Physics 133, Quiz 3, Spring 2006; 3:30

Name: __KEY__

TA: _____

$\lambda = h/p$ $E = hf = hc/\lambda$ Flux $= I/E_{ph}$ Intensity $I = P_{source}/A$ Single slit width $w = 2\lambda L/a$

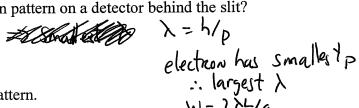Multiple choice: choose the best answer for each question.

1) A proton, an electron and an oxygen atom each pass at the same speed through a 1-μm-wide slit. Which will produce a wider diffraction pattern on a detector behind the slit?

A. The proton.
B. The electron.
C. The oxygen atom.
D. All three will be the same.
E. None of them will produce a diffraction pattern.

$\lambda = h/p$

electron has smallest p
$\therefore$ largest λ
$w = 2\lambda L/a$

2) Light beams A and B have the same intensity but λ_A is longer than λ_B. The photon flux (number crossing a unit area per unit time) is:

A. Greater for A than for B
B. Greater than B than for A
C. The same for A and B
D. Not enough info to decide

$E_A = hc/\lambda_A$ $E_B = hc/\lambda_B$

$\Rightarrow E_A < E_B$

$Flux = \dfrac{I}{E_{ph}}$ $\therefore$ Flux A > Flux B

3) Monoenergetic electrons are incident on a single slit barrier. If the energy of each incident electron is increased the central maximum of the diffraction pattern:

A. widens
B. narrows
C. Stays the same
D. Depends on the speed of the electrons

if E increases, p increases, λ decreases

$w = \dfrac{2\lambda L}{a}$ decreases

4) A photon in light beam A has twice the energy of one in light beam B. The ratio of λ_A / λ_B of the wavelengths is:

A. 1/2
B. 1/4
C. 1
D. 2
E. 4

$\lambda_A = \dfrac{hc}{E_A}$ $\lambda_B = \dfrac{hc}{E_B}$

$\dfrac{\lambda_A}{\lambda_B} = \left(\dfrac{hc}{E_A}\right)\left(\dfrac{E_B}{hc}\right) = \dfrac{E_B}{E_A} = \dfrac{E_B}{2E_B} = \dfrac{1}{2}$

5) J. J. Thomson's conclusion that cathode ray particles are *fundamental* constituents of atoms was based primarily on which observation?

A. They have a negative charge.
B. They are the same from all cathode materials.
C. Their mass is much less than hydrogen.
D. They penetrate very thin metal foils.