臺灣綜合大學系統112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 3 頁

Some useful constants

Gas constant $R = 8.314$ J/mol·K

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

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

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

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

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

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

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

Gravitational constant $G = 6.68 \times 10^{-11}$ N·m^2 /kg^2

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

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

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

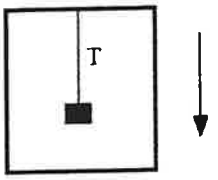
1 eV $= 1.6 \times 10^{-19}$ J

第一部分：填充簡答題（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. The position of a particle moving in circular motion in the xy plane is $\vec{r} = 3\cos(2t)\,\hat{\imath} + 3\sin(2t)\hat{\jmath}$, where r is in meters and t is in seconds. What is the period of the circular motion? _____

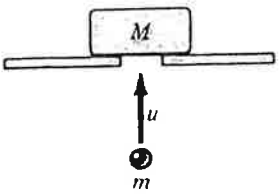
2. An object with mass m is hanging from a wire attached to the ceiling of an elevator. The elevator is moving downward and has a downward acceleration of magnitude a. The gravitational acceleration is g. Find the magnitude of the tension of the wire. _____



3. The position of a particle of mass m kg is given by $x(t)=At^3+B$, where A and B are constants, and the unit of x is in meter, and t is in second. Find the instantaneous net power done on this particle at t=2 s.

_____

4. A bullet of mass m strikes a stationary block of mass M from below with a speed u. The mass of M is three times of m (M=3 m). After the collision, the bullet embeds in the block. The gravitational acceleration is g. To what height does the block rise? Express your answer by u and g. _____



5. A mass m is connected to two springs, with spring constants k_1 *and* k_2, as shown in the figure. Find the oscillation period for this configuration.

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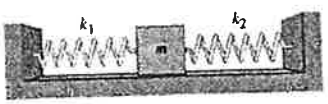

6. The maximum oscillation speed of a string carrying a sinusoidal wave is v_s. When the displacement of a point on the string is half its maximum, what is the oscillation speed of the point? _____

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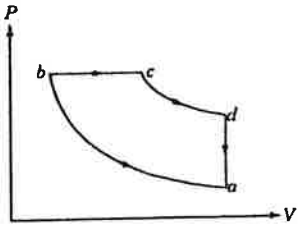
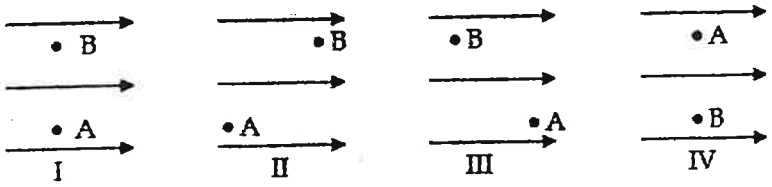
7. The ideal Diesel cycle is shown in the figure, where a to b and c to d are adiabatic processes, b to c is constant pressure compression, and d to a is constant volume process. The temperature at a, b, c, d points are T_a, T_b, T_c, and T_d, respectively. The ratio of molar specific heat at constant pressure to that at constant volume is $\gamma = C_p/C_v = 5/3$. Find the entropy change (ΔS) of the engine after a complete cycle: $a \rightarrow b \rightarrow c \rightarrow d \rightarrow a$. _____



8. Same conditions as the ideal Diesel cycle mentioned in above question, find the efficiency of the engine.

_____

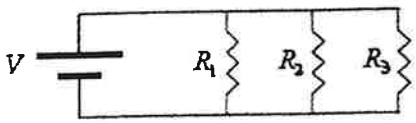
9. Four electrons move from point A to point B in a uniform electric field as shown below. Rank the electrons in diagrams I through IV by the changes in potential from most positive to most negative when traveling from A to B. _____



10. Addition of a metal slab of thickness a between the plates of a parallel-plate capacitor of plate separation d is equivalent to introducing a dielectric with dielectric constant κ between the plates. The value of κ is:

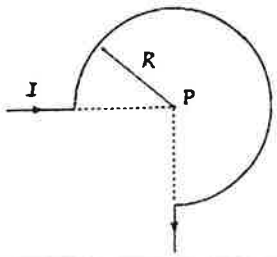
_____.

11. The circuit below shows three resistors in parallel. $R_3 > R_2 > R_1$. The resistors are all made of the same wire with the same diameter but have different lengths. Rank the magnitudes of the electric fields in the resistors from least to greatest. _____



12. Using the electric constant (permittivity) ϵ_0 and magnetic constant (permeability) μ_0, the speed of light is given by the value of _____.

13. The segment of wire (total length including portions of incoming and outgoing wire = $6R$) is formed into the shape shown and carries a current I. What is the magnitude of the resulting magnetic field at the point P? _____



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14. There is no current in the circuit shown in the figure below until the switch is closed. The current through the 20-Ω resistor the instant after the switch is closed is either [1] 15 A or [2] 5.0 A, and the current through the 20-Ω resistor after the switch has been closed a long time is either [3] 5.0 A or [4] 15 A. Which combination of the above choices is correct? _____

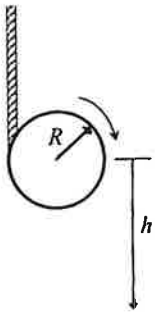
15. The centers of two slits of width a are a distance d apart. If the fourth minimum of the interference pattern occurs at the location of the first minimum of the diffraction pattern for light of wavelength λ, the ratio a/d is equal to _____.

16. The light intensity incident on a metallic surface produces photoelectrons with a maximum kinetic energy of 2 eV. The light intensity is doubled. Determine the maximum kinetic energy of the photoelectrons (in eV). _____

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. A Yo-Yo of of mass M and radius R unwinds on a vertical string without slipping. The moment of inertia about the axis through the center (I) is about $(1/2)MR^2$. The gravitational acceleration is g.
   (a) Find the tension of the rope; (5 points)
   (b) After the Yo-Yo falls a distance h starting form rest (v_0=0), find the speed of center of the mass of the Yo-Yo. (5 points)



2. In 1963, astronaut Gordon Cooper orbited the Earth 22 times. The press stated that for each orbit, he aged two-millionths of a second less than he would have had he remained on the Earth.
   (a) Assuming Cooper was 160 km above the Earth in a circular orbit, determine the difference in elapsed time between someone on the Earth and the orbiting astronaut for the 22 orbits. You may use the approximation $\frac{1}{\sqrt{1-x}} \approx 1+\frac{x}{2}$, for small x. (5 points)
   (b) Did the press report accurate information? Please explain. (5 points)