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【物理系二年級】　　題號：723001

※本科目依簡章規定「不可以」使用計算機　　

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 $\lim_{x\to 0}\frac{\sin x^2}{x}=$ ①.
2. Find $\frac{d^2y}{dx^2}=$ ② in terms of x and y if $x^2-y^2=36$.
3. Find all asymptotes = ③ of $g(x)=\frac{2x}{\sqrt{3x^2+1}}$.
4. The sum of the perimeters of an equilateral triangle and a square is 10. Find the dimensions = ④ of the triangle and the square that produce a minimum total area.
5. Evaluate $\int_0^4 |x^2-9|\,dx=$ ⑤.
6. Find $\lim_{n\to\infty}\sum_{i=1}^{n}\frac{\sin(i\pi/n)}{n}=$ ⑥.
7. Find the equation = ⑦ of the tangent line to $y=\ln(e^{x^2})$ at $(-2,4)$.
8. Find $\frac{d}{dx}\left[\cosh^{-1}x\right]=$ 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 $x=2$.
10. Find the volume = ⑩ of the solid of revolution formed by revolving the circle $(x-5)^2+y^2=16$ about the y-axis.
11. Find $\int_0^4 x\sqrt{4-x}\,dx=$ ⑪.
12. Evaluate $\lim_{x\to 0}(x+1)^{(\ln 2)/x}=$ ⑫.
13. Determine the convergence or divergence of $\sum_{n=1}^{\infty}\frac{\ln n}{n^2}=$ ⑬.
14. Find the Maclaurin series = ⑭ for the function $f(x)=2\cosh x$.
15. Find the arc length = ⑮ of the curve $x=a\cos^3\theta$ and $y=a\sin^3\theta$ on the interval $[0,2\pi]$.
16. Find the area = ⑯ of the triangle with the given vertices $A(0,0,0)$, $B(1,0,3)$, and $C(-3,2,0)$.
17. Find the maximum value = ⑰ of the directional derivative of $w=xy^2z^2$ at $P(2,1,1)$.
18. Find the maximum = ⑱ of $f(x,y,z)=xyz$ subject to constraints $x+y+z=32$, $x-y+z=0$, $x\geq 0$, $y\geq 0$, and $z\geq 0$.
19. Evaluate $\int_0^2\int_0^{\sqrt{2x-x^2}} xy\,dy\,dx=$ ⑲.
20. Find the volume = ⑳ of the solid is bounded by $r^2+z^2=a^2$ and $r=a\cos\theta$.

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【物理系二年級】　　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.

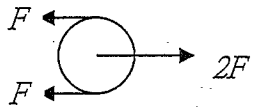
1. Four particles are moving on a plane under the same constant acceleration $\vec{a}=\hat{y}$, each having its initial velocity vector as follows: (a) $10\hat{x}+10\hat{y}$, (b) $10\hat{x}+8\hat{y}$, (c) $8\hat{x}+10\hat{y}$, (d) $12\hat{x}+12\hat{y}$. If the respective displacements are R_a, R_b, R_c, R_d, which of the following is correct? (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) $R_a > R_c > R_b > R_d$.

2. Given a position vector $\vec{r}=(-t^2+1)\hat{i}+(3t-5)\hat{j}+(t^2-2t+2)\hat{k}$, find the magnitude of acceleration at t=1. (A) $\sqrt{5}$, (B) $\sqrt{14}$, (C) $2\sqrt{2}$, (D) 2, (E) 0.

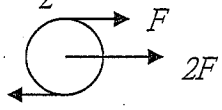
3. What is the rotational inertia of a solid sphere about an axis that passes through the spherical center? (Assume the radius is R and mass is M.) (A) $\frac{1}{2}MR^2$, (B) $\frac{2}{3}MR^2$, (C) $\frac{1}{4}MR^2$, (D) $\frac{2}{5}MR^2$, (E) MR^2.

4. A man of mass m falls from rest at point A that is at a horizontal distance of D from the origin O of an xyz coordinate system, i.e., $A = (D, 0, 0)$. Assuming gravity $\vec{g}=-g\hat{z}$. What is the angular momentum of the falling man about O 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) $-\frac{1}{2}Dmgt\hat{z}$.

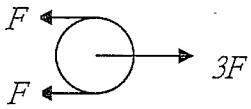
5. Which wheel is at equilibrium? (A)



(B)



(C)



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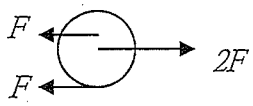

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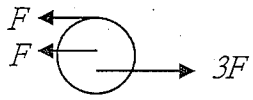

6. If the mass density of the Earth is ρ, for a tunnel drilled through between the north and south poles, what is the period of oscillation of a particle pulled by the gravity and moving without friction in the tunnel from one pole to the other? (A) $\sqrt{\frac{3\pi}{G\rho}}$, (B) $\sqrt{\frac{3\pi}{4G\rho}}$, (C) $\sqrt{\frac{3}{4\pi G\rho}}$, (D) $\sqrt{\frac{3\pi}{2G\rho}}$, (E) $\sqrt{\frac{4\pi}{G\rho}}$.

7. A linear SHM occurs at a frequency of f=2Hz. If initially at $t = 0$ the displacement $x(t)$ is $x(0)$=3, and the velocity $v(0) = 0$, what is $v(0.5)$? (A) 0, (B) π, (C) 2π, (D) 3π, (E) 6π.

8. A sound source of frequency f moves at a velocity of v_s, while a detector moves at v_d in parallel. If the speed of the sound in air is v, what is the frequency of the sound as measured by the detector? (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. What is the heat capacity of two connected metals, each with masses M_1 and M_2 and specific heats of X_1 and X_2? (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. For a particle of temperature T located in an environment T_{env}, what is the temperature dependence of thermal radiation energy that is emitted from the particle? (A) T^4, (B) T_{env}^4, (C) $T^4-T_{env}^4$, (D) T, (E) T_{env}.

11. The speed of molecules in an ideal gas follows Maxwell's distribution law. Which of the following is

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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 held at the corner of an equilateral triangle whose length of each side is 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 idea batter of *emf* ε in series. During a charging process, what is the charge in the capacitor after a time $t = RC$? (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 field 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 one 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 resonance angular frequency of a series RLC circuit? (A) $\sqrt{RC}$, (B) $\sqrt{LC}$, (C) $\frac{1}{\sqrt{RC}}$, (D) $\frac{1}{\sqrt{LC}}$, (D) $\sqrt{\frac{R}{LC}}$.

19. A light incident from material 1 with index of refraction, n_1, into material 2 with index of refraction, n_2. Assuming that $n_1>n_2$. What is the Brewster angle? (A) $\sin^{-1} n_1$, (B) $\sin^{-1} n_2$, (C) $\tan^{-1} n_1$, (D) $\tan^{-1} n_2$, (E) $\tan^{-1} \frac{n_2}{n_1}$.

20. A single-slit of width a is illuminated by a light of wavelength. For what value of a will the first minimum appear at θ? (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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