

Announcements

- ▶ Exam Thursday. **Pick up an Exam Info sheet from the front.**
- ▶ Optional review session tonight, here, at 8:30 pm.
- ▶ Last year's exam is available on the Solutions page.
- ▶ Graded group exercise in problem session tomorrow.
- ▶ Graded post-exam activity in problem session on Friday.

What Will You Be Tested On?

- ▶ PHYS 212 exams are not evaluating if you are “good at math” or “good at physics”. This exam will test your mastery of the material covered in Unit 2 of PHYS 212.
- ▶ This includes:
 - Lectures 8-14
 - Problem Session (assigned problems)
 - Some PHYS 211 content used in this unit (equipartition, vector addition, oscillations, ...)
- ▶ We thoroughly check our exams to eliminate bias with respect to race, gender, or culture.

You're allowed one index card for Unit 2. Things you might put on it:

- ▶ Fundamental equations
- ▶ Basic derivatives and integrals: x^n , e^x , $\sin x$, $\cos x$
- ▶ Prefixes: you should know nano, micro, milli, centi, kilo, mega, and giga.
- ▶ Examples. How to find the distance on the screen for the second side minimum for two-slit interference.
- ▶ Step-by-step methods.
- ▶ Maybe a chart of which $\Delta\phi$ give maxima and minima for double slit, multi-slit, single slit, and diffraction gratings.

You are also allowed to bring your notecard from the previous 212 exam.

PHYS 212 Second Exam

March 19, 2026

Name _____

P. S. Instructor: _____

P. S. Time: _____

Show all work for full credit! Answers must have correct units. For all problems (except multiple choice questions) start with either (a) a generally applicable equation, or (b) a sentence explaining your approach.

The work for each problem should appear on the same page as the problem for full consideration.

All smart devices (phones, watches, glasses, etc.) have to be packed away during the exam. If your cell phone is out, we will have to confiscate your exam.

$$k = 8.99 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2 \quad \epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2 \quad c = 3.00 \times 10^8 \text{ m/s}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ T}\cdot\text{m/A} = 1.26 \times 10^{-6} \text{ T}\cdot\text{m/A} \quad v_{\text{sound}} = 340 \text{ m/s}$$

$$h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s} = 4.14 \times 10^{-15} \text{ eV}\cdot\text{s} \quad hc = 1240 \text{ eV}\cdot\text{nm} \quad 1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$$

$$g = 9.80 \text{ N/kg} \quad m_e = 9.11 \times 10^{-31} \text{ kg} \quad m_p = 1.67 \times 10^{-27} \text{ kg}$$

$$k_B = 1.38 \times 10^{-23} \text{ J/K} = 8.62 \times 10^{-5} \text{ eV/K}$$



Don't take shortcuts!

- ▶ Show all work. We grade the process and not the answer, so you need to communicate your approach.
- ▶ A generally applicable equation such as

$$|\mathcal{E}| = \left| \frac{d\Phi_B}{dt} \right|$$

can be used without explanation. Starting with

$$|\mathcal{E}| = \frac{d}{dt}(BA)$$

is not valid.

- ▶ If using a specialized equation that is valid only for a particular situation, you must state the assumptions.

$$\Delta r_{\text{adj}} = d \sin \theta \quad \text{because } d \ll L$$

Lecture 14 — Concept Test 1

A uniform magnetic field points into the page. A wire loop has an increasing radius. Which expression gives the correct magnitude of the emf in the loop?

1. $NBA \cos \theta$

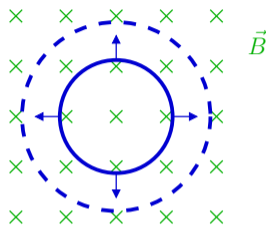
2. $N \frac{dB}{dt} A \cos \theta$

3. $NBA \sin \theta \frac{d\theta}{dt}$

4. $NBA \sin \theta$

5. $NB \frac{dA}{dt} \cos \theta$

6. $\frac{dN}{dt} BA \cos \theta$

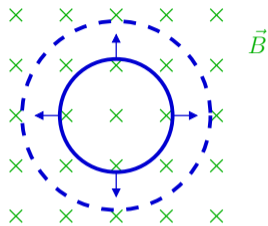


Note: none of these are valid starting points!

Lecture 14 — Concept Test 2

A uniform magnetic field points into the page. A wire loop has an increasing radius. What is the direction of the induced current in the loop?

1. clockwise
2. into the page
3. there is no induced current
4. counterclockwise
5. out of the page
6. not enough information



Lecture 14 — Concept Test 3

The magnetic field of an EM wave is expressed as

$$\vec{B} = 2 \times 10^{-4} \text{ T} \cos(0.25 \times 10^7 y + 0.75 \times 10^{15} t) \hat{i}$$

where y is in meters and t is in seconds. What is the direction of propagation of this wave?

1. $+x$

3. $+y$

5. $+z$

2. $-x$

4. $-y$

6. $-z$

Lecture 14 — Concept Test 4

The magnetic field of an EM wave is expressed as

$$\vec{B} = 2 \times 10^{-4} \text{ T} \cos(0.25 \times 10^7 y + 0.75 \times 10^{15} t) \hat{i}$$

where y is in meters and t is in seconds. Along which axis is this EM wave polarized?

1. $\pm x$

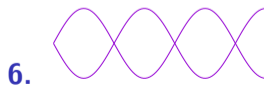
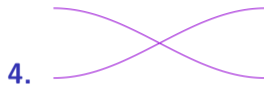
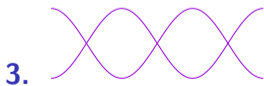
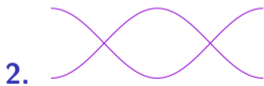
3. $\pm z$

2. $\pm y$

4. not enough information

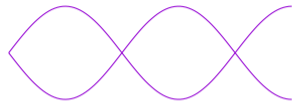
Lecture 14 — Concept Test 5

I blow on my slide whistle and create an awful squawking sound that corresponds to the third lowest frequency. Which of the following diagrams depicts the nodes and antinodes for this standing wave?



Lecture 14 — Concept Test 6

I blow on my slide whistle and create an awful squawking sound that corresponds to the third lowest frequency, with the standing wave sketched to the right.



My slide whistle is 20 cm long. What is the wavelength?

1. 20 cm

3. 40 cm

5. 10 cm

2. 25 cm

4. 12 cm

6. 16 cm

Phase difference

$$\Delta\phi$$

Path length difference

$$\Delta r$$

$$\Delta\phi = 2\pi \frac{\Delta r}{\lambda}$$

$$\Delta r = r_2 - r_1$$

or

$$\Delta r = d \sin \theta \text{ if } d \ll L$$

phasor
diagram

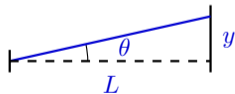


Interference

constructive,
destructive,
maxima, minima

Geometry

- pythagoras
- $y = L \tan \theta$

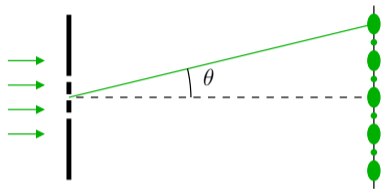


- $\sin \theta \simeq \tan \theta$
for small θ

Lecture 14 — Concept Test 7

Light of wavelength 510 nm falls on a barrier with 3 thin slits each spaced $2.5 \mu\text{m}$ apart from its adjacent slit as shown in the figure. A pattern of dots appears on a distant screen.

Determine the angle θ for the 2nd major bright side maximum.



Which of the following is the sequence that you'll use to solve this problem?

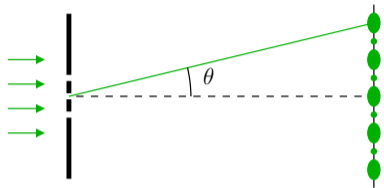
1. interference \rightarrow determine $\Delta\phi \rightarrow$ determine $\Delta r \rightarrow$ geometry
2. geometry \rightarrow determine $\Delta r \rightarrow$ determine $\Delta\phi \rightarrow$ interference

Lecture 14 — Concept Test 8

Light of wavelength 510 nm falls on a barrier with 3 thin slits each spaced $2.5 \mu\text{m}$ apart from its adjacent slit as shown in the figure. A pattern of dots appears on a distant screen.

Determine the angle θ for the 2nd major bright side maximum.

What is the phase difference $\Delta\phi$ for this problem?



1. 0

3. π

5. 3π

2. $\pi/2$

4. 2π

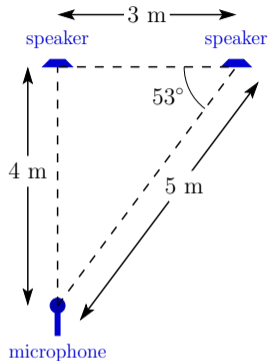
6. 4π

Lecture 14 — Concept Test 9

The illustrated speakers emit sound waves that are in phase as they leave the speakers. The waves have a frequency of 170 Hz and a wavelength of 2 m. The stereo is adjusted so that the individual sound waves from the speakers have identical amplitudes A at the microphone. Calculate the amplitude of the total sound wave detected by the microphone when both speakers are on.

Which of the following is the sequence that you'll use to solve this problem?

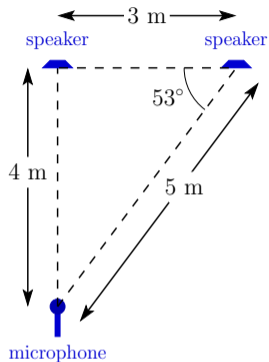
1. interference \rightarrow determine $\Delta\phi$ \rightarrow determine Δr \rightarrow geometry
2. geometry \rightarrow determine Δr \rightarrow determine $\Delta\phi$ \rightarrow interference



Lecture 14 — Concept Test 10

The illustrated speakers emit sound waves that are in phase as they leave the speakers. The waves have a frequency of 170 Hz and a wavelength of 2 m. The stereo is adjusted so that the individual sound waves from the speakers have identical amplitudes A at the microphone. Calculate the amplitude of the total sound wave detected by the microphone when both speakers are on.

What is Δr for this problem?



1. 1 m

3. $(1 \text{ m}) \sin 53^\circ$

5. $(3 \text{ m}) \sin 53^\circ$

2. 3 m

4. $(1 \text{ m}) \sin 37^\circ$

6. $(3 \text{ m}) \sin 37^\circ$

Lecture 14 — Concept Test 11

I have a green laser with wavelength 532 nm and a red laser with wavelength 633 nm. Both lasers emit the same power (3 mW) of light. Which laser emits a greater number of photons per unit time?

1. the green laser
2. the red laser
3. both emit the same number
4. not enough information