國立高雄大學 106 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：107.6.28(星期四)

考試時間：17：00-19：00

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）”

姓名：_____ **學號：**_____

國立高雄大學106學年度第2學期
理學院普通物理學基礎能力會考試題

<第一部份：基礎題型，單選題>共 20 題，每題 2 分，共 40 分。

1. Two particles A and B have identical charge *Q*. For a net force of zero to be exerted on a third charged particle it must be placed:
   (A) midway between A and B
   (B) on the perpendicular bisector of the line joining A and B but away from the line
   (C) on the line joining A and B, not between the particles
   (D) on the line joining A and B, closer to one of them than the other
   (E) at none of these places (there is no place)

2. An electric dipole consists of a particle with a charge of $+6 \times 10^{-6}$ C at the origin and a particle with a charge of -6×10^{-6} C on the *x* axis at $x = 3 \times 10^{-3}$ m. The direction of the electric field due to the dipole at points on the *x* axis is:
   (A) in the positive *x* direction
   (B) in the negative *x* direction
   (C) in the positive *y* direction
   (D) in the negative *y* direction
   (E) in the positive *x* direction between the charges and in the negative *x* direction elsewhere

3. Consider Gauss law: $\oint \vec{E} \cdot d\vec{A} = \frac{q}{\varepsilon_0}$. Which of the following is true?
   (A) $\vec{E}$ must be the electric field due to the enclosed charge
   (B) If $q = 0$ then $\vec{E} = 0$ everywhere on the Gaussian surface
   (C) If the three particles inside have charges of $+q$, $+q$ and $-2q$, then the integral is zero
   (D) On the surface $\vec{E}$ is everywhere parallel to $d\vec{A}$
   (E) If a charge is placed outside the surface, then it cannot affect $\vec{E}$ at any point on the surface

4. Compared to the magnitude of the electric potential far from a point charge, the magnitude of the electric potential far from an electric dipole:
   (A) decreases more slowly with distance
   (B) decreases more quickly with distance
   (C) increases more slowly with distance
   (D) increases more quickly with distance
   (E) varies in the same way with distance

5. A battery is used to charge a series combination of two identical capacitors. If the potential difference across the battery terminals is *V* and total charge *Q* flows through the battery during the charging process

then the charge on the positive plate of each capacitor and the potential difference across each capacitor are:

(A) $Q/2$ and $V/2$, respectively

(B) Q and V, respectively

(C) $Q/2$ and V, respectively

(D) Q and $V/2$, respectively

(E) Q and $2V$, respectively

6. A wire 2.0 m long carries a current of 12.0 A and makes an angle of 30.0^{o} with a uniform magnetic field of magnitude B=1.50 T. Calculate the magnetic force on the wire.

(A) 6 N

(B) 18 N

(C) 25.4 N

(D) 31.1 N.

(E) 40 N

7. A circular coil of 500 turns has a radius of 1.90 cm. Calculate the current that results in a magnetic dipole moment of magnitude 3.80 $A \cdot m^2$.

(A) 1.2 A

(B) 2.5 A

(C) 4.4 A

(D) 5.9 A

(E) 6.7 A

8. A 520-turn solenoid having a length of 25 cm and a diameter of 10 cm carries a current of 0.2 A. Calculate the magnitude of the magnetic field inside the solenoid.

(A) 2.6×10^{-4} T

(B) 3.1×10^{-4} T

(C) 5.2×10^{-4} T

(D) 8.6×10^{-4} T

(E) 9.4×10^{-4} T

9. Two coils are at fixed locations. When coil 1 has no current and the current in coil 2 increases at the rate 17.0 A/s, the emf in coil 1 is 0.025 V. What is their mutual inductance?

(A) 1.47×10^{-3} H

(B) 7.35×10^{-3} H

(C) 30.9×10^{-3} H

(D) 70.4×10^{-3} H

(E) 425×10^{-3} H

10. A toroidal inductor with an inductance of 0.120 H encloses a volume of 0.02 m^3. If the average energy density in the toroid is 85.0 J/m^3, what is the current through the inductor?

(A) 2.78 A

(B) 3.21 A

(C) 4.64 A

(D) 5.32 A

(E) 6.89 A

11. A 35-Hz power line emits electromagnetic radiation. What is the wavelength?

(A) $3.3x10^6$ m

(B) $5.6x10^6$ m

(C) $4.2x10^7$ m

(D) $6.5x10^6$ m

(E) $8.6x10^6$ m

12. If a sunlight-powered sailing spacecraft accelerated at $1m/s^2$ in the vicinity of Earth's orbit, what would be its acceleration at Mars, about 1.5 times as far from the Sun as Earth?

(A) About 0.25 m/s^2

(B) A little less than 0.5 m/s^2

(C) A little more than 0.5 m/s^2

(D) About 0.66 m/s^2

(E) About 0.88 m/s^2

13. The magnetic field of a plane electromagnetic wav e is given by $B_z = 68.0\sin(kx - 2.6\times10^6 t)$ nT($10^{-9}\ Tesla$). What is the amplitude of the electric field of this wave.

(A) 33.3 V/m

(B) 44.8 V/m

(C) 12.8 V/m

(D) 24.4 V/m

(E) 36.6 V/m

14. An AC generator with an rms emf of 15.0 V is connected in series with a 0.54 H inductor. The frequency of the source emf is 70.0 Hz. When the current through the inductor is a maximum, what is the potential difference across the inductor.

(A) 0 V

(B) 15.0 V

(C) 7.5 V

(D) 30 V

(E) 40.6 V

15. Find the intensity of the electromagnetic wave in an electromagnetic wave with wave length 710 nm and a peak electric field magnitude of 2.5 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) 0.025 W/m^2

16. Room temperature of 25 ^oC is equal to

(A) 298.15 ^oK

(B) 298.15 ^oF

(C) 25 oK

(D) 25 ^oF

(E) 0 oF

17. What is the physical quantity in units of the Boltzmann constant k_B?

(A) Energy

(B) Temperature

(C) Heat

(D) Work

(E) Entropy

18. The consumption of 1500 Cal (kcal) food roughly equals to

(A) 6.3×10^3 J

(B) 6.3×10^4 J

(C) 6.3×10^5 J

(D) 6.3×10^{6} J

(E) 6.3×10^{7} J

19. The first law of thermodynamics is the law for the conservation of

(A) particle number

(B) energy

(C) momentum

(D) angular momentum

(E) charge

20. According to the second law of thermodynamics, the entropy of a closed system

(A) is zero

(B) never increases

(C) never decreases

(D) is the same at all time

(E) cannot be known

<第二部份：進階題型，單選題>共 12 題，每題 5 分，共 60 分。

1. The plate areas and plate separations of five parallel plate capacitors are

capacitor 1: area A_0, separation d_0

capacitor 2: area $2A_0$, separation $2d_0$

capacitor 3: area $2A_0$, separation $d_0/2$

capacitor 4: area $A_0/2$, separation $2d_0$

capacitor 5: area A_0, separation $d_0/2$

Rank these according to their capacitances, least to greatest.

(A) 1, 2, 3, 4, 5

(B) 5, 4, 3, 2, 1

(C) 5, then 3 and 4 tie, then 1, then 2

(D) 4, then 1 and 2 tie, then 5, then 3

(E) 3, then 5, then 1 and 2 tie, then 4

2. Five cylindrical wires are made of the same material. Their lengths and radii are

wire 1: length ℓ, radius r

wire 2: length $3\ell/2$, radius $r/2$

wire 3: length $\ell/2$, radius $r/2$

wire 4: length ℓ, radius $r/2$

wire 5: length 5ℓ, radius $r/2$

Rank the wires according to their resistances, least to greatest.

(A) 1, 2, 3, 4, 5

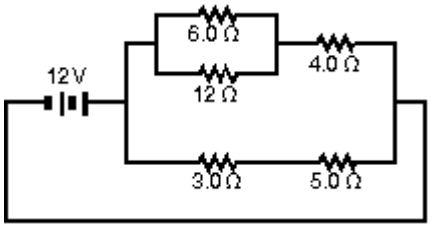
(B) 5, 4, 3, 2, 1

(C) 1 and 2 tie, then 5, 3, 4

(D) 1, 3, 4, 2, 5

(E) 1, 2, 4, 3, 5

3. The current in the 5.0-Ω resistor in the circuit shown is:



(A) 0.42 A

(B) 0.67 A

(C) 1.5 A

(D) 2.4 A

(E) 3.0 A

4. An electron is accelerated from rest by a potential difference of 400 V. It then enters a uniform magnetic field of magnitude 0.20 T with its velocity perpendicular to the field. Calculate the radius of its path in the magnetic field.

(A) 8.25×10^{-5} m

(B) 1.61×10^{-4} m

(C) 2.45×10^{-4} m

(D) 3.37×10^{-4} m.

(E) 4.19×10^{-4} m

5. A long solenoid has 125 turns/cm and carries current *i*. An electron moves within the solenoid in a circle of radius 3.0 cm perpendicular to the solenoid axis. The speed of the electron is 3.0×10^{6} m/s. Find the current *i* in the solenoid.

(A) 3.62×10^{-2} A

(B) 4.13×10^{-2} A

(C) 5.78×10^{-2} A

(D) 7.62×10^{-2} A

(E) 8.33×10^{-2} A

6. A circular loop of wire 0.050 m in radius carries a current of 80 A. Find the energy density at the center of the loop.

(A) 0.30 J/m^3

(B) 0.40 J/m^3

(C) 0.50 J/m^3

(D) 0.60 J/m^3

(E) 0.70 J/m^3

7. An LC circuit with a $20\mu F$ capacitor oscillates with period 5.0ms. The peak current is 25mA. Find (a) the inductance and (b) the peak voltage.

(A) 16mH (b) 2.0V

(B) 32mH (b) 1.0V

(C) 28mH (b) 1.0V

(D) 16mH (b) 1.0V

(E) 24mH (b) 2.0V

8. When giving presentations, many people use a laser pointer to direct the attention of the audience to information on a screen. If a 3.0 mW pointer creates a spot on a screen that is 2.0 mm in diameter, determine the radiation pressure on a screen that reflects 70% of the light that strikes it.

(A) $6.8\text{x}10^{-6}$ N/m^2

(B) $8.8\text{x}10^{-5}$ N/m^2

(C) $1.2\text{x}10^{-4}$ N/m^2

(D) $5.4\text{x}10^{-6}$ N/m^2

(E) $3.2\text{x}10^{-5}$ N/m^2

9. In a series RLC circuit with a 25.0Ω resistor, a 430.0 mH inductor, and a 24.0 μF capacitor connected to an AC source with V_{max} = 60.0 V operating at 60 Hz. What is the maximum voltage across the resistor?

(A) 13.1 V

(B) 22.8 V

(C) 26.2 V

(D) 44.6 V

(E) 52.2 V

10. An ideal heat engine contains 1 mole gas. If the heat engine double of its volume at 25 ^{o}C, how much the wok the heat engine has done ? (Note the mole gas constant R = 8.315 J mol^{-1} K^{-1}).

(A) 1.7184 J

(B) 17.184 J

(C) 171.84 J

(D) 1718.4J

(E) 17184 J

11. If an ideal Carnot heat engine operates between a hot temperature of 100 C and cold temperature of 25 ^{o}C, what is its maximum efficiency?

(A) 80%

(B) 20%

(C) 50 %

(D) 100 %

(E) 1%

12. The molar mass of oxygen O_2 gas is 32g/mole. What is the mean-square speed of the oxygen gas at room temperature 25 ^{o}C ? (The Avogadro number is 6.022×10^{23}. The Boltzmann constant $k_B = 1.38\times10^{-23}$J/K)

(A) 284 m/s

(B) 842 m/s

(C) 482 m/s

(D) 100 m/s

(E) 300 m/s