

- 注意事項： 1. 答案一律寫在答案紙上，否則不予計分。
 2. 請標明題號依序作答，答錯不倒扣。
 3. 試題應隨同試卷繳回，不得攜出試場。

單選題：(每題四分，共一百分)

- Which of the following effects will make PV/nRT less than 1 for real gas?
 (A) A large number of molecules have speeds greater than the average speed.
 (B) The gas molecules are large enough to occupy a substantial amount of space.
 (C) The gas molecules have a very low molar mass.
 (D) The gas molecules attract one another. (E) None of the above
- Calculate the ratio (O_3/O_2) of the frequency of molecular collisions with the walls of the container for the sample of $O_3(g)$ as compared to $O_2(g)$ (A) $(3/2)^{1/2}$ (B) $(8/27)^{1/2}$ (C) $(2/3)^{1/2}$ (D) $2/3$ (E) $4/9$
- For the reaction, $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$, $K_p = 1.16$ atm at $800^\circ C$. If a 20.0 g of $CaCO_3$ is put into a 10.0-liter container and heated to $800^\circ C$, what percent of the $CaCO_3$ will react to reach equilibrium?
 (A) 14.6% (B) 26.8% (C) 34.1% (D) 65.9% (E) 73.2%
- The pH of a solution is raised from 3 to 5. Which of the following statements describing this process is false? (A) The pOH will be lowered from 11 to 9. (B) The $[H^+]$ will be decreased by a factor of 20.
 (C) The final $[OH^-]$ is $10^{-9}M$ (D) The initial $[H^+]$ is $10^{-3}M$
 (E) The initial solution could be 0.001 M HNO_3
- The K_{sp} of $PbSO_4(s)$ is 1.3×10^{-8} . Calculate the solubility of $PbSO_4(s)$ in a 0.0010M solution of Na_2SO_4 .
 (A) $1.3 \times 10^{-11} M$ (B) $4.5 \times 10^{-6} M$ (C) $1.3 \times 10^{-5} M$ (D) $1.3 \times 10^{-8} M$ (E) $1.4 \times 10^{-4} M$
- What is the pH of a 0.2 M solution of NH_4Cl ? (K_b of $NH_3 = 1.8 \times 10^{-5}$)
 (A) 5.0 (B) 4.3 (C) 2.7 (D) 7.2 (E) 9.0
- A solution contains 25 mmoles of H_3PO_4 and 10 mmoles of NaH_2PO_4 . What volume of 2.0 M NaOH must be added to reach the second equivalence point of the titration of the H_3PO_4 with NaOH?
 (A) 5.0 mL (B) 12 mL (C) 25 mL (D) 30 mL (E) 60 mL
- Which of the following compounds has the lowest solubility in mol/L in water?
 (A) $Al(OH)_3$, $K_{sp} = 2.0 \times 10^{-32}$ (B) CdS , $K_{sp} = 1.0 \times 10^{-28}$ (C) $PbSO_4$, $K_{sp} = 1.3 \times 10^{-8}$
 (D) $Sn(OH)_2$, $K_{sp} = 3.0 \times 10^{-27}$ (E) MgC_2O_4 , $K_{sp} = 8.6 \times 10^{-5}$
- Under conditions of constant pressure, the heat flow that occurs during a chemical change is equal to:
 (A) ΔE (B) ΔT (C) Δw (D) ΔV (E) ΔH
- Which of the following properties is/are intensive properties?
 I. Mass; II. Temperature; III. Volume; IV. Concentration; V. Energy
 (A) I, III and V (B) II only (C) II and IV (D) III and IV (E) I and IV
- In which of the following changes is the work done by the system the largest at $25^\circ C$?
 (A) An isothermal free expansion of an ideal gas from 1 to 10 liters.
 (B) An isothermal expansion of an ideal gas from 1 to 10 liters against an opposing pressure of 1 atm.
 (C) An isothermal expansion of an ideal gas from 1 to 10 liters against an opposing pressure of 5 atm.
 (D) An isothermal reversible expansion of an ideal gas from 1 to 10 liters.
 (E) The work is the same for processes (A) to (D)
- A concentration cell is constructed using two Ni electrodes with Ni^{2+} concentrations of 1.0 M and $1.00 \times 10^{-4} M$ in the two half-cells. The reduction potential of Ni^{2+} is $-0.23 V$. Calculate the potential of the cell at $25^\circ C$ (A) $-0.368 V$ (B) $+0.132 V$ (C) $-0.132 V$ (D) $+0.118 V$ (E) $+0.0592 V$

(背面仍有問題，請繼續作答)

13. Which of the following statements are false?
 I. Aluminum is protected from corrosion by the formation of an aluminum oxide coating on the surface
 II. Iron is protected from corrosion by the formation of an iron oxide coating on the surface.
 III. Cathodic protection of iron uses a metal that is more easily reduced than iron.
 IV. Cathodic protection of iron uses a metal that is more easily oxidized than iron.
 (A) I and III (B) I and IV (C) II and III (D) II and IV (E) I, II and III
14. Which statements about hydrogen are true?
 I. H had a lower ionization energy than He. II. H^- is smaller than H.
 III. H bonds with the halogens to form polar covalent compounds
 IV. H does not have a second ionization energy
 (A) I, III, IV (B) I, II, III (C) I, IV (D) II, IV (E) II, III
15. Consider the following orderings
 I. $Al < Si < P < Cl$ II. $Be < Mg < Ca < Sr$ III. $I < Br < Cl < F$ IV. $Na^+ < Mg^{2+} < Al^{3+} < Si^{4+}$.
 Which of these give a correct trend in ionization energy?
 (A) I, IV (B) III, IV (C) I, III, IV (D) II, IV (E) I, II, III
16. The bond order in the NO molecule is
 (A) 1 (B) 1.5 (C) 2 (D) 2.5 (E) 3
17. The rate expression for a particular reaction is $rate = k[A][B]^2$. If the initial concentration of B is increased from 0.1 M to 0.3 M, the initial rate will increase by which of the following factors?
 (A) 12 (B) 9 (C) 6 (D) 3 (E) 2
18. When one mole of benzene is vaporized at a constant pressure of 1.00 atm and its boiling point of 353 K, 30.79 kJ of energy (heat) is absorbed and the volume change is +28.90 L. What is ΔH for this process?
 (1 L-atm = 101.3 J) (A) 24.95 kJ (B) 27.87 kJ (C) 28.72 kJ (D) 30.79 kJ (E) 36.63 kJ
19. The triple point of iodine is at 90 torr and 115°C. This means that liquid I_2
 (A) cannot have a vapor pressure less than 90 torr (B) cannot exist at a pressure of 10 torr
 (C) is more dense than $I_2(s)$ (D) cannot exist above 115°C (E) cannot exist at 1 atm
20. At a given temperature the vapor pressures of pure liquid benzene and toluene are 745 torr and 290 torr, respectively. A solution prepared by mixing benzene and toluene obeys Raoult's law. At this temperature the vapor pressure of benzene over a solution in which the mole fraction of benzene is equal to 0.340 is (A) 99 torr (B) 253 torr (C) 352 torr (D) 417 torr (E) 491 torr
21. The solid substance with the empirical formula SiO_2 is commonly called
 (A) silica (B) silicate (C) silicon (D) silane (E) silicic acid
22. Which of the following statements concerning the complex ion $Co(en)_2Cl_2^+$ is true? (en = ethylenediamine)
 (A) The complex ion contains Co(I)
 (B) The complex ion exhibits cis and trans geometric isomers, but no optical isomer
 (C) The complex ion exhibits two geometric isomers (cis and trans) and two optical isomers
 (D) Since en is a strong field ligand, the complex ion is paramagnetic
 (E) The geometric isomers of the complex ion have identical chemical properties
23. What is the most likely mode of decay for ^{18}Ne ?
 (A) α production (B) β production (C) fission (D) positron production (E) neutron production
24. The number of a certain radioactive nuclide present in a sample decays from 1.00×10^3 to 2.50×10^2 in 10 minutes. What is the half-life of the radioactive species?
 (A) 10 min (B) 5 min (C) 20 min (D) 2.5 min (E) 7.5 min
25. A polypeptide is (A) an addition polymer of nucleic acids (B) a condensation polymer of nucleic acids
 (C) an addition polymer of amino acids (D) a condensation polymer of amino acids
 (E) a polymer of sugar molecules