Modern physics Ch.6 HW a: 7, 19, 25, 27, and from lecture:
Exercise in probability, infinite square well centered on x=0, and show that stationary states are separable.

7.

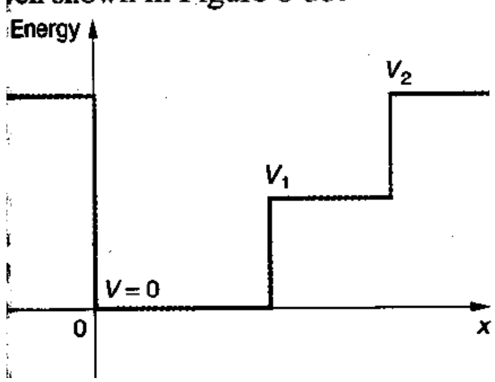
A particle with mass m and total energy zero is in a particular region of space re its wave function is $\psi(x) = Ce^{-x^2/L^2}$. (a) Find the potential energy $V(x)$ versus x and make a sketch of $V(x)$ versus x.

19.

6-19. In the early days of nuclear physics before the neutron was discovered, it thought that the nucleus contained only electrons and protons. If we consider nucleus to be a one-dimensional infinite well with L = 10 fm and ignore relativ compute the ground-state energy for (a) an electron and (b) a proton in the nucle (c) Compute the energy difference between the ground state and the first excited st for each particle. (Differences between energy levels in nuclei are found to be typica of the order of 1 MeV.)

25.

Using arguments concerning curvature, wavelength, and amplitude, sketch very lly the wave function corresponding to a particle with energy E in the finite poten- ell shown in Figure 6-33.



27.

The mass of the deuteron (the nucleus of the hydrogen isotope ^{2}H) is 1.88 GeV/c^2. deep must a finite potential well be whose width is 2×10^{-15} m if there are two y levels in the well?

Exercises in probability: quantitative

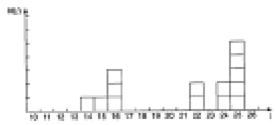


Figure 1.4: Histogram showing the number of people, $N(j)$, with age j, for the example in Section 1.3.

1. Probability that an individual selected at random has age=15?
2. Most probable age? 3. Median? $\langle j\rangle = \frac{\sum jN(j)}{N} = \sum_{j=0}^{\infty} jP(j)$
4. Average = expectation value of repeated measurements of many identically prepared system:
5. Average of squares of ages = $\langle j^2\rangle = \frac{\sum j^2N(j)}{N} = \sum_{j=0}^{\infty} j^2P(j)$
6. Standard deviation σ will give us uncertainty principle...

Exercises in probability: uncertainty

Standard deviation σ can be found from the deviation from the average: $\Delta j = j - \langle j\rangle$

But the average deviation vanishes: $\langle \Delta j\rangle = 0$

So calculate the average of the square of the deviation: $\sigma^2 = \langle (\Delta j)^2\rangle$

Exercise: show that it is valid to calculate σ more easily by:

$$\sigma^2 = \langle j^2\rangle - \langle j\rangle^2$$

HW: Find these quantities for the exercise above.

<u>Show that stationary states are separable</u>:

Guess that SE has separable solutions Ψ(x,t) = ψ(x) f(t)

$\frac{\partial\Psi}{\partial t} =$ $\frac{\partial^2\Psi}{\partial x^2} =$

sub into SE=Schrodinger Eqn $i\hbar\frac{\partial\Psi}{\partial t} = -\hbar^2\frac{\partial^2\Psi}{\partial x^2} + V\Psi$

Divide by ψ(x) f(t) :

LHS(t) = RHS(x) = constant=E. Now solve each side:

You already found solution to LHS: f(t)=_________

$$\frac{-\hbar^2}{2m}\frac{d^2\psi}{dx^2} + V\psi = E\psi$$

RHS solution depends on the form of the potential V(x).