

國立中央大學八十六學年度碩士班研究生入學試題卷

所別: 太空科學研究所 不分組 科目:

普通物理

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Physical constants : (Planck's constant $h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$, Boltzman constant $k = 1.381 \times 10^{-23} \text{ J/K}$, gas constant $R = 8.314 \text{ J/K}\cdot\text{mol}$, Coulomb-law constant $k = 9.0 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$, charge $e = 1.602 \times 10^{-19} \text{ C}$, Permeability constant $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$)

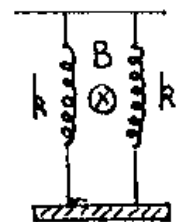
1. A block of mass m is placed on a wedge of mass M that is on a horizontal table as shown in the figure. All surfaces are frictionless.

Find the acceleration of the wedge.

(15%)



2. A 10-g object with a velocity $6\vec{i} \text{ m/s}$ explodes into two equal fragments. One flies off with a velocity $2\vec{i} - \vec{j} \text{ m/s}$. What is the velocity of the other fragment? (10%)
3. Find the work done by n moles of ideal gas when its state changes isothermally (at constant temperature T) from P_1, V_1 to P_2, V_2 . (10%)
4. A copper ball of mass $m = 1 \text{ kg}$ and specific heat $c = 390 \text{ J/kg}\cdot\text{K}$ is at temperature $T_1 = 90^\circ\text{C}$. The ball is thrown into a large lake at $T_2 = 10^\circ\text{C}$, which stays constant. Find the change in entropy of (a) the ball, (b) the lake, and (c) the universe. (15%)
5. A nonconducting disk of radius a has a uniform surface charge density $\sigma \text{ C/m}^2$. What is the electric field strength at a distance y from the center along the central axis for (a) $y \ll a$; (b) $y \gg a$. (10%)
6. A metal rod of mass 10 g and length 10 cm is suspended on two springs, as shown in the figure. The springs are extended by 5 cm. When a 20-A current flows through the rod it rises by 1 cm. Determine the magnetic field. (15%)



7. (a) The waves in a microwave oven have a frequency of 2450 MHz. Find the momentum of a photon.
 (b) A proton (mass is $1.672 \times 10^{-27} \text{ kg}$) is moving at 10^3 m/s . Find its de Broglie wavelength. (15%)
8. The intensity of solar radiation at the surface of the earth is 1 kW/m^2 . A roof has a square solar panel of side 10 m that absorbs the radiation completely. What is the average force exerted on the panel? (10%)