**PHYSICS 2021 - 22 May 23, 2022**

**Today’s Agenda (Day 163)**

1. HOUSEKEEPING ITEMS

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1. HOMEWORK CHECK:

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1. CLASS ACTIVITY

🡪 BEGIN: Ch 19 PPT Review

1. **Section 19.1 – Interference**
2. **Section 19.2 - Diffraction**

HOMEWORK:

* READ: Chapter 18 – Refraction and Lenses
* READ: Chapter 19 – Interference and Diffraction
* STUDY: Chapter 18Test

<http://glencoe.mheducation.com/sites/0078807220/student_view0/self-check_quizzes.html>

Ch 19 – Interference and Diffraction

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| Incoherent light | Coherent light | Interference fringes | Monochromatic light |
| Thin-film interference | Diffraction pattern | Diffraction grating | Rayleigh criterion |

REMINDERS:

* TEST: Chapter 18 **🡪 May 24**
* TEST: Chapter 19 **🡪 June 2**

**PHYSICS 2021 - 22 Review Questions**

**CH 18 PRACTICE PROBLEMS**

SECTION 18.1

1. A laser beam in air enters ethanol at an angle of incidence of 37.0°. What is the angle of refraction?
2. As light travels from air into water, the angle of refraction is 25.0° to the normal. Find the angle of incidence.
3. Light in air enters a diamond facet at 45.0°. What is the angle of refraction?
4. A block of unknown material is submerged in water. Light in the water enters the block at an angle of incidence of 31.0°. The angle of refraction of the light in the block is 27.0°. What is the index of refraction of the material of the block?
5. Light travels from air into another medium. The angle of incidence is 45.0° and the angle of refraction is 27.7°. What is the other medium?
6. You notice that when a light ray enters a certain liquid from water, it is bent toward the normal, but when it enters the same liquid from float glass, it is bent away from the normal. What can you conclude about the liquid’s index of refraction?
7. A ray of light in air has an angle of incidence of 30.0° on a block of unknown material and an angle of refraction of 20.0°, as shown in Figure 10. What is the index of refraction of the material?



1. A beam of light passes from water into polyethylene with n = 1.50. If Θ1 = 57.5°, what is the angle of refraction in the polyethylene?
2. What is the speed of light in chloroform (n = 1.51)?
3. If you were to use quartz and float glass to make an optical fiber, which would you use for the cladding layer? Why?
4. Why can you see the image of the Sun just above the horizon when the Sun itself has already set?
5. Could an index of refraction ever be less than 1? What would this imply about the speed of light in that medium?
6. In what direction would you have to be looking to see a rainbow on a rainy late afternoon? Explain.

SECTION 18.2

1. A 2.25-cm-tall object is 8.5 cm to the left of a convex lens of 5.5-cm focal length. Find the image position and height.
2. An object near a convex lens produces a 1.8 cm tall real image that is 10.4 cm from the lens and inverted. If the focal length of the lens is 6.8 cm, what are the object position and height?
3. An object is placed to the left of a convex lens with a 25 mm focal length so that its image is the same size as the object. What are the image and object position?
4. Calculate the image position and height of a 2.0 cm tall located 25 cm from a convex lens with a focal length of 5.0 cm. What is the orientation of the image?
5. Use a scale ray diagram to find the image position of an object that is 30 cm to the left of a convex lens with a 10 cm focal length.
6. A magnifier with a focal length of 30 cm is used to view a 1 cm tall object. Us a ray diagram to determine the location and size of the image when the magnifier is positioned 10 cm from object.
7. Magnifying lenses normally are used to produce images that are larger than the related objects, but they also can produce images that are smaller than the related objects. Explain.
8. Redraw the ray diagram in Figure 19 and use it to determine the location and size of the image. Use the thin lens equation and the magnification equation to verify your answer.
9. An object is placed 1.5 cm from a convex lens with a focal length of 1.0 m. Use the thin lens equation to determine the distance of the image from the lens. If the object height is 2.0 m, what is the image height? Is the image real or virtual? Is the image inverted or upright?
10. Calculations in this chapter use a thin lens approximation. What does this mean? Why is a thin lens approximation used?
11. Use the ray diagram in Figure 20 to determine whether the images for object 1 will be reduced or enlarged, inverted or upright, and real or virtual. Do the same for object 2.



1. A 6.5-cm tall salt shaker is viewed through a diverging lens with a focal length of 5.0 cm.
2. If the shaker is 6.0 cm from the lens, what is the image distance from the lens? Is the image virtual or real?
3. What is the magnification? Is the image smaller or larger than the object?
4. If the salt shaker is moved to 4 cm from the lens, what is the distance of the image from the lens? What is the magnification? Is the image now smaller or larger than the object?
5. An air lens constructed of two watch glasses is placed in a tank of water. Copy Figure 21 and draw the effect of this lens on parallel light rays incident on the lens.



SECTION 18.3

1. Which type of lens, convex or concave, should a nearsighted person use? Which type should a farsighted person use? See Figure 28. Explain.



1. Explain why the cornea is the primary focusing element in the eye.
2. Your camera is focused on a tree 2 m away. You now want to focus it on a tree that is farther away.  Will the lens move closer to the sensor or farther away?
3. How does the angle of incidence compare with the angle of refraction when a light ray passes from air into glass at a nonzero angle?
4. How does the angle of incidence compare with the angle of refraction when a light ray leaves glass and enters air at a nonzero angle?
5. Figure 29 depicts a ray of light traveling from air into several mediums. Rank the mediums according to index of refraction from greatest to least. Specifically indicate any ties.



1. Although the light coming from the Sun is refracted while passing through Earth’s atmosphere, the light is not separated into its spectrum. What does this indicate about the speeds of different colors of light traveling through air?
2. Explain why the Moon looks red during a lunar eclipse.

**PHYSICS 2021 - 22 Review Questions**

 **CH 19 PRACTICE PROBLEMS**

SECTION 19.1 - Interference

1. Violet light falls on two slits separated by 1.90×10−5 m. A first-order bright band appears 13.2 mm from the central bright band on a screen 0.600 m from the slits. What is the λ?
2. Yellow orange light from a sodium lamp of wavelength 596 nm is aimed at two slits that are separated by 1.90 x 105 m. What is the distance from the central band to the first-order yellow band if the screen is 0.600 m from the slits?
3. In a double-slit experiment, physics students use a laser with λ = 632.8 nm. A student places the screen 1.00 m from the slits and find the first-order bright band 65.5 mm from the central line. What is the slit separation?
4. Yellow-orange light with a wavelength of 596 nm passes through two slits that are separated by 2.25×105 m and makes an interference pattern on a screen. If the distance from the central line to the first-order yellow band is 2.00×10−2 m, how far is the screen from the slits?
5. A glass lens has a non-reflective coating placed on it. If a film of magnesium fluoride is placed on the glass, how thick should the layer be to keep yellow-green light (λ = 555 nm) from being reflected? See the sketch in Figure 9.



1. You can observe thin-film interference by dipping a bubble wand into some bubble solution and holding the wand in the air. What is the thickness of the thinnest soap film at which you would see a black stripe if the light illuminating the film has a wavelength of 521 nm? Use n = 1.33 for the bubble solution.
2. What is the thinnest soap film (n = 1.33) for which light of wavelength 521 nm will constructively interfere with itself?
3. Two very narrow slits are cut close to each other in a large piece of cardboard. They are illuminated by monochromatic red light. A sheet of white paper is placed far from the slits, and a pattern of bright and dark bands is seen on the paper. Describe how a wave behaves when it encounters a slit, and explain why some regions are bright while others are dark. Sketch the pattern described.
4. Sketch what happens to the pattern in the previous problem when the red light is replaced by blue light.
5. Lucien is blowing bubbles and holds the bubble wand with a soap film (n = 1.33) in it vertically.

a) What is the second thinnest width of the soap film at which he could see a bright stripe if the light illuminating the film has a wavelength of 575 nm? B) What other widths produce a bright stripe at 575 nm?

SECTION 19.2

1. Monochromatic green light of wavelength 546 nm falls on a single slit with a width of 0.095 mm. The slit is located 75 cm from a screen. How wide will the central bright band be?
2. Yellow light with a wavelength of 589 nm passes through a slit of width 0.110 mm and makes a pattern on a screen.  If the width of the central bright band is 2.60×10−2 m, how far is it from the slits to the screen?
3. Light from a He-Ne laser (λ = 632.8 nm) falls on a slit of unknown width. A pattern is formed on a screen 1.15 m away, on which

the central bright band is 15.0 mm wide. How wide is the slit?

1. Yellow light falls on a single slit 0.0295 mm wide. On a screen that is 60.0 cm away, the central bright

band is 24.0 mm wide. What is the wavelength of the light?

1. White light shines through a grating onto a screen. Describe the pattern that is produced.
2. If blue light of wavelength 434 nm shines on a diffraction grating and the spacing of the resulting lines

on a screen that is 1.05 m away is 0.55 m, what is the spacing between the slits in the grating?

1. A diffraction grating with slits separated by 8.60×10−7 m is illuminated by violet light with a wavelength of 421 nm. If the screen is 80.0 cm from the grating, what is the separation of the lines in the diffraction pattern?
2. White light falls on a single slit that is 0.050 mm wide. A screen is placed 1.00 m away. A student first puts a blue-violet filter (λ = 441 nm) over the slit, then a red filter (λ = 622 nm). The student measures the width of the central bright band.

a) Which filter produced the wider band?

b) Calculate the width of the central bright band for both filters.

1. A diffraction grating with slits separated by 8.60×10−7 m is illuminated by violet light with a wavelength of 421 nm. If the screen is 80.0 cm from the grating, what is the separation of the lines in the diffraction pattern?
2. Light of wavelength 632 nm passes through a diffraction grating and creates a pattern on a screen that

is 0.55 m away. If the first bright band is 5.6 cm from the central bright band, how many slits per centimeter does the grating have?