

PHYSICS 20323/60323: Scientific Analysis Fall 2019 - LaTeX Example

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

$$V(x, y) = \begin{cases} 0, & 0 \leq x \leq a, 0 < y < a \\ \infty, & \text{otherwise} \end{cases} \quad (1)$$

The eigenfunctions have the form:

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

with the corresponding energies being given by:

$$E_{nm} = (n^2 + m^2) \frac{\pi^2 \hbar^2}{2ma^2} \quad (3)$$

- (a) (5 points) What are the levels of degeneracy of the five lowest energy values?

- (b) (5 points) Consider a perturbation given by:

$$\hat{H}' = a^2 V_0 \delta\left(x - \frac{a}{2}\right) \delta\left(y - \frac{a}{2}\right) \quad (4)$$

Calculate the first order correction to the ground state energy.

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

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