

臺灣綜合大學系統 113 學年度學士班轉學生聯合招生考試試題

科目名稱	普通物理 B	類組代碼	共同考科
		科目碼	E0015

※本項考試依簡章規定所有考科均「不可」使用計算機。 本科試題共計 4 頁

Some useful constants

Gas constant $R = 8.314 \text{ J/mol}\cdot\text{K}$

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 $G = 6.68 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2$

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

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

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

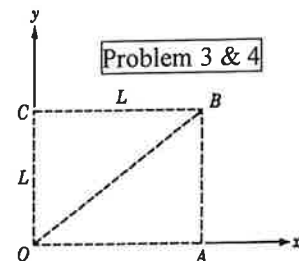
$1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$

第一部分：填充及簡答題（80 分）

共 16 題，每題 5 分，請於答案卷上依序作答並標明題號（無需詳列計算過程）。

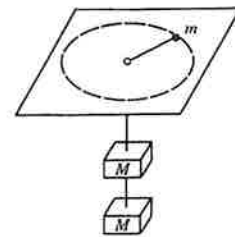
1. A physical equation $A = 5 \cdot \sin(BC)$, where A has the dimensions L/M , and C has the dimensions L/T . So B has the dimensions _____.
2. A 18-N horizontal force is applied to a 40-N block initially at rest on a rough horizontal surface. If the coefficients of friction are $\mu_s = 0.5$ (static) and $\mu_k = 0.4$ (kinetic), the magnitude of the frictional force on the block is _____.

3. A force varies as $\vec{F} = xy^2 \hat{i}$. What is the work done by the force along the paths OB ?

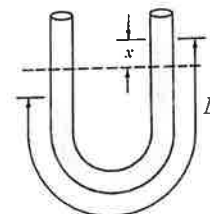


4. Same conditions as the above question, does the force $\vec{F} = xy^2 \hat{i}$ satisfy the criterion for being conservative (yes or no)?

5. A particle of mass m travels in a horizontal circle on a frictionless table. The centripetal force is provided by a string, attached to two bodies of equal mass M , which passes through a hole in the table. The radius of the circle is r . If one of the hanging masses is removed, the new radius will be _____.



6. Water fills a length L of a U tube. The water is slightly displaced and then allowed to move freely. The liquid will then execute a simple harmonic motion. What is the angular frequency (ω) of the oscillation?

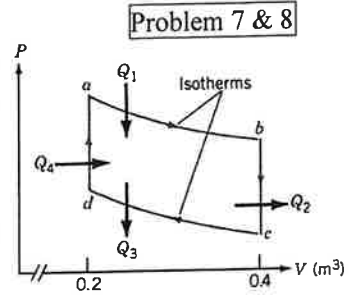


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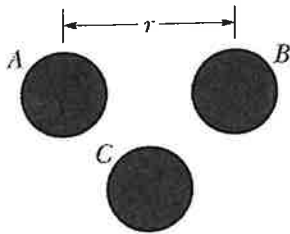
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7. One mole of an ideal monatomic gas is taken around the reversible cycle as shown in the figure. The isothermals are at 500 K and 300 K. Find the efficiency of the engine.



8. Same conditions as the above question, find the total entropy change of the heat engine from $b \rightarrow a$ through the process of $b \rightarrow c \rightarrow d \rightarrow a$.

9. The figure shows three identical conducting spheres with these initial charges: $A, -12Q, B, +8Q, C, 0$. Here is the procedure for connecting and then disconnecting spheres with wire:



Step 1: connect A and C and then disconnect;

Step 2: connect B and C and then disconnect, moving C far away;

Step 3: connect A and B and then disconnect.

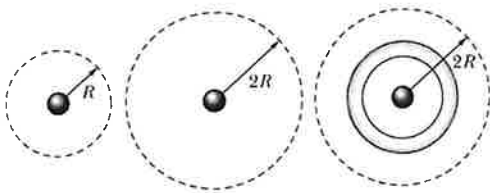
A and B have a center-to-center separation r . What is the magnitude of the final force between those two spheres? Answer by writing what goes in the blank in this equation: $F = \underline{\hspace{1cm}} kQ^2 / r^2$.

10. The figure shows three situations in which the same charged particle is surrounded by a concentric Gaussian sphere.

(1) sphere has radius R

(2) sphere has radius $2R$

(3) sphere has radius $2R$ and also surrounds a neutral metal spherical shell



Rank the three situations according to the magnitude of the electric flux through the surface of the

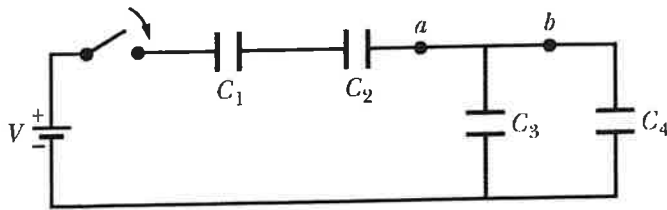
Gaussian sphere, greatest first. **NOTE:** 請依序排列，並加註大於、小於、或等於符號(>, <, or =)。

11. In the following figure, we have $V = 9.0 \text{ V}$, $C_2 = 3.0 \mu\text{F}$, and $C_4 = 4.0 \mu\text{F}$, and all the capacitors are initially uncharged. When switch S is closed, a total charge of $20 \mu\text{C}$ passes through point a and a total charge of $8.0 \mu\text{C}$ passes through point b . What is capacitance C_3 (μF)?

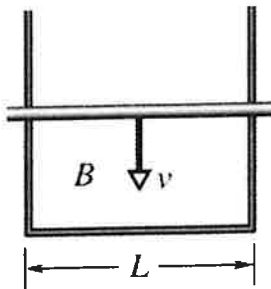
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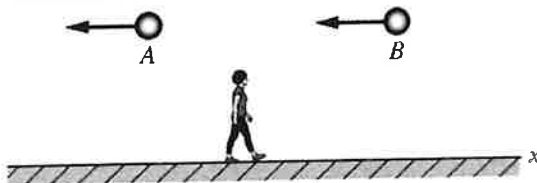
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12. An alpha particle ($q = +2e$, $m = 6.644 \times 10^{-27}$ kg) travels in a circular path of radius 4.50 cm in a uniform magnetic field with $B = 1.20$ T. Through what potential difference (volts) was it accelerated (from rest) to have the kinetic energy required for this path?
13. The figure shows a conducting bar sliding at speed along a wire in the shape of “U” through a uniform magnetic field that is perpendicular to the wire and bar: speed = 3.0 m/s, left-right width $L = 5.0$ m, induced emf = 360 V counterclockwise. What is the magnitude (T) of the magnetic field?



14. The large space telescope that has been placed into Earth orbit has an aperture diameter of 2.40 meters. What angular resolution will this telescope achieve for visible light with a wavelength of $\lambda = 4.80 \times 10^{-7}$ m? Please show the unit in radians.
15. The figure shows two particles moving in the negative direction of an x axis past an observer. Relative to the observer, particle A moves at speed $0.950c$ and particle B moves at speed $0.900c$. What speed will A measure for B ?

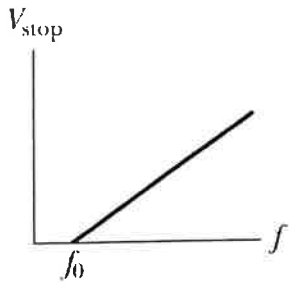


16. The following figure is a plot of stopping voltage V_{stop} versus light frequency f in a photoelectric experiment with a certain metal with a work function Φ . What is the slope?

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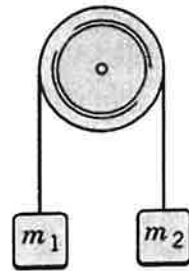
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第二部分：計算題（20 分）

共 2 題，每題 10 分，請於答案卷上依序作答並標明題號（中英文作答均可，需詳列計算過程）。

1. As shown in the figure, two blocks with masses m_1 and m_2 ($m_1=2m_2$) are connected by a massless string that hangs over a pulley of mass M ($M=2m_1$) and radius R . The string does not slip. Treat the pulley as a disk.



- (a) Find the angular acceleration of the pulley. (5 points)
 (b) Assuming that the system starts from rest, find the speed of m_1 after it has fallen by H . (5 points)
2. A hydrogen atom in a state having a binding energy (the energy required to remove an electron) of 0.85 eV makes a transition to a state with an excitation energy (the difference between the energy of the state and that of the ground state) of 10.2 eV.
- (a) What is the energy of the photon emitted as a result of the transition? (5 points)
 (b) What are the higher quantum number and lower quantum number of the transition producing this emission? (5 points)