國立高雄大學 108 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：109.6.19(星期五)

考試時間：17：30-19：30

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)”

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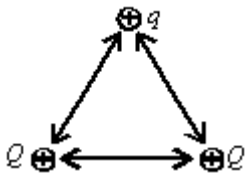
<第一部份-基礎題型 1-20 共 20 題，每題 2.5 分，共 50 分>

1. Two particles, each with charge *Q*, and a third particle, with a charge *q*, are placed at the vertices of an equilateral triangle as shown. The total force on the particle with charge *q* is:



(A)Parallel to the left side of the triangle
(B)Parallel to the right side of the triangle
(C)Parallel to the bottom side of the triangle
(D)perpendicular to the bottom side of the triangle
(E)perpendicular to the left side of the triangle

2. Which of the following is NOT a possible value for the electric charge on an object?
(A)8×10^{-20} C
(B)8×10^{-19} C
(C)8×10^{-18} C
(D)8×10^{-17} C
(E)8×10^{-16} C

3. Let *k* denote$1/4\pi\varepsilon_0$. The magnitude of the electric field at a distance *r* from an isolated point charge *q* is:
(A) kq/r
(B) kr/q
(C) kq/r^3
(D) kq/r^2
(E) kq^2/r^2

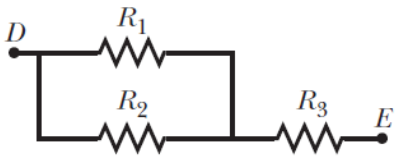
4. The potential difference between two points is 100 V. If a particle with a charge of 2 C is transported from one of these points to the other, the magnitude of the work done is:
(A)200 J
(B)100 J
(C)50 J
(D)100 V
(E)2 J

5. An electron is accelerated from rest through a potential difference *V*. Its final speed is proportional to:
(A) V (B) V^2 (C) $\sqrt{V}$ (D) $1/V$ (E) $1/\sqrt{V}$

6. The units of capacitance are equivalent to:
(A) J/C (B) V/C (C) J^2/C (D) C/J (E) C^2/J

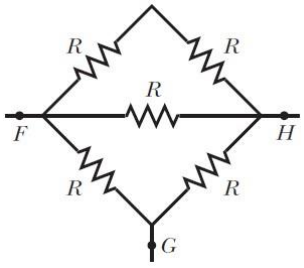
7. Capacitors C_1 and C_2 are connected in series. The equivalent capacitance is given by:
   (A) $C_1C_2/(C_1 + C_2)$
   (B) $(C_1 + C_2)/C_1C_2$
   (C) $1/(C_1 + C_2)$
   (D) C_1/C_2
   (E) $C_1 + C_2$

8. As shown in the figure, $R_1 = R_2 = 4.00\Omega$ and $R_3 = 2.50\Omega$. Find the equivalent resistance between points D and E.
   (*Hint*: Imagine that a battery is connected across those points.)
   (A)4.50 Ω
   (B)5.00 Ω
   (C)5.*50* Ω
   (D)6.*00* Ω
   (E) 6.50 Ω



9. A car battery with a 12V emf and an internal resistance of 0.040 Ω is being charged with a current of 50 A. What is the potential difference V across the terminals?
   (A)10 V
   (B)11 V
   (C)12 V
   (D)13 V
   (E) 14 V

10. The figure shows five 5.00 Ω resistors. Find the equivalent resistance between points F and H?(*Hint*: For each pair of points, imagine that a battery is connected across the pair.)
   (A)2.5 Ω
   (B)3.0 Ω
   (C)3.5 Ω
   (D)4.0 Ω
   (E) 4.5 Ω

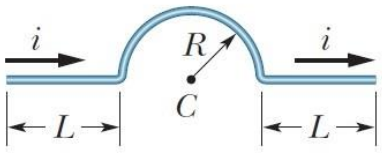


11. An electric field of $1.50k\,V/m$ and a perpendicular magnetic field of 0.400 T act on a moving electron to produce no net force. What is the electron's speed?
   (A)$2.75 \times 10^3\ m/s$
   (B) $2.95 \times 10^3\ m/s$
   (C) $3.15 \times 10^3\ m/s$

(D) $3.75 \times 10^3\ m/s$

(E) None of the above.

12. As shown in the figure, a wire forms a semicircle of radius $R = 9.26\ cm$ and two (radial) straight segments each of length $L = 13.1\ cm$. The wire carries current $i = 34.8\ mA$. What is the magnitude of the net magnetic field at the semicircle's center of curvature C? ($\mu_0 = 4\pi \times 10^{-7}\ Tm/A$)



(A) $1.18 \times 10^{-7}\ T$

(B) $1.20 \times 10^{-7}\ T$

(C) $2.21 \times 10^{-7}\ T$

(D) $3.15 \times 10^{-7}\ T$

(E) None of the above.

13. During the 4.0 min a 5.0 A current is set up in a wire, how many coulombs pass through any cross section across the wire's width?

(A) $1.2 \times 10^2\ C$

(B) $1.6 \times 10^2\ C$

(C) $1.2 \times 10^3\ C$

(D) $1.6 \times 10^3\ C$

(E) $1.8 \times 10^3\ C$

14. Thermal energy is produced in a resistor at a rate of 100 W when the current is 3.00 A. What is the resistance?

(A) 11.1 Ω

(B) 13.1 Ω

(C) 15.1 Ω

(D) 17.1 Ω

(E) 19.1 Ω

15. Two coils are at fixed locations. When coil 1 has no current and the current in coil 2 increases at the rate 10.0 A/s, the emf in coil 1 is 25.0 mV. What is their mutual inductance?

(A) 0.4 mH

(B) 2.5 mH

(C) 6.0 mH

(D) 40.0 mH

(E) 250 mH

16. What must be the magnitude of a uniform electric field if it is to have the same energy density as that possessed by a 20 mT magnetic field?

(A)6.00×10^{6} V/m
(B)7.50×10^{6} V/m
(C)8.14×10^{6} V/m
(D)8.52×10^{6} V/m
(E)9.05×10^{6} V/m

17. In an oscillating *LC* circuit in which C=6.00 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 inductance L?
(A)1.20×10^{-3} H
(B)3.30×10^{-3} H
(C)5.40×10^{-3} H
(D)7.80×10^{-3} H
(E)8.10×10^{-3} H

18. A magnet in the form of a cylindrical rod has a length of 5.00 cm and a diameter of 6.00 cm. It has a uniform magnetization of 5.30×10^{2} A/m. What is its magnetic dipole moment?
(A)1.27×10^{-2} J/T
(B)2.53×10^{-2} J/T
(C)4.91×10^{-2} J/T
(D)6.58×10^{-2} J/T
(E)7.49×10^{-2} J/T

19. 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 15 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)1.2×10^{-7} T
(B)2.6×10^{-7} T
(C)3.9×10^{-7} T
(D)4.7×10^{-7} T
(E)5.5×10^{-7} T

20. A plane electromagnetic wave has a maximum electric field magnitude of 1.80×10^{-4} V/m. Find the magnetic field amplitude.
(A)1.00×10^{-13} T
(B)3.00×10^{-13} T
(C)6.00×10^{-13} T

(D)8.00×10^{-13} T
(E)9.00×10^{-13} T

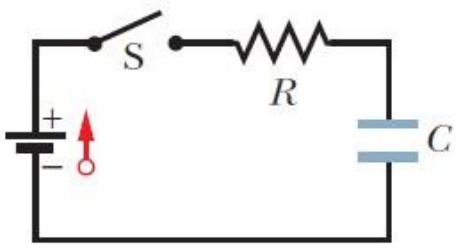
<第二部份-進階題型 21-30 共 10 題，每題 5 分，共 50 分>

21. Two identical charges, 2.0 m apart, exert forces of magnitude 4.0 N on each other. The value of either charge is:
(A)1.8×10^{-9} C
(B)2.1×10^{-5} C
(C)4.2×10^{-5} C
(D)1.9×10^{5} C
(E)3.8×10^{5} C

22. Two point particles, one with charge $+8\times10^{-9}$ C and the other with charge -2×10^{-9} C, are separated by 4 m. The electric field midway between them is:
(A)9×10^{9} N/C
(B)13,500 N/C
(C)135,000 N/C
(D)36×10^{-9} N/C
(E)22.5 N/C

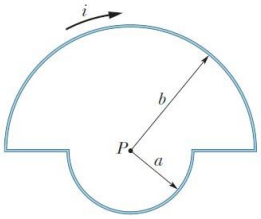
23. A uniform electric field of 300 N/C makes an angle of 45° with the dipole moment of an electric dipole. If the torque exerted by the field has a magnitude of 2.5×10^{-7} N·m, the dipole moment must be:
(A)8.3×10^{-10} C·m
(B)9.2×10^{-10} C·m
(C)1.2×10^{-9} C·m
(D)8.3×10^{-5} C·m
(E)1.8×10^{-4} C·m

24. Switch S in the figure is closed at time $t=0$, to begin charging an initially uncharged capacitor of capacitance C through a resistor of resistance R. At **what time** is the potential across the capacitor equal to that across the resistor?
(A)$RCln2\ s$
(B)$RCln3\ s$
(C)$RCln4\ s$
(D)$RCln5\ s$
(E) None of the above.



25. An electron that has an instantaneous velocity of $\vec{v} = (2.0 \times 10^6\ m/s)\hat{\imath} + (3.0 \times 10^6\ m/s)\hat{\jmath}$ is moving through the uniform magnetic field $\vec{B} = (0.030\ T)\hat{\imath} - (0.15\ T)\hat{\jmath}$. Find the force on the electron due to the magnetic field.
($e = -1.60 \times 10^{-19} C$)
(A) $6.00 \times 10^{-14}\ N$
(B) $6.15 \times 10^{-14}\ N$
(C) $6.24 \times 10^{-14}\ N$
(D) $7.00 \times 10^{-14}\ N$
(E) $7.15 \times 10^{-14}\ N$

26. As shown in the figure, current $i = 56.2\ mA$ is set up in a loop having two radial lengths and two semicircles of radii $a = 5.72\ cm$ and $b = 9.36\ cm$ with a common center P. What are the magnitude and direction (into or out of the page) of the magnetic field at P?
(A) $2.13 \times 10^{-6}\ T$, out of the page
(B) $3.88 \times 10^{-6}\ T$, out of the page
(C) $4.97 \times 10^{-6}\ T$, out of the page
(D) $3.88 \times 10^{-7}\ T$, into the page
(E) $4.97 \times 10^{-7}\ T$, into the page



27. A length of copper wire carries a current of 3.5 A uniformly distributed through its cross section. The wire diameter is 2.5 mm. Calculate the energy density of the magnetic field at the surface of the wire.
(A) 0.12 J/m^3
(B) 0.37 J/m^3
(C) 0.54 J/m^3
(D) 0.78 J/m^3
(E) 0.96 J/m^3

28. An ac generator with emf amplitude ε_m=220 V and operating at frequency 400 Hz causes oscillations in a series *RLC* circuit having *R*=180 Ω, *L*=150 mH, and *C*=24.0 μF. Find the current amplitude *I*.
(A) 0.153 A
(B) 0.394 A
(C) 0.407 A
(D) 0.546 A
(E) 0.791 A

29. At what rate must the potential difference between the plates of a parallel-plate capacitor with a 2.0 μF capacitance be changed to produce a displacement current of 1.5 A?
(A) 1.4×10^{5} V/s
(B) 5.2×10^{5} V/s
(C) 7.5×10^{5} V/s
(D) 8.6×10^{5} V/s
(E) 9.8×10^{5} V/s

30. In a plane radio wave the maximum value of the electric field component is 8.00 V/m. Calculate the wave intensity.
(A) 1.58×10^{-2} W/m^2
(B) 3.86×10^{-2} W/m^2
(C) 4.22×10^{-2} W/m^2
(D) 6.13×10^{-2} W/m^2
(E) 8.49×10^{-2} W/m^2