NAME

PHYS-1200 PHYSICS II QUIZ 3 DECEMBER 7, 2005

SOLUTIONS

PART A.

1. E
2. B
3. D
4. E
5. D
6. D
7. A
8. A

PART B.

1. a) The answer can be read off the graph, where the stopping potential equals zero.

$\underline{f_c = 6.0 \times 10^{14} \text{ Hz}}$

b) When the stopping potential equals zero, $0 = hf_c - \Phi$, so $\Phi = hf_c$.

$\Phi = (6.63 \times 10^{-34}\ \text{J}\cdot\text{s})(6.0 \times 10^{14}\ \text{Hz})$ $\underline{\Phi = 4.0 \times 10^{-19}\ \text{J} = 2.5\ \text{eV}}$

2. a) From the symmetry of the graph, it is clear that 1/3 of the area under the plotted curve is in the range from $x = 0$ to $x = L/3$. Each of the three peaks is equal.

$$\int_0^{L/3} |\psi_3|^2\, dx = \underline{1/3 = 0.33}$$

b) I deduced the answer based on the symmetry of the wave function.

NAME

PART C.

1. a)

405 nm	VIOLET
436 nm	BLUE
546 nm	GREEN
578 nm	YELLOW

b) 405 nm. The first minimum is at $\sin\theta = \frac{1.22\lambda}{d}$. This is smallest for the shortest wavelength.

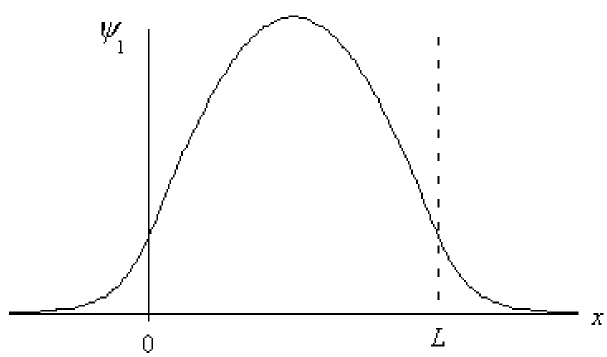
c) $I = \frac{P}{A} = \frac{P}{\pi r^2} = \frac{3.0\text{ W}}{\pi(2.5\times10^{-2}\text{ m})^2}$ <u>$I = 1.5\times10^3$ W/m² = 1500 W/m²</u>

d) The radius of the central maximum is given by $R = D\tan\theta$ where θ is the angular location of the first diffraction minimum. θ is given by $\sin\theta = \frac{1.22\lambda}{d}$. Then,

$R = D\frac{1.22\lambda}{d}$, since sin θ = tan θ. Since *D*, and *d* are the same for both wavelengths,

$\frac{R_2}{R_1} = \frac{\lambda_2}{\lambda_1}$, or $R_2 = R_1\frac{\lambda_2}{\lambda_1} = (2.5\text{ cm})\frac{436\text{ nm}}{546\text{ nm}}$ <u>$R = 2.0$ cm</u>

2. a)



b) **Greater than 2.0 nm** For an infinitely deep well, the wavelength would be double the width of the well. For a finite well, the wavelength must be greater.

c) $E_{ph} = hf = \frac{hc}{\lambda} = \frac{(6.63\times10^{-34}\text{ J}\cdot\text{s})(3.0\times10^8\text{ m/s})}{620\times10^{-9}\text{ m}}$ <u>$E_{ph} = 3.2\times10^{-19}$ J = 2.0 eV</u>

d) $\boldsymbol{E_3}$ **= 2.27 eV** $E_1 + E_{ph} = 0.27\text{ eV} + 2.0\text{ eV} = 2.27\text{ eV} = E_3$