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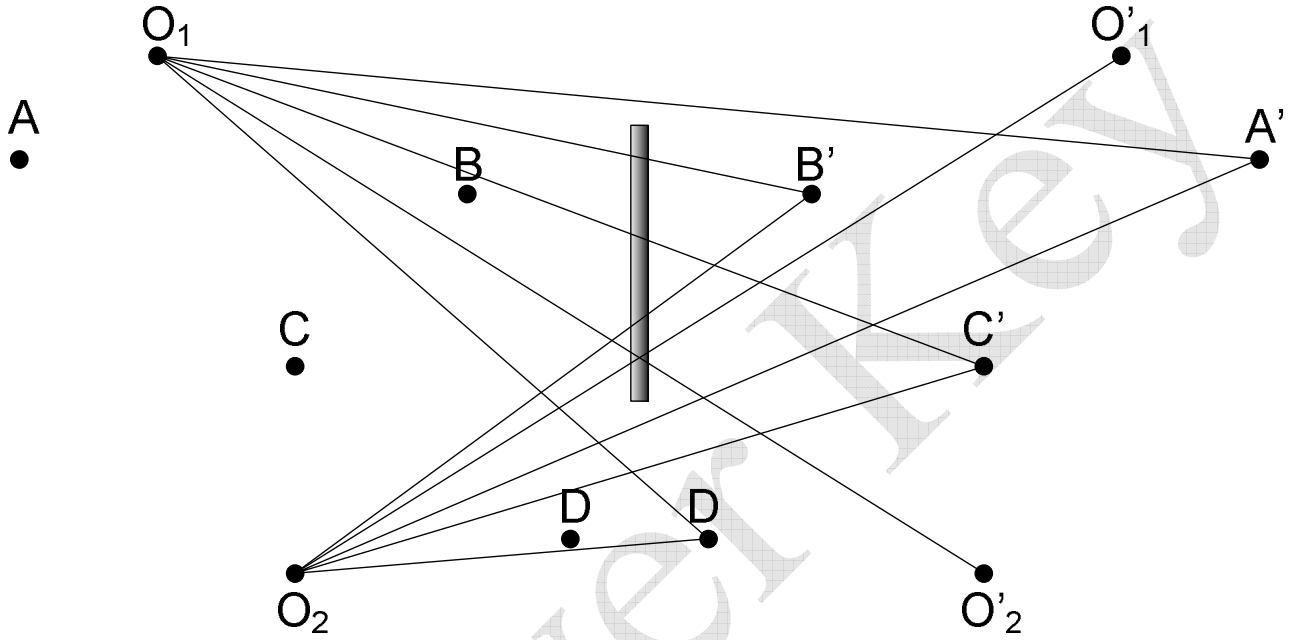
2011 Science Olympiad Kenston Invitational
Optics – Out of Sight

PART B - Geometric Optics

Each question is worth two (2) points
Partial credit is possible on a sketch only



There are two observers in the drawing above O1 and O2 along with four objects to the left of the mirror. Answer the following question based on this drawing.

26. Can observer O1 see observer O2 in the mirror? __yes_____

27. Which point(s) can both observers see in the mirror? __B_____

28. Which point(s) can observer O1 see that observer O2 cannot see in the mirror? __C____

29. Which point(s) can neither observer see in the mirror? ___A & D_____

30. Can observer O2 see observer O1 in the mirror? __yes_____

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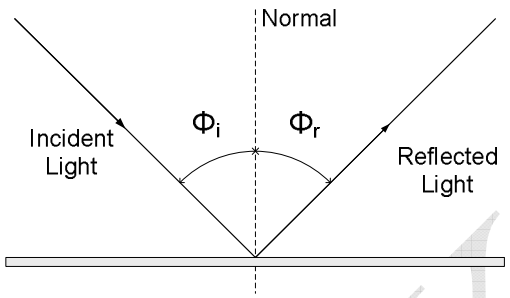
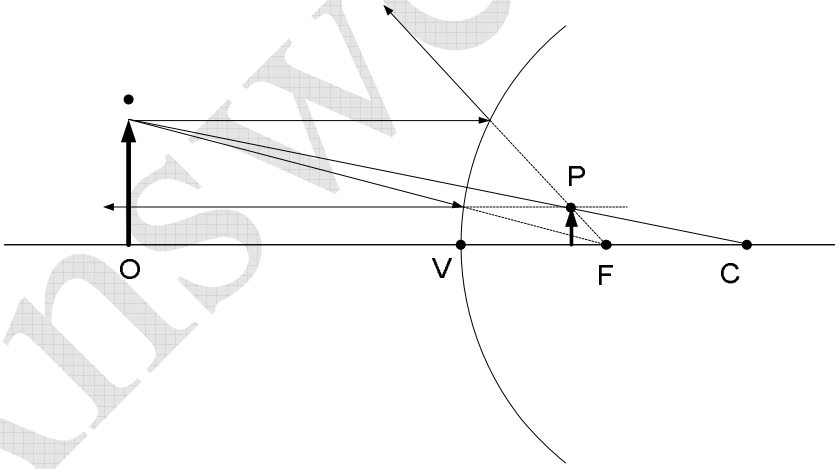
31. Draw and label a diagram depicting reflection off a plane reflective surface such as a mirror. Be sure to include and reference all angle to the normal.



32. Show the mathematical relationship between the angle of incidence and the angle of reflection for the diagram made in the above question.

$\theta_i = \theta_r$ or angle of incidence equals angle of reflection. (Symbols or words are ok)

33. Using the sketch provided, determine the placement, orientation and approximate size of the image in the mirror using ray tracing techniques.



34. The radius of the mirror in the above diagram is 40 cm. What is the focal length of the mirror?
-20 cm

35. Is the image in the above diagram real or virtual? virtual

36. What kind of mirror is in the above question? convex

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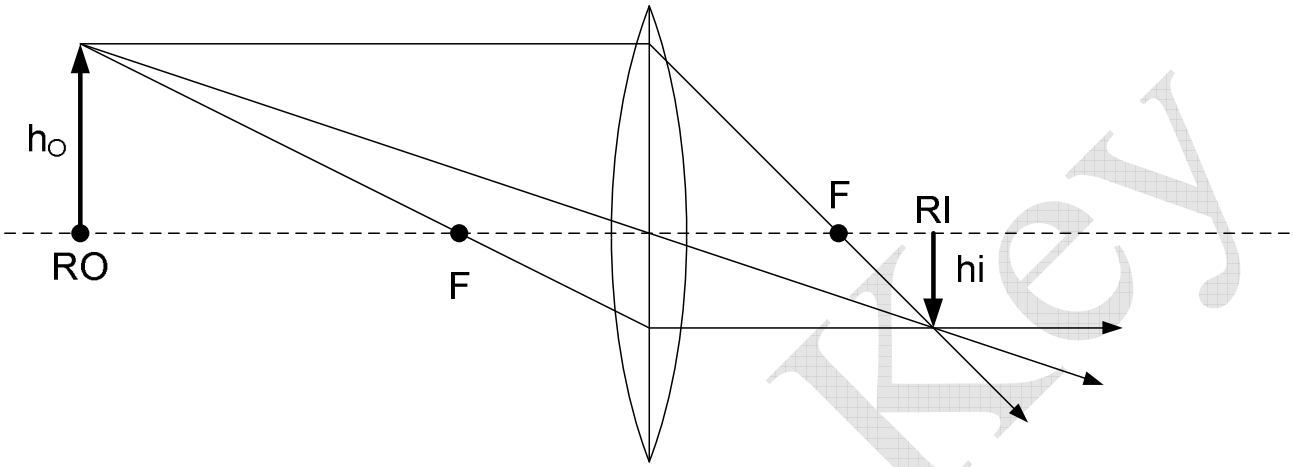
37. Using the sketch provided, determine the placement, orientation and approximate size of the image for the thin lens using ray tracing techniques.

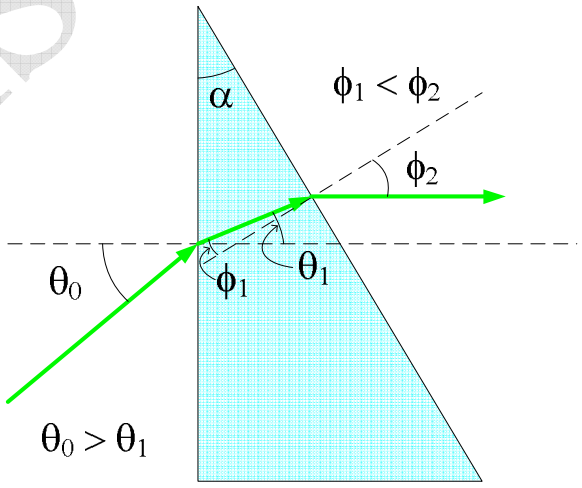


38. The height of the object in the above drawing is 20 cm, its distance from the vertex is 30 cm, and the absolute value of the height of the image is 10 cm, what is the magnification of the system? _-0.5_____

39. Is the image in the above problem real of virtual? __real_____

40. Is a concave lens diverging or converging? __diverging_____

41. Using the sketch provided, show the ray of light that would be leaving the prism and justify you answer by showing the normal and appropriate angles.



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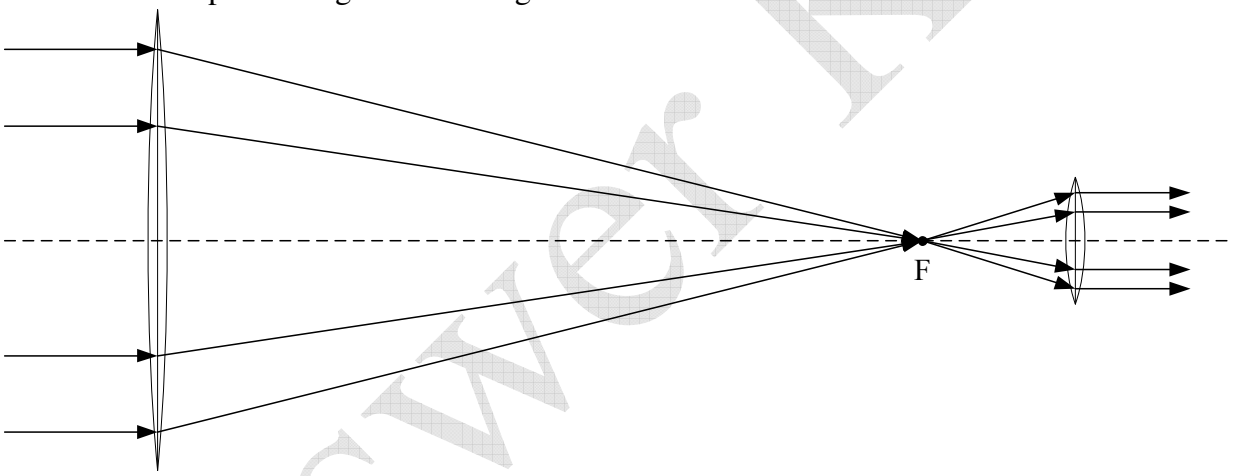
42. Draw a Plano-concave lens

43. The sketch below shows the lenses of a refracting telescope. The point F is the focal point of both lenses. Using ray tracing techniques draw at least four light rays from a distant object that illustrates the path the light take through both lenses.



44. What is the primary optical component of a reflecting telescope _concave mirror_____

45. The optometrist hand you a prescription for new eye glasses. The prescription states that each lens should be 10 diopters. What is the focal length of each lens? __10 cm or 0.1 m_____

46. Most people cannot focus closer than 25cm. What is this point called? __near point_____

47. A reflecting or refracting surface that forms perfect images is called __Cartesian surfaces__

48. Optical systems that produce imperfect images are said to have aberrations or astigmatism

49. The fact that optical system work in both directions is called __reversibility_____

50. What does it mean if the magnification is negative? _image is upside down_____

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Substance	Index of Refraction*
Vacuum	1
Air	1.00029
Ice (H_20)	1.309
Methyl alcohol (CH_3OH)	1.329
Water (H_2O)	1.333
Ethyl alcohol (C_4H_5OH)	1.36
Fluorite (CaF_2)	1.434
Carbon tetrachloride (CCl_4)	1.46
Turpentine	1.472
Glycerin	1.473
Benzene (C_6H_6)	1.501
Plexiglas	1.51
Crown glass	1.52
Rock salt (NaCl)	1.544
Fused Quartz (SiO_2)	1.544
Light flint glass	1.58
Polystyrene	1.59
Medium flint glass	1.62
Carbon disulfide (CS_2)	1.628
Dense flint glass	1.66
Lanthanum flint glass	1.8
Zircon (ZrO_2 * SiO_2)	1.923
Fabulite ($SrTiO_3$)	2.409
Diamond	2.417
Rutile (TiO2)	2.907
Gallium phosphide	3.5
* These are measures using yellow sodium light at $\lambda = 589$ nm, gas and liquids are specified at 20° C	