

PHYS 20323/60323: Fall 2021 - 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_{sun}	$10^6 L_{sun}$	8×10^5 years		
Epsilon	6.0 M_{sun}	$10^3 L_{sun}$		20,000K	
Delta	2.0 M_{sun}		5×10^8 years		2 R_{sun}
Beta	1.3 M_{sun}	3.5 L_{sun}			
Alpha	1.0 M_{sun}				1 R_{sun}
Gamma	0.7 M_{sun}		4.5×10^{10} years	5000K	

- (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.