國立中山大學103學年度轉學考招生考試試題

科目名稱：微積分【光電系二年級】　　題號：735001

※本科目依簡章規定「不可以」使用計算機　　共1頁第1頁

注意事項：本試卷共20題填充題，每一題5分。
請依題號順序作答，不會作答題目請寫下題號並留空白。

1. Find $\lim_{x\to 0}\frac{\cos x-1}{2x^2}=$ ①.
2. Find $\frac{d^2y}{dx^2}=$ ② in terms of x and y if $x^2y^2-2x=3$.
3. Find all asymptotes = ③ of $f(x)=\frac{3x}{\sqrt{4x^2+1}}$.
4. A solid is formed by adjoining two hemispheres to the ends of a right circular cylinder. The total volume of the solid is 14 cubic centimeters. Find the radius = ④ of the cylinder that produces the minimum surface area.
5. Evaluate $\int_0^4 |x^2-4x+3|\,dx=$ ⑤.
6. Evaluate $\int \frac{-x}{(x+1)-\sqrt{x+1}}\,dx=$ ⑥.
7. Find the equation = ⑦ of the tangent line to $y=e^{-2x+x^2}$ at $(2,1)$.
8. Find $\frac{d}{dx}\left[\sinh^{-1}x\right]=$ ⑧.
9. Find the volume = ⑨ of the solid generated by revolving the plane region bounded by the graphs of $y=x^2$ and $y=4x-x^2$ about the line $x=4$.
10. Find the volume = ⑩ of the solid of revolution formed by revolving the circle $x^2+(y-3)^2=4$ about the x-axis.
11. Find $\int \cos\sqrt{x}\,dx=$ ⑪.
12. Evaluate $\lim_{x\to\infty} x^{\ln 2/(1+\ln x)}=$ ⑫.
13. Determine the convergence or divergence of $\sum_{n=2}^{\infty}\frac{1}{n\sqrt{\ln n}}=$ ⑬.
14. Find the Maclaurin series = ⑭ for the function $f(x)=\cos^2 x$.
15. Find the arc length = ⑮ of the curve $x=a(\theta-\sin\theta)$ and $y=a(1-\cos\theta)$ on the interval $[0,2\pi]$.
16. Find the area = ⑯ of the triangle with the given vertices $A(2,-3,4)$, $B(0,1,2)$, and $C(-1,2,0)$.
17. Find the maximum value = ⑰ of the directional derivative at $(3,2)$.
18. Find the minimum value = ⑱ of $f(x,y,z)=x^2+y^2+z^2$ subject to constraints $x+2z=6$, $x+y=12$, $x\geq 0$, $y\geq 0$, and $z\geq 0$.
19. Evaluate $\int_0^2\int_y^{\sqrt{8-y^2}}\sqrt{x^2+y^2}\,dx\,dy=$ ⑲.
20. Find the volume = ⑳ of the solid is inside the sphere $x^2+y^2+z^2=4$ and above the upper nappe of the cone $z^2=x^2+y^2$.

國立中山大學 103 學年度轉學考招生考試試題

科目名稱：普通物理【光電系二年級】　　題號：723002

※本科目依簡章規定「不可以」使用計算機　　共2頁第1頁

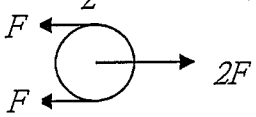
單選題, 共 20 題, 每題 5 分, 總分 100 分, 不作答 0 分, 答錯倒扣 1 分.

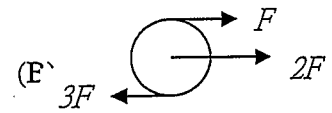
1. Four particles, labeled as *a*, *b*, *c*, *d*, move at an identical acceleration $a\hat{y}$ and $a>0$. At $t=0$, the velocities are $\vec{v}_a(0)=12\hat{x}+10\hat{y}$, $\vec{v}_b(0)=12\hat{x}+8\hat{y}$, $\vec{v}_c(0)=8\hat{x}+12\hat{y}$, and $\vec{v}_d(0)=12\hat{x}+12\hat{y}$. Compare their magnitudes of respective displacements for time $t>0$, R_a, R_b, R_c, R_d: (A) $R_a>R_b>R_c>R_d$, (B) $R_c>R_b>R_d>R_a$, (C) $R_d>R_a>R_b>R_c$, (D) $R_d>R_a>R_c>R_b$, (E) $R_a>R_c>R_b>R_d$. (To avoid confusion, consider all relevant dimensions in SI units.)

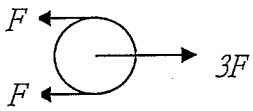
2. For the position vector $\vec{r}=(-t^2+2)\hat{i}+(-t^2-t+1)\hat{j}+(t^3-3t^2)\hat{k}$, what is the magnitude of acceleration at t = 1? (A) $\sqrt{5}$, (B) $\sqrt{14}$, (C) $2\sqrt{2}$, (D)2, (E) 0. (Dimensions all in SI units.)

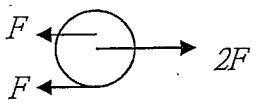
3. For a solid sphere of radius R and mass M rotating about an axis passing through the spherical center, what is the magnitude of rotational inertia? (A) $\frac{1}{2}MR^2$, (B) $\frac{2}{3}MR^2$, (C) $\frac{1}{4}MR^2$, (D) $\frac{2}{5}MR^2$, (E) MR^2.

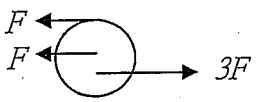
4. A man of mass m, initially at rest, falls from a point at (d, 0, 0). If the gravitational acceleration is $\vec{a}_g=-g\hat{z}$, find the angular momentum of the falling man about the origin at time t: (A) $dmgt\hat{x}$, (B) $\frac{1}{2}dmgt\hat{x}$, (C) $dmgt\hat{y}$, (D) $\frac{1}{2}dmgt\hat{y}$, (E) $-\frac{1}{2}dmgt\hat{z}$.

5. Which wheel is at equilibrium? (A) 

(B) 

(C) 

(D) 

(E) 

6. Imagine that a tunnel is drilled from the north pole through the center of the Earth to reach the south pole, and a particle of mass m is dropped from one end of the tunnel, what is the period of oscillation? (A) $\sqrt{\frac{3\pi}{G\rho}}$, (B) $\sqrt{\frac{3\pi}{4G\rho}}$, (C) $\sqrt{\frac{3}{4\pi G\rho}}$, (D) $\sqrt{\frac{3\pi}{2G\rho}}$, (E) $\sqrt{\frac{4\pi}{G\rho}}$.

7. A system of linear simple harmonic oscillation takes place at a frequency of 2 Hz about $x=0$. At $t=0$, the displacement is $x(0)=3$ and the velocity $v(0)=0$. Find $v(0.5)$. (A) 0, (B) π, (C) 2π, (D) 3π, (E) 6π.

8. If the speed and frequency of a sound wave are v and f as measured with the source and detector both at rest, then what is the frequency measured by the detector now moving at a speed of v_d while the sound source is moving in parallel at v_s? (A) $\frac{v+v_d}{v+v_s}f$, (B) $\frac{v-v_d}{v-v_s}f$, (C) $\frac{v+v_s}{v+v_d}f$, (D) $\frac{v-v_d}{v+v_s}f$, (E) $\frac{v+v_s}{v-v_d}f$.

9. Find the heat capacity of two metals, each of masses M_1 and M_2 and specific heat of X_1 and X_2, when they are connected: (A) $\frac{X_1}{M_1}+\frac{X_2}{M_2}$, (B) $\frac{M_1}{X_1}+\frac{M_2}{X_2}$, (C) $M_1X_1+M_2X_2$, (D) $\frac{X_1+X_2}{M_1+M_2}$, (E) $\frac{M_1+M_2}{X_1+X_2}$.

10. A particle of temperature T is placed in an environment of temperature T_{env}, what is the temperature dependence of thermal energy emission from the particle? (A) T^4, (B) T_{env}^4, (C) $T^4-T_{env}^4$, (D) T, (E) T_{env}.

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11. The speed of molecules in an ideal gas follows Maxwell's distribution law. Which of the following is correct when comparing the average speed v_a, most probable speed v_p, and root mean square speed v_{rms}? (A) $v_p > v_a > v_{rms}$, (B) $v_{rms} > v_a > v_p$, (C) $v_{rms} > v_p > v_a$, (D) $v_a > v_{rms} > v_p$, (D) $v_p > v_{rms} > v_a$.

12. A point charge Q is located at a distance of $R/2$ from the center of a spherical shell of radius R. If the shell is electrically neutral, what is the net flux of electric field through the sphere shell? (A) Q, (B) $\varepsilon_0 Q$, (C) Q/ε_o, (D) 0, (E) $Q/2$.

13. Three point charges are held at the corners of an equilateral triangle of side d. If $Q_1=+q$, $Q_2=+2q$, $Q_3=-3q$, the total electrostatic energy is (A) $\frac{6q^2}{4\pi\varepsilon_0 d}$, (B) $\frac{-6q^2}{4\pi\varepsilon_0 d}$, (C) $\frac{7q^2}{4\pi\varepsilon_0 d}$, (D) $\frac{-7q^2}{4\pi\varepsilon_0 d}$, (E) 0.

14. An RC circuit consists of a resistor, a capacitor, and an ideal battery of *emf* ε in series. On charging, what is the charge in the capacitor at time $t = RC$ after it starts? (A) $0.37C\varepsilon$, (B) $0.5C\varepsilon$, (C) $0.63C\varepsilon$, (D) $C\varepsilon$, (D) 0. (Note: $e = 2.7183$ and $1/e = 0.3679$)

15. A long straight wire of radius R carries a uniformly distributed current i. What is the magnetic induction at a distance $r < R$ from the center of the wire? (A) 0, (B) $\frac{\mu_0 i}{2\pi r}$, (C) $\frac{\mu_0 i}{2\pi R}$, (D) $\frac{\mu_0 ir}{2\pi R^2}$, (E) $\frac{\mu_0 iR}{2\pi r^2}$.

16. Which of the following describes the Faraday's law? (A) $\oint \vec{E} \bullet d\vec{s} = -\frac{d\Phi_B}{dt}$, (B) $\oint \vec{B} \bullet d\vec{s} = \mu_0 i$, (C) $\oint \vec{B} \bullet d\vec{A} = 0$, (D) $\oint \vec{B} \bullet d\vec{s} = \mu_0 \varepsilon_0 \frac{d\Phi_E}{dt}$, (E) $\oint \vec{E} \bullet d\vec{A} = 0$.

17. Consider a long solenoid of n turns per unit length carrying in it a current i. What is the stored energy density of this solenoid? (A) 0, (B) $\frac{1}{2}\mu_0 n^2 i^2$, (C) $\frac{1}{2}\mu_0 ni^2$, (D) $\mu_0 n^2 i^2$, (E) $\mu_0 ni^2$

18. What is the angular frequency of resonance for a series RLC circuit? (A) $\sqrt{RC}$, (B) $\sqrt{LC}$, (C) $1/\sqrt{RC}$, (D) $1/\sqrt{LC}$, (D) $\sqrt{\frac{R}{LC}}$.

19. A beam of unpolarized light is incident onto the interface of material 1 with index of refraction n_1 and material 2 with index of refraction n_2. What is the angle of incidence at which the reflected light becomes fully polarized? (A) $\sin^{-1}\frac{n_2}{n_1}$, (B) $\sin^{-1}\frac{n_1}{n_2}$, (C) $\cos^{-1}\frac{n_1}{n_2}$, (D) $\tan^{-1}\frac{n_1}{n_2}$, (E) $\tan^{-1}\frac{n_2}{n_1}$.

20. A plane wave of monochromatic light with wavelength λ is incident normally onto a thin plate cut with a single-slit of width a. If the first minimum appears at angle θ, then the width $a =$ (A) $\frac{1}{2}\lambda\sin\theta$, (B) $\lambda\sin\theta$, (C) $\frac{\lambda}{2\sin\theta}$, (D) $\frac{\lambda}{\sin\theta}$, (E) $\frac{3\lambda}{2\sin\theta}$.

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