

# 2009-10 Light and Optics 3

1. Give three ways can you tell that an image is real.

2. A convex lens is used to make an image.  
 A. Is the imager real or virtual?  
 B. What happens if the top half of the lens is blocked by a piece of paper?



C. Why do telescopes have really large lenses?

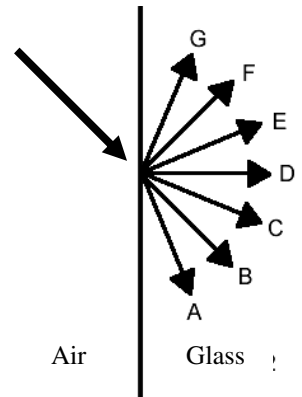
*The following picture is for those of you that need a reminder of why light refracts.*

Kim steps in the water first and slows down. Jim takes another long step, causing them to bend towards the water.

sand (fast)  
 water (slow)

3. The diagram at the right shows a light ray coming from air into glass.

- A. If the light does not refract at all, it would go straight. Write "straight" next to the correct letter.  
 B. Which letter is the normal?  
 C. Now it should be easy to figure out which path the light takes in the glass.  
 D. Which letter shows the light's path if it started in glass and ended up in air?

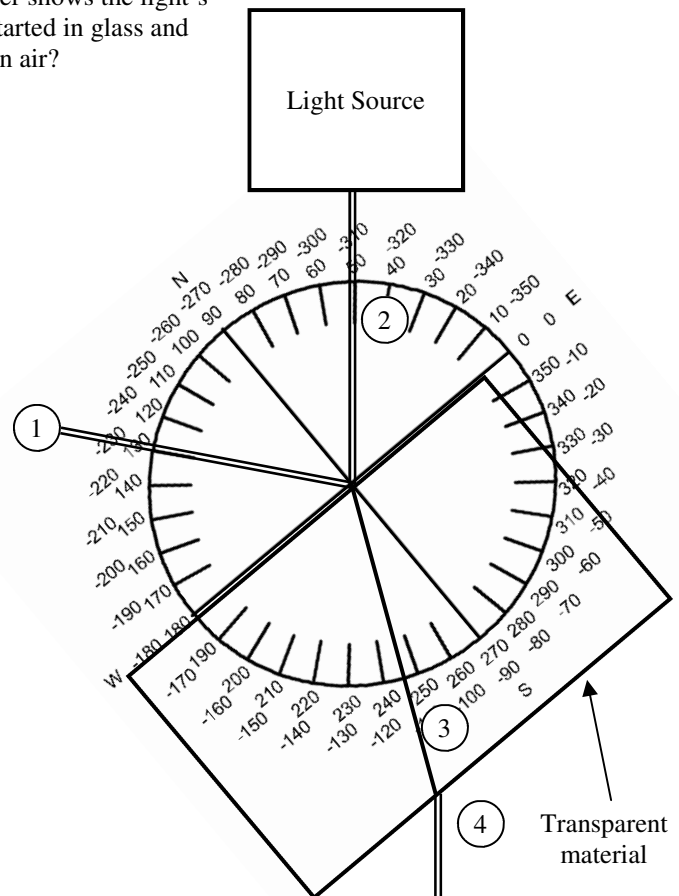


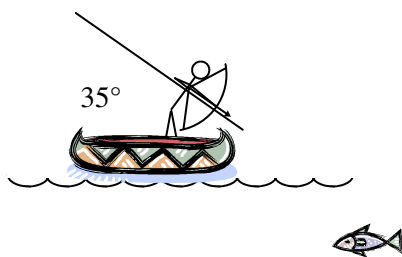
4. The diagram at the right is from the index of refraction lab we did in class. I have provided a protractor for those of you that do not have one. The different light rays are numbered.
- A. Which light ray is the incident ray?  
 B. What is the angle of incidence?  
 C. Which ray is the reflected ray?  
 D. What is the angle of reflection?  
 E. How do these angles compare?

*(This is ALWAYS the case. This is known as the "Law of Reflection". Also, it is always true that when a wave crosses a boundary some of the energy is reflected.)*

- F. Which ray is the ray that refracts inside the block?  
 G. For Snell's Law, what is  $\theta_1$ ?  
 H. What is  $\theta_2$ ?  
 I. What is  $n_1$ ?  
 J. Calculate the index of refraction for this material.

K. Using the table of indexes of refractions, what material is this?





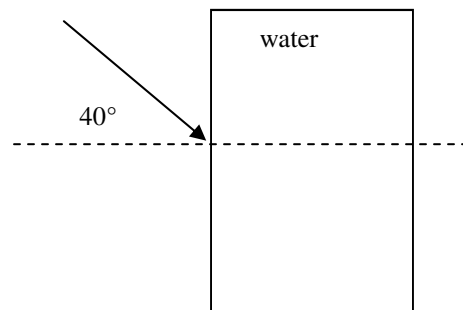
5. Slim Jim decides to go fishing. Fortunately for the fish, Jim forgets his physics. In his optical ignorance Jim aims exactly where he SEES the fish.
  - A. Draw where the fish may really be (*approximately*).
  - B. Where are all angles measured from in optics?
  - C. What angle do we need to use for our equations?
  - D. You know the indexes of refraction for air and water, so calculate the angle that the light will travel in the water.

6. A substance has an index of refraction of 2.
  - A. Calculate the speed of light in that substance.

B. How does the speed of light in the substance compare with that of the speed of light in space?

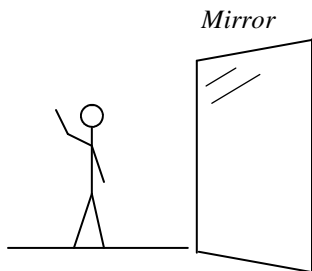
7. So, (quickly, now), light travels  $1 \times 10^8$  m/s in a substance. What is its index of refraction?

8. 450 nm light traveling in air then passes into a tray of water, as shown.
  - A. What part of the light wave is the same as it passes into water?
  - B. Calculate the wavelength of the light in the water.



C. Calculate the angle that the light refracts in the water.

D. At what angle will the light reflect off the surface?



9. Slim Jim is waving hello to you. (He's a good guy!) Just so happens that he is standing next to a mirror. Draw the image of Jim you see in the mirror. (*Think about what you see in your mirror at home.*)

### Energy of a Photon

$$\text{Energy (in J)} \rightarrow E = hf$$

Planck's Constant  
( $6.63 \times 10^{-34} \text{ J}\cdot\text{s}$ )

Photon's Frequency  
(in Hz)

Let's start to get used to a new equation...

10. A light wave has a frequency of  $4 \times 10^{15}$  Hz. How much energy does each photon have?
11. A photon has a wavelength of 350nm.
  - A. Write the speed of a wave equation.
  - B. Solve for frequency, substitute into the formula and solve for energy of the photon.

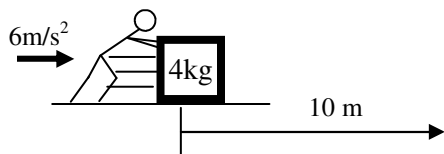
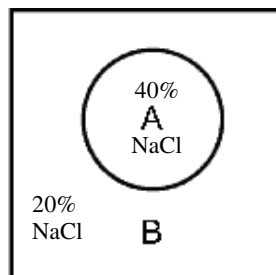
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1. Using your TAKS notes (all 5 objectives)....
2. (Day 14) Salt is dissolved in water. Is this a physical or chemical change? Why?
3. (Day 15) Things that are less dense float or sink? This can lead to what kind of heat transfer?
4. When a liquid is heated it tends to flow better this means it has less \_\_\_\_\_.
5. (Day 16) Give an element that has the same reactivity as oxygen.
6. What is the chemical symbol for sodium? Potassium?
7. Consider Magnesium. A) How many valence electrons? B) How many protons? C) Metal or nonmetal? D) Does it tend to gain or lose electrons?
8. (Day 17) Give the formula for the balanced ionic compound created when Beryllium combines with Fluorine.
  
9. (Day 19) Which dissolves faster:
 

A. Powdered sugar or granulated sugar?	B. In hot water or in cold water?
C. Stirred or not stirred?	D. Large particles or small particles?
10. (Day 20) Which side of water is positive? This makes water a \_\_\_\_\_ molecule.
11. (Day 21) A compound is mixed into water and it creates a lot of OH<sup>-</sup> ions. Is it an acid or a base?
12. A compound has a pH of 2.5. Acid or base?
13. A solution has a pH of 11. To get its pH to 9, what do you add?
14. What is the pH of pure water?
  
15. (Day 6) Which organelle is responsible for keeping unwanted materials out of the cell?
16. Which organelle makes proteins? Makes energy?
17. (Day 7A) Are two organisms more closely related if they have the same class or the same genus?
18. Which of the four organisms are the most closely related? (And can you name any of them?)
 

A. Ursus Maritimus	B. Melursus Ursinus
C. Ailuropoda melanoleuca	D. Ursus arctos

19. (Day 7B) If the diagram shows a round membrane that is permeable to water, which way will the water flow?



20. Slim Jim pushes on a box for 10 meters.
  - A. How much work does he do on the box (there is enough information)?
  
  - B. If there is no friction, how much kinetic energy does it gain?