Exam 3  Chapters 23-26 in Young 9e

Multiple choice questions. Circle the correct answer. No work needs to be shown and no partial credit will be given.

(6 pts) 1. Unpolarized light of initial intensity 12.0 W/m² is passed through three polarizing filters. Viewed in the direction the light is traveling, the axis of the first polarizing filter is vertical, the axis of the second polarizing filter is at 37.0° clockwise from the vertical, and the axis of the third polarizing filter is horizontal. What is the intensity of the light after it has passed through all three polarizing filters?
   (a) zero
   (b) 1.39 W/m²
   (c) 2.17 W/m²
   (d) 2.76 W/m²
   (e) 3.83 W/m²
   (f) none of the above answers

(6 pts) 2. An object is to the left of a mirror. If the image is to the right of the mirror, the image is
   (a) upright
   (b) inverted

(6 pts) 3. An object is to the left of a thin lens. If the image is to the right of the lens, the image is
   (a) upright
   (b) inverted

(6 pts) 4. When monochromatic light of wavelength (in air) of λ = 500 nm passes through two very narrow slits and the interference pattern is observed on a screen 2.0 m from the slits, the distance between adjacent maxima near the center of the screen is 3.0 mm. If the entire apparatus (slits and screen) is submerged in water, the distance between the adjacent maxima is
   (a) 3.0 mm
   (b) larger than 3.0 mm
   (c) smaller than 3.0 mm

(6 pts) 5. Without corrective lenses, a farsighted person can’t focus clearly on objects that are closer to her eye than 75.0 cm. What is the focal length of the contact lens that will allow this person to see objects clearly that are 25.0 cm from her eye?
   (a) +75.0 cm
   (b) −75.0 cm
   (c) +18.75 cm
   (d) −18.75 cm
   (e) +37.5 cm
   (f) −37.5 cm
   (g) none of the above answers
(6 pts) 6. Monochromatic light of wavelength $\lambda = 500$ nm passes through a narrow slit of width $a$ and on a screen 2.0 m from the screen the width of the central maximum is 3.0 mm. If the width of the slit is increased, the width of the central maximum is
(a) 3.0 mm
(b) larger than 3.0 mm
(c) smaller than 3.0 mm

(6 pts) 7. Antennas $A$ and $B$ emit coherent radio waves that have wavelength 8.0 m and that are in phase. Antenna $B$ is 4.0 m to the right of antenna $A$ and point $P$ is 4.0 m to the right of antenna $B$. Is the interference at point $P$ for the waves from the two antennas constructive or destructive?
(a) constructive
(b) destructive

On the following problems show all your work. Partial credit will be given, if earned. Write your answers in the blanks provided.

(14 pts) 8. Sinusoidal electromagnetic waves from a radio station pass perpendicularly through an open window that has area 0.400 m$^2$. The intensity of the wave is constant over the area of the window. The wave carries 0.800 J of energy through the window in 5.00 s.
(Note: $\varepsilon_0 = 8.854 \times 10^{-12} \text{ C}^2/\text{N} \cdot \text{m}^2$ and $\mu_0 = 4\pi \times 10^{-7} \text{ T} \cdot \text{m/} \text{A}$)

a) What is the intensity of the wave at the window? Ans.

b) At the window, what is the amplitude of the magnetic field of the wave?

Ans.

c) The window is replaced by a mirror that has area 0.400 m$^2$. What is the force that the wave exerts on the mirror, if the wave is totally reflected?

Ans.
(14 pts) 9. A concave mirror is placed 0.800 m to the left of an object that is 2.00 mm tall. The mirror forms an image on a screen that is to the right of the object. The height of the object is 6.00 mm.

\[ \begin{array}{c}
\text{object} \\
\downarrow \\
0.2 \text{ m} \\
\rightarrow \\
\text{image} \\
\end{array} \]

a) Is the image upright or inverted?  
Ans. ________________

b) What is the distance from the object to the screen?  
Ans. ________________

c) What is the focal length of the mirror?  
Ans. ________________

(14 pts) 10. Light traveling in air is incident perpendicular to the surface of a thin film of plastic that is on the surface of a sheet of glass. The plastic film is 200 nm thick and has refractive index 1.60. The glass has refractive index 1.40. For what wavelengths of light (in air) within the limits of the visible spectrum (\( \lambda_{\text{air}} = 400 \text{ nm to 700 nm} \)) is there destructive interference between the light reflected from the top and bottom surfaces of the plastic film?

Ans. ________________
(16 pts) 11. A diverging lens with focal length $f_1 = -20.0 \text{ cm}$ is 10.0 cm to the left of a converging lens that has focal length $f_2 = +50.0 \text{ cm}$. An object that is 2.0 mm tall is placed 12.0 cm to the left of the diverging lens. The final image is formed after the light has passed through both lenses.

a) What is the object distance for the second lens? 

b) How far is the final image from the converging lens? 

c) Is the final image to the left or to the right of the converging lens? 

d) Is the final image upright or inverted? 

e) What is the height of the final image?