

國立中央大學100學年度碩士班考試入學試題卷

所別：物理學系生物物理碩士班 不分組(一般生)

科目：普通物理

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本科考試禁用計算器

*請在試卷答案卷(卡)內作答

參考用

1. (15%) A force $F(x)$ acts on a particle that moves along an x axis. The potential energy associated with force $F(x)$ is given by $U(x) = ax^2 + bx + c$.

(a) (5%) Find the force $F(x)$

(b) (5%) Find the work done by the force when the particle moves from x_1 to point x_2

(c) (5%) Is this force a conservative force? Why?

2. (20%) An arbitrary physical pendulum of mass m is displaced to one side by angle θ . The gravitational force acts at its center of mass, at a distance h from the pivot point. Prove that

(a) (15%) the motion of the physical pendulum swinging through only small angles is approximately simple harmonic motion (SHM) and

(b) (5%) its period is

$$T = 2\pi \sqrt{\frac{I}{mgh}}$$

Assume the pendulum's rotational inertia about the pivot point is I .

3. (12%) The equation to describe a sinusoidal wave on a stretched string is

$$y(x,t) = A \sin(kx - \omega t)$$

where A , k , ω are the amplitude, the wave number and the angular frequency, respectively.

(a) (3%) Does an element on the string move along x direction? If yes, describe the motion?

(b) (3%) Does an element on the string move along y direction? If yes, describe the motion?

(c) (6%) The wave $y_2(x,t)$, traveling in the negative direction of x . Its wavelength is half of that of $y(x,t)$ and its speed is 5 times larger than that of $y(x,t)$. Write down the equation of $y_2(x,t)$.

4 (20%) Suppose n moles of an ideal gas undergoes a reversible isothermal expansion from volume V to volume $2V$ at temperature T . Find

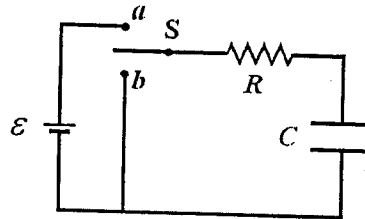
(a) (5%) the work done by the gas and

(b) (10%) the entropy change of the gas.

(c) (5%) If the expansion is reversible and adiabatic instead of isothermal, what is the entropy change of the gas?

注意：背面有試題

5. (15%) To charge a capacitor of capacitance C in the RC circuit,
- (2%) where switch S is connected to (a or b)?
 - (3%) Derive the charging equation.
 - (5%) The solution to the charging equation is $q = C\varepsilon(1 - e^{-t/RC})$. Define the time constant τ and calculate the charge q at time τ .
 - (5%) Find the current $i(t)$.



6. (8%) Electrons (mass m , charge $-e$) are accelerated from rest through a potential difference V and are then deflected by a perpendicular magnetic field B . Find the radius of the resulting electron trajectory.
7. (10%) The matter wave of a particle is described by a wave function $\psi = \psi_0 e^{ikx}$.
- (4%) Plot the probability density of this particle as a function of x .
 - (6%) Where can this particle be found most likely? Discuss this result in terms of Heisenberg's uncertainty principle.

參考用

注意：背面有試題