

# 2011-12 Light and Optics 1

Due Thurs., April 12

From the "Light" notes:

1. Is light a wave or a particle?  
Defend your answer.
2. What part of the electromagnetic spectrum:
  - A. Has the least amount of energy?
  - B. Has the shortest wavelength?
  - C. Has the fastest speed?
3. What is the speed of light (*from the notes*)?
4. What is the speed of microwaves?
5. What is the speed of x-rays?

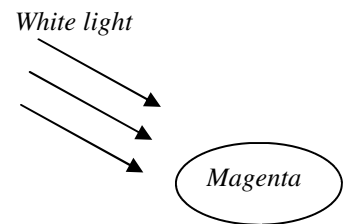
Let's be sure we remember some prefixes:

"Kilo" means  $\times 10^3$  (1000g = 1 kg); Mega means  $\times 10^6$  (1,000,000 m = 1 Mm); 1 nanometer =  $1 \times 10^{-9}$  m. (1 m = 1,000,000,000 nm)

Interestingly 10,000 nm = width of a human hair (approximately)

So 3.4 MHz = 3,400,000 Hz (that's a lot of times per second);  $350 \text{ nm} = 350 \times 10^{-9} \text{ m} = 3.5 \times 10^2 \times 10^{-9} \text{ m} = 3.5 \times 10^{-7} \text{ m}$

6. What is 750 nm: period, frequency, amplitude, speed, or wavelength?
7. What part of the electromagnetic spectrum is 750 nm?
8. Calculate the frequency of 750 nm light.



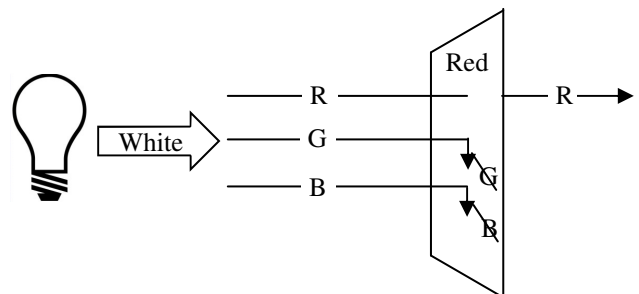
9. What is the wavelength of  $3.75 \times 10^{16}$  Hz X-rays?
10. If the moon is approximately 384,000,000 m from the earth, how long did it take the radio signals from the Apollo moon lander to reach the earth?

From the "Color Notes":

11. Given three lights: red, green, and blue.
  - A. \_\_\_\_\_ What color is the background (*before you turn the lights on*)?
  - B. \_\_\_\_\_ How do you make blue?
  - C. \_\_\_\_\_ How do you make magenta?
  - D. \_\_\_\_\_ How do you make yellow?
  - E. \_\_\_\_\_ If you make red, what colors are off?
  - F. \_\_\_\_\_ To make magenta, what color is off?
  - G. \_\_\_\_\_ What color is off when you see cyan?

Help with subtractive color: Our eyes can only see lights. When looking at a red stop sign, we can only see the red light reflected OFF of the stop sign.

In the example at the right, notice that a red filter only allows red light to go thru. Therefore a red filter would block (absorb) green and blue light. If I put a blue light behind a red filter, you would see black, because blue cannot get thru a red filter.



The other big help for light reflecting off of objects can be found on the "color" notes, especially the banana example.

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12. A. What colors make up white light (label them on the diagram)?  
B. What color lights must be reflected for us to see Magenta (label them as arrows coming off of Magenta)?  
B. So, what color does Magenta absorb?
13. Using the same logic, what color does Cyan absorb?
14. In a printer you only have cyan, magenta, yellow, and black. What colors would the printer use to make red?
15. A prism causes a rainbow by d\_\_\_\_\_.
16. Which bends more red or blue light?
17. (*From the "Wave Action" notes*) This bending is called:
18. Remembering from sound:  
A. When a string vibrates at 440 Hz, the sound wave in the air around it has what frequency?  
B. Does the string and the sound wave in the air have the same wavelength?
19. So, when a light wave passes from air into glass, what is the same in both mediums: speed, frequency, or wavelength?

