

## Indian Institute of Technology Goa

<b>CH 107</b>	<b>Physical Chemistry</b>	<b>Quiz</b>
<b>August 21 2017</b>	<b>Total Marks = 10</b>	<b>0830-0930</b>
$h=6.626 \times 10^{-34} \text{ Js}; c=3 \times 10^8 \text{ ms}^{-1}; m_e=9.1 \times 10^{-31} \text{ kg}; m_p=1.672 \times 10^{-27} \text{ kg}; e=6 \times 10^{-19} \text{ C};$ $1 \text{ eV}=1.6 \times 10^{-19} \text{ J}; k_B=1.308 \times 10^{-23} \text{ JK}^{-1}$		

1. Calculate de Broglie wavelength of a He atom traveling at a speed of  $1000 \text{ m s}^{-1}$ . **(2 marks)**
2. Particle in a box model can be applied successfully to  $\pi$ -electrons of hexatriene. Calculate the probability of finding the highest energy electron in a region  $\Delta x = \pm 0.01 \text{ \AA}$  about the center of the molecule, given the length of the molecule to be  $8 \text{ \AA}$  **(3 marks)**
3. Sketch the contours of the wavefunction of a particle in a two dimensional box, with  $n_x = 2, n_y = 3, L_x = 2L_y$ , where  $n_x$  and  $n_y$  are the quantum numbers and  $L_x$  and  $L_y$  are lengths of the box, along  $x$  and  $y$  directions, respectively. **(2 marks)**
4. The  $\phi$ -dependent part of Schrödinger wave equation is:

$$\frac{1}{\Phi(\phi)} \frac{d^2 \Phi(\phi)}{d\phi^2} + m^2 = 0$$

Propose a solution for this equation. Then, apply an appropriate boundary condition and hence determine the allowed values of  $m$ . **(3 marks)**

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