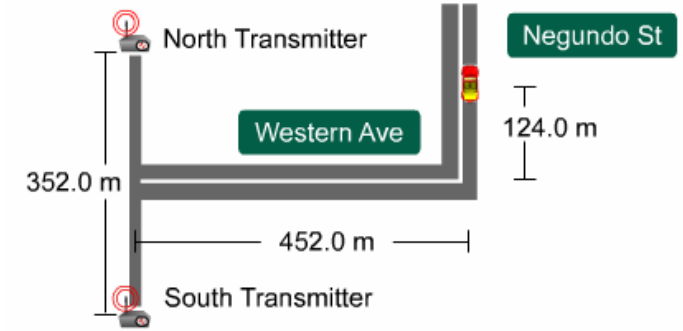
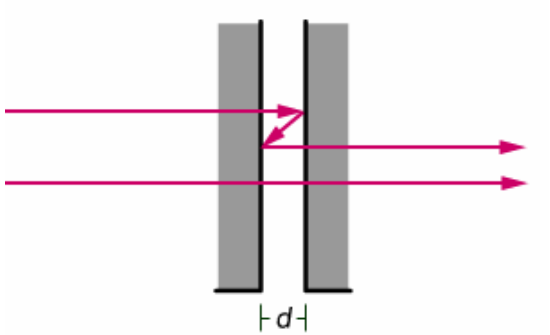
Quiz 6 for interference and diffraction

1. Two shortwave radio antennas broadcast identical, in-phase signals at the same frequency. The transmitters are 176.0 m north, and 176.0 m south of Western Ave, respectively, as shown (that is, they are separated by 352.0 m). Western Ave is 452.0 m long. Starting at the end of that avenue, a car drives north along Negundo Street, which lies parallel to the line joining the two radio antennas. The car first encounters a minimum in reception after it travels 124.0 m. What is the wavelength of the radio waves? Assume that the car and the transmitters are all at the same altitude.



2. A Fabry-Perot interferometer consists of two parallel partially-reflecting plates placed a distance d from each other as shown. The beam that passes straight through interferes with the beam that reflects once off each of the mirrored surfaces. (The reflected beams are essentially perpendicular to the mirrors. The angles of reflection are exaggerated – and unequal to the angles of incidence – in this diagram.) For light of wavelength 622 nm, what is the smallest, nonzero value of d that results in constructive interference?



3. A spy plane flies at a height of 21 km above Earth's surface. If you wanted to equip the plane with a camera that could resolve objects of width 1.0 cm, about enough to make out a license plate number, what diameter aperture would the camera need to have? Assume the light has a wavelength of 550 nm

4. Light of a particular wavelength shines on a single slit of width 1.20e−4 m, creating a diffraction pattern with the first dark fringe at an angle of 0.224° from the centerline. If the same light shines instead on two even narrower slits, the interference pattern has its first dark fringe (the one adjacent to the central maximum) at the same angle. What is the distance between the centers of the two slits?