國立中山大學九十四學年度轉學生招生考試試題

科目：微積分【物理系二年級、電機系二年級、材光系二年級、海工系二年級、機電系二年級、資管系二年級】

1. 求 $\lim_{x\to+\infty}\left[\sin\left(x+\frac{1}{x}\right)-\sin x\right]$

2. 求 $\lim_{x\to 0}\left(\frac{\sin x}{x}\right)^{1/x^2}$

3. 製作函數 $f(x)=\frac{x}{x^2+1}$ 之圖形.

4. 求 $\int \ln(x^2-1)\,dx$

5. 求 $\lim_{x\to+\infty}\left(\frac{1}{\sqrt{n^2}}+\frac{1}{\sqrt{n^2+n}}+\frac{1}{\sqrt{n^2+2n}}+\cdots+\frac{1}{\sqrt{n^2+(n-1)n}}\right)$

6. 求 $\int_{0^+}^{+\infty}\frac{dx}{(1+x)\sqrt{x}}$

7. 求橢圓體 $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$ 之體積.

8. 求冪級數 $\sum_{n=1}^{\infty}\frac{(2x-3)^n}{2^n\sqrt{n}}$ 之收斂區間.

9. 求 $\iint_A x^2\,dA$，其中 A 為由 $xy=16$，$y=x$，$y=0$ 與 $x=8$ 在第一象限所圍區域.

10. 求 $\int_0^1\int_x^1\frac{\sin y}{y}\,dy\,dx$.

＊1－10題，每題十分.

94 學年度轉學生入學考試 普通物理試題

第一部分為選擇題，每題 6 分，共 60 分

1. An ideal gas is allowed to undergo a free expansion. If its initial volume is V_1 and its final volume is V_2, the change in entropy is
   (A) $nR \ln (V_2/V_1)$
   (B) $nRT \ln (V_2/V_1)$
   (C) $nk \ln (V_2/V_1)$
   (D) 0
   (E) $nR\, V_2/V_1$

2. The specific heat at constant pressure at 0°C of one mole of an ideal monatomic gas is
   (A) 0.5R
   (B) R
   (C) 1.5R
   (D) 2R
   (E) 2.5R

3. A uniform rod (length = 2.4 m) of negligible mass has a 1.0-kg point mass attached to one end and a 2.0-kg point mass attached to the other end. The rod is mounted to rotate freely about a horizontal axis that is perpendicular to the rod and that passes through a point 1.0 m from the 2.0-kg mass. The rod is released from rest when it is horizontal. What is the angular velocity of the rod at the instant the 2.0-kg mass passes through its low point?
   (A) 1.72 rad/s
   (B) 2.96 rad/s
   (C) 4.1 rad/s
   (D) 1.5 rad/s
   (E) 3.1 rad/s

4. A parallel-plate capacitor has a charge Q and plates of area A. What force acts on one plate to attract it toward the other plate?
   (A) $Q^2/\varepsilon_0 A$
   (B) $2Q^2/\varepsilon_0 A$
   (C) $Q^2/2\varepsilon_0 A$

(D) $Q^2/3\varepsilon_0 A$

(E) $3Q^2/\varepsilon_0 A$

5. A uniform rod (mass m = 1.0 kg and length L = 2.0 m) pivoted at one end oscillates in a vertical plane as shown below. The period of oscillation (in s) is approximately

(A) 4.0

(B) 2.3

(C) 3.2

(D) 1.6

(E) 2.0

6. The coil shown in the figure 2 has 3 turns, a cross-sectional area of 0.20 m^2, and a field (parallel to the axis of the coil) with a magnitude given by B = $(-4.0 + 3.0t^2)$ T, where t is in s. What is the potential difference, $V_A - V_C$, at t = 3.0 s?

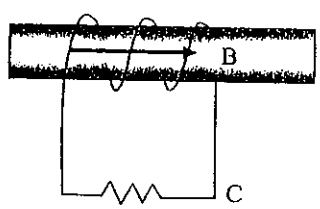


Fig. 2

(A) -10.8V

(B) +10.8V

(C) -3.6V

(D) +3.6V

(E) 24V

7. The magnetic field of a plane-polarized electromagnetic wave moving in the z-direction is given by $B = 1.2\times 10^{-6} \sin\left[2\pi\left(\frac{z}{240} - \frac{t\times 10^7}{8}\right)\right]$ in SI units. What is the speed of the EM wave?

(A) 100 m/s

(B) 1.2×10^6 m/s

(C) 2×10^7 m/s

(D) 2×10^8 m/s

(E) 3×10^8 m/s

8. When you look at a single slit diffraction pattern produced on a screen by light of a single wavelength, you see a bright central maximum and a number of maxima on either side, their intensity decreasing with distance from the central maximum. If the width of the slit is increased,

(A) the width of the central maximum decreases, but the other maxima do not change in position or width.

(B) the width of the central maximum increases, but the other maxima do not change in position or width.

(C) the pattern shrinks in size. (central maximum less wide; other maxima in closer to it)

(D) the pattern increases in size. (central maximum wider; other maxima farther from it)

(E) it does not affect the size of the pattern.

9. A stopping potential of 3.2 V is needed for radiation whose wavelength is 200 *nm*. What is the work function (in eV) of the material?

(A) 2.0

(B) 3.0

(C) 4.0

(D) 5.0

(E) 6.0

10. A particle of mass m= 0.10 kg and speed v_0 = 5.0 m/s collides and sticks to the end of a uniform solid cylinder of mass M = 1.0 kg and radius R = 20 cm. If the cylinder is initially at rest and is pivoted about a frictionless axle through its center, what is the final angular velocity (in rad/s) of the system after the collision?

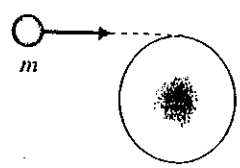


Fig. 3

(A) 5.0

(B) 2.47

(C) 6.1

(D) 4.16

(E) 10

第二部分為非選擇題，每題 10 分，共 40 分

1. A non-conducting sphere has mass m and radius a. A flat compact coil of wire with N turns is wrapped tightly around it, with each turn concentric with the sphere. As shown in Fig. 4, the sphere is placed on an inclined plane that slopes downward to the left, making an angle θ with the horizontal, so that the coil is parallel to the inclined plane. A uniform magnetic field B vertically upward exists in the region of the sphere. What current in the coil will enable the sphere to rest in equilibrium on the inclined plane? Please draw the force diagram in detail.

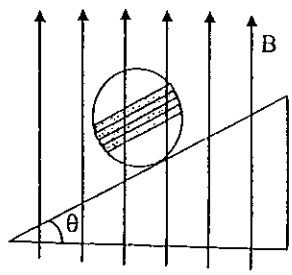


Fig. 4

2. A bullet of mass m is fired into a block of mass M initially at rest at the edge of a frictionless table of height h (Fig. 5). The bullet remains in the block, and after impact the block lands a distance d from the bottom of the table. Determine the initial speed of the bullet.

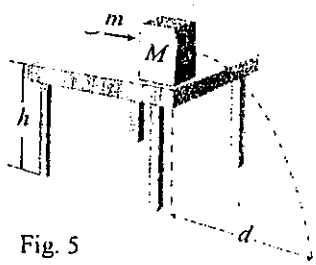


Fig. 5

3. A mole ideal monatomic gas is taken through the cycle shown in Figure 6. The process $A \rightarrow B$ is a reversible isothermal expansion. Calculate (a) the net work done by the gas, (b) the energy added to the gas by heat, (c) the energy exhausted from the gas by heat, and (d) the efficiency of the cycle.

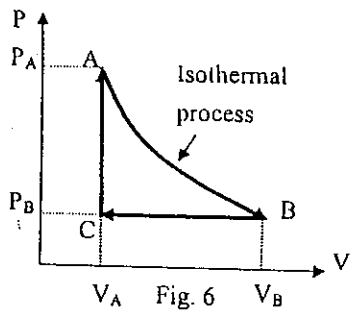


Fig. 6

4. Determine the magnetic field at a point P located a distance x from the corner of an infinitely long wire bent at a right angle, as shown in Figure 7. The wire carries a steady current I.

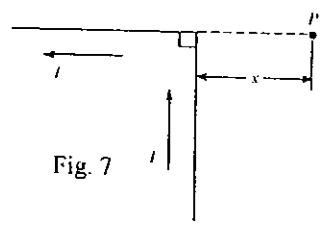


Fig. 7

國立中山大學九十四學年度轉學生招生考試試題

科目：普通化學【海資系二年級、海工系二年級】

共 25 題選擇題（單選），每題 4 分，不做答以 0 分計，答錯倒扣 1 分。

1. The pOH of a 0.1M solution of HCl is:
   (A)1 (B) 13 (C) 14 (D) 0 (E) 15

2. The compound CH_3-O-CH_3 is best described as being a(n)
   (A) alcohol (B) alkene (C)ether (D)ester (E) carboxylic acid

3. Which one of the following compounds contains chlorine in a positive oxidation state?
   (A) HCl (B) KCl (C) $HClO_3$ (D) PCl_3 (E) NH_4Cl

4. Which of the following is a superoxide?
   (A) $KClO_3$ (B) RbO_2 (C) FeO (D) H_2O_2 (E) Na_2O_2

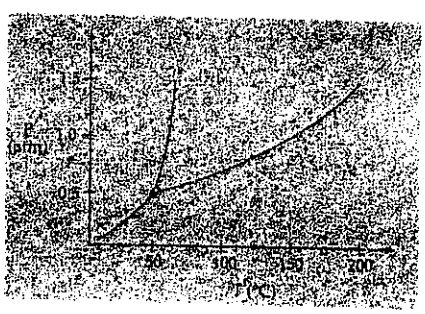
5. Which one of the following is paramagnetic ?
   (A) He (B) Be (C) Cl^- (D) F^- (E) Li

6. Which gas has a rate of diffusion 0.25 times that of hydrogen at the same temperature and pressure ?
   (A) CH_4 (B) PH_3 (C) Ar (D) N_2 (E) O_2

7. Which of the following aqueous solutions has the highest boiling point?
   (A)0.5 m NaCl (B) 0.5 m KBr (C) 0.5 m $CaCl_2$ (D) 0.5 m $C_6H_{12}O_6$ (E) 0.5 m $NaNO_3$

8. Which of the following assumptions is (are) valid based on kinetic molecular theory?
   I. Gas molecules have negligible volume.
   II. Gas molecules exert no attractive forces on each other.
   III. The temperature of a gas is directly proportional to its kinetic energy.
   (A) I only (B) III only (C) I and III only (D) II and III only. (E) I, II, and III

9. If the pressure of the substance shown in the diagram is decreased from 1.0 atmosphere to 0.5 tmosphere at a constant temperature of 100℃, which phase change will occur?



   (A)Freezing (B) Vaporization (C) Condensation (D) Sublimation (E) Deposition

10. The temperature above which gas molecules become too energetic to form a true liquid, no matter what the pressure, is called the
(A) melting point (B) critical point (C) boiling point (D) triple point (E) freezing point

11. $H_2O_{(s)} \rightarrow H_2O_{(l)}$
Which of the following is true of the reaction shown above at room temperature?
I. ΔG is greater than zero II. ΔH is greater than zero III. ΔS is greater than zero
(A) II only (B) III only (C) I and II only (D) I and III only (E) II and III only

12. Citric acid, $H_3C_6H_5O_7$, can give up three hydrogen ions in solution. The three dissociation reactions are as follows:
$H_3C_6H_5O_7 \rightleftharpoons H^+ + H_2C_6H_5O_7^-$ $K_1 = x$
$H_2C_6H_5O_7^- \rightleftharpoons H^+ + HC_6H_5O_7^{2-}$ $K_2 = y$
$HC_6H_5O_7^{2-} \rightleftharpoons H^+ + C_6H_5O_7^{3-}$ $K_3 = z$
Which of the following expressions gives the equilibrium constant for the reaction shown below?
$H_3C_6H_5O_7 \rightleftharpoons 3H^+ + C_6H_5O_7^{3-}$
(A) xyz (B) xy/z (C) x/yz (D) z/xy (E) $1/xyz$

13. When solid copper shavings are placed in a solution of dilute HNO_3, Cu^{2+} ions appear and NO gas bubbles form. Which of the following has occurred?
(A) Cu has been oxidized by H^+. (B) Cu has been oxidized by NO_3^-. (C) Cu has been reduced by NO_3^-.
(D) NO_3^- has been oxidized by H^+. (E) NO_3^- has been reduced by H^+.

14. A solution prepared by mixing equal volumes of 0.2-molar HCl and 0.2-molar NH_3, has a pH of
(A)1 (B) greater than 1 and less than 7 (C) 7 (D) greater than 7 and less than 13 (E) 13
(For NH_3, $K_b = 1.8 \times 10^{-5}$)

15. Which of the following sets of quantum numbers (n, l, m_l, m_s) best describes the highest energy valence electron in a ground-state aluminum atom?
(A)2, 0, 0, 1/2 (B) 2, 1, 0, 1/2 (C) 3, 0, 0, 1/2 (D) 3, 0, 1, 1/2 (E) 3, 1, 1, 1/2

16. The density of a sample of water decreases as it is heated above a temperature of 4℃. Which of the following will be true of an aqueous solution of $NaC_2H_3O_2$ when it is heated from 10℃ to 60℃?
(A) The molarity will increase. (B) The molarity will decrease. (C) The molality will increase.
(D) The molality will decrease. (E) The molarity and the molality will remain unchanged.

17. Which of the following salts will produce a colorless solution when added to water?
(A) $Cu(NO_3)_2$ (B) $NiCl_2$ (C) $KMnO_4$ (D) $ZnSO_4$ (E) $FeCl_3$

18. The first ionization energy for magnesium is 730 kJ/mol. The third ionization energy for magnesium is 7700 kJ/mol. What is the most likely value for magnesium's second ionization energy?
(A) 490 kJ/mol (B) 1400 kJ/mol (C) 4200 kJ/mol (D) 7100 kJ/mol (E) 8400 kJ/mol

19. A 100 gram sample of pure $^{37}_{18}Ar$ decays by electron capture with a half-life of 35 days. How long will it take for 90 grams of $^{37}_{17}Cl$ to accumulate?
(A) 31 days (B) 39 days (C) 78 days (D) 116 days (E) 315 days

20. $2\ Cu^{+}_{(aq)} + M_{(s)} \rightarrow 2\ Cu_{(s)} + M^{2+}_{(aq)}$ $E^{o} = +0.92$ V
$Cu^{+}_{(aq)} + e^{-} \rightarrow Cu_{(s)}$ $E^{0} = +0.52$ V
Based on the reduction potentials given above, what is the standard reduction potential for the following half-reaction?
$M^{2+}_{(aq)} + 2e^{-} \rightarrow M_{(s)}$
(A) +0.40 V (B) +0.12 V (C) -0.12 V (D) -0.40 V (E) -1.44 V

21. The reaction of elemental chlorine with ozone in the atmosphere occurs by the two-step process shown below
I. $Cl + O_3 \rightarrow ClO + O_2$
II. $ClO + O \rightarrow Cl + O_2$
Which of the statements below is true regarding this process?
(A) Cl is a catalyst. (B) O_3 is a catalyst. (C) ClO is a catalyst. (D) O_2 is an intermediate.
(E) O is an intermediate.

22. For which of the following reactions will the equilibrium constants K_C and K_P have the same value?
(A) $2\ N_2O_{5(g)} \rightleftharpoons 2\ NO_{2(g)} + O_{2(g)}$ (B) $2\ CO_{2(g)} \rightleftharpoons 2\ CO_{(g)} + O_{2(g)}$
(C) $H_2O_{(g)} + CO_{(g)} \rightleftharpoons H_{2(g)} + CO_{2(g)}$ (D) $3\ O_{2(g)} \rightleftharpoons 2\ O_{3(g)}$ (E) $CO_{(g)} + Cl_{2(g)} \rightleftharpoons COCl_{2(g)}$

23. A $^{222}_{86}Rn$ nuclide decays through the emission of two beta particles and two alpha particles. The resulting nuclide is (A) $^{214}_{84}Po$ (B) $^{210}_{84}Po$ (C) $^{214}_{83}Bi$ (D) $^{210}_{83}Bi$ (E) $^{214}_{82}Pb$

24. $N_{2(g)} + 3\ Cl_{2(g)} \rightarrow 2\ NCl_{3(g)}$ $\Delta H = 460$ kJ
Which of the following statements is true regarding the reaction shown above?
(A) It is not spontaneous at any temperature. (B) It is spontaneous only at very high temperature.
(C) It is spontaneous only at very low temperature. (D) It is spontaneous only at very high concentrations.
(E) It is spontaneous only at very low concentrations.

25. At 25℃, the vapor pressure of water is 24 mmHg. Which of the following expressions gives the vapor pressure of a solution created by adding 2.0 moles of glucose to 55 moles of water?
(A) $\frac{(24)(2.0)}{(55)}$ mmHg (B) $\frac{(2.0)}{(24)(55)}$ mmHg (C) $\frac{(24)(55)}{(57)}$ mmHg (D) $\frac{(55)}{(24)(57)}$ mmHg
(E) $\frac{(24)(57)}{(55)}$ mmHg