Quiz 1

Name: _____

Total = 10 marks

1. (2 marks) Estimate the number of photons per second in a 10 Watt blue argon ion laser beam?

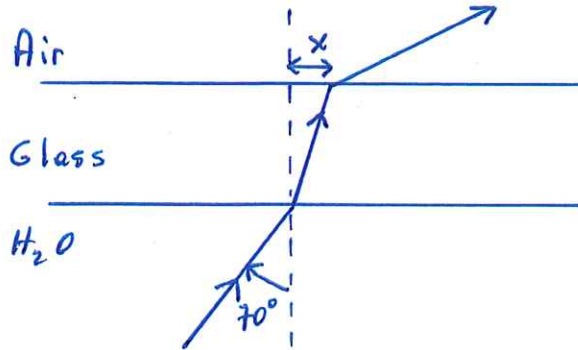$$\# \, photons/sec = \frac{P}{h\nu}$$

$$= \frac{10 \, Watt}{6.63 \times 10^{-34} \, Js \times \frac{3 \times 10^{8} \, m/s}{6 \times 10^{-7} \, m}}$$

$$= 3 \times 10^{19} \, phot/s$$

2. (3 marks) Derive the law of reflection using Fermat's Principle.

See lecture notes.

3. Refraction

   a) (3 marks) A light beam travelling in water strikes a 1 meter thick glass plate at an angle of incidence of $70°$ as shown below. Find the position x where the light ray enters the air on the other side of the glass surface.

   Refraction at H_2O/Glass interface: $n_W \sin 70° = n_G \sin \theta_t$

   $$\sin \theta_t = \frac{1.33 \sin 70°}{1.5}$$

   $$\theta_t = 56.4°$$

   Now $\tan \theta_t = \frac{x}{1}$

   $$x = 1.51 \text{ meters}$$

   b) (2 marks) How does the answer change if the light ray is initially in glass and then hits a 1 meter thick water layer?

   Refraction: $n_G \sin 70° = n_W \sin \theta_t$

   $$\sin \theta_t = \frac{1.5 \sin 70°}{1.33}$$

   $$= 1.06$$

   ∴ no refraction occurs. Ray is totally internally reflected and never reaches air.