

light - practice problems

1. A charged particle in an antenna is forced to accelerate back and forth. Why can that produce radio light even though no visible glow is seen?
2. A Wi-Fi router uses light with frequency 2.4×10^9 Hz. The signal carries data through walls and across a room, even though your eyes cannot detect it. What is the wavelength of this microwave signal in air? Use 3.00×10^8 m/s for the speed of light.
3. A red laser pointer has wavelength 650 nm. It is useful in a classroom because the light is concentrated and easy for human cone cells to detect. What is the frequency of the red light?
4. Put these spectrum regions in order from lowest frequency to highest frequency: x-ray, infrared, visible, radio, ultraviolet, microwave, gamma ray.

5. An airport radar system uses electromagnetic waves with wavelength 3.0 cm. The beam sweeps across the sky many times per minute, but the wave itself moves at light speed. What is the frequency of the radar wave?

6. Some vitamin D chemistry in skin is triggered by ultraviolet light with wavelength around 290 nm. What is the frequency of this ultraviolet light?

7. In the visible spectrum, red is on the long-wavelength side and violet is on the short-wavelength side. Which color has the higher frequency, and why?

8. The Sun is about 1.50×10^8 km from Earth. Sunlight carries the energy that drives weather, photosynthesis, and most food chains. How long does sunlight take to reach Earth?

9. A laser pulse is sent from Earth to a retroreflector on the Moon and back. The center-to-center Earth-Moon distance is 384 400 km, and the reflected pulse returns to the telescope. What is the round-trip travel time for the light?

10. The page says light moves slower in dense media. What is happening to the light inside matter that makes the wave delayed?

11. A tiny sparkle travels through a 2.0 mm thick diamond chip. Use 1.20×10^8 m/s for the speed of light in diamond. How long does the light take to cross the diamond?

12. Green light has frequency 5.0×10^{14} Hz. In water, light travels at about 2.25×10^8 m/s. What is the wavelength of this green light in water?

13. White light enters a glass prism and spreads into colors. Which color bends more, red or violet, and what does that tell you about their speeds in glass?

14. A nearby star is 6.2 light-years away. A light-year is the distance light travels in one year, about 9.46×10^{15} m. How far away is the star in meters?

15. A science article says a star is 2.84×10^{17} m away. Convert that distance to light-years using 9.46×10^{15} m for one light-year.

16. Why do humans mostly lose color vision in a very dark room, even if objects are still faintly visible?

17. A phone screen makes yellow by turning on red and green light in the same small pixel. Is this additive color or subtractive color, and why?

18. A printer puts cyan and yellow ink on white paper to make green. Is this additive color or subtractive color, and what colors are being removed?

19. A pair of polarized sunglasses reduces glare from sunlight reflecting off a lake. What does the filter do to the light wave, and why is polarization a property of transverse waves?

20. A green beam with wavelength 530 nm hits a glass prism at 35° . The prism is 4.0 cm thick. What angle does the beam leave the prism at?

21. A tungsten filament in an old incandescent bulb is about 3000 K when glowing. Convert this temperature to Celsius and Fahrenheit.

22. Objects at room temperature give off light, but people do not usually glow visibly in a dark room. What kind of light are they mostly emitting?

23. A photography light is labeled 4500 K. This is a color temperature, not the air temperature in the room. Convert 4500 K to Celsius and Fahrenheit.

24. The visible spectrum runs roughly from 380 nm violet light to 750 nm red light. Find the frequency at each end of the visible spectrum.

25. A gas stove flame can look blue, while a wood fire often looks yellow-orange. Why is flame color not always a simple thermal radiation color?

26. A video call signal goes from Earth up to a geostationary satellite 36 000 km above the ground and then back down to another station. Ignoring electronics delay and atmosphere, how long does the light-speed signal take for the up-and-down trip?