

科目：綜合化學(2001)

校系所組：中央大學化學學系 交通大學應用化學系 清華大學化學系

單選題：總分 100 分，每題 2 分共 50 題，答錯不倒扣分數

- For a solution of phosphoric acid, write the equation for the fraction of (HPO_4^{2-}) .
 - $K_{a3}/([\text{H}_3\text{O}^+]^3 + K_{a1}[\text{H}_3\text{O}^+]^2 + K_{a1}K_{a2}[\text{H}_3\text{O}^+] + K_{a1}K_{a2}K_{a3})$
 - $[\text{H}_3\text{O}^+]/([\text{H}_3\text{O}^+]^3 + K_{a1}[\text{H}_3\text{O}^+]^2 + K_{a1}K_{a2}[\text{H}_3\text{O}^+] + K_{a1}K_{a2}K_{a3})$
 - $K_{a1}K_{a2}[\text{H}_3\text{O}^+]/([\text{H}_3\text{O}^+]^3 + K_{a1}[\text{H}_3\text{O}^+]^2 + K_{a1}K_{a2}[\text{H}_3\text{O}^+] + K_{a1}K_{a2}K_{a3})$
 - $K_{a1}K_{a2}K_{a3}/([\text{H}_3\text{O}^+]^3 + K_{a1}[\text{H}_3\text{O}^+]^2 + K_{a1}K_{a2}[\text{H}_3\text{O}^+] + K_{a1}K_{a2}K_{a3})$
 - $K_{a1}[\text{H}_3\text{O}^+]^2/([\text{H}_3\text{O}^+]^3 + K_{a1}[\text{H}_3\text{O}^+]^2 + K_{a1}K_{a2}[\text{H}_3\text{O}^+] + K_{a1}K_{a2}K_{a3})$
- Use the following:
 $\text{Pb(s)} | \text{PbSO}_4(\text{s}) | \text{SO}_4^{2-}(\text{aq}, 0.60 \text{ M}) || \text{H}^+(\text{aq}, 0.70 \text{ M}) | \text{H}_2(\text{g}, 192.5 \text{ kPa}) | \text{Pt}$
 In this cell, if E° is 0.36 V at 25°C, what is the Nernst equation for the cell at this temperature?
 - $E = 0.36 - 0.01285 \ln[1.90/\{(0.70)^2(0.60)\}]$
 - $E = 0.36 + 0.01285 \ln[1.90/\{(0.70)^2(0.60)\}]$
 - $E = 0.36 + 0.01285 \ln[192.5/\{(0.70)^2(0.60)\}]$
 - $E = 0.36 - 0.02569 \ln[192.5/\{(0.70)^2(0.60)\}]$
 - $E = 0.36 - 0.01285 \ln[1.90/\{(0.70)(0.60)\}]$
- Which species will oxidize Cr^{2+} but not Mn^{2+} ?
 - Pb^{4+}
 - O_3 in acidic medium
 - Zn^{2+}
 - Fe^{2+}
 - V^{3+}
- How do the saline hydrides react in water?
 - They reduce water and produce $\text{O}_2(\text{g})$.
 - They all produce $\text{H}_3\text{O}^+(\text{aq})$.
 - They oxidize water and produce $\text{O}_2(\text{g})$.
 - Saline hydrides are actually insoluble in water.
 - They reduce water and produce $\text{H}_2(\text{g})$.
- Which of the following has bond angles of 90°, 120°, and 180°?
 - SF_4
 - PF_6^-
 - ICl_4^-
 - XeF_4
 - IF_5
- Which of the following is an acidic oxide?
 - $\text{CaO}(\text{s})$
 - $\text{MgO}(\text{s})$
 - $\text{Bi}_2\text{O}_3(\text{s})$
 - $\text{Na}_2\text{O}(\text{s})$
 - $\text{SiO}_2(\text{s})$

注意：背面有試題

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7. All of the following elements form hydrides except
- K
 - Be
 - Ca
 - Rb
 - Li
8. Phosphorus(V) oxide reacts with water to produce
- H_3PO_2 .
 - H_3PO_4 .
 - HPO_3 .
 - H_3PO_3 .
 - H_3PO_2^- .
9. Write the proper cell diagram for the following reaction:

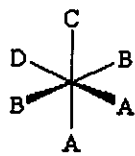
$$2\text{AuCl}(\text{s}) + \text{H}_2(\text{g}) \rightarrow 2\text{Au}(\text{s}) + 2\text{H}^+(\text{aq}) + 2\text{Cl}^-(\text{aq})$$
- $\text{Pt} | \text{Cl}^-(\text{aq}) | \text{H}^+(\text{aq}) || \text{H}_2(\text{g}) | \text{AuCl}(\text{s}) | \text{Au}(\text{s})$
 - $\text{Au}(\text{s}) | \text{AuCl}(\text{s}) | \text{Cl}^-(\text{aq}) || \text{H}^+(\text{aq}) | \text{H}_2(\text{g}) | \text{Pt}$
 - $\text{Pt} | \text{H}_2(\text{g}) | \text{H}^+(\text{aq}) || \text{Cl}^-(\text{aq}) | \text{AuCl}(\text{s}) | \text{Au}(\text{s})$
 - $\text{Pt} | \text{H}_2(\text{g}) | \text{H}^+(\text{aq}) || \text{Cl}^-(\text{aq}) | \text{Au}(\text{s}) | \text{Pt}$
 - $\text{Au}(\text{s}) | \text{AuCl}(\text{s}) | \text{H}^+(\text{aq}) || \text{Cl}^-(\text{aq}) | \text{H}_2(\text{g}) | \text{Pt}$
10. Which of the following statements is true?
- A metallic conductor is a substance with a resistance that increases with increasing temperature.
 - A superconductor is a substance that has zero resistance below a certain temperature.
 - An insulator is a substance that does not conduct electricity below a certain temperature.
 - A semiconductor is a substance with a resistance that increases with increasing temperature.
 - An insulator behaves like a metallic conductor with a very high resistance.
11. When sulfuric acid and calcium fluoride are mixed, a product is
- $\text{F}_2(\text{g})$.
 - $\text{SO}_2(\text{g})$.
 - $\text{HF}(\text{g})$.
 - $\text{H}_2\text{S}(\text{g})$.
 - $\text{SF}_2(\text{g})$.
12. A complex that is the subject of a great deal of research because of its high oxidation potential is ferrate, FeO_4^{2-} . How many unpaired electrons are in this complex?
- 4
 - 2
 - 1
 - 6
 - 3

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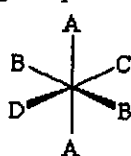
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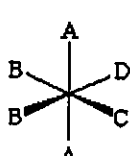
13. Which of the following complexes is (are) chiral?



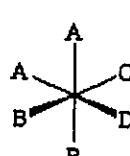
1



2



3



4

- a) 4
- b) 1 and 3
- c) 2
- d) 3
- e) 1

14. Which of the following would be the strongest acid in aqueous solution?

- a) $\text{Mg}(\text{OH}_2)_6^{2+}(\text{aq})$
- b) $\text{V}(\text{OH}_2)_6^{2+}(\text{aq})$
- c) $\text{Ni}(\text{OH}_2)_6^{2+}(\text{aq})$
- d) $\text{Sc}(\text{OH}_2)_6^{3+}(\text{aq})$
- e) $\text{Fe}(\text{OH}_2)_6^{2+}(\text{aq})$

15. How many electrons are in the expanded valence in XeOF_2 ?

- a) 14
- b) 12
- c) 8
- d) 10
- e) 6

16. When pyridinium chloride is added to $\text{C}_5\text{H}_5\text{N}(\text{aq})$,

- a) the pH of the solution does not change.
- b) the pH of the solution increases.
- c) the pH of the solution decreases.
- d) the K_b increases.
- e) the equilibrium concentration of $\text{NH}_3(\text{aq})$ decreases.

17. Which of the following statements is true?

- a) The electronegativity of an atom is defined as electron affinity of the atom.
- b) The electronegativity of an atom depends only on the value of the ionization energy of the atom.
- c) Atoms with high ionization energies and high electron affinities have low electronegativities.
- d) Atoms with low ionization energies and low electron affinities have low electronegativities.
- e) Atoms with low ionization energies and low electron affinities have high electronegativities.

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18. The following 0.1 M aqueous solutions are arranged in order of increasing pH, with the highest pH on the far right.

HNO ₃	HCOOH		KBr	KNO ₂
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Which one of the following 0.10 M aqueous solutions should be placed in the empty box?

- a) NaHSO₄
 b) KF
 c) HNO₂
 d) CH₃NH₂
 e) (CH₃)₃NHCl
19. Of the following, which is not a Lewis acid?
 a) H₃O⁺
 b) SO₃
 c) NO₂⁻
 d) BF₃
 e) None of the above.
20. What is wrong with the following Lewis structure?

$$\text{O}-\text{C}\equiv\text{O}$$
 a) the valence electron count
 b) the positioning of the carbon atom
 c) the distribution of valence electrons
 d) the charge on the carbon atom
 e) the dipole of the molecule
21. Which gas is least dense at STP?
 a) argon
 b) hydrogen cyanide
 c) chlorine
 d) helium
 e) ammonia
22. Consider the following statements:
 1. Real gases act more like ideal gases as the temperature increases.
 2. When n and T are constant, a decrease in P results in a decrease in V.
 3. At 1 atm and 273 K, every molecule in a sample of a gas has the same speed.
 4. At constant T, CO₂ molecules at 1 atm and H₂ molecules at 5 atm have the same average kinetic energy.
 Which of these statements is true?
 a) 2 and 3
 b) 1 and 2
 c) 1 and 4
 d) 3 and 4
 e) 2 and 4

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23. Which of the following cations is likely to be hydrated in compounds?
- Rb⁺
 - Li⁺
 - K⁺
 - Cs⁺
 - NH₄⁺
24. Which of the following statements is true?
- 1,1-Dichloro-2-methyl-1-propene has a higher boiling point than *trans*-2,3-dichloro-2-butene.
 - CH₄ has a higher boiling point than CCl₄.
 - o*-Dichlorobenzene has a lower boiling point than *p*-dichlorobenzene.
 - HI has a lower boiling point than HBr.
 - Butane, C₄H₁₀, has a higher boiling point than acetone, CH₃COCH₃.
25. A nuclide undergoes α decay and forms ²³¹Th. What is the nuclide?
- ²³⁵Pu
 - ²³⁵U
 - ²³⁵Th
 - ²³⁷U
 - ²³¹Pa
26. Table sugar, sucrose, is an example of
- a heterogeneous mixture
 - a homogeneous mixture
 - a mineral
 - an element
 - a compound
27. A HCl molecule has a bond length of 0.128 nm and a dipole moment of 1.109 Debye(D). What is the percent ionic character of the HCl bond? (1 D = 3.336 × 10⁻³⁰ C m)
- 10%
 - 18%
 - 54%
 - 100%
 - not enough information to estimate
28. For the one dimensional particle in a box if you double the length of the box the ground state energy will
- decrease by a factor of 4.
 - decrease by a factor of 2.
 - stay the same.
 - increase by a factor of 2.
 - increase by a factor of 4.
29. What phenomenon is defined by electrons being ejected from a metal surface when it is bombarded by radiation above a certain, threshold frequency?
- The wave - particle duality.
 - The photon electron effect.
 - The Stefan - Boltzmann Law.
 - The black-body radiation.
 - The photoelectric effect.

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30. What does the orbital angular momentum quantum number specify?
- The size of an orbital.
 - The shape of an orbital.
 - The orientation of an orbital.
 - The number of electrons in an orbital.
 - All the above.
31. Where is π -bond electron density located?
- Along the bond axis of two atoms.
 - Above and below the bond axis between two atoms.
 - Above and below the bond axis as well as on the bond axis between two atoms.
 - On either end of the bond axis between two atoms.
 - a and d.
32. A laser emits 10 mJ pulses of 532 nm light. How many photons are in each pulse?
- 2.68×10^{16}
 - 3.73×10^{17}
 - 2.52×10^{18}
 - 3.73×10^{18}
 - 5.36×10^{18}
33. If you excite the electron in H_2^+ from the $1\sigma_g$ to the $1\sigma_u^*$ what would you expect to happen to the molecule?
- It would eject an electron to become two H^+ ions.
 - It would vibrate.
 - It would contract to a short bond length.
 - It would expand to a longer bond length.
 - It would dissociate to an H atom and H^+ ion.
34. The statement, the internal work of an isolated system is constant, is also known as what?
- The first law of thermodynamics.
 - The law of conservation of energy.
 - The law of conservation of mass.
 - The second law of thermodynamics.
 - None of the above.
35. For the reaction $2 \text{NO}_2(\text{g}) \rightarrow \text{N}_2\text{O}_4(\text{g})$, as temperature increases the value of ΔG_{rxn} will?
- become more positive.
 - become more negative
 - asymptotically approach the value of ΔH_{rxn}
 - equal to the value of Ω (Ω : number of different microstates with the same energy)
 - a and d
36. A process can be spontaneous at low temperature but nonspontaneous at high temperature if
- both ΔH and ΔS are positive
 - both ΔH and ΔS are negative
 - ΔH is positive and ΔS is negative
 - ΔH is negative and ΔS is positive
 - this can never happen

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37. What is the value for the total change in entropy at equilibrium?
- It is always positive.
 - It is always negative.
 - It is always zero.
 - It is dependent upon the temperature.
 - It is dependent upon the pressure.
38. How is vapor pressure related to equilibrium?
- It is the equilibrium between the liquid and solid phase of a material.
 - It occurs at the boiling point of a material.
 - It is the equilibrium between a material's vapor and condensed phase.
 - It occurs at the condensation point or dew point of a material.
 - None of the above.
39. How are surfactants best described?
- As molecules having hydrophobic regions.
 - As molecules having hydrophilic regions.
 - As molecules having ambiphilic regions that can be hydrophilic or hydrophobic.
 - As molecules having hydrophobic and hydrophilic regions.
 - None of the above.
40. In determining instantaneous rate of reaction, what two factors must be graphed and in what manner?
- Concentration as a function of speed.
 - Concentration as a function of time.
 - Speed as a function of concentration.
 - Concentration as a function of molarity.
 - Concentration as a function of temperature.
41. If a reaction is first order and a plot of the natural logarithm of its concentration versus time is determined, what shape should the data have?
- A slope that becomes closer to zero with increased time.
 - A sloped line that moves towards infinity with increased time.
 - A straight line.
 - A parabola.
 - A hyperbola.
42. Which of the following will a catalyst affect?
- Activation Energy
 - Enthalpy of Reaction
 - Final reaction concentrations.
 - all of the above
 - none of the above
43. Benzene has a π electron system composed of the six p_z orbitals on the carbon atoms. How many bonding and antibonding molecular orbitals can be formed?
- 6 bonding and 0 antibonding
 - 4 bonding and 2 antibonding
 - 3 bonding and 3 antibonding
 - 2 bonding and 4 antibonding
 - 0 bonding and 6 antibonding

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44. Why does the strength of London forces in alkanes decrease with increasing molar mass?
- Because there are more sites of repulsion.
 - Because there are less molecule-to-molecule interactions.
 - Because the molecules all repel each other.
 - Because there are more electrons.
 - It doesn't; rather, the strength increases.
45. The process of vulcanization combines natural rubber with
- sulfur
 - metals such as iron and manganese
 - zeolites
 - clays
 - none of the above.
46. What are the preferred sites for electrophilic substitution of benzene with electron donating substituents?
- Meta positions.
 - Ortho position.
 - Ortho and meta positions.
 - Meta and para positions.
 - Ortho and para positions.
47. In the coalification process, what is generally lost, resulting in an increase in aromatic rings?
- Carbon.
 - Oxygen.
 - Oxygen and hydrogen.
 - Carbon and hydrogen.
 - Oxygen and carbon.
48. Why do alcohols not form hydrogen bonds?
- They are too un-like water to form the hydrogen bonding network.
 - The hydroxy functional group is not electronegative enough.
 - The carbon on the hydroxy group blocks the formation of hydrogen bonds.
 - Alcohols do form hydrogen bonds.
 - None of the above.
49. In DNA, genetic information is encoded by
- hydrogen bonding
 - the order of amino acids
 - transfer polymerization
 - the order of base pairs
 - none of the above
50. Which of the following will affect the pitch of a liquid crystal?
- distance between planes with the same orientation
 - chain length
 - temperature
 - a and b
 - a and c