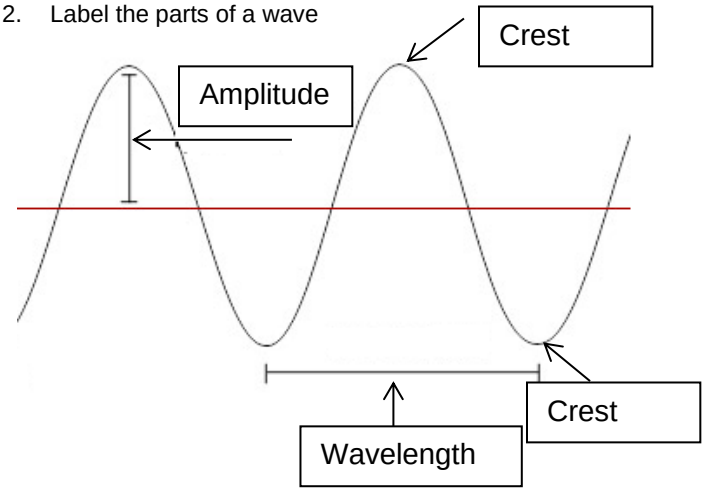
SNC 2DI

Optics Review

Date: _____

1. Properties of light
   1. An electromagnetic wave
   2. Moves in straight lines
   3. Moves at a speed of 3.00×10^8 m/s

2. Label the parts of a wave



3. What is the Electromagnetic spectrum –

   The range of electromagnetic radiation arranged based on their wavelengths or frequencies

   The electromagnetic spectrum is made up the following

   Radio, micro, infra red, visible light, UV, X ray and Gama

   Shortest wave length

   Gama waves
   Longest wavelength

   Radio
   Write the name of the visible wavelengths from long to short
red; orange; yellow; green; blue; indigo; violet

4. What is the difference between incandescent and luminescent light? Give some examples

   Incandescent – light produced when objects are heated

   Luminescent – light produced by cold objects

5. What are the different types of light you have studied with few examples

Incandescence – candle; old filament bulb

Electric Discharge – neon lights; sodium vapour lamps

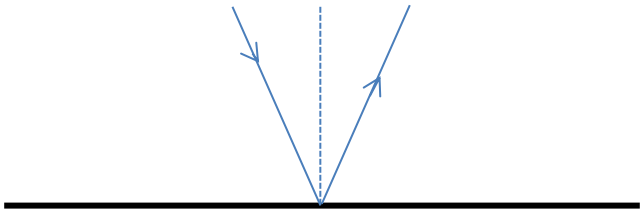
Phosphorescence – glow in the dark objects

Fluorescent – curly bulbs; fluorescent bulbs

Bioluminescence – fire flies; some bacteria

Chemiluminesnce – glow sticks

6. Draw a diagram with the following:
   - A plane mirror
   - A normal
   - An incident ray with an angle of incidence of 25°
   - A reflected ray



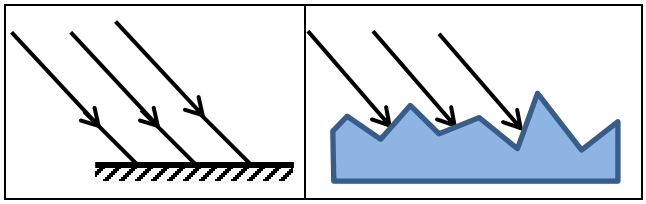
State the Law of Reflection and explain how your ray diagram follows the law.

1. The incident ray, normal and reflected ray are on one plane.
2. The angle of incidence is equal to the angle of reflection

7. Match each descriptor on the left with the best term on the right. Each descriptor may be used only once.

Term	Description
1. **D** angle of incidence	A. a smooth, flat reflecting surface
2. **E** angle of reflection	B. the point where reflected rays meet when incident rays are parallel to and near the principal axis
3. **C** center of curvature	C. the point that is the same distance from all points on the surface of a curved mirror
4. **M** concave mirror	D. the angle between the incident ray and the normal
5. **N** convex mirror	E. the angle between the reflected ray and the normal
6. **B** focal point	F. an image that is formed when light rays meet and do not have to be extended backward
7. **G** focal length	G. the distance from the mirror to the focal point
8. **L** incident ray	H. an image that is located behind a mirror
9. **I** normal	I. a line that is perpendicular to a surface
10. **A** plane mirror	J. a line drawn through the center of a spherical mirror, and through the vertex.
11. **J** principal axis	K. a light ray that "bounces off" a surface
12. **K** reflected ray	L. a light ray that travels toward a mirror
13. **F** real image	M. a mirror that "caves in"
14. **H** virtual image	N. a mirror that bulges outwards.

8. Explain the difference between specular and diffuse reflection. Use the diagrams provided to illustrate your explanation.



Give an example of a surface that would show diffuse reflection and a surface that would show specular reflection.
Specular – even surface

Diffuse – uneven surface
Which type of reflection obeys the laws of reflection?

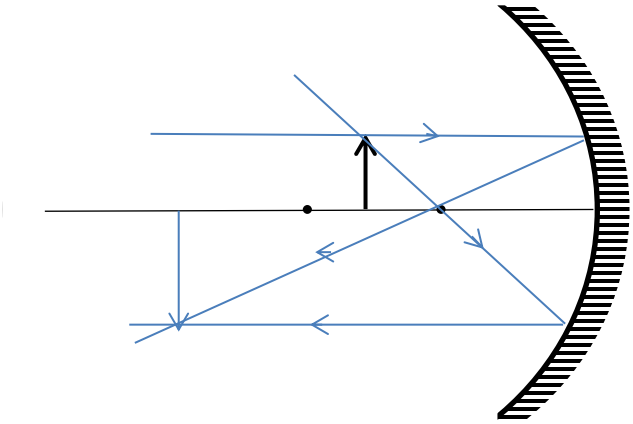
Both follow the laws of reflection

9. Draw a fish 1.5 cm high and 3 cm in front of the plane mirror. Draw a picture of its image.
Make sure the image distance is correct for three points on your drawing.

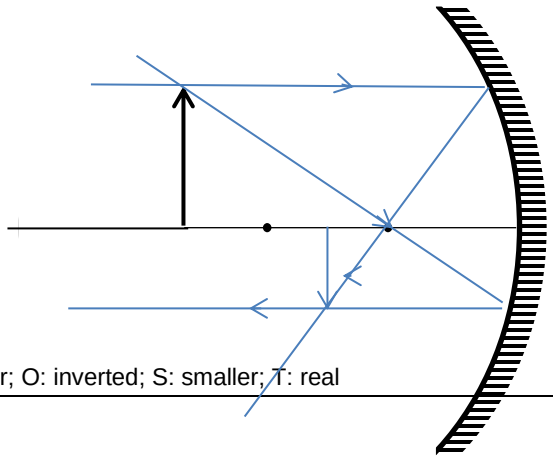
Image should be the same size at the same distance virtual but laterally reversed

10. Draw a ray diagram to find the image of the object, then state the characteristics of the image

L: Farther O: inverted S: larger T: real

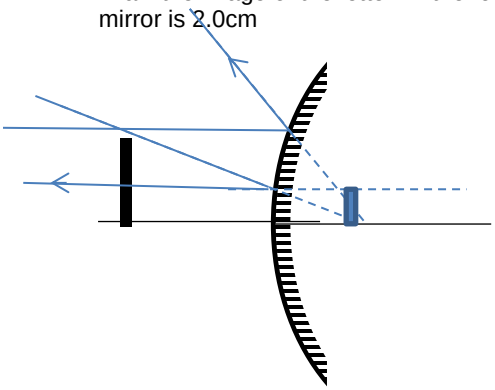


11. Draw a ray diagram to find the image of the object, then state the characteristics of the image.



L: closer; O: inverted; S: smaller; T: real

12. Draw the image of the letter I if the focal length of the mirror is 2.0cm



L: Closer; O: upright; S: smaller; T: virtual

13. How would the image change as the I moves further from the mirror?

L: Closer; O: upright; S: smaller; T: virtual

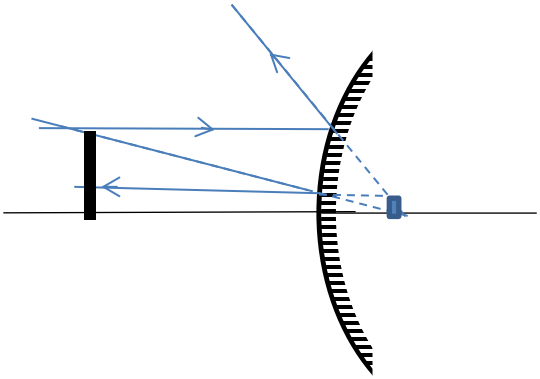


Image gets farther and smaller

14. Complete the following table to describe the characteristics of the image in each situation.

Type of Mirror	Location	Orientation	Size	Type
Plane Mirror	Same	Upright but L-R reversed	Same	virtual
Concave Mirror	---	---	----	----
object between F and V	Closer	Upright	larger	virtual
object between C and F	Farther	Inverted	Larger	Real
object beyond C	Closer	Inverted	Smaller	Real
Convex Mirror	Closer	Upright	Smaller	Virtual

15. When listing the characteristics of a concave mirror, we had to consider three different cases. Why didn't we need to do this for the convex mirror?

As 'f' and 'C' are not on the side of the reflective surface with convex mirrors, there is no reference to the place where the object is being placed.

16. Identify the type of mirror that is best suited for each use

	Type of Mirror
Dentist Mirror	Concave
Security Mirror	Convex
Dressing Room	Plane
Passenger side mirror on a car	Convex
Hallway safety mirror	Convex
Flashlight	Concave

17. A concave mirror has a focal length of 6.0cm. An object with a height of 1.5cm is placed 10.0cm in front of the mirror. Calculate the image distance and height.

G: f=6cm; h_o=1.5cm; d_o=10cm

U: d_i =? and h_i=?

18. The passenger-side rearview mirror on a car has a focal length of -2.5m. A person with a height of 1.5 m is standing 5.2m away from the mirror. Calculate the height and distance of their image using a ray diagram.

G: f=-2.5m; h_o=1.5m; d_o=5.2m

U: d_i =? and h_i=?

E: $\frac{1}{f}=\frac{1}{di}+\frac{1}{do}$ and $\frac{hi}{ho}=-\frac{di}{do}$

S: $\frac{1}{di}=\frac{1}{f}-\frac{1}{do}$ $\quad hi=-\frac{di}{do}xho$

$\frac{1}{di}=\frac{1}{6}-\frac{1}{10}$ $\quad hi=-\frac{15}{10}x1.5$

$\frac{1}{di}=\frac{1}{6}-\frac{1}{10}$ $\quad hi=-2.25$

$$\frac{1}{di}=\frac{10}{60}-\frac{6}{60}$$

$$\frac{1}{di}=\frac{4}{60}$$

S: Therefore d_i = 15 cm(60/4) and h_i = -2.25cm

L: farther; O: inverted; S: larger; T: real

E: $\frac{1}{f}=\frac{1}{di}+\frac{1}{do}$ and $\frac{hi}{ho}=-\frac{di}{do}$

S: $\frac{1}{di}=\frac{1}{f}-\frac{1}{do}$ $\quad hi=-\frac{di}{do}xho$

$\frac{1}{di}=\frac{1}{-2.5}-\frac{1}{5.2}$ $\quad hi=-\frac{1.69-}{105.2}x1.5$

$hi=0.49m$

$$\frac{1}{di}=-\frac{5.2}{13}-\frac{2.5}{13}$$

$$\frac{1}{di}=\frac{-7.7}{13}$$

S: Therefore d_i = -1.69 m(-13/7.7) and h_i = 0.49m

L: closer; O: upright; S: smaller; T: virtual

19. Complete the table to compare and contrast concave and convex mirrors

	Concave	Convex
Description (what does it look like)	The reflective surface is caved in	The reflective surface is bulging out.
Type of image produced	Real expect when the object is between the focal point and the vertex	Virtual
Location of Focal Point	In front of the reflective surface	Behind the mirror on the non-reflective surface

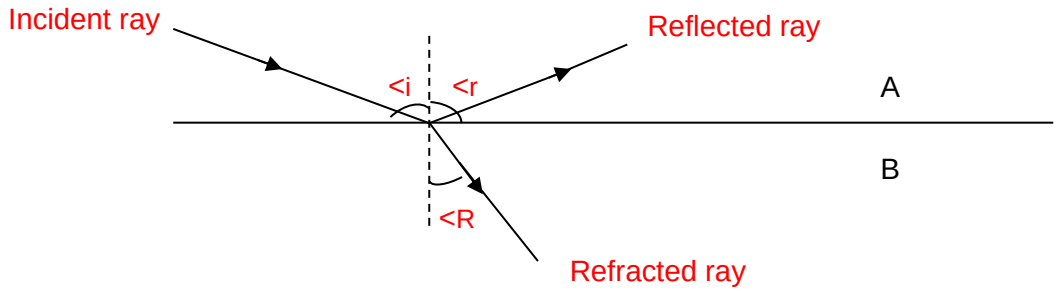
20. Complete the following table to compare and contrast real and virtual images

	Real	Virtual
How they are formed	When reflective rays actually meet	When reflected rays are extended behind the mirror and meet
Where they are located	In front of the mirror	Behind the mirror
How do we view them	On a screen	On the mirror
What type of mirror produces this type of image?	Concave	Convex, plane mirrors and concave when the object is between the focal point and the vertex

21. Match each term on the left with the best descriptor on the right. Each descriptor may be used only once.

Term	Descriptor
1. E angle of refraction 2. A medium 3. F total internal reflection 4. D refracted ray 5. B refraction 6. C critical angle	A. The substance through which light travels. B. The change in direction light takes when it crosses a boundary between two media. C. The angle of incidence for which the angle of refraction is 90°. D. The ray that has crossed the boundary between two media. E. The angle between the refracted ray and the normal at which the ray crossed the boundary. F. Occurs when light can't escape a medium because the angle of incidence is larger than the critical angle. All light is reflected back into the original medium.

22. a) Label the incident ray, refracted ray, reflected ray, angle of incidence (i), angle of reflection (r) and angle of refraction (R) in this diagram.

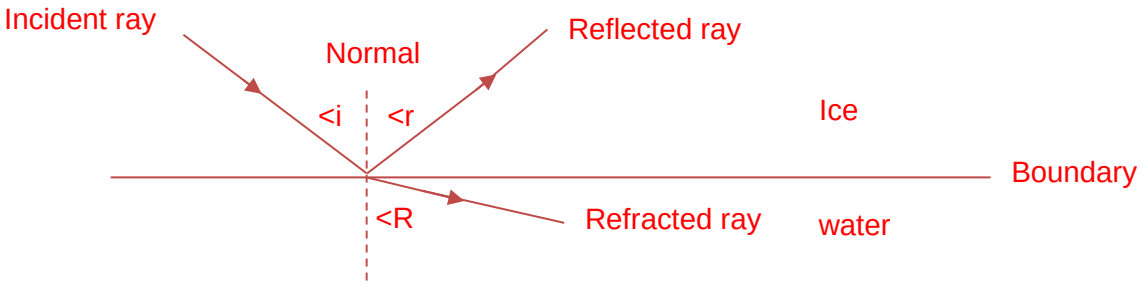


b) Based on this diagram, does light travel faster in substance A (top substance) or in substance B? Explain how do you know? Substance A – as the refracted ray moved towards the normal in medium B

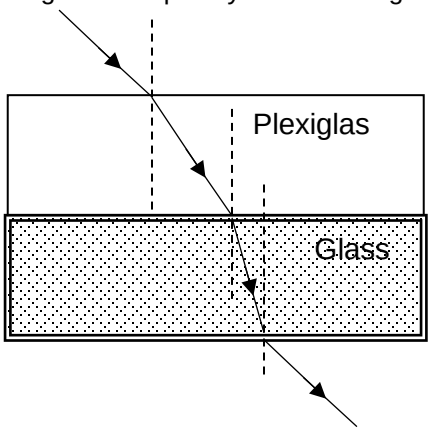
c) One of the substances is air and one is glass. Which one is substance A? Air

d) Measure the angle of incidence, the angle of reflection, and the angle of refraction.
Angle of incidence = approx. 70º Angle of reflection = approx. 70º
Angle of refraction = approx. 35º

23. Light travels more quickly in ice than in water. Draw a ray diagram of a light ray traveling through ice into water. Label the two different media, the boundary between them, an incident ray, a refracted ray, the normal, the angle of incidence (i), and the angle of refraction (R).



24. In this diagram, a ray of light travels through air, Plexiglas, glass, and air again. Does light travel more quickly in Plexiglas or glass? Explain your reasoning.



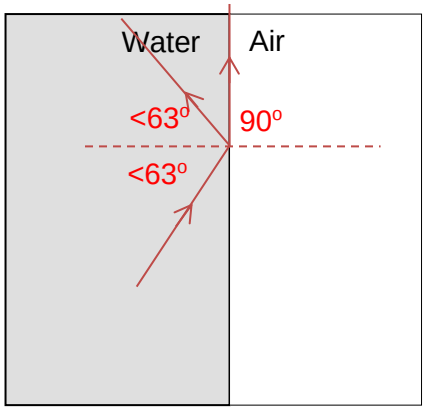
Faster in plexiglas – when light travels through glass the refracted ray bent further towards the normal meaning it is getting more slow in glass.

25. Draw an incident ray traveling through water at an angle of incidence of 63°.

a) Assume that the critical angle for water is 63°.

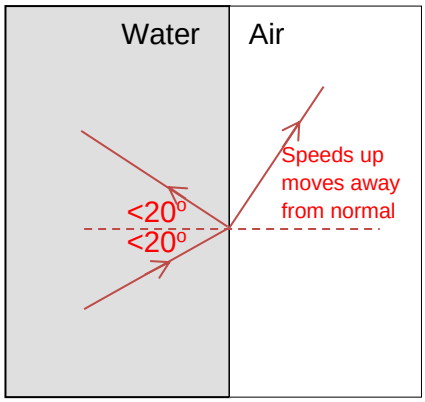
i. What will the angle of refraction be? 90°

ii. Draw the refracted ray.

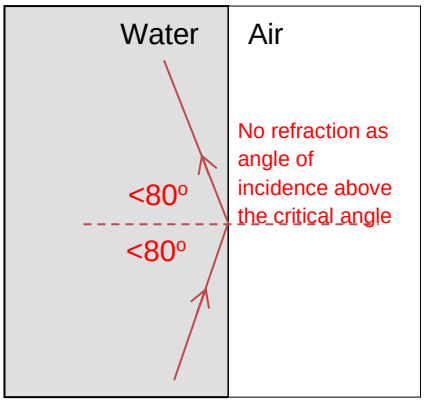


b) Based on the information above, what would happen if the angle of incidence was 20°? 80°? Draw the incident ray, refracted ray (if any) and reflected ray (if any).

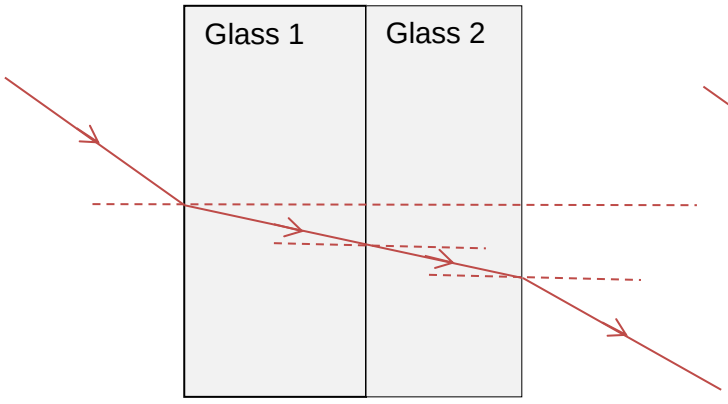
Angle of incidence = 20°



Angle of incidence = 80°

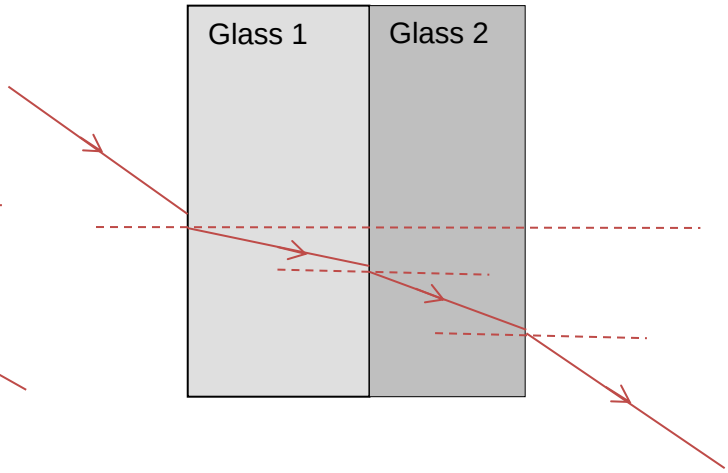


26. You are given two blocks of glass that look just alike. A classmate tells you that they are really two different types of glass. Describe an experiment that you could carry out that would determine whether the blocks of glass were identical or different types of glass.



SAME TYPE OF GLASS

Shine light through both blocks of glass. Light should bend only once when the blocks are made of the same type of glass



DIFFERENT TYPE OF GLASS

Shine light through both blocks of glass. Light should bend twice when the blocks are made of two type of glass

27. Textbook Questions

Answers to Textbook review questions

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1. Incandescent, fluorescent
2. Bioluminescence
3. Reflection
4. incidence, reflection
5. Virtual
6. concave
7. focal, principal axis
8. convex

13. Light rays are reflecting off the mirror in a way that makes them to appear to be coming from behind the mirror. This is called a virtual image.

14. Draw rays parallel to the principal axis then reflecting off the mirror. Extend the reflecting rays back behind the mirror. The point where the lines meet is the focal point.

24. a. d_o= 8cm h_o= 2cm f= 5cm
Draw ray diagram: L- farther; O – inverted; S – larger; T– real

c. The real image is inverted. *d*i = 13.33 cm (in front of mirror); *h*i = −3.33 cm (inverted)
By calculation:
L- farther; O – inverted; S – larger; T– real

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1. index of refraction
3. critical angle

6. It slows down, refracting closer to the normal.

7. Yellow light is used as the standard for comparison.

12. The angle of refraction will increase at the same rate as the angle of incidence until the critical angle is passed (the angle of refraction is 90°), at which point all light will be reflected.

17. a. *n* = 1.52 b. 1.24 × 108 m/s c. 2.04 × 108 m/s d. 1.92, zircon

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8. converging lens

10. Light can pass through a lens from either side, so there is a focal point on each side of the lens and at the same distance from the centre of the lens. Light can only pass through a mirror from one side.

13. Converging lens; The object must be between the focal point and the lens.

18. A. See Figure 12.12C on student textbook page 496. The image is closer to the lens than the object is, inverted, smaller than the object, and real.

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1. a. 2. d.

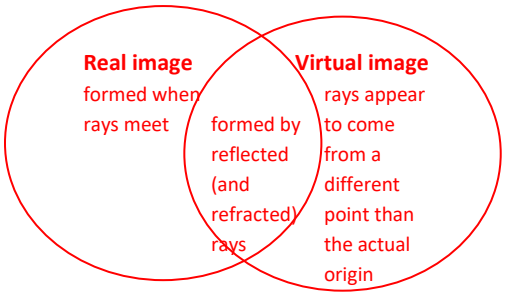
6. Example: All production of light can be categorized according to the energy transformations at the atomic level. Light energy is released when atoms are
- fused (e.g., in the Sun) - heated (incandescence) - electrically excited (electric discharge)
- struck by electrons (fluorescence) - slowly releasing absorbed energy (phosphorescence)

- reacting chemically, without a temperature increase (chemiluminescence)

7. Light is produced in an incandescent source when atoms are heated. Diagram should show atoms vibrating rapidly when heated, releasing light energy.

11. Myopia is near-sightedness caused by an eyeball that is longer than the focal length of the cornea, while hyperopia is far-sightedness caused by a too-short eyeball.

12.



16. The focal length is 4 cm. See the ray diagram for step 5 in Table 10.2 on student textbook page 422.

17. For the real image, see the ray diagram for step 4 in Table 10.3 on student textbook page 423. For the virtual image, see the ray diagram for step 5 in Table 10.1 on student textbook page 416.

18. Example: The index of refraction is calculated by dividing the speed of light by the density of the medium. Because hydrogen is less dense than glass, the light can travel faster through it.

21. Example: Compare refraction in the sample to refraction in a known sample of glass. If light refracts at the same angle, then the sample is glass. If the light refracts at a smaller angle in the unknown sample, then it is likely quartz, since glass has a higher refractive index than quartz.

23. Example:

	Cause	Treatment
Myopia	eye longer than focal length of cornea	• concave lens lengthens focal length • laser reshaping of cornea
Hyperopia	eye shorter than focal length of cornea	• convex lens shortens focal length • laser reshaping of cornea
Presbyopia	(aging) eye muscles cannot adjust lens shape	• bifocal lenses with both convex and concave sections
Astigmatism	oval shaped (not round) cornea	• hard contact lenses matched to eye distortion

28. Examples:
a. plane mirror reflects image of back of teeth; convex mirror enlarges field for precision work; concave mirror redirects and intensifies light reaching area
b. convex mirror provides wide angle of view for security surveillance; plane mirror provides view on outside of counter beneath cashier
c. convex mirror provides wide angle view of around corner of switchback; plane mirror helps see around corners
Astigmatism