

PHYS 20323/60323: Fall 2020- LaTeX Example

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

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

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 the stars in the Table below.

Note: There may be multiple answers.

| Name | Mass | Luminosity | Lifetime | Temperature | Radius |
|---------|---------------|----------------|----------------------------|-------------|-------------|
| Zeta | 60. M_{sun} | $10^6 L_{sun}$ | 8.0×10^5 years | | |
| Epsilon | 6.0 M_{sun} | $10^3 L_{sun}$ | | 20,000 K | |
| Delta | 2.0 M_{sun} | | 5.0×10^8 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 | 5000 K | |

(a) (4 Points) Which of these stars will produce a planetary nebula at the end of their life?

(b) (4Points) Elements heavier than *Carbon* will be produced in which stars?