

# 2009-10 Light and Optics 1

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?

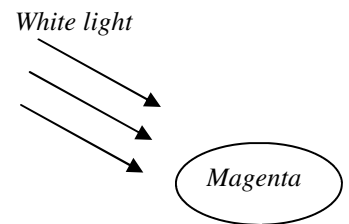
Let's be sure we remember some prefixes:

"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.



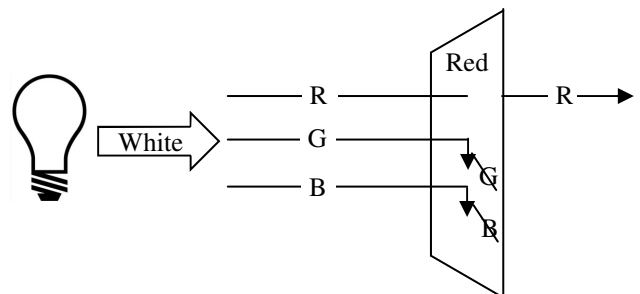
9. What is the wavelength of  $3.75 \times 10^{16}$  Hz X-rays?
10. If the moon is approximately 384,000,000 m from the earth, how long did it take the radio signals from the Apollo moon lander to reach the earth?

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.

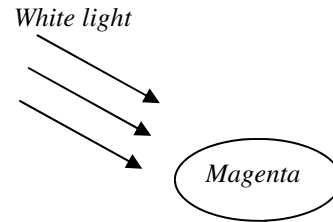
In the example at the right, notice that a red filter only allows red light to go thru. Therefore a red filter would block (absorb) green and blue light. If I put a blue light behind a red filter, you would see black, because blue cannot get thru a red filter.



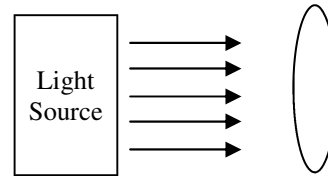
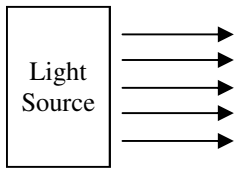
The other big help for light reflecting off of objects can be found on the "color" notes, especially the banana example.

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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. This bending is called:
- 18. From the "Optics Basics" Notes:
- 19. What is the focal point?
- 20. Does the image come into focus at the focal point?
- 21. For the objects below, label what devices they are and show what the light rays will do.



- 22. Which of the above objects has a real focal point? Why?
- 23. For optics what is the "normal"?
- 24. What is the incident ray?
- 25. What is the reflected ray?
- 26. 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?
- 27. So, when a light wave passes from air into glass, what is the same in both mediums: speed, frequency, or wavelength?
- 28. What are the two properties of a real image?
- 29. True or false: I see the image, therefore it is real.
- 30. For mirrors how does the angle of reflection compare with the angle of incidence?