Unit Review: Light

① a) Light is emitted by our eyes. It reflects off of an object and returns to our eyes, allowing us to see the object.

b) Filaments of light from our eyes are able to reach out and touch objects. Whatever they touch, we see.

② Vibrating charged particles.

③ Yes. The spectrum also includes radio waves, microwaves, IR, UV, x-rays, and gamma rays.

④ IR Visible UV

lowest ⟶ highest

⑤ Sunlight and starlight are visible on Earth.

⑥ a) radio waves

b) visible light

c) UV

d) gamma rays

⑦ high frequency light

⑧ A particle of light.

(9) $v = \frac{d}{t}$

$t = \frac{d}{v} = \frac{3 \times 10^{11}\ m}{3 \times 10^{8}\ m/s} = \boxed{1000\ s}$

(10) one year

(11) A narrower opening results in more pronounced spreading. This is called diffraction.

(12) Yes, by destructive interference.

(13) For waves in general, e.g. sound beats, Young's experiment, water waves.

(14) a) $n = \frac{c}{v} = \frac{3 \times 10^{8}}{2.21 \times 10^{8}} = \boxed{1.36}$

b) ethyl alcohol

(15) $n = \frac{c}{v}$

$v = \frac{c}{n} = \frac{3 \times 10^{8}}{2.16} = \boxed{1.39 \times 10^{8}\ m/s}$

(16) $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$1.33 \sin 56.4 = n_2 \sin 42.1$

$n_2 = \frac{1.33 \sin 56.4}{\sin 42.1} = \boxed{1.65}$

(17) $n_2 = \frac{c}{v} = \frac{3 \times 10^8}{2.27 \times 10^8} = 1.32$

$n_1 \sin \theta_1 = n_2 \sin \theta_2$

(1) $\sin 36.1 = 1.32 \sin \theta_2$

$\theta_2 = \sin^{-1}\left(\frac{\sin 36.1}{1.32}\right)$

$\theta_2 = \boxed{26.5^\circ}$

(18) Light and dark fringes formed when light waves interfere.

(19) Interference of light waves.

(20) Sound waves have much longer wavelengths than light. Diffraction is more pronounced for longer wavelengths.

(21) Radio waves have much longer wavelengths than light.

(22) The lines will be further apart for red light because it has a longer wavelength than blue light.

(23) $d = 0.25\ mm = 0.25 \times 10^{-3}\ m$

$\Delta x = \frac{12.8\ cm}{5} = 2.56\ cm = 2.56 \times 10^{-2}\ m$

$L = 8.2\ m$

$\lambda = \frac{\Delta x \cdot d}{L} = \frac{(2.56 \times 10^{-2})(0.25 \times 10^{-3})}{8.2}$

$\lambda = \boxed{7.80 \times 10^{-7}\ m}$

or

780 nm

(24) $d = 0.5\ mm = 0.5 \times 10^{-3}\ m$

$L = 525\ cm = 5.25\ m$

$\Delta x = \frac{98\ mm}{3} = 32.\overline{6}\ mm = 32.\overline{6} \times 10^{-3}\ m$

$\lambda = \frac{\Delta x \cdot d}{L} = \frac{(32.\overline{6} \times 10^{-3})(0.5 \times 10^{-3})}{5.25}$

$\lambda = \boxed{3.11 \times 10^{-6}\ m}$

or

3111 nm

(25) The listener is walking through the nodal lines produced by the interfering sound waves.

(26) The guitar could be either:

$$440 - 2 = \boxed{438 \text{ Hz}}$$

$$440 + 2 = \boxed{442 \text{ Hz}}$$

(note: $f_{beat} = \frac{6 \text{ beats}}{3 \text{ sec.}} = 2 \text{ Hz}$)

(27) higher

(28) lower

(29) They are equal.

(30) Blue because it has a higher frequency.

(31) The ejection of electrons from a metal, caused by light.

(32) Blue light has a higher frequency, and thus more energy than red.

Blue has enough energy to eject an electron, red does not.

(32) Yes. Each photon ejects one electron. Since bright light has more photons, it ejects more electrons.

(34) Particle.