PHYSICS 2220 - PRACTICE EXAM #4

 1. A radio station broadcasts at a frequency of 97 MHz. What is
the wavelength of the radio wave?

 2. A light wave has a maximum electric field of 80 V/m. What is
the maximum value of the magnetic field?

 3. For the light wave described above, find the average power
carried by the wave across each square meter of area.

 4. 5.71 watts of power cross every square meter of space at a
distance of 3 feet from a 60 watt light bulb. What is the
maximum value of the electric field of the light there?

 5. What is the force due to radiation pressure on a flat square
piece of velvet 30 cm on a side at a distance of 6 m from the
light bulb described above?

 6. A 5 mW laser beam has a diameter of 2 mm. What are the
maximum values of the beam's electric and magnetic fields?

 7. Unpolarized light passes through four polarizing filters. The
polarizing direction of each filter is offset by 25° from the filter
in front of it. Find the fraction of light that gets through all
four filters.

 8. A ray of light in air enters glass at an angle of incidence of
56.31°. Find the angle between the reflected and refracted rays.

 9. At what angle (measured from the normal) does a fish 3 m below
the surface in the middle of Bear Lake see the setting Sun?

10. An object 6 cm high is placed 18 cm in front of a spherical
concave mirror that has a radius of curvature of 30 cm. Find the
image's location and height. Is this a real or a virtual image?

11. The object in the previous question is moved 6 cm toward the
mirror. Find the image's location and height. Is this a real or a
virtual image?

12. A concave spherical mirror has a focal length of 26 cm. The
mirror forms an image at the location of the object. How far is the
object from the mirror?

13. A lens made of glass has one concave side with a radius of
curvature of 5.0 cm, and one convex side with a radius of curvature
of 7.5 cm. What is the focal length of the lens? Is this a
converging or a diverging lens?

14. A biconvex lens has equal radii of curvature and a focal length of 15 cm. If light travels through the lens at 2 x 10^8 m/sec, what is the radius of curvature of each surface of the lens?

15. An object 4.5 cm high is placed 3 cm in front of the lens in problem 14. Find the image's location and height. Is this a real or virtual image?

16. An object is placed 12 cm in front of a biconvex lens with an 8 cm focal length. Find the location and magnification of the image.

17. An object 7 cm high is placed 15 cm in front of a lens, and a virtual image is produced that is 35 cm high. Find the focal length of the lens, and tell whether it is a converging or a diverging lens.

18. Blue light (λ = 400 nm) and red light (λ = 700 nm) are both incident upon a double slit. On a screen 6 m from the slits, the 3rd order maxima of the blue and red light are separated by 3.6 mm. What is the distance between the slits?

19. In the previous question, what are the locations on the screen of the 3rd order maximum and minimum of the red light?

20. A thin layer of oil floats on a puddle and strongly reflects blue light (λ = 400 nm). Find the minimum thickness of the oil.

21. Visible light (λ = 500 nm) is incident normally on a single slit of width 0.8 mm. What is the angle between the central maximum and the second-order minimum?

22. Find is the distance between the blue (λ = 400 nm) and green (λ = 550 nm) first-order maxima on a screen 35 m away from a diffraction grating with 800 lines per centimeter.

23. The Hubble Space Telescope has a mirror 2.4 m in diameter. At what distance can two stars separated by 1.5 x 10^{11} m (the Earth-Sun separation) just be resolved? Assume λ = 500 nm.

Data: Index of refraction: air: n = 1.00   oil: n = 1.25
                                      water: n = 1.33   glass: n = 1.50

Ans: (1) 3.09 m (9) 2.67 x 10^{-7} T (3) 8.49 W/m^2 (4) 65.6 V/m
(5) 3.98 x 10^{-11} N (6) E_m = 1.10 x 10^3 V/m, B_m = 3.65 x 10^{-6} T
(7) 27.7% (8) 90° (9) 48.8° (10) i = 90 cm, h' = -30 cm, real
(11) i = -60 cm, h' = 30 cm, virtual (12) 52 cm
(13) -30 cm, diverging (14) 15 cm (15) i = -3.75 cm,
h' = 5.63 cm, virtual (16) 24 cm, m = -2 (17) 18.8 cm, converging
(18) 1.5 mm (19) 8.4 mm (max), 7.0 mm (min) (20) 160 nm
(21) 0.0716° (22) 42.0 cm (23) 5.9 x 10^{17} m