

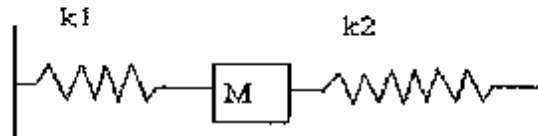
國立中央大學八十八學年度碩士班研究生入學試題卷

所別: 物理研究所 不分組 科目: 古典物理 共 2 頁 第 1 頁

1999 碩士班入學考古典物理

(1)(15%) A mass M is connected by two spring with force constants k_1 and k_2 . There is no friction. (a) write down the Lagrangian and Hamiltonian function for this system (8%) (b) derive the oscillating frequency? (7%)

Fig. 1

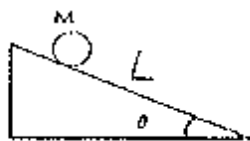


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(2)(20%) Two particles (such as the earth and the sun) with masses m_1 (r_1) and m_2 (r_2) respectively interacting through a central force potential $U(r)$, where r_1 and r_2 are the position vectors and r is the relative position $r = |r_1 - r_2|$ (a) Derive the Kepler's 2nd law : the radius vector r sweeps out equal areas in equal times. (5%) (b) show that the motions of m_1 and m_2 are in a plane. (5%) (c) Show that the total kinetic energy can be written as $T = \frac{1}{2} \mu (\dot{r}^2 + r^2 \dot{\theta}^2)$ and derive μ , which is the reduced mass (10%)

(3)(15%) (a) Show that the rotational inertia for a disk of mass M and radius R is $(1/2)MR^2$ 5%

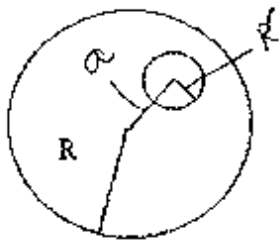
(b) A disk is rolling down a ramp at an angle θ , what is the speed of the disk at the bottom of the ramp if the ramp has a length L ? 10%



(4)(20%)(a) Show for adiabatic process of the ideal gas satisfies the relationship: $PV^\gamma = \text{constant}$. Where γ is ratio of the heat capacities c_p/c_v (10%)

(b) Derive the work done by adiabatic expansion of an ideal gas from volume V_1 to V_2 . (10%)

(5). (15%) As shown in the following figure(5), there is a charged sphere of radius R with



uniform charge density distribution ρ . A smaller spherical cavity with center O' and radius R' is made within the large sphere and with its center a distance a from the center of big sphere. Find the electric field E within the cavity.

(6). (15%) (a) A coil with radius R and carrying a current i . What is the magnetic field along the center axis (7%) (b). Show that the orbiting electron in an atom produces a magnetic field at the center nucleus with $B = (Ze/4\pi\epsilon_0 c^2 m r^3)L$, where L is the angular momentum, m the mass of the electron, and r the radius(8%).

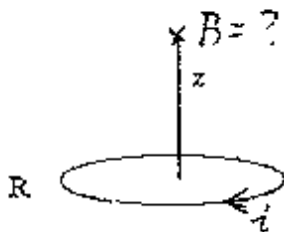


Fig 6

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