Physics 1302, Exam 3 Review

The following is a list of things you should *definitely* know for the exam, however, the list *is not* exhaustive. You are responsible for all the material covered in the assigned readings, lectures, and homework assignments. Note that we did not cover microscopes or interference in reflected waves, so you are not responsible for those topics.

- Be able to solve basic problems about reflection and refraction using the law of reflection and Snell's law.
- Describe when total internal reflection will occur, and solve basic problems regarding total internal reflection.
- Be able to solve basic problems concerning the formation of images by single lenses and mirrors.
- Be able to solve basic problems concerning the formation of images by combinations of lenses and mirrors.
- Describe when constructive and destructive interference of light waves will occur, and solve basic problems concerning wave interference.
- Describe why diffraction occurs in light passing through a single aperture, and solve basic problems regarding single slit diffraction.
- Explain how the eye functions to produce images, and describe how various common vision defects that occur.
- Solve basic problems regarding image formation by telescopes.

Exam 3 Multiple Choice Problems

Sample **Dr. Andersen**

On the scantron sheet provided, *write* and *bubble in* your name. In the *identification number* field, write and bubble in the 7 digits from your student id number from your black cougar 1 card, or from your fee bill (do not try to fill the first two characters, which are letters.) Each of the following multiple choice questions is worth seven points. Mark the correct answer on the scantron sheet provided.

1. Three polarizers are lined up in a row, with the axis of the second polarizer making an angle of 30° with the axis of the first, and the axis of the third making an angle of 90° with respect to the first. If unpolarized light with an intensity I_0 enters the first polarizer, what intensity emerges from the third polarizer?

   (a) $\frac{3}{32}I_0$.
   (b) $\frac{1}{2}I_0$.
   (c) $\frac{3}{8}I_0$.
   (d) $\frac{3}{16}I_0$.
   (e) 0.

2. A car is going past a radio station at a speed of 40.0 m/s. If the radio station broadcasts at a frequency of 74.5 MHz, what change in frequency does the driver observe?

   (a) 9.93 Hz
   (b) 99.3 Hz
   (c) 993 Hz
   (d) 7.45 Hz
   (e) 74.5 Hz

3. The wavelength of an electromagnetic wave is 600 nm. What is its frequency?

   (a) $2 \times 10^{14}\ Hz$

(b) $3 \times 10^{14}\ Hz$

(c) $4 \times 10^{14}\ Hz$

(d) $5 \times 10^{14}\ Hz$

(e) $6 \times 10^{14}\ Hz$

4. In an electromagnetic wave, the direction of the magnetic field:

   (a) will be parallel to the direction of the electric field.

   (b) will be perpendicular to the direction of the electric field.

   (c) will be parallel to the direction of travel of the wave.

   (d) will be randomly oriented with respect to the direction of the electric field.

5. A telescope is constructed with an objective lens with diameter 25 cm and a focal length of 120 cm. What focal length eyepiece must be used with this telescope to give a magnification of 75 times?

   (a) 1.6 $cm.$

   (b) 9000 $cm.$

   (c) 0.33 $cm.$

   (d) 1900 $cm.$

   (e) 4.8 $cm.$

6. The "power" of the Hubble Space Telescope comes largely from:

   (a) Its detector systems being much more sensitive than a ground based telescope's.

   (b) Its ability to reach its theoretical limit of angular resolution, because it is above the atmosphere.

   (c) The fact that it has a much larger light gathering power than a ground based telescope.

   (d) It being significantly nearer the objects it observes than a ground based telescope.

   (e) It being free of the affects of the roation of the earth, unlike a ground based telescope.

7. In a person who suffers from hyperopia (i.e. is far sighted):

   (a) their eyes are constantly moving, and are unable to focus on a object for any length of time.

   (b) the light that enters their eye is focussed at a position in front of their retina.

   (c) the light that enters their eye is focussed at a position behind their retina.

   (d) their eye is not spherical but oblong, causing their eye to have different focal positions along different axes of their eye.

   (e) cloudy portions of the lens in their eye obscures their vision.

8. What is the focal length of a concave mirror with radius of curvature 30. cm?

   (a) 30. cm.

   (b) -0.033 cm.

   (c) $+0.033$ cm.

   (d) -15 cm.

   (e) $+15$ cm.

9. An object is placed 40. cm from a converging lens with focal length 10. cm. What is the lateral magnification of the the image that is formed?

   (a) -0.33

   (b) -0.25

   (c) 0.25

   (d) -0.50

   (e) -0.67

10. How many rulings per centimeter must a diffraction grating have in order for the second order maxima for light with a wavelength of 420. nm to occur at an angular position of 23.0°?

    (a) 2330 cm^{-1}.

    (b) 9300 cm^{-1}.

    (c) $11,000$ cm^{-1}.

    (d) 4650 cm^{-1}.

    (e) 5500 cm^{-1}.

11. Light of frequency $5.00 \times 10^{14}\ Hz$ passes from air into a block of crown glass (index of refraction 1.52. What is the frequency of the light within the glass?

    (a) $7.60 \times 10^{14}\ Hz$.
    (b) $2.60 \times 10^{14}\ Hz$.
    (c) $9.61 \times 10^{14}\ Hz$.
    (d) $5.00 \times 10^{14}\ Hz$.
    (e) $3.29 \times 10^{14}\ Hz$.

12. An object is placed 10. cm from the vertex of a convex mirror with focal length $-20.\ cm$. What is the image distance for the image that is formed?

    (a) $-\frac{20}{3}\ cm$.
    (b) $\frac{20}{3}\ cm$.
    (c) $-10.\ cm$.
    (d) $10.\ cm$.
    (e) $-20.\ cm$.

13. Light of wavelength 540 nm passes through a pair of slits with separation $3.4 \times 10^{-5}\ m$. What angle corresponds to the second bright fringe in this setup?

    (a) 1.8°
    (b) 3.7°
    (c) 4.3°
    (d) 1.5°
    (e) 5.0°

14. What is the critical angle for light traveling from crown glass ($n = 1.52$) into water (n=1.33)?

    (a) 42°
    (b) 48°
    (c) 53°
    (d) 57°
    (e) 61°

Exam 2 Worked Problems

Sample Dr. Andersen

Both problems are worth 15 points, and will be graded in a manner similar to the assigned homework problems in the book; up to 6 points possible for the description of your solution method, up to 6 points for your algebra and other work *(available only if you receive the full 6 points for the description)*, and three points for the correct answer *(available only if you receive the full 6 points for your work)*, including units.

1.) The Arecibo radio telescope consists of a single dish (i.e. aperture) of diameter. a) What is the angular resolution of the Arecibo dish if it observes radio waves with a wavelength of 20. cm? b) What diameter object lens or mirror would you need to give you the same angular resolution for an optical telescope observing at 550 nm?

2.) An object is placed 30. cm to the left of a converging lens with focal length of 15 cm, that is 55 cm to the left of a converging lens with a focal length of 25 cm. What is the position the final image produced by this two lens system?