Physics Unit 11: Electromagnetic Rays Review

1. Know about electromagnetic waves, emission spectra, absorption spectra, refraction, reflection, myopia, hyperopia.
2. Know the spectrum of light including the complete spectrum and visible light.
3. Which types of electromagnetic waves are dangerous and why?
4. Know how an atom absorbs or emits light.
5. Know about the eye, vision correction, and color vision.
6. Know how to make ray diagrams for mirrors and lenses.
7. What type of images to the various mirrors and lenses make? (real or virtual) (upright or inverted) (enlarged or reduced)
8. Why does refraction happen?
9. WAUS has a frequency of 90.7 MHz. What is its wavelength?
10. If the index of refraction is 12.5, what is the speed of light in the material?
11. A beam of light in a material of index of refraction of 1.5 hits a boundary with air (n = 1.00). If the angle of incidence is 25°, what is the angle of refraction?
12. A light ray is traveling in a fluorite (n = 1.434). If the ray approaches the fluorite-air interface, what is the minimum angle of incidence that will result in all of the light being reflected back into the diamond? The index of refraction for air is 1.000.
13. A beetle is 3.0 cm in front of a convex lens with focal length of 5.0 cm. Where is the image?
14. A 2 cm object is placed 15 cm from a lens. The resulting image height has a magnitude of 0.5 cm and the image is inverted. What is the focal length of the lens?
15. The focal length of a spherical convex mirror is −4.0 cm. What is its radius of curvature?
16. What is the image distance if an object is placed 10 cm in front of a concave mirror with radius of curvature of 12 cm?
17. A pebble is 15.0 cm from a convex mirror. If the magnification is -2.5, where is the image?

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Answers

3. UV, x-rays, gamma rays cause cell damage. When absorbed by an electron, one of these photons can completely remove the electron from the atom. This leaves the atom ionized and subject to chemical reactions.

4. Absorption: An electron absorbs a photon and its energy. This causes it to jump to a higher energy orbital.
Emission: An electron falls from a higher energy orbital to a lower orbital. The excess energy is released as a photon.
Because the orbitals are specific levels, the absorption and emission spectra have distinct lines.

7. Mirrors
Concave: $d_o > R$ image real, inverted, reduced, between C and F
$f < d_o < R$ image real, inverted, enlarged, beyond C
$d_o < f$ image virtual, upright, enlarged, behind mirror
Convex: image virtual, upright, reduced, behind mirror

Lenses
Converging: $d_o > 2f$ image real, inverted, reduced, between 2F and F
$f < d_o < 2f$ image real, inverted, enlarged, beyond 2F
$d_o < f$ image virtual, upright, enlarged, behind lens
Diverging: image virtual, upright, reduced, behind lens

8. **Speed of light changes**

9. $f = 90.7 \times 10^6\ Hz, c = 3.00 \times 10^8\ \frac{m}{s}$
$c = f\lambda$
$3.00 \times 10^8\ \frac{m}{s} = (90.7 \times 10^6 Hz)\lambda$
$\boldsymbol{\lambda = 3.31\ m}$

10. $n = 12.5$
$n = \frac{c}{v}$
$12.5 = \frac{3.00 \times 10^8 \frac{m}{s}}{v}$
$\boldsymbol{v = 2.4 \times 10^7\ \frac{m}{s}}$

11. $n_1 = 1.5, \theta_1 = 25°, n_2 = 1.0, \theta_2 = ?$
$n_1 \sin\theta_1 = n_2 \sin\theta_2$
$1.5 \sin 25° = 1.0 \sin\theta$
$0.6339 = \sin\theta$
$\theta = \sin^{-1} 0.6339 = \boldsymbol{39.3°}$

12. $n_1 = 1.434, n_2 = 1.000\ , \theta_c = ?$
$\theta_c = \sin^{-1}\left(\frac{n_2}{n_1}\right)$
$\theta_c = \sin^{-1}\left(\frac{1.000}{1.434}\right)$
$\boldsymbol{\theta_c = 44.2°}$

13. $d_o = 3.0\ cm, f = 5.0\ cm, d_i = ?$
$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$
$\frac{1}{5.0\ cm} = \frac{1}{3.0\ cm} + \frac{1}{d_i}$
$\frac{1}{5.0\ cm} - \frac{1}{3.0\ cm} = \frac{1}{d_i}$
$-\frac{2}{15\ cm} = \frac{1}{d_i}$
$\boldsymbol{d_i = -7.5\ cm}$

14. $h_0 = 2\ cm, d_o = 15\ cm, h_i = -0.5\ cm, f = ?$
$\frac{h_i}{h_o} = -\frac{d_i}{d_o}$
$\frac{-0.5}{2} = \frac{-d_i}{15}$
$-2d_i = -7.5$
$d_i = 3.75\ cm$
$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$
$\frac{1}{f} = \frac{1}{15} + \frac{1}{3.75}$
$\boldsymbol{f = 3\ cm}$

15. $f = -4.0\ cm, R = ?$
$f = -\frac{1}{2}R$
$-4.0\ cm = -\frac{1}{2}R$
$\boldsymbol{R = 8.0\ cm}$

16. $R = 12\ cm, f = 6\ cm, d_o = 10\ cm$
$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$
$\frac{1}{6} = \frac{1}{10} + \frac{1}{d_i}$
$\frac{1}{6} - \frac{1}{10} = \frac{1}{d_i}$
$\boldsymbol{d_i = 15\ cm}$

17. $d_o = 15.0\ cm, m = -2.5, d_i = ?$
$m = -\frac{d_o}{d_i}$
$-2.5 = -\frac{15.0\ cm}{d_i}$
$2.5d_i = 15.0\ cm$
$\boldsymbol{d_i = 6.0\ cm}$