

臺灣綜合大學系統

107 學年度 學士班

轉學生聯合招生考試

試 題

類組：C02

科目名稱：普通物理 C

科目代碼：E0016

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本科試題共計 3 頁

Some useful constants

Gas constant $R = 8.314 \text{ J/mol}\cdot\text{K}$
 $\text{N}\cdot\text{m}^2/\text{kg}^2$

Mass of Sun = $2.0 \times 10^{30} \text{ kg}$

Radius of Earth = $6.4 \times 10^6 \text{ m}$

Electron mass $m_e = 9.1 \times 10^{-31} \text{ kg}$

Electric constant (permittivity) $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2$

Magnetic constant (permeability) $\mu_0 = 4\pi \times 10^{-7} \text{ T}\cdot\text{m/A}$

Plank's constant $h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$

Boltzmann constant $k_b = 1.380 \times 10^{-23} \text{ J}\cdot\text{K}^{-1}$

Gravitational constant $G = 6.68 \times 10^{-11}$

Mass of Earth = $6.0 \times 10^{24} \text{ kg}$

Radius of Sun = $7.0 \times 10^8 \text{ m}$

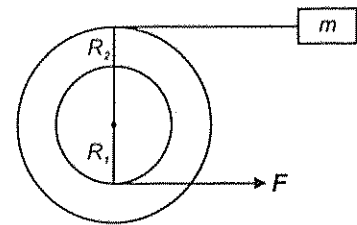
Electron charge $e = 1.6 \times 10^{-19} \text{ C}$

$1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$

第一部分：簡答題（70 分）

共 14 題，每題 5 分，請於答案卷上標明題號並依序作答（中英文作答均可，無需詳列計算過程）。

- An 8.0-cm radius disk with a rotational inertia of $0.12 \text{ kg}\cdot\text{m}^2$ is free to rotate on a horizontal axis. A string is fastened to the surface of the disk and a 10-kg mass hangs from the other end. The mass is raised by using a crank to apply a $9.0\text{-N}\cdot\text{m}$ torque to the disk. What is the acceleration of the mass?
- A small disk of radius R_1 is fastened coaxially to a larger disk of radius R_2 . The combination is free to rotate on a fixed axle, which is perpendicular to a horizontal frictionless table top, as shown in the right figure. The rotational inertia of the combination is I . A string is wrapped around the larger disk and attached to a block of mass m , on the table. Another string is wrapped around the smaller disk and is pulled with a force \vec{F} as shown. What is the tension in the string pulling the block?
- The coefficient of static friction between a certain cylinder and a horizontal floor is 0.40. If the rotational inertia of the cylinder about its symmetry axis is given by $I = (1/2)MR^2$, then what is the maximum acceleration the cylinder can have without sliding?
- Suppose you have a pendulum clock which keeps correct time on Earth (acceleration due to gravity = 9.8 m/s^2). Without changing the clock, you take it to the Moon (acceleration due to gravity = 1.6 m/s^2). For every hour interval (on Earth), what is the time interval that the Moon clock will record?
- A solid has a volume of 8 cm^3 . When weighed on a spring scale calibrated in grams, the scale indicates 20 g. What does the scale indicate if the object is weighed while immersed in a liquid of density 2 g/cm^3 ?



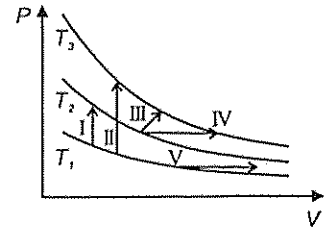
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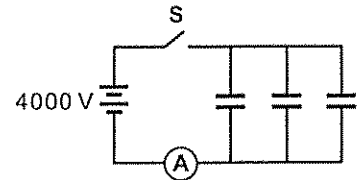
本科試題共計 3 頁

6. The diagram shows three isotherms for an ideal gas, with $T_3 - T_2$ the same as $T_2 - T_1$. It also shows five thermodynamic processes carried out on the gas. Please rank the processes in order of the change in the internal energy of the gas, least to greatest.

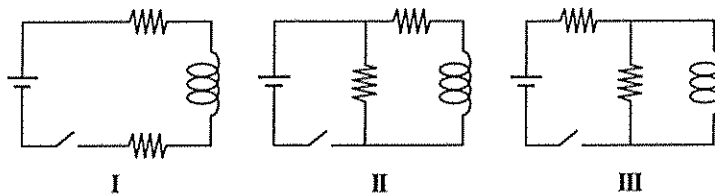


7. An ideal gas of N monatomic molecules is in thermal equilibrium with an ideal gas of the same number of diatomic molecules and equilibrium is maintained as temperature is increased. What is the ratio of the changes in the internal energies $\Delta E_{dia} / \Delta E_{mon}$?
8. Let k be the Boltzmann constant. If the thermodynamic state of gas at temperature T changes isothermally and reversibly to a state with three times the number of microstates as initially, what is the energy input to gas as heat?
9. Positive charge Q is distributed uniformly throughout an insulating sphere of radius R , centered at the origin. A particle with a positive charge Q is placed at $x = 2R$ on the x axis. What is the magnitude of the electric field at $x = R/2$ on the x axis?

10. As shown in the right figure, each of the three $25\text{-}\mu\text{F}$ capacitors shown is initially uncharged. How many coulombs of charge pass through the ammeter A after the switch S is closed?



11. The diagrams show three circuits with identical batteries, identical inductors, and identical resistors. Rank them according to the current through the battery just after the switch is closed, from least to greatest.



12. A thin film with an index of refraction of 1.60 is placed in one of the beams of a Michelson interferometer. If this causes a shift of 8 bright fringes in the pattern produced by light of wavelength 580 nm, what is the thickness of the film?
13. The stopping potential for electrons ejected by 6.8×10^{14} -Hz electromagnetic radiation incident on a certain sample is 1.8 V. What are the kinetic energy of the most energetic electrons ejected and the work function of the sample, respectively?
14. Observer A measures the velocity of a rocket as \vec{v} and a comet as \vec{u} . Here \vec{u} and \vec{v} are parallel and in the direction of the observer's positive x axis. What is the speed of the comet as measured by an observer on the rocket?

第二部分：複選題（30分）

共3題，每題10分，**全對才給分**，請於答案卷上**標明題號**並**依序作答**。

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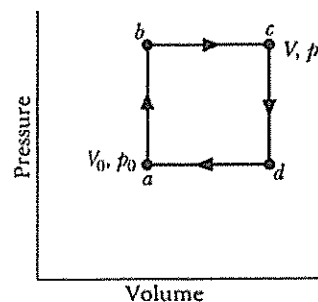
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1. A particle moves as follows as a function of time: $x = 3.0 \text{ m} \times \cos(2.0 \text{ radian/s} \times t + \pi/3)$, where distance x is measured in meters (m) and time t in seconds (s). Which answers are correct in the followings?
- (A) The amplitude of the simple harmonic motion is 3.0 m.
 - (B) The amplitude of the simple harmonic motion is 6.0 m.
 - (C) The angular frequency is 2.0 radian/s.
 - (D) The angular frequency is 0.318 cycle/s.
 - (E) The angular frequency is 6.28 radian/s.

2. The molecular theory of magnetism can explain each of the following:
- (A) hammering tends to destroy magnetization
 - (B) a N pole attracts a S pole
 - (C) stroking an iron bar with a magnet will magnetize the bar
 - (D) when a bar magnet is broken in two, each piece is a bar magnet
 - (E) heating tends to destroy magnetization

3. Right figure shows a reversible cycle through which 1 mol of a monatomic ideal gas is taken. Assume $p = 2p_0$, $V = 2V_0$, $p_0 = 1.01 \times 10^5 \text{ Pa}$, and $V_0 = 0.0225 \text{ m}^3$.



- (A) The work done during the cycle is 2.27 kJ.
- (B) The energy added as heat during stroke abc is 14.8 kJ.
- (C) The efficiency of the cycle is 0.217.
- (D) The efficiency of a Carnot engine operating between the highest and lowest temperatures that occur in the cycle is 0.25.
- (E) The efficiency of Carnot engine is thus greater than the efficiency in the cycle showed in right figure.