

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

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

 - heterogeneous mixture
 - homogeneous mixture
 - heterogeneous substance
 - homogeneous substance
 - none of these
- If two samples labeled "NaCl" are analyzed and found to contain different percentages of chlorine, which of the following is probably true?

 - There must be at least two different compounds with the formula NaCl.
 - The two samples must have been from different origins.
 - The ratio of the two different chlorine percentages must result in a small integer value.
 - At least one of the samples must not be pure.
 - None of these.
- Which one of the following could not be an empirical formula?

 - C₁₇H₂₅NO₃
 - C₁₄H₁₀CuO₄
 - C₉H₁₅N₃O₆
 - C₈H₁₈O₃
 - All of these could be empirical formulas.
- The outermost electrons of an atom determine most of its chemistry, because those electrons are

 - more negatively charged due to their distance from the center.
 - more shielded from the effects of approaching atoms.
 - more strongly affected when other atoms approach.
 - All of these are correct.
 - None of these is correct.
- Which of the following Lewis structures can be drawn as two or more resonance forms?

 - $$\begin{array}{c} \cdot\cdot\cdot\cdot \\ \text{O}=\text{O}-\text{O}: \\ \cdot\cdot\cdot\cdot \end{array}$$
 - $$\begin{array}{c} \cdot\cdot \\ [:\text{N}=\text{N}-\text{N}:]^- \\ \cdot\cdot \end{array}$$
 - $$\begin{array}{c} \cdot\cdot\cdot\cdot \\ [:\text{O}-\text{N}=\text{O}:]^- \\ \cdot\cdot \end{array}$$
 - all of these
 - none of these
- 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

 - bonds normally found within the water molecule.
 - covalent bonds between atoms of the ionic compound.
 - electrical attractions between the ions in the ionic compound.
 - All of these are correct.
 - None of these is correct.
- Which of the following can serve as a Lewis acid?

 - NH₃
 - Cl⁻
 - AlCl₃
 - all of these
 - none of these

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8. Which of the following would be expected to have the highest normal boiling point?
- I_2
 - ICl
 - HI
 - KI
 - cannot be predicted
9. Which of the following represents the most general definition of a solution?
- a homogeneous mixture formed by adding a solid to a liquid
 - a homogeneous mixture of two or more substances
 - a homogeneous mixture formed by adding one or more solids to a liquid
 - a homogeneous mixture formed by dissolving any gas, liquid, or solid in a liquid
 - None of these definitions is truly general.
10. The vapor pressure of a dilute solution of a nonvolatile solute is
- greater than that of the pure solvent.
 - less than that of the pure solvent.
 - equal to that of the pure solvent.
 - equal to that of the pure solute.
 - none of these
11. As the equilibrium state of a chemical reaction is approached,
- the rate of the forward reaction approaches zero.
 - the rate of the backward reaction approaches zero.
 - the rates of the forward and backward reactions approach the same value.
 - Both a and b are correct.
 - none of these
12. A weak acid is characterized by
- a K_a with a value smaller than one.
 - a pK_a with a value larger than zero.
 - a substantial quantity of undissociated acid in aqueous solution.
 - all of these.
 - 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 saturated solution.
 - a supersaturated solution.
 - an unsaturated solution.
 - a concentrated solution.
 - 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
- increase.
 - decrease.
 - remain constant.
 - This cannot be predicted.
 - none of these.
15. The First Law of Thermodynamics is the law of
- conservation of energy
 - conservation of matter
 - conservation of enthalpy
 - All of these are involved.
 - none of these

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16. In a bomb calorimeter, reactions are carried out
- at fixed pressure.
 - at fixed volume.
 - at fixed temperature.
 - in the liquid and solid states only.
 - All of these are true.
17. Which one of the following elements is not in its standard state?
- $F_2(g)$
 - $H_2(g)$
 - $O_3(g)$
 - $Hg(l)$
 - $I_2(s)$
18. Which of the following is an example of a process which cannot occur spontaneously?
- Gaseous hydrogen and oxygen react to form water when ignited with a spark.
 - $NaCl(s)$ crystallizes out of a supersaturated $NaCl(aq)$ solution.
 - Heat flows from a cold object to a hot object when the two are placed in contact.
 - All of these processes can occur spontaneously under suitable conditions.
 - 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 _____.
- at equilibrium, spontaneous, impossible
 - impossible, spontaneous, at equilibrium
 - spontaneous, at equilibrium, impossible
 - spontaneous, impossible, at equilibrium
 - none of these
20. Which of the following statements is not true concerning ozone?
- It is an allotrope of oxygen having the formula O_3 .
 - It is a stronger oxidizing agent than O_2 .
 - It is a stronger oxidizing agent than H_2O_2 .
 - It is a more effective oxidizing agent in basic solution than in acidic solution.
 - All of these statements are true.
21. Reaction rates can change with
- temperature.
 - the addition of a catalyst.
 - reactant concentrations.
 - all of these
 - none of these
22. The rate law relates the rate of a chemical reaction to
- the concentrations of reactants.
 - the reaction mechanism.
 - the activation energy.
 - the temperature.
 - all of these
23. In a living organism, the ^{14}C concentration
- continually increases.
 - continually decreases.
 - remains approximately constant.
 - varies unpredictably during the lifetime of the organism.
24. The property that is common to all wave phenomena is
- the necessity of a medium for propagation.
 - a fixed velocity of propagation, independent of medium.
 - the oscillatory variation of some property with time, at a fixed location in space.
 - all of these
 - 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.
- increase, increase
 - increase, decrease
 - decrease, increase
 - decrease, decrease
 - The radii of the Bohr orbits are all equal to the Bohr radius, a_0 .
26. Generally, there is a decrease in atomic size as one moves
- down a group
 - up a group
 - from left to right across a period
 - from right to left across a period
 - both b and c
27. Molecular oxygen has _____ unpaired electrons and therefore is _____
- 0, diamagnetic
 - 1, paramagnetic
 - 2, paramagnetic
 - 3, paramagnetic
28. The species bonded to the central atom in a coordination complex are called
- coordinants
 - complex ions
 - Lewis acids
 - chelates
 - ligands
29. Solids with long-range microscopic order in their structures are called
- amorphous.
 - crystalline.
 - glasses.
 - metals.
 - 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.
- 1
 - 3
 - 5
 - 7
 - none of these
31. A sample of pure silicon is doped with equal molar amounts of gallium and arsenic. The resulting material is
- an n-type semiconductor
 - a p-type semiconductor
 - an np-type semiconductor
 - a metallic conductor
 - none of the above
32. Which of the following is not a possible way to dispose of the by-products of a chemical process?
- sell them as starting materials for another process
 - recycle them into the original process
 - bury them in an approved land-fill
 - ship them abroad for burial
 - all of the above are possible
33. Large amounts of sodium carbonate are essential in which one of the following industries?
- glass
 - steel
 - fertilizer
 - paint
 - petrochemical
34. In addition polymerization, the reaction to form a polymer chain occurs
- by splitting out small molecules
 - without net loss of atoms
 - by forming an initiator
 - without need for initiation
 - none of the above
35. All graft copolymers are
- random copolymers
 - straight-chain polymers
 - block copolymers
 - cross-linked polymers
 - branched-chain polymers

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 l , 求 l 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 $\int_0^1 e^x \left(\frac{1-x}{1+x^2} \right)^2 dx$

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 $z = 0$ 所夾部份之體積.

7. 討論級數 $\sum_{k=2}^{\infty} \frac{(-1)^k}{\sqrt{k+10}}$ 之斂散性.

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 $\sin^4 x$ 對 $x = 0$ 之冪級數展開式.

1. A ball is thrown horizontally from the top of a building 35.0 m high. The ball strikes the ground at a point 80.0 m from the base of the building. Find (a) the time the ball is in flight, (3%)(b) its initial velocity, (3%) and (c) the x and y components of velocity just before the ball strikes the ground (4%).

2. A mass $M = 2.20$ kg is accelerated across a rough surface by a rope passing over a pulley, as shown in Fig. 1. The tension in the rope is 10.0 N and the pulley is 10.0 cm above the top of the block. The coefficient of kinetic friction is 0.400 . (a) Determine the acceleration of the block when $x = 40.0$ cm. (5%) (b) Find the value of x at which the acceleration becomes zero (5%).

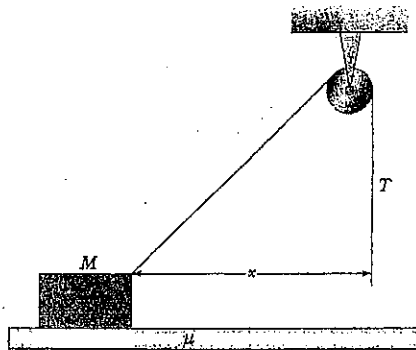


Fig. 1

3. A bullet of mass m_1 is fired into a wooden block of mass m_2 initially at rest on a horizontal surface. After impact, the block slides a distance d before coming to rest. If the coefficient of friction between block and surface is μ , what was the speed of the bullet immediately before impact? (10%)

4. A particle of mass m slides inside a frictionless hemispherical bowl of radius R . Show that if it starts from rest with a small displacement from equilibrium, the particle moves in simple harmonic motion with an angular frequency equal to that of a simple pendulum of length R . That is, $\omega = (g/R)^{0.5}$. (10%)

5. One mole of gas initially at a pressure of 2.00 atm and a volume of 0.300 L has an internal energy that may be set equal to 91.0 J. In its final state, the pressure is 1.50 atm, the volume is 0.800 L, and the internal energy equals 182 J. For the three paths IAF, IBF, and IF in Fig. 2, calculate (a) the work done by the gas (5%) and (b) the net thermal energy transferred in the process (5%). (1.00 atm = 1.013×10^5 Pa)

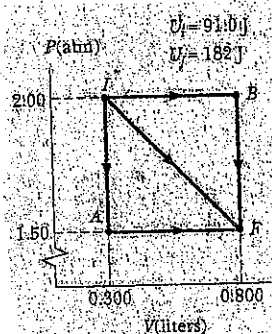


Fig. 2

6. A continuous line of charge lies along the x axis, extending from $x = +x_0$ to positive infinity. The line carries a uniform linear charge density λ_0 . What are the magnitude and direction of the electric field at the origin? (10%)

7. A spherical capacitor consists of a spherical conducting shell of radius b and charge $-Q$ that is concentric with a smaller conducting sphere of radius a and charge $+Q$ (Fig.3). Show that its capacitance is (10%)

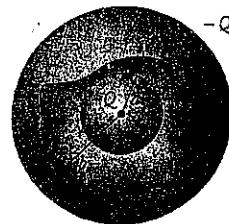


Fig.3

$$C = \frac{ab}{k_e(b-a)}$$

8. The ammeter in Fig.4 reads 2.00 A. Find I_1 , I_2 , and ϵ . (10%)

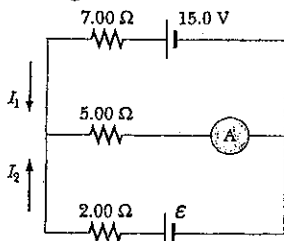


Fig.4

9. A conducting rectangular loop of mass M , resistance R , and dimensions w by l falls from rest into a magnetic field B , as shown in Fig.5. The loop accelerates until it reaches a terminal speed v_t . Show that (10%)

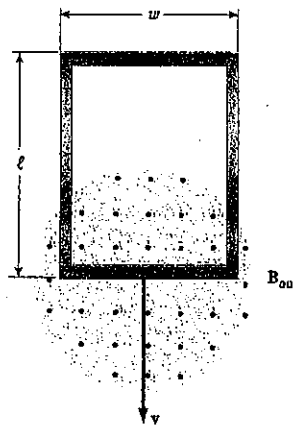


Fig.5

$$v_t = \frac{MgR}{B^2 w^2}$$

10. An air wedge is formed between two glass plates separated at one edge by a very fine wire as in Fig.6. When the wedge is illuminated from above by 600-nm light, 30 dark fringe are observed. Calculate the radius of the wire.(10%)



Fig.6