Problem 1

> *Light emitted from a conventional source is said to be* **incoherent**. *Why???*

When electrons de-excite they emit photons in random directions at random phases. Thus there is no coherence in the direction and phase of the light.

Problem 2

> *Light traveling in a vacuum will experience changes as it enters a different medium. What properties change and what do not change? Briefly explain.*

The speed and wavelength change, but the frequency remains the same, and by consequence the color is the same. Intensity will also change.

Problem 3

> *Can you perform this Speed Out of Luck lab with a 532 nm green laser, instead of the red laser? Do not answer yes or no.*

Without saying a firm yes or no, technically the lab would work with a different laser, but absorption of light depends on wavelength for most materials, so different lasers may be less optimal with certain mediums. For water, an ultraviolet laser or infrared laser would be less ideal. With a green laser would arguably be better due to lower absorption.

Problem 4

> *SOL in a sapphire?*

Index of refraction $n = 1.77$. This corresponds to the ratio of the speed of light in vacuum to the speed of light in that material. $2.998e8 * /1.77 = 1.693e8$ m/s

Problem 5

> *List and briefly describe the important parts of a fiber optic cable.*

- Jacket/Sheathing just an outside cover
- Kevlar protects the cable and prevents damage while the cable is pulled
- Cladding a reflective cladding that goes around the core and keeps light from stopping
- Core a continuous strand of super thin glass that is roughly the same size as a human hair. Serves as the medium through which the light moves.
- Boot begins the transition from cable to connector, bends more comfortably to protect the connection.
- Connector plugs in to the equipment.
- Ferrule a protuding portion of a fiber connector, houses the end of the fiber to align it with another cable.

Problem 6

> *Describe* **total internal reflection**.

This means that light does not leave the medium through some interface, and that it will be completely reflected back inwards. More specifically, this happens which going from a more dense to a less dense medium when the angle of incidence is greater than the critical angle.

Problem 7

> *What is the value of the critical angle for total internal reflection in a diamond crystal?*

The critical angle is the incident angle at which the refracted angle is 90. Assuming the medium the refracted ray is traversing is vacuum, or $n_2 = 1$, and $n_1 = 2.3778$.

$$\theta_{crit} = arcsin\left(\frac{n_2}{n_1}\right) = arcsin(1/2.3778) = 24.8\ degrees$$

Problem 8

> *Suppose you are measuring the speed of light in air by splitting a laser beam into two beams that are traveling different distances and you measure the time delay between the two beams. If you did the same experiment in a vacuum, what would be the percentage difference in the computed speed of light?*

This question is super unclear, but I think it means what's the difference in speed of light in vacuum compared to speed of light in air??? In which case, it's going to be equal to n-1 (since in a vaccuum n is 1), for air that is going to give us 0.0293%.

Problem 9

> *How much longer than in air would it take for light to pass through a 1.0000 cm diamond?*

$$t = \frac{d}{v}$$

$$v = \frac{c}{n}$$

$$t = \frac{dn}{c}$$

$$\Delta t = \frac{d(n_{diamond} - n_{air}}{c}$$

$$\Delta t = \frac{1.0000e-2\ m(2.417 - 1.000}{2.9979\ m/s}$$

$$\Delta t = 0.0047266\ seconds$$