

國立中央大學100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 不分組(一般生) 科目：普通物理 共 1 頁 第 1 頁

本科考試禁用計算器

\*請在試卷答案卷(卡)內作答

1. The spaceman Joe puts his spaceship in a circular orbit around an unknown planet. His orbit diameter is 10,000 km and it takes 1.939 hours to complete one revolution of the orbit. What is the acceleration of gravity where he is (in gravitational constant  $G$ )? (10%)
2. A 0.1 kg particle is projected vertically upward by a spring. The spring has a force constant of 980 Nt/m and was compressed 10 cm. What is the particle's velocity when it is 5 m height? (10%)
3. A disk of mass 4 kg and radius 10 cm has an angular velocity of 100 rad/sec. It is dropped on top of another disk of radius 12 cm and mass 6 kg. The second disk is free to rotate on its axis. What is (i) the final angular velocity of the two disks and (ii) how much energy is lost? (10%)
4. A 600 kg satellite with 400 kg of rocket fuel is projected to 500 km above the surface of the earth where a rocket fuel is fired which burns the fuel and places the satellite in a circle orbit. How much the total energy was required to obtain this orbit (in gravitational constant  $G$  and earth's radius  $R_E$ )? (10%)
5. An electric dipole consists of two opposite charges of magnitude  $q$  separated by  $d$ . It is placed in a uniform electric field  $E$ . Find the maximum torque and the potential energy at 45 degrees where the potential energy is zero at 90 degrees. (10%)
6. A uniform atom has 92 electrons and 92 protons. Suppose you have 92 electrons evenly distributed over a sphere of radius  $5 \times 10^{-11}$  meters. How much work is required to bring 92 protons from infinity to the center of the sphere (in eV)? (10%)
7. Doubly charged positive ions travel west in a beam of cross section  $5 \text{ cm}^2$ , which results in a current of 192 micro amps. If there are  $3 \times 10^5$  ions per  $\text{cm}^3$ , what is the drift speed of the ions? (10%)
8. Two electrons (A and B) in a cyclotron have kinetic energies of 2.0 keV and 8.0 keV, respectively. If cyclotron has a magnetic field of 2.0 Tesla, what will be the ratio (A/B) of (i) the cyclotron frequency and (ii) the radii of their orbits? (10%)
9. A uniform magnetic field makes an angle of 30 degrees with the plane of a 12 loop coil of radius 4 cm. The magnetic field is a function of time according to  $B = 5 \sin(6t)$  Tesla. If the coil has a total resistance of 0.80 Ohm, determine the rate of joule heating at  $t = 1$  second. (10%)
10. Name, write, and state Maxwell's equations. Write one Maxwell's equation which one predicts that a current in a wire sets up a magnetic field near the wire. Indicate which part of the equation was added by Maxwell and why it was added. (10%)

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