國立高雄大學 111 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：112.6.12(星期一)

考試時間：17：00-19：00

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＋－×÷√%M 等功能)”
7. 考試期間請全程配戴口罩，未佩戴口罩不得進入考場。

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

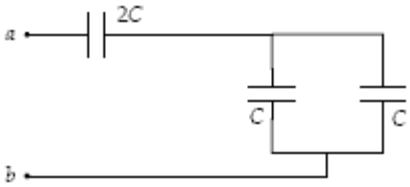
1. A particle (charge = +40 μC) is located on the x axis at the point x = –20 cm, and a second particle (charge = –50 μC) is placed on the x axis at x = +30 cm. What is the magnitude of the total electrostatic force on a third particle (charge = –4.0 μC) placed at the origin (x = 0)?
   (A) 41 N (B) 16 N (C) 56 N (D) 35 N (E) 72 N

2. The field just outside the surface of a long conducting cylinder which has a 2.0-cm radius points radially outward and has a magnitude of 200 N/C. What is the charge density on the surface of the cylinder?
   (A) 2.7 nC/m^2 (B) 1.8 nC/m^2 (C) 3.5 nC/m^2 (D) 4.4 nC/m^2 (E) 0.90 nC/m^2

3. A proton (mass = 1.67×10^{-27} kg, charge = 1.60×10^{-19} C) moves from point A to point B under the influence of an electrostatic force only. At point A the proton moves with a speed of 50 km/s. At point B the speed of the proton is 80 km/s. Determine the potential difference $V_B - V_A$.
   (A) +20 V (B) –20 V (C) –27 V (D) +27 V (E) –40 V

4. When a positive charge is released and moves along an electric field line, it moves to a position of
   (A) lower potential and lower potential energy.
   (B) lower potential and higher potential energy.
   (C) higher potential and lower potential energy.
   (D) higher potential and higher potential energy.
   (E) greater magnitude of the electric field.

5. The equivalent capacitance of the circuit shown below is
   (A) 0.50 C. (B) 1.0 C. (C) 1.5 C. (D) 2.0 C. (E) 2.5 C.



6. A 15-μF capacitor and a 25-μF capacitor are connected in parallel, and charged to a potential difference of 60 V. How much energy is then stored in this capacitor combination?
   (A) 50 mJ (B) 18 mJ (C) 32 mJ (D) 72 mJ (E) 45 mJ

7. When the dipole moment of a dipole in a uniform electric field rotates to become more nearly aligned with the field:
   (A)the field does positive work and the potential energy increases
   (B)the field does positive work and the potential energy decreases
   (C)the field does negative work and the potential energy increases
   (D)the field does negative work and the potential energy decreases
   (E) the field does no work

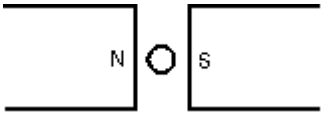
8. A wire with a length of 150 m and a radius of 0.15 m carries a current with a uniform current density of 2.8×10^7 A/m^2. The current is:
   (A) 0.63 A^2 (B) 2.0 A (C) 5.9 A^2 (D)296 A (E) 400 A^2

9. Nine identical wires, each of diameter *d* and length *L*, are connected in series. The combination has the same resistance as a single similar wire of length *L* but whose diameter is:
   (A) 3*d* (B) 9*d* (C) *d*/3 (D) *d*/9 (E) *d*/81

10. "The sum of the currents into a junction equals the sum of the currents out of the junction" is a consequence of:
   (A) Newton's third law
   (B) Ohm's law
   (C) Newton's second law
   (D) conservation of energy
   (E) conservation of charge

11. An electron is moving north in a region where the magnetic field is south. The magnetic force exerted on the electron is:
   (A) zero (B) up (C) down (D) east (E) west

12. The diagram shows a straight wire carrying a flow of electrons into the page. The wire is between the poles of a permanent magnet. The direction of the magnetic force exerted on the wire is:
   (A) ↑ (B) ↓ (C) ← (D) → (E) into the page



13. The magnetic field *B* inside a long ideal solenoid is independent of:
    (A) the current
    (B) the core material
    (C) the spacing of the windings
    (D) the cross-sectional area
    (E) the direction of the current

14. The magnetic field outside a long straight current-carrying wire depends on the distance *R* from the wire axis according to:
    (A) R (B) $1/R$ (C) $1/R^2$ (D) $1/R^3$ (E) $1/R^{3/2}$

15. A conducting loop with radius of 0.5m. The loop lies in a uniform magnetic field B that is directed out of the page. The magnitude of the B is given by $B=2t^2+3t+2$, with B and t in Tesla and seconds, respectively. What are the induced emf around the loop by the field B at t= 10s?
    (A) 13.75 V (B) 23.75 V (C) 33.75V (D) 43.75V (E) 53.75V

16. The magnitude of the electric field between the two parallel plates is $E = (4 \times 10^5) - (6 \times 10^4\ t)$, with E in V/m and t in seconds. At t = 0, $\vec{E}$ pointed upward. The plate area is 4.0 × 10^{-2} m^2. For $t \geq 0$, what is the displacement current between the plates? Note: $\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N \cdot m^2$
    (A) 3.2×10^{-8} A
    (B) -3.2×10^{-8} A
    (C) -1.6×10^{-8} A
    (D) 1.6×10^{-8} A
    (E) 3.6×10^{-8} A

17. A 16H inductor carries a current of 8.0 A. At what rate must the current be changed to produce a 24 V emf in the inductor?
    (A) −1.5 A/s (B) −3.2 A/s (C) −6.0 A/s (D) −7.1 A/s (E) −9.0 A/s

18. An external alternating emf device, with maximum amplitude of emf $\mathcal{E}_m = 36V$ and driving frequency f_d=60Hz, was connected to a series RLC circuit, as shown in Figure, with R=200 ohm, L= 230mH and C= 15uF. What is the natural angular frequency of the circuit?
    (A) 60 rad/s (B) 18.23 rad/s (C) 538 rad/s (D) 0.147 rad/s (E) 147 rad/s

19. A plane electromagnetic wave has a maximum electric field magnitude of 2.50×10^{-5} V/m. Find the magnetic field amplitude.
(A) 1.06×10^{-14} T
(B) 2.14×10^{-14} T
(C) 4.32×10^{-14} T
(D) 6.64×10^{-14} T
(E) 8.33×10^{-14} T

20. Find the intensity of the electromagnetic wave in an electromagnetic wave with wave length 710 nm and a peak electric field magnitude of 1.76 V/m.
(A) 0.0041 W/m^2
(B) 0.0062 W/m^2
(C) 0.0083 W/m^2
(D) 0.0126 W/m^2
(E) 0.1126 W/m^2

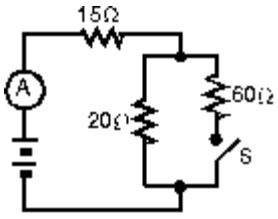
<第二部份：進階題型 1-10 共 10 題，每題 5 分，共 50 分>

1. A charge of 80 nC is uniformly distributed along the x axis from x = 0 to x = 2.0 m. Determine the magnitude of the electric field at a point on the x axis with x = 8.0 m.
(A) 30 N/C (B) 15 N/C (C) 48 N/C (D) 90 N/C (E) 60 N/C

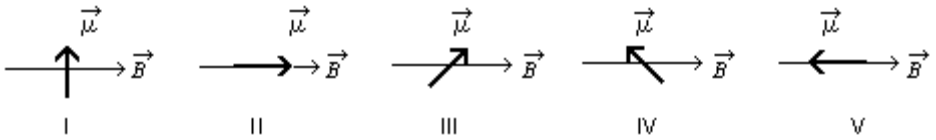
2. Particle A (mass = m, charge = Q) and B (mass = m, charge = 5 Q) are released from rest with the distance between them equal to 1.0 m. If Q = 12 μC, what is the kinetic energy of particle B at the instant when the particles are 3.0 m apart?
(A) 8.6 J (B) 3.8 J (C) 6.0 J (D) 2.2 J (E) 4.3 J

3. If the electric field is in the positive x direction and has a magnitude given by $E = Cx^2$, where C is a constant, then the electric potential is given by V =
(A) $2Cx$ (B) $-2Cx$ (C) $Cx^3/3$ (D) $-Cx^3/3$ (E) $-3Cx^3$

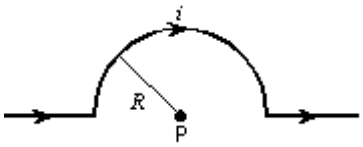
4. When switch S is open, the ammeter in the circuit shown reads 2.0 A. When S is closed, the ammeter reading:
   (A) increases slightly
   (B) remains the same
   (C) decreases slightly
   (D) doubles
   (E) halves



5. The diagrams show five possible orientations of a magnetic dipole $\vec{\mu}$ in a uniform magnetic field $\vec{B}$. For which of these is the potential energy the greatest?
   (A) I (B) II (C) III (D) IV (E) V



6. The magnitude of the magnetic field at point P, at the center of the semicircle shown, is given by:
   (A) $2\mu_{0i}/R^2$
   (B) $\mu_0 i/2\pi R$
   (C) $\mu_0 i/4\pi R$
   (D) $\mu_0 i/2R$
   (E) $\mu_0 i/4R$



7. In an oscillating LC circuit in which C = 4.00 μF, the maximum potential difference across the capacitor during the oscillations is 1.50 V and the maximum current through the inductor is 50.0 mA. What is the magnitude of the inductance L?
   (A) 5.40×10^{-3} H
   (B) 6.40×10^{-3} H
   (C) 2.70×10^{-3} H
   (D) 3.40×10^{-3} H
   (E) 7.40×10^{-3} H

8. In an oscillating series RLC circuit, find the time required for the maximum energy present in the capacitor during an oscillation to fall to half its initial value. Assume q = Q at t = 0.

(A) $\frac{2L}{R}\ln\left(\frac{1}{\sqrt{2}}\right)$ (B) $\frac{2L}{R}\ln 2$ (C) $\frac{L}{R}\ln 2$ (D) $\frac{L}{\sqrt{2}R}\ln 2$ (E) $\frac{L}{2R}\ln 2$

9. As a parallel-plate capacitor with circular plates 20 cm in diameter is being charged, the current density of the displacement current in the region between the plates is uniform and has a magnitude of 20 A/m^2. Calculate the magnitude B of the magnetic field at a distance r = 50 mm from the axis of symmetry of this region.

(A) 0.21 μT (B) 2.1 μT (C) 21 μT (D) 6.3 μT (E) 0.63 μT

10. In the previous question, calculate dE/dt in this region.

(A) $2.3\times10^{13}\frac{V}{m\cdot s}$ (B) $4.6\times10^{13}\frac{V}{m\cdot s}$ (C) $2.3\times10^{12}\frac{V}{m\cdot s}$ (D) $6.9\times10^{12}\frac{V}{m\cdot s}$

(E) $69\times10^{12}\frac{V}{m\cdot s}$