Assignment-3

Year: 2017, Semester: Fall, Course: PHY-105, Title: Physics

1. Light is reflected from a smooth surface of water at the polarizing angle. Assume that refractive index of water is μ = 1.33. Find the (a) angle of incidence and (b) angle of refraction.
2. The refractive index of plastic is 1.25. Calculate the angle of refraction for a ray of light incident at polarizing angle.
3. Find the thickness of a quarter wave plate when the wavelength of sodium light is 5890Å. Given μ_E = 1.553 and μ_o = 1.544.
4. How will you orient the polarizer and analyzer so that a beam of natural light is reduced to (a) 0.125 and (b) 0.75 of its original intensity?
5. Find the thickness of a half wave plate for a light of wavelength 5000Å. Given μ_E = 1.45 and μ_o = 1.55. Also comment on the nature of the crystal.
6. If the plane of vibration makes an angle of 30^o with optic axis, compare the intensity of extraordinary ray and ordinary ray. Also calculate the intensity of e-ray when the intensity of o-ray is 65×10^{-1} W/m^2 and express the intensity ratio as percentage.
7. Calculate the mass defect, binding energy and binding energy per nucleon of $^{16}_{8}O$. The mass of neutral oxygen is 15.994915 amu, m_p = 1.007825 amu and m_n =1.008665 amu (1 amu = 1.66057×10^{-27} kg).
8. Calculate the Q value of the reaction $^{3}_{1}H + {}^{2}_{1}D \rightarrow {}^{4}_{2}He + {}^{1}_{o}n + Q$ if the rest masses of the neutral atoms $^{3}_{1}H$, $^{2}_{1}D$ and $^{4}_{2}He$ are 3.016049, 2.014102 and 4.002603 amu respectively.
9. A sample of carbon from an ancient wooden boat piece gives 5 count/min/g of carbon due to ^{14}C present in it. If freshly cut wooden piece gives 16 count/min, what is the age of the boat? Half-life of ^{14}C= 5760 years?
10. If a sample of radium weighs one gram today. How much will it weigh in 100 years? Given $T_{1/2}$ (Ra)=1600 years.
11. A photo-electric surface has a work function of 4 eV. What is the maximum velocity of photoelectrons emitted by light of frequency 10^{15} Hz incident on the surface?
12. Calculate the threshold frequency and the corresponding wavelength of radiation incident on a certain metal whose work function is $3.31\text{x}10^{-19}$ J. Given Planck's constant=$6.62\text{x}10^{-34}$ Js.
13. The threshold wavelength for photo-electric emission in tungsten is 250 nm. What wavelength of light must be used in order for electrons with a maximum energy 1.5 eV to be ejected?
14. A measurement establishes the position of a proton with an accuracy of $\pm1.00\text{x}10^{-11}$m. Find the uncertainty in the position 1 sec later. Assume v$\ll$c.
15. Suppose a photon is incident on a metal. Using electron microscope, calculate the uncertainty in momentum if electron exists a distance 0.2Å inside the atom.
16. An excited atom gives up its excess energy by emitting a photon of characteristic frequency. The average period that elapse between the excitation of an atom and the time it radiates is $1\text{x}10^{-8}$ sec. Find the inherent uncertainty, in the frequency of the photon.
17. X-rays of wavelength 10 pm are scattered from a target. (a) Find the wavelength of the X-rays scattered through 45^o, (b) Find the maximum wavelength present in the scattered X-rays, (c) Find the maximum K.E. of the recoil e$^-$s.
18. Find the de-Broglie wavelengths of (a) a 46 gm golf ball with a velocity of 30 m/s and (b) an e$^-$ with a velocity of 10^7 m/s.

[Problem 1-6 have been set from Polarization of light, Problem 7-10 from Nuclear physics, Problem 11-18 from Modern physics]