LASER PROBLEMS

More difficult problems are indicated with an asterisk.

1. A helium neon laser emits light of 632.8 nm wavelength. This corresponds to what energy transition?

2.* How would the laser speckle pattern seen by an observer change if the observer were to place a very small pinhole in front of his eye?

3.* A helium-neon laser aimed at a matte surface moving slowly to the right produces a speckle pattern which an observer perceives as being stationary. A green laser beam is now aimed at an adjacent part of the surface. If the red speckle pattern remains stationary, what movement would be expected of the green speckle pattern?

4.* A laser refraction apparatus consists of a helium-neon laser aimed at a matte surface on a slowly rotating drum 6 m from a patient. When the drum is vertical the patient reports no speckle pattern motion when looking through a -2.00 D lens. When the drum is horizontal, the patient sees no speckle motion when looking through a -3.00 D spherical lens. What is the patient's spectacle prescription?

5. What wavelength photon can cause an electron to fall from a –18 ev energy level to a –20 ev energy level, with emission of a second photon. What is the wavelength of the second photon?

ANSWERS

1. 1.96 ev

2. Because the speckles are formed by diffraction through the pupil, the artificial pinhole pupil would increase the size of the speckles.

3. Because of chromatic aberration, the focus of green light will lie in front of the retina, so the green speckle pattern will move in the same direction as the matte surface, to the right, just as it would for a myope.

4. What the laser refractor is doing here is refracting the horizontal and vertical meridians of the eye, so called meridional refraction. The prescription in cross-cylinder form is
-2.00 DCx090/-3.00 DCx180, where DC means diopters of cylinder power. This can be written -2.00/-1.00x180 in the usual optometric notation.

5. Both photons will have 620 nm wavelength.