Wednesday May 01, 2024	Physics 250: UnTest #4	Name: _____

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. 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.

Constants: $c=3x10^8$ m/s . $n_{air}=1$

(1) (a) A material has an index of refraction of 2.45 and is surrounded by air. When light is incident (from the air) on this material at an angle of 20^0, what is the angle of refraction?

(b) At what angle will a beam of light striking this material (from the air) produce a reflected beam that makes a 90^0 angle with respect to the refracted beam?

(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 25 cm from a lens, the magnification is +2.
(a) What is the focal length of the lens?

(b) If the object is placed at 10 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.

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(3) (a) When an object is placed 20 cm from a mirror, a real image is formed at 20 cm. What is the radius of curvature of the mirror?

(b) What is the magnification when an object is placed 5 cm from the same mirror?

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

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(4) Suppose lens L1 has a focal length of -25 cm. This lens is in direct contact with a second lens named L2. If an object is placed 50 cm from the lens combination, the resulting magnification is seen to be M=-1. Find the focal length of the second lens in the combination.

(b) A material has an index of refraction of 2 and light is shining on it from the air. At what angle is the reflected light completely polarized?

(c) Light is incident from a material with an idex of refraction of 2 onto an interface with air. What is the critical angle for total internal reflection?

(d) Two 500 nm light sources are separated by 1 m. How far away can the sources be so that a 0.1 m lens will just resolve the two images?

(e) A diffraction grating with $N=4x10^5$ lines/m has coherent light of 700 nm ($700x10^{-9}$ m) shining through it. What is the highest order of interference dots that are observed?

(f) A diffraction grating with $N=4x10^5$ lines/m has coherent light of 700 nm ($700x10^{-9}$ m) shining through it. At what angle is the m=1 interference dot observed?

(g) A TEM wave has an electric field amplitude of 3 V/m. What is the magnetic field amplitude?

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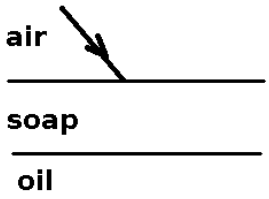
(5) (a)A soap film has an index of refraction of 1.5 and is of thickness t. The film is on an oil film with an index of refraction of 1.7, and air is on the other side of the soap. What is the minimum thickness of the soap film that would **strongly reflect** light of 500 nm which is normally incident from the air?



(b) Suppose an oil film had an index of refraction of 1.7 and was on a slide with an index of refraction of 1.4 with air on the other side of the oil. What is the minimum thickness of the oil film that would **not reflect** light of 500 nm which is normally incident from the air?