

國立清華大學命題紙

96學年度微核電系統工程研究所(所) _____ 組碩士班入學考試

科目 物理 科目代碼 1904 共 4 頁第 1 頁 *請在【答案卷卡】內作答

注意：

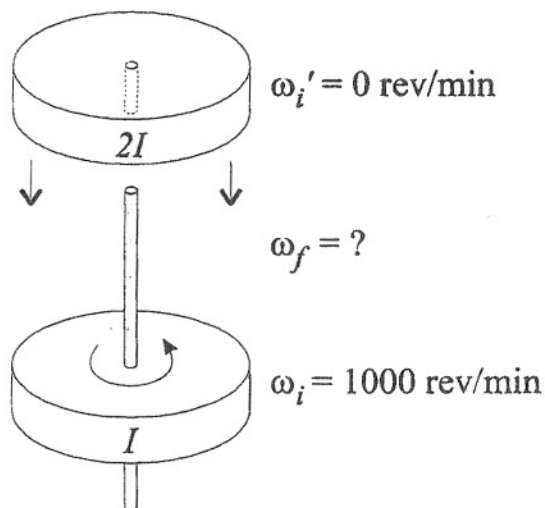
1. 請按題目順序作答。
2. 填充題不需要寫計算過程。

填充題(30%):

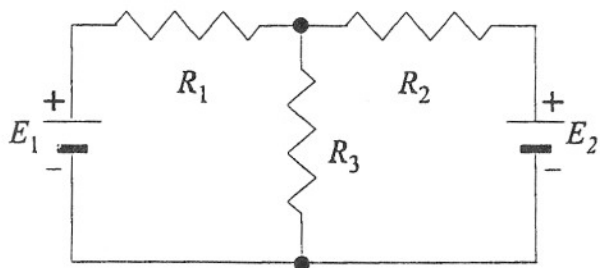
1. (5%) Two charges $+q$ and $-q$ a distance l apart have a dipole moment of magnitude (1).
2. (5%) If the voltage across a capacitor is doubled, the energy stored changes by a factor of (2).
3. (5%) Two waves of the same type but with different frequencies f_1 and f_2 will produce beats at a frequency (3).
4. (5%) If the index of reflection is 2, the speed of light is (4) times the speed of light in vacuum.
5. (5%) A damped oscillator has its amplitude reduced by a factor of 10. By what factor is its energy reduced? (5)
6. (5%) One of Kepler's laws of planetary motion states that a line joining a planet to the sun sweeps out equal areas in equal times. This law follows from the fact that the (6) of the planet is conserved.

計算題(70%) :

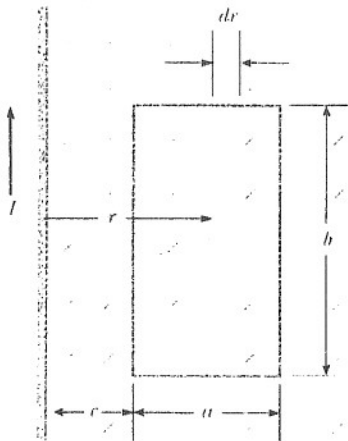
1. A wheel is rotating freely with an angular speed of 1000 rev/min on a shaft. The combined rotational inertia is I . A second wheel, initially at rest and with the rotational inertia of $2I$, is suddenly coupled to the same shaft (Fig. 1). (a) What is the angular speed of the resultant combination of the shaft and two wheels? (b) What fraction of the original rotational kinetic energy is lost? (10%)



2. In the circuit shown below, $E_1 = 3.0 \text{ V}$, $E_2 = 2.0 \text{ V}$, $R_1 = 3.0 \Omega$, $R_2 = 2.0 \Omega$, $R_3 = 4.0 \Omega$, and both batteries are ideal. (a) What is the rate at which energy is dissipated in R_1 ? In R_2 ? In R_3 ? (10%) (b) What is the power of battery 1? of battery 2? (5%)



3. A disk of radius a has a uniform charge density σ C/m². It rotates about its central axis at ω rad/s with its axis normal to a uniform field B . (a) Find its magnetic moment. (10%) (b) Find the torque on the disk. (5%)
4. A rectangular loop of width a and length b is located near a long wire carrying a current I . The distance between the wire and the closest side of the loop is c . The wire is parallel to the long side of the loop. (a) Find the total magnetic flux through the loop due to the current in the wire. (10%) (b) If the loop moves away from the wire, what is the direction of the induced current in the loop (clockwise or counterclockwise)? (5%)



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5. A diatomic ideal gas ($\gamma = C_p/C_v = 7/5 = 1.40$) confined to a cylinder is subjected to a close cycle. Initially, the gas is at p_1 , V_1 , and T_1 . First, its pressure is increased to $3p_1$ under constant volume. Then, it expands *adiabatically* to its original pressure. Finally, the gas is compressed *isobarically* to its original volume. (a) Find the temperature of the gas at the start of the adiabatic expansion (T_2 , in terms of T_1). (b) Determine the volume of the gas at the end of the adiabatic expansion (V_3 , in terms of V_1). (c) What is total Q (heat) for this cycle (in terms of p_1 and V_1) (15%)

