OPAC101-INTRODUCTION TO OPTICS. [ Solved Problems (set1)]

## 1.What is the speed, energy (in eV ) and frequency of a green light of $0.55 \mu \mathrm{~m}$ wavelength

(a) in air
(b) in water?
2.A laser in a compact disc player generates light that has a wavelength of 780 nm in air.
(a) Find the speed of this light once it enters the plastic of a compact disc $(\mathrm{n}=1.55)$
(b) What is the wavelength of this light in the plastic?
3.Assume that a 1 kW -oven at 2.45 GHz gives all of its energy as microwave radiation. How long does it take to boil a glass of water $(200 \mathrm{ml})$ if its initial temperature is $20^{\circ} \mathrm{C}$ ?
4. Assume that $10 \%$ energy of total energy from a 100 W monochormaticlight-bulb is radiated as photons. Calculate number of violet $(\lambda=400 \mathrm{~nm})$ photons leaving from the bulb in 10 s .
5.A soprano's voice is sent by radio waves to a listener in a city 90 km away.
(a)How long does it take for the soprano's voice to reach the listener?
(b)In the same time interval, how far from the soprano has the sound wave in the auditorium traveled? Take the speed of sound to be $340 \mathrm{~m} / \mathrm{s}$.
6. Passive triangulation method is a geometrical technique of measuring the shortest distance between a point on the target and the baseline, defined by two observation points. Figure depicts the basic setup for this technique. The baseline has a known length x , and at both ends there are instruments (e.g., cameras) capable of measuring the angles $\alpha$ and $\beta$, respectively. Each angle is the angle between the corresponding line of sight to the target point and the baseline. The target point and the two observation points form a triangle; with known x and measured $\alpha$ and $\beta$, the distance $d$ can be calculated. Find $d$ if $\alpha=40^{\circ}, \beta=30^{\circ}$ and $x=1 \mathrm{~m}$.

7.Calculate the minimum and maximum time required to send a light signal from Earth to Mars?
8.A green light of wavelength 580 nm is incident on a slit of width $d$.

For which of the following value of $d$ is the ray approximation valid?
(a) $10 \mu \mathrm{~m}$
(b) $1 \mu \mathrm{~m}$
(c) $0.1 \mu \mathrm{~m}$
(d) 1 nm
9.Which of the following em-radiations can be absorbed by molecular vibrations?
(a) gamma-ray
(b) x-ray
(c) microwave
(d) radio waves
10. Which of the following em-radiations can be produced by sub-atomic particle interactions?
(a) gamma-ray
(b) x-ray
(c) microwave
(d) radio waves
11. Which of the following em-radiations can be used in transmission of data?
(a) gamma-ray
(b) x-ray
(c) microwave
(d) radio waves
12. Which of the following em-radiations can be used to heat food?
(a) gamma-ray
(b) x-ray
(c) microwave
(d) radio waves
13. Which of the following em-radiations can be used in radiography?
(a) gamma-ray
(b) x-ray
(c) microwave
(d) radio waves

