

國立中山大學 95 學年度轉學生招生考試試題

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

共 頁第 頁

(30%) 1. 求極限 (每小題 5 分, $[x]$ 表示大於 x 之最大整數)

(a) $\lim_{x \rightarrow \infty} (\sqrt{x+\sqrt{x}} - \sqrt{x-\sqrt{x}})$

(b) $\lim_{x \rightarrow 1} [2 + 2x - x^2]$

(c) $\lim_{x \rightarrow \infty} x^4 \left(\cos \frac{1}{x} - 1 + \frac{1}{2x^2} \right)$

(d) $\lim_{x \rightarrow 0} \left(\frac{\sin x}{x} \right)^{1/x^2}$

(e) $\lim_{x \rightarrow \infty} x \left(\left(1 + \frac{1}{x} \right)^x - e \right)$

(f) $\lim_{x \rightarrow \infty} \left(\cos \left(x + \frac{1}{x} \right) - \cos x \right)$

(10%) 2. $\int_0^2 \int_0^1 \sqrt{|y-x^2|} dx dy$

(10%) 3. $\iint_{\Omega} x^2 dA$, 其中 $\Omega = \{ (x, y) \mid x \geq 0, y \geq -1, x^2 + y^2 \leq 2 \}$.

(10%) 4. $\lim_{n \rightarrow \infty} \left\{ \frac{n}{n^2} + \frac{n}{n^2+1^2} + \dots + \frac{n}{n^2+(n-1)^2} \right\}$

(10%) 5. $\int \sin^4 x \cos^2 x dx$

(10%) 6. 求 $y^2 = x^4(2x+1)$ 在圖狀部分之面積.

(10%) 7. 求由曲面 $\sqrt{x^2+y^2} + z = 1$ 與兩個平面 $x = z$, 及 $x = 0$ 所圍部分之體積.

(10%) 8. 求級數 $\sum_{n=1}^{\infty} \frac{n!}{n^n} x^n$ 之收斂區間, 其中 $n! = 1 \cdot 2 \cdot 3 \cdots n$.

國立中山大學 95 學年度轉學生招生考試試題

科目：普通物理【化學系二年級、物理系二年級、電機系二年級、機電系二年級、材光系二年級、海工系二年級】

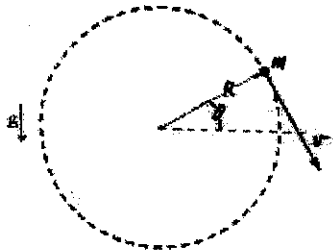
共 4 頁 第 1 頁

一. 選擇題、共有十題、每題 5 分

1. The vector r indicates the instantaneous displacement of a projectile from the origin. At the instant when the projectile is at r , its velocity and acceleration vectors are v and a . Which statement is correct?

- a. v is always perpendicular to r .
- b. a is always perpendicular to r .
- c. a is always perpendicular to v .
- d. a is always perpendicular to v_x .
- e. a is always perpendicular to v_y .

2. An object attached to the end of a string swings in a vertical circle ($R = 1.2$ m), as shown. At an instant when $\theta = 30^\circ$, the speed of the object is 5.1 m/s and the tension in the string has a magnitude of 20 N. What is the mass of the object?



- a. 2.0 kg
- b. 1.5 kg
- c. 1.8 kg
- d. 1.2 kg
- e. 0.80 kg

3. A rocket with an initial mass of 1000 kg adjusts its thrust by varying the rate at which mass is ejected. The ejection speed relative to the rocket is 40 km/s. If the acceleration of the rocket is to have a magnitude of 20 m/s^2 at an instant when its mass is 80% of the original mass, at what rate is mass being ejected at that instant? Ignore any external forces on the rocket.

- a. 0.40 kg/s
- b. 0.50 kg/s
- c. 0.60 kg/s
- d. 0.70 kg/s
- e. 0.80 kg/s

【背面還有試題】

國立中山大學 95 學年度轉學生招生考試試題

科目：普通物理【化學系二年級、物理系二年級、電機系二年級、機電系二年級、材光系二年級、海工系二年級】

共 4 頁 第 2 頁

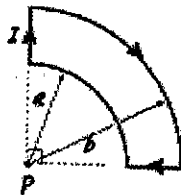
4. Water pressurized to 3.5×10^5 Pa is flowing at 5.0 m/s in a horizontal pipe which contracts to 1/3 its former area. What are the pressure and velocity of the water after the contraction?
- 2.5×10^5 Pa, 15 m/s
 - 3.0×10^5 Pa, 10 m/s
 - 3.0×10^5 Pa, 15 m/s
 - 4.5×10^5 Pa, 1.5 m/s
 - 5.5×10^5 Pa, 1.5 m/s
5. For the transverse wave described by $y = 0.15 \sin\left[\frac{\pi}{16}(2x - 64t)\right]$ (SI units) determine the maximum transverse speed of the particles of the medium.
- 0.192 m/s
 - 0.6π m/s
 - 9.6 m/s
 - 4 m/s
 - 2 m/s
6. If n moles of an ideal gas are compressed isothermally from an initial volume V_1 to a final volume V_2 , the change in entropy is
- $nR \ln(V_2/V_1)$
 - $nRT \ln(V_2/V_1)$
 - $nk_B \ln(V_2/V_1)$
 - $n C_v \int dT/T$
 - $n C_v/T$
7. An electron ($m = 9.1 \times 10^{-31}$ kg, $q = -1.6 \times 10^{-19}$ C) starts from rest at point A and has a speed of 5.0×10^6 m/s at point B. Only electric forces act on it during this motion. Determine the electric potential difference $V_A - V_B$.
- 71 V
 - +71 V
 - 26 V
 - +26 V
 - 140 V

國立中山大學 95 學年度轉學生招生考試試題

科目：普通物理【化學系二年級、物理系二年級、電機系二年級、機電系二年級、材光系二年級、海工系二年級】

共 4 頁 第 3 頁

8. What is the kinetic energy of an electron that passes undeviated through perpendicular electric and magnetic fields if $E = 4.0 \text{ kV/m}$ and $B = 8.0 \text{ mT}$?
- a. 0.65 eV
b. 0.71 eV
c. 0.84 eV
d. 0.54 eV
e. 1.4 eV
9. What is the magnitude of the magnetic field at point P if $a = R$ and $b = 2R$?



- a. $\frac{\mu_0 I}{6R}$
b. $\frac{3\mu_0 I}{16R}$
c. $\frac{\mu_0 I}{12R}$
d. $\frac{\mu_0 I}{16R}$
e. $\frac{\mu_0 I}{32R}$
10. At what frequency should a 200-turn, flat coil of cross sectional area of 300 cm^2 be rotated in a uniform 30-mT magnetic field to have a maximum value of the induced emf equal to 8.0 V ?
- a. 7.5 Hz
b. 7.1 Hz
c. 8.0 Hz
d. 8.4 Hz
e. 16 Hz

【背面還有試題】

國立中山大學 95 學年度轉學生招生考試試題

科目：普通物理【化學系二年級、物理系二年級、電機系二年級、機電系二年級、材光系二年級、海工系二年級】

共 4 頁 第 4 頁

二. 計算題、共有五題、每一題 10 分

1. A string is wound around a uniform disk of radius R and mass M . The disk is released from rest with the string vertical and its top end tied to a fixed bar (Fig. 1). Determine (a) the tension in the string, (b) the magnitude of acceleration of the center of mass, (c) the speed of the center of mass after the disk has descended through a distance of h .

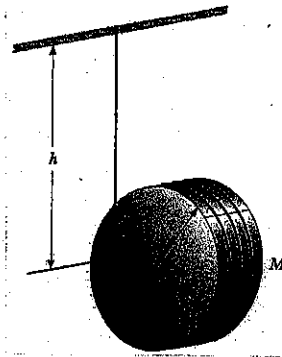


Fig. 1

2. The traveling wave propagates according the expression

$$y(x,t) = (4.0\text{cm})\sin(2.0x - 3.0t)$$

where x is in centimeters and t is in seconds. Determine (a) the amplitude, (b) the wavelength, (c) the frequency, (d) the period, and (e) the direction of travel of the wave.

3. A Carnot heat engine uses a steam boiler at 100°C as the high-temperature reservoir. The low-temperature reservoir is the outside environment at 20.0°C . Energy is exhausted to the low-temperature reservoir at the rate of 15.4 W . Determine the useful power output of the heat engine.
4. A solid sphere of radius R has a uniform charge density ρ and total Charge Q . Derive an expression for its total electric potential energy.

5. A rectangular loop of width a and b is located near a long wire carrying a current I (Fig. 2). The distance between the wire and the closest side of the loop is c . The wire is parallel to the long side of the loop. Find the total magnetic flux through the loop due to the current in the wire.

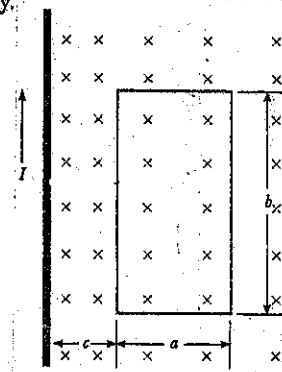


Fig. 2

國立中山大學 95 學年度轉學生招生考試試題

科目：普通化學【生科系二年級、化學系二年級】

共 5 頁 第 1 頁

選擇題（單選；共 40 題；每題 2.5 分；答錯不倒扣分數）

數據： $R = 0.082 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K} = 8.31 \text{ J}/\text{mol}\cdot\text{K}$ ； $N = 6.022 \times 10^{23} \text{ mol}^{-1}$

原子量：C = 12；H = 1；O = 16；Cl = 35.45；Ne = 20.2；N = 14；He = 4；Kr = 83.8；F = 16

- Vitamin C contains the elements C, H, and O. It is known to contain 40.9% C and 4.58% H by mass. The molar mass of vitamin C has been found to be about 180. The molecular formula for vitamin C is:
 - $\text{C}_2\text{H}_3\text{O}_2$
 - $\text{C}_3\text{H}_4\text{O}_3$
 - $\text{C}_4\text{H}_6\text{O}_4$
 - $\text{C}_6\text{H}_8\text{O}_6$
 - none of these
- Which one of the following basic solutions will not neutralize 25.0 mL of a 1.0 M sulfuric acid solution?
 - 25.0 mL of 1.0 M NaOH
 - 25.0 mL of 2.0 M KOH
 - 50.0 mL of 1.0 M NaOH
 - 100.0 mL of 0.50 M NaOH
 - All of these (a-d) will neutralize 25.0 mL of a 1.0 M sulfuric acid solution.
- In the following reaction, which species is the reducing agent?
 $3\text{Cu} + 6\text{H}^+ + 2\text{HNO}_3 \rightarrow 3\text{Cu}^{2+} + 2\text{NO} + 4\text{H}_2\text{O}$
 - H^+
 - Cu
 - N in NO
 - Cu^{2+}
 - N in HNO_3
- Which of the following is not an oxidation-reduction reaction?
 - A precipitation reaction.
 - A reaction in which a metal reacts with a nonmetal.
 - A combustion reaction.
 - A metal reacting with an acid.
 - All of the above are oxidation-reduction reactions.
- The valve between a 5.00-L tank containing O_2 (g) at 9.00 atm and a 7.00-L tank containing Ne (g) at 6.00 atm is opened. Calculate the ratio of partial pressures ($\text{O}_2:\text{Ne}$) in the container.
 - 0.933
 - 1.00
 - 1.07
 - 1.50
 - none of these
- How many of the following gases at STP are less dense than air at STP: NH_3 , He, Kr, and F_2 ?
 - 0
 - 1
 - 2
 - 3
 - 4
- Which statement about kinetic energy (K.E.) is true?
 - All objects moving with the same velocity have the same K.E.
 - As the velocity of a body increases, its K.E. decreases.
 - The K.E. of a body will double if its velocity doubles.
 - The K.E. of a body is independent of its mass.
 - none of these
- How does the observed pressure of a gas relate to the ideal pressure?
 - The observed pressure is less than the ideal pressure.
 - The observed pressure is greater than the ideal pressure.
 - They are equal.
 - The relationship depends on the gas.
 - None of these.
- The conjugate base of a weak acid is
 - a strong base
 - a weak base
 - a strong acid
 - a weak acid
 - none of these

【背面還有試題】

國立中山大學 95 學年度轉學生招生考試試題

科目：普通化學【生科系二年級、化學系二年級】

共 5 頁 第 2 頁

10. At 0° C, the ion-product constant of water, K_w , is 1.2×10^{-15} . What is the pH of pure water at 0° C?
 - a) 7.00
 - b) 6.88
 - c) 7.56
 - d) 7.46
 - e) none of these
11. If an acid, HA, is 10.0% dissociated in a 1.0 M solution, what is the K_a for this acid?
 - a) 9.1×10^{-2}
 - b) 1.1×10^{-2}
 - c) 8.1×10^{-1}
 - d) 6.3×10^{-2}
 - e) none of these
12. Calculate ΔE for a system that releases 28 J of heat while 63 J of work is done on it.
 - a) 35 J
 - b) 91 J
 - c) -35 J
 - d) -91 J
 - e) none of the above
13. The enthalpy of formation of an element in its standard state is
 - a) the enthalpy of its reaction with hydrogen.
 - b) the enthalpy of its reaction with oxygen.
 - c) determined by its melting point.
 - d) zero.
 - e) none of these
14. Choose the correct statement.
 - a) Exothermic reactions are always spontaneous.
 - b) Free energy is independent of temperature.
 - c) A reaction that exhibits a negative value of ΔS cannot be spontaneous.
 - d) At constant pressure and temperature, a decrease in free energy ensures an increase in the entropy of the system.
 - e) none of these
15. Which of the following is the strongest oxidizing agent?

$\text{MnO}_4^- + 4\text{H}^+ + 3\text{e}^- \rightarrow \text{MnO}_2 + 2\text{H}_2\text{O}$	$E^\circ = 1.68 \text{ V}$
$\text{I}_2 + 2\text{e}^- \rightarrow 2\text{I}^-$	$E^\circ = 0.54 \text{ V}$
$\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}$	$E^\circ = -0.76 \text{ V}$

 - a) MnO_4^-
 - b) I_2
 - c) Zn^{2+}
 - d) Zn
 - e) MnO_2
16. How many electrons are transferred in the following reaction?

$$\text{SO}_3^{2-}(\text{aq}) + \text{MnO}_4^-(\text{aq}) \rightarrow \text{SO}_4^{2-}(\text{aq}) + \text{Mn}^{2+}(\text{aq})$$
 - a) 6
 - b) 2
 - c) 10
 - d) 4
 - e) 3
17. In which of the following cases can E° be equal to zero?
 - a) In any cell at equilibrium.
 - b) In a concentration cell.
 - c) E° can never be equal to zero.
 - d) Choices a and b are both correct.
18. Which of the following statements is false?
 - a) An orbital can accommodate at most two electrons.
 - b) The electron density at a point is proportional to ψ^2 at that point.
 - c) The spin quantum number of an electron must be either $+1/2$ or $-1/2$.
 - d) A 2p orbital is more penetrating than a 2s; i.e., it has a higher electron density near the nucleus and inside the charge cloud of a 1s orbital.
 - e) In the usual order of filling, the 6s orbital is filled before the 4f orbital.

國立中山大學 95 學年度轉學生招生考試試題

科目：普通化學【生科系二年級、化學系二年級】

共 5 頁 第 3 頁

19. How many electrons in an atom can have the quantum numbers $n = 3, l = 2$?
 - a) 2
 - b) 5
 - c) 10
 - d) 18
 - e) 6
20. Which form of electromagnetic radiation has the shortest wavelengths?
 - a) gamma rays
 - b) microwaves
 - c) radio waves
 - d) infrared radiation
 - e) x-rays
21. In Bohr's atomic theory, when an electron moves from one energy level to another energy level more distant from the nucleus
 - a) energy is emitted.
 - b) energy is absorbed.
 - c) no change in energy occurs.
 - d) light is emitted.
 - e) none of these
22. Which of the following has a zero dipole moment?
 - a) NH_3
 - b) NO_2
 - c) PF_5
 - d) SO_2
 - e) HCN
23. Which of the following has the central atom that is dsp^3 hybridized?
 - a) SF_4
 - b) SCl_4
 - c) CCl_4
 - d) SF_6
 - e) none of the above
24. Which of the following statements is correct?
 - a) A triple bond is composed of two σ bonds and one π bond.
 - b) σ bonds result from the head-to-head overlap of atomic orbitals.
 - c) Free rotation may occur about a double bond.
 - d) π bonds have electron density on the internuclear axis.
 - e) More than one of these statements are correct.
25. Which of the following is diamagnetic?
 - a) N_2^-
 - b) N_2^+
 - c) O_2
 - d) N_2
 - e) At least two of the above are diamagnetic.
26. Which of the following statements is true?
 - a) Electrons are never found in an antibonding MO.
 - b) All antibonding MOs are higher in energy than the atomic orbitals of which they are composed.
 - c) Antibonding MOs have electron density mainly outside the space between the two nuclei.
 - d) None of the above is true.
 - e) Two of the above statements are true.
27. The reaction rate constant k is dependent on
 - a) the concentration of the reactant.
 - b) the concentration of the product.
 - c) the temperature.
 - d) the order of the reaction.
 - e) none of these
28. A first-order reaction is 42% complete at the end of 17 minutes. What is the value of the rate constant?
 - a) $3.2 \times 10^{-2} \text{ min}^{-1}$
 - b) 20 min^{-1}
 - c) 31 min^{-1}
 - d) $5.1 \times 10^{-2} \text{ min}^{-1}$
 - e) none of these

【背面還有試題】

國立中山大學 95 學年度轉學生招生考試試題

科目：普通化學【生科系二年級、化學系二年級】

共 5 頁 第 4 頁

29. For which order reaction is the half-life of the reaction proportional to $1/k$ (k is the rate constant)?
a) zero order
b) first order
c) second order
d) all of the above
e) none of the above
30. The resistance of a liquid to an increase in its surface area is called
a) capillary action.
b) surface tension.
c) vapor pressure
d) viscosity.
e) none of these
31. Which one of the following is the strongest intermolecular force experienced by Noble gases?
a) London dispersion forces
b) Dipole-dipole interactions
c) Hydrogen bonding
d) Ion-ion
e) Polar covalent bonds
32. The net number of face-centered atoms contained in a face-centered cubic unit cell is
a) 1
b) 3
c) 4
d) 6
e) none of these
33. Which of the following chemical or physical changes is an endothermic process?
a) the evaporation of water
b) the combustion of gasoline
c) the mixing of sulfuric acid and water
d) the freezing of water
e) none of these
34. The destruction of a colloid is called
a) degeneration
b) coagulation
c) denaturation
d) reconfiguration
e) none of these
35. What is the expected osmotic pressure in torr of a 0.0100 M solution of NaCl in water at 25°C?
a) 0.245
b) 15.6
c) 372
d) 186
e) none of these
36. The Haber process
a) is used to manufacture ammonia.
b) transforms nitrogen to other nitrogen-containing compounds.
c) is used to recover sulfur from underground deposits.
d) is used to produce nitric acid.
e) none of these
37. Which of the following complexes shows geometric isomerism?
a) $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$
b) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$
c) $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
d) $\text{K}[\text{Co}(\text{NH}_3)_2\text{Cl}_4]$
e) none of these
38. Which of the following is true about coordination complexes?
a) The metal is a Lewis base and the ligands are Lewis acids.
b) Only complexes with coordination number six are found in nature.
c) When the ligands approach a transition metal ion in an octahedral field, the d_{xz} , d_{yz} , and d_{xy} atomic orbitals are affected the least by the ligands.
d) None of the above is true.
e) All of the above are true.

