1.A research submarine is 50.0 m below the surface of the ocean. What is the net force on a circular submarine window of diameter 40.0cm due to the pressure difference between the two sides of the window? Assume that the window is also 50.0 m below the surface, and that the pressure inside the submarine is $0.90\times10^5 N/m^2$. Atmospheric pressure is $1.01\times10^5 N/m^2$, and the density of seawater is $1.03\times10^3 kg/m^3$. (15%)

2.A drainpipe is attached to a water tower as shown in the figure 1. (a) What is the pressure at V when the valve is closed? (b) What is the speed of the water at this same point when the valve is open? (c) How much water passes through the valve per second? (15%)

3.A body of mass m=4.00 kg is attached to a horizontal spring with force constant k=100 N/m. The body is displaced 10.0 cm from its equilibrium position and released. For the resulting simple harmonic motion, find (a) the period, (b) the frequency, (c) the mechanical energy, (d) the maximum velocity, (e) the maximum acceleration and (f) calculate the velocity and acceleration when the position is x=5.0 cm. (24%)

4.A uniform sphere of radius R is attached to the ceiling so that it is free to oscillate around a horizontal axis through the point of attachment O (figure 2). Find its period of oscillation. (15%)

5.A uniform stick of length d and mass m hangs vertically. It is free to rotate around a horizontal axis that passes through its end and is perpendicular to the plane of the page. The stick is struck sharply at its center by a force F, as shown in the figure 3 and it starts rotating with an angular velocity ω. (a) What is the angular impulse on the stick? (b) If the force is applied for a short time t, what is the average value of the force? Assume that m=150g, d=1.0m, ω=4.0 rad/s, and $t=2.0\times10^{-3}$ s. (16%)

6. Derive the Kepler's second and third law. (15%)

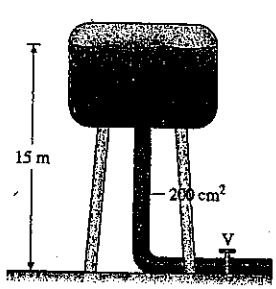

Fig. 1

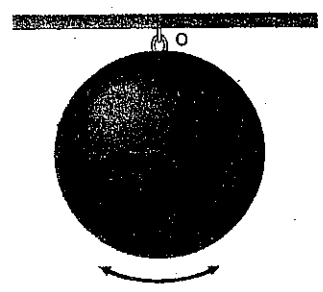

Fig. 2

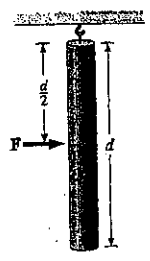

Fig. 3

(橫書式) 國立中山大學八十八學年度轉學生招生考試試題

科目：**微積分**（化學系、物理系、電機系、海工系二年級） 共 1 頁 第 頁

1. 四尖內擺線 $x^{2/3}+y^{2/3}=4$ 之任一切線在兩軸之間有定長 k，求 k 之值。

2. 試決定方程式 $x^3-x+b=0$ 之實根個數。

3. 求 $\int \frac{\sqrt[3]{\sin x}}{\cos x}\,dx$

4. 求 $\int_0^1 e^t\left(\frac{1-t}{1+t^2}\right)^2 dt$

5. 求擺線 $x=a(t-\sin t)$, $y=a(1-\cos t)$ 一拱繞 x 軸旋轉所得旋轉體之體積。

6. 求曲面 $xy=z$ 及二平面 $x+y+z=1$, $z=0$ 所夾部份之體積。

7. 討論級數 $\sum_{k=2}^{\infty}\frac{(-1)^k}{\sqrt{k}+(-1)^k}$ 之收斂性。

8. 求球面 $x^2+y^2+z^2=1$ 上距離點 $(1,2,3)$ 最近之點。

9. 求曲面 $\sqrt{x^2+y^2}+z=2$ 與兩個平面 $x=z$ 及 $x=0$ 所圍部份之體積。

10. 求函數 $\sin^{-1}x$ 對 $x=0$ 之冪級數展開式。

1~30 題每題 3 分，31~35 題每題 2 分。答錯每題倒扣 2 分。

1. A sample of pure ice water (containing solid ice at 0°C, the melting point) is an example of a

   a. heterogeneous mixture
   b. homogeneous mixture
   c. heterogeneous substance
   d. homogeneous substance
   e. none of these

2. If two samples labeled "NaCl" are analyzed and found to contain different percentages of chlorine, which of the following is probably true?

   a. There must be at least two different compounds with the formula NaCl.
   b. The two samples must have been from different origins.
   c. The ratio of the two different chlorine percentages must result in a small integer value.
   d. At least one of the samples must not be pure.
   e. None of these.

3. Which one of the following could <u>not</u> be an empirical formula?

   a. $C_{17}H_{25}NO_3$
   b. $C_{14}H_{10}CuO_4$
   c. $C_9H_{15}N_3O_6$
   d. $C_8H_{18}O_3$
   e. All of these could be empirical formulas.

4. The outermost electrons of an atom determine most of its chemistry, because those electrons are

   a. more negatively charged due to their distance from the center.
   b. more shielded from the effects of approaching atoms.
   c. more strongly affected when other atoms approach.
   d. All of these are correct.
   e. None of these is correct.

5. Which of the following Lewis structures can be drawn as two or more resonance forms?

   a. 

   b. 

   c. 

   d. all of these
   e. none of these

6. The formation of an aqueous solution of an ionic compound requires that the attractions between the water molecules and the ions are strong enough to replace the

   a. bonds normally found within the water molecule.
   b. covalent bonds between atoms of the ionic compound.
   c. electrical attractions between the ions in the ionic compound.
   d. All of these are correct.
   e. None of these is correct.

7. Which of the following can serve as a Lewis acid?

   a. NH_3
   b. Cl^-
   c. $AlCl_3$
   d. all of these
   e. none of these

1~30 題每題 3 分，31~35 題每題 2 分。答錯每題倒扣 2 分。

8. Which of the following would be expected to have the highest normal boiling point?

   a. I_2
   b. ICl
   c. HI
   d. KI
   e. cannot be predicted

9. Which of the following represents the most general definition of a solution?

   a. a homogeneous mixture formed by adding a solid to a liquid
   b. a homogeneous mixture of two or more substances
   c. a homogeneous mixture formed by adding one or more solids to a liquid
   d. a homogeneous mixture formed by dissolving any gas, liquid, or solid in a liquid
   e. None of these definitions is truly general.

10. The vapor pressure of a dilute solution of a nonvolatile solute is

    a. greater than that of the pure solvent.
    b. less than that of the pure solvent.
    c. equal to that of the pure solvent.
    d. equal to that of the pure solute.
    e. none of these

11. As the equilibrium state of a chemical reaction is approached,

    a. the rate of the forward reaction approaches zero.
    b. the rate of the backward reaction approaches zero.
    c. the rates of the forward and backward reactions approach the same value.
    d. Both a and b are correct.
    e. none of these

12. A weak acid is characterized by

    a. a K_a with a value smaller than one.
    b. a pK_a with a value larger than zero.
    c. a substantial quantity of undissociated acid in aqueous solution.
    d. all of these.
    e. none of these.

13. In many ways, the properties of dissolution-precipitation equilibria closely parallel those of vaporization-condensation equilibria. For example, the case of a vapor present in a closed container in the absence of the condensed phase is analogous to

    a. a saturated solution.
    b. a supersaturated solution.
    c. an unsaturated solution.
    d. a concentrated solution.
    e. none of these

14. For $CaF_2(s)$, $K_{sp} = 3.9 \times 10^{-11}$. As the pH is lowered, K_{sp} for CaF_2 in water should

    a. increase.
    b. decrease.
    c. remain constant.
    d. This cannot be predicted.
    e. none of these.

15. The First Law of Thermodynamics is the law of

    a. conservation of energy
    b. conservation of matter
    c. conservation of enthalpy
    d. All of these are involved.
    e. none of these

1~30題每題3分，31~35題每題2分。答錯每題倒扣2分。

16. In a bomb calorimeter, reactions are carried out

a. at fixed pressure.
b. at fixed volume.
c. at fixed temperature.
d. in the liquid and solid states only.
e. All of these are true.

17. Which one of the following elements is not in its standard state?

a. $F_2(g)$
b. $H_2(g)$
c. $O_3(g)$
d. $Hg(l)$
e. $I_2(s)$

18. Which of the following is an example of a process which cannot occur spontaneously?

a. Gaseous hydrogen and oxygen react to form water when ignited with a spark.
b. NaCl(s) crystallizes out of a supersaturated NaCl(aq) solution.
c. Heat flows from a cold object to a hot object when the two are placed in contact.
d. All of these processes can occur spontaneously under suitable conditions.
e. None of these can occur spontaneously.

19. If ΔS_{univ} is positive for a process, the process is _____, if ΔS_{univ} for a process is negative, the process is _____, and if the ΔS_{univ} accompanying a process is zero, the process is _____.

a. at equilibrium, spontaneous, impossible
b. impossible, spontaneous, at equilibrium
c. spontaneous, at equilibrium, impossible
d. spontaneous, impossible, at equilibrium
e. none of these

20. Which of the following statements is not true concerning ozone?

a. It is an allotrope of oxygen having the formula O_3.
b. It is a stronger oxidizing agent than O_2.
c. It is a stronger oxidizing agent than H_2O_2.
d. It is a more effective oxidizing agent in basic solution than in acidic solution.
e. All of these statements are true.

21. Reaction rates can change with

a. temperature.
b. the addition of a catalyst.
c. reactant concentrations.
d. all of these
e. none of these

22. The rate law relates the rate of a chemical reaction to

a. the concentrations of reactants.
b. the reaction mechanism.
c. the activation energy.
d. the temperature.
e. all of these

23. In a living organism, the ^{14}C concentration

a. continually increases.
b. continually decreases.
c. remains approximately constant.
d. varies unpredictably during the lifetime of the organism.

24. The property that is common to all wave phenomena is

a. the necessity of a medium for propagation.
b. a fixed velocity of propagation, independent of medium.
c. the oscillatory variation of some property with time, at a fixed location in space.
d. all of these
e. none of these

25. In the Bohr model of the one-electron atom, the electron travels in fixed orbits, the radii of which _____ as the principle quantum number n increases and _____ as the nuclear charge Z increases.

a. increase, increase
b. increase, decrease
c. decrease, increase
d. decrease, decrease
e. The radii of the Bohr orbits are all equal to the Bohr radius, a_o.

26. Generally, there is a decrease in atomic size as one moves

a. down a group
b. up a group
c. from left to right across a period
d. from right to left across a period
e. both b and c

27. Molecular oxygen has ____ unpaired electrons and therefore is _____.

a. 0, diamagnetic
b. 1, paramagnetic
c. 2, paramagnetic
d. 3, paramagnetic

28. The species bonded to the central atom in a coordination complex are called

a. coordinants
b. complex ions
c. Lewis acids
d. chelates
e. ligands

29. Solids with long-range microscopic order in their structures are called

a. amorphous.
b. crystalline.
c. glasses.
d. metals.
e. none of these

30. In a face-centered cubic lattice, each lattice point located in a side of the unit cell is shared equally with ___ other unit cells.

a. 1
b. 3
c. 5
d. 7
e. none of these

31. A sample of pure silicon is doped with equal molar amounts of gallium and arsenic. The resulting material is

a. an n-type semiconductor
b. a p-type semiconductor
c. an np-type semiconductor
d. a metallic conductor
e. none of the above

32. Which of the following is <u>not</u> a <u>possible</u> way to dispose of the by-products of a chemical process?

a. sell them as starting materials for another process
b. recycle them into the original process
c. bury them in an approved land-fill
d. ship them abroad for burial
e. all of the above are possible

33. Large amounts of sodium carbonate are essential in which one of the following industries?

a. glass
b. steel
c. fertilizer
d. paint
e. petrochemical

34. In addition polymerization, the reaction to form a polymer chain occurs

a. by splitting out small molecules
b. without net loss of atoms
c. by forming an initiator
d. without need for initiation
e. none of the above

35. All graft copolymers are

a. random copolymers
b. straight-chain polymers
c. block copolymers
d. cross-linked polymers
e. branched-chain polymers