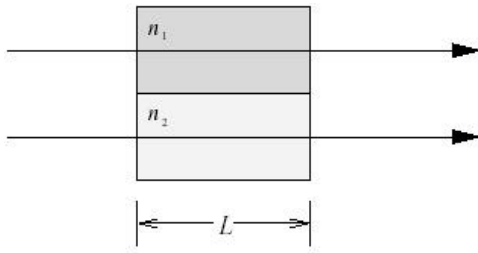


1. A clear sheet of polaroid is placed on top of a similar sheet so that their polarizing axes make an angle of 30° with each other. The ratio of the intensity of emerging light to incident unpolarized light is: 6/15
- A. 1:4
 - B. 1:3
 - C. 1:2
 - D. 3:4
 - E. 3:8
2. A monochromatic light ray that has been traveling through water ($n = 1.33$) enters air. After the ray enters the air, which of the following correctly describes the relative change in the speed, frequency, and wavelength of the ray? 7/3
- A. its speed and wavelength both decrease; its frequency stays the same.
 - B. its speed and wavelength both increase; its frequency stays the same.
 - C. its speed and wavelength both decrease; its frequency increases.
 - D. its speed and wavelength both increase; its frequency decreases.
 - E. its speed stays the same, its wavelength increases, and its frequency decreases.
3. A 5.0-ft woman wishes to see a full length image of herself in a plane mirror. The minimum length mirror required is: 11/7
- A. 5 ft
 - B. 10 ft
 - C. 2.5 ft
 - D. 3.54 ft
 - E. no answer: the farther away she stands the smaller the required mirror length
4. A concave spherical surface with radius r separates a medium with index of refraction 2 from air. As an object is moved toward the surface from far away along the central axis its image: 14/6
- A. changes from virtual to real when it is $r/2$ from the surface.
 - B. changes from virtual to real when it is $2r$ from the surface.
 - C. changes from real to virtual when it is $r/2$ from the surface.
 - D. changes from real to virtual when it is $2r$ from the surface.
 - E. remains virtual.

5. A converging lens (lens 1) with a focal length of +20 cm is located 10 cm to the left of a diverging lens (lens 2) having a focal length of -25 cm. If an object is located 30 cm to the left of the converging lens, which of the following statements is true? 15/27

The final image formed by the diverging lens is:

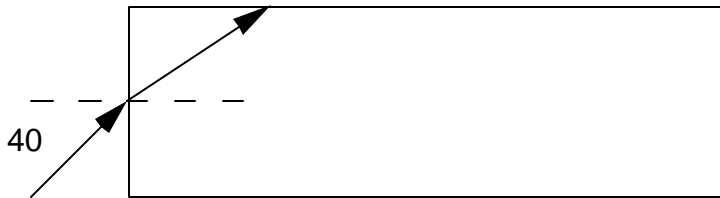
- A. 9.50 cm to the left of lens 2 and real.
 B. 50 cm to the left of lens 2 and twice the size of the object.
 C. real and upright
 D. 30 cm to the left of lens 2 and half the size of the object.
 E. upside down and twice the size of the object.
6. In the figure, two parallel light rays that are initially in phase pass through two different media, as shown, each of thickness L . If $n_1 = 1.40$ and $n_2 = 1.55$, and the wavelength of the light is 480 nm, then what is the *minimum* value that L can have if the rays later arrive at some common point and undergo fully destructive interference? Assume the only phase difference of the rays arises from passing through the two different media. 24/7



- A. 226 nm
 B. 452 nm
 C. 1600 nm
 D. 3200 nm
 E. 10,100 nm
7. A silicon solar cell of refractive index $n_1 = 3.5$ is coated with a thin film of SiO of refractive index $n_2 = 1.45$ so as to minimize reflection of light with wavelength $\lambda = 550$ nm. Determine the minimum required thickness of the SiO. 24/9
- A. 189.6 nm
 B. 379.3 nm
 C. 94.8 nm
 D. 47.4 nm
 E. 23.7 nm

8. At a particular time, the electric field of an electromagnetic wave is maximum in the $-y$ direction, and the magnetic field is in the positive z direction. Which of the following statements is true? 2/19
- A. The wave travels in $-y$ direction.
 - B. The wave travels in $-z$ direction.
 - C. The wave travels in z direction.
 - D. The wave travels in x direction.
 - E. The wave travels in $-x$ direction.
9. If a person tries to induce a fire on an object by focusing sun light using a concave mirror. The object should be placed: 14/7
- A. as close to the mirror as possible.
 - B. at the center of curvature.
 - C. midway between the center of curvature and the focal point.
 - D. at the focal point.
 - E. midway between the focal point and the mirror.
10. In a plane mirror image, which of the axes are inverted? 11/8
- A. Up and down (vertical, parallel to the mirror surface).
 - B. Front and back (normal to the mirror surface).
 - C. Left and right (horizontal, parallel to the mirror surface).
 - D. Both B and C.
 - E. none of them because mirror image is identical to the object.
11. In a class demo on "tricks used in magic shows", an image of a light bulb from a concave mirror was seen to be right-side up with the same size as the real light bulb. Where should be the location of the object light bulb and what is its orientation? 12/3
- A. at the focal-point, upside down.
 - B. at the center of curvature, upside down.
 - C. at the focal-point, upright.
 - D. at the center of curvature, upright.
 - E. at midway between the center of curvature and the focal point, upside down.

12. An object is placed in front of a diverging lens. Which of the following statements is true about the image? 15/37
- A. The image is real and inverted.
 - B. The image is virtual and inverted.
 - C. The image is real and upright.
 - D. The image is virtual and upright.
 - E. Whether the image is real or virtual depends on the position of the object.
13. Applying the lens equation to a lens system, one obtains $d_i = -20$ cm and $m = 3$. Which one of the following statements is true? 15/38
- A. The image is virtual and inverted.
 - B. The image is real and upright.
 - C. The image is at the same side of the lens as the object and inverted.
 - D. The image is at the same side of the lens as the object and upright.
 - E. The image is at the opposite side of the lens as the object and upright.
14. A ray of light makes an angle of incidence of 40° on one face of a fused quartz rod ($n = 1.47$) from the air ($n = 1$) and strikes the second surface of the quartz as shown. The light will exit the second surface of quartz with an angle (to the normal of the second surface) of: 7/18



- A. 38°
- B. 43°
- C. 50°
- D. 87°
- E. Light will not exit from the second surface and will be totally reflected at that surface.

15. A photographer wants to take a picture of a 20 m tall building from a distance of 50 m. What focal length should be used if he wants the image to fill the 35 mm film? 15/39
- A. 14 mm
 - B. 87 mm
 - C. 25 cm
 - D. 20 m
 - E. 50 m
16. When using a thin lens as a magnifier, in order to have the maximum magnification, the object should be placed (use ray diagram to check your answer): 15/40
- A. near the center of the curvature.
 - B. as close to the lens as possible.
 - C. as far from the lens as possible.
 - D. near the focal point.
17. How far away theoretically can a human eye distinguish two car headlights 2.0 m apart (choose closest answer)? Assuming the eye diameter of 5.0 mm and a wave length of 500 nm. 30/5
- A. 24 m
 - B. 120 m
 - C. 1.2 Km
 - D. 2.4 Km
 - E. 16 Km
18. As an object is moved from the distance of $2f$ to f of a converging lens, its image: 15/41
- A. remains virtual and becomes larger.
 - B. remains virtual and becomes smaller.
 - C. remains real and becomes larger.
 - D. remains real and becomes smaller.
 - E. remains real and approaches the same size as the object.

19. A ray of light of 400 nm wavelength makes an angle of incidence of θ on one face of a prism of fuse quartz ($n=1.47$); the prism's cross section is an equilateral triangle. What is the value of θ at which the total internal reflection starts to occur at the second surface? 8/2
- A. 34°
 - B. 62°
 - C. 26°
 - D. 47°
 - E. 56°
20. An illumination slide is held 44 cm from a screen. In order to have an image of the slide's picture on the screen three times the size of the picture, how far from the slide must a converging lens be placed and what focal length it should have? 15/42
- A. 22 cm and 8.25 cm
 - B. 22 cm and 11 cm
 - C. 11 cm and 8.25 cm
 - D. 11 cm and 22 cm
 - E. 8.25 cm and 11 cm
21. You look downward at a penny at the bottom of a pool of water ($n = 1.33$). If the depth at which you perceive the penny to be is 2 m, the depth of the pool is (Hint: Use the small-angle approximation) 7/16
- A. 3 m
 - B. 2.66 m
 - C. 2.0 m
 - D. 1.33 m
 - E. 1.0 m
22. A slit 0.50 mm wide is illuminated by light of wavelength 589 nm. We see a diffraction pattern on a screen 3 m away. What is the distance between the first and the third diffraction minima on the same side of the central diffraction maximum? 27/12
- A. 7.07 mm
 - B. 5.31 mm
 - C. 3.54 mm
 - D. 2.66 mm
 - E. 1.77 mm

23. In an experiment to measure the interference fringes using a double slit, it is found that the fringes are too close together to easily count them. To spread out the fringe pattern, one could: 31/6
- A. halve the slit separation.
 - B. double the slit separation.
 - C. double the width of each slit.
 - D. halve the width of each slit.
 - E. none of the above.

Answer Key for Test "214Fa04MT.tst", 11/10/2004

No. in Q-Bank	No. on Test	Correct Answer
6	15	1 E
7	3	2 B
11	7	3 C
14	6	4 E
15	27	5 B
24	7	6 C
24	9	7 C
2	19	8 E
14	7	9 D
11	8	10 B
12	3	11 B
15	37	12 D
15	38	13 D
7	18	14 E
15	39	15 B
15	40	16 D
30	5	17 E
15	41	18 C
8	2	19 C
15	42	20 C
7	16	21 B
27	12	22 A
31	6	23 A