

中原大學 100 學年度 碩士班 入學考試

3 月 19 日 10:30~12:00

物理學系、物理學系(在職)

誠實是我們珍視的美德，
我們喜愛「拒絕作弊，堅守正直」的你！

科目：普通物理

(共 2 頁第 1 頁)

可使用計算機，惟僅限不具可程式及多重記憶者

不可使用計算機

一、 填充題 (每題4分，共60分) (請把答案寫在答案卷上，不必寫出計算過程)

1. A particle has a total relativistic energy of 5 GeV and a relativistic momentum of 4 GeV/c. What is the rest mass of this particle? _____ GeV/c²
2. Suppose an ideal gas expands to twice its original volume (a) adiabatically, (b) isothermally. Which process would result in a greater change in entropy? _____
3. What is the total entropy change in a Carnot cycle? _____
4. The energy required to remove both electrons from the helium atom in its ground state is 79.0 eV. How much energy is required to single ionize helium (i.e., to remove one electron)? _____
5. At a location that is 3.0 m from wave source A and 4.2 m from wave source B, destructive interference occurs. Source A and source B are coherent and in phase. What is the maximum wavelength of the waves? _____
6. A particle rotates in a circle of radius 5 m. At a particular instant, the particle's speed is 5 m/s and is increasing at a rate of 5 m/s². The angle between the particle's velocity and acceleration vectors is _____.
7. Two moons orbit a planet in nearly circular orbits. Moon A has orbital radius r , and moon B has orbital radius $4r$. Moon A takes 20 days to complete one orbit. How long does it take moon B to complete an orbit? _____
8. What is the work needed to bring point charge Q from infinity to a distance r to point charge q ? _____
9. A playground merry-go-round with a radius of 1.8 m and a rotational inertia of 120 kg·m² is stationary. A child with a mass of 25 kg gets on and walks around the edge of the merry-go-round. How many revolutions around the merry-go-round must the child make in order for the merry-go-round to make one full revolution? _____
10. Consider a solid sphere of radius R and mass M rolling without slipping. Which form of kinetic energy is larger, translational or rotational? _____
11. An infinite plate of dielectric constant K and permittivity $\epsilon = K\epsilon_0$ is placed in a uniform electric field of magnitude E_0 . The electric field is perpendicular to the surface of the dielectric. The magnitude of the electric field inside the dielectric is _____
12. What value might we assign to the dielectric constant for a good conductor? _____
13. A bird stands on a dc electric transmission line carrying a current of 3000 A. The line has $2.5 \times 10^{-5} \Omega$ resistance per meter, and the bird's feet are 4.0 cm apart. What is the potential difference between the bird's feet? _____

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14. For a particle of mass m and charge q moving in a circular path in a uniform magnetic field with magnitude B , what is its angular momentum about the center of the circle? _____
15. Suppose that you want to take a photograph of yourself as you look at your image in a mirror 3.0 m away. For what distance should the camera lens be focused? _____

二、計算題 (共 40 分) (請詳列計算過程於答案卷上)

1. Suppose a typical lightning can transfer 10^9 J of energy across a potential difference of 10^8 V during a time interval of about 0.2 s. Use the information to estimate (a) (8%) the total amount of charge transferred between the clouds and ground, (b) (6%) the current in the lightning bolt, and (c) (6%) the average power delivered over the 0.2s.
2. The electric field of a plane EM wave is given by $E_x = E_0 \cos(kz + vt)$, $E_y = E_z = 0$. (a) (6%) Determine the direction of propagation, (b) (6%) Find the magnitude and direction of \vec{B} , and (c) (8%) This EM wave is normally incident on a perfect conductor at $z = 0$. Immediately to the top of the conductor, Find the total electric field E and the total magnetic field B .