

Instructions: You have a total of 50 minutes to complete this test.

Answer each of the following questions completely.

Time Start _____ Time finish _____ Pledged _____

You must supply all details that led to your answer. You must provide correct SI units where required (Units in cm or nm are ok if specified in the problem). Do not discuss any aspect of this test with anyone until I return the test. Although you may use additional sheets of paper which should be turned in with your test, please write (neatly) your answers on the pages where the problems are presented.

(1) (a) A material has an index of refraction of 1.5 and is surrounded by air. When light is incident (from the air [$n=1$]) **from this material onto the interface with air** at an angle of 30° , what is the angle of refraction?

(b) At what angle of incidence will a beam of light striking this material (from the air) produce a reflected beam that is completely polarized?

(c) When a beam of light travels through this material and strikes an interface with air, at what angle will the light be completely reflected internally?

(2) When an object is placed at a distance of 40 cm from a lens, the image is virtual and located at 20 cm from the lens.

(a) What is the focal length of the lens?

(b) If the object is placed at 20 cm from the same lens, what is the magnification of the image?

(c) Characterize the image formed in **(b)** by <Real:Virtual> <Upright:Inverted> <Enlarged:Unmagnified:Reduced> and tell why.

(3) When an object is placed 10 cm from a mirror, a **real** image is formed at 25 cm.

(a) What is the radius of curvature of the mirror?

(b) What is the magnification when an object is placed 50 cm from the same mirror? Be sure to report your sign correctly.

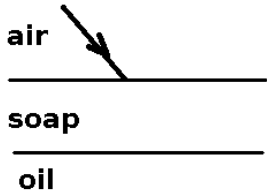
(c) Characterize the image formed in **(b)** by <Real:Virtual> <Upright:Inverted> <Enlarged:Unmagnified:Reduced> and tell why.

(4) Suppose lens L1 has a focal length of -10 cm. This lens is in direct contact with a second lens named L2 which has a focal length of +5 cm.

(a) Find the image position when an object is placed 2 cm from the lens combination. Be sure to report your result with the correct sign.

(b) Suppose light of 500 nm (500×10^{-9} m) is emitted from two sources separated by a distance of 0.183 m. What is the maximum distance this source be from a lens which is 0.1 m in diameter in order to just resolve the two sources? You will need to calculate the angular separation which is given by $\Theta = \text{separation}/\text{distance}$.

(5) (a) A soap film has an index of refraction of 1.5 and is of thickness t . The film is on oil with an index of refraction of 1.2, and air is on the other side of the soap. What is the minimum thickness of the soap film that would reflect light of 600 nm which is normally incident from the air?



(b) Suppose an oil film had an index of refraction of 1.5 and was on a slide with an index of refraction of 2.0 with air on the other side of the oil. What is the minimum thickness of the oil film that would strongly reflect light of 600 nm, normally incident from the air?

