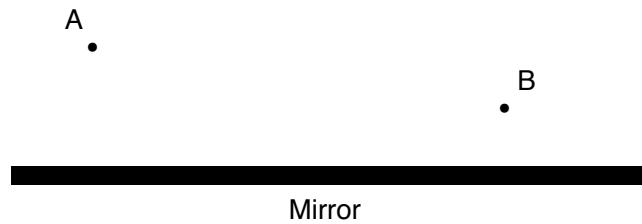


Physics

Light Wave Homework

1. Are light waves transverse or longitudinal waves? What about radio waves? Gamma rays? Sound waves? X-rays?
2. What is the medium that vibrates as light travels through it?
3. What special property must a tiny object vibrating at 2.1×10^{14} Hz have in order to generate a heat wave?
4. Name two differences between microwave radiation and visible light.
5. Calculate the wavelength of the heat waves that would be generated by the object in question #3.
6. Which waves carry more energy, microwaves or ultraviolet waves?
7. Which of the following are examples of electromagnetic waves: x-rays, ripples on a pond, ultrasonic imaging of a baby in a mother's womb, lasers, global positioning satellite communications, cooking with a microwave oven, cooking with a conventional oven, the beauty of a sunset.
8. Which has a higher frequency, visible light or infrared light? Which has a longer wavelength? Which has a greater wave speed? Which carries more energy?
9. If a white star looks a little bluer than it should, does this mean that the star is moving toward you or away from you? How does this affect the frequency, wavelength and wave speed of the light you receive from the star?
10. Explain where the energy carried by light goes as an atom absorbs it. Does this make the atom more or less stable?
11. Explain what happens to an atom as it emits light. Does this make the atom more or less stable?
12. Suppose a particular atom absorbs light with a wavelength of 500 nanometers. Does this mean the atom was "in tune" with or "out of tune" with that light? Can the same atom absorb light of any wavelength, or only light with a wavelength of 500 nanometers?
13. Does an electron that moves to an orbit closer to the nucleus gain or lose energy in the process?
14. Would you say that ultraviolet light is "in tune" or "out of tune" with the possible orbit transitions of the electrons surrounding the glass molecules of a window? How about visible light?
15. Which does light travel faster through, water or air? Explain why. Which does sound travel faster through? Again, explain why.
16. Which cells in the retina are more sensitive to low intensity light, rods or cones?
17. Which color(s) of light does a blue object absorb? Which are reflected?
18. What color would a light bulb appear to you if it generated both red and green light simultaneously?
19. What colors of light combine to form cyan?
20. Which will keep a hot cup of cocoa warm longer on a cold night, a white cup or a black one?
21. Complete the **Color** practice sheet (the one with the picture of a guy with less hair than Mr. Schneider).
22. What additive primary color(s) are absorbed by magenta pigment? Which additive primary color(s) are reflected back to your eye?
23. What additive primary color(s) are absorbed by yellow pigment? Which additive primary color(s) are reflected back to your eye?
24. If you mix magenta and yellow pigments, what color will the mixture appear? Explain **carefully** why this is, using your answers to **Questions #22** and **#23** to calculate your answer and **showing all your work**.
25. Explain why you can't get a sunburn through your car window, but your arm will still heat up.
26. Why do snowfields on distant mountains look a little yellow (even though eating this snow would be perfectly OK), whereas close ones look pure white?
27. Explain how a red crab can be camouflaged when it's underwater.
28. What color is the sun around 10:00am? Why does it appear this color even though it emits all colors of visible light?

29. Use a ruler to **carefully** measure and record the total length of three **very different** paths from **point A** down to the surface of the mirror and then back up to **point B** in the diagram below, including the path that light would actually take. Which path is shortest?



30. Draw dotted lines to show the normal at each point where a path strikes the mirror above. Use a protractor to estimate the angles of incidence and reflection for each path.
31. Suppose that you're standing 3 meters from a mirror, and a friend is standing 2 meters behind you. How far away from you does the virtual image of your friend appear to be?
32. Recall that Fermat's famous principle is of least **time**. Would a principle of least **distance** work for reflection? How about refraction? Explain why your answers are different.
33. If you're hunting fish from a boat with a laser gun, should you aim above, below, or directly at the fish?
34. If light bends away from the normal when passing from **medium A** to **medium B**, which has a larger index of refraction? Which is larger, the angle of incidence or the angle of refraction?
35. Does light travel faster or slower when the temperature of the air is increased? Explain why. What about sound? Again, explain why.
36. Complete the **Refraction** practice sheet (the one with the wheels and grass on it).
37. Suppose that you're inside your house and your friend is outside it on a moonless night. Each of you is exactly 2 meters from your desk lamp, and you are on opposite sides of a window. Which of you will be more visible to the other? Explain why, in terms of reflection and refraction.
38. Suppose light **inside** a diamond (critical angle = 24.5°) strikes the surface at a 45° angle of incidence. Will all, part, or none of this light escape into the air?
39. Rays of light generated underwater that shine up to the surface with angles of incidence more than the critical angle of 48° are totally reflected. No rays beyond 48° are refracted and allowed to escape into the air from the surface. How about the other way around? Is there a critical angle at which light rays coming from the air above will be totally reflected off the surface of the water?
40. Which carries more energy, red light or blue light? Which travels faster through glass? Explain this discrepancy.
41. Draw a picture of how the light striking the pane of glass in the **side view** below is dispersed when it enters the glass from the left, and then what happens to it when it exits the glass to the right.

