1. (20%) Describe below in brief.
(a) photoelectric effect, (b) Stern-Gerlach experiment, (c) Boltzmann distribution,
(d) LS coupling, (e) Born postulate, (f) graphene, (g) Pauli principle, (h) degeneracy,
(i) Boson, (j) light amplification by stimulated emission of radiation.

2. (10%) The wavelength of the photoelectric threshold for silver is 3250×10^{-10} m.
Determine the velocity of electron ejected from a silver surface by ultraviolet light
of wavelength 2536×10^{-10} m.

3. (10%) (a) State the ground state electron configuration of hydrogen ($Z = 1$).
　　　　(b) State the ground state electron configuration of sodium ($Z = 11$).

4. (30%) The state of a free particle is described by the following wave function
which is also shown in Fig. 1.
　　$\psi(x) = 0$ for $x < -3a$
　　$\psi(x) = t$ for $-3a < x < a$
　　$\psi(x) = 0$ for $x > a$
(a) Determine t using the normalization condition.
(b) Find the probability of finding the particle in the interval $[0, a]$.
(c) Compute $< x >$.
(d) Compute σ^2.
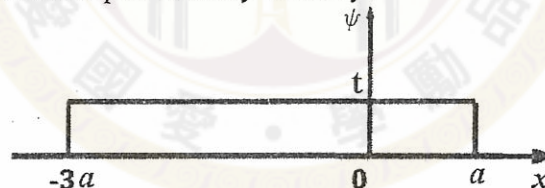(e) Calculate the momentum probability density.

Fig. 1 Uniform distribution of ψ.

5. (30%) The one-dimensional time-independent Schrodinger equation is written as
$$\left(-\frac{\hbar^2}{2m}\right) \frac{d^2\psi(x)}{dx^2} + U(x)\psi(x) = E\psi(x)$$

(a) A particle of mass m is contained in a one-dimensional box of width a. The
potential energy $U(x)$ is infinite at the walls of the box ($x = 0$ and $x = a$) and zero in
between ($0 < x < a$). Solve the Schrodinger equation for this particle and hence
show that the normalized solutions have the form $\psi_n(x) = \left(\frac{2}{a}\right)^{\frac{1}{2}} \sin\left(\frac{n\pi x}{a}\right)$, with
energy $E_n = h^2 n^2 / 8ma^2$, where n is an integer ($n > 0$).
(b) For the case $n = 3$, find the probability that the particle will be located in the
region $\frac{a}{3} < x < \frac{2a}{3}$.
(c) Sketch the wave-functions and the corresponding probability density
distributions for the cases $n = 1, 2$ and 3.

試題隨卷繳回