

國立中央大學103學年度碩士班考試入學試題卷

所別：大氣科學學系大氣物理碩士班 不分組(一般生) 科目：普通物理 共 2 頁 第 / 頁
大氣科學學系大氣物理碩士班 不分組(在職生)
太空科學研究所碩士班 不分組(一般生)
太空科學研究所碩士班 不分組(在職生)

本科考試禁用計算器

*請在試卷答案卷(卡)內作答

1. A particle of mass m attached to the end of a rope moves in a vertical circle of radius r under the influence of the gravity to the earth and the tension of the rope. If its speed is v_t at the highest point of the circle.
 - (a) Find the tension in the rope at the highest point of the circle. (5%)
 - (b) Find the minimum value of v_t for the minimum force acted on the particle. (5%)
 - (c) Find the tension in the rope when the rope is at angle θ to the vertical. (5%)
2. A uniform thin rod of length l and mass m pivoted at one end is held horizontal above the ground at altitude $h > l$ and then it is released from rest. Assuming the pivot to be frictionless,
 - (a) Find the moment of inertia of the rod. (5%)
 - (b) Find the angular velocity of the rod when it reaches its vertical position at the bottom of its swing. (5%)
 - (c) Find the force exerted by the pivot when it reaches its vertical position at the bottom of its swing. (5%)
 - (d) What initial angular velocity is needed for the rod to reach a vertical position at the top of its swing? (5%)
3. A hollow sphere with an inner radius R_1 and outer radius R_2 is made of material of density ρ and floating in a liquid of density 2ρ .
 - (a) Find the buoyant force acting on the hollow sphere. (5%)
 - (b) If the cavity in the sphere is filled with material of density ρ_0 so that the sphere just floats completely submerged under the surface of the liquid. Find ρ_0 . (5%)
4. For a harmonic wave of amplitude y_0 traveling in the direction of increasing x with speed v , satisfies the wave equation
$$\frac{\partial^2 y}{\partial x^2} = \frac{1}{v^2} \frac{\partial^2 y}{\partial t^2}$$
 - (a) Find the harmonic wave function. (5%)
 - (b) If the harmonic wave is traveling along a string with mass density λ (mass per unit length). Find the average power transmitted. (5%)
 - (c) If a wave in the string is the result of the linear superposition of two harmonic waves of the same frequency and amplitude. The phase difference between the two harmonic waves is δ . Find the average power of the wave transmitted. (5%)

參考用

注意：背面有試題

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5. An ideal gas with the ratio of the heat capacities γ is initially at a pressure p , a volume V , and a temperature T . It is expanded isothermally until its volume is $4V$ and is then compressed at constant pressure until its volume and temperature are such that an adiabatic compression will return the gas to its original state.
- (a) Sketch this cycle on a pV diagram. (5%)
 - (b) Find the volume and temperature after the isobaric compression. (5%)
 - (c) Find the work done during each cycle. (5%)
 - (d) Find the efficiency of the cycle. (5%)

6. A disk of radius R carries a fixed surface charge density σ and rotates with angular velocity ω .
- (a) Find the current density. (5%)
 - (b) Find the magnetic moment of the current system. (5%)
 - (c) Find the magnetic field at a point on the axis of the disk a distance d from the center. (5%)
 - (d) Find the approximate magnetic field at a point \vec{r} , $|\vec{r}| \gg R$. (5%)

參考用

注意：背面有試題