國立中山大學103學年度轉學考招生考試試題

科目名稱：普通化學【海工系二年級】　　題號：759001

※本科目依簡章規定「不可以」使用計算機　　

1. Write the names (in English) of the following compounds：
   a. KCl　b. $CaSO_4$　c. $PbCrO_4$　d. $Fe_3(PO_4)_2$　e. TiO_2
   (10% total, 2% each.)

2. A sample of a gaseous substance at 25℃ and 0.862 atm has a density of 2.26 g/L. What is the molecular weight of the substance ? (10%)

3. State whether each of the following sets of quantum numbers is permissible for an electron in an atom. If a set is not permissible, explain why. (10% total, 2% each.)
   a. $n = 1, l = 1, m_l = 0, m_s = +\frac{1}{2}$
   b. $n = 3, l = 1, m_l = -2, m_s = -\frac{1}{2}$
   c. $n = 2, l = 1, m_l = 0, m_s = +\frac{1}{2}$
   d. $n = 2, l = 0, m_l = 0, m_s = 1$
   e. $n = 2, l = 1, m_l = 0, m_s = 0$

4. What kind of intermolecular forces (London, dipole—dipole, hydrogen bonding) are expected in the following substances ? (10% total, 2% each.)
   a. methane, CH_4
   b. chloroform, $CHCl_3$
   c. butanol, $CH_3CH_2CH_2CH_2OH$
   d. carbon dioxide, CO_2
   e. sulfur dioxide, SO_2

5. Order each of the following pairs by acid strength, giving the weaker acid first. Explain your answer.
   a. HNO_3, HNO_2
   b. HCO_3^-, H_2CO_3
   c. H_2S, H_2Te
   d. HCl, H_2S
   e. H_3PO_4, H_3AsO_4
   (10% total, 2% each.)

6. What is the concentration of formate ion, CHO_2^-, in a solution at 25℃ that is 0.10*M* $HCHO_2$ and 0.20 *M* HCl ? What is the degree of ionization of formic acid, $HCHO_2$? (*Ka* for formic acid is 1.0×10^{-4} at 25℃) (10%)

7. Calculate the pH of the solution at the equivalence point when 25 mL of 0.20 *M* nicotinic acid is titrated by 0.20 *M* sodium hydroxide. *Ka* for nicotinic acid equals 1.0×10^{-5}. (10%)

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8. What is the concentration of $Ag^+(aq)$ ion in 0.010 *M* $AgNO_3$ that is also 1.00 *M* NH_3 ? K_f for $Ag(NH_3)_2^+$ ion is 1.7×10^7. (10%)

9. Predict the sign of ΔS° for each of the following reactions. Explain your answer.
   a. $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
   b. $CS_2(l) \rightarrow CS_2(g)$
   c. $2Hg(l) + O_2(g) \rightarrow 2HgO(s)$
   d. $2Na_2O_2(s) + 2H_2O(l) \rightarrow 4NaOH(aq) + O_2(g)$
   e. $2NH_3(g) + CO_2(g) \rightarrow NH_2CONH_2(aq) + H_2O(l)$
   (10% total, 2% each.)

10. Define the following terms of electrochemistry：
    a. voltaic(galvanic) cell b. electrolytic cell
    c. standard electrode potential d. cathode e. anode
    (10% total, 2% each.)

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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【海工系二年級】　　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.

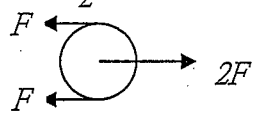
1. At an identical constant acceleration $a\hat{y}$ with $a>0$, four particles move with their velocities at t = 0 $v(0)$= (a)$12\hat{x}+10\hat{y}$, (b)$12\hat{x}+8\hat{y}$, (c)$8\hat{x}+12\hat{y}$, (d)$12\hat{x}+12\hat{y}$. Compare their magnitudes of displacements R_a, R_b, R_c, and R_d for $t>0$. (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) $R_a>R_c>R_b>R_d$. (Take all relevant dimensions in SI units.)

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

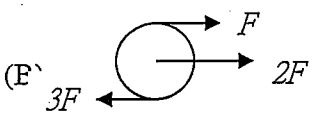
3. What is the rotational inertia of a solid sphere of radius R and mass M about an axis passing through the spherical center? (A)$\frac{1}{2}MR^2$, (B) $\frac{2}{3}MR^2$, (C) $\frac{1}{4}MR^2$, (D) $\frac{2}{5}MR^2$, (E) MR^2.

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)



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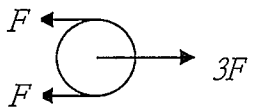

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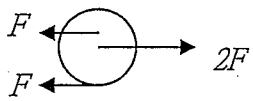
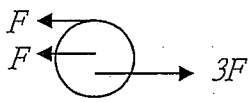


(E)



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 $v(0.25)$? (A) 0, (B)π, (C)2π, (D)3π, (E)6π.

8. If the speed and frequency of a sound wave are f when measured with the source and detector both at rest, what is the frequency measured if the detector is moving at v_d while the sound source is moving in parallel at v_S vs. 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)$\frac{M_1+M_2}{X_1+X_2}$.

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}.

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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 with 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. Calculate 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 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) $\frac{1}{\sqrt{RC}}$, (D) $\frac{1}{\sqrt{LC}}$, (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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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【海工系二年級】　　題號：759003

※本科目依簡章規定「不可以」使用計算機　　

請標示題號並詳細作答.

1. (a) Find the first and second derivatives of $f(x) = xe^{x^2}$. (10%)

   (b) Find all relative extreme values of $f(x) = \frac{x^2+1}{x}$. (10%)

2. (a) Evaluate $\int_{-1}^{1} x^2 \cos(n\pi x)\, dx$. (10%)

   (b) Evaluate $\int_0^\infty e^{-st} \sin t\, dt$ for $s > 0$. (10%)

3. (a) Find the Maclaurin series of $f(x) = \sqrt{1+x}$. (10%)

   (b) Determine the radius of convergence of the power series $\sum_{n=1}^{\infty} n2^n(x+1)^{n+1}$. (10%)

4. (a) Find the gradient of $f(x,y) = x^2 - xy + y^2 - 2y + 2$ at the point $(1,0)$. (10%)

   (b) Find the absolute maximum and minimum values of $f(x,y) = x^2 - 2x + y^2 - 2y + 4$ on the disk $x^2 + y^2 \le 4$. (10%)

5. (a) Let $E = \{(x,y) | \, 0 \le x \le 2,\ 0 \le y \le 2\}$. If the density function is $\rho(x,y) = 1 + x + 2y$, find the center of mass of E. (10%)

   (b) Find the work done by the force field $\mathbf{F}(x,y) = x\mathbf{i} - xy\mathbf{j}$ in moving a particle along the curve $\mathbf{r}(t) = (t, t^2)$, $0 \le t \le 2$. (10%)