

系所別:

大氣物理研究所

科目:

近代物理學

1. If you were traveling with respect to the stars at a speed close to the speed of light. Could you detect it? (Give your reasons) (5%)
2. If a moving spacecraft that emits a light wave into the vacuum space. Is there any way an observer in the spacecraft could measure any property of the wave, other than the speed of light? (5%)
3. The Doppler effect in sound varies depending on whether the source, or the observer, or both are moving. Does it violate the principle of relativity? (5%)
4. If you see a person traveling through space at half the speed of light, what is the time of his clock running you will see? (5%)
5. A block of matter with a white surface and a block of matter with a black surface of the same size are each heated to the same temperature. Which radiates the most energy? Now consider a cavity that is cut in each block of matter. From which block does the most energy come out of the cavity? (10%) (You must give the explanations for your answers.)
6. Show that a free electron cannot absorb a photon. (10%)
7. An oscillator of mass m moves in a one-dimensional potential
$$V(x) = \frac{1}{2} \kappa x^2,$$
 - (a) What is its time-dependent Schrödinger equation? (5%)
 - (b) Show that the wave function $\Psi(x) = A \exp(-x^2/\sigma^2)$ is a stationary state of the oscillator. (5%)
 - (c) Determine the uncertainty of position Δx of the oscillator at the state in (b). (10%)
 - (d) Determine the energy of the oscillator and the uncertainty of momentum at the state in (b). (10%)
8. What is the principle of a three-level laser? (10%)
9. A gas of 4 particles, each of which can occupy a state of energy $E_n = n\epsilon$, where n is an integer (0,1,2,...). The total energy of the system is $E = 9\epsilon$. List all possible macrostates and determine the number of microstates associated with each macrostate, for (a) a gas of bosons, and (b) a gas of fermions. (10%)
10. A piece of wood from the ruins of ancient dwelling was found to have the ^{14}C activity of 12 disintegrations per minute per gram of its carbon content. The ^{14}C activity of living wood is 16 disintegrations per minute per gram. How long ago did the tree die from which the wood sample came? (The half-life of ^{14}C is 5700 yr.) (10%)

參
考
用