

Physics Problem Set 4 - due Mon. April 25 by 6pm (8929179)

Question

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

1. Question Details

OSColPhys1 24.P.001.WA. [2668129]

The Curiosity Rover has recently landed on Mars and likes to send Twitter updates on its progress. If a tweet is posted 10 minutes after it was sent, how far is Curiosity from Earth? (Assume there is no network lag.)

  1.80e+11 m

Supporting Materials

[Physical Constants](#)

2. Question Details

OSColPhys1 24.P.022.WA. [2668237]

Radar is used to determine distances to various objects by measuring the round-trip time for an echo from the object.

(a) How far away is the planet Venus if the echo time is 875 s?

  1.31e+11 m

(b) What is the echo time for a car 80.0 m from a Highway Patrol radar unit?

  0.533 μ s

Supporting Materials

[Physical Constants](#)

3. Question Details

OSColPhys1 24.P.015.WA. [2668211]

Two microwave frequencies are authorized for use in microwave ovens: 900 and 2565 MHz. Calculate the wavelength of each.

(a)  33.3 cm (frequency = 900 MHz)

(b)  11.7 cm (frequency = 2565 MHz)

Supporting Materials

[Physical Constants](#)

4. Question Details

OSColPhys1 24.P.017.WA. [2668253]

Electromagnetic radiation having a 15.3 μ m wavelength is classified as infrared radiation. What is its frequency?

  1.96e+13 Hz


Supporting Materials

[Physical Constants](#)

5. Question Details

OSColPhys1 24.P.029.WA. [2692038]

You have been taken to the emergency room. To get a constant update on your vital signs, equipment is attached to you, including a pulse oximeter. The pulse oximeter shines two LEDs on your finger to test how much oxygen is in your blood. One LED transmits in infrared (903 nm) and one transmits in visible red (656 nm). What are the frequencies of these LEDs?

red  4.57e+14 Hz
infrared  3.32e+14 Hz

Supporting Materials

[Physical Constants](#)

6. Question Details

OSColPhys1 27.P.008.WA. [2668238]

Working in lab class you shine a green laser (5.65×10^2 nm) onto a double slit with a separation of 0.290 mm. What is the distance between the first and second dark fringe that shines on the wall 1.80 m away?

 0.00351 m

Supporting Materials

[Physical Constants](#)

7. Question Details

OSColPhys1 27.P.012.WA. [2667959]

You shine an orange laser (632 nm) on a double slit in an experiment you perform in your physics lab. Measuring with a protractor you see that the interference pattern makes the first fringe at 18.0° with the horizontal. What is the separation between the slits?

 2.05e-06 m

Supporting Materials

[Physical Constants](#)

8. Question Details

OSColPhys1 27.P.009.WA. [2667974]

A 2000 Hz sound wave passes through a wall with two narrow openings 30 cm apart. If sound travels on average 354 m/s, find the following.

(a) What is the angle of the first order maximum?

 36.2 °

(b) Find the slit separation when you replace the sound wave with a 2.65 cm microwave, and the angle of the first order maximum remains unchanged.

 0.0449 m

(c) If the slit separation is $1.00 \mu\text{m}$, what frequency of light gives the same first order maximum angle?

 5.08e+14 Hz

Supporting Materials

[Physical Constants](#)

9. Question Details

OSColPhys1 27.P.010.WA. [2667982]

The double slit experiment is a quintessential wave experiment in physics. Given a sixth order fringe 4.90 cm away from the central fringe, a double slit with slit separation 0.0530 mm, and a gap between the slits and the fringes of 1.90 m, find the following.

(a) wavelength

  228 nm

(b) separation between adjacent fringes

  0.817 cm

Supporting Materials

[Physical Constants](#)

10. Question Details

OSColPhys1 27.P.023.WA. [2692027]

What is the spacing between structures in a feather that acts as a reflection grating, given that they produce a first-order maximum for 545-nm light at a 29.4° angle?

  1.11e-06 m

Supporting Materials

[Physical Constants](#)

11. Question Details

OSColPhys1 27.P.024.WA. [2668205]

What is the distance between fringes produced by a diffraction grating having 150 lines per centimeter for 615 nm light, if the screen is 1.50 m away?

  0.0138 m

Supporting Materials

[Physical Constants](#)

12. Question Details

OSColPhys1 27.P.026.WA. [2668334]

(a) Calculate the angle at which a 1.90- μm wide slit produces its first minimum for 410-nm violet light. Enter your result to the nearest 0.1°.

  12.5 °

(b) Where is the first minimum for 740-nm red light?

  22.9 °

Supporting Materials

[Physical Constants](#)

13. Question Details

OSColPhys1 27.P.027.WA. [2667957]

(a) What is the width of a single slit that produces its first minimum at 60.0° for 575-nm light?

  6.64e-07 m

(b) Using the slit from part (a), find the wavelength of light that has its first minimum at 61.1° .

  581 nm

Supporting Materials

[Physical Constants](#)

14. Question Details

OSColPhys1 27.P.040.Tutorial.WA. [2668124]

The width of a telescope aperture is important because it determines what you will be able to resolve.

(a) You are out stargazing with your 12.2-cm telescope. You point your telescope at an interesting formation in the sky, which you think is a binary star system. A binary star system consists of two stars in orbit around each other. You guess that the average wavelength coming from the stars is 574 nm. What is the minimum angular separation between the two stars required for your telescope to resolve the two stars of the binary system?

  5.74e-06 rad

(b) Having graduated with a degree in astronomy, you seek a job at the Arecibo radio telescope. You use a large radio telescope (300-m diameter) to observe the same binary system that you observed in part (a). You estimate that the average radio emissions from the system have a wavelength of 5.30 cm. What is the minimum angular separation required for the Arecibo telescope to resolve the two stars of the binary system?

  0.000216 rad

Supporting Materials

[Physical Constants](#)

15. Question Details

OSColPhys1 27.P.043.WA. [2668105]

What is the minimum diameter mirror on a telescope that would allow you to see details as small as 5.20 km on the Moon some 384,000 km away? Assume an average wavelength of 542 nm for the light received.

  4.88 cm

Supporting Materials

[Physical Constants](#)