國立中山大學 101 學年度轉學生招生考試試題

科目：普通物理【光電系學士班二年級】

題號：7029

一. 單選題（每題三分；共 25 題）

1. A block of mass m is initially moving to the right on a horizontal frictionless surface at a speed v. It then compresses a spring of spring constant k. At the instant when the kinetic energy of the block is equal to the potential energy of the spring, the spring is compressed a distance of:
(A) $v\sqrt{m/2k}$ (B) $(1/2)mv^2$ (C) $(1/4)mv^2$ (D) $mv^2/4k$ (E) $(1/4)\sqrt{mv/k}$

2. A block of mass m is placed on top of a light vertical spring of force constant k and pushed downward, so that the spring is compressed by x. After the block is released from rest it travels upward and then leaves the spring. To what maximum height above the point of release does it rise?
(A) $kx^2/(mg)$ (B) $2kx^2/(mg)$ (C) $kx^2/(2mg)$ (D) $kx^2/(\sqrt{2}\,mg)$ (E) $\sqrt{2}\,kx^2/(mg)$

3. A spherical shell has inner radius R_1, outer radius R_2, and mass M, distributed uniformly throughout the shell. The magnitude of the gravitational force exerted on the shell by a point particle of mass m located a distance d from the center, outside the inner radius and inside the outer radius, is:
(A) 0 (B) GMm/d^2 (C) $GMm/(R_2^3-R_1^3)$ (D) $GMm(d^3-R_1^3)/d^2(R_2^3-R_1^3)$
(E) $GMm/(d^3-R_1^3)$.

4. A simple pendulum is suspended from the ceiling of an elevator. The elevator is accelerating upwards with acceleration a. The period of this pendulum, in terms of its length L, g, and a is:
(A) $2\pi\sqrt{(L/g)}$ (B) $2\pi\sqrt{(L/(g+a))}$ (C) $2\pi\sqrt{(L/(g-a))}$ (D) $2\pi\sqrt{(L/a)}$
(E) $(1/2\pi)\sqrt{(g/L)}$.

5. What is the speed of transverse wave in a steel wire with a tensile stress of 2×10^8 N/m^2. The density of steel is 7.8 g/cm^3.
(A) 60 m/s (B) 120 m/s (C) 160 m/s (D) 200 m/s (E) 250 m/s.

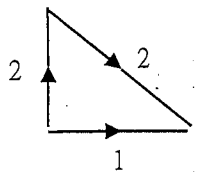
6. A point source emits sound waves with a power output of 100 watts. What is the sound level (in dB) at a distance of 10 m?
(A)139 (B)119 (C)129 (D)109 (E)10

7. An ideal gas is allowed to expand adiabatically. Assume the process is reversible. The change in entropy is:
(A) 0 (B) nR ln (V_2/V_1) (C) nR ln (T_2/T_1) (D) kn ln (V_2/V_1) (E) kn ln (T_2/T_1).

背面有題

8. The p-V diagram in Fig. 8 shows two paths along which a sample of gas can be taken from state a to state b, where $V_b=3V_1$. Path 1 requires that energy equal to $5\,p_1V_1$ be transferred to the gas as heat. Path 2 requires that energy equal to $5.5\,p_1V_1$ be transferred to the gas as heat. The ratio p_2/p_1 should be
(A) 1.5. (B) 2.0. (C) 2.5. (D) 3.0. (E) 4.0.

Fig.8

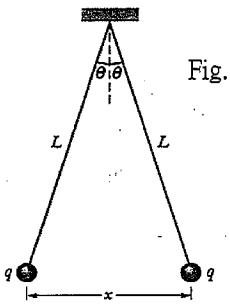


9. During an isothermal compression of 1 mol of ideal gas from a volume of 22.4 L at 0°C to a volume of 16.8 L, (Gas constant R=8.31J/mol·K.) The work done by an external agent is
(A) 0 J (B) 326 J (C) 653 J (D) 979 J (E) 1306 J

10. Work done in an isobaric process by an ideal gas is
(A) $nRT_2\ln(V_2/V_1)$ (B) $nRT_2(1-V_1/V_2)$ (C) $nRT_2\ln(V_1/V_2)$
(D) $nRT_1(1-V_2/V_1)$ (E) $nRT_1(1-V_1/V_2)$

11. In Fig. 11, two tiny conducting balls of identical mass m and identical charge q hang from nonconducting threads of length L. Assume that θ is small, then the equilibrium separation x is approximately
(A) $q^2L/(4\pi\varepsilon_0 mg)$. (B) $[q^2L/(4\pi\varepsilon_0 mg)]^{1/2}$. (C) $2[q^2L/(\pi\varepsilon_0 mg)]^{1/2}$.
(D) $[q^2L/(2\pi\varepsilon_0 mg)]^{1/3}$. (E) $3[q^2L/(\pi\varepsilon_0 mg)]^{1/3}$.

Fig.11



12. Three particles, each with positive charge Q, form an equilateral triangle, with each side of length d. Then the magnitude of the electric field produced by the particles at the midpoint of any side is
(A) $Q/(4\pi\varepsilon_0 d^2)$. (B) $Q/(3\pi\varepsilon_0 d^2)$. (C) $2Q/(3\pi\varepsilon_0 d^2)$. (D) $Q/(\pi\varepsilon_0 d^2)$. (E) $4Q/(3\pi\varepsilon_0 d^2)$.

13. Two conducting spheres have radii R_1 and R_2, with R_1 greater than R_2. If they are far apart the capacitance is proportional to:
(A) $R_1R_2/(R_1-R_2)$ (B) $R_1^2-R_2^2$ (C) $(R_1-R_2)/R_1R_2$ (D) $R_1^2+R_2^2$
(E) none of these.

14. A 0.20 cm radius cylinder, 3.0 cm long, is wrapped with wire to form an inductor. At the instant the magnetic field in the interior is 5.0 mT the energy stored in the field is about:
(A) 0 (B) 3.8×10^{-6} J (C) 7.5×10^{-6} J (D) 7.5×10^{-4} J (E) 9.9J.

15. If an electron travels with speed **v** around a circle of radius **r**, then the magnitude of the orbital magnetic dipole moment is :
(A) evr/2 (B) ev/r (C) ev/2πr (D) 2πer/v (E) 2πev/r.

背面有題

16. An LC circuit consists of a 1-μF capacitor and a 4 mH inductor. Its oscillation frequency is approximately:
(A) 0.025 Hz (B) 25 Hz (C) 60 Hz (D) 2500 Hz (E) 15800 Hz.

17. A charge of +3.0 μC is distributed uniformly along the circumference of a circle with a radius of 20 cm. How much external energy is required to bring a charge of 25μC from infinity to the center of the circle?
(A) 5.4 J (B) 3.4 J (C) 4.3 J (D) 2.7 J (E) 6.8 J

18. A proton is accelerated from rest through a potential difference of 2.5 kV and then moves perpendicularly through a uniform 0.60-T magnetic field. What is the radius of the resulting path?
(A) 15 mm (B) 12 mm (C) 18 mm (D) 24 mm (E) 8.5 mm

19. A dipole of dipole moment p is placed in a uniform electric field E. The maximum potential energy difference that can occur as the dipole is rotated is
(A) 0 (B) pE (C) 2 pE (D) πpE (E) pE/π

20. A 2-μF capacitor in series with a 2-k resistor is connected to a 60-Hz ac source. Calculate the impedance of the circuit.
(A) 1500 ohms (B) 1800 ohms (C) 2100 ohms (D) 2400 ohms (E) 8600 ohms

21. A 30-μF capacitor is charged to 40 V and then connected across an initially uncharged 20-μF capacitor. What is the final potential difference across the 30-μF capacitor?
(A) 15 V (B) 24 V (C) 18 V (D) 21 V (E) 40 V

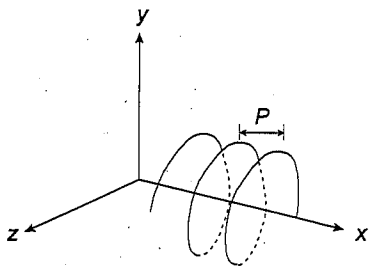
22. An electric field of approximately 100 V/m is often observed near the surface of Earth. If this were the field over the entire surface, what would be the electric potential of a point on the surface of Earth? (set V=0 at infinity)
(A) 0 (B) 1.6×10^8 V (C) 3.2×10^8 V (D) 6.4×10^8 V (E) 1.28×10^9 V

23. An inductance L, resistance R, and ideal battery of emf ε are wired in series. A switch in the circuit is closed at time 0, at which time the current is zero. At any later time t, the emf of the inductor is given by:
(A) $\varepsilon(1-e^{-Lt/R})$ (B) $\varepsilon e^{-Lt/R}$ (C) $\varepsilon(1+e^{-Rt/L})$ (D) $\varepsilon e^{-Rt/L}$ (E) $\varepsilon(1-e^{-Rt/L})$

24. A conductor of radius r, length and resistivity has resistance R. It is melted down and formed into a new conductor, also cylindrical, with one fourth the length of the original conductor. The resistance of the new conductor is
(A) $\frac{1}{16}R$ (B) $\frac{1}{4}R$ (C) R (D) $4R$ (E) $16R$

背面有題

25. A charged particle (m = 2.0 g, q = –50 μC) moves in a region of uniform field along a helical path (radius = 4.0 cm, pitch = 8.0 cm) as shown. What is the angle between the velocity of the particle and the magnetic field?



(A)27° (B) 72° (C) 63° (D) 18° (E) 58°

計算題（每題二十五分）

An electric field is directed out of the page within a circular region of radius R=3.00cm.The magnitude of the electric field is given by E = (0.500 V/m · s)(1 – r/R)t, where t is in seconds and r is the radial distance ($r \leq R$). What is the magnitude of the induced magnetic field at radial distance (a)2.00 cm and (b) 5.00 cm?

背面有題

國立中山大學101學年度轉學生招生考試試題

科目：微積分【光電系學士班二年級】

題號：7028

注意事項：本試卷共20題填充題，每一題5分。

1. Determine the slope = ① of the tangent line to the graph of $x^2 + 4y^2 = 4$ at the point $(\sqrt{2}, -1/\sqrt{2})$.
2. Find the extrema = ② of $f(x) = x^3 - 12x$ on the interval $[0, 4]$.
3. Find two positive numbers = ③ which satisfy that the sum of the first number and twice the second number is 108 and the product is a maximum.
4. Evaluate $\int_0^4 |x^2 - 9|\, dx =$ ④.
5. Evaluate $\int \tan^4 x \sec^2 x\, dx =$ ⑤.
6. Find $(f^{-1})'(a) =$ ⑥ where $f(x) = 5 - 2x^3$ and $a = 7$.
7. Find the volume = ⑦ of the solid generated by revolving the region bounded by the graphs of $y = x\sqrt{9 - x^2}$ and $y = 0$ about the x-axis.
8. Find the area = ⑧ of the surface generated by revolving $y = \sqrt{4 - x^2}$, $-1 \le x \le 1$ about the x-axis.
9. Evaluate $\int \dfrac{4x^2 + 2x - 1}{x^3 + x^2}\, dx =$ ⑨.
10. Evaluate $\lim_{x\to\infty} \dfrac{\int_1^x \ln(e^{4t-1})\, dt}{x} =$ ⑩.
11. Determine the convergence or divergence = ⑪ of the series $\sum_{n=2}^{\infty} \dfrac{1}{n\sqrt[3]{(\ln n)^2}}$.
12. Find the interval = ⑫ of convergence of the power series $\sum_{n=1}^{\infty} \dfrac{(-1)^{n+1}(x-c)^n}{nc^n}$.
13. Find the Maclaurin series = ⑬ for the function $f(x) = \dfrac{1}{(1+x)^4}$.
14. Find the arc length = ⑭ of the curve $x = 6t^2$ and $y = 2t^3$, $1 \le t \le 4$.
15. Find the area = ⑮ of the common interior of $r = 2(1 + \cos\theta)$ and $r = 2(1 - \cos\theta)$.
16. Determine whether the statement is true or false = ⑯. Two planes in space are either intersecting or parallel.
17. Find the directional derivative = ⑰ of $f(x, y) = \cos(x + y)$ at $P(0, \pi)$ in the direction of $Q\left(\dfrac{\pi}{2}, 0\right)$.
18. Find the maximum value = ⑱ of $f(x, y) = \sqrt{6 - x^2 - y^2}$ subject to the constraint $x + y - 2 = 0$.
19. Evaluate $\int_{-1}^{1} \int_0^{\sqrt{1-x^2}} \cos(x^2 + y^2)\, dy\, dx =$ ⑲.
20. Find the volume = ⑳ of the solid inside $x^2 + y^2 + z^2 = 16$ and outside $z = \sqrt{x^2 + y^2}$.