

1. 本科試題共五頁，如有缺頁應立即舉手，請監試人員補發。
2. 答案應寫在試卷內，寫在試題紙上無效。
3. 不必抄題，但須寫明題號，並依次序整齊作答，每行限答五題。
例： 1. A 2. B 3. C 4. D 5. E
6. A 7. B 8. C 9. D 10. E
4. 本試題共四十題，答錯不倒扣，每答對一題計 2.5 分，最後成績採四捨五入僅取整數。
5. 本試題必須隨同試卷一併繳交。

1. All of the following are true except:
(A) Ions are formed by adding electrons to a neutral atom.
(B) Ions are formed by changing the number of protons in an atom's nucleus.
(C) Ions are formed by removing electrons from a neutral atom.
(D) An ion has a positive or negative charge.
(E) Metals tend to form positive ions.
2. Worldwide, what chemical is produced more than any other?
(A) hydrochloric acid (B) sulfuric acid (C) ammonium nitrate
(D) phosphoric acid (E) sodium hydroxide
3. You have exposed electrodes of a light bulb in a solution of H_2SO_4 such that the light bulb is on. You add a dilute salt solution and the bulb grows dim. Which of the following could be the salt in the solution?
(A) $Ba(NO_3)_2$ (B) $NaNO_3$ (C) K_2SO_4 (D) $Ca(NO_3)_2$ (E) $NaCl$
4. A 0.307 g sample of an unknown triprotic acid is titrated to the third equivalence point using 35.2 mL of 0.106 M NaOH. Calculate the molar mass of the acid.
(A) 247 g/mol (B) 171 g/mol (C) 165 g/mol
(D) 151 g/mol (E) 82.7 g/mol
5. What would happen to the average kinetic energy of the molecules of a gas sample if the temperature of the sample increased from 20°C to 40°C?
(A) It would double. (B) It would increase (C) It would decrease.
(D) It would become half its value. (E) Two of these.
6. Which of the following statements is incorrect?
(A) The two main sources of air pollution are transportation and the production of electricity
(B) The net product of photochemical smog is NO_2 , a major pollutant.
(C) Ozone is a pollutant at ground level, but desirable in the upper atmosphere.
(D) Coal burning power plants contribute to acid rain.
(E) The composition of the earth's atmosphere is not constant.

(背面仍有題目,請繼續作答)

7. Consider the following numbered processes : (1). $A \rightarrow 2B$ (2). $B \rightarrow C + D$
 (3). $E \rightarrow 2D$; ΔH for the process $A \rightarrow 2C + E$ is
 (A) $\Delta H_1 + \Delta H_2 + \Delta H_3$ (B) $\Delta H_1 + \Delta H_2$ (C) $\Delta H_1 + \Delta H_2 - \Delta H_3$
 (D) $\Delta H_1 + 2\Delta H_2 - \Delta H_3$ (E) $\Delta H_1 + 2\Delta H_2 + \Delta H_3$
8. For the reaction $AgI_{(s)} + (1/2)Br_{2(g)} \rightarrow AgBr_{(s)} + (1/2)I_{2(s)}$, $\Delta H^\circ = -54.0 \text{ kJ}$ ΔH_f° for $AgBr_{(s)} = -100.4 \text{ kJ/mol}$;
 ΔH_f° for $Br_{2(g)} = +30.9 \text{ kJ/mol}$
 The value of ΔH_f° for $AgI_{(s)}$ is:
 (A) -123.5 kJ/mol (B) $+77.3 \text{ kJ/mol}$ (C) $+61.8 \text{ kJ/mol}$
 (D) -77.3 kJ/mol (E) -61.8 kJ/mol
9. Of the following elements, which needs three electrons to complete its valence shell?
 (A) Ba (B) Ca (C) Si (D) P (E) Cl
10. Which of the following atoms has three electrons in p orbitals in its valence shell?
 (A) Ba (B) Ga (C) V (D) Bi (E) Cu
11. Which of the following pairs is isoelectronic?
 (A) Li^+ and K^+ (B) Na^+ and Ne (C) I^- and Cl^-
 (D) S^{2-} and Ne (E) Al^{3+} and B^{3+}
12. In which of the following compounds does the bond between the central atom and fluorine have the greatest ionic character?
 (A) OF_2 (B) SF_2 (C) SeF_2 (D) AsF_3 (E) SbF_3
13. The fact that O_2 is paramagnetic can be explained by
 (A) the Lewis structure of O_2 (B) resonance (C) a violation of the octet rule
 (D) the molecular orbital diagram for O_2 (E) hybridization of atomic orbitals in O_2
14. Which of the following has the largest bond energy?
 (A) O_2 (B) O_2^- (C) O_2^{2-} (D) O_2^+ (E) O_2^{2+}
15. Which of the following statements is (are) false?
 I. The hexagonal closest-packed structure is ABAB - - - .
 II. A body-centered cubic unit cell has four atoms per unit cell.
 III. For unit cells having the same edge length, a simple cubic structure would have a smaller density than a body-centered cube.
 IV. Atoms in a solid consisting of only one element would have six nearest neighbors if the crystal structure was a simple cubic array.
 (A) I (B) II (C) II, III (D) I, IV (E) II, III, IV

16. When a nonpolar liquid displays a convex meniscus, which of the following explains this behavior?
- (A) It has a low surface tension, and therefore clings to the glass.
 - (B) The cohesive forces are stronger than the adhesive forces toward the glass.
 - (C) The adhesive forces toward the glass are stronger than the cohesive forces.
 - (D) The liquid's viscosity is low.
 - (E) The density is higher than water
17. Which statement about hydrogen bonding is true?
- (A) Hydrogen bonding is the intermolecular attractive forces between two hydrogen atoms in solution.
 - (B) The hydrogen bonding capabilities of water molecules cause $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$ to be more soluble in water than CH_3OH .
 - (C) Hydrogen bonding of solvent molecules with a solute will not affect the solubility of the solute.
 - (D) Hydrogen bonding interactions between molecules are stronger than the covalent bonds within the molecule.
 - (E) Hydrogen bonding arises from the dipole moment created by the unequal sharing of electrons within certain covalent bonds within a molecule.
18. When a substance dissolves in water, heat energy is released if:
- (A) the lattice energy is positive.
 - (B) the hydration energy is positive.
 - (C) the hydration energy is greater than the lattice energy.
 - (D) the hydration energy is less than the lattice energy.
 - (E) the hydration energy is negative
19. The reaction $\text{A} \rightarrow \text{B} + \text{C}$ is second order in A. When $[\text{A}]_0 = 0.100 \text{ M}$, the reaction is 20.0% complete in 40.0 min. Calculate the value of the rate constant (in $\text{L}/\text{min}\cdot\text{mol}$).
- (A) 6.25×10^{-2} (B) 2.5×10^{-2} (C) 5.0×10^{-3} (D) 2.0×10^{-3} (E) 1.60×10^1
20. At a particular temperature, N_2O_5 decomposes according to a first-order rate law with a half-life of 3.0 s. If the initial concentration of N_2O_5 is 1.0×10^{16} molecules/ cm^3 , what will be the concentration in molecules/ cm^3 after 10.0 s?
- (A) 9.9×10^{14} (B) 1.8×10^{12} (C) 7.3×10^9 (D) 6.3×10^3 (E) 9.4×10^2
21. If, at a given temperature, the equilibrium constant for the reaction $\text{H}_{2(g)} + \text{Cl}_{2(g)} \rightleftharpoons 2 \text{HCl}_{(g)}$ is K_p , then the equilibrium constant for the reaction $\text{HCl}_{(g)} \rightleftharpoons (1/2)\text{H}_{2(g)} + (1/2)\text{Cl}_{2(g)}$ can be represented as:
- (A) K_p^{-2} (B) K_p^2 (C) $K_p^{-1/2}$ (D) $K_p^{1/2}$ (E) K_p

(背面仍有題目,請繼續作答)

22. The equilibrium system $2A \rightleftharpoons 2B + C$ has a very small equilibrium constant:
 $K = 2.6 \times 10^{-6}$ mol/L. Initially 3 moles of A are placed in a 1.5-L flask. Determine the concentration of C at equilibrium.
 (A) 0.011 M (B) 0.022 M (C) 0.033 M (D) 0.044 M (E) 2.0 M
23. Given the following acids and (K_a) values:
 HClO_4 (1×10^7); HOAc (1.76×10^{-5}); HCN (4.93×10^{-10}); HF (3.53×10^{-4})
 which shows the conjugate bases listed by increasing strength?
 (A) CN^- , F^- , OAc^- , ClO_4^- (B) CN^- , OAc^- , F^- , ClO_4^- (C) CN^- , ClO_4^- , F^- , OAc^-
 (D) ClO_4^- , OAc^- , CN^- , F^- (E) ClO_4^- , F^- , OAc^- , CN^-
24. Calculate the pH of a 2 M nitric acid (HNO_3) solution.
 (A) -0.70 (B) -0.3 (C) 0.3 (D) 1.0 (E) 2.0
25. Consider the titration of equal volumes of 0.1 M HCl and 0.1 M CH_3COOH with 0.1 M NaOH. Which of the following would be the same for both titrations?
 (A) the pH at the equivalence point (B) the pH at the halfway point
 (C) the initial pH (D) the volume of NaOH added to reach the equivalence point
 (E) none of these
26. A 100 mL sample of 0.10 M HCl is mixed with 50 mL of 0.10 M NH_3 . What is the resulting pH? (K_b for $\text{NH}_3 = 1.8 \times 10^{-5}$)
 (A) 12.52 (B) 7.85 (C) 3.87 (D) 1.48 (E) 1.30
27. If the change in entropy of the surroundings for a process at 451 K and constant pressure is -326 J/K, what is the heat flow absorbed by for the system?
 (A) 326 kJ (B) 24.2 kJ (C) -147 kJ (D) 12.1 kJ (E) 147 kJ
28. For the reaction $A + B \rightarrow C + D$, $\Delta H^\circ = +40$ kJ and $\Delta S^\circ = +50$ J/K. Therefore, the reaction under standard conditions is
 (A) spontaneous at temperatures less than 10 K.
 (B) spontaneous at temperatures greater than 800 K.
 (C) spontaneous only at temperatures between 10 K and 800 K.
 (D) spontaneous at all temperatures.
 (E) nonspontaneous at all temperatures.
29. Which energy conversion shown below takes place in a galvanic cell?
 (A) electrical to chemical (B) chemical to electrical
 (C) mechanical to chemical (D) chemical to mechanical
 (E) mechanical to electrical

30. Which of the following species cannot function as an oxidizing agent?
 (A) $S_{(s)}$ (B) $NO_3^-_{(aq)}$ (C) $Cr_2O_7^{2-}_{(aq)}$ (D) $I^-_{(aq)}$ (E) $NO_{(g)}$
31. How many unpaired electrons are present in the tetrahedral complex $[CoCl_4]^{2-}$?
 (A) 1 (B) 2 (C) 3 (D) 4 (E) 5
32. Choose the element that is the strongest reducing agent in aqueous solution.
 (A) Li (B) Na (C) K (D) Rb (E) Cs
33. How many possible oxidation states does nitrogen have?
 (A) 1 (B) 3 (C) 5 (D) 7 (E) 9
34. What nitrogen-containing compound has a role in controlling the earth's temperature?
 (A) N_2O (B) nitric oxide (C) nitrogen oxide (D) ammonia (E) N_2O_4
35. Which of the following transition metal complexes can exhibit the phenomenon of optical isomerism?
 (A) $[Co(NH_3)_4Cl_2]$ (B) $[CoCl_6]^{4-}$ (C) $[Fe(H_2O)_6]^{3+}$
 (D) $[Ni(SCN)_3Br_3]^{4-}$ (E) $[Mn(oxalate)_2Br_2]^{4-}$
36. According to crystal field theory, how many unpaired electrons are present in the complex ion $[Fe(H_2O)_6]^{3+}$. The water molecules are weak field ligands.
 (A) 1 (B) 2 (C) 3 (D) 4 (E) 5
37. The nuclide ^{12}N is unstable. What type of radioactive decay would be expected?
 (A) β^- (B) β^+ (C) σ (D) α (E) neutron
38. The number of half-lives needed for a radioactive element to decay to one-eighth of its original activity is (choose nearest number):
 (A) 2 (B) 3 (C) 5 (D) 10 (E) 100
39. Which of the following names is a correct one?
 (A) 3,4-dichloropentane (B) 1-chloro-2,4-methyl-3-ethylcyclohexane
 (C) cis-1,3-dimethylpropane (D) 1,1-dimethyl-2,2-diethylbutane
 (E) 2-bromo-1-chloro-4,4-diethyloctane
40. An example of a secondary structure of a protein is
 (A) an alpha amino acid. (B) a peptide linkage. (C) a pleated sheet.
 (D) serine. (E) none of these