

國立嘉義大學 101 學年度基礎學科學力競賽試題卷

科目：化學

題型：選擇題

配分：100%

- The density of lead is 11.35 g/mL. The experimental values obtained for the density of lead are 10.9, 11.5, and 11.8 g/mL. Which one of the best describes this collection of data?
(A) accurate (B) precise (C) both A and B (D) not enough information
- Which of the following numbers has the fewest number of significant figures?
1235 0.30001 12000 0.00800
(A) 1235 (B) 0.30001 (C) 12000 (D) 0.00800
- Consider the numbers 23.68 and 4.12. The sum of these numbers has ____ significant figures, and the product of these numbers has ____ significant figures.
(A) 3, 3 (B) 4, 4 (C) 3, 4 (D) 4, 3
- The melting point for aspirin is 275°F. What is its melting point in °C?
(A) 135°C (B) 333°C (C) 257°C (D) 121°C
- Which of the following is the greatest mass?
(A) 2.0×10^2 mg (B) 10.0 dg (C) 1.0×10^5 μg (D) 2.0×10^2 cg
- Which one of the following statements about atomic structure is false?
(A) An atom is mostly empty space.
(B) Almost all of the mass of the atom is concentrated in the nucleus.
(C) The protons and neutrons in the nucleus are very tightly packed.
(D) The number of protons and neutrons is always the same in neutral atom.
- $^{40}_{20}\text{Ca}^{2+}$ has
(A) 20 protons, 20 neutrons, and 18 electrons
(B) 20 protons, 20 neutrons, and 20 electrons
(C) 20 protons, 22 neutrons, and 18 electrons
(D) 22 protons, 18 neutrons, and 18 electrons
- Which of the following pairs is incorrect?
(A) NH_4Br , ammonium bromide (B) K_2CO_3 , potassium carbonate (C) BaPO_4 , barium phosphate,
(D) CuCl , copper (I) chloride
- Which of the following compounds has the same percent composition by mass as styrene, C_8H_8 ?
(A) acetylene, C_2H_2 (B) benzene, C_6H_6 (C) cyclobutadiene, C_4H_4 (D) all of these
- What is the coefficient for water when the following equation is balanced?
 $\text{As}(\text{OH})_3(s) + \text{H}_2\text{SO}_4(aq) \rightarrow \text{As}_2(\text{SO}_4)_3(aq) + \text{H}_2\text{O}(l)$
(A) 12 (B) 6 (C) 4 (D) 2
- Consider the following reaction: $2\text{A} + \text{B} \rightarrow 3\text{C} + \text{D}$
3.0 mol A and 2.0 mol B react to form 4.0 mol C. What is the percent yield of this reaction?
(A) 67% (B) 75% (C) 89% (D) 100%
- How many of the following salts are expected to be insoluble in water?
Sodium sulfide barium nitrate ammonium sulfate potassium phosphate
(A) none (B) 1 (C) 2 (D) 3
- In accordance with the solubility rules, which of the following will occur when solutions containing about 0.1 g of $\text{Pb}(\text{NO}_3)_2(aq)$ and $\text{KI}(aq)$ /100 mL are mixed?
(A) KNO_3 will precipitate; Pb^{2+} and I^- will be spectator ions. (B) No precipitate will form
(C) $\text{Pb}(\text{NO}_3)_2$ will precipitate; K^+ and I^- will be spectator ions. (D) PbI_2 will precipitate; K^+ and NO_3^- will be spectator ions.
- All of the following are weak acids except
(A) HCNO (B) HBr (C) HF (D) HNO_2
- As the volume of a gas decreases, the pressure increases due to
(A) an increase in temperature of the gas molecules.
(B) a decrease in the density of the gas system.
(C) an increase in the number of collisions occurring per unit time.
(D) a decrease in the kinetic energy of the gas molecules.
- Two metals of equal mass with different heat capacities are subjected to the same amount of heat. Which undergoes the smallest change in temperature?
(A) The metal with the higher heat capacity.
(B) The metal with the lower heat capacity.
(C) Both undergo the same change in temperature.
(D) You need to know the initial temperatures of the metals.
- Of energy, work, enthalpy, and heat, how many are state functions?
(A) 1 (B) 2 (C) 3 (D) 4
- When an hydrogen electron makes transition from $n = 3$ to $n = 1$, which of the following statement is true?
I. Energy is emitted.
II. Energy is absorbed.
III. The electron loses energy.
IV. The electron gains energy.
V. The electron cannot make this transition.
(A) II, III (B) V (C) I, III (D) II, III
- How many electrons in an atom can have the quantum numbers $n = 4, l = 2$? 《背面尚有試題》
(A) 14 (B) 12 (C) 5 (D) 10

20. Order the elements, S, Cl, and F in the terms of increasing ionization energy.
 (A) S, Cl, F (B) Cl, F, S (C) F, S, Cl (D) F, Cl, S
21. 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.
22. In the gaseous phase, which of the following diatomic molecules would be the most polar?
 (A) LiF (B) CsF (C) NaCl (D) GsCl
23. Which of the following has the smallest radius?
 (A) F⁻ (B) Ne (C) O²⁻ (D) Mg²⁺
24. Which of the following ionic compounds has the largest lattice energy?
 (A) BaO (B) BeO (C) CsI (D) NaBr

Draw the Lewis structures of the molecules below and use them to answer the questions from 25 to 27.

- I. BH₃ II. NO₂ III. SF₆ IV. O₃ V. PCl₅

25. Which of the molecules obeys the octet rule?
 (A) IV (B) III (C) II (D) I
26. How many of the molecules have no dipole moment?
 (A) 1 (B) 2 (C) 3 (D) 4
27. Which of these molecules show resonance?
 (A) I, II (B) II, IV (C) II, V (D) III, IV
28. The molecular structure of OF₂ is
 (A) pyramidal (B) bent (C) Octahedral (D) trigonal planar
29. The bond angles about the carbon atom in the formaldehyde molecule, H₂C=O, are about:
 (A) 120° (B) 60° (C) 109° (D) 90°
30. The hybridization of the central atom in NO₃⁻ is
 (A) p³ (B) sp² (C) sp³ (D) sp
31. As the bond order of a bond increases, the bond energy _____ and the bond length _____.
 (A) increases, increases (B) decreases, decreases (C) increases, decreases (D) decreases, increases
32. Which of the following is the correct order of boiling points for KNO₃, CH₃OH, C₂H₆, Ne?
 (A) Ne < CH₃OH < C₂H₆ < KNO₃ (B) KNO₃ < CH₃OH < C₂H₆ < Ne (C) Ne < C₂H₆ < KNO₃ < CH₃OH (D) Ne < C₂H₆ < CH₃OH < KNO₃
33. Generally the vapor pressure of a liquid is related to:
 I. the amount of liquid II. atmospheric pressure

- III. temperature IV. intermolecular forces
 (A) I, III (B) II, III, IV (C) I, III, IV (D) III, IV

34. A solution of hydrogen peroxide is 23.3% H₂O₂ by mass and has a density of 1.11 g/cm³. The molarity of the solution is :
 (A) 7.14 M (B) 0.259 M (C) 7.60 M (D) 7.93 M
35. Rank the following compounds according to increasing solubility in water.
 I. CH₃-CH₂-CH₂-CH₃
 II. CH₃-CH₂-O-CH₂-CH₃
 III. CH₃-CH₂-OH
 IV. CH₃-OH
 (A) I<III<IV<II (B) I<II<IV<III (C) I<II<III<IV (D) III<IV<II<I
36. Which of the following solutions would have the highest osmotic pressure?
 (A) 0.2 M NaBr, sodium bromide (B) 0.2 M CaCl₂, calcium chloride (C) 0.3 M CH₃COOH, acetic acid (D) 0.3 M C₆H₁₂O₆, glucose
37. Given the following acids and K_a values:

HClO ₄	HOAc	HCN	HF
1 × 10 ⁷	1.76 × 10 ⁻⁵	4.93 × 10 ⁻¹⁰	3.53 × 10 ⁻⁴

 What is the order of increasing base strength?
 (A) CN⁻, F⁻, OAc⁻, ClO₄⁻ (B) CN⁻, OAc⁻, F⁻, ClO₄⁻ (C) ClO₄⁻, OAc⁻, CN⁻, F⁻ (D) ClO₄⁻, F⁻, OAc⁻, CN⁻
38. In deciding which of two acids is the stronger, one must know:
 (A) the concentration of each acid solution (B) the pH of each acid solution (C) the equilibrium constant of each acid (D) all of the above
39. The dihydrogenphosphate ion, H₂PO₄⁻, has both a conjugate acid and a conjugate base. These are, respectively:
 (A) H₃PO₄, PO₄³⁻ (B) H₃PO₄, HPO₄²⁻ (C) H₂PO₄⁻, HPO₄²⁻ (D) HPO₄²⁻, PO₄³⁻
40. A buffer solution is prepared by dissolving 0.3 mol of NaC₂H₃O₂ and 0.6 mol of HC₂H₃O₂ in water. Which substance will show a decrease in concentration when a strong base is added?
 (A) Na⁺ (B) C₂H₃O₂⁻ (C) HC₂H₃O₂ (D) H₃O⁺
41. Consider a solution consisting of the following two buffer systems:

$$\text{H}_2\text{CO}_3 \rightleftharpoons \text{HCO}_3^- + \text{H}^+ \quad \text{p}K_a = 6.4$$

$$\text{H}_2\text{PO}_4^- \rightleftharpoons \text{HPO}_4^{2-} + \text{H}^+ \quad \text{p}K_a = 7.2$$
 At pH 6.4, which one of the following is true of the relative amounts of acid and conjugate base present?
 (A) [H₂CO₃] > [HCO₃⁻] and [H₂PO₄⁻] > [HPO₄²⁻]
 (B) [H₂CO₃] = [HCO₃⁻] and [H₂PO₄⁻] > [HPO₄²⁻]

- (C) $[\text{H}_2\text{CO}_3] = [\text{HCO}_3^-]$ and $[\text{HPO}_4^{2-}] > [\text{H}_2\text{PO}_4^-]$
 (D) $[\text{HCO}_3^-] > [\text{H}_2\text{CO}_3]$ and $[\text{HPO}_4^{2-}] > [\text{H}_2\text{PO}_4^-]$
42. In the reaction $\text{P}_4(\text{s}) + 10\text{Cl}_2(\text{g}) \rightarrow 4\text{PCl}_5(\text{s})$, the reducing agent is
 (A) Chlorine (B) PCl_5 (C) phosphorus (D) Cl^-
43. The oxidation state of iodine in IO_3^- is
 (A) +3 (B) -3 (C) +5 (D) -5
44. The following reactions are examples of
 $\text{Pb}^{2+} + 2\text{I}^- \rightarrow \text{PbI}_2$
 $2\text{Ce}^{4+} + 2\text{I}^- \rightarrow \text{I}_2 + 2\text{Ce}^{3+}$
 $\text{HOAc} + \text{NH}_3 \rightarrow \text{NH}_4^+ + \text{OAc}^-$
 (A) acid-base reactions (B) precipitation, acid-base, and redox reactions, respectively (C) redox, acid-base, and precipitation reactions, respectively (D) precipitation, redox, and acid-base reactions, respectively
45. How much heat is required to raise the temperature of a 4.48-g sample of iron (specific heat = 0.450 J/g°C) from 25.0°C to 79.8°C?
 (A) 1.98 J (B) 246 J (C) 110 J (D) 546 J
46. Consider the following rate law: $\text{Rate} = k[\text{A}]^n[\text{B}]^m$, How are the exponents n and m determined?
 (A) by using the balanced chemical equation (B) by using the subscripts for the chemical formulas (C) by using the coefficients of the chemical formulas (D) by experiment
47. The freezing point of helium is -270°C . The freezing point of xenon is -112°C . Both of these are in the noble gas family. Which of the following statements is supported by these data?
 (A) Helium and xenon form highly polar molecules. (B) As the molecular weight of the noble gas increases, the freezing point decreases. (C) The London dispersion forces between the helium molecules are less than the London dispersion forces between the xenon molecules. (D) None of these.
48. Which of the following compounds has the lowest viscosity?
 (A) $\text{CCl}_4(\text{l})$ (B) $\text{N}_2(\text{g})$ (C) $\text{H}_2\text{O}(\text{l})$ (D) $\text{CH}_3-(\text{CH}_2)_{25}-\text{CH}_3(\text{l})$
49. Which of the following best describes an orbital?
 (A) space which may contain electrons, protons, and/or neutrons (B) the space in an atom where an electron is most likely to be found (C) small, walled spheres that contain electrons (D) a single space within an atom that contains all electrons of that atom
50. The most likely reason for colloidal dispersion is _____.
 (A) the Tyndall effect (B) coagulation (C) emulsion formation (D) electrostatic repulsion
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