

國立高雄大學 114 學年度 第 2 學期理學院

普通物理學基礎能力 會考試題

考試日期：115.06.09(星期二)

考試時間：16：40-18：40

系所：_____ 姓名：_____ 學號：_____

規定事項：

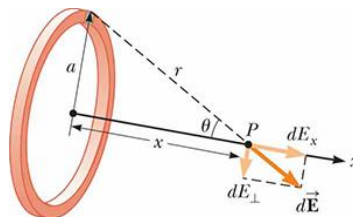
1. 請攜帶學生證（或有照片之證件）準時應考，以便身分核對。
2. 應試時請依當日公告之座位表入座。
3. 遲到逾 20 分鐘者，不得入場；已入場應試者，60 分鐘內不得出場。
4. 答案卡應以 2B 鉛筆作答，攜帶軟性品質較佳之橡皮擦備用。
5. 禁止使用電子產品（如：手機）
6. 電子計算器：僅限簡易型電子計算機（限僅有數字鍵 0~9 及 $+$ $-$ $\times$ $\div$ $\sqrt{}$ $\%$ M 等功能）”

<第一部份-基礎題型 1-20 共 20 題，每題 2.5 分，共 50 分>

1. A hemispherical surface (half of a spherical surface) of radius R is located in a uniform electric field of magnitude E that is parallel to the axis of the hemisphere. What is the magnitude of the electric flux through the hemisphere surface?
(A) $E\pi R^2$
(B) $2E\pi R^2$
(C) $4E\pi R^2$
(D) $2E\pi R^2/3$
(E) $4E\pi R^2/3$
2. Four point charges each having charge Q are located at the corners of a square having sides of length a . What is the total electric potential at the center of the square due to the four charges?
(A) $4k_e Q/a$
(B) $2\sqrt{2}k_e Q/a$
(C) $4\sqrt{2}k_e Q/a$
(D) $2k_e Q/a$
(E) $\sqrt{2}k_e Q/2a$
3. A parallel-plate capacitor is charged to a voltage V and then disconnected from the battery. Leopold says that the voltage will decrease if the plates are pulled apart. Gerhardt says that the voltage will remain the same. Which one, if either, is correct, and why?
(A) Gerhardt, because the maximum voltage is determined by the battery.
(B) Leopold, because charge is transferred from one plate to the other when the plates are separated.
(C) Gerhardt, because the charge per unit area on the plates does not change.
(D) Leopold, because the force each plate exerts on the other decreases when the plates are pulled apart.
(E) Neither, because the voltage increases when the plates are pulled apart.
4. Two large parallel conducting plates are separated by a distance d and connected to a battery that maintains a constant potential difference V_0 . Point A is located halfway between the plates. A proton (charge q) is released from rest at the positive plate and moves toward the negative plate. Which of the following statements is correct?
(A) The electric potential at point A is zero because the electric field is uniform.
(B) The electric potential energy of the proton increases as it moves toward the negative plate.
(C) The electric field between the plates becomes weaker as the proton approaches the negative plate.
(D) The work done by the electric field on the proton from the positive plate to point A is equal to qV_0 .
(E) The electric potential decreases linearly from the positive plate to the negative plate.

5. Where is the maximum magnitude $E_{\max}$ of the electric field along the axis of a uniformly charged ring (radius a), as shown in Fig.1?

- (A) At $x = 0$
- (B) At $x = a$
- (C) At $x = a/\sqrt{2}$
- (D) At $x = a/\sqrt{3}$
- (E) At $x = 2a$



6. A parallel-plate capacitor with capacitance C_0 is initially charged to a voltage V_0 and then disconnected from the battery. A dielectric slab with dielectric constant $k > 1$ is slowly inserted until it completely fills the space between the plates. Which of the following statements is correct after the dielectric is fully inserted?

- (A) The capacitance remains unchanged, while the stored energy increases.
- (B) The charge on the capacitor decreases because the dielectric attracts charges.
- (C) The electric field between the plates increases by a factor of k .
- (D) The potential difference across the capacitor decreases to V_0/k .
- (E) The stored energy remains constant because the capacitor is isolated.

7. An insulating solid sphere of radius R carries a total positive charge Q uniformly distributed throughout its volume. A spherical Gaussian surface of radius $r < R$ is drawn inside the sphere. Which of the following statements is correct?

- (A) The electric field at every point inside the sphere is zero because the charge is uniformly distributed.
- (B) The electric flux through the Gaussian surface depends only on the charge enclosed within radius r .
- (C) The electric field at radius r depends on the total charge Q of the entire sphere, including the charge outside the Gaussian surface.
- (D) Gauss's law cannot be applied because the charge is distributed continuously rather than concentrated at a point.
- (E) The electric flux through the Gaussian surface is zero because electric field lines entering and leaving the surface cancel each other.

8. What is the current (amps) in a wire between radial distances 3.00 mm and 5.00 mm if the current density is given by $J = (2.00 \times 10^{10})r^3$ in (proper) units of amps/m² and m?

- (A) 6.7×10^{-2}
- (B) 7.2×10^{-2}
- (C) 9.5×10^{-2}
- (D) 3.9×10^{-2}
- (E) 8.8×10^{-2}

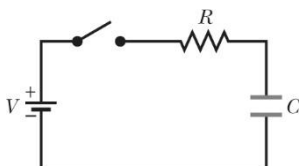
國立高雄大學 114 學年度第 2 學期
理學院普通物理學基礎能力會考試題

9. How long (hours) do electrons take to move through a cable of length 6.00 m? There are 8.49×10^{28} conduction electrons per cubic meter. The current is 8.00 A. The cross-sectional area is $2.50 \times 10^{-5} \text{ m}^2$.

- (A) 8.17 (B) 4.40 (C) 47.2 (D) 70.8 (E) 14.8

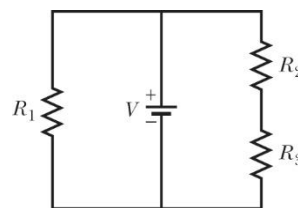
10. In the figure, the capacitance is $6.00 \times 10^{-6} \text{ F}$, the battery's voltage is $V = 12.0 \text{ V}$, and the resistance is 600Ω . At time $t = 0$, the capacitor has no charge and the switch is closed. At what time (s) is the voltage across the capacitor equal to 2.00 volts?

- (A) 5.47×10^{-4}
(B) 6.56×10^{-4}
(C) 1.20×10^{-5}
(D) 9.19×10^{-4}
(E) 3.33×10^{-4}



11. The figure shows an ideal 12 V battery and three resistors: $R_1 = 6.0 \Omega$, $R_2 = 5.0 \Omega$, $R_3 = 3.0 \Omega$. At what rate (W) is energy dissipated in resistor 1?

- (A) 24 (B) 22 (C) 16 (D) 30 (E) 32

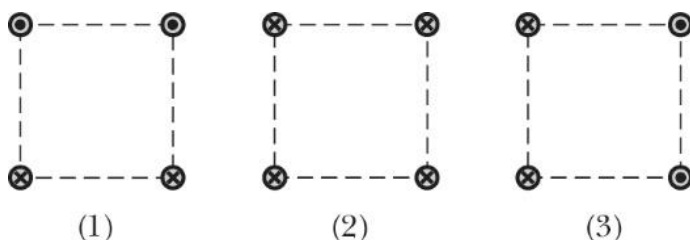


12. A particle circles in a uniform magnetic field with kinetic energy $K = 4.8 \times 10^{-22} \text{ J}$, experiencing a magnetic force of magnitude $F = 1.2 \times 10^{-17} \text{ N}$. What is the radius (m) of the circle?

- (A) 8.0×10^{-5}
(B) 4.0×10^{-5}
(C) 5.6×10^{-5}
(D) 8.7×10^{-6}
(E) 2.8×10^{-6}

13. The figure shows three arrangements in which long, parallel wires carry equal currents directly into or out of the plane of the figure at the corners of identical squares. Rank the arrangements according to the magnitude of the net magnetic field at the center of the square, greatest first. () indicates a tie.

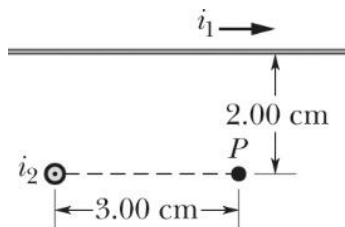
- (A) $3 > 1 > 2$
(B) $(1=2) > 3$
(C) $3 > (1=2)$
(D) $(1=3) > 2$
(E) $(1=2=3)$



國立高雄大學 114 學年度第 2 學期
理學院普通物理學基礎能力會考試題

14. The figure shows two long straight wires. One is in the plane of the figure, carrying $i_1 = 4.00$ A rightward. The other is perpendicular to the plane, carrying $i_2 = 5.00$ A outward. What is the magnitude (μT) of the net magnetic field at point P ?

- (A) 6.67
(B) 86.7
(C) 73.3
(D) 18.0
(E) 52.1



15. A long solenoid has a turn density of $n=800$ turns/m and a cross-sectional area of $A=2.0\times 10^{-4}$ m². What is its approximate self-inductance? Assume $\mu_0=4\pi\times 10^{-7}$ H/m.

- (A) 1.6×10^{-7} H/m
(B) 1.6×10^{-4} H/m
(C) 2.0×10^{-3} H/m
(D) 4.0×10^{-2} H/m
(E) 0.80 H/m

16. An inductor with inductance 0.50 H carries a current of 4.0 A. How much magnetic energy is stored in the inductor?

- (A) 1.0 J
(B) 2.0 J
(C) 4.0 J
(D) 8.0 J
(E) 16 J

17. An LC oscillation circuit has an inductance of 2.0 mH and a capacitance of 8.0 μF . What is the approximate angular frequency of the circuit?

- (A) 2.5×10^2 rad/s
(B) 2.5×10^3 rad/s
(C) 7.9×10^3 rad/s
(D) 1.6×10^4 rad/s
(E) 6.3×10^4 rad/s

18. A pure inductor of inductance 0.20 H is connected to an alternating current circuit with angular frequency 300 rad/s. What is the inductive reactance of the inductor?

- (A) 15 Ω (B) 30 Ω (C) 60 Ω (D) 150 Ω (E) 600 Ω

國立高雄大學 114 學年度第 2 學期
理學院普通物理學基礎能力會考試題

19. In vacuum, the electric flux in a certain region changes at a rate of 2.0×10^5 V-m/s. What is the magnitude of the Maxwell displacement current? Assume $\epsilon_0 = 8.85 \times 10^{-12}$ F/m.

- (A) 1.77×10^{-6} A
- (B) 1.77×10^{-5} A
- (C) 2.26×10^{-7} A
- (D) 8.85×10^{-7} A
- (E) 2.00×10^{-5} A

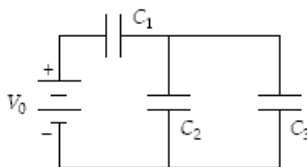
20. An electromagnetic wave with an average intensity of 8.0 W/m^2 is completely absorbed by a surface. What is the radiation pressure on the surface? Assume $c = 3.0 \times 10^8$ m/s.

- (A) 2.7×10^{-8} Pa
- (B) 5.3×10^{-8} Pa
- (C) 8.0×10^{-8} Pa
- (D) 2.4×10^{-7} Pa
- (E) 1.5×10^{-6} Pa

<第二部份：進階題型 1-10 共 10 題，每題 5 分，共 50 分>

21. Determine the energy stored in C_2 when $C_1 = 15 \mu\text{F}$, $C_2 = 10 \mu\text{F}$, $C_3 = 20 \mu\text{F}$, and $V_0 = 18 \text{ V}$.

- (A) 0.18 mJ
- (B) 0.36 mJ
- (C) 0.50 mJ
- (D) 0.75 mJ
- (E) 1.50 mJ

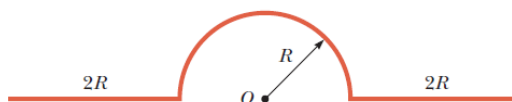


22. A uniformly charged rod (length L , charge per unit length λ) is bent to form a semicircle (radius R). What is the electric field at the center of the circle?

- (A) $k\lambda/R$ (B) $2k\lambda/R$ (C) $k\lambda/2R$ (D) $k\lambda/\pi R$ (E) $k\lambda/2\pi R$

23. A wire having a uniform linear charge density λ is bent into the shape shown in the figure below. What is the electric potential at point O?

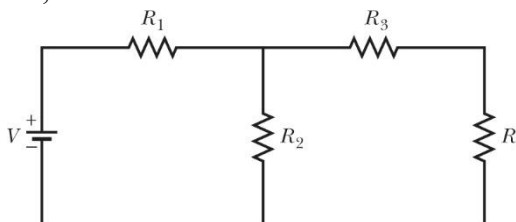
- (A) $k_e \lambda \pi$
- (B) $k_e \lambda (\pi + 2)$
- (C) $k_e \lambda (\pi + 2 \ln 2)$
- (D) $k_e \lambda (\pi + 2 \ln 3)$
- (E) $k_e \lambda (\pi + 2R)$



24. The figure shows an ideal 12.0 battery. What is the current (A) through resistor 2?

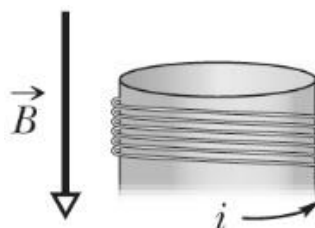
$$R_1 = 1.40 \, \Omega, R_2 = 2.00 \, \Omega, R_3 = 6.00 \, \Omega, R_4 = 2.00 \, \Omega,$$

- (A) 3.2
- (B) 6.8
- (C) 4.3
- (D) 6.4
- (E) 7.0



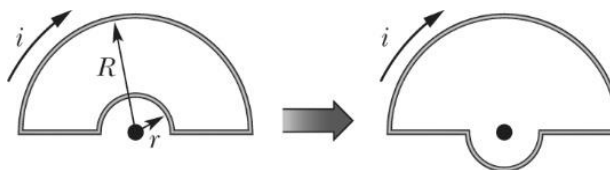
25. The figure shows a current carrying coil in an external magnetic field. Let θ be the angle between that magnetic field and the coil's magnetic moment vector. For what value of θ (degrees) is the potential energy maximum?

- (A) 0
- (B) 45
- (C) 90
- (D) 135
- (E) 180



26. The first figure shows a closed loop with current i . The loop consists of a half-circle of radius r and a half-circle of radius $R = 2r$. The second figure shows the same half-circles but the small one has been flipped over. The net magnetic field at the common center of the circular sections is B_1 for the first figure and B_2 for the second figure. What is the magnitude of the ratio B_2 / B_1 ?

- (A) 2
- (B) 4
- (C) 3
- (D) 2.5
- (E) 1.5



27. A series RLC circuit with resistance $30 \, \Omega$, inductance $0.20 \, \text{H}$, and capacitance $50 \, \mu\text{F}$ is connected to an alternating current source of angular frequency $1000 \, \text{rad/s}$. What is the approximate impedance of the circuit?

- (A) $30 \, \Omega$
- (B) $70 \, \Omega$
- (C) $130 \, \Omega$
- (D) $180 \, \Omega$
- (E) $250 \, \Omega$

國立高雄大學 114 學年度第 2 學期
理學院普通物理學基礎能力會考試題

28. An ideal transformer has a primary coil with 500 turns and a secondary coil with 100 turns. The primary is connected to a 120 V alternating current source, while the secondary is connected to a $4.0\ \Omega$ resistor. Assuming no energy loss, what is the approximate primary current?
- (A) 0.24 A
(B) 0.48 A
(C) 1.2 A
(D) 6.0 A
(E) 30 A
29. An electromagnetic wave with an average intensity of $12\ \text{W/m}^2$ is completely reflected from an ideal mirror of area $0.50\ \text{m}^2$. What is the approximate force acting on the mirror? Assume $c = 3.0 \times 10^8\ \text{m/s}$
- (A) $2.0 \times 10^{-8}\ \text{N}$
(B) $4.0 \times 10^{-8}\ \text{N}$
(C) $8.0 \times 10^{-8}\ \text{N}$
(D) $2.0 \times 10^{-7}\ \text{N}$
(E) $4.0 \times 10^{-7}\ \text{N}$
30. In a series RLC circuit, the resistance is $40\ \Omega$, the inductive reactance is $90\ \Omega$, and the capacitive reactance is $60\ \Omega$. If the rms current is 2.0 A, what is the approximate rms voltage supplied by the source?
- (A) 60 V
(B) 80 V
(C) 100 V
(D) 120 V
(E) 180 V