

PHYS 20323/60323: Fall 2020

Assignment #12

Due: Friday Nov. 13, 2020

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PHYS 20323/60323: Fall 2020 - LaTeX Example

1. Consider a particle confined in a two-dimensional infinite square well

$$V(x,y) = \begin{cases} 0, & \text{if } 0 \leq x \leq a, \ 0 < y < a \\ \infty, & \text{otherwise} \end{cases}$$

The eigenfunctions have the form:

$$\Psi(x,y) = \frac{2}{a} \sin\left(\frac{n\pi x}{a}\right) \sin\left(\frac{m\pi y}{a}\right)$$

with the corresponding energies being given by:

$$E_{nm} = (n^2 + m^2) \frac{\pi^2 \hbar^2}{2ma^2}$$

- (a) (5 points) What are the levels of degeneracy of the five lowest energy values?
 (b) (5 points) Consider a perturbation given by:

$$\hat{H}' = a^2 V_0 \delta\left(x - \frac{a}{2}\right) \delta\left(y - \frac{a}{2}\right)$$

Calculate the first order correction to the ground state energy.

2. **The following questions refer to stars in the Table below.**

Note: There may be multiple answers.

Name	Mass	Luminosity	Lifetime	Temperature	Radius
Zeta	$60. M_{\text{sun}}$	$10^6 L_{\text{sun}}$	8.0×10^5 years		
Epsilon	$6.0 M_{\text{sun}}$	$10^3 L_{\text{sun}}$		20,000 K	
Delta	$2.0 M_{\text{sun}}$		5.0×10^8 years		$2 R_{\text{sun}}$
Beta	$1.3 M_{\text{sun}}$	$3.5 L_{\text{sun}}$			
Alpha	$1.0 M_{\text{sun}}$				$1 R_{\text{sun}}$
Gamma	$0.7 M_{\text{sun}}$		4.5×10^{10} years	5000 K	

- (a) (4 points) Which of these stars will produce a planetary nebula at the end of their life.
 (b) (4 points) Elements heavier than *Carbon* will be produced in which stars.