參考用

10 points each :

1　A brick is thrown straight up from 18 m above the ground by a person standing at the edge of a roof. The brick reaches the ground at a velocity of 24 m/s. Find the velocity with which the brick is thrown (hint: energy conservation)

2　A small block sits 0.15 m from the center of a turntable. The coefficient of static friction between the block and the turntable is 0.55. At what rotational frequency of the turntable will the block begin to slide off?

3　One hundred grams of ice at $0°C$ is dropped into 200 g of water at $49°C$. After melting, the system is left with 300 g of water at $6°C$. Given that the specific heat of water is 1 cal/g · $°C$, calculate the latent heat of fusion of water.

4　A quantity of 0.2 mol of argon gas contained in a volume of 5 L mixes with 0.5 mol of neon gas contained in a volume of 12.5 L, making a total volume of 17.5 L. Both gases are at the same temperature and can be regarded as ideal. What is the change in entropy? (hint: $R = 8.3$ J/mol · K)

5　What is the mean free path in air at sea level when the temperature is 300 K? (hint: 1 atm = 10^5 Pa, $k = 1.38 · 10^{-23}$ J/K, molecular radius ~ 10^{-10} m)

6　Determine the electric field due to an infinite long, straight charged rod with charge density λ. (hint: Gauss law)

7　A wire, whose cross section has a radius R, is carrying a current I. What's the magnetic field as a function of the distance r from the wire's axis inside the wire and outside the wire? (hint: Ampere's law)

8　Diffraction patterns of electron beams are evidence of the wavelike behavior of matter. At what angles do diffraction peaks occur for electrons of kinetic energy 120 eV incident on a crystal whose scattering planes are 0.12 nm apart? (hint: de Broglie wavelength, Bragg's law, Planck's constant = $6.63 · 10^{-34}$ J · s, $m_e = 9.1 · 10^{-31}$ kg, 1 eV = $1.6 · 10^{-19}$ J)

9　A star emits radiation at an intensity of $1.6 · 10^{-9}$ W/m^2 at a wavelength of 560 nm. Estimate the rate at which photons enter the eye from such a star. (hint: speed of light = $3 · 10^8$ m/s, radius of pupil ~2.5 mm)

10　An atom has $Z = 37$ electrons. What are the values of n (principal quantum number) and l (orbital angular momentum quantum number) for the least-tightly-bound electron?