

Diffraction Questions from 12.2A

Young's Double Slit:

- Two slits are separated by a small distance and are illuminated by 575 nm light. The interference pattern has bright fringes that are 1.20 cm apart on a screen that is 2.46 m away. A. What distance separates the two slits? B. What is the angle between the second order and the fifth order fringes on one side? (0.118 mm or 1.18×10^{-4} m, 0.839°)
- Two slits are separated by a distance of 0.145 mm and are illuminated by monochromatic light. The interference pattern has bright fringes separated by 1.41 cm and falls on a screen that is 3.95 m away. A. What is the wavelength of light? B. What is the distance on the screen between the central maximum and the fourth order maximum? (518 nm, 5.64 cm)
- Two slits are separated by a distance of 0.102 mm and are illuminated by 632.8 nm light. The interference pattern has fringes separated by a distance of 2.65 cm on a screen some distance away. A. What is the distance to the screen? B. What is the angle between the central maximum and the fourth order maximum? (4.27 m, 1.42° or 0.0248 rad)
- Two slits are separated by a small distance and are illuminated by 478 nm light. The interference pattern has fringes separated by 1.65 cm on a screen that is 2.25 m away. A. What distance separates the slits? B. What is the distance on the screen between the first order and the third order maximum on one side? (0.0652 mm or 6.52×10^{-5} m, 3.30 cm)
- Two slits are separated by a distance of 0.188 mm and are illuminated by 632.8 nm light. The interference pattern falls on a screen that is 3.24 m away. A. What distance separates the fringes on the screen? B. What is the angle between the central maximum and the second order maximum? (1.09 cm, 0.386° or 0.00673 rad)

Single Slit:

- A single slit has a diameter of 0.152 mm and is illuminated by 743 nm light. The interference pattern is projected on a screen that is 2.57 m away. What is the distance on the screen from the center of the central maximum to the center of the second maximum on one side? (3.14 cm)
- A single slit has a diameter of 0.132 mm and is illuminated by monochromatic light. A screen 1.83 m away has a pattern where the center of the central maximum is separated from the center of the next maximum by a distance of 1.41 cm. What is the wavelength of light? (678 nm)
- A single slit is illuminated by 524 nm light. A screen 3.20 m away has a central maximum pattern where the first minimum on one side is separated from the second by a distance of 1.32 cm. What is the diameter of the slit? (0.127 mm or 1.27×10^{-4} m)
- A single slit has a diameter of 0.0795 mm and is illuminated by 632.8 nm light. A screen some distance away has a central maximum pattern that is 3.65 cm wide. What is the distance to the screen? (2.29 m)
- A single slit has a diameter of 0.189 mm and is illuminated by 614 nm light. The interference pattern is projected on a screen that is 3.51 m away. What is the distance on the screen from the center of the first maximum on the left side to the center of the first maximum on right side? (3.42 cm)

Diffraction Gratings:

- A diffraction grating is illuminated by a 596 nm light. There is an angle of 37.2° between the central maximum and the third order fringe on one side. A. How many lines per cm does the grating have? B. How wide does the beam of light have to be to resolve the two wavelengths 596.147 nm and 596.217 nm in the first order using the same diffraction grating? (3381 lines/cm, 2.52 cm)
- A diffraction grating has 5616 lines per cm. It is illuminated by a monochromatic light, and the central maximum and third order fringe are separated by 32.0° . A. What is the wavelength of the light? B. What is the smallest difference in wavelength this grating can resolve in the first order given a beam that is 2.20 mm wide, and 632 nm light? (315 nm, 0.512 nm)
- A diffraction grating has 3214 lines per cm. It is illuminated by 589 nm light. A. What angle separates the second order and the fourth order fringes? B. For what wavelength of light could this grating resolve a difference of 0.550 nm in the first order if the beam of light is 3.50 mm wide? (27.0° between, 619 nm)
- A diffraction grating is illuminated by a 682 nm light beam that is 1.62 mm wide. There is an angle of 5.85° between the central maximum and the second order fringe on one side. A. How many lines per cm does the grating have? B. What is the smallest difference in wavelength from 682 nm this setup can resolve in the first order? (747 lines/cm, 5.63 nm)
- A diffraction grating has a distance of 3.05×10^{-6} m between lines. It is illuminated by a monochromatic light beam. There is an angular separation of 7.21° between the central maximum and the first order fringe. A. What is the wavelength of light? B. How wide does the beam of light have to be to resolve the two wavelengths 412.117 nm and 412.243 nm in the second order using the same diffraction grating? (383 nm, 4.99 mm)