Sound differs from light in that sound:

A. is not subject to diffraction

B. is a torsional wave rather than a longitudinal wave

C. does not require energy for its origin

D. is a longitudinal wave rather than a transverse wave

E. is always monochromatic

D. is a longitudinal wave rather than a transverse wave

Radio waves are readily diffracted around buildings whereas light waves are negligibly diffracted around buildings. This is because radio waves:

A. are plane polarized

B. have much longer wavelengths than light waves

C. have much shorter wavelengths than light waves

D. are nearly monochromatic (single frequency)

E. are amplitude modulated (AM).

B. have much longer wavelengths than light waves

Diffraction plays an important role in which of the following phenomena?

A. The sun appears as a disk rather than a point to the naked eye

B. Light is bent as it passes through a glass prism

C. A cheerleader yells through a megaphone

D. A farsighted person uses eyeglasses of positive focal length

E. A thin soap film exhibits colors when illuminated with white light

C. A cheerleader yells through a megaphone

The rainbow seen after a rain shower is caused by:

A. diffraction

B. interference

C. refraction

D. polarization

E. absorption

C. refraction

When a highly coherent beam of light is directed against a very fine wire, the shadow formed behind it is not just that of a single wire but rather looks like the shadow of several parallel wires. The explanation of this involves:

A. refraction

B. diffraction

C. reflection

D. the Doppler effect

E. an optical illusion

B. diffraction

When the atmosphere is not quite clear, one may sometimes see colored circles concentric with the Sun or the Moon. These are generally not more than a few diameters of the Sun or Moon and invariably the innermost ring is blue. The explanation for this phenomena involves:

A. reflection

B. refraction

C. interference

D. diffraction

E. the Doppler effect

D. diffraction

The shimmering or wavy lines that can often be seen near the ground on a hot day are due to:

A. Brownian movement

B. reflection

C. refraction

D. diffraction

E. dispersion

C. refraction

A point source of monochromatic light is placed in front of a soccer ball and a screen is placed behind the ball. The light intensity pattern on the screen is best described as:

A. a dark disk on a bright background

B. a dark disk with bright rings outside

C. a dark disk with a bright spot at its center

D. a dark disk with a bright spot at its center and bright rings outside

E. a bright disk with bright rings outside

D. a dark disk with a bright spot at its center and bright rings outside

In the equation sin θ = /a for single-slit diffraction, θ is:

A. the angle to the first minimum
B. the angle to the second maximum
C. the phase angle between the extreme rays
D. Nπ where N is an integer
E. (N + 1/2)π where N is an integer

C. the phase angle between the extreme rays

No fringes are seen in a single-slit diffraction pattern if:

A. the screen is far away

B. the wavelength is less than the slit width

C. the wavelength is greater than the slit width

D. the wavelength is less than the distance to the screen

E. the distance to the screen is greater than the slit width

C. the wavelength is greater than the slit width

The diagram shows a single slit with the direction to a point P on a distant screen shown. At P, the pattern has its second minimum (from its central maximum). If X and Y are the edges of the slit, what is the path length difference (PX) - (PY)?

A. lambda/2

B. lambda

C. 3lambda/2

D. 2lambda

E. 5lambda/2

D. 2lambda

The diagram shows a single slit with the direction to a point P on a distant screen shown. At P, the pattern has its maximum nearest the central maximum. If X and Y are the edges of the slit, what is the path length difference (PX) - (PY)?

A. lambda/2

B. lambda

C. 3lambda/2

D. 2lambda

E. 5lambda/2

C. 3lambda/2

At the first minimum adjacent to the central maximum of a single-slit diffraction pattern the phase difference between the Huygens wavelet from the top of the slit and the wavelet from the midpoint of the slit is:

A. π/8 rad

B. π/4 rad

C. π/2 rad

D. π rad

E. 3π/2 rad

D. π rad

At the second minimum adjacent to the central maximum of a single-slit diffraction pattern the Huygens wavelet from the top of the slit is 180 out of phase with the wavelet from:

A. a point one-fourth of the slit width from the top

B. the midpoint of the slit

C. a point one-fourth of the slit width from the bottom of the slit

D. the bottom of the slit

E. none of these

A. a point one-fourth of the slit width from the top

A plane wave with a wavelength of 500 nm is incident normally on a single slit with a width of 5.0 × 10-6 m. Consider waves that reach a point on a far-away screen such that rays from the slit make an angle of 1.0 with the normal. The difference in phase for waves from the top and bottom of the slit is:

A. 0

B. 0.55 rad

C. 1.1 rad

D. 1.6 rad

E. 2.2 rad

C. 1.1 rad

Consider a single-slit diffraction pattern caused by a slit of width a. There is a maximum if sin θ is equal to:

A. slightly more than 3lambda/2a

B. slightly less than 3lambda/2a

C. exactly 3lambda/2a

D. exactly lambda /2a

E. very nearly lambda/2a

B. slightly less than 3 lambda/2a

24. Consider a single-slit diffraction pattern caused by a slit of width a. There is a minimum if sin θ is equal to:

A. exactly lambda/a

B. slightly more than lambda/a

C. slightly less than lambda/a

D. exactly lambda /2a

E. very nearly lambda /2a

A. exactly lambda/a

In a single-slit diffraction pattern, the central maximum is about twice as wide as the other maxima. This is because:

A. half the light is diffracted up and half is diffracted down
B. the central maximum has both electric and magnetic fields present
C. the small angle approximation applies only near the central maximum
D. the screen is flat instead of spherical
E. none of the above

E. none of the above

Two slits in an opaque barrier each have a width of 0.020 mm and are separated by 0.050 mm. When coherent monochromatic light passes through the slits the number of interference maxima within the central diffraction maximum:

A. is1

B. is2

C. is4

D. is5

E. cannot be determined unless the wavelength is given

D. is5

When 450-nm light is incident normally on a certain double-slit system the number of interfer- ence maxima within the central diffraction maximum is 5. When 900-nm light is incident on the same slit system the number is:

A. 2 B. 3 C. 5 D. 9 E. 10

...

In a double-slit diffraction experiment the number of interference fringes within the central diffraction maximum can be increased by:

A. increasing the wavelength

B. decreasing the wavelength

C. decreasing the slit separation

D. increasing the slit width

E. decreasing the slit width

E. decreasing the slit width

Two stars that are close together are photographed through a telescope. The black and white film is equally sensitive to all colors. Which situation would result in the most clearly separated images of the stars?

A. Small lens, red stars

B. Small lens, blue stars

C. Large lens, red stars

D. Large lens, blue stars

E. Large lens, one star red and the other blue

D. Large lens, blue stars

The resolving power of a telescope can be increased by:

A. increasing the objective focal length and decreasing the eyepiece focal length

B. increasing the lens diameters

C. decreasing the lens diameters

D. inserting a correction lens between objective and eyepiece

E. none of the above

B. increasing the lens diameters

In the equation $d \sin \theta = m\text{lambda}$ for the lines of a diffraction grating d is:

A. the number of slits

B. the slit width

C. the slit separation

D. the order of the line

E. the index of refraction

C. the slit separation

As more slits with the same spacing are added to a diffraction grating the lines:

A. spread farther apart

B. move closer together

C. become wider

D. becomes narrower

E. do not change in position or width

D. becomes narrower

An N-slit system has slit separation d and slit width a. Plane waves with intensity I and wavelength lambda are incident normally on it. The angular separation of the lines depends only on:

A. a and N

B. a and lambda

C. N and lambda

D. d and lambda

E. I and N

D. d and lambda

600-nm light is incident on a diffraction grating with a ruling separation of 1.7 × 10-6 m. The second order line occurs at a diffraction angle of:

A. 0

B. 10

C. 21

D. 42

E. 45

E. 45

Monochromatic light is normally incident on a diffraction grating that is 1cm wide and has 10, 000 slits. The first order line is deviated at a 30 angle. What is the wavelength, in nm, of the incident light?

A. 300

B. 400

C. 500

D. 600

E. 1000

C. 500

A light spectrum is formed on a screen using a diffraction grating. The entire apparatus (source, grating and screen) is now immersed in a liquid of refractive index 1.33. As a result, the pattern on the screen:

A. remains the same

B. spreads out

C. crowds together

D. becomes reversed, with the previously blue end becoming red

E. disappears because the refractive index isn't an integer

C. crowds together

The spacing between adjacent slits on a diffraction grating is 3lambda. The deviation θ of the firstorder diffracted beam is given by:

A. $\sin(\theta/2) = 1/3$

B. $\sin(\theta/3) = 2/3$

C. $\sin(\theta) = 1/3$

D. $\tan(\theta/2) = 1/3$

E. $\tan(\theta) = 2/3$

C. $\sin(\theta) = 1/3$

When light of a certain wavelength is incident normally on a certain diffraction grating the line of order 1 is at a diffraction angle of 25 . The diffraction angle for the second order line is:

A. 25

B. 42

C. 50

D. 58

E. 75

D. 58

A diffraction grating of width W produces a deviation θ in second order for light of wavelength lambda. The total number N of slits in the grating is given by:

A. 2Wlambda/sinθ

B. (W/lambda) sin θ

C. lambdaW/2 sin θ

D. (W/2lambda) sin θ

E. 2lambda/ sin θ

D. (W/2lambda) sin θ

550-nm light is incident normally on a diffraction grating and exactly 6 lines are produced. The ruling separation must be:

A. between 2.75 × 10-7 m and 5.50 × 10-7 m

B. between 5.50 × 10-7 m and 1.10 × 10-6 m

C. between 3.30 × 10-6 m and 3.85 × 10-6 m

D. between 3.85 × 10-6 m and 4.40 × 10-6 m

E. greater than 4.40 × 10-6 m

E. greater than 4.40 × 10-6 m

Light of wavelength is normally incident on some plane optical device. The intensity pattern shown is observed on a distant screen (θ is the angle measured from the normal of the device). The device could be:

A. a single slit of width W

B. a single slit of width 2W

C. two narrow slits with separation W

D. two narrow slits with separation 2W

E. a diffraction grating with slit separation W

A. a single slit of width W

A person with her eye relaxed looks through a diffraction grating at a distant monochromatic point source of light. The slits of the grating are vertical. She sees:

A. one point of light

B. a hazy horizontal strip of light of the same color as the source

C. a hazy strip of light varying from violet to red

D. a sequence of horizontal points of light

E. a sequence of closely spaced vertical lines

D. a sequence of horizontal points of light

Monochromatic light is normally incident on a diffraction grating. The mth order line is at a diffraction angle θ and has width w. A wide single slit is now placed in front of the grating and its width is then slowly reduced. As a result:

A. both θ and w increase
B. both θ and w decrease
C. θ remains the same and w increases
D. θ remains the same and w decreases
E. θ decreases and w increases

C. θ remains the same and w increases

At a diffraction line phasors associated with waves from the slits of a multiple-slit barrier:

A. are aligned
B. form a closed polygon
C. form a polygon with several sides missing
D. are parallel but adjacent phasors point in opposite directions
E. form the arc of a circle

A. are aligned

For a certain multiple-slit barrier the slit separation is 4 times the slit width. For this system:

A. the orders of the lines that appear are all multiples of 4

B. the orders of lines that appear are all multiples of 2

C. the orders of the missing lines are all multiples of 4

D. the orders of the missing lines are all multiples of 2

E. none of the above are true

C. the orders of the missing lines are all multiples of 4

The dispersion D of a grating can have units:

A. cm

B. 1/nm

C. nm/cm

D. radian

E. none of these

B. 1/nm

The resolving power R of a grating can have units:

A. cm

B. degree/nm

C. watt

D. nm/cm

E. watt/nm

D. nm/cm

The dispersion of a diffraction grating indicates:

A. the resolution of the grating

B. the separation of lines of the same order

C. the number of rulings in the grating

D. the width of the lines

E. the separation of lines of different order for the same wavelength

B. the separation of lines of the same order

The resolving power of a diffraction grating is defined by R = / . Here and + are:

A. any two wavelengths

B. any two wavelengths that are nearly the same

C. two wavelengths for which lines of the same order are separated by radians

D. two wavelengths for which lines of the same order are separated by 2 radians

E. two wavelengths for which lines of the same order are separated by half the width of a maximum

E. two wavelengths for which lines of the same order are separated by half the width of a maximum

A light beam incident on a diffraction grating consists of waves with two different wavelengths. The separation of the two first order lines is great if:

A. the dispersion is great

B. the resolution is great

C. the dispersion is small

D. the resolution is small

E. none of the above (line separation does not depend on either dispersion or resolution)

A. the dispersion is great

To obtain greater dispersion by a diffraction grating:

A. the slit width should be increased
B. the slit width should be decreased
C. the slit separation should be increased
D. the slit separation should be decreased
E. more slits with the same width and separation should be added to the system

D. the slit separation should be decreased

Two nearly equal wavelengths of light are incident on an N-slit grating. The two wavelengths are not resolvable. When N is increased they become resolvable. This is because:

A. more light gets through the grating

B. the lines get more intense

C. the entire pattern spreads out

D. there are more orders present

E. the lines become more narrow

E. the lines become more narrow

A diffraction grating just resolves the wavelengths 400.0 nm and 400.1 nm in first order. The number of slits in the grating is:

A. 400

B. 1000

C. 2500

D. 4000

E. not enough information is given

D. 4000

What is the minimum number of slits required in a diffraction grating to just resolve light with wavelengths of 471.0 nm and 471.6 nm?

A. 99

B. 197

C. 393

D. 786

E. 1179

C. 393

X rays are:

A. electromagnetic waves

B. negatively charged ions

C. rapidly moving electrons

D. rapidly moving protons

E. rapidly moving neutrons

A. electromagnetic waves

Bragg's law for x-ray diffraction is $2d\sin\theta$ = mlambda , where θ is the angle between the incident beam and:

A. a reflecting plane of atoms

B. the normal to a reflecting plane of atoms

C. the scattered beam

D. the normal to the scattered beam

E. the refracted beam

A. a reflecting plane of atoms

Bragg's law for x-ray diffraction is 2d sin θ = mlambda, where the quantity d is:

A. the height of a unit cell

B. the smallest interatomic distance

C. the distance from detector to sample

D. the distance between planes of atoms

E. the usual calculus symbol for a differential

D. the distance between planes of atoms

Which of the following is true for Bragg diffraction but not for diffraction from a grating?

A. Two different wavelengths may be used

B. For a given wavelength, a maximum may exist in several directions

C. Long waves are deviated more than short ones

D. There is only one grating spacing

E. Maxima occur only for particular angles of incidence

E. Maxima occur only for particular angles of incidence

The longest x-ray wavelength that can be diffracted by crystal planes with a separation of 0.316 nm is:

A. 0.158 nm

B. 0.316 nm

C. 0.474 nm

D. 0.632 nm

E. 1.26 nm

D. 0.632 nm

A beam of x rays of wavelength 0.20nm is diffracted by a set of planes in a crystal whose separation is 3.1 × 10-8 cm. The smallest angle between the beam and the crystal planes for which a reflection occurs is:

A. 0.70 rad

B. 0.33 rad

C. 0.033 rad

D. 0.066 rad

E. no such angle exists

C. 0.033 rad

73. An x-ray beam of wavelength 3 × 10-11 m is incident on a calcite crystal of lattice spacing 0.3nm. The smallest angle between crystal planes and the x-ray beam that will result in constructive interference is:

A. 2.87

B. 5.73

C. 11.63

D. 23.27

E. none of these

A. 2.87

A beam of x rays of wavelength 0.10 nm is found to diffract in second order from the face of a LiF crystal at a Bragg angle of 30 . The distance between adjacent crystal planes, in nm, is about:

A. 0.15

B. 0.20

C. 0.25

D. 0.30

E. 0.40

B. 0.20