

國立中央大學97學年度碩士班考試入學試題卷

所別：太空科學研究所碩士班

科目：普通物理 共 2 頁 第 1 頁

*請在試卷答案卷(卡)內作答

1. Terminology and short problem (20%)
 - (1) State the Doppler effect, and differences between the sound and light Doppler.
 - (2) A very strong and uniform magnetic field points into this examination sheet. Draw four trajectories to show a proton and an electron entering perpendicularly the field from the right side and also the left side.
 - (3) A gas with the number of molecular per unit volume N has the averaged speed v and collision frequency f . If the diameter and mass the molecular are d and m , respectively, find the mean free path λ , the energy flux F , and the pressure P .
 - (4) Give Maxwell's equations in both differential and integral forms, and their associated physical meanings.
2. Suppose a tunnel could be dug through the Earth from one side to the other along a diameter. One satellite travels with a near-Earth orbit (NEO) and the other satellite goes through the tunnel. (a) If the two satellites were simultaneously deployed from one end, find the elapse times for them reaching the other end of the tunnel. Which one reaches the other end first, why? (b) If the accretion of gravity near the Earth's surface is about 10 m/s^2 , calculate the period and speed of the NEO satellite. Neglect all frictional forces and assume that the Earth has a uniform density. The constant of universal gravitation is $G=6.67 \times 10^{-11} \text{ nt-m}^2/\text{kg}^2$. The Earth's radius and density are $R_e=6400 \text{ km}$ and $\rho=5.5 \times 10^3 \text{ kg/m}^3$, respectively. (20%)
3. A mass M is pulled to the top of a frictionless half cylinder of radius R . (a) Determine the work done (by integration) in moving the mass at constant speed from the bottom to the top of the cylinder. (b) If sliding down from the top, where will the mass take off from the cylinder? (10%)
4. A 440 Hz sine wave (wave number 30/cm) travels to the left down an infinite string. The total transverse motion of string over half a cycle is 1.0 cm. At $t=1.0 \text{ sec}$ and $x=1.0 \text{ meter}$, determine (a) the transverse displacement, (b) the wavelength, and (c) the longitudinal and transverse velocities. (d) Do the two velocities have the same quantity and physical meaning? (10%)
5. Use Gauss's law to show that an excess charge, placed on an insulated conductor, resides entirely on its outer surface. Show all steps, arguments, or assumptions. (10%)

參考用

注意：背面有試題

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6. A parallel-plate capacitor is charged to a potential V and disconnected from the battery. It has plates of area A separated by D and a total energy U_0 . The plates are now separated by a distance $2D$ and a dielectric of constant 4 and thickness $2D$ is inserted. Determine the work required to separate the plate and to insert the dielectric (in terms of U_0). (10%)
7. A beam of light with an energy flux S of 12 W/cm^2 falls perpendicularly on a perfect reflecting plane mirror of 1.5-cm^2 area. (a) What force acts on the mirror? (b) If the beam falls on a black board instead, what is the radiation pressure? (10%)
8. A rectangular closed loop 20 cm wide and a resistance of 6 ohm has one 20 cm side in and perpendicular to a 2.5 tesla magnetic field. The loop is moved at a velocity of $v=2 \sin(2\pi t)$ m/s (the other 20 cm side never enters the field). At $t=2.5$ sec determine (a) induced EMF and (b) the induced current. (10%)

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