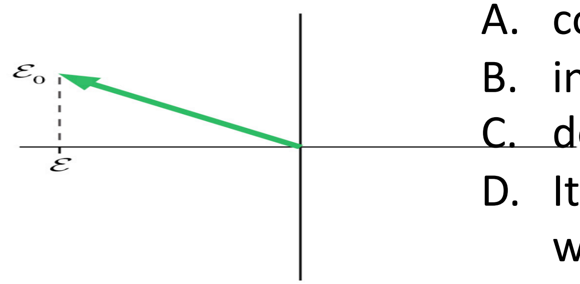
Questions and answers for chapter 36

1. In a series *RLC* circuit, what quantity is maximum at resonance and why?

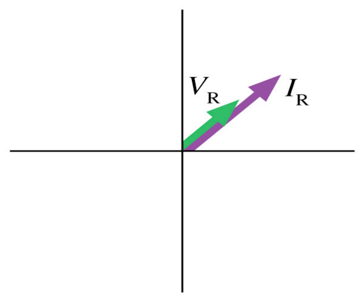
A. The voltage
B. The current
C. The impedance
D. The phase

2.The magnitude of the instantaneous value of the emf represented by this phasor is



A. constant.
B. increasing.
C. decreasing.
D. It's not possible to tell without knowing *t*.

3. The resistor whose voltage and current phasors are shown here has resistance *R*

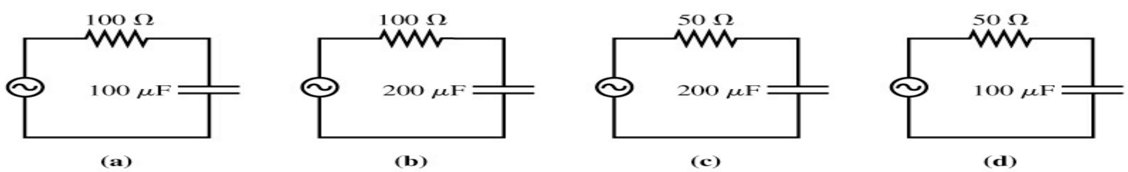


A. > 1 Ω.
B. < 1 Ω.
C. It's not possible to tell.

4. What is the capacitive reactance of "no capacitor," just a continuous wire?

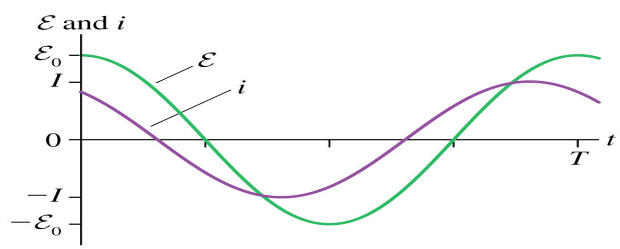
A. 0
B. ∞
C. Undefined

5. Rank in order, from largest to smallest, the cross-over frequencies of these four circuits.



A. $(\omega_c)_a > (\omega_c)_b = (\omega_c)_d > (\omega_c)_c$
B. $(\omega_c)_b > (\omega_c)_a = (\omega_c)_c > (\omega_c)_d$
C. $(\omega_c)_b = (\omega_c)_c > (\omega_c)_a = (\omega_c)_d$
D. $(\omega_c)_c > (\omega_c)_b = (\omega_c)_d > (\omega_c)_a$
E. $(\omega_c)_d > (\omega_c)_a = (\omega_c)_c > (\omega_c)_b$

6. The emf and the current in a series *RLC* circuit oscillate as shown. Which of the following would increase the rate at which energy is supplied to the circuit? (perhaps more than one correct answer). Explain your answer.



A. Decrease $\mathcal{E}_0$
B. Increase *C*
C. Increase L
D. Decrease *L*
E. Increase $\mathcal{E}_0$
F. Decrease C

36.9. The current in a series *RLC* circuit lags the emf by 20°. You cannot change the emf. What two different things could you do to the circuit that would increase the power delivered to the circuit by the emf?

36.10. The average power dissipated by a resistor is 4.0 W. What is P_{avg} if:

a. The resistance *R* is doubled?
b. The peak emf $\mathcal{E}_0$ is doubled?
c. Both are doubled simultaneously?

Answers: 1. B Imedance Z minimizes at resonance since capacitive and reactive responses cancel out
2. B Negative but increasing in amplitude since phasor rotates ccw
3. C Voltage and current are measured in different units you cannot compare the length of the phasors
4. A There is no capacitive reactance since the wire allows the current to flow according to the value of its resistance when a voltage is applied
5. E
6. C,E and F. You can always increase the current by increasing the emf. In the figure the current leads the emf which tells us that the current is mostly capacitive. Maximum is at resonance which you can get by either Increasing L or decreasing C.

36.9. The power will increase when the peak current I increases. This will increase when you **(1)** decrease R, **(2)** set $X_r = X_r$.

36.10. **(a)** 8.0 W. Use $P_R = \frac{1}{2} I_R{}^2 R$.

(b) 16.0 W. Doubling the peak emf doubles the current.

(c) 8.0 W. Doubling the emf would double the current except that when the resistor is doubled I_r remains the same. P_r increases due to doubling R, as in part (a).

1.A paraxial ray

A. moves in a parabolic path.

B. is a ray that has been reflected from parabolic mirror.

C. is a ray that moves nearly parallel to the optical axis.

D. is a ray that moves exactly parallel to the optical axis.

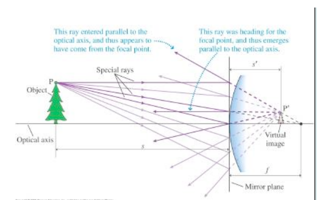
2. A virtual image is

A. the cause of optical illusions.

B. a point from which rays appear to diverge.

C. an image that only seems to exist.

D. the image that is left in space after you remove a viewing screen.



3.The focal length of a converging lens is

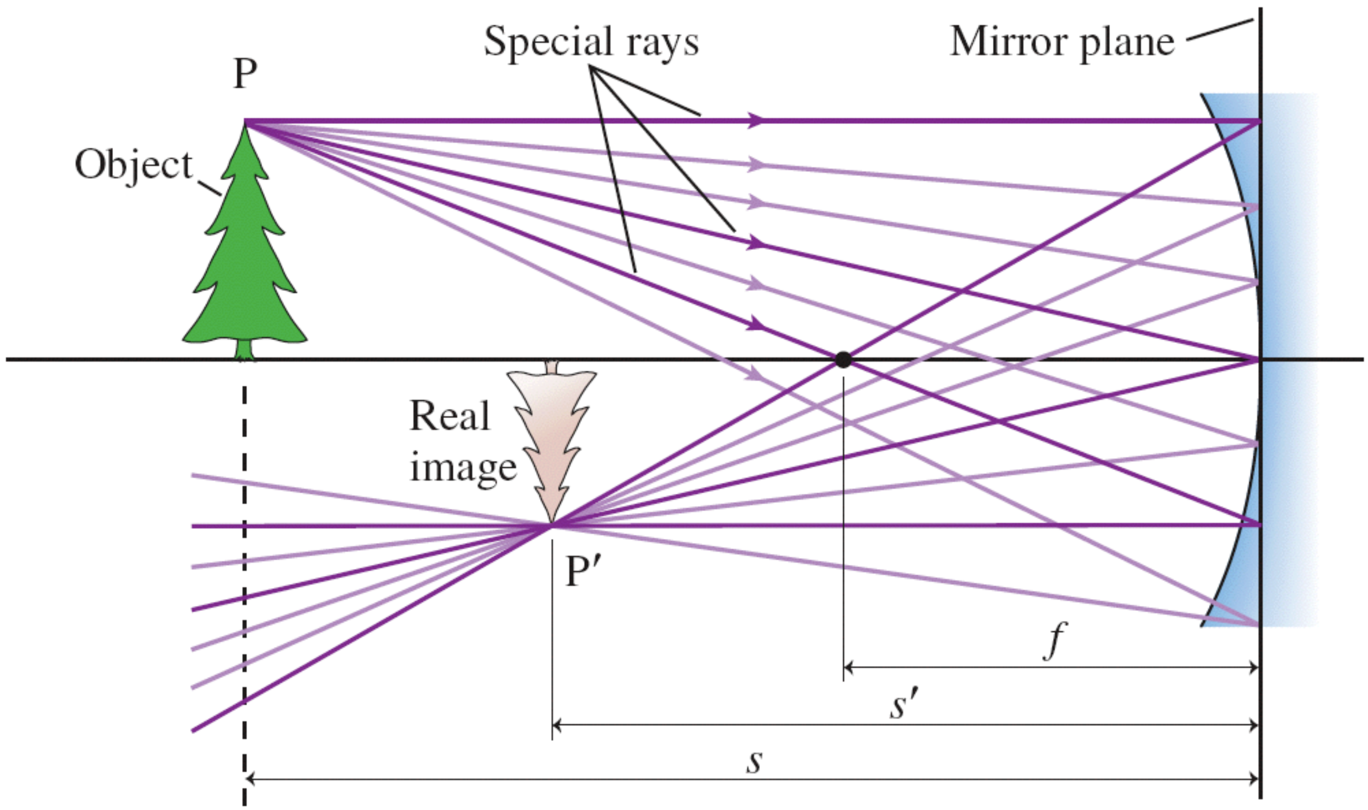
A. the distance at which an image is formed.

B. the distance at which an object must be placed to form an image.

C. the distance at which parallel light rays are focused.

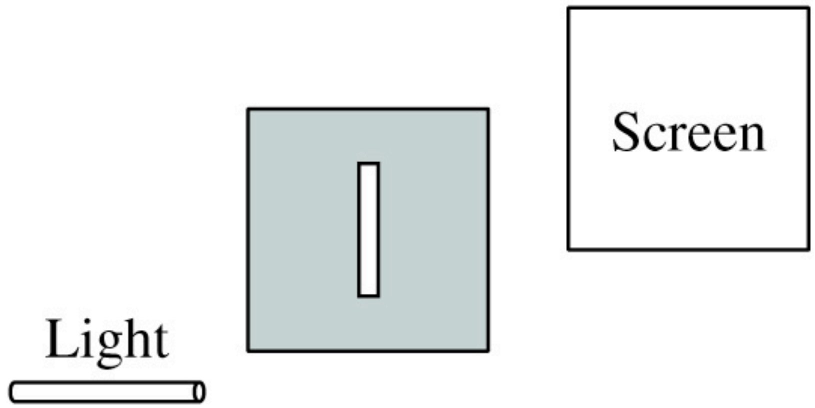
D. the distance from the front surface to the back surface.

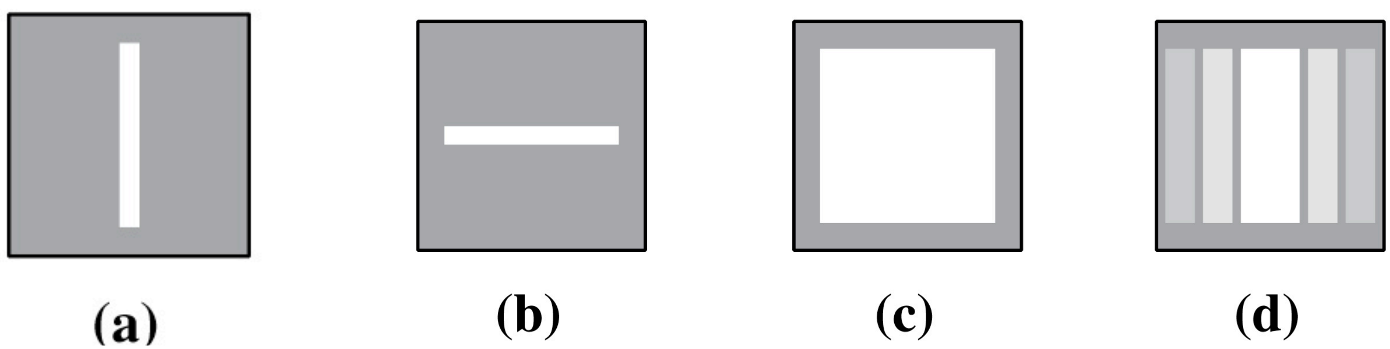
FIGURE 23.52 A real image formed by a concave mirror.



Questions and Answers Ch. 23

A long, thin light bulb illuminates a vertical aperture. Which pattern of light do you see on a viewing screen behind the aperture?



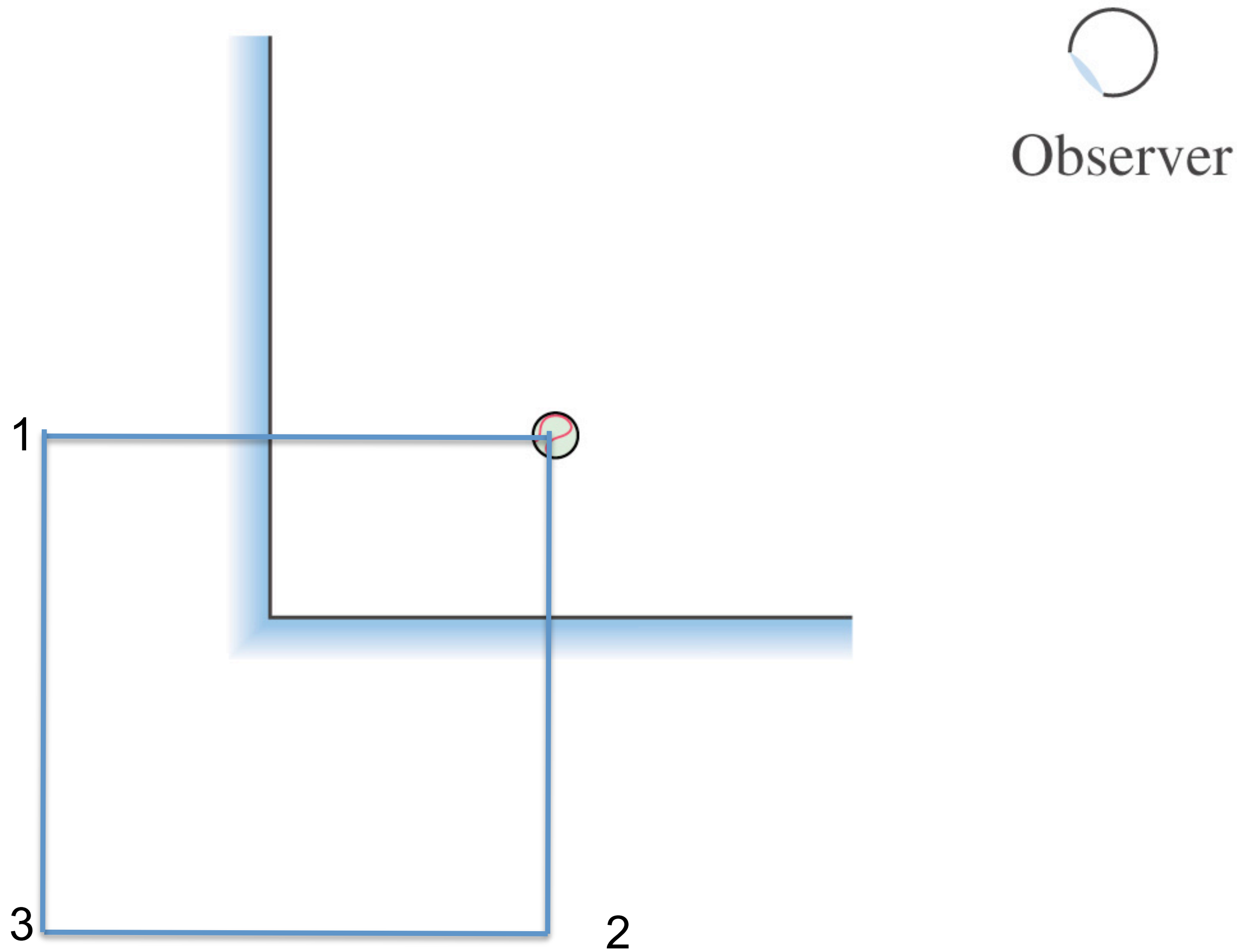


c

Stop to Think 23.1: **c.** The light spreads vertically as it goes through the vertical aperture. The light spreads horizontally due to different points on the horizontal lightbulb.

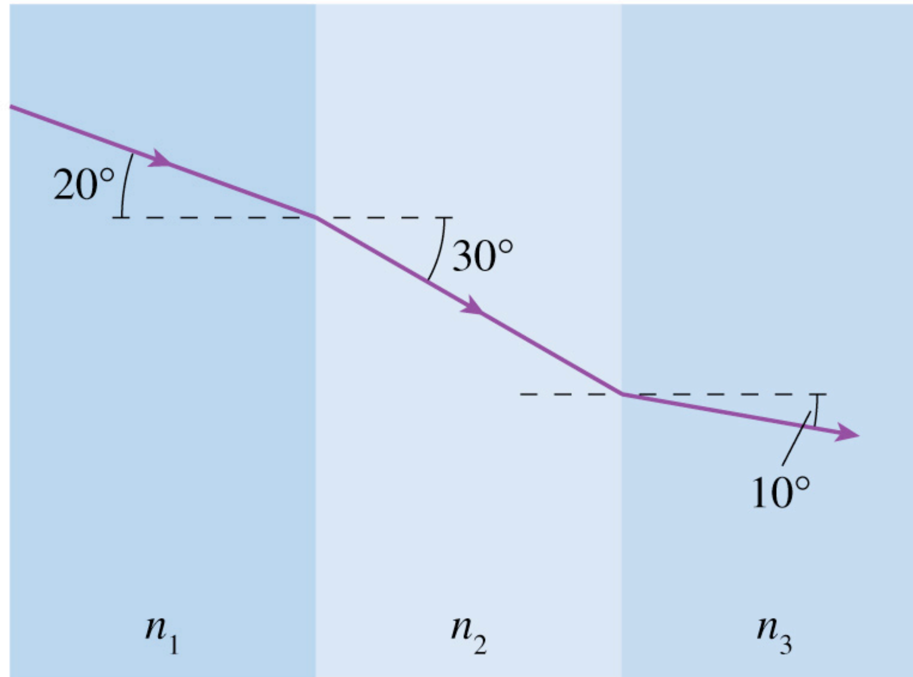
Two plane mirrors form a right angle. How many images of the ball can you see in the mirrors?

A. 1
B. 2
C. 3
D. 4



Stop to Think 23.2: **c.** There's one image behind the vertical mirror and a second behind the horizontal mirror. A third image in the corner arises from rays that reflect twice, once off each mirror.

A light ray travels from medium 1 to medium 3 as shown.
For these media,

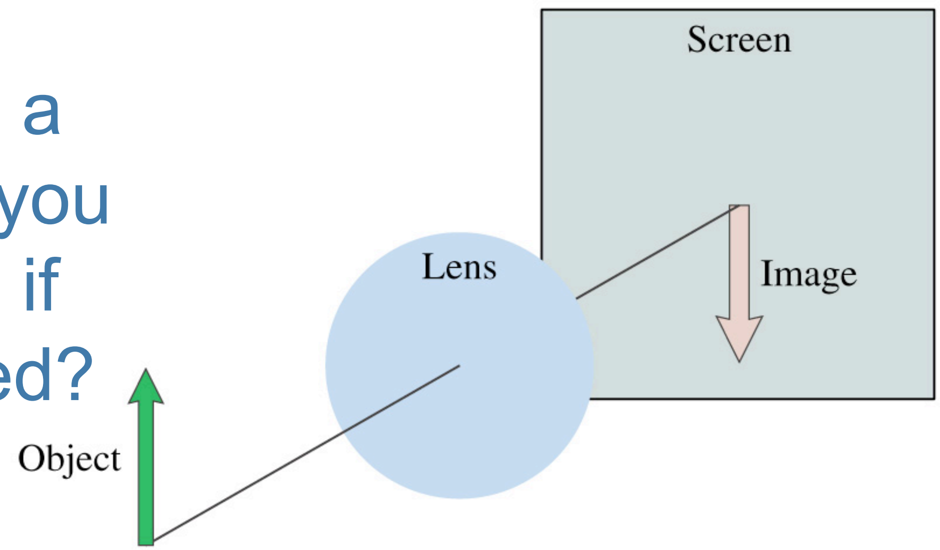


A. $n_3 = n_1$.
B. $n_3 > n_1$.
C. $n_3 < n_1$.
D. We can't compare n_1 to n_3 without knowing n_2.

B

Stop to Think 23.3: The ray travels closer to the normal in both media 1 and 3 than in medium 2, so n_1 and n_3 are both larger than n_2. The angle is smaller in medium 3 than in medium 1, so $n_3 > n_1$.

A lens produces a sharply-focused, inverted image on a screen. What will you see on the screen if the lens is removed?



A. The image will be inverted and blurry.
B. The image will be as it was, but much dimmer.
C. There will be no image at all.
D. The image will be right-side-up and sharp.
E. The image will be right-side-up and blurry.

C

Stop to Think 23.4: The rays from the object are diverging. Without a lens, the rays cannot converge to form any kind of image on the screen.

The image of a slide on the screen is blurry because the screen is in front of the image plane. To focus the image, should you move the lens toward the slide or away from the slide?

A. Away from the slide.
B. Toward the slide.

Stop to Think 23.6: **Away from.** You need to decrease s' to bring the image plane onto the screen. s' is decreased by increasing s.

A concave mirror of focal length *f* forms an image of the moon. Where is the image located?

A. Almost exactly a distance behind the mirror.
B. Almost exactly a distance in front of the mirror.
C. At a distance behind the mirror equal to the distance of the moon in front of the mirror.
D. At the mirror's surface.

B

Stop to Think 23.7: A concave mirror forms a real image in front of the mirror. Because the object distance is $s \approx \infty$, the image distance is $s' \approx f$.

Questions and Answers Ch. 22

L=1 m, d=.3 mm, Ten bright fringes are 1.7 cm apart . Find lamda

VISUALIZE The interference pattern looks like the photograph of Figure 22.3b.

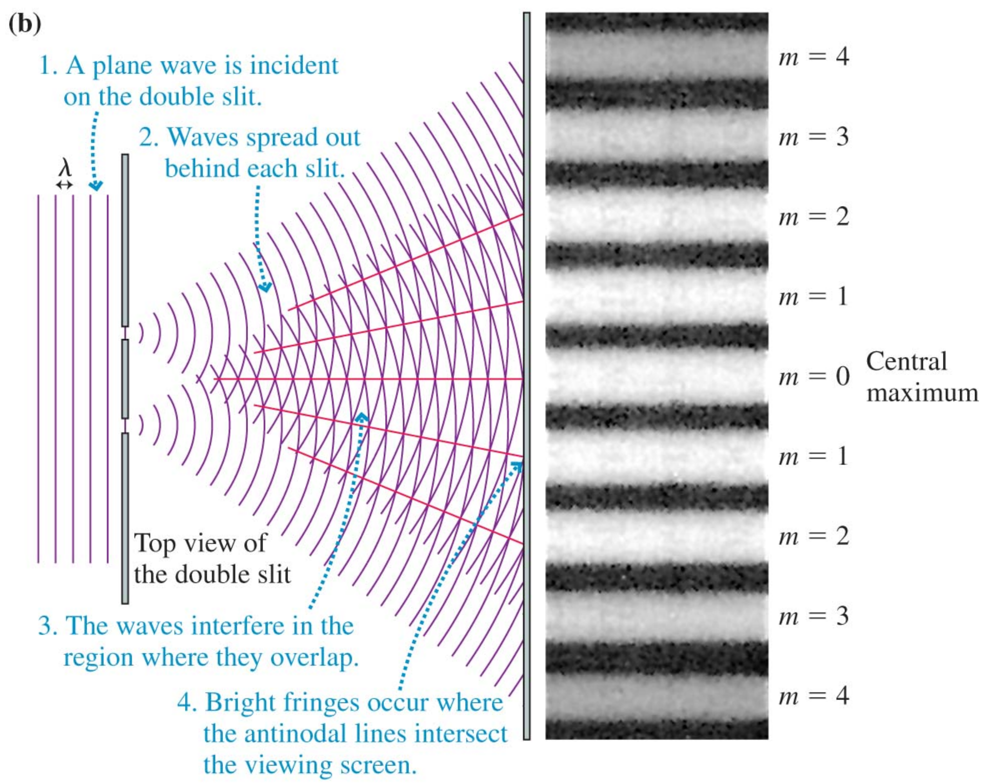
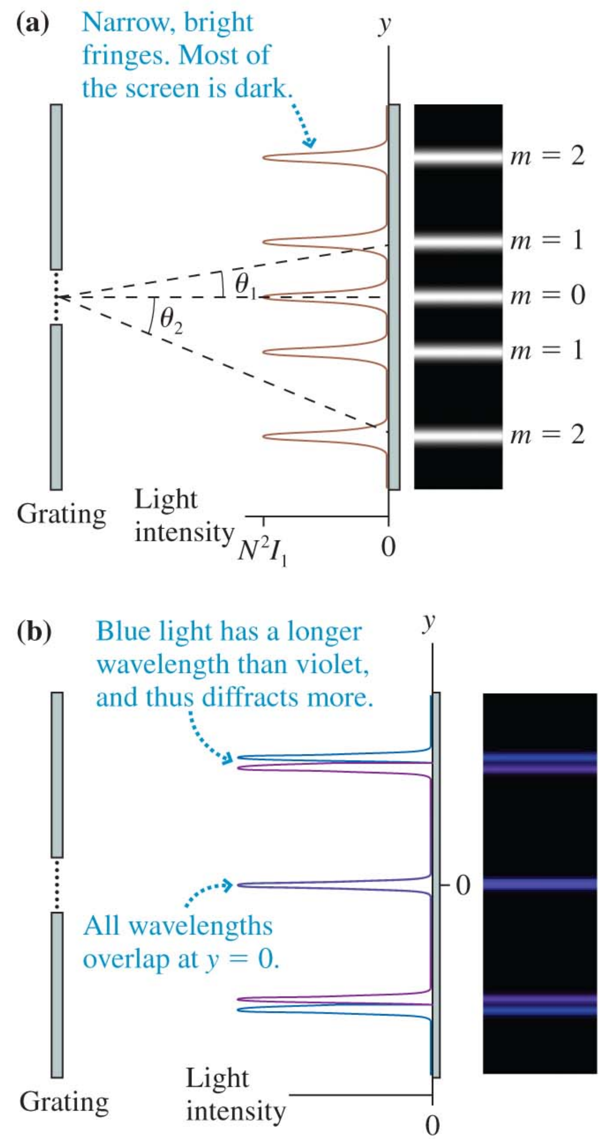


FIGURE 22.8 The interference pattern behind a diffraction grating.



Problem 5: Interference

In an experiment you shine red laser light (λ=600 nm) at a slide and see the following pattern on a screen placed 1 m away:

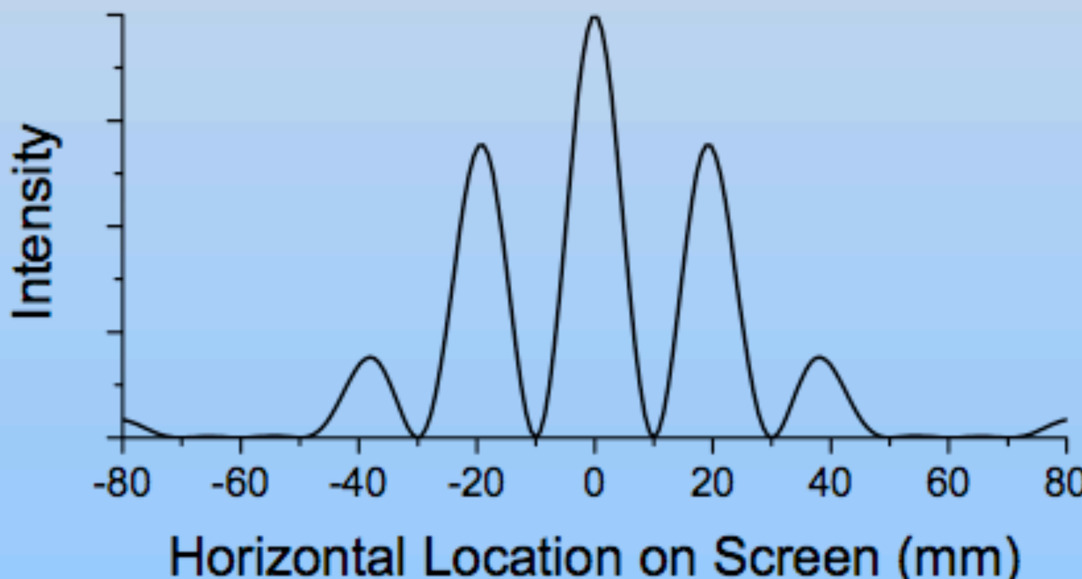
You measure the distance between successive fringes to be 20 mm

a) Are you looking at a single slit or at two slits?

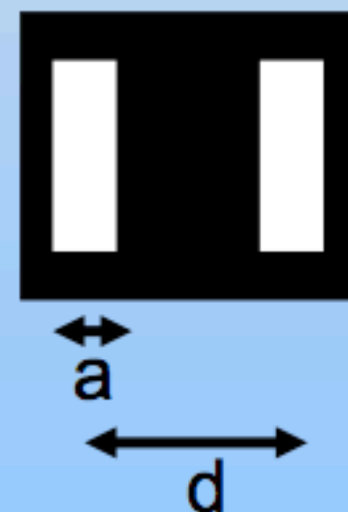
b) What are the relevant lengths (width, separation if 2 slits)? What is the orientation of the slits?

Solution 5.1: Interference

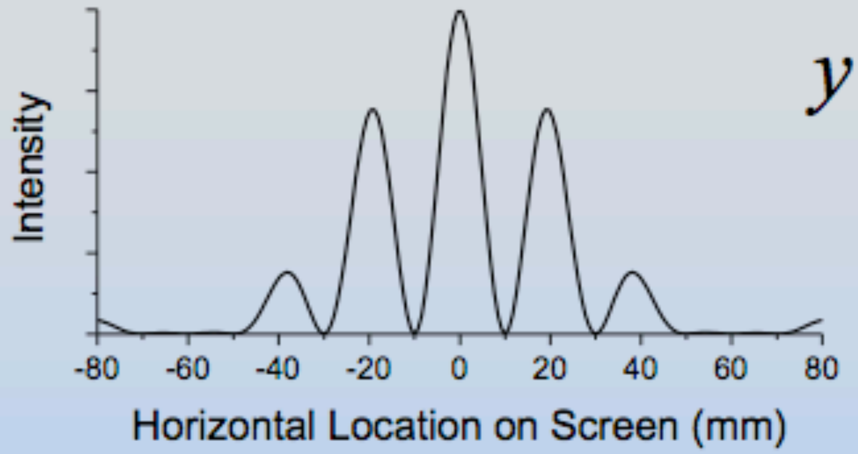
First translate the picture to a plot:



(a) Must be two slits



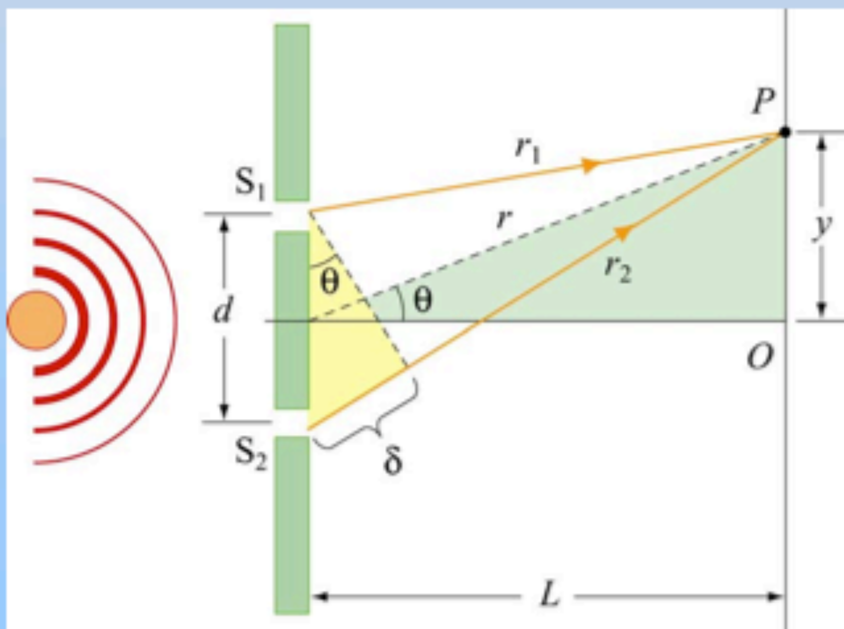
Solution 5.2: Interference



$$y = L\tan\theta \approx L\sin\theta = L\frac{m\lambda}{d}$$

$$d = L\frac{m\lambda}{y} = (1\text{m})\frac{(1)(600\text{nm})}{(20\text{mm})}$$

$$= (1\text{m})\frac{\left(6\times10^{-7}\right)}{\left(2\times10^{-2}\right)} = \boxed{3\times10^{-5}\text{m}}$$



At 60 mm…

$$a\sin\theta = (1)\lambda$$

$$d\sin\theta = (3)\lambda \Rightarrow \frac{a}{d} = \frac{1}{3}$$

$$\boxed{a = 10^{-5}\text{m}}$$

STOP TO THINK 22.1 Suppose the viewing screen in Figure 22.3 is moved closer to the double slit. What happens to the interference fringes?

a. They get brighter but otherwise do not change.
b. They get brighter and closer together.
c. They get brighter and farther apart.
d. They get out of focus.
e. They fade out and disappear.

STOP TO THINK 22.2 Light of wavelength λ_1 illuminates a double slit, and interference fringes are observed on a screen behind the slits. When the wavelength is changed to λ_2, the fringes get closer together. Is λ_2 larger or smaller than λ_1?

STOP TO THINK 22.3 White light passes through a diffraction grating and forms rainbow patterns on a screen behind the grating. For each rainbow,

a. The red side is on the right, the violet side on the left.
b. The red side is on the left, the violet side on the right.
c. The red side is closest to the center of the screen, the violet side is farthest from the center.
d. The red side is farthest from the center of the screen, the violet side is closest to the center.

VISUALIZE The interference pattern looks like the photograph of Figure 22.3b.

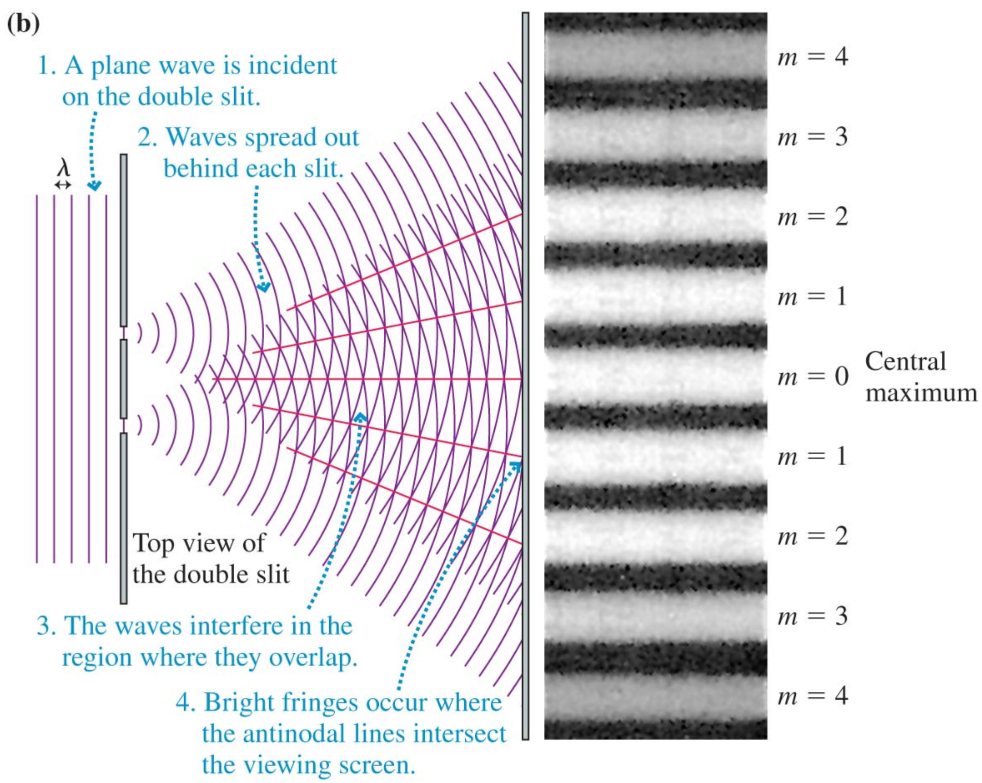
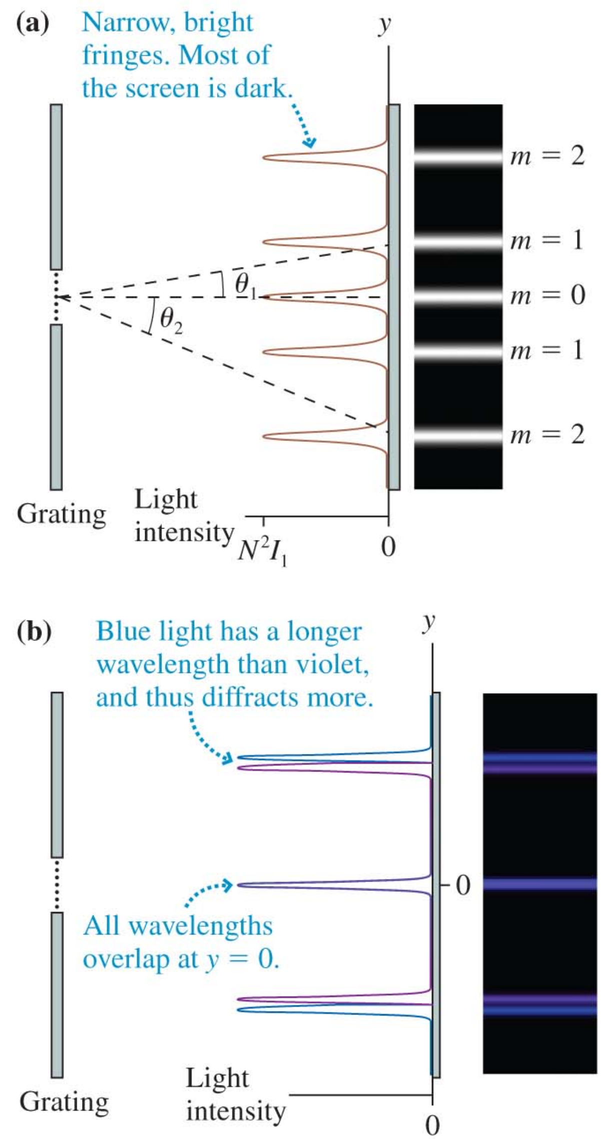
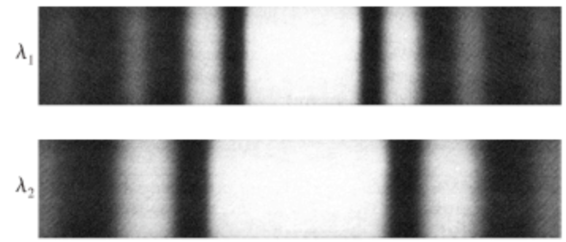


FIGURE 22.8 The interference pattern behind a diffraction grating.



STOP TO THINK 22.4 The figure shows two single-slit diffraction patterns. The distance between the slit and the viewing screen is the same in both cases. Which of the following (perhaps more than one) could be true?



a. The slits are the same for both; $\lambda_1 > \lambda_2$.
b. The slits are the same for both; $\lambda_2 > \lambda_1$.
c. The wavelengths are the same for both; $a_1 > a_2$.
d. The wavelengths are the same for both; $a_2 > a_1$.
e. The slits and the wavelengths are the same for both; $p_1 > p_2$.
f. The slits and the wavelengths are the same for both; $p_2 > p_1$.

Answers

Stop to Think 22.1: b. The antinodal lines seen in Figure 22.3b are diverging.

Stop to Think 22.2: Smaller. Shorter-wavelength light doesn't spread as rapidly as longer-wavelength light. The fringe spacing Δy is directly proportional to the wavelength λ.

Stop to Think 22.3: d. Larger wavelengths have larger diffraction angles. Red light has a larger wavelength than violet light, so red light is diffracted farther from the center.

Stop to Think 22.4: b or c. The width of the central maximum, which is proportional to λ/a, has increased. This could occur either because the wavelength has increased or because the slit width has decreased.