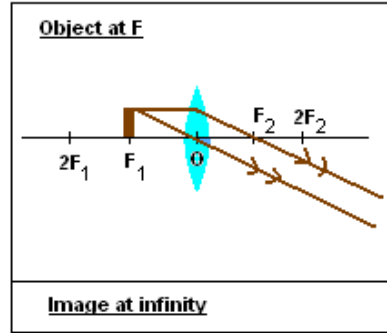
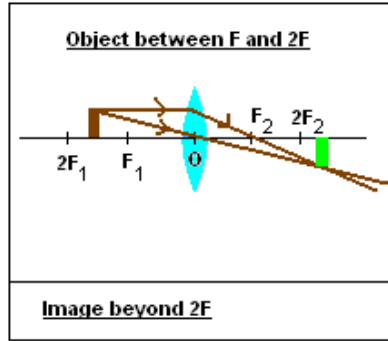


Gopher Invitation 2018 - Optics Answer Key

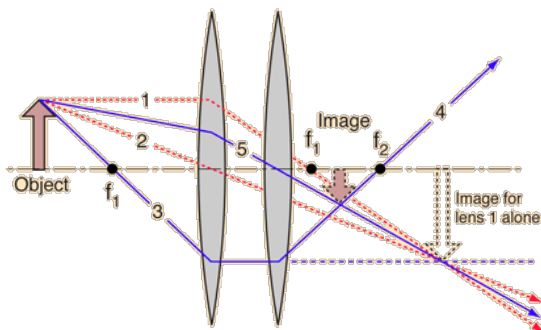
1. ___ Specular ___ (1)
2. ___ 40 degrees ___ (1)
3. ___ 8.39 m ___ * (3)
4. ___ Thin film interference ___ (1)
5. ___ Principle of Superposition ___ (1)
6. ___ **Some light waves are reflected off the surface of the water while others are reflected off the surface below. These two waves combine to form an interference pattern.** ___ (2)
7. ___ 541 nm ___ * (3)
8. ___ C ___ (1)
9. ___ Total internal reflection ___ (1)
10. ___ accept 34.15-41.84 degrees ___ (3)
11. ___ D ___ (1)
12. ___ B ___ (1)
13. ___ $d_i=26.96$ cm, $h_i=-107.85$ cm ___ (2)

Must include a diagram where the image is inverted.

- 14.



1. The principal rays **1** and **2** are used to determine the location of the of the image for lens 1 alone.



2. Ray **3** through f_1 will approach lens 2 parallel to the axis and will project through focal point f_2 , forming one principal ray (**4**) for the final image.

3. Back projecting from the single lens image through the center of lens 2 will define the second needed ray (**5**) since that ray will be undeflected.

15. *

16. i. a ii. a iii. d

17. 2500x (2)

18. ocular ; objective ; convex (3) 1 & 2 may be switched

19. magenta ; yellow ; cyan (3)

20. yellow (1)

21. 620-700 (1)

22. red ; violet (2)

23. a,b,c (1)

24. ___ 120 million ___ (1)

25. ___ 95 ___; ___ 5 ___ (2)

26. ___ iris ___ (1)

27. ___ sclera ___ (1)

28. ___ a,b ___ (1)

29. ___ 41.3 degrees ___ (2)

30. ___ 1.5 ___ (2)

31. (i): ___ continuous ___

32. (ii): ___ emission _

33. (iii): ___ absorption ___