

國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：普通物理【物理系碩士班】

題號：4046
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1. A block of mass M rests on a frictionless horizontal table and is connected to two fixed posts by spring having spring constants k_1 and k_2 respectively, as shown in Fig. 1.

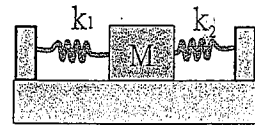


Fig. 1

- (a) If the block is displaced slightly from its equilibrium position, what is the frequency of vibration? (5%)
 (b) Suppose that the block is vibrating with amplitude A and that, at the instant that it is passing through its equilibrium position, a mass m is dropped vertically onto the block and sticks to it. Find the new frequency and new amplitude of vibration. (10%)

2. A marble of mass M and radius R rolls without slipping on an inclined plane making an angle θ with the horizontal.



Fig. 2

- (a) Calculate the acceleration of the center of the marble. (8%)
 (b) If the marble is started with initial velocity v_0 directly up the inclined plane, how long will it be before the marble returns to its starting point? (7%)

3. A long coaxial cable consists of two concentric cylindrical conductors of radii a and b and length h as shown in Fig. 3. The inner conductor is assumed to be a thin cylindrical shell. The conductors carry current I in opposite directions.

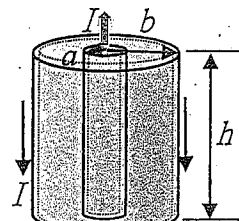


Fig. 3

- (a) Calculate the self-inductance L of this cable. (8%)
 (b) Calculation the total energy stored in the magnetic field of the cable. (7%)

4. A Faraday disk consists of a rotating conducting disk with one stationary brush (a sliding electrical contact) at its axle, A, and another at a point, B on its circumference, as shown in Fig. 4.

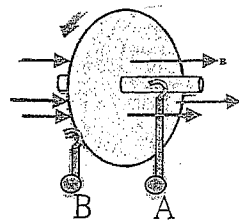


Fig. 4

- (a) A magnetic field \vec{B} is applied perpendicular to the plane of the disk which the angular speed is ω , and the radius of the disk is R . Find the *emf* generated between the brushes. (8%)
 (b) If a resistor was connected between A and B, what is the direction of current passed through the resistor? (7%)

5. An ideal gas is carried through a thermodynamic cycle consisting of two isobaric and two isothermal processes as shown in Fig. 5. Calculate that the net work done on the gas in the entire cycle. (15%)

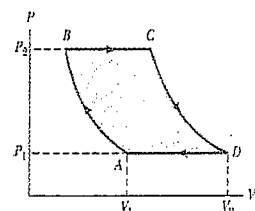


Fig. 5

6. The hydrogen spectrum has a red line at $656nm$ and a blue line at $434nm$. What are the angular separations between two spectral lines in first order obtained with a diffraction grating that has 4500 grooves/cm? (10%)

(請注意，下面尚有題目)

7. As shown in Fig. 6, a bullet of mass m and speed v passes completely through a pendulum bob of mass M . The bullet emerges with a speed of $v/2$. The pendulum bob is suspended by a stiff rod (not a string) of length l and negligible mass. What is the minimum value of v such that the pendulum bob will barely swing through a complete vertical circle? (15%)

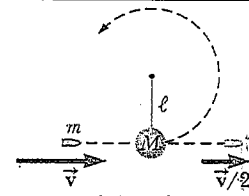


Fig. 6