

Name _____

Physics 111 Quiz #6, October 28, 2024

Please show all work, thoughts and/or reasoning to receive partial credit. The quiz is worth 10 points total, and all parts may not be of equal weight.

I affirm that I have carried out my academic endeavors with full academic honesty.

1. A 100mW beam of red laser light with wavelength $\lambda_{\text{red}} = 632\text{nm}$ is incident on a slab of gemstone that has been submerged in water ($n_w = 1.33$). The beam of red laser light is incident at an angle of 40° in the water and the beam of red laser light is seen to make an angle of 31.6° in the gemstone. Both angles are measured with respect to the normal to the gemstone's surface. From the chart below, what could be the identity of the gemstone?

Gemstone material	n_m
Opal	1.40
Emerald	1.55
Topaz	1.60
Sapphire	1.77
Cubic Zirconia	2.15
Diamond	2.40

2. Suppose that the gemstone from part 1 was removed from the water and placed in the air. The red laser light is again incident on the gemstone at an angle of 40° in the air. The red laser light travels through the gemstone and exits on the opposite side from where it entered. What is the critical angle at the gemstone/air interface? Use the index of refraction value from the table above, for the gemstone you found in part 1.

- Suppose that this gemstone from part 1 was used as a lens in an experiment. The lens is placed 30cm from an object. The image of the object is found on the same side of the lens as the object, at a distance of 75cm from the lens. What is the focal length and type of lens used in the experiment?
- The image of the object was measured and found to be 5.5cm tall. How tall was the object and what is the orientation of the object with respect to its image?
- Suppose that a second gemstone lens (with focal length 12cm) was made placed 10cm to the right of the first lens. If the object is again placed to the 30cm left of the first lens, where is the final image of the object located. Measure this distance with respect to the second lens.