Physics 202 MWF 10:20 Spring 2005 (Ford)

Name (printed) with Answers

Name (signature as on ID)_____

Lab Section_____

Exam IV Chapts. 27, 29, 30 in Cutnell and Johnson 5e

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

(4 pts) 1. A photon has energy 6.0 eV and linear momentum p_1. A photon with linear momentum $2p_1$ has energy

(a) 1.5 eV
(b) 3.0 eV
(c) 6.0 eV
d (d) 12.0 eV
(e) 24.0 eV
(f) 48.0 eV

(4 pts) 2. Photoelectrons are ejected from a metal surface when light of wavelength λ shines on the surface. Which of the following will cause the maximum kinetic energy of the photons to increase:

b (a) increase λ
(b) decrease λ
(c) increase the intensity of the light

(4 pts) 3. Light of frequency f and wavelength λ passes through a slit of width W and produces a diffraction pattern on a screen a distance L from the screen. Which of the following will increase the width of the central diffraction maximum:

b (a) increase W
(b) decrease W
(c) decrease λ
(d) increase f

(4 pts) 4. Light of wavelength λ passes through a diffraction grating and produces an interference pattern on a screen. The distance between the bright lines near the center of the screen is 3.00 mm. If the separation d between the slits in the grating is doubled, the distance between the bright lines becomes:

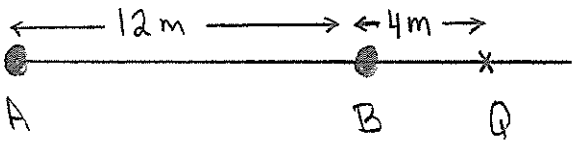
(a) 0.75 mm
b (b) 1.50 mm
(c) 3.00 mm
(d) 4.50 mm
(e) 6.00 mm
(f) 12.0 mm

(4 pts) 5. In the Bohr model, what is the energy in eV of the state of the hydrogen atom for which the electron has angular momentum $3(h/2\pi)$?

(a) -13.6 eV
(b) -6.80 eV
(c) -4.53 eV
(d) -3.40 eV
e (e) -1.51 eV
(f) -0.86 eV

(5 pts) 6. Two radio antennas A and B radiate identical waves in phase. Antenna B is 12.0 m to the right of antenna A. Consider a point Q along the extension of the line connecting the antennas,a horizontal distance of 4.0 m to the right of antenna B. The wavelength of the waves emitted by the antennas can be varied. What is the longest wavelength for which there will be destructive interference at point Q?

a (a) 24.0 m
(b) 16.0 m
(c) 12.0 m
(d) 8.0 m
(e) 4.0 m
(f) 2.0 m



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

(14 pts) 7. What is the kinetic energy of an electron that has a de Broglie wavelength equal to the wavelength of a 5.0 eV photon?

Ans. 3.92×10^{-24} J
$= 2.45 \times 10^{-5}$ eV

(15 pts) 8. An incident photon with wavelength 0.03000 nm scatters from an electron that is initially at rest. If the scattered photon is traveling in the opposite direction from the incident photon, what is the momentum of the electron after it is struck by the photon?

Ans. 4.11×10^{-23} kg·m/s

(16 pts) 9. When an electromagnetic wave with wavelength 200 nm shines on a metal surface the maximum kinetic energy of the photoelectrons that are produced is 3.0 eV. What is the longest wavelength electromagnetic wave that will produce photoelectrons from this surface?

Ans. 387 nm

(16 pts) 10. Light of wavelength 600 nm in air falls perpendicularly on a thin film of gasoline ($n = 1.40$) that is floating on water ($n = 1.33$). What is the minimum nonzero thickness of the film for which there is constructive interference in the reflected light?

Ans. 107 nm

(14 pts) 11. In the emission spectrum of a hydrogen atom,the Paschen series wavelengths are emitted in transitions for which the final state has $n = 3$. What are the longest and shortest wavelengths for the Paschen series?

Ans. longest 1875 nm

Ans. shortest 820 nm