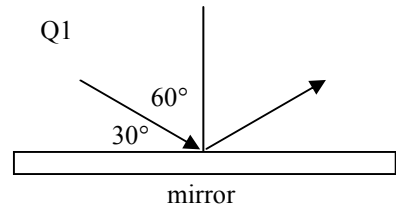


## 2010 Light and Optics In Class Review

1. A. For the diagram at the right what is the angle of reflection?  
 B. What is the focal length of the mirror?  
 C. Which is the real side of the mirror: top or bottom?



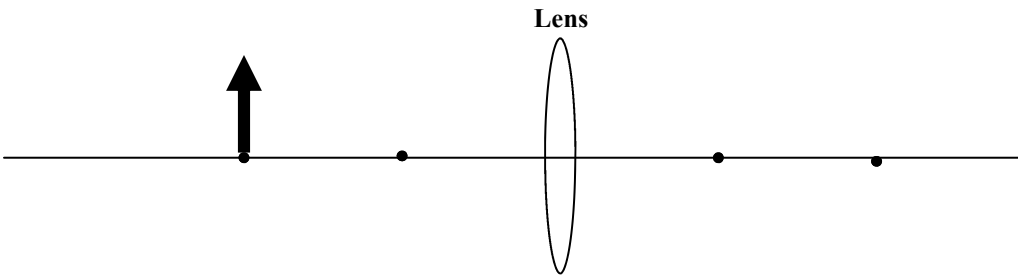
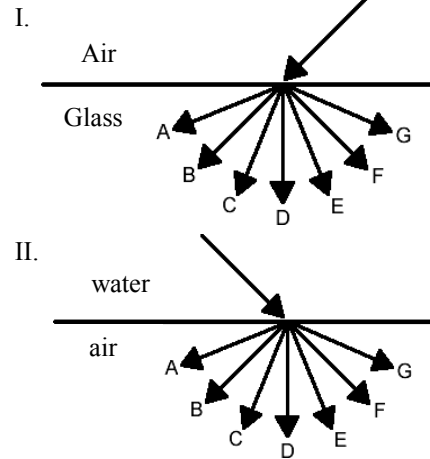
2. Find the critical angle for light passing from glass to water.

3. What is the speed of light in a cubic zirconium ( $n = 2.20$ )?

4. Why does light refract? (*Be specific as to direction, too.*)

5. In the two pictures at the right, decide which way light will refract as it passes from the top medium into the bottom medium.

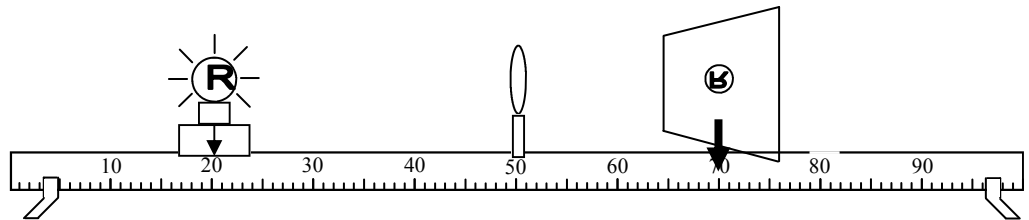
6. For the top example at the right,
  - A. Which substance has a faster speed of light?
  - B. Which substance has a higher frequency?
  - C. Which substance has a longer wavelength for light?



7. A. Draw the ray diagram.  
 B. Label  $p$ ,  $q$ ,  $h$ , and  $h'$ .

8. Use the diagram at the right to answer the following questions.

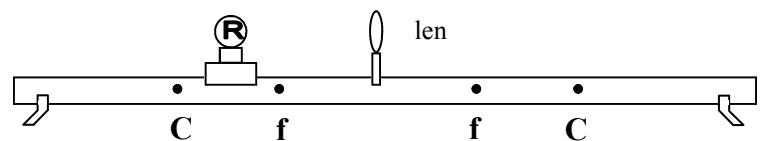
- A. Mark  $p$ ,  $q$ ,  $h$  and  $h'$ .
- B. What kind of lens is it?
- C. Is it a real or virtual image?
- D. Why?
- E. Which is bigger  $p$  or  $q$ ?
- F. + or -:  $p$  \_\_\_\_;  $q$  \_\_\_\_;  $f$  \_\_\_\_;  $h$  \_\_\_\_;  $h'$  \_\_\_\_.



- G. Calculate the focal length and magnification of the lens. (Label  $f$  and  $C$  when you have calculated  $f$ .)

9. Use the setup below to answer the following.

- A. Label the object.
- B. Will the image be real or virtual?
- C. Will the image be magnified, reduced, or equal in height?
- D. Which way would you move the object to increase the size of the image?
- E. Draw where you think the image might be.
- F. Where would you put the object if you wanted a magnification of 1?
- G. Where would the image be if you put the object at  $f$ ?



10. (From the July 2004 Exit Level TAKS test.) When trying to spear a fish in water, a person needs to take into account the way light bends as it moves from water into air. The bending of light as it passes from one medium into another is known as—
11. Is light a wave or a particle? Prove your answer.
12. Where does light come from?

Total internal reflection

Photon

Electromagnetic (EM) Spectrum

Polarizer

Critical angle

Laser

Fiber Optics

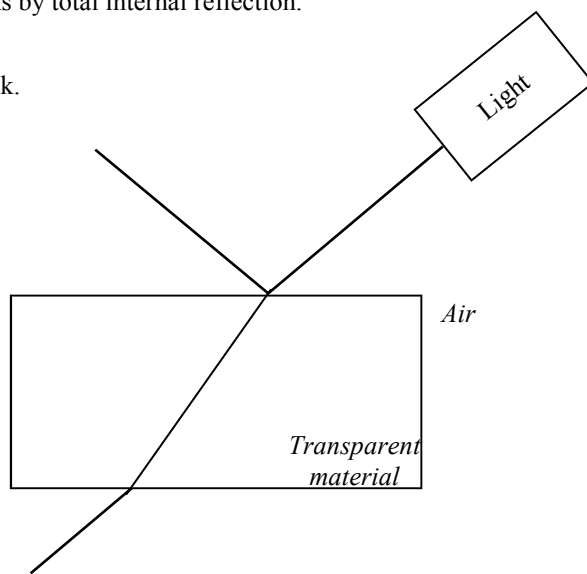
Index of Refraction

Dispersion

13. Use this word bank for the following definitions. Words will be used more than once.

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>A. Includes radio waves, x-rays, and microwaves.</li> <li>B. Is the principle used by fiber optics.</li> <li>C. Two of these at right angles can cancel out light.</li> <li>D. If this number is bigger, the light refracts more.</li> <li>E. A single packet or particle of light.</li> <li>F. Angle at which light refracts at 90° to the surface.</li> <li>G. When white light separates into its different colors.</li> <li>H. A light source that has only one wavelength of light.</li> <li>I. Given off when the excited electrons in the atom fall to a lower orbit.</li> <li>J. A tube that can guide light, even around corners.</li> <li>K. Beyond this light reflects instead of refracts.</li> </ol> | <ol style="list-style-type: none"> <li>L. Will not spread out when passed thru a prism.</li> <li>M. All light, both visible and invisible.</li> <li>N. If the incoming ray is within this amount light will refract thru.</li> <li>O. When light becomes trapped inside a substance.</li> <li>P. After passing thru one of these all of the light is in one direction.</li> <li>Q. Light amplification by stimulated emission of radiation.</li> <li>R. A number that tells you how slow light moves in a substance.</li> <li>S. What happens to white light when it passes thru a prism.</li> <li>T. Works by total internal reflection.</li> </ol> |
|--|--|

14. The diagram at the right shows light passing from air into a transparent block. Calculate the index of refraction for the transparent material.

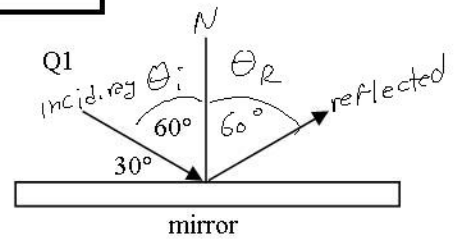


15. You have red, green, and blue lights. What makes the following colors?
  - A. Red:
  - B. Magenta:
  - C. Black:
16. A. What colors are reflected from cyan paint?  
B. What color is absorbed by cyan paint?
17. You have cyan, magenta, yellow, and black paints. Make the following:
  - A. Red:
  - B. Magenta:
  - C. Black:
18. A. More energy: Microwaves or X-rays?  
B. Shorter wavelength: gamma rays or radio waves?  
C. Faster speed: green light or radio waves?  
D. Higher frequency: gamma rays or visible light?  
E. Less energy: red light or blue light?
19. At its closest, Mars is  $5.46 \times 10^{10}$  m from the earth. How long does it take the radio signals of a Mar's lander to reach the earth?

20. What is the frequency of 350 nm light?
21. Light is shining on a photovoltaic cell and electricity is not flowing. Will the following will cause electrons to flow?
  - A. Increase the brightness (intensity)
  - B. Keep the light on longer.
  - C. Make the wavelengths longer.
  - D. Make the frequency higher.
  - E. Make the wavelength shorter.
  - F. Switch from blue to red light.

# 2010 Light and Optics In Class Review

- For the diagram at the right what is the angle of reflection?  $60^\circ$
  - What is the focal length of the mirror? *none (flat)*
  - Which is the real side of the mirror? top or bottom?



- Find the critical angle for light passing from glass to water.  

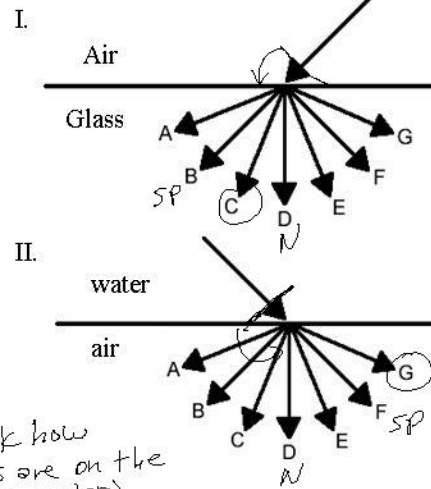
$$\sin \theta_c = \frac{n_2}{n_1} = \frac{1.33}{1.52} \quad \theta_c = \sin^{-1}\left(\frac{1.33}{1.52}\right) = 61^\circ$$

- What is the speed of light in a cubic zirconium ( $n = 2.20$ )?  

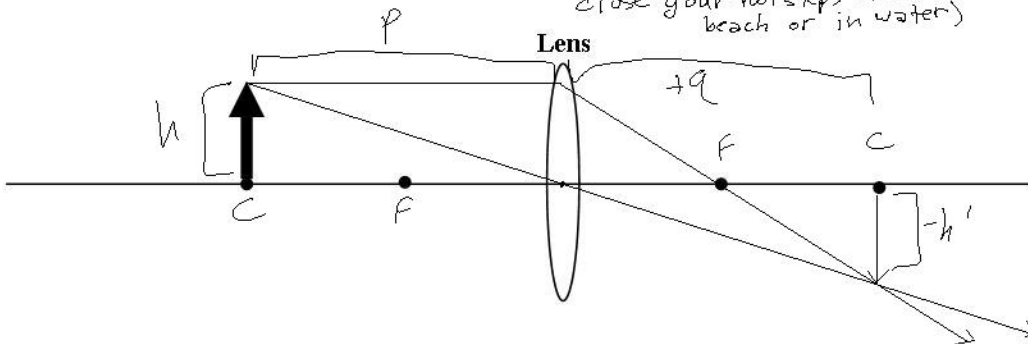
$$n = \frac{c}{v} \quad \text{so } v = \frac{c}{n} = \frac{3 \times 10^8}{2.20} = 1.36 \times 10^8 \text{ m/s}$$

- Why does light refract? (Be specific as to direction, too.)  
*light that hits a boundary at an angle and one side slows + it bends that way.*

- In the two pictures at the right, decide which way light will refract as it passes from the top medium into the bottom medium.



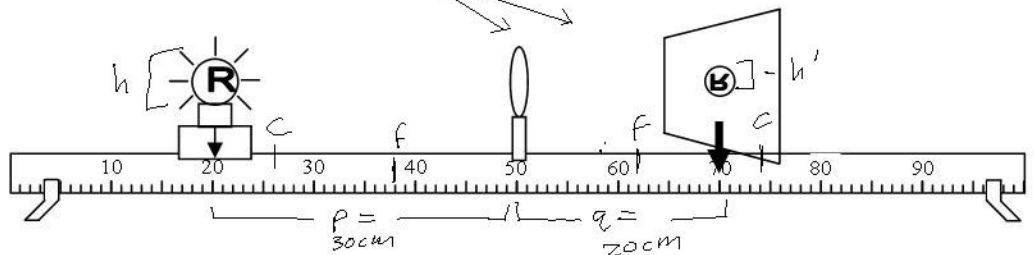
- For the top example at the right,
  - Which substance has a faster speed of light? *Air*
  - Which substance has a higher frequency? *same for both*
  - Which substance has a longer wavelength for light? *Air (think how close your footsteps are on the beach or in water)*



- Draw the ray diagram.
  - Label p, q, h, and h'.

- Use the diagram at the right to answer the following questions.

- Mark p, q, h and h'.
- What kind of lens is it? *convex*
- Is it a real or virtual image?
- Why? *inverted*
- Which is bigger? p or q?
- + or -: p +; q +; f +; h +; h' -.



- Calculate the focal length and magnification of the lens. (Label f and C when you have calculated f.)

$$\frac{1}{30} + \frac{1}{20} = \frac{1}{f}$$

$$.0833 = \frac{1}{f}$$

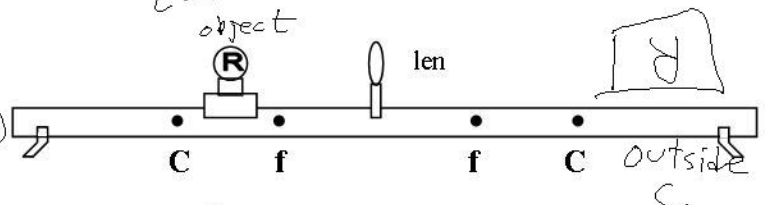
$$f = \frac{1}{.0833} = 12 \text{ cm}$$

$$C = 2f = 24 \text{ cm}$$

$$M = \frac{-q}{p} = \frac{-20}{30} = -.66$$

- Use the setup below to answer the following.

- Label the object.
- Will the image be real or virtual? *real*
- Will the image be magnified, reduced, or equal in height?
- Which way would you move the object to increase the size of the image? *R (closer to f)*
- Draw where you think the image might be.
- Where would you put the object if you wanted a magnification of 1? *at C*
- Where would the image be if you put the object at f? *no where*



10. (From the July 2004 Exit Level TAKS test.) When trying to spear a fish in water, a person needs to take into account the way light bends as it moves from water into air. The bending of light as it passes from one medium into another is known as— *refraction*

11. Is light a wave or a particle? Prove your answer. *Both*  
*\*waves— bend diffraction, refraction | Particle— can go thru space.*

12. Where does light come from?  
*\* e's falling from high to low orbit,*

Total internal reflection  
 Photon  
 Electromagnetic (EM) Spectrum

Polarizer  
 Critical angle  
 Laser

Fiber Optics  
 Index of Refraction  
 Dispersion

13. Use this word bank for the following definitions. Words will be used more than once.

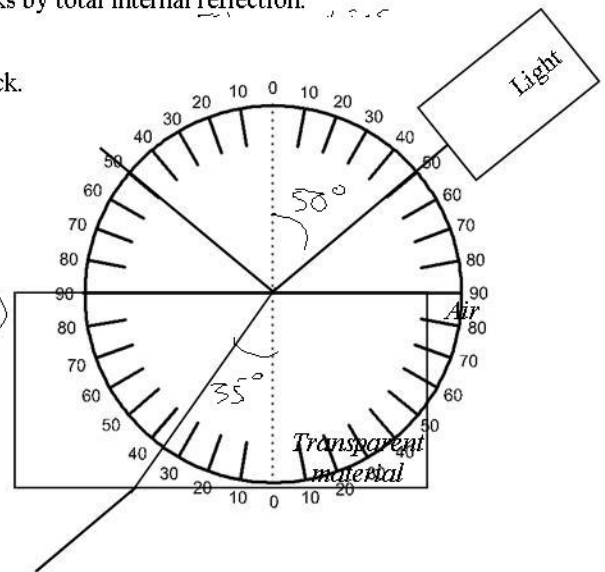
- A. Includes radio waves, x-rays, and microwaves. *\* EM spectrum*
- B. Is the principle used by fiber optics. *total int. reflecti*
- C. Two of these at right angles can cancel out light. *polariz*
- D. If this number is bigger, the light refracts more. *index of refraction*
- E. A single packet or particle of light. *photon*
- F. Angle at which light refracts at 90° to the surface. *critical angle*
- G. When white light separates into its different colors. *dispersion*
- H. A light source that has only one wavelength of light. *laser*
- I. Given off when the excited electrons in the atom fall to a lower orbit. *photon*
- J. A tube that can guide light, even around corners. *Fiber optics*
- K. Beyond this light reflects instead of refracts. *critical L*
- L. Will not spread out when passed thru a prism. *laser*
- M. All light, both visible and invisible. *EM spectrum*
- N. If the incoming ray is within this amount light will refract thru. *critical L*
- O. When light becomes trapped inside a substance. *total inter. reflection*
- P. After passing thru one of these all of the light is in one direction. *polarizer*
- Q. Light amplification by stimulated emission of radiation. *"laser"*
- R. A number that tells you how slow light moves in a substance. *index of refraction (n)*
- S. What happens to white light when it passes thru a prism. *dispersion*
- T. Works by total internal reflection. *total inter. reflection*

14. The diagram at the right shows light passing from air into a transparent block. Calculate the index of refraction for the transparent material.

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$1 \sin 50^\circ = n_2 \sin 35^\circ$$

$$n_2 = 1.34$$



15. You have red, green, and blue lights. What makes the following colors?

- A. Red: *red*
- B. Magenta: *R, B*
- C. Black: *none (turn 'em off)*

16. A. What colors are reflected from cyan paint? *B, G*  
 B. What color is absorbed by cyan paint? *R*

17. You have cyan, magenta, yellow, and black paints. Make the following:

- A. Red: *y, M*
- B. Magenta: *magenta*
- C. Black: *black (or all)*

- 18. A. More energy: *Microwaves or X-rays?*
- B. Shorter wavelength: *gamma rays or radio waves?*
- C. Faster speed: *green light or radio waves? same*
- D. Higher frequency: *gamma rays or visible light?*
- E. Less energy: *red light or blue light?*

19. At its closest, Mars is  $5.46 \times 10^{10}$  m from the earth. How long does it take the radio signals of a Mar's lander to reach the earth?

$$v = 3 \times 10^8 \text{ m/s}$$

$$S = \frac{D}{T}$$

$$3 \times 10^8 = \frac{5.46 \times 10^{10}}{t}$$

$$t = \frac{5.46 \times 10^{10}}{3 \times 10^8} = 1.82 \times 10^2 = 182 \text{ seconds}$$

20. What is the frequency of 350 nm light?

$$c = f \lambda$$

$$f = \frac{c}{\lambda} = \frac{3 \times 10^8}{350 \times 10^{-9}} = 8.57 \times 10^{14} \text{ Hz}$$

21. Light is shining on a photovoltaic cell and electricity is not flowing. Will the following will cause electrons to flow?

- A. Increase the brightness (intensity)
  - B. Keep the light on longer.
  - C. Make the wavelengths longer.
  - D. Make the frequency higher.
  - E. Make the wavelength shorter.
  - F. Switch from blue to red light.
- only D + E*