PHY2049

STUDY EDGE

SPRING 2022

Physics 2 with Calc

Exam 3 Session 11 (Ch 34)

The content of this packet is only applicable to Spring 2022

Over 70,000 UF students have trusted our Study Experts to get better grades. Shouldn't you?

Location: Study Edge is right on the edge of campus! The Study Edge building is open 10 a.m. to 8 p.m. - 7 days a week. You can stop by anytime for more information or to pick up a packet! Go to studyedge.com/directions for parking and more information!

What We Do: Study Edge provides Review Sessions, Practice Problems, Mock Exams, Expert Study Plans, and Study Hours for many undergraduate courses. All of our Review Sessions are prepared and led by our Study Experts who have spent an average of more than 5 years becoming experts in their respective subjects and, equally important, making the material relatable to students. Is it your first time? Ask for our one-page flyer for more information!

Study Hours: Looking to study with other students or get questions answered outside of a review session? We will host a minimum of 2 hours of Study Hours per exam, per class! Check the Study Edge apps to see the schedule for your class. In addition, for the Fall 2021 semester, all members have access to weekly, Virtual Study Hours. Check the announcement on the app for scheduling and more information.

Online Content: All video content that our Study Experts post is available through the use of our Facebook app and mobile apps (iPhone/iPad/Android). There are two types of videos on our apps: short videos that have **individual concepts or problem explanations,** and longer videos that are **recordings of in-person or online review sessions**. Our memberships are monthly **auto-recurring memberships**, which can be purchased at the Edge building or at StudyEdge.com/uf through our app. For more information about memberships, please visit StudyEdge.com/pricing or call 1-888-97-STUDY to speak with a Study Edge representative!

Diamond Only: Diamond members have priority access to weekly Virtual Study Hours, exclusive access to Study Tips and Life Essentials "adulting" videos, and a limited-edition t-shirt. You can also skip lines at all In-Person Reviews at the Study Edge building.

To watch accompanying videos:

Step 1: Go to StudyEdge.com/uf and click on the "Facebook App".

Step 2: Click the "University of Florida" button. Then, select your subject from the dropdown menu. Now, click the "Log In With Facebook" button and log in.

Step 3: Go to the Videos & More tab (below the video player) and open the folders for your course.

Step 4: Have any questions while you're studying? Click the Class Wall tab (below the video player) and post them below!

Study Edge Referral Program!

Short version:
Give your friends who haven't used Study Edge a 7-day free trial and $10 off their first month. You'll earn $10 cash when they buy a membership!

Details:

- You can earn an unlimited amount of money because we would rather give money back to our members than buy Alligator ads or Facebook ads to get the word out, and Study Edge doesn't exist if people don't tell their friends!
- Your referral code is the first piece of your UF email address (the part BEFORE the @ symbol) For example, if your email is AlbertaGator@ufl.edu, your referral code would be AlbertaGator.
- Just tell your friends who have never used Study Edge before (freshman, transfer students, and others) that they should put in your referral code now. As long as your friend uses the code THEY will get a 7-day free trial and $10 off their first paid month and YOU will get $10.
- To collect your money just email rewards@studyedge.com from your UF email address with the name of your friend(s) who bought a **first-time membership** and we'll Venmo or Paypal you the money.
- Consider posting on social media with your referral code so that all of your friends learn that they can get a 7-day free trial and $10 off their first paid month of Study Edge membership by using your code.
- Remember, there is no limit to how many friends you can refer (and how much money you make) so start spreading the word!

PHY2049 – Exam 3 Session 11 (Ch 34) Review

Who am I?

- My name is Marty. I have a BS Math, a BS Stats and a MS in Electrical Engineering from UF.
- My favorite artists are The Mars Volta, Crystal Castles, and MF Doom.
- If you have questions about physics content, the best way to get them answered quickly is to post on the Class Wall on our Facebook or Android/iOS apps.
- If you have questions about Study Edge, or if you need extra tokens, etc., please email PHY2049@studyedge.com. This will go to multiple tutors and guarantee you the quickest response. If you want to reach just one of us specifically, you can do that too. You can email me at: marty@studyedge.com. Your other main Study Expert for this class is Kate, you will see her on the walls and emails.

What's going to happen?

- This review will be ~1 hour long.
- We will be covering: Optics, including lenses and mirrors.
- Make sure you have a printed copy of this review guide before starting the video
    - In Gainesville? The SE building is open daily from 10 a.m.-8 p.m. for packet pickup
    - Not in town? If you don't have a printer, we ship packets through studyedge.com/shipping

What do I do after the session?

- Be happy it's over, and that you have learned a bunch of physics. Now try out the practice problems!
- Consider a Study Edge membership, if you don't have one already. Go to www.StudyEdge.com/uf, and click 'Pricing' at the top.

Want more face to face help? Try Study Hours!

- Study Hours are like private tutoring and are included with every membership. Students who come to Study Hours do better on the exams.
- You're welcome to come even if you don't have a specific question in mind. We'll work through problems you need and give any recommendations to try to make sure you understand all the exam material.
- We have a Study Hours session every week, with extra hours a few days before each exam! For a limited time, the Weekly Study Hours sessions are open to both Gold and Diamond members! Sessions are held on Zoom.
- Check out the announcements on your class page for the time and a link to join! See you at Study Hours!

Study Edge Road Map

Don't know where to start studying? Here's our suggested plan to do well on your exam!

- ☐ Come to Study Edge Chapter and Exam Review Sessions (or watch them online).
- ☐ Do all of the Study Edge practice problems (treat these like a test, don't cheat!).
- ☐ Study regularly from past released UF physics exams (Linked from Study Edge app).
- ☐ Post Questions on the Wall.
- ☐ Check our Study Expert Plan and Virtual Study Hours available on the app
- ☐ If you need a private tutor for this class or any other class check out UF's official Tutor Matching Service at http://www.tutormatchingservice.com/

Flat (Plane) Mirrors

→ When you look at your bathroom mirror, you see yourself behind it, at the same size, an equal distance away.

→ Rays bounce off at the same angle they hit the mirror.

→ **Quantities of interest:**
  - $p =$ object distance from the mirror
  - $i =$ image distance from the mirror

→ **Conventions:**
  - p is a positive quantity
  - i is a negative quantity
  - $i = -p$
  - **The left side of our diagrams will be positive and the right side will be negative.**

→ **Images:**
  - Real images exist independent of the person observing them.
  - Virtual images depend on the position of the person observing them

1. How tall of a mirror does a 6-foot-tall man need to see his whole body? How far away does his reflection appear?

Spherical Mirrors

→ Imagine taking a hollow, reflecting sphere and cutting out arcs from it.
  - This is precisely what a spherical mirror is.

→ If we take a piece that reflects outward, we have a _____ mirror.

→ If we take a piece that reflects inward, we have a _____ mirror.

→ Quantities of interest:
  - p = object distance from mirror
  - i = image distance from mirror
  - r = radius of curvature
  - f = focal length = $\frac{r}{2}$
  - m = magnification
  - h = object height
  - h' = image height

→ Equations:

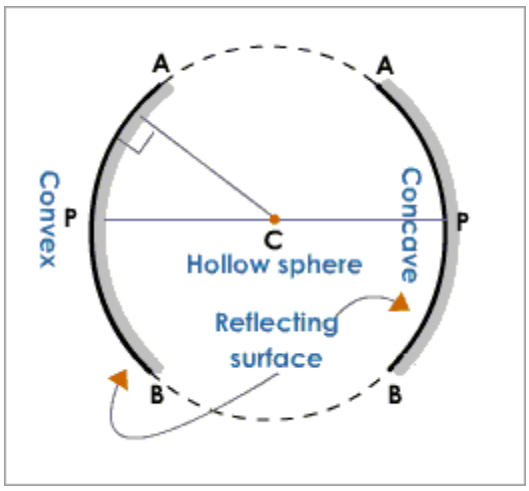
$$\frac{1}{p}+\frac{1}{i}=\frac{1}{f}=\frac{2}{r}$$

$$i=\frac{pf}{p-f}$$

$$m=\frac{h'}{h}=-\frac{i}{p}$$

→ Magnification:
  - If $m > 0$, then the image has the same orientation of the object (not inverted)
  - If $m < 0$, then the image has the opposite orientation of the object (inverted)

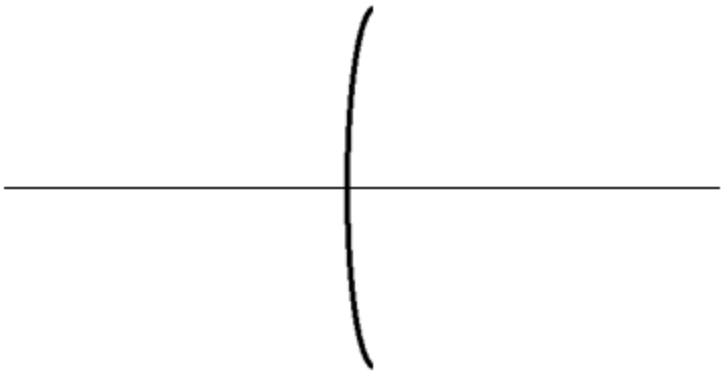
Hand with Reflecting Sphere, M.C. Escher. Lithograph, 1935.



Convex

p is always positive

→ f and i are always negative



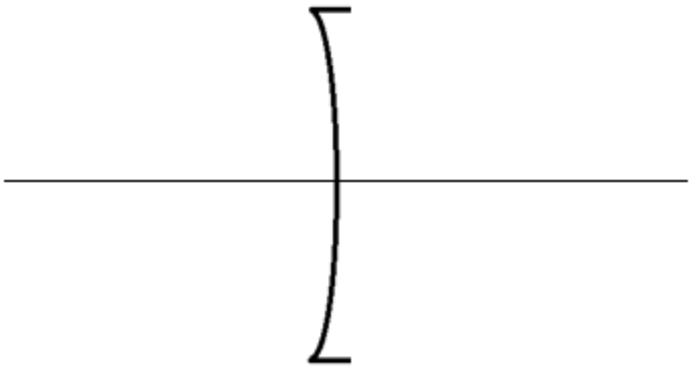
$$\frac{1}{p}+\frac{1}{i}=\frac{1}{f}$$

Mirror Type	Sign of f	Sign of i	Real or Virtual?	Inverted or Nah?	Smaller or Larger?
Convex					

Concave

→ p is still always positive

→ f is always positive



$$\frac{1}{p}+\frac{1}{i}=\frac{1}{f}$$

Case 1: $p < f$

Mirror Type	Object Location	Sign of f	Sign of i	Real or Virtual?	Inverted or Nah?	Smaller or Larger?
Concave	$p < f$					

Case 2: $p > f$

Mirror Type	Object Location	Sign of f	Sign of i	Real or Virtual?	Inverted or Nah?	Smaller or Larger?
Concave	$f < p < 2f$					
	$p > 2f$					

What if $p = f$ (object at focal point)?

2. Determine the type of mirror, radius of curvature, image distance, lateral magnification, whether the image is real or virtual, inverted or non-inverted, and which side of the mirror the image is located.

Type	***f***	***r***	***p***	***i***	***m***	**R/V**	**I/NI**	**Side**
	-20 cm		+30 cm					

Type	***f***	***r***	***p***	***i***	***m***	**R/V**	**I/NI**	**Side**
			45 cm		-1/2			

Thin Lenses

Left (side where light begins) is NEGATIVE and
Right (side where light ends up) is POSITIVE.

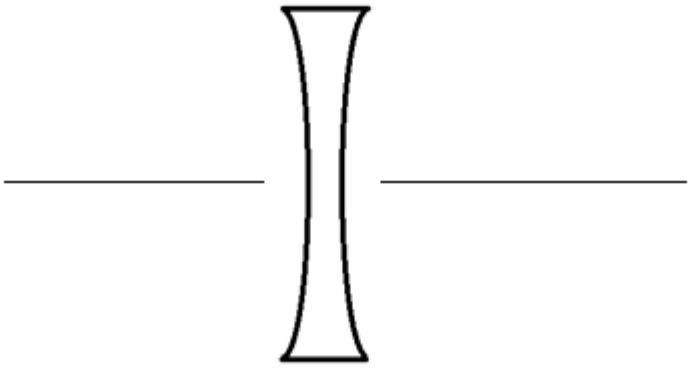
→ Same equation (from before) applies here:

$$\frac{1}{p}+\frac{1}{i}=\frac{1}{f}$$

→ Two types of lenses form images:
- Diverging- all incoming light _____ on the opposite side of the lens.
  - We perceive the light to diverge from a single focal point on the _____ side as where light enters.
- Converging- all incoming light _____ at a single focal point on the _____ side as where light enters.

→ Real images will be formed on the _____ side (where light actually ends up).
→ Virtual images will be formed on the _____ side (where light enters).

Diverging
→ p is still always positive
→ f is always negative
→ i is always negative

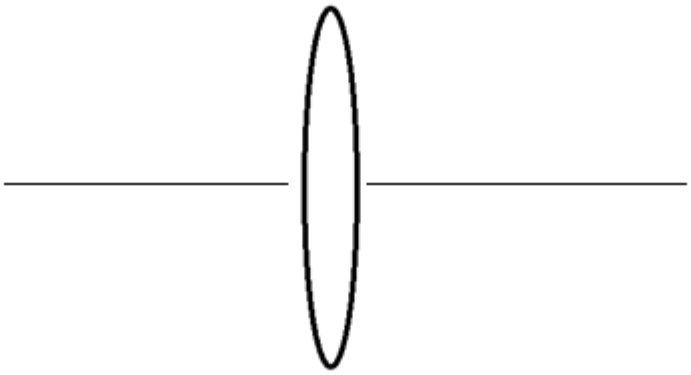


Lens Type	Object Location	Sign of f	Sign of i	Real or Virtual?	Inverted or Nah?	Smaller or Larger?
Diverging						

Converging

→ p is still always positive

→ f is always positive



Case 1: $p < f$

Lens type	Object Location	Sign of f	Sign of i	Real or Virtual?	Inverted or Nah?	Smaller or Larger?
Converging	$p < f$					

Case 2: $p > f$

Lens Type	Object Location	Sign of f	Sign of i	Real or Virtual?	Inverted or Nah?	Smaller or Larger?
Converging	$f < p < 2f$					
	$p > 2f$					

3. Given an object distance, the type of lens, and the distance between a focal point and the lens, fill in this super fun table.

p	***Lens***	***i***	***m***	**R/V**	**I/NI**	**Side**
+4 cm	C, 6.0					

Sign conventions for mirrors and lenses

$$M = -\frac{i}{p} = \frac{h_i}{h_o} \qquad \frac{1}{p} + \frac{1}{i} = \frac{1}{f} \qquad f = \frac{r}{2}$$

	Mirrors	**Lenses**
Focal length, f	+ concave	+ converging
	- convex	- diverging
Object distance, d_o	+ object in front of mirror (real object)	+ object left of lens (real object)
	- object behind mirror (virtual object)	- object right of lens (virtual object)
Image distance, d_i	+ image in front of mirror (real image)	+ image right of lens, formed by real object (real image)
	- image behind mirror (virtual image)	- image left of lens, formed by real object (virtual image)
Magnification, M	+ upright image	+ upright image
	- inverted image	- inverted image

Shortcut predictions

Given	Concave Mirror	Converging/convex lens
	Image is	
p < f	Virtual, upright, larger	
p = f	No image	
f < p < r	Real, inverted, larger	
p = r	Real, inverted, same size	
p > r	Real, inverted, smaller	

- Object in front of **convex mirror** (p > 0) will produce a virtual, upright, smaller image.
- Object in front of **diverging/concave lens** (p > 0) will produce a virtual, upright, smaller image.

Two Lens Systems

→ Magnification multiplies!
  - If lens 1 has magnification m_1 and lens 2 has magnification m_2, then the total magnification will be $M = m_1 m_2$.

→ If $M > 0$, then the final image has the _____ orientation as the original.

→ If $M < 0$, then the final image is _____.

→ **p can take on negative values now**

Process:

1. Find i_1 as you would for a 1-lens system. i_1 is the image distance.
2. The image from lens 1 becomes the object for lens 2.
3. Use the new object for lens 2 to find the new image from lens 2. Note: p_2 can be negative now.

4. Now we have TWO lenses. Find the image distance from the second lens, TOTAL magnification, and all the other cool facts in the table below.

p_1	Lens 1	d	Lens 2	i_2	M	R/V	I/NI	Side
29 cm	C, 9.1	10 cm	C, 6.6					

Spherical Refracting Surfaces

→ When we are given an "image" problem with indices of refraction, we have a more general equation to use.

$$\frac{n_1}{p} + \frac{n_2}{i} = \frac{n_2 - n_1}{r}$$

→ When your object faces a convex surface, $r > 0$.
→ When your object faces a concave surface, $r < 0$.
n_1 is for the initial medium, and n_2 is for the final medium

5.

n_1	n_2	p	r	i	R/V	Side
1.3	1.6		+40	+825		

Chapter 34 End of Packet Problems

Video solutions can be found on the Study Edge App

1. A mirror with a focal length of +24 cm has an object placed at p = 36 cm.
   a) What kind of mirror is this?
   b) Find r, i, m.
   c) Is the image real or virtual, inverted or upright, on the same or opposite side?

2. Light travels from air into a spherical puddle with R radius +32 cm. A certain object in the air has an image distance of +650 cm. Determine the object's distance from the puddle.

3. A real inverted image appears 30 cm from an object at half its size.
   a) What kind of lens must be used to produce this image?
   b) How far from the object must the lens be placed?
   c) What is the focal length of this lens?

4. The lens makes an erect image three times the size of the object. If the image is 4 cm from the lens find the lens focal length.

5. Two converging lenses are a distance L apart, the focal length of each is 20 cm. An object is placed 30 cm to the left of the left lens and its image appears 40 cm behind the right lens. Find the distance between the two lenses.

6. Suppose the farthest distance a person can see without a visual aid is 50 cm.

   a) What is the focal length of the corrective lens that will allow the person to see very far away?

   b) Is the lens converging or diverging?

   c) The power P of a lens (in diopters) is equal to 1/f, where f is in meters. What is P for the lens?

7. Two identical converging lenses with a focal distance of $f = 10\ cm$ are separated by a distance of $20\ cm$. An object of 1-cm height is placed 3 cm in front of the two-lens package. What is the absolute value of the image height formed by the two lenses?

8. An inverted image is formed 30 cm from an object by a thin lens located between the two. The image is 1/3 the height of the object. What is the distance from the object to the lens?

9. A concave mirror has a radius of curvature of R = 7 m. An object is placed 4 m in front of the mirror. Is the image real or virtual, upright or inverted, larger or smaller than the object?

   a) real, inverted, larger
   b) real, inverted, smaller
   c) real, upright, larger
   d) real, upright, smaller
   e) virtual, inverted, larger
   f) virtual, inverted, smaller
   g) virtual, upright, larger
   h) virtual, upright, smaller

10. A person cannot see clearly objects closer than 1.6 m from her/him. What is the refractive power (in diopters) of the correction lenses that will allow her/him to clearly see objects located 25.0 cm, but not closer, from her eyes? Ignore the distance between her/his eyes and the lenses. Diopter is 1/f, where f is a lens's focal distance in meters.

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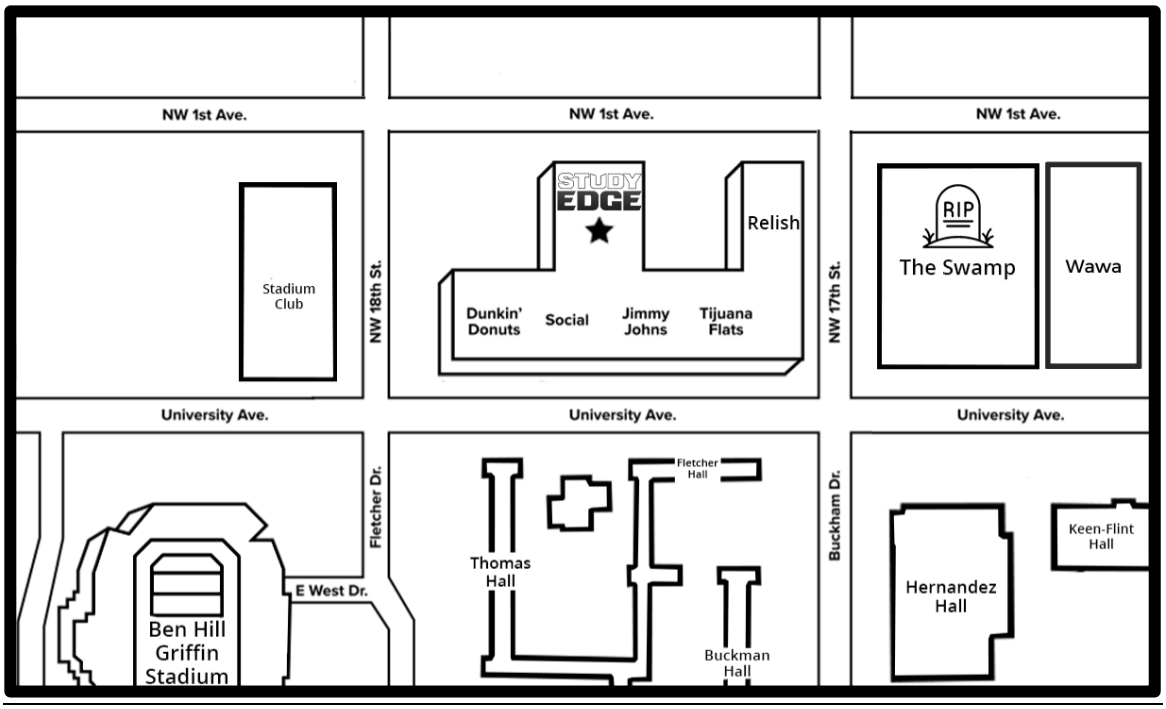

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