計算題 (5大題)

1. (20%) Describe briefly their contributions to the quantum mechanics (or quantum physics). (a) P. A. M. Dirac (b) E. Shrödinger (c) M. Planck (d) W. Heisenberg (e) N. Bohr

2. (20%) A uniform rope of mass m and length L hangs from a ceiling. (a) Let y be the distance from the lower end. Consider a transverse wave traveling on the rope, compute the velocity of the wave as the function of y. (b) Compute the time to take for the wave to travel through the whole length of the rope.

3. (20%) An engine of the ideal gas undergoes the thermodynamic cycle as shown in Fig.(1A). It starts from B, goes to C in the isobaric process, then goes to D in the adiabatic process, then goes to A, and finally returns to B in the adiabatic process. Compute the efficiency of the engine in terms of their temperatures T_A, T_B, T_C, T_D, and the $\gamma(= c_p/c_v)$.

4. (20%) A uniform thin rod with mass M and length L nailed by a frictionless pivot can swing freely on the wall as shown in Fig.(1B). The pivot locates at the distance $L/4$ from the top end. A small bullet of mass m is shot into the rod at the distance $L/4$ from the bottom and stops inside. The velocity of the bullet before hitting the rod is v. (a) Compute the maximum angle that the rod can reach after the shot. (b) If the swinging angle is small, describe the motion of the whole system (rod+bullet) in detail.

5. (20%) A loop of wire in the shape of a rectangle of width k and length L and a long, straight wire carrying a current I lie on a tabletop as shown in Fig.(1C). (a) Compute the magnetic flux through the loop due to the current I. (b) Suppose the current is changing with time according to $I(t) = I_0 \sin \omega t$, where I_0 and ω are constants. Compute the electromotive force induced in the loop.

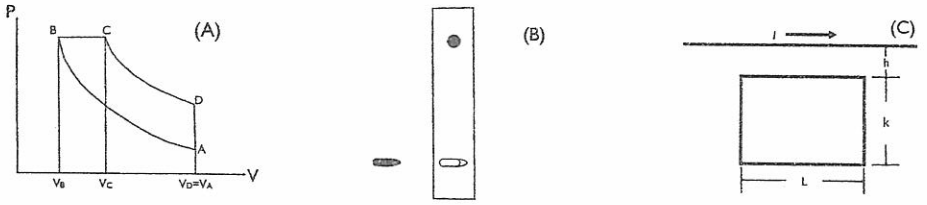

FIG. 1. (A) for problem 3. (B) for problem 4. (C) for problem 5.

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