Review | Constants

Two radio antennas A and B radiate in phase. Antenna B is a distance of 140 m to the right of antenna A. Consider point Q along the extension of the line connecting the antennas, a horizontal distance of 50.0 m to the right of antenna B. The frequency, and hence the wavelength, of the emitted waves can be varied.

Part A

What is the longest wavelength for which there will be destructive interference at point Q?

Express your answer in meters.

$\lambda =$ 280 m

Submit Previous Answers

Correct

Part B

What is the longest wavelength for which there will be constructive interference at point Q?

Express your answer in meters.

ΑΣφ ?

$\lambda =$ m

Exercise 35.8 - Enhanced - with Feedback

Review | Constants

Coherent light with wavelength 410 nm falls on a pair of slits. On a screen 1.82 m away, the distance between dark fringes is 3.90 mm.

Part A

What is the slit separation?

Express your answer with the appropriate units.

d = Value Units

Submit Request Answer

Consider two identical antennas separated by 9.00 m that radiate in phase at 120 MHz. A receiver placed 150 m from both antennas measures an intensity I_0. The receiver is moved so that it is 1.8 m closer to one antenna than to the other.

Part A

What is the phase difference ϕ between the two radio waves produced by this path difference?

Express your answer in radians.

ϕ = rad

Submit Request Answer

Part B

In terms of I_0, what is the intensity measured by the receiver at its new position?

Express your answer as a fraction of I_0.

I = I_0

Exercise 35.14 - Enhanced - with Feedback

Review | Constants

Coherent light that contains two wavelengths, 660 nm (red) and 470 nm (blue), passes through two narrow slits that are separated by 0.410 mm. Their interference pattern is observed on a screen 4.00 m from the slits.

Part A

What is the distance on the screen between the first-order bright fringes for the two wavelengths?

Express your answer with the appropriate units.

μÅ ?

$\Delta y =$ Value Units

Submit

Request Answer

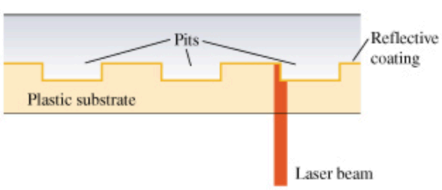
Review | Constants

A compact disc (CD) is read from the bottom by a semiconductor laser with wavelength 800 nm passing through a plastic substrate of refractive index 1.8. When the beam encounters a pit, part of the beam is reflected from the pit and part from the flat region between the pits, so these two beams interfere with each other (Figure 1).

For related problem-solving tips and strategies, you may want to view a Video Tutor Solution of Thin-film interference iii.

Figure

1 of 1



Part A

What must the minimum pit depth be so that the part of the beam reflected from a pit cancels the part of the beam reflected from the flat region? (It is this cancellation that allows the player to recognize the beginning and end of a pit. For a fuller explanation of the physics behind CD technology, see the article "The Compact Disc Digital Audio System," by Thomas D. Rossing, in the December 1987 issue of *The Physics Teacher*.)

Express your answer in nanometers.

t = nm

Submit Request Answer

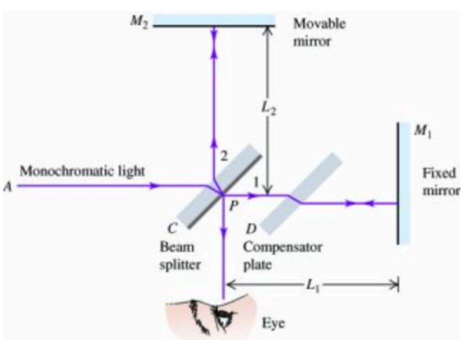
Provide Feedback

Next >

Exercise 35.31

Review | Constants

Figure



Part A

How far must the mirror M_2 (Figure 1) of the Michelson interferometer be moved so that 1930 fringes of He-Ne laser light (633 nm) move across a line in the field of view?

Express your answer in millimeters.

x = mm

Submit Request Answer

Provide Feedback

Next

Review | Constants

After an eye examination, you put some eyedrops on your sensitive eyes. The cornea (the front part of the eye) has an index of refraction of 1.38, while the eyedrops have a refractive index of 1.45. After you put in the drops, your friends notice that your eyes look red, because red light of wavelength 600 nm has been reinforced in the reflected light.

Part A

What is the minimum thickness of the film of eyedrops on your cornea?

Express your answer in nanometers.

t = ______ nm

Submit Request Answer

Part B

Will any other wavelengths of visible light be reinforced in the reflected light?

- There are two visible wavelengths which are reinforced.
- There are three visible wavelengths which are reinforced.
- No other visible wavelengths are reinforced.

Submit Request Answer

Part C

Will any be cancelled?

- ○ There are no visible wavelengths for which there is destructive interference.
- ○ There are two visible wavelengths which are cancelled.
- ○ There is one visible wavelength which is cancelled.

Submit   Request Answer

Part D

Suppose you had contact lenses, so that the eyedrops went on them instead of on your corneas. If the refractive index of the lens material is 1.50 and the layer of eyedrops has the same thickness as in part A, what wavelengths of visible light will be reinforced?

Please Choose

Submit   Request Answer

Part E

What wavelengths will be cancelled?

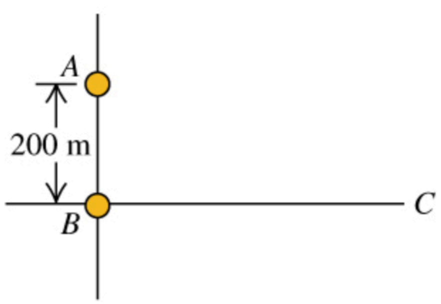
✓ Please Choose
650 nm
600 nm and 650 nm
600 nm
550 nm
There are no cancelled wavelengths.

Provide Feedback

Next

Two radio antennas radiating in phase are located at points A and B, 200 m apart (Figure 1). The radio waves have a frequency of 5.80 MHz. A radio receiver is moved out from point B along a line perpendicular to the line connecting A and B (line BC shown in the figure).

Figure



Review | Constants

Part A

At what distances from B will there be *destructive* interference? (*Note:* The distance of the receiver from the sources is not large in comparison to the separation of the sources, so equation $d\sin\theta = (m + \frac{1}{2})\lambda$ does not apply.)

Express your answers in meters to two significant figures. Enter your answers in ascending order separated by commas.

$x =$ m

Submit Request Answer

Provide Feedback

Next ›

Review | Constants

Laser light of wavelength 510 nm is traveling in air and shines at normal incidence onto the flat end of a transparent plastic rod that has n = 1.30. The end of the rod has a thin coating of a transparent material that has refractive index 1.65.

Part A

What is the minimum (nonzero) thickness of the coating for which there is maximum transmission of the light into the rod?

Express your answer with the appropriate units.

h = Value Units

Submit Request Answer

Part B

What is the minimum (nonzero) thickness of the coating for which transmission into the rod is minimized?

Express your answer with the appropriate units.

h = Value Units

Submit Request Answer

Problem 35.47

Review | Constants

Red light with wavelength 700 nm is passed through a two-slit apparatus. At the same time, monochromatic visible light with another wavelength passes through the same apparatus. As a result, most of the pattern that appears on the screen is a mixture of two colors; however, the center of the third bright fringe ($m = 3$) of the red light appears pure red, with none of the other color.

Part A

What are the possible wavelengths of the second type of visible light?

Express your answer in nanometers. If there is more than one wavelength, enter each wavelength separated by a comma.

λ_2 = nm

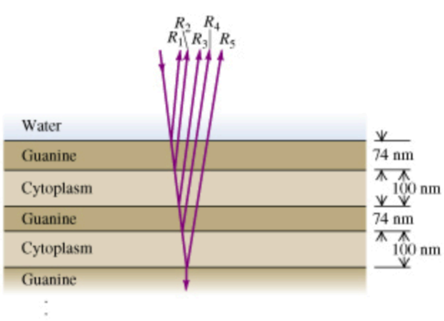
Submit Request Answer

Provide Feedback

Next >

Herring and related fish have a brilliant silvery appearance that camouflages them while swimming in a sunlit ocean. The silveriness is due to *platelets* attached to the surfaces of these fish. Each platelet is made up of several alternating layers of crystalline guanine (n = 1.80) and of cytoplasm (n = 1.333, the same as water), with a guanine layer on the outside in contact with the surrounding water (Figure 1). In one typical platelet, the guanine layers are 74 nm thick and the cytoplasm layers are 100 nm thick.

Figure



Review | Constants

Part A

For light striking the platelet surface at normal incidence, for which vacuum wavelengths of visible light will all of the reflections R_1, R_2, R_3, R_4, and R_5, shown in the figure, be approximately in phase?

Express your answer in nanometers.

ΑΣφ ?

λ = nm

Submit Request Answer

Part B

Is such a “stack” of layers more reflective than a single layer of guanine with cytoplasm underneath?

- No, because part of the reflected light is caught in secondary reflections, decreasing overall amount of reflected light.
- Yes, because guanine increases reflected fraction of the incident light.
- No, because reflected fraction of the incident light is the same regardless of the number of reflections.
- Yes, because each interface reflects a part of the transmitted light.

Part C

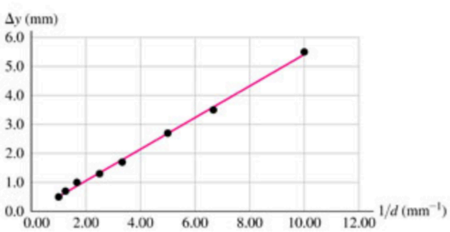
Does the color that is most strongly reflected from a platelet depends on the angle at which it is viewed?

- Yes, the path length of the light in layers changes with the angle and so does the constructively interfered wavelength.
- Yes, like in reflection on a single interface different colors are reflected in different directions.
- No, the reflected light is refracted on multiple interfaces to an extent that there is no distinctive direction with the constructive interference of a particular color.
- No, thicknesses of the layers are the same regardless of the angle so the constructive interference occurs in all directions.

In your summer job at an optics company, you are asked to measure the wavelength λ of the light that is produced by a laser. To do so, you pass the laser light through two narrow slits that are separated by a distance d. You observe the interference pattern on a screen that is 0.950 m from the slits and measure the separation Δy between adjacent bright fringes in the portion of the pattern that is near the center of the screen. Using a microscope, you measure d. But both Δy and d are small and difficult to measure accurately, so you repeat the measurements for several pairs of slits, each with a different value of d. Your results are shown in (Figure 1), where you have plotted Δy versus $1/d$. The line in the graph is the best-fit straight line for the data.

Figure

1 of 1



Review | Constants

Part A

Explain why the data points plotted this way fall close to a straight line.

- In theory the relationship is $\Delta y = \frac{R\lambda^2}{d}$.
- In theory the relationship is $\Delta y = \frac{R\lambda}{d^2}$.
- In theory the relationship is $\Delta y = \frac{R^2\lambda}{d}$.
- In theory the relationship is $\Delta y = \frac{R\lambda}{d}$.

Submit Request Answer

Part B

Use (Figure 1) to calculate λ.

Express your answer with the appropriate units.

λ = Value Units

Review | Constants

(Figure 1) shows an interferometer known as *Fresnel's biprism*. The magnitude of the prism angle A is extremely small.

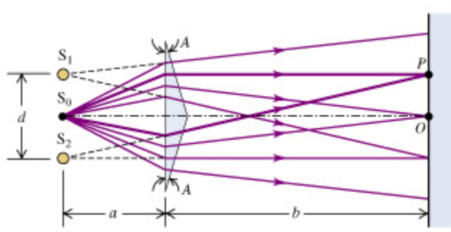
Part A

If S_0 is a very narrow source slit, what is the correct expression for the separation of the two virtual coherent sources S_1 and S_2? The index of refraction of the material of the prism is n.

- $d = aA(n-1)$
- $d = aA(n+1)$
- $d = 2aA(n+1)$
- $d = 2aA(n-1)$

Submit Request Answer

Figure



Part B

Calculate the spacing of the fringes of green light with wavelength 520 nm on a screen 2.00 m from the biprism. Take a = 0.200 m, A = 3.30 mrad, and n = 1.60.

Express your answer in meters.

Δy = m