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請依題號順序將答案寫於答案卷上

一、選擇題：（單選題共 50 分，每題 2 分）

1. Under which of the following conditions does a gas behave most ideally?
A) STP
B) P = 1.0 atm, T = 100.0°C
C) P = 0.50 atm, T = 100.0°C
D) P = 0.50 atm, T = 0.0°C
E) P = 2.0 atm, T = -100.0°C

2. The kinetic-molecular theory of gases does *not* assume that
A) gases are made up of tiny particles in constant chaotic motion.
B) gas particles are very small compared to the average distance between the particles.
C) gas particles collide with the walls of their container in elastic collisions.
D) the average velocity of gas particles is directly proportional to the absolute temperature.
E) All of these are correct.

3. How is the observed pressure of a gas related to the ideal pressure?
A) The observed pressure is less than the ideal pressure.
B) The observed pressure is greater than the ideal pressure.
C) They are equal.
D) The relationship depends on the gas.
E) none of these

4. The value of the equilibrium constant K depends on:
I. the temperature of the system. II. the nature of the reactants and products.
III. the concentrations of the reactants. IV. the concentrations of the products.
A) I and II only B) II and III only C) III and IV only
D) three of these E) none of these

5. Predict the direction in which the system will move to reach equilibrium at 2000°C if 0.4 mol of N_2, 0.1 mol of O_2, and 0.08 mol of NO are placed in a 1.0-L container.
A) The system remains unchanged.
B) The concentration of NO will decrease; the concentrations of N_2 and O_2 will increase.
C) The concentration of NO will increase; the concentrations of N_2 and O_2 will decrease.
D) The concentration of NO will decrease; the concentrations of N_2 and O_2 will remain unchanged.
E) More information is necessary

6. In deciding which of two acids is the stronger, one must know
A) the concentration of each acid solution only.
B) the pH of each acid solution only.
C) the equilibrium constant of each acid only.
D) all of the these.
E) both the concentration and the equilibrium constant of each acid.

7. As water is heated, its pH decreases. This means that
A) the water is no longer neutral.
B) $[H^+] > [OH^-]$.
C) $[OH^-] > [H^+]$.
D) Two of these are correct.
E) None of these is correct.

8. The salt BX, when dissolved in water, produces an acidic solution. Which of the following could be true?
A) HX is a weak acid.
B) HX is a strong acid.
C) The cation B^+ is a weak acid.
D) All of these could be true.
E) Both HX and the cation B^+ are weak acids

（背面仍有題目，請繼續作答）

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9. The pH at the equivalence point of a titration of a weak acid with a strong base is
A) less than 7.00. B) equal to 7.00. C) greater than 7.00.
D) More data are needed to answer this question

10. An indicator HIn has $K_a = 1 \times 10^{-8}$. At pH = 6.0, what is the ratio HIn/In^-?
A) 1/1 B) 100/1 C) 1/100 D) 10/1 E) none of these

11. For a particular process q = -10 kJ and w = 25 kJ. Which of the following statements is true?
A) Heat flows from the surroundings to the system.
B) The system does work on the surroundings.
C) E = -35 k D) All of these are true. E) None of these is true

12. Which of the following is true?
A) As long as the disorder of the surroundings is increasing, a process will be spontaneous.
B) For any process, S_{surr} and S_{sys} have opposite signs.
C) If $S_{surr} = -S_{sys}$, the process is at equilibrium.
D) $H°$ is zero for a chemical reaction at constant temperature.
E) none of these

13. The following two half-reactions take place in a galvanic cell. At standard conditions, what species are produced at each electrode?
$Sn^{2+} + 2e^- \rightarrow Sn \quad E° = -0.14\ V \quad ; \quad Cu^{2+} + 2e^- \rightarrow Cu \quad E° = 0.34\ V$
A) Sn is produced at the anode, and Cu^{2+} is produced at the cathode.
B) Sn is produced at the anode, and Cu is produced at the cathode.
C) Sn is produced at the cathode, and Cu^{2+} is produced at the anode.
D) Cu is produced at the cathode, and Sn^{2+} is produced at the anode.
E) Cu is produced at the anode, and Sn^{2+} is produced at the cathode.

14. For a reaction in a voltaic cell, both $H°$ and $S°$ are positive. Which of the following statements is true?
A) $E°_{cell}$ will increase with an increase in temperature.
B) $E°_{cell}$ will decrease with an increase in temperature.
C) $E°_{cell}$ will not change when the temperature increases.
D) $G° > 0$ for all temperatures. E) None of the above statements is true.

15. Which of the following statements about quantum theory is *incorrect*?
A) The energy and position of an electron cannot be determined simultaneously.
B) Lower energy orbitals are filled with electrons before higher energy orbitals.
C) When filling orbitals of equal energy, two electrons will occupy the same orbital before filling a new orbital.
D) No two electrons can have the same four quantum numbers.
E) All of these are correct.

16. Which of the following statements is *incorrect*?
A) Ionic bonding results from the transfer of electrons from one atom to another.
B) Dipole moments result from the unequal distribution of electrons in a molecule.
C) The electrons in a polar bond are found nearer to the more electronegative element.
D) A molecule with very polar bonds can be nonpolar.
E) Linear molecules cannot have a net dipole moment.

17. Which of the following molecules contains a nitrogen atom that is sp^2 hybridized?
A) NH_3 B) NO_3^- C) N_2 D) HCN E) C_2N_2

18. If the reaction $2HI \rightarrow H_2 + I_2$ is second order, which of the following will yield a linear plot?
A) log [HI] vs. time B) 1/[HI] vs. time C) [HI] vs. time
D) ln [HI] vs. time

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19. Which statement regarding water is true?
A) Energy must be given off in order to break down the crystal lattice of ice to a liquid.
B) Hydrogen bonds are stronger than covalent bonds.
C) Liquid water is less dense than solid water.
D) Only covalent bonds are broken when ice melts.
E) All of these statements are false.

20. A salt solution sits in an open beaker. Assuming constant temperature and pressure, the vapor pressure of the solution
A) increases over time.
B) decreases over time.
C) stays the same over time.
D) We need to know which salt is in the solution to answer this.
E) We need to know the temperature and pressure to answer this.

21. Hydrogen and lithium react very differently, although they are both members of Group 1. What is the primary reason for this difference?
A) Metallic character increases going down a group.
B) Ionization energy increases going down a group.
C) Electron affinity increases going down a group
D) Electronegativity increases going down a group.
E) There is a very large difference between the atomic radii of H and Li.

22. How many unpaired electrons are there in a complex ion having a d^5 electron configuration and an octahedral geometry in the weak-field case?
A) 1 B) 2 C) 3 D) 4 E) 5

23. The most likely decay mode (or modes) of the unstable nuclide $_6C^{11}$ would be
A) positron production .B) α-particle production.
C) electron capture D) β-emission
E) either positron production or electron capture or both.

24. Which of the following names is a correct one?
A) 3,4-dichloropentane
B) 1-chloro-2,4-methyl-3-ethylcyclohexane
C) 1,1-dimethyl-2,2-diethylpentane
D) *cis*-1,3-dimethylbutane
E) 2-bromo-1-chloro-4,4-diethyloctane

25. Which one of the following statements about the structure of proteins is *incorrect*?
A) Disulfide bonds provide strong intrachain interactions.
B) Hydrogen bonding stabilizes the α-helix proteins.
C) Nonpolar groups tend to face the outside of a protein in an aqueous solution.
D) Ionized amino acid side chains can form salt bridges within a protein.
E) Heat can disrupt tertiary structure.

二、非選擇題：(50 分)

1. The molecular weight (MW) of bacteriophage T4 DNA is 1.3×10^8 (double stranded). The average MW of an amino acid residue is 120 and the average MW of a nucleoptide pair is 618.

(a) How many amino acids can be coded for by T4 DNA? (5 分)
(b) How many different proteins of MW 55,000 could be coded for by T4 DNA. (5 分)

(背面仍有題目,請繼續作答)

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2. Does the complex ion $[Co(NH_3)Br(en)_2]$ exhibit geometrical isomerism? Does it exhibit optical isomerism? (en stands for ethylenediamine. (10 分)

3. The reaction

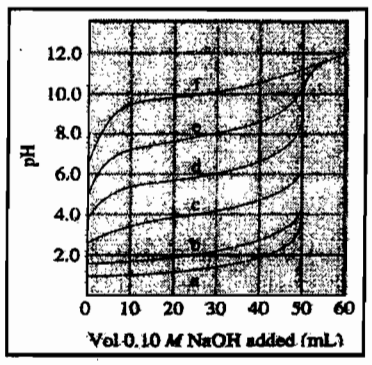
$$2\,N_2O_5\,(g) \rightarrow 4\,NO_2\,(g) + O_2\,(g)$$

was studied at several temperature and the following values of k were ontained:

k^{-1} (s^{-1})	T (°C)
2.0×10^{-5}	20
7.3×10^{-5}	30
2.7×10^{-4}	40
9.1×10^{-4}	50
2.9×10^{-3}	60

Calculate the value of E_a for this reaction. (10 分)

4. Following plot shows the pH curves for the titrations of various acids with 0.10 M NaOH (all the acids were 50.0 mL samples of 0.10 M concentration).



(a). Which pH curve corresponds to the weakest acids? (2 分)
(b). Which pH curve corresponds to the strongest acids? (2 分)
(c). Which point on the pH curve would you examine to see if this acid is a strong acid or weak acid? (3 分)
(d). Which pH curve corresponds to an acid with $K_a = 1 \times 10^{-6}$? (3 分)

5. You are assigned by your professor to prepare a solution buffered at pH4.30 using one of the following acids (and its salt)
1. Chloroacetic acid ($Ka = 1.35 \times 10^{-3}$) 2. Propanic acid ($Ka = 1.3 \times 10^{-5}$)
3. Benzoic acid ($Ka = 6.4 \times 10^{-5}$)

a). Calculate the ratio of $[HA]/[A^-]$ required for each system to yield a pH of 4.3. (6 分)
b). Which system will work best? Why? (4 分)