Indian Institute of Technology Guwahati

Tutorial-2 PH1410H: ntroductory Quantum Mechanics Due on :24 March 2026

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1. (a) We know that double slit interference pattern can be observed in the case of an electron beam. In a similar way can we observe interference pattern by making a double slit apparatus with some bigger object , such as a cricket ball (each with mass=160 gm, diameter=7.2 cm)? If not, why?
(b) The beam of electrons in a double slit experiment is replaced by particles of greater mass (keeping d and D same). If the fringe separation of the interference pattern on the screen is to remain same, what must be the change in the kinetic energy?

2. (i) Which of the wave functions shown in the figure below cannot have any physical significance in the interval shown? Give reasons.

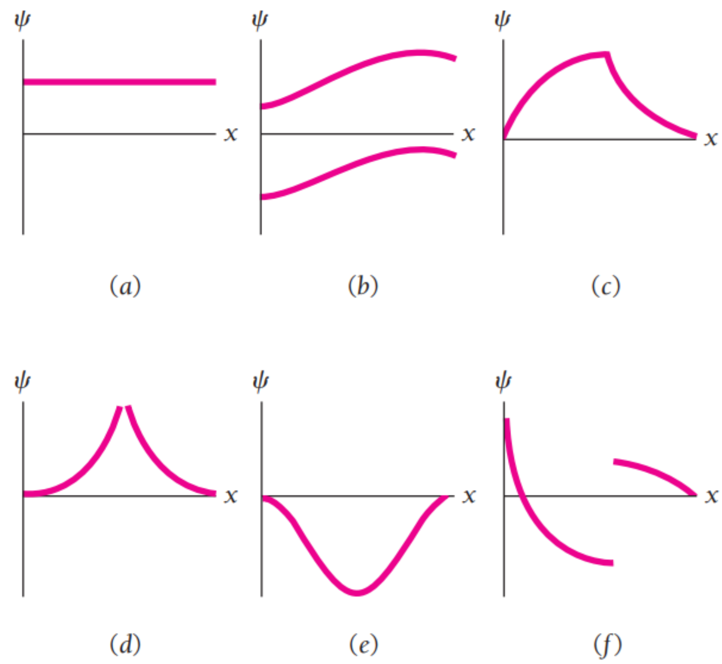

Figure 1:

(ii) Explain whether the following wave functions for all values of x can be that of a physical particle or not, (a) $\psi = A \sec x$, (b) $\psi = A \tan x$, (c) $\psi = Ae^{x^2}$, (d) $\psi = Ae^{-x^2}$.

3. The needle on a broken car speedometer is free to swing and bounces perfectly off the pins at either end so that if you give it a flick, it is equally likely to come to rest at any angle between 0 and π. What is the probability density? Compute $\langle\theta\rangle$, $\langle\theta^2\rangle$ and σ for this distribution.

4. At $t = 0$ a particle is represented by the wave function,

$$\Psi(x,0) = \begin{cases} A\frac{x}{a} & \text{if } 0 \leq x \leq a \\ A\frac{b-x}{b-a} & \text{if } a \leq x \leq b \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

where A, a and b are constants. Find A so that Ψ is square integrable. Make a rough plot of Ψ vs x and find where the particle is most likely to be found at $t = 0$. What is the probability of finding the particle to the left of a?
