

科目：普通物理(2002)

校系所組：中央大學光電科學與工程學系照明與顯示科技碩士班

交通大學電子物理學系(丙組)

交通大學物理研究所

清華大學物理學系

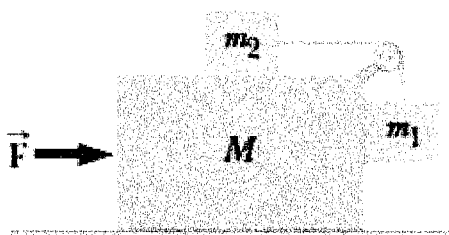
清華大學先進光源科技學位學程(物理組)

清華大學材料科學工程學系(乙組)

陽明大學生醫光電研究所(理工組)

清華大學天文研究所

1. (20%) In the following figure, a horizontal force F is applied to the larger block of mass $M=10\text{kg}$ so that the two smaller blocks of masses $m_1=5\text{kg}$ and $m_2=3\text{kg}$ remain stationary relative to the larger block. (a) (10%) Assume all surfaces and the pulley are frictionless, give the value of F in terms of the magnitude of gravitational acceleration g . (b) (10%) If the surfaces between any two of the blocks have frictions with the same static coefficient $\mu_s=0.1$ but the pulley is still frictionless, what are the maximum and minimum values of F ?



2. (10%) A solid cylinder and a hollow cylinder shell, both of mass M and radius R , roll without slipping on a ramp from at rest initially. The ramp has a length L and is inclined at an angle θ with the horizontal ground. (a) (5%) Which one of the two cylinders reaches the ground first and why? (b) (5%) τ_1 and τ_2 are the times requiring for the solid cylinder and the hollow cylinder rolling down to the ground, respectively. What is the ratio τ_1/τ_2 ?
3. (10%) (a) (5%) Write down the wave equation for a wave function $y(x,t)$, which represents the transverse displacement of the element at position x at time t , traveling along a one-dimensional string. (b) (5%) What is the rate of energy transfer by a sinusoidal traveling wave $y(x,t)=A \sin(kx-\omega t)$ on a string with mass density μ and a tension T .
4. (10%) An ideal gas of N particles at temperature T is initially restricted to a part of volume V in an insulated container. During a free expansion, the ideal gas is allowed to expand into the remainder of the container of total volume $3V$. What is the change in entropy of the ideal gas and give the reasons how you get your answer.

注意：背面有試題

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5. (10%) For a point light source which radiates 100 Joules of energy per second, calculate the root-mean-square magnetic field strength at the point P which is 10 cm away from the source. What is the maximal strength of electric field at the same point?
6. (15%) (a) (5%) Write down the relation between current density J inside a strip of copper and the drift velocity v_d of the charge carriers in the copper. (b) (10%) Explain how one can measure the number of charge carriers per unit volume in the copper using Hall effect.
7. (10%) A parallel plate capacitor with $C=0.15 \mu\text{F}$ has a separation between its plates of $d=40.0 \mu\text{m}$. The dielectric that fills the space between the plates has dielectric constant $\kappa=2.5$ and resistivity $\rho=4.0 \times 10^{12} \Omega\text{m}$. What is the time constant for this capacitor?
8. (5%) Explain what Maxwell's displacement current is?
9. (10%) Two metal spheres of radii $r_1=20 \text{ cm}$ and $r_2=40 \text{ cm}$, respectively, have been positively charged so that both have a total charge of $400 \mu\text{C}$. (a) (5%) What is the ratio of their surface charge densities? (b) (5%) If the two spheres are connected by a copper wire, how much charge flows through the wire before the system reaches equilibrium?

參考用