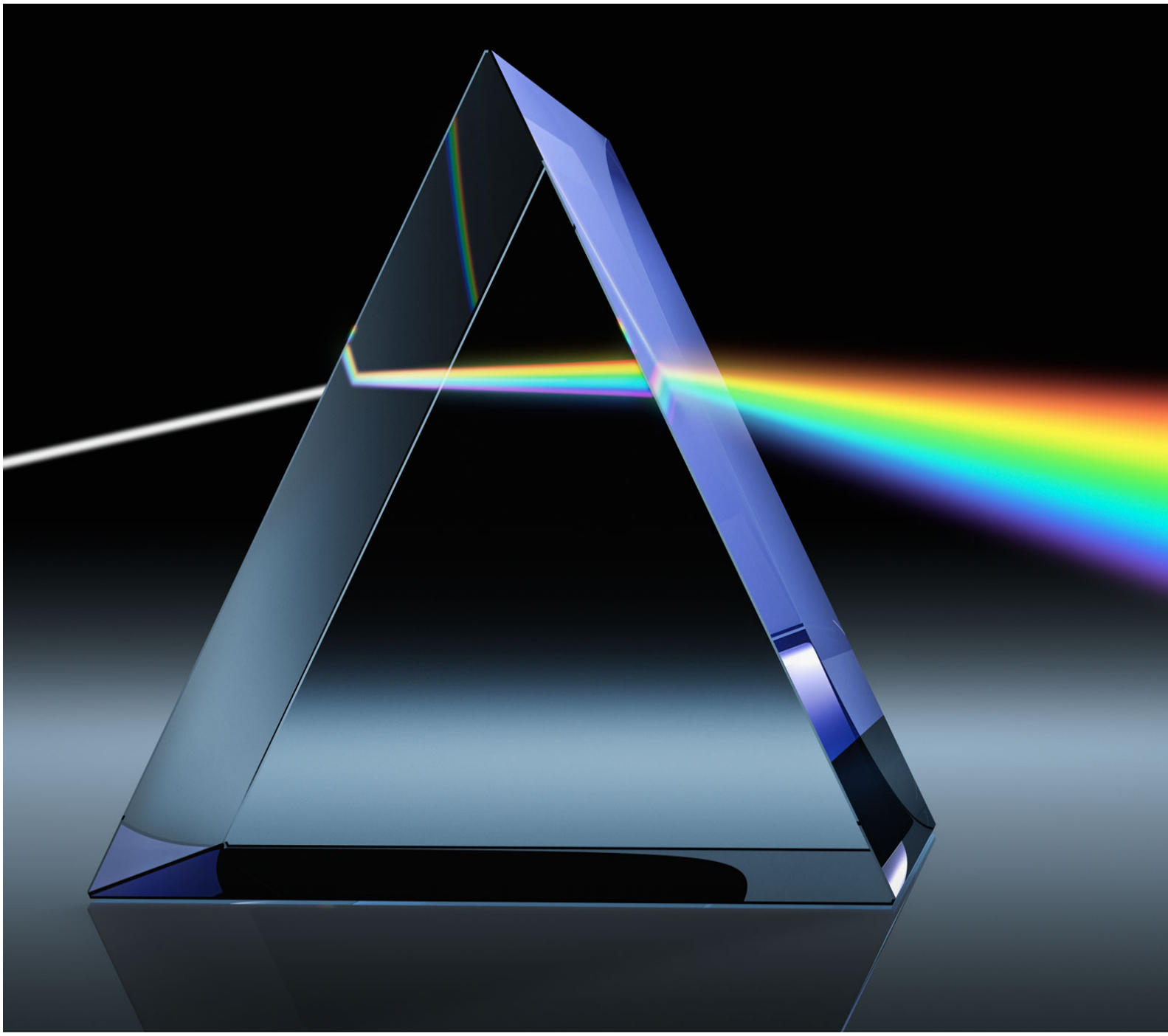


CHAPTER (6)

LIGHT

Light:

- Engineering optics: is the studying how the light interacts with the matter.
- The speed of light is m/s and it is very high speed, so no object can precede its shadow.
- Luminous flux: is the measure of the total amount of energy radiated per second from a light source in all directions. Its SI unit is (lumens) (lm).
- Illumination: is a measure of the light falling upon a surface. Its unit is (Lux) (lx)
- The basic SI unit of luminous intensity is candela. (cd).

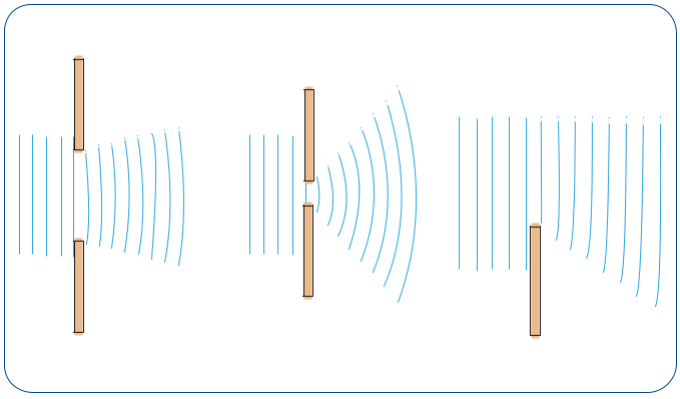
$$E = \frac{P}{4\pi r^2}$$

E is the illumination [xl], P is luminous flux or light flux [lm], r is the distance between the source and the surface [m].

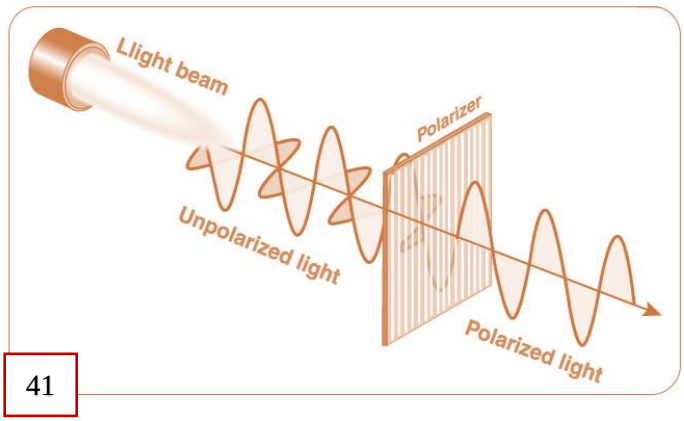
- Lux = lm/m²

Light as wave:

- Diffraction: the spreading of waves around obstacles.

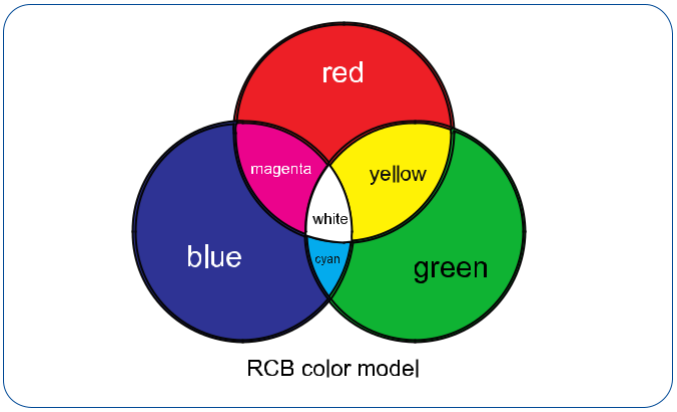


- Polarization: the action of restricting the vibrations of a transverse wave, especially light, wholly or partially to one direction.



- Primary colors are Red, Blue, and Green.
- Secondary colors are Yellow, Magenta, and Cyan.
- Yellow + blue = green, so Yellow is complement color for blue.
- The cyan is complement for red color.
- The magenta is complement color for the green.

Combination of colors:



RCB color model

1. The science that studies light as light ray regardless of whether the light is a particle or wave is

A Quantum mechanics
B Optics
C Relativistic physics
D Laser physics

2. No object, at any speed, can precede its shadow, because light.

A has very high speed
B travels in straight lines
C has great energy
D lights the objects

3. Lumens Unit" (lm) is used for.

A Polarization
B Light intensity
C Illumination
D Luminous flux

4. Lux Unit" (lx) is used for.

A Polarization
B Light intensity
C Illumination
D Luminous flux

5. If P is the luminous flux for a lighting source, r is the vertical dimension between the source and the surface, so the illumination E proportional.

A Directly with p and r²
B Inversely with p and r²
C Directly with p and inversely withr²
D Inversely with p and directly with r²

6. bending of light around the barriers represents:

A Interference B Diffraction
C Polarization D Flux

7. making the light oscillates in one dimension is called:

A Diffraction B Interference
C Scattering D Polarization

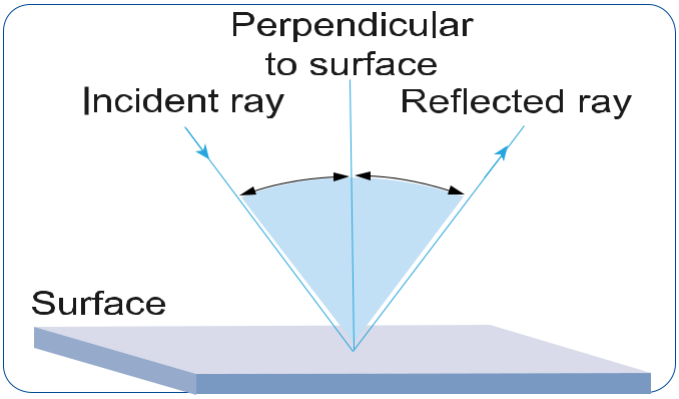
8. The color that complement for yellow is.

A Blue B Green
C Red D White

Reflection on plane mirrors

Reflection's law:

Angle of incidence ($\theta_i = \theta_2$)= Angle of reflection (θ_r)



Note: The incident ray perpendicularly (90°) on the surface reflects on its self.

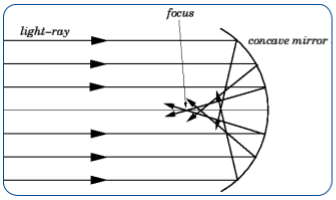
Characteristics of image that formed by plane mirrors:

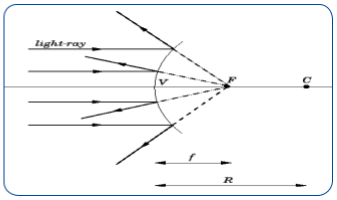
- Upright or erect.
- Virtual.
- Same size as the object.
- Laterally inverted.
- The distance between the image and mirror = the distance between object and mirror.

Spherical mirrors:

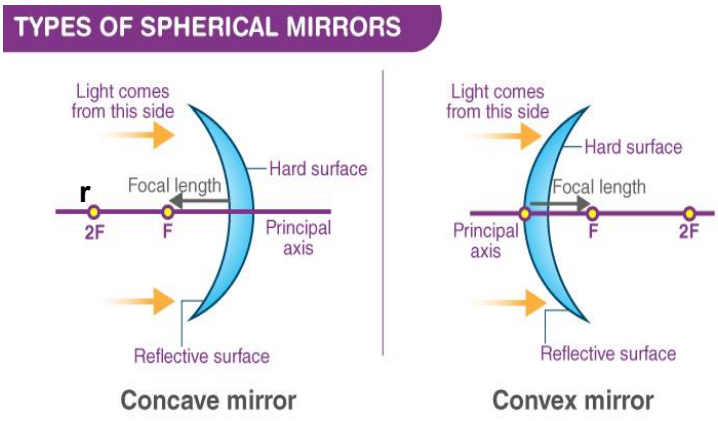
Types of spherical mirrors: (curved mirrors)

1. Concave mirrors: collect the light rays and used in telescope. (Converged mirror)
2. Convex mirrors: Scattering light rays and used at sides of the cars. (Diverge mirror).





- Principal axes: the line passing through the optical center and centres of curvature of the faces of a curved mirror.
- Focus: Rays of light parallel to the principal axis of a concave mirror will appear to converge on a point in front of the mirror somewhere between the mirror's pole and its center of curvature. That makes this a con-verging mirror and the point where the rays converge is called the focal point or focus.
- Focal length: The distance between the center of mirror and the focal point.



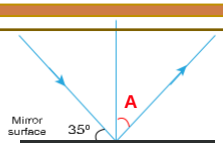
$$f = \frac{r}{2}$$

f is the focal length [m], r is the radius of curvature [m].

9. In the chart, if an incident ray falls on a plane mirror, which statement is correct.

A $\theta_1 = \theta_2$ B $\theta_1 = \theta_3$
C $\theta_1 = \theta_4$ D $\theta_2 = \theta_4$

10. Angle A is equal to.



A 25° B 40° C 65° D 55°

Solution:

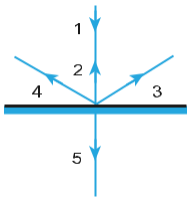
35 + x = 90

$X = 90 - 35 = 55^o$

Incident angle = Reflection angle

$A = x = 55^o$

11. The reflection of incident ray 1 is ray number



A 2 B 3 C 4 D 5

12. An upright, virtual, same size as the object and laterally inverted image appears on a ..... mirror

A Concave B Convex

C Cylindrical D Plane

13. Images in a plane mirror looks .....

A Real and same size as the object

B Real and smaller than the object

C Virtual and same size as the object

D Virtual and smaller than the object

14. The type of mirror that used on the sides of the car is:

A Concave B Plane

C Convex D Plan and concave

15. All rays of light parallel to the principal axis of a concave mirror will reflect .....

A Between curvature center and focal point

B Between the center point and focal point

C At Curvature center

D At Focal center

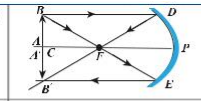
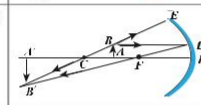
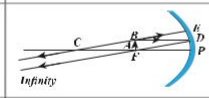
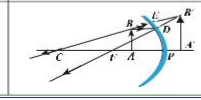
16. The relation between the curvature center of a concave mirror C and its focal length f is....

A $c = f$ B $c = 2f$

C $c = \frac{1}{2}f$ D $c = \frac{1}{4}f$

Characteristics of image that formed by spherical mirrors:

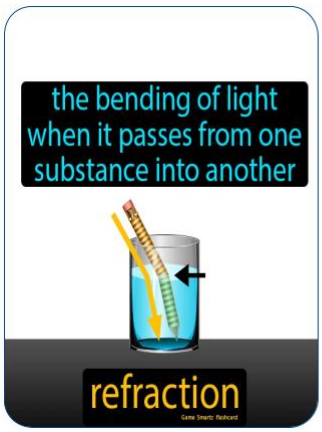
- Convex mirror: Virtual, upright, smaller. (Always)
- Concave mirror: Depends on the position of an object as shown below:

(c)		At C	At C	Real, same size and inverted
(d)		Between C and F	Between C and infinity	Real, enlarged and inverted
(e)		At F	At infinity	Real, infinitely large and inverted
(f)		Between the pole P and F	Behind the mirror	Virtual, enlarged and erect

- If the object at distance greater than C then the image will be: real, inverted, and smaller.

Refraction of light:

- Refraction: is the bending of light (it also happens with sound, water and other waves) as it passes from one transparent substance into another.



- Snell's law:

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

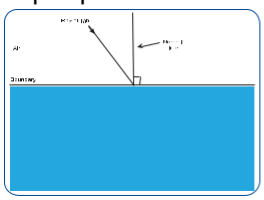
Where n1 is the refractive index for medium 1, is the angle of incidence, n2 is the refractive index for medium 2, and is the angle of refraction.

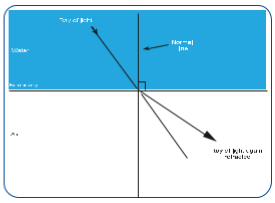
- The refraction index for the medium is given as:

$$n = \frac{c}{v}$$

Where n is the refractive index, c is the speed of light in vacuum [m/s], and v is the speed of light in the medium [m/s].

- When the light passes from medium that has less refractive index to other medium that has greater refractive index then the light bending closely to the perpendicular line on the surface.
- When the light passes from medium that has greater refractive index to other medium that has less refractive index then the light bending far away from the per-pendicular line on the suface.





The complete internal reflection and the critical angle

17. An object is 15cm far from a concave mirror (its focal length is 30cm), describe the reflection of it?

A Real and smaller than the object

B Virtual and smaller than the object

C Real and bigger than the object

D Virtual and bigger than the object

18. How far an object should be from a concave mirror (its focal length is 20cm), to reflect a real and smaller image?

A 20 cm B 30 cm

C 40 cm D 50 cm

19. A concave mirror (its focal length is 4cm), an object is 10cm far, describe the image that reflect?

A Real, smaller and inverted

B Real, enlarged and inverted

C Virtual, smaller and upright

D Virtual, enlarged and upright

20. Mathematical formula of Snell's law is

A $\frac{n_1}{n_2} = \frac{\sin\theta_2}{\sin\theta_1}$ B $\frac{n_1}{n_2} = \frac{\sin\theta_1}{\sin\theta_2}$

C $\frac{n_1}{n_2} = \frac{\cos\theta_2}{\cos\theta_1}$ D $\frac{n_1}{n_2} = \frac{\cos\theta_1}{\cos\theta_2}$

21. If the speed of light is, then the refractive index in medium is..

A 1 B 2

C 0.6 D 1.5

Solution:

N = $\frac{c}{v} = \frac{3x10^8}{3x10^8}$ = 1 , the answer is A.

22. If the speed of light is ,how much is its speed in the glass (which its reflective index is 1.5)?

A $2\times10^3\ m/s$ B $4.5\times10^3\ m/s$

C $2\times10^8\ m/s$ D $4.5\times10^8\ m/s$

23. When the light passes from medium that has less refractive index to other medium that has greater refractive index then the light.

A bending closely to the perpendicular line on the surface

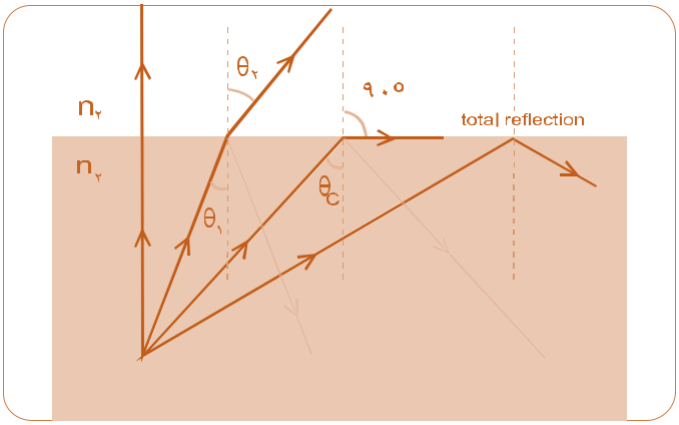
B bending far away from the perpendicular line on the surface

C bending on to the perpendicular line on the surface

D Bounces on to the perpendicular line on the surface

The complete internal reflection:

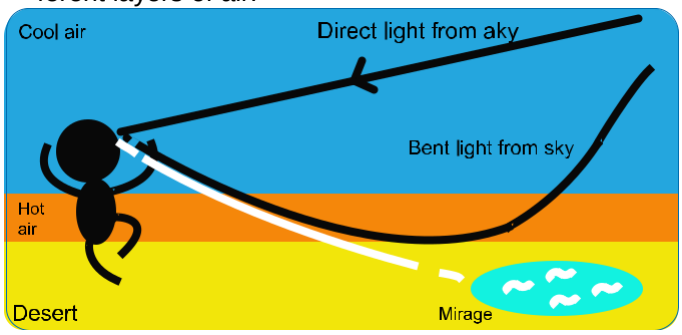
- a complete reflection of a ray of light within a medium such as water or glass from the surrounding surfaces back into the medium. The phenomenon occurs if the angle of incidence is greater than a certain limiting angle, called the critical angle.
- Critical angle (θ_c): the greatest angle at which a ray of light, travelling in one transparent medium, can strike the boundary between that medium and a second of lower refractive index without being totally reflected within the first medium. (Simply the angle of incidence of light that makes the refracted light with angle 90º).



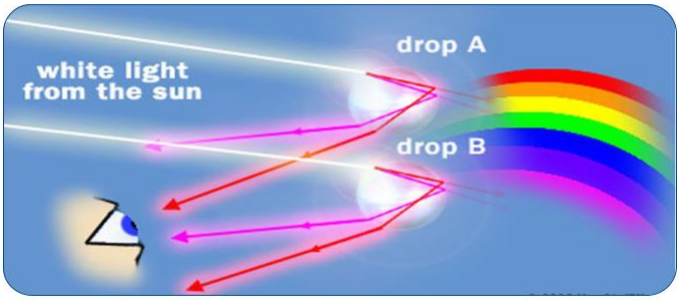
Applications: optical fibers

Mirage and rainbow:

- Mirage: Mirages happen when the ground is very hot and the air is cool. When the light moves through the cold air and into the layer of hot air it is refracted (bent). A layer of very warm air near the ground refracts the light from the sky nearly into a U-shaped bend.
- The change in temperature of air changes the refractive index of the air near to ground and makes two different layers of air.



- Rainbow: A rainbow is caused by sunlight and atmospheric conditions. Light enters a water droplet, slowing down and bending as it goes from air to denser water. The light reflects off the inside of the droplet, separating into its component wavelengths--or colors. When light exits the droplet, it makes a rainbow.



Lenses:

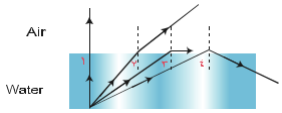
Types of lenses:

1. Convex lens: Collect light rays (Convergent)
2. Concave lens: Scatter light rays (Divergent).

24. The angle of incidence must be ……. in a complete internal reflection.

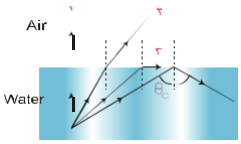
A square
B less than the critical angle
C same as the critical angle
D greater than the critical angle

25. In the chart, which point is the critical angle?



A 2 B 3 C 4 D 5

26. Find the error in the chart.



A The position of critical angle
B Unrefracting of light 1
C The lights translate from water to air
D The refraction of light 3 parallel to surface

27. The optical fiber is an example of .

A Complete internal refraction
B Complete internal reflection
C Refraction
D Reflection

28. The mirage happens due to.

A Light reflection
B Light refraction
C Light diffraction
D Light interference

29. Which one of these doesn't affect the mirage?

A reflection
B refraction
C Hertz waves
D The heating of air closed to earth

30. Which one of these doesn't affect the rainbow?

A Diffraction
B Scattering
C Reflection
D Refraction

31. Which type of lenses is used for light gathering?

A Concave
B Plane
C Convex
D Plane and concave

Magnification in spherical mirrors and lenses:

- Magnification: is the ratio of image's length to object's length. $m = \frac{h_i}{h_o}$ $m = \frac{-d_i}{d_o}$

  M is the magnification, hi is the image's length [m], ho is the object's length [m], di is the distance between im-age and mirror or lens [m], do is the distance between the object and mirror or lens [m].

The sign of magnification:

\+ if the image is real.
– if the image is virtual.

The equation of spherical mirrors and lenses:

f is (+) in: Concave mirror and convex lens(convergent)
f is (-) in: Convex mirror and concave lens (divergent).

32. A spherical mirror its magnification is 3, how long is the image of a 10 cm object in the mirror?

A 60 cm B 30 cm C 20 cm D 10 cm

Solution:

Magnification = Length of mage / Length of object 3 = L_i / 10
Li = 3 x 10 = 30 cm , the answer is B

33. An object is 10 cm far from a concave mirror, formats a 3 times magnificent real image, how far is the image from the mirror?

A 15 cm B 30 cm C 60 cm D 120 cm

34. An object is 4 cm far from a convex lens, formats a real image 4 cm far, calculate the focal length of the lens?

A $\frac{1}{8}$ B $\frac{1}{2}$ C 2 cm D 4 cm

35. The focal length of a concave mirror is 11 cm, formats the image 12 cm far, how far is the object from the mirror?

A 132 cm B 121 cm C 66 cm D 23 cm

36. An object is 30 cm far from a concave mirror (its radius is 10 cm), how far is its image from the mirror?

A 6 cm B 12 cm C 15 cm D 40 cm

37. An object is 15 cm far from a concave mirror (its radius is 24 cm), the image will format .

A at the focus
B between the center of curvature and focus
C behind the mirror
D after the center of curvature

38. An object is 12 cm far from a concave lens (its focal length is 6 cm), how far is its virtual image from the lens?

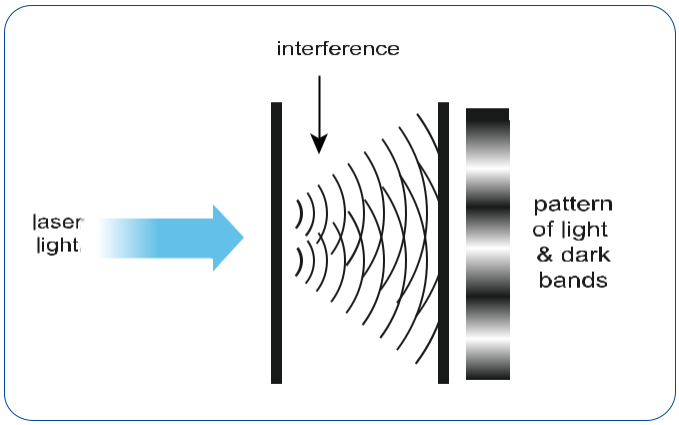
A 18 B 4 C 8 D 20

Sight defects:

- Farsightedness: is a condition affecting a person's vi-sion. People with farsightedness: Typically have an easier time seeing objects that are far away. Have a dif-ficult time focusing their eyes on things that are close, like words in a book.
- Reasons: the focal length of the eye is greater than the normal eye which makes image is formed behind retina.
- In farsightedness case: doctors use convex lens to cor-rect the sight of the eye.
- Nearsightedness: is a common vision condition in which you can see objects near to you clearly, but ob-jects farther away are blurry.
- It occurs when the shape of your eye causes light rays to bend (refract) incorrectly, focusing images in front of your retina instead of on your retina.
- In nearsightedness: doctors use concave lens to cor-rect sight of the eye.
- Note: if you cover a part of lens then the image that formed is dark.

Interference of light:

- Interference of light: is the phenomenon in which two waves superpose to form the resultant wave of the low- er, higher or same amplitude. The most common ex- ample of interference of light is the soap bubble which reflects wide colors when illuminated by a light source.
- Results from light interference: light and dark bands.



Measuring the wavelength of light using Young's double – slits experiment:

$$\lambda = \frac{xd}{L}$$

λ is the wavelength of light [m], x is the distance between the central band and the first lighted band [m], d is the distance between the two slits [m], L is the distance between the double slits and the screen [m].

39. An object is 40 cm far from a concave mirror, forms a virtual image magnifies 3.5 times, calculate the focal length of the mirror.

A -56 B -40 C 40 D 56

40. Use a …….to correct the farsightedness

A Convex lens B Concave lens
C apochromatic lens D achromatic lens

41. The images that the nearsightedness people see form

A In front of the retina B Behind the retina
C Above the retina D Under the retina

42. What happens to the image that is formed from a half covered convex lens?

A Half of image disappears B Image doesn't appear
C Image dims D Image reflects

43. Young's double-slit experiment is used in.

A Light reflection B Light refraction
C Light interference D Light diffraction

44. The distance between the two slits and screen in Young's double-slit experiment L in the rate is.

A $xd\lambda$ B $\frac{\lambda d}{x}$
C $\frac{xd}{\lambda}$ D $\frac{x\lambda}{d}$

45. In Young's experiment, pupils used laser lights, its wavelength is 600nm, they put the screen 1m far from the slits, so the first lighted band is 60 m far from the center, calculate the distance between the two bands.

A $0.01 \times 10^{-5}\ m$ B $0.1\times10^{-5}\ m$
C $1\times10^{-5}\ m$ D $10\times10^{-5}\ m$

Chapter 6: Light Solution

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
B	A	D	C	C	B	D	A	A	D	A	D	C	C	D	B	D	D	A	A

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
A	C	A	D	C	A	B	B	A	A	C	B	B	C	A	A	D	B	D	A

41	42	43	44	45
A	C	C	C	C