

國立成功大學

114學年度碩士班招生考試試題

編 號：39

系 所：物理學系

科 目：普通物理學

日 期：0211

節 次：第 2 節

注 意：1.不可使用計算機
2.請於答案卷(卡)作答，於
試題上作答，不予計分。

※ 考生請注意：本試題不可使用計算機。請於答案卷上作答，於本試題紙上作答者，不予計分。

Some useful constants

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

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

作答所用對數值： $\ln 2 = 0.7$

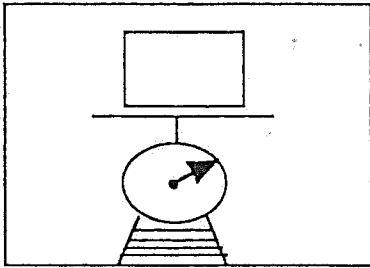
第一部分：選擇題(35分)

共 7 題，每題 5 分，請在答案卷上標明題號並依續作答，答錯不倒扣。

1. A block of mass M is pushed up an incline of slope $3/4$ by a horizontal force equal to twice its weight. If the coefficient of kinetic friction between the block and the incline is $\mu = 0.25$, what is the acceleration of the block along the incline?

- (A) $g/5$ (B) $g/2$ (C) $3g/4$ (D) $4g/5$ (E) g

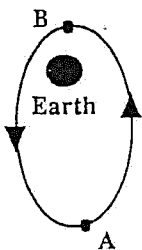
2. The diagram represents a mass on a spring scale in an elevator. If the reading on the spring scale is 0.75 of the value when at rest, what is the acceleration of the elevator? (In units of g .)



- (A) 1.25 up (B) 0.75 up (C) 0.25 up (D) 0.25 down (E) 0.75 down

3. Young's modulus is a proportionality constant that relates the force per unit area applied perpendicularly at the surface end of an object to: (A) the shear (B) the fractional change in volume (C) the fractional change in length (D) the pressure (E) the spring constant

4. A small satellite is in elliptical orbit around the earth as shown. If L denotes angular momentum and K denotes kinetic energy, which of the following statement is correct?



- (A) $L_B > L_A$ and $K_B > K_A$ (B) $L_B > L_A$ and $K_B = K_A$ (C) $L_B = L_A$ and $K_B = K_A$ (D) $L_B < L_A$ and $K_B = K_A$ (E) $L_B = L_A$ and $K_B > K_A$

5. The "Principle of Equipartition of Energy" states that the energy of a gas is shared equally:

- (A) among the molecules (B) between kinetic and potential energy (C) among the relevant degrees of freedom (D) between translational and vibrational kinetic energy (E) between heat and work

6. Choose the correct statement concerning electric fields \vec{E} :

- (A) lines of \vec{E} may cross (B) an electric dipole never experiences a torque due to \vec{E} (C) an electric dipole experiences a net force due to a uniform \vec{E} field (D) a point charge q , released from rest, will move along a line of \vec{E} field (E) none of these

7. An initially uncharged capacitor C is connected in series with resistor R . This combination is then connected to a battery of emf V_0 . Sufficient time elapses so that a steady state is reached. Which of the following statements is NOT true?

- (A) the time constant is independent of V_0 (B) the final charge on C is independent of R (C) the total energy dissipated by R is independent of R (D) the total energy dissipated by R is independent of V_0 (E) the initial current (just after the battery was connected) is independent of C

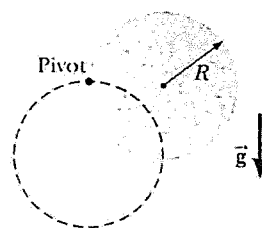
第二部分：簡答題(45分)

共9題，每題5分，請在答案卷上標明題號並依續作答(請直接寫下答案，不須列計算過程，數值答案須寫上單位)。

8. A force $\vec{F} = (cx - 3x^2)\hat{i}$ acts on a particle as the particle moves along an x axis, with \vec{F} in newtons, x in meters, and c a constant. At $x = 0$, the particle's kinetic energy is 20.0 J; at $x = 3.00$ m, it is 11.0 J. Find c .

9. At time t , the vector $\vec{r} = 4.0t^2\hat{i} - (2.0t + 6.0t^2)\hat{j}$ gives the position of a 4.0 kg particle relative to the origin of an xy coordinate system (\vec{r} is in meters and t is in seconds). Find an expression for the torque acting on the particle relative to the origin.

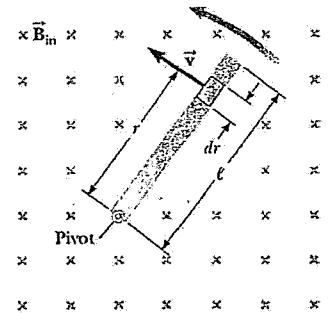
10. A uniform solid disk of radius R and mass M is free to rotate on a frictionless pivot through a point on its rim. If the disk is released from rest in the position shown by the gray-colored circle, what is the speed of its center of mass when the disk reaches the position indicated by the dashed circle?



11. Calculate the sound intensity ratio ($I_{\text{drill}}/I_{\text{conversation}}$) for a pneumatic drill at 3 m (90 dB) compared to normal conversation at 1 m (60 dB).

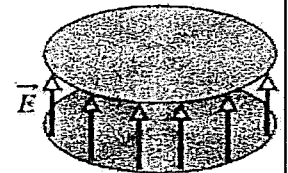
12. A charge distribution that is spherically symmetric but not uniform radially produces an electric field of magnitude $E = Kr^4$, directed radially outward from the center of the sphere. Here r is the radial distance and K is a constant. What is the volume density ρ of the charge distribution?

13. A conducting bar of length l rotates with a constant angular speed ω about pivot at one end. A uniform magnetic field \vec{B}_{in} is directed perpendicular to the plane of rotation as shown. Find the motional emf induced between the ends of bar.



14. An oscillator producing 10 volts (rms) at 200 rad/s is connected in series with a 50 Ω resistor, a 400 mH inductor, and a 200 F capacitor. What is the rms voltage (in volts) across the inductor?

15. The magnitude of the electric field between the two circular parallel plates in the figure is $E = (4.0 \times 10^5) - (6.0 \times 10^4 t)$, with E in volts per meter and t in seconds. At $t = 0$, \vec{E} is upward. The plate area is $6.0 \times 10^{-2} \text{ m}^2$. For $t \geq 0$, what is the magnitude of the displacement current between the plates?



16. White light, with a uniform intensity across the visible wavelength range of 400 to 690 nm, is perpendicularly incident on a water film, of index of refraction $n = 1.33$ and thickness $L = 320 \text{ nm}$, that is suspended in air. At what wavelength λ is the light reflected by the film brightest to an observer?

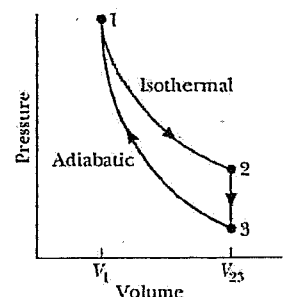
第三部分：計算題(20分)

共2大題，請在答案卷上標明題號依續作答，並詳列計算過程(中英文作答均可)。

17. In the figure, where $V_{23} = 4.00V_1$, n moles of a diatomic ideal gas are taken through the cycle with the molecules rotating but not oscillating. The temperature at point 1(3) is $T_1(T_3)$.

(a) What is T_3/T_1 ? (5%)

(b) For path $2 \rightarrow 3$, what is $\Delta S/nR$? (5%)



18. The x -, y -, and z -components of the electric field on an EM wave in vacuum are $E_y(x, y, z, t) = -60.0 \frac{\text{V}}{\text{m}} \times \cos[(4.0 \text{ m}^{-1})x + \omega t]$, $E_x = E_z = 0$

(a) Find the value of ω . (4%)

(b) Write an expression for the components of the magnetic field of the wave. (6%)