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【機電系二年級】　　題號：738001

※本科目依簡章規定「不可以」使用計算機，「不可以」於試題紙上作答　　共1頁第1頁

1.(10 points) Calculate $\int \frac{4}{\sqrt{1+e^x}}dx$

2.(20 points) Test this series for (a) absolute convergence (10 points) (b) conditional convergence (10 points)

$$\sum_{n=1}^{\infty} \frac{\cos(n\pi)}{n}$$

3.(10 points) Determine whether or not $f(x,y)$ has a limit at (1,1)

$$f(x,y)=\frac{x-y^4}{x^3-y^4}$$

4.(20 points) Let Ω be the first-quadrant rregion bounded by the curves:

$x^2+y^2=4$, $x^2+y^2=16$, $x^2-y^2=1$, $x^2-y^2=4$

Evaluate

$$\iint_{\Omega} \frac{1}{4}x^3 y dxdy$$

5.(20 points) Evaluate the line integral

$$\oint_C (1+20xy+y^2)dx+(5x^2)dy$$

where C is the oriented counter clockwise square with vertices (0,0) (1,0) (1,1) (0,1)

6.(20 points) Calculate the flux of the vector field $v(x,y,z)=xi+j+zk$ across the sphere $S: x^2+y^2+z^2=4$ in the outward direction.

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科目名稱：普通物理【機電系二年級】　　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

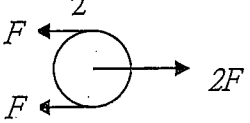
單選題, 共 20 題, 每題 5 分, 總分 100 分, 不作答 0 分, 答錯倒扣 1 分.

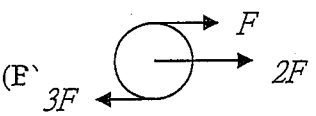
1. Four particles move on a horizontal plane with the same constant acceleration $a\hat{y}$, where $a>0$. At $t=0$, their initial velocity vectors are (a) $12\hat{x}+10\hat{y}$, (b) $12\hat{x}+8\hat{y}$, (c) $8\hat{x}+12\hat{y}$, (d) $12\hat{x}+12\hat{y}$. If the respective displacements at $t>0$ are 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) $R_a>R_c>R_b>R_d$.

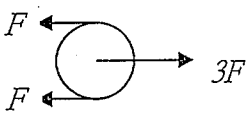
2. Given the position vector $\vec{r}=(t^2+2)\hat{i}+(3t-5)\hat{j}+(-t^2-t+1)\hat{k}$, what is the magnitude of acceleration at t = 1? (A) $\sqrt{5}$, (B) $\sqrt{14}$, (C) $2\sqrt{2}$, (D)2, (E) 0.

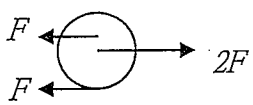
3. What is the rotational inertia of a solid sphere of radius R and mass M about an axis passing through the center of the sphere? (A) $\frac{1}{2}MR^2$, (B) $\frac{2}{3}MR^2$, (C) $\frac{1}{4}MR^2$, (D) $\frac{2}{5}MR^2$, (E) MR^2.

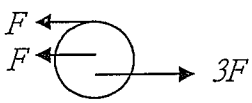
4. A man of mass m, initially at rest, falls from a point at (d, 0, 0). If the gravitational acceleration is $\vec{a}_g=-g\hat{z}$, find the angular momentum of the falling man about the origin at time t: (A) $dmgt\hat{x}$, (B) $\frac{1}{2}dmgt\hat{x}$, (C) $dmgt\hat{y}$, (D) $\frac{1}{2}dmgt\hat{y}$, (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 linear SHM takes place at a frequency of 2 Hz about $x=0$. At $t=0$, the displacement is $x(0)=3$ and the velocity is $v(0)=0$. What is $v(1)$? (A) 0, (B) π, (C) 2π, (D) 3π, (E) 6π.

8. If the speed and frequency of a sound wave are v and f when measured by a detector at rest with respect to the source, what is the frequency measured by the detector moving at a speed of v_d while the sound source is moving in parallel at v_s with respect the rest frame? (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) $\frac{M_1+M_2}{X_1+X_2}$.

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10. A particle of temperature T is located in an environment of temperature 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 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 three corners of an equilateral triangle with side d. If $Q_1=+q$, $Q_2=+q$, $Q_3=-4q$, 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. What is the charge in the capacitor at time $t = RC$ after it starts charging? (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 of what follows 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) $\frac{1}{\sqrt{RC}}$, (D) $\frac{1}{\sqrt{LC}}$, (D) $\sqrt{\frac{R}{LC}}$.

19. An unpolarized light is incident from material 1 with refractive index n_1 into material 2 with index n_2. What is the angle of incidence with respect to the interface when the reflected light becomes fully polarized? (A) $\cos^{-1}\frac{n_2}{n_1}$, (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 single-slit, cut from a thin plate to a width a, is illuminated by a plane wave of light with wavelength λ at normal incidence onto the plate. Find a if 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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