Physics 202 MWF 10:20 Spring 2006 (Ford)

Name (printed) With Answers

Name (signature as on ID)_____

Lab Section_____

Exam IV Chapts. 27, 29, 30 in Cutnell and Johnson 6e

Multiple choice questions. Circle the correct answer. No work need be shown and no partial credit will be given.

(4 pts) 1. Coherent monochromatic light passes through a narrow slit and the diffraction pattern is observed on a screen. When the apparatus (source, slit, screen) is in air, the width of the central diffraction maximum on the screen is 2.0 mm. If the space between the slit and the screen is filled with water, the width of the central diffraction maximum would

(a) increase

b (b) decrease

(c) remain the same

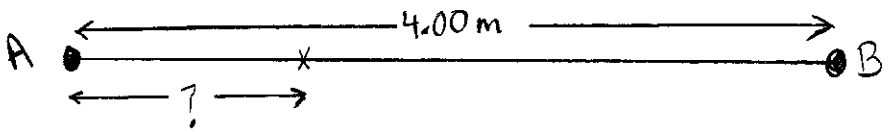
(4 pts) 2. Coherent monochromatic light passes through a narrow slit and the diffraction pattern is observed on a screen. If the width of the slit is decreased, the width of the central maximum will

a (a) increase

(b) decrease

(c) remain the same

(4 pts) 3. Two in-phase sources of waves, speakers A and B, are separated by a distance of 4.00 m. The sources produce identical waves that have a wavelength of 5.00 m. Consider points on the line connecting the two sources. What is the closest distance to speaker A where destructive interference will be observed?



(a) 0.25 m

(b) 0.50 m

C (c) 0.75 m

(d) 1.00 m

(e) 1.25 m

(f) 1.50 m

(g) 1.75 m

(h) 2.00 m

(i) none of the above

(4 pts) 4. Light of wavelength 200 nm shines on a clean metal surface and photoelectrons are produced that have maximum kinetic energy of 1.6 eV. If the intensity of the light is increased while the wavelength is kept the same, the maximum kinetic energy of the photoelectrons

(a) increases
(b) decreases
c (c) stays the same

(4 pts) 5. Light of wavelength 200 nm shines on a clean metal surface and photoelectrons are produced that have maximum kinetic energy of 1.6 eV. If the wavelength of the light is increased while the intensity is kept the same, the maximum kinetic energy of the photoelectrons

(a) increases
b (b) decreases
(c) stays the same

(4 pts) 6. When a hydrogen atom ($Z = 1$) undergoes a transition from the $n = 3$ to the $n = 2$ level, the wavelength of the photon emitted is 656 nm. When a helium ion He^+ ($Z = 2$) undergoes the transition from the $n = 3$ to $n = 2$ level, the wavelength of the photon emitted is

(a) 656 nm
(b) larger than 656 nm
c (c) smaller than 656 nm

(4 pts) 7. Take the zero of energy to be so that the ground state of atomic hydrogen has energy -13.6 eV. In the Bohr model, an excited state of a hydrogen atom has angular momentum $2(h/2\pi)$. The energy of this state is

(a) -13.6 eV
(b -11.6 eV
(c) -7.8 eV
d (d) -3.4 eV
(e) -2.0 eV
(f) none of the above

Show all your work. Partial credit will be given if earned. Write your answers in the blanks provided.

(18 pts) 8.
(a) Coherent monochromatic light passes through two very narrow slits that are separated by 6.00×10^{-5} m. The interference pattern is observed on a screen that is 4.50 m from the slits. The spacing between the first and second order bright fringes is 0.037 m. What is the wavelength of the light?

Ans. 493 nm

(b) Coherent monochromatic light passes through a single narrow slit that is 6.00×10^{-5} m wide. The diffraction pattern is observed on a screen that is 4.50 m from the slit. The width of the central diffraction maximum is 0.037 m. What is the wavelength of the light?

Ans. 247 nm

(16 pts) 9. Light of wavelength 500 nm in air is incident perpendicularly on a soap film ($n = 1.33$) that has air on either side of the film. What is the smallest nonzero thickness of the film for which light reflected from the two surfaces of the film will interfer destructively?

Ans. 188 nm

(17 pts) 10. A photon with wavelength $\lambda = 0.0300$ nm is incident on an electron that is initially at rest. If the photon scatters in the backward direction, what is the momentum of the electron just after the collision with the photon?

Ans. 4.11×10^{-23} kg.m/s

(21 pts) 11.
a) What are the wavelength and momentum (in units of kg·m/s) of a photon that has energy 6.0 eV?

Ans. $\lambda =$ 207 nm

$p =$ 3.2×10^{-27} kg·m/s

b) What is the de Broglie wavelength of an electron moving in empty space with kinetic energy 6.0 eV?

Ans. 0.501 nm

c) An atom in an excited state emits a photon with wavelength 500 nm. What is the energy change of the atom, in eV, when it emits a photon of this wavelength?

Ans. 2.49 eV