

## PHYS 20323/60323: FALL 2021 - LaTeX example

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

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

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.

Note: There may be multiple answers.

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

(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 star.