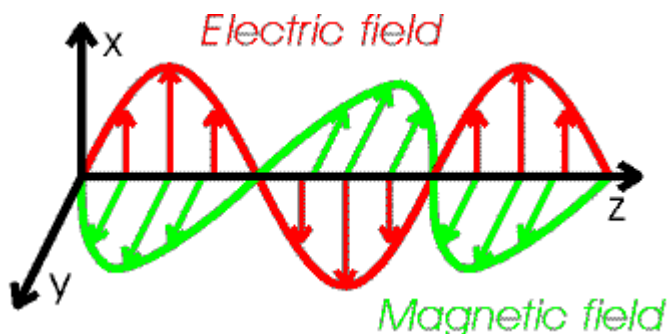


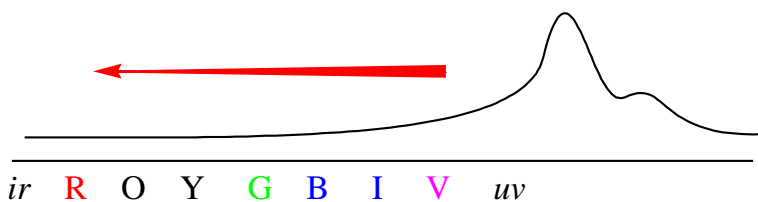
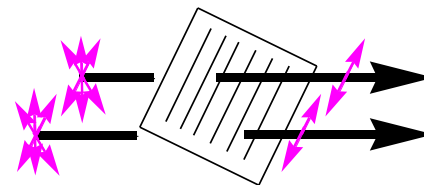
This handout is not a stand-alone piece. It was used in conjunction with a Visual Basic 6.0 simulation (<http://www.stolaf.edu/people/hanson/origami/WIN/optics.exe>) and a demonstration of optical rotation using corn syrup. Answers are given at the end of this document.



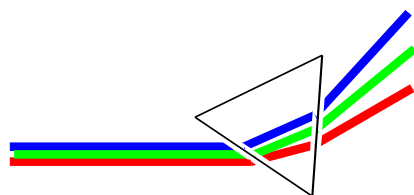
A. Light can be thought of either in terms of an oscillating magnetic field or an oscillating electric field. Light oscillating like this in a single plane (in terms of the electric field) is called \_\_\_\_\_.

B. The time-dependent oscillation can be seen as the sum of two \_\_\_\_\_.

C. Normally light is composed of a randomly polarized fields, but certain \_\_\_\_\_ materials are selective in which polarizations are allowed to pass through.

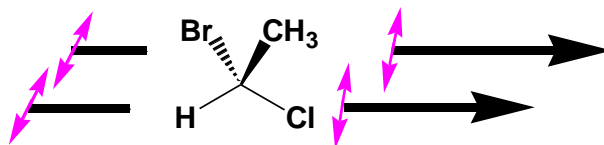


D. All chemical compounds absorb \_\_\_\_\_ light, because all compounds contain \_\_\_\_\_ bonds. This absorption is primarily electronic in nature, but also involves \_\_\_\_\_ and \_\_\_\_\_. The broad UV absorptions tail off into the \_\_\_\_\_ region, which is at \_\_\_\_\_ energy.



E. The absorption of light results in its being slowed down. As a result, the light \_\_\_\_\_. Higher energy light refracts \_\_\_\_\_ than lower energy light. (This is why the sky is blue and sunsets are red.)

F. \_\_\_\_\_ molecules selectively absorb one of the counter-rotating components of light more than the other. If you think about it, they *have* to. How could they not? This “retardation” of one component more than the other results in a rotation of the plane of polarization.

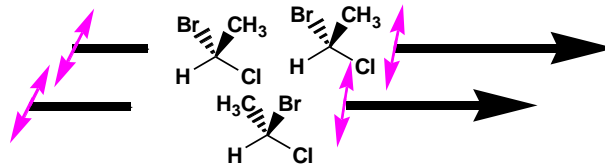


G. The extent to which the plane of polarization is rotated is called the \_\_\_\_\_ (alpha), which depends upon several factors, including the intrinsic structure of the molecule and arrangement of bonds (the \_\_\_\_\_) at a specific wavelength of light, the \_\_\_\_\_ of the sample, and the \_\_\_\_\_ according to the following formula:

\_\_\_\_\_

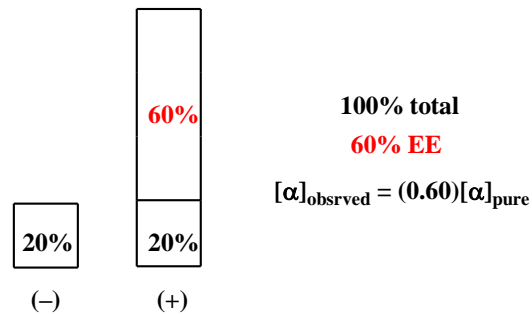
H. Note that the concentration is given in the units of grams per mL and the path length is given in the odd units of decimeters. This is for historical reasons. Our cells are 20 cm, or \_\_\_ dm, long. They hold about 25 mL of solution.

I. The specific rotation of a sample also depends upon its purity. Each \_\_\_\_\_ of a compound rotates the plane in the opposite direction, so if both are present, the \_\_\_\_\_ specific rotation is lower than the specific rotation for the \_\_\_\_\_ enantiomer.



J. “optical \_\_\_\_\_” is defined as the ratio \_\_\_\_\_ / \_\_\_\_\_. (This is often expressed in percent.) If a sample is “100% optically pure” then it is a single enantiomer.

K. Optical purity is sometimes called “\_\_\_\_\_” because it represents the amount of one enantiomer that is in excess of the other enantiomer. If we have, for example, “60% EE,” then \_\_\_% of the mixture is one enantiomer and \_\_\_% is the other, for a DIFFERENCE (an *excess*) of 60%. Effectively, if the EE is 60%, then  $(100 - 60) = 40\%$  of the mixture is racemic (20% is one enantiomer, and 20% is the other) and contributes nothing to the overall rotation. Thus,  $(100 - EE) / 2$  gives the percent of the \_\_\_\_\_ enantiomer in a mixture.



L. If both enantiomers are present in exactly the same amounts, then optical purity, or enantiomeric excess, is \_\_\_% and we have what is called a “\_\_\_\_\_.”

- A. polarized
- B. counter-rotating components
- C. translucent
- D. ultraviolet, single, vibration, rotation, visible, lower
- E. refracts, more
- F. chiral
- G. optical rotation, specific rotation, concentration, path length,  
$$\alpha = [\alpha]_{\lambda} \times \text{CONC (g/mL)} \times \text{PATHLENGTH (dm)}$$
- H. 2.0
- I. enantiomer, observed, pure
- J. purity,  $[\alpha](\text{observed}) / [\alpha](\text{pure enantiomer})$
- K. enantiomeric excess, 80, 20, minor
- L. 0, racemic mixture