

國立中央大學102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)

本科考試禁用計算器

*請在試卷答案卷(卡)內作答

參考用

- A particle of mass m is dropped onto the top of a vertical spring with the force constant k . If the particle is released from a height h above the top of spring.
 - What is the maximum kinetic energy of the particle? (5%)
 - What is the maximum compression of the spring? (5%)
 - At what compression is the particle kinetic energy half its maximum value? (5%)
- A particle of mass m sliding on a frictionless table is attached to a string that passes through a hole in the table. Initially, the particle is sliding with speed v_i in a circle of radius r_i .
 - Find the tension in the string in terms of the angular momentum of the particle. (5%)
 - If the string is pulled downward very slowly. How much work is required to reduce the radius of the circle $r_f = r_i/2$? (5%)
- A large spherical helium weather balloon with the radius $3m$ and the total mass $18kg$ (balloon, helium and equipment). The air mass density is $1.3kg/m^3$ at sea level where the atmospheric pressure is $1atm$.
 - What is the initial upward acceleration of the balloon when it is released from sea level? (5%)
 - If the drag force on the balloon is given by $f_d = \frac{\pi r^2}{2} \rho v^2$, where r is the balloon radius, ρ is the density of air, and v is the ascension speed of the balloon, determine the terminal velocity of the ascending balloon. (5%)
 - Estimate the time will it take for the balloon to ascend to a height of $20km$. (5%)
- Two sources separated by some distance emit harmonic waves of the same frequency with wavelength λ . At some point P , the intensity of the wave due to each source separately is I_0 . The path distance from P to one of the sources is $\lambda/2$ greater than that from to the other source. What is the intensity at P for each case,
 - the sources are coherent and in phase. (5%)
 - the sources are incoherent. (5%)
 - the sources are coherent but have a phase difference of π rad. (5%)
- One mole of an ideal gas with the ratio of the heat capacities $\gamma = 1.4$ and the heat capacities of constant volume $C_v = \frac{5}{2}R$ initially at a pressure of $1 atm$ and a temperature of $T_1 = 0^\circ C$, where the gas constant $R = 8.314J/mol \cdot K$. The gas is heated at constant volume to $T_2 = 100^\circ C$ and is then expanded adiabatically until its pressure is again $1 atm$. It is then compressed at constant pressure back to its original state.
 - Find the temperature T_3 after the adiabatic expansion. (5%)
 - Calculate the heat entering or leaving the system during each process. (5%)
 - Estimate the efficiency of this cycle. (5%)

注意：背面有試題

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6. A ring of radius R that lies in the x - y plane carries a positive charge Q uniformly distributed over its length. A particle of mass m that carries a negative charge magnitude q is at the center of the ring.
- (a) Find the electric field along the axis of the ring (z -axis). (5%)
 - (b) Let the charge particle of mass m moving in z -axis with coordinates $z \ll R$, Find the force on it as a linear function of z . (5%)
 - (c) Estimate the period T of the harmonic moving particle near the center of the ring along z -axis. (5%)
7. A ray of light passes from one medium to another medium, striking the surface of the boundary. Which of the following quantities change as the light enters the second medium:
(1) wavelength; (2) frequency; (3) speed of propagation; (4) direction of the propagation, (5) the polarizing angle for which the reflected light is completely polarized. (5%)
8. A ray of light is incident in air of the refraction index $n = 1$ and the polarizing angle for a certain substance is 30° .
- (a) What is the angle of refraction of light incident at this angle? (5%)
 - (b) What is the index of refraction of this substance? (5%)

注意：背面有試題