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A little light Reading Key

1.
 - light is an electromagnetic wave
 - travels in a straight line (rectilinear propagation)
 - straight line path is a "ray". A collection of rays is a "beam"
 - transparent: light passes through (can see through clearly)
 - translucent: scatter light as it passes (cannot see clearly)
 - opaque: light cannot pass through
 - two types of shadows: umbra - total shadow
penumbra - partial shadow
 - luminous: objects that emit light.
 - non-luminous: objects that reflect light
 - incandescent: objects that emit light when heated.
 - rate that light is emitted is called Luminous Flux
 - amount of light given off is illuminance.
 - illuminance decreases with the square of the distance.

2.
 - a) Luminous body - an object that emits light
 - b) Illuminated body - an object that has light falling on it.
 - c) luminous flux - the rate that light is given off by a source
 - d) illuminance - the amount of light given off by a source.
 - e) polarized light - light that only oscillates in one plane (which is perpendicular to the direction of travel).
 - f) visible light spectrum - the range of wavelengths of light that we are able to see. We see these as different colours.
 - g) black - is the absence of visible light.

3) DO NOT DO! ☺

4. $v = f\lambda$ $v = 3.00 \times 10^8 \text{ m/s}$ $\lambda = 475 \text{ nm} = 4.75 \times 10^{-7} \text{ m}$ $f = ?$
 $f = v/\lambda = (3.00 \times 10^8 \text{ m/s}) \div (4.75 \times 10^{-7} \text{ m}) = \boxed{6.32 \times 10^{14} \text{ Hz}}$

5. $v = d/t$ $v = 3.00 \times 10^8 \text{ m/s}$ $t = 17.46 \text{ s}$ $d = ?$
 $d = vt = (3.00 \times 10^8 \text{ m/s})(17.46 \text{ s}) = \boxed{5.24 \times 10^9 \text{ m}}$

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6. $d_i = 45.4 \text{ cm}$ $d_o = ?$ $h_o = 18.0 \text{ m}$ $h_i = 26.4 \text{ cm}$

$$\frac{h_i}{h_o} = \frac{d_i}{d_o} \quad d_o = \frac{h_o d_i}{h_i} = \frac{(1800 \text{ cm})(45.4 \text{ cm})}{26.4 \text{ cm}} = 3,095 \text{ cm}$$

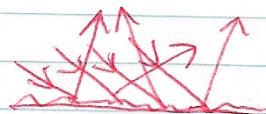
$$d_o = 31.0 \text{ m or } 3100 \text{ cm}$$

7. $h_o = 23.3 \text{ cm}$ $d_o = 111 \text{ cm}$ $d_i = 30.0 \text{ cm}$ $h_i = ?$

$$\frac{h_i}{h_o} = \frac{d_i}{d_o} \quad h_i = \frac{h_o d_i}{d_o} = \frac{(23.3 \text{ cm})(30.0 \text{ cm})}{111 \text{ cm}} = 6.30 \text{ cm}$$

$$M = \frac{h_i}{h_o} = \frac{6.30 \text{ cm}}{23.3 \text{ cm}} = 0.270$$

8.



diffuse reflection

- reflects off different curvatures of the surface and leaves at different directions



specular reflection

↳ reflects off a smooth surface in the same direction.

9. The Law of Reflection states that the angle of incidence is equal to the angle of Reflection.

10. "Line of sight" is the straight-line path that our eye "sees" light take after it enters our eye.

11. Location - appears behind mirror at same distance as the object.
Orientation - upright but laterally inverted (#5)
Size - same size
Type - virtual!

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A little light Reading

14. $d_i = ?$ $h_i = ?$ $h_o = 13.4 \text{ cm}$ $d_o = 42.0 \text{ cm}$ $f = 17.7 \text{ cm}$

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o} \quad \frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} = \frac{1}{17.7 \text{ cm}} - \frac{1}{42.0 \text{ cm}}$$

$$d_i = 30.6 \text{ cm}$$

$$\frac{h_i}{h_o} = -\frac{d_i}{d_o} \quad h_i = -\frac{h_o d_i}{d_o} = -\frac{(13.4 \text{ cm})(30.6 \text{ cm})}{42.0 \text{ cm}}$$

$$h_i = -9.76 \text{ cm}$$

15. $M = \frac{h_i}{h_o} = \frac{-9.76 \text{ cm}}{13.4 \text{ cm}} \quad M = -0.728$

16. $h_o = 3.33 \text{ cm}$ $d_o = 27.0 \text{ cm}$ $f = -12.5 \text{ cm}$ $d_i = ?$ $h_i = ?$

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o} \quad \frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} = \frac{1}{-12.5} - \frac{1}{27.0}$$

$$d_i = -8.54 \text{ cm}$$

$$\frac{h_i}{h_o} = -\frac{d_i}{d_o} \quad h_i = -\frac{h_o d_i}{d_o} = -\frac{(3.33)(-8.54)}{27.0}$$

$$h_i = 1.05 \text{ cm}$$

17. $M = \frac{h_i}{h_o} = \frac{1.05 \text{ cm}}{3.33 \text{ cm}} \quad M = 0.316$

19. $h_o = 9.35 \text{ mm}$ $d_o = 25 \text{ cm}$ $f = 12.25 \text{ cm}$ $d_i = ?$ $h_i = ?$

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o} \quad \frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} = \frac{1}{12.25} - \frac{1}{25}$$

$$d_i = 24 \text{ cm}$$

$$\frac{h_i}{h_o} = \frac{d_i}{d_o} \quad h_i = \frac{h_o d_i}{d_o} = \frac{(0.935 \text{ cm})(24 \text{ cm})}{25 \text{ cm}}$$

$$h_i = 0.90 \text{ cm or } 9.0 \text{ mm}$$

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20. $h_o = 5.23 \text{ cm}$ $d_o = 7.15 \text{ cm}$ $f = 20.2 \text{ cm}$ $d_i = ?$ $h_i = ?$ $M = ?$

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o} \quad \frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} = \frac{1}{20.2 \text{ cm}} - \frac{1}{7.15 \text{ cm}}$$

$$d_i = -11.1 \text{ cm}$$

$$\frac{h_i}{h_o} = \frac{d_i}{d_o} \quad h_i = \frac{h_o d_i}{d_o} = \frac{(5.23)(-11.1)}{20.2} \text{ cm}$$

$$h_i = 2.87 \text{ cm}$$

$$M = \frac{h_i}{h_o} = \frac{2.87 \text{ cm}}{5.23 \text{ cm}} \quad M = 0.548$$

21. $f = -11.5 \text{ cm}$ $d_o = 35.5 \text{ cm}$ $d_i = ?$

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o} \quad \frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} = \frac{1}{-11.5 \text{ cm}} - \frac{1}{35.5 \text{ cm}}$$

$$d_i = -8.69 \text{ cm}$$

22. $h_o = 2.88 \text{ cm}$ $d_o = 22.0 \text{ cm}$ $f = -11.5 \text{ cm}$ $d_i = ?$ $h_i = ?$ $M = ?$

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o} \quad \frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} = \frac{1}{-11.5} - \frac{1}{22.0}$$

$$d_i = -7.55 \text{ cm}$$

$$\frac{h_i}{h_o} = \frac{d_i}{d_o} \quad h_i = \frac{h_o d_i}{d_o} = \frac{(2.88)(-7.55)}{22.0}$$

$$M = \frac{h_i}{h_o} = \frac{0.989}{2.88} \quad M = 0.343$$

23. (high n to low n)

Sapphire ($n = 1.77$), Sodium chloride ($n = 1.54$), fused quartz ($n = 1.46$), ice ($n = 1.31$)

24. (low n to high n)

Air ($n = 1.0003$), water ($n = 1.33$), acetone ($n = 1.36$), crown glass ($n = 1.52$), Sapphire ($n = 1.77$), diamond ($n = 2.42$).

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A Little Light Reading Key

25. $n = \frac{3.00 \times 10^8 \text{ m/s}}{v}$ $v = \frac{3.00 \times 10^8 \text{ m/s}}{n}$ $n = 2.42$
 $v = \frac{3.00 \times 10^8 \text{ m/s}}{2.42}$ $v = 1.24 \times 10^8 \text{ m/s}$

26. $n = 1.77$ $v = \frac{3.00 \times 10^8 \text{ m/s}}{1.77}$ $v = 1.69 \times 10^8 \text{ m/s}$

27. $n = \frac{3.00 \times 10^8 \text{ m/s}}{v}$ $v = 2.35 \times 10^8 \text{ m/s}$
 $n = \frac{3.00 \times 10^8 \text{ m/s}}{2.35 \times 10^8 \text{ m/s}}$ $n = 1.28$

28. $n_i = 1.28$ $n_r = 1.0003$ $\theta_i = 17^\circ$ $\theta_r = ?$
 $n_i \sin \theta_i = n_r \sin \theta_r$ $(1.28) \sin(17) = 1.0003 \sin \theta_r$
 $\theta_r = 22^\circ$

29. $n_i = 1.77$ $n_r = 1.0003$ $\theta_r = 90.0^\circ$ $\theta_i = ?$
 $n_i \sin \theta_i = n_r \sin \theta_r$ $(1.77) \sin \theta_i = (1.0003) \sin(90.0)$
 $\theta_i = 34.4^\circ$

30. $n_i = 1.31$ $n_r = 1.33$ \rightarrow no critical angle. water is more refractive.
 but if water \rightarrow ice.

$n_i = 1.33$ $n_r = 1.31$ $\theta_r = 90.0$ $\theta_i = ?$
 $n_i \sin \theta_i = n_r \sin \theta_r$ $(1.33) \sin \theta_i = 1.31 \sin(90.0)$
 $\theta_i = 80.1^\circ$

31. Total Internal Reflection is when the angle of refraction is 90.0° and all the light becomes reflected. It will only occur if light travels from a medium with a higher index of refraction to a medium with a lower index of refraction, and the angle of incidence is greater than the critical angle.

A little Light Reading Key

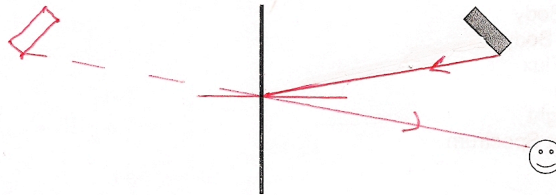
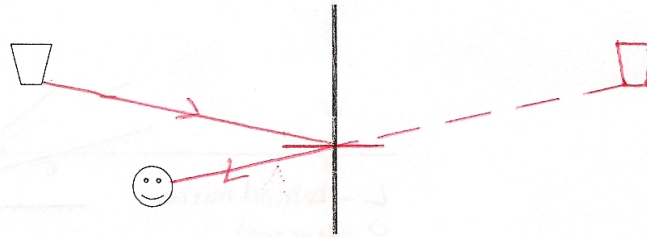
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32. $n_i = 1.36$, $\theta_i = 47^\circ$, $n_r = 1.33$, $\theta_r = ?$
 $n_i \sin \theta_i = n_r \sin \theta_r$ $(1.36) \sin(47) = (1.33) \sin \theta_r$
 $\theta_r = 48$

33. A mirage occurs when light from an object travelling through the atmosphere gets refracted by air at different temperatures (density).

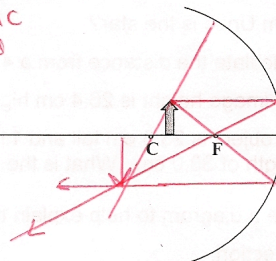
34. Dispersion is the spreading out of light rays when white light passes through a refractive medium. Different wavelengths (colours) get refracted at different angles and form a rainbow.

12. Draw a ray diagram to locate the image and demonstrate how the observers see the images:

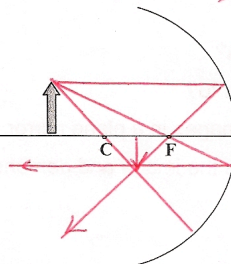


13. Draw a ray diagram to locate the image. Remember to draw all THREE rays!
Also list 4 image characteristics for each:

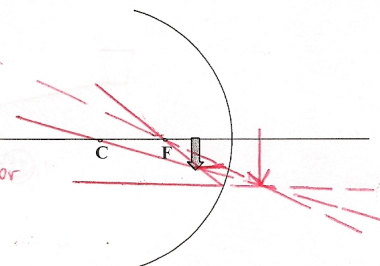
L - behind C
O - inverted
S - larger
T - real



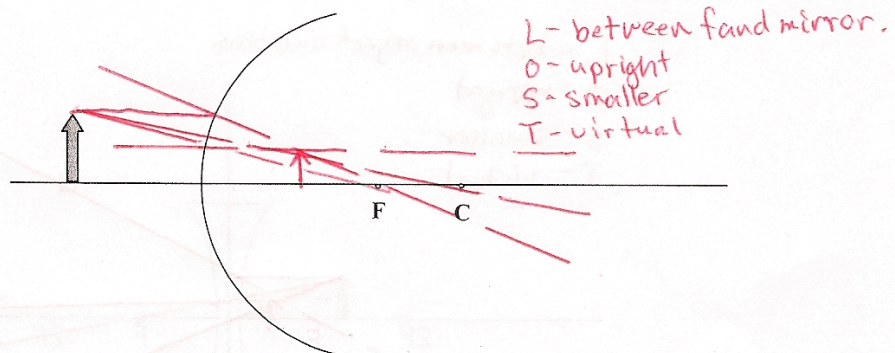
L - between C and F
O - inverted
S - smaller
T - real



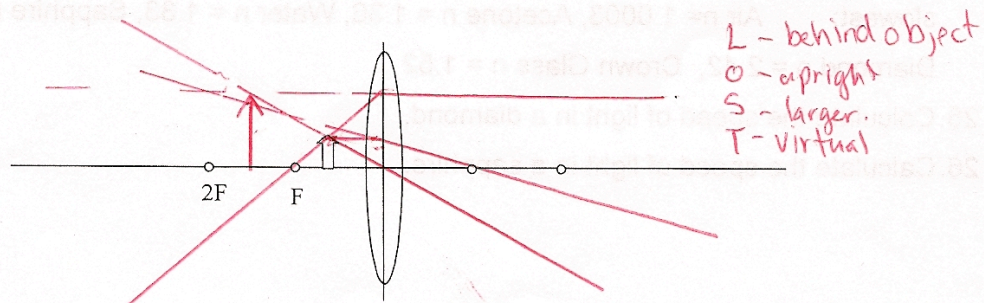
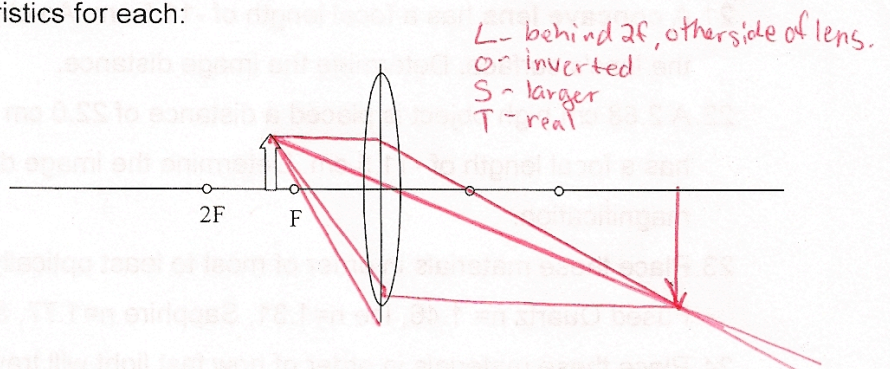
L - behind mirror
O - upright
S - larger
T - virtual.



A Little Light Reading



14. Determine the image distance and image height for a 13.4 cm tall object placed 42.0 cm from a concave mirror having a focal length of 17.7 cm.
 15. What is the magnification of the image in question 14?
 16. A 3.33 cm high object is placed a distance of 27.0 cm from a **convex** mirror which has a focal length of -12.5 cm. Determine the image distance and the image height.
 17. What is the magnification of the image in question 16?
 18. Draw a ray diagram to locate the image. Remember to draw all THREE rays!
- Also list 4 image characteristics for each:



A Little Light Reading

L - between object and lens
O - upright
S - smaller
T - virtual

