cycle.

![Wave length and period diagram](chart)

Lower frequency  Higher frequency

Wave Length  Wave Length

Wave Period  Wave Period

Distance  Time
The type of radiant energy depends on the wavelength.

Shorter wavelengths transmit more energy than longer wavelengths.
Information transfer

- Transferring information requires …
  1) a source of information (a person or device)
  2) a signal (the information)
  3) a receiver
  4) modulation (changing) of the signal in a meaningful way. Examples: spoken language, Morse Code, or radio and TV broadcasts

- Some transfers of information involve the transfer of matter, such as current flowing through an electric circuit.

- Radiant energy can transfer information without transferring matter by modulating radiant energy, such as radio waves.
Signal-to-noise ratio (SNR)

- Any energy that combines with a signal is called **noise**.
- In a radio broadcast, the program broadcast is the signal and any static is noise.
- A stronger signal and weaker noise is desirable.

Signal-to-noise ratio \( \text{SNR} = \frac{\text{average energy of signal}}{\text{average energy of noise}} \)

**Example:** If the energy of a signal is 750 joules and the energy of the noise is 250 joules,

\[
\text{the SNR} = \frac{750 \text{ J}}{250 \text{ J}} = 3
\]
Signal-to-noise ratio

Lower SNR (more noise)  Higher SNR (less noise)
Encoding information

- Give examples of encoding information in a signal.
- What examples were shown in the video *Light Speed*?
Loudspeakers

A loudspeaker converts electrical energy into sound energy.

1) A changing current induces a changing magnetic field.

2) This changing magnetic field is attracted to and repelled by a magnet attached to the speaker’s cone.

3) The moving speaker cone exerts pressure on air molecules, which produce sound waves.

Microphones

A microphone converts sound energy into electrical energy.

1) Pressure from sound waves moves a magnet inside the microphone.

2) The moving magnet produces a changing magnetic field.

3) The changing magnetic field induces a changing electric current.
Loudspeakers vs. microphones

A loudspeaker is the opposite of a microphone:

- **Loudspeakers** convert electrical energy into sound energy.
- **Microphones** convert sound energy into electrical energy.

Both microphones and loudspeakers use

- a changing current, which induces a changing magnetic field around the wire and
- the magnetic force between the changing magnetic field and another magnet.
Building a loudspeaker

• First, tune your radio to a station playing music. Then, follow the directions to build a loudspeaker.

• What is the purpose of wrapping wire around the bolt?

• What makes the speaker cone (the foil pan) move?
Carbon telephone

Why does the resistance of the cup and charcoal change when you speak into the cup?

- Cups with carbon
- Resistance meter set to R x 1
- Amplifier
Info transfer with induced current

How is the radio broadcast transferred to the amplifier?

Ends of wires are clipped together
Info transfer using radiant energy

• Information can be transferred with waves of radiant energy (electromagnetic radiation)

• Different wavelengths of radiant energy result in waves of different frequencies.

Longer Wave Length = Lower Frequency

Shorter Wave Length = Higher Frequency

• Long radio waves are used to broadcast radio signals.

• Shorter microwaves are used for cell phones and other communication devices.
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BEFORE THE NEXT CLASS…

✓ Read textbook chapter 26
✓ Complete Homework Exercise 25
✓ Bring a blank Activity Sheet 26 to class.

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