

**Light, Flat Mirrors and Reflection Review**

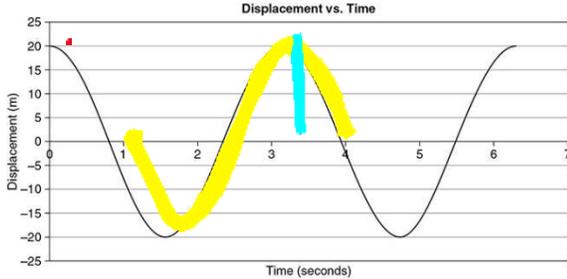
Name: \_\_\_\_\_

1. Write the components of the electromagnetic spectrum in order of increasing frequency. How does the wavelength compare? How does energy compare? Note 1-2 uses of each.



2. What are the relationships between wavelength, frequency, energy, and speed/velocity of electromagnetic waves?  
**Wavelength is inverse to frequency and energy. As wavelength decreases, frequency and energy increases. Speed/velocity remains the same.**

3. What is the approximate wavelength, amplitude, and frequency of the wave below?



**Wavelength:** 3.1m (I know it says seconds but just go with it, wavelength is measured in meters)-one full wave cycle

**Frequency:**  $\frac{2 \text{ full waves}}{6 \text{ seconds}} = 0.33 \text{ Hz}$

**Amplitude:** 20m

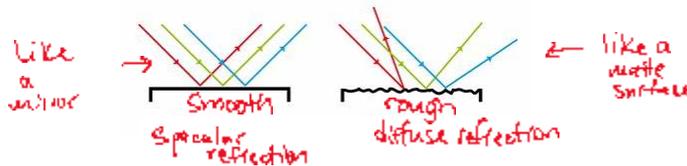
4. If the wave above has a shorter amplitude, how would that affect the brightness of the wave?  
**When the amplitude gets shorter, it will get less bright (brightness decreases)**
5. If the wave above had a longer wavelength, how would that affect the energy of the wave?  
**If the wavelength increases, the energy decreases.**
6. If the wave above had a bigger/faster frequency, how would that affect the speed/velocity of the wave?  
**Speed/velocity is not affected by changing frequency or wavelength because it is constant. When you change frequency, the wavelength changes at the same ratio so that velocity remains constant.**
7. What is the wavelength, in nanometers, of a light wave with a frequency of  $5.77 \times 10^{14} \text{ Hz}$ ? ( $1\text{m} = 1 \times 10^9 \text{ nm}$ )

$$\lambda = \frac{c}{f} = \frac{3.00 \times 10^8 \text{ m/s}}{5.77 \times 10^{14} \text{ Hz}} = 5.20 \times 10^{-7} \text{ m} \times \frac{1 \times 10^9 \text{ nm}}{1 \text{ m}} = 520 \text{ nm}$$

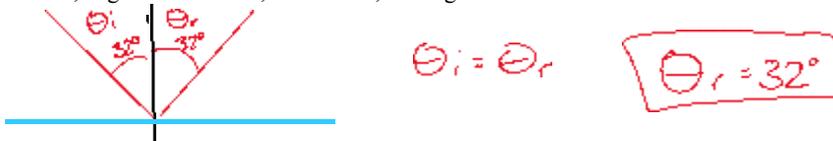
8. What is the frequency of an x-ray with a wavelength of 5nm? ( $1\text{m} = 1 \times 10^9 \text{ nm}$ )

$$\frac{5 \text{ nm}}{1 \times 10^9 \text{ nm}} = 5 \times 10^{-9} \text{ m} \quad f = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \text{ m/s}}{5 \times 10^{-9} \text{ m}} = 6 \times 10^{16} \text{ Hz}$$

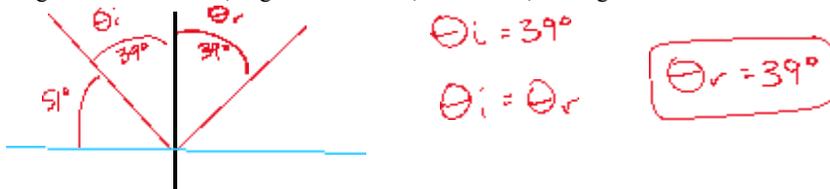
9. For each image below, describe the surface type and determine the type of reflection:



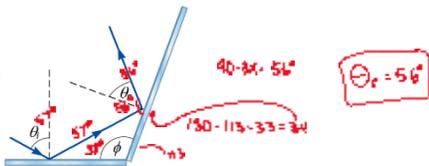
10. A light ray strikes a mirror with an angle of incidence of  $32^\circ$ . What is the angle of reflection? Draw a sketch of this reflection including the mirror surface, angle of incidence, the normal, the angle of reflection.



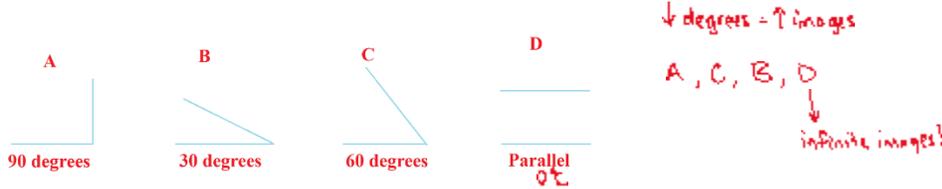
11. A light ray strikes a mirror with an angle of  $51^\circ$  with the mirror's surface. What is the angle of reflection? Draw a sketch of this reflection including the mirror surface, angle of incidence, the normal, the angle of reflection.



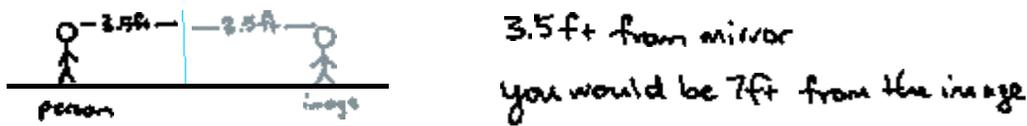
12. Two mirrors are arranged at an angle  $\phi=113^\circ$ . A light ray approaches the first mirror at an angle of incidence ( $\theta_i$ ) of  $57^\circ$ . What would be the angle of reflection ( $\theta_r$ ) off the second mirror? Show work and then circle your final answer.



13. Two mirrors are arranged in the following ways below. Put them in order to least images created to most images created.



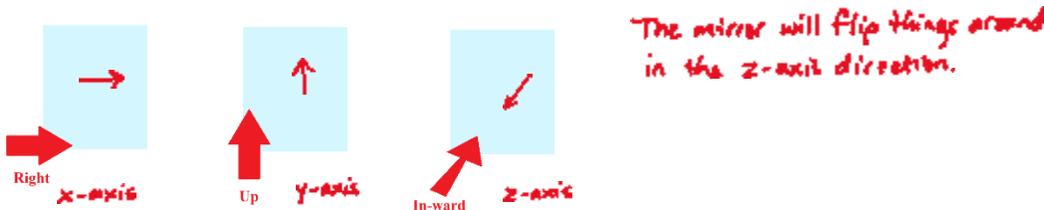
14. How far back would you need to stand from a flat mirror to have your image appear 3.5ft behind the mirror? How far would you be from this image?



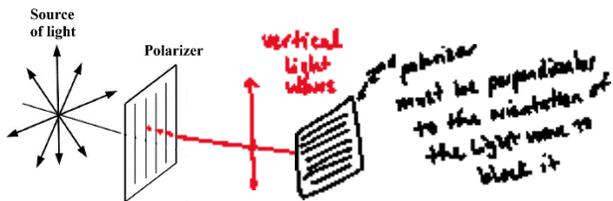
15. Michael is searching for a new bathroom mirror. He needs to be able to see the top of his head all the way to his waist. The top of his head to his waist measures 32 inches. What is the minimum size mirror he can buy and still see this part of his body?

The mirror would need to be HALF of the height of the part of the body you want to be able to see. So this mirror would need to be at least 16 inches tall.

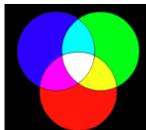
16. Below you will find three mirrors with three arrows pointed in different orientations. Determine how the mirror's reflection of each arrow will appear. Which arrow gets flipped, in what direction, and why?



17. Which orientation of light will be able to pass through the polarizer? If you added a second polarizer, which way would it need to be oriented so that it blocks the polarized light from the first polarizer?



18. What color of light would need to be added to blue to make white? What two colors of light are needed to make yellow?



yellow (across + complementary) red + green

19. What pigment color would need to be added to cyan to make black? What two pigment colors are needed to make red?



red (across + complementary) magenta + yellow

20. How is color addition and color subtraction different? (Hint: Describe them but also how their "mediums" differ).

Color addition uses light and adds colors of light. All the primary colors (red, green, blue) will give white light.

Color subtraction uses pigments and dyes and removes colors through absorption while reflecting/transmitting the color you perceive. All the primary colors for pigments (magenta, cyan, yellow) will make black.