


# 國立嘉義大學 106 學年度轉學生招生考試試題

科目：普通化學 (每題 2.5 分，共 100 分)

(請將答案寫在答案卷上，不可使用計算機)

- Which of the following is *not* a unit in the SI system?  
(A) Ampere (B) Candela (C) Kelvin (D) Meter (E) Calorie
- The density of gasoline is 0.7025 g/mL at 20°C. When gasoline is added to water:  
(A) It will float on top. (B) It will sink to the bottom. (C) It will mix so, you can't see it.  
(D) The mixture will improve the running of the motor. (E) None of these things will happen.
- When 87.7 is added to 73.841, the result should be reported with \_\_\_\_\_ significant figures. And when 87.7 is divided by 73.841 the result should be reported with \_\_\_\_\_ significant figures.  
(A) 3,3 (B) 4,3 (C) 3,5 (D) 4,4 (E) 6,5
- Which of the following salts is insoluble in water?  
(A) Na<sub>2</sub>S (B) K<sub>2</sub>CO<sub>3</sub> (C) Pb(NO<sub>3</sub>)<sub>2</sub> (D) CaCl<sub>2</sub> (E) All of these are soluble in water.
- You have separate solutions of HCl and H<sub>2</sub>SO<sub>4</sub> with the same concentrations in terms of molarity. You wish to neutralize a solution of NaOH. Which acid solution would require more volume (in mL) to neutralize the base?  
(A) The HCl solution. (B) The H<sub>2</sub>SO<sub>4</sub> solution.  
(C) You need to know the acid concentrations to answer this question.  
(D) You need to know the volume and concentration of the NaOH solution to answer this question.  
(E) C and D
- In which of the following does iodine have the lowest oxidation state?  
(A) LiIO<sub>3</sub> (B) IO<sub>2</sub> (C) I<sub>2</sub>O (D) NH<sub>4</sub>I (E) I<sub>2</sub>
- Which of the following statements is correct?  
(A) The internal energy of a system increases when more work is done by the system than heat was flowing into the system.  
(B) The internal energy of a system decreases when work is done on the system and heat is flowing into the system.  
(C) The system does work on the surroundings when an ideal gas expands against a constant external pressure.  
(D) All statements are true.  
(E) All statements are false.
- In the lab, you mix two solutions (each originally at the same temperature) and the temperature of the resulting solution decreases. Which of the following is true?  
(A) The chemical reaction is releasing energy. (B) The energy released is equal to  $s \times m \times \Delta T$ .  
(C) The chemical reaction is absorbing energy. (D) The chemical reaction is exothermic.  
(E) More than one of these.
- Which of these is an isoelectronic series?  
(A) Na<sup>+</sup>, K<sup>+</sup>, Rb<sup>+</sup>, Cs<sup>+</sup> (B) K<sup>+</sup>, Ca<sup>2+</sup>, Ar, S<sup>2-</sup> (C) Na<sup>+</sup>, Mg<sup>2+</sup>, S<sup>2-</sup>, Cl<sup>-</sup>  
(D) Li, Be, B, C (E) none of these (A-D)
- Which of the following best describes an orbital?  
(A) Space where electrons are unlikely to be found in an atom.  
(B) Space which may contain electrons, protons, and/or neutrons.  
(C) The space in an atom where an electron is most likely to be found.  
(D) Small, walled spheres that contain electrons.  
(E) A single space within an atom that contains all electrons of that atom.
- Consider the ionization energy (IE) of the magnesium atom. Which of the following is *not* true?  
(A) The IE of Mg is lower than that of sodium. (B) The IE of Mg is lower than that of neon.  
(C) The IE of Mg is lower than that of beryllium. (D) The IE of Mg is higher than that of calcium  
(E) The IE of Mg is lower than that of Mg<sup>+</sup>.
- In which pair do both compounds exhibit predominantly ionic bonding?  
(A) SCl<sub>6</sub> and HF (B) Na<sub>2</sub>SO<sub>3</sub> and NH<sub>3</sub> (C) KI and O<sub>3</sub>  
(D) LiF and H<sub>2</sub>O (E) LiBr and MgO
- Which of the following statements concerning lattice energy is *false*?  
(A) It is often defined as the energy released when an ionic solid forms from its ions.  
(B) MgO has a larger lattice energy than NaF.  
(C) The lattice energy for a solid with 2+ and 2- ions should be two times that for a solid with 1+ and 1- ions.  
(D) MgO has a larger lattice energy than LiF.  
(E) All of these are true.
- What type of structure does the XeOF<sub>2</sub> molecule have?  
(A) pyramidal (B) tetrahedral (C) T-shaped (D) trigonal planar (E) octahedral
- Which of the following molecules (or ions) has a dipole moment?  
(A) CO<sub>2</sub> (B) CO<sub>3</sub><sup>2-</sup> (C) NH<sub>4</sub><sup>+</sup> (D) PF<sub>3</sub> (E) two of them
- The hybridization of the carbon atom in the cation CH<sub>3</sub><sup>+</sup> is:  
(A) sp<sup>2</sup> (B) sp<sup>3</sup> (C) dsp (D) sp (E) none of these
- For solid ammonium perchlorate (NH<sub>4</sub>ClO<sub>4</sub>), NH<sub>4</sub><sup>+</sup>, K<sub>a</sub> = 5.6 × 10<sup>-10</sup>; for ClO<sub>4</sub><sup>-</sup>, K<sub>b</sub> ≈ 10<sup>-21</sup>. How would you predict the property of its aqueous solution?  
(A) acidic (B) basic (C) neutral (D) cannot tell (E) none of these (A-D)
- You have equal masses of different solutes dissolved in equal volumes of solution. Which of the solutes would make the solution having the highest molar concentration?  
(A) NaOH (B) KCl (C) KOH (D) LiOH (E) all the same
- When a hydrogen electron goes from  $n = 2$  to  $n = 1$ , the energy of the light emitted is equal to what fraction of its ground-state ionization energy?  
(A) 3/4 (B) 1/2 (C) 1/4 (D) 1/8 (E) 1/9
- Consider the following representation of a 2p-orbital:   
Which of the following statements best describes the movement of electrons in a p-orbital?  
(A) The electrons move along the outer surface of the p-orbital, similar to a figure "8" type of movement.  
(B) The electrons move within the two lobes of the p-orbital, but never beyond the outside surface of the orbital.  
(C) The electrons are concentrated at the center (node) of the two lobes.  
(D) The electrons are only moving in one lobe at any given time.  
(E) The electron movement cannot be exactly determined.
- The hybridization of the central atom in XeF<sub>5</sub><sup>+</sup> is:  
(A) sp (B) sp<sup>2</sup> (C) sp<sup>3</sup> (D) dsp<sup>3</sup> (E) d<sup>2</sup>sp<sup>3</sup>
- If four orbitals on one atom overlap four orbitals on a second atom, how many molecular orbitals will form?  
(A) 1 (B) 4 (C) 8 (D) 16 (E) none of these

23. When comparing  $\text{Be}_2$  and  $\text{H}_2$ :
- $\text{Be}_2$  is more stable because it contains both bonding and antibonding valence electrons.
  - $\text{H}_2$  has a higher bond order than  $\text{Be}_2$ .
  - $\text{H}_2$  is more stable because it only contains  $\sigma_{1s}$  electrons.
  - $\text{H}_2$  is more stable because it is diamagnetic, whereas  $\text{Be}_2$  is paramagnetic.
- (A) I, II (B) III only (C) II, III (D) II, III, IV (E) III, IV

24. For the following molecules, how many of them would decrease the bond order if you add one electron to the neutral molecule?  $\text{B}_2$ ,  $\text{C}_2$ ,  $\text{P}_2$ ,  $\text{F}_2$

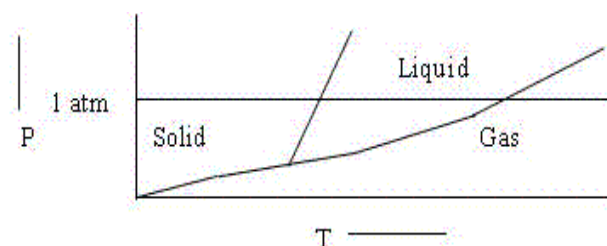
(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

25. A species has the following MO configuration:  $(\sigma_{1s})^2(\sigma_{1s}^*)^2(\sigma_{2s})^2(\sigma_{2s}^*)^2(\sigma_{2p})^2(\pi_{2p})^2$

This substance is

- (A) paramagnetic with one unpaired electron (B) paramagnetic with two unpaired electrons  
 (C) paramagnetic with three unpaired electrons (D) paramagnetic with four unpaired electrons  
 (E) diamagnetic

26. Choose the correct statement about the diagram below.



- (A) The diagram is qualitatively correct for water.  
 (B) The diagram shows that the melting point of the solid increases with increasing pressure.  
 (C) The diagram shows the triple point above 1 atm pressure.  
 (D) The diagram could represent the phase diagram of  $\text{CO}_2$ .  
 (E) None of the above statements is correct.

27. For each of the following pairs of substances, select the one expected to have the lower melting point:

I.  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{S}$  II.  $\text{HCl}$ ,  $\text{NaCl}$  III.  $\text{CH}_4$ ,  $\text{C}_3\text{H}_8$

- (A)  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{C}_3\text{H}_8$  (B)  $\text{H}_2\text{O}$ ,  $\text{NaCl}$ ,  $\text{C}_3\text{H}_8$  (C)  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{CH}_4$   
 (D)  $\text{H}_2\text{S}$ ,  $\text{HCl}$ ,  $\text{CH}_4$  (E)  $\text{H}_2\text{S}$ ,  $\text{NaCl}$ ,  $\text{CH}_4$

28. Which of the following intermolecular forces exist in all solid substances?

- (A) Dispersion forces (B) Dipole-dipole forces (C) Covalent bonding  
 (D) Hydrogen bonding (E) Ion-induced dipole forces

29. A solution of hydrogen peroxide is 23.6%  $\text{H}_2\text{O}_2$  by mass and has a density of  $1.11 \text{ g/cm}^3$ . The molarity of the solution is:

(A)  $7.23 \text{ M}$  (B)  $0.262 \text{ M}$  (C)  $7.70 \text{ M}$  (D)  $8.03 \text{ M}$  (E) none of these

30. How many of the following help determine whether or not a solution forms?

- the polarities of the solute and solvent
- the densities of the solute and solvent
- the probability of the mixed state (of the solution)
- the energies needed for the solution formation to occur
- the state of matter of the solute (solid, liquid, gas)

(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

31. Two liquids form a solution and release a quantity of heat. How does the pressure above the solution compare to that predicted by Raoult's law?

- (A) It will be greater. (B) It will be less. (C) It will be the same.  
 (D) It will show positive deviation. (E) None of these.

32. The observed van't Hoff factor for an electrolyte is less than the expected factor because of \_\_\_\_\_.

- (A) electrolytic repulsion (B) complete dissociation (C) coagulation  
 (D) ion pairing (E) gelation

33. Ethylenediamine (en) is a bidentate ligand. What is the coordination number of cobalt in  $[\text{Co}(\text{en})_2\text{Cl}_2]\text{Cl}$ ?

(A) 4 (B) 5 (C) 6 (D) 7 (E) 8

34. Which of the following complexes shows geometrical isomerism?

- (A)  $[\text{Cu}(\text{NH}_3)_4]\text{Cl}_2$  (B)  $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$  (C)  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$   
 (D)  $\text{K}[\text{Co}(\text{NH}_3)_2\text{Cl}_4]$  (E) none of these

35. The complex ions of  $\text{Zn}^{2+}$  are all colorless. The most likely explanation for this is:

- (A)  $\text{Zn}^{2+}$  is paramagnetic.  
 (B)  $\text{Zn}^{2+}$  exhibits "d orbital" splittings in its complexes such that they absorb all wavelengths in the visible region.  
 (C) Since  $\text{Zn}^{2+}$  is a  $d^{10}$  ion, it does not absorb visible light even though the "d orbital" splittings are correct for absorbing visible wavelengths.  
 (D)  $\text{Zn}^{2+}$  is not a transition metal ion.  
 (E) None of these is correct.

36. What is the sum of all isomers (geometrical and optical) that the complex ion  $\text{Co}(\text{en})_2\text{Cl}_2^+$  exhibits?

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

37. Fluoride ion ranks low in the spectrochemical series and produces a weak crystal field in complex ions. Based on this information, predict the number of unpaired electrons in  $\text{CoF}_6^{4-}$ .

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

38. The color of a transition metal complex results from:

- (A) bending vibrations (B) stretching vibrations (C) transition of an electron between d orbitals  
 (D) transition of an electron between an s and a p orbital (E) nuclear magnetic resonance

39. The phenomenon called \_\_\_\_\_ contraction is responsible for the great similarity in atomic size and chemistry of 4d and 5d elements.

- (A) transition (B) coordination (C) lanthanide (D) isomeric (E) none of these

40. Identify the strongest base.

(A)  $\text{CH}_3\text{O}^-$  (B)  $\text{CH}_3\text{OH}$  (C)  $\text{CN}^-$  (D)  $\text{H}_2\text{O}$  (E)  $\text{NO}_3^-$