# Optics Review Sheet

1 An object placed 10 cm in front of a *diverging* lens with a 15 cm focal length. The image distance to the lens is

   (A) 30 cm   (B) -30 cm   (C) 6 cm   (D) -6 cm

2 Referring to the previous question, the image type, size, orientation and location are,

   (A) virtual, larger, upright, in front of lens
   (B) virtual, smaller, inverted, behind lens
   (C) virtual, smaller, upright, in front of lens
   (D) real, smaller, inverted, behind lens

3 Any mirror or lens that can enlarge an image is

   (A) concave   (C) convex
   (B) converging   (D) diverging

4 Which diagram below correctly represents rays of light passing through a glass lens?


   (A)   (B)   (C)   (D)
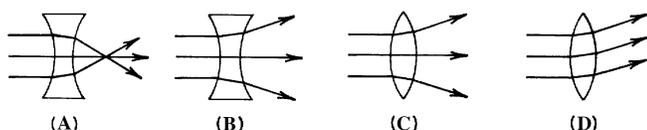
5 A mirage occurs when the light coming from above the Earth's surface encounters

   (A) regions of air less optically dense closer to the Earth.
   (B) regions of air more optically dense closer to the Earth.
   (C) regions of upper atmosphere with varying optical density
   (D) regions of upper atmosphere at greater than critical angle

6 A lens' focal length is not dependent on the

   (A) material from which the lens is made
   (B) color of the light incident on the lens
   (C) distance of an object from the lens
   (D) shape or curvature of the lens

7 An object 16 cm in front of a concave mirror forms an image 24 cm in front of the mirror. If the mirror is two-sided (so the convex side is a mirror as well), what will be the new image location if the mirror is turned around?

   (A) –6 cm   (B) –24 cm   (C) 40 cm   (D) 6 cm

8 The diagram shows parallel rays of incident light being reflected from a concave mirror. The mirror fails to produce a sharp focal point. This is called:
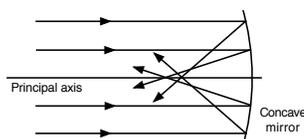
   (A) dispersion   (C) spherical aberration
   (B) diffuse reflection   (D) chromatic aberration

9 In the diagram, the ray *AB* is incident on the surface *XY* at point *B*. Medium 2 has a lower index of refraction than medium 1. Through which point will the ray pass?
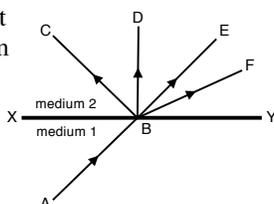

   (A) E   (B) F   (C) C   (D) D

10 As an object is moved from the focal point towards the center of curvature of a concave mirror, the image type and orientation will

   (A) remain virtual and become smaller
   (B) remain virtual and become larger
   (C) remain real and become smaller
   (D) remain real and become larger

11 Which diagram represents image I, formed by placing object O in front of a plane mirror?

   (A)   (B)   (C)   (D)
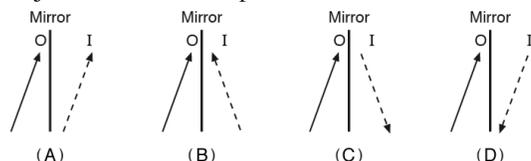
12 The diagram below shows light ray R incident on a glass lens in air. Which ray best represents the path of light ray R after it passes through the lens?
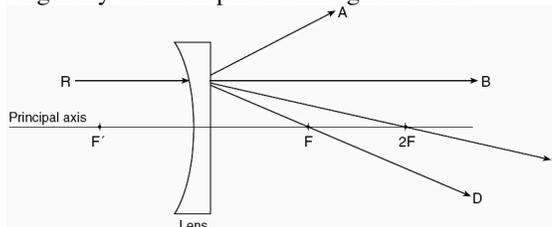
13 A laser beam is directed at the surface of a smooth, calm pond as represented in the diagram. Which objects could be illuminated by the laser light?
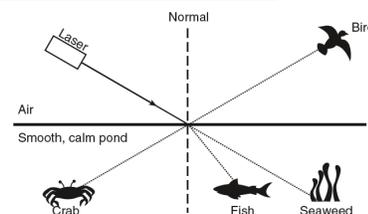
   (A) bird and fish   (C) crab and seaweed
   (B) crab and fish   (D) bird and seaweed

14 A spherical concave mirror is used in the back of a car headlight. Where must the bulb of the headlight be located to produce a parallel beam of reflected light?

   (A) between the focus and the mirror
   (B) beyond the center of curvature of the mirror
   (C) at the focus of the mirror
   (D) at the center of curvature of the mirror

15 What type of lens does a near-sighted person need to correct their vision? Explain why?

   (A) converging   (C) asymmetrical
   (B) diverging   (D) apochromatic

16 Light rays from a candle flame are incident on a convex mirror. After reflecting from the mirror, these light rays

   (A) converge and form a virtual image
   (B) converge and form a real image
   (C) diverge and form a virtual image
   (D) diverge and form a real image

17 Which is the eye component responsible for the *primary* focusing of light entering the eye?
(A) cornea   (C) lens
(B) fovea   (D) retina

18 Referring to the last question, which eye component causes far-sightedness in many older people.

19 Which of the materials listed to the right would make the best lens to minimize chromatic aberration?

	n_{blue}	n_{red}
A	1.66	1.60
B	1.71	1.70
C	1.93	1.91
D	1.84	1.81

20 Which of the materials listed would make the best prism for demonstrating dispersion?

Problem solving. Use separate paper and show all your work including general equation, substitutions, calculations and units.

21 In the table below, fill in the missing blanks for the mirrors and lenses.

|	shape	type	f (cm)	d_o (cm)	d_i (cm)	h_o (cm)	h_i (cm)	M
a.	concave mirror	converging	50	40			6	
b.	convex mirror			75	-30	5		
c.	concave lens			12			4	0.25
d.	convex lens		12		60	2		

22 <u>Honors only:</u> You're photographing a bird on a tree branch, but a tall hedge is blocking your view, as shown on right. However, as the drawing to the right shows, a plane mirror that is 2.1 m from the bird reflects light from the bird into your camera. If $x = 3.7$ m and $y = 4.3$ m, for what distance must you set the camera lens in order to snap a sharp picture of the bird's image?
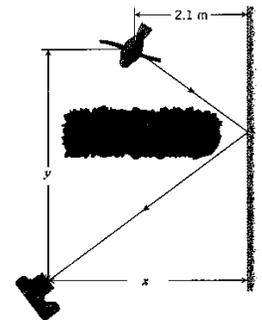
23 (a) A concave mirror has a focal length of 10 cm. A 2-cm tall object is located 6 cm in front of this mirror. Draw a ray diagram to scale and measure the location and height of the image. (b) repeat for a concave lens. (c) repeat for a convex lens with a focal length of 4 cm.

24 The speed of light in a transparent gel is 2.2 x 10^8 m/s. If the angle of incidence of a beam of light directed at the surface of the gel is 30°, what is the angle of refraction?

25 Using the diagram to the right, determine the paths of the incident ray at 30° and the incident ray at 60°, given the index of refraction of the two media are 1.9 and 1.5.
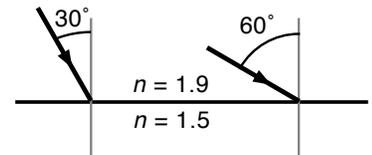
26 Consider the optical fiber shown in the diagram to the right. The index of refraction of the inner core is 1.480, and the index of refraction of the outer cladding is 1.44. (a) What is the critical angle for the core-cladding interface? <u>Honors only:</u> (b) For what range of angles in the core at the entrance of the fiber (θ_2) will the light be completely internally reflected at the core-cladding interface? (c) What range of incidence angles in air does this correspond to?
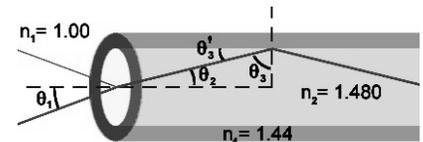
27 (a) A *convex* mirror, focal length 30 cm, is used to create a virtual image one-quarter the size of the object. Determine the object and image distances. (b) <u>Honors:</u> What two distances can the object be placed in front of the *concave* side of this mirror to create an image that is 5 times the size of the object?

28 <u>Honors only:</u> A converging lens with a focal length of +20 cm is located 40 cm to the left of a diverging lens having a focal of -10 cm. If an object is located 60 cm to the left of the converging lens, determine the final image distance and magnification of the image.

29 <u>Honors only:</u> A person struggles to read by holding a book at arm's length, a distance of 50 cm away (= near point). What power of reading glasses should be prescribed for him, assuming they will be placed 1.9 cm from the eye and he wants to read at the normal near point of 25 cm?

30 Light is incident on a prism, as seen in the diagram below. The index of refraction of the prism is 1.5. (a) Calculate the angle of refraction of the ray that enters the prism. (b) Draw the normal line and the refracted ray from step (a) and calculate the incident angle for the ray strikes the right side of the prism. (c) Determine if the ray exits the prism on the right side or if it is totally internally reflected (d) Calculate the angle for the ray that exits the prism (right side or bottom?), and draw the normal line and the final refracted ray out of the prism.
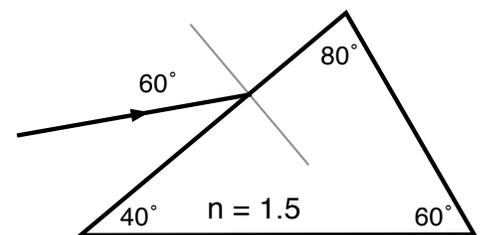
1. D   3. B   5. A   7. A   9. B   11. B   13. A   15. B   17. A   19. B   22. 7.22m 25. 39.3°,60° 27. a 90, -22.5 cm b 36,24 cm 29.2.25
2. C   4. B   6. C   8. C   10. C   12. A   14. C   16. C   18. C   20. A   24. 21.5° 26. 76.7° 13.3°,20° 28. –5cm, –0.25 30. 35.3°,44.7°,23.3°