

所別：水文科學研究所碩士班 一般生 科目：普通化學

Please use the following information to answer the questions or solve the problems.

Gas constant: $R = 0.082 \text{ atm L mol}^{-1} \text{ K}^{-1}$

Planck constant: $h = 6.63 \times 10^{-34} \text{ Js}$

Atomic weight: $H = 1.008, C = 12.01, O = 16.00, Na = 23.00, S = 32.06, Ca = 40.08$

Atomic number: $C = 6, Si = 14, P = 15, Ar = 18, K = 19, Br = 35, U = 92$

Dissociation constant: acetic acid $K_a = 1.7 \times 10^{-5}$, water $K = 1.0 \times 10^{-14}$, ammonia $K_b = 1.8 \times 10^{-5}$

A. Multiple choices (2.5 points each)

1. A sample of carbon dioxide that undergoes transformation from solid to gas would undergo (a) a change in density. (b) a change in mass. (c) a change in composition. (d) a change in bonding. (e) no change in physical properties.
2. The nucleus of a uranium atom, ^{238}U , contains (a) 238 protons and 92 neutrons; (b) 200 protons and 38 neutrons; (c) 92 protons and 146 neutrons; (d) 238 neutrons and 238 electrons; (e) 146 protons and 92 neutrons.
3. There are three isotopes of hydrogen, differing with respect to (a) atomic number; (b) atomic mass; (c) nuclear charge; (d) electron configuration; (e) number of protons.
4. The name of the NO_3^- ion is (a) nitride; (b) nitrate; (c) nitrite; (d) nitrous; (e) nitric.
5. Which of the following is an ionic compound? (a) H_2O ; (b) NH_3 ; (c) CaSO_4 ; (d) SO_2 ; (e) HCOOH
6. Liquid propane boils at -42°C . What is its boiling point on the Kelvin scale? (a) 231 K. (b) 242 K. (c) 273 K. (d) 305 K. (e) 358 K.
7. Which of the following samples contains the largest number of atoms? (a) 88 g of C_3H_8 ; (b) 100 g of CaCO_3 ; (c) 1 mole of I_2 ; (d) 10 moles of neon; (e) 98 g of H_2SO_4
8. The hormone testosterone has a molecular mass of 288.4 and contains 79.12% carbon by mass. How many carbon atoms are in each testosterone molecule? (a) 17; (b) 19; (c) 21; (d) 23; (e) 28.
9. How much 0.100 N H_2SO_4 is needed to titrate 50.0 ml of 0.500 M NaOH ? (a) 50.0 ml; (b) 100 ml; (c) 125 ml; (d) 250 ml; (e) 500 ml.
10. For a gas, which two variables are inversely proportional to each other, when all other conditions remain the same? (a) P, T; (b) P, V; (c) V, T; (d) n, V; (e) n, P.
11. If $\Delta H = +32 \text{ kJ}$ for a chemical reaction, that reaction: (a) occurs rapidly; (b) releases heat; (c) is endothermic; (d) cannot occur; (e) requires a catalyst.
12. The first ionization energy of Cs is $6.24 \times 10^{-19} \text{ J/atom}$. Calculate the minimum frequency of light that is required to ionize a cesium atom. (a) $1.06 \times 10^{-15} \text{ /s}$; (b) $1.06 \times 10^{-12} \text{ /s}$; (c) $9.42 \times 10^{11} \text{ /s}$; (d) $4.13 \times 10^{14} \text{ /s}$; (e) $9.41 \times 10^{14} \text{ /s}$.
13. All of the following orbital representations are allowed except: (a) 7s; (b) 2d; (c) 6f; (d) 4f; (e) 3p.
14. The electronic configuration of a stable sulfide ion? (a) $1s^2 2s^2 2p^6$; (b) $1s^2 2s^2 2p^6 3s^2$; (c) $1s^2 2s^2 2p^6 3s^2 3p^3$; (d) $1s^2 2s^2 2p^6 3s^2 3p^4$; (e) $1s^2 2s^2 2p^6 3s^2 3p^6$.
15. Which of the following atoms has the highest electron affinity? (a) Na; (b) Cl; (c) Br; (d) S; (e) As.
16. Which of the following molecules exhibits hydrogen bonding? (a) CH_4 ; (b) HF ; (c) PH_3 ; (d) HBr ; (e) CaH_2 .
17. Ammonia can be oxidized to nitric acid. How many moles of electrons are lost from one mole of

注意：背面有試題

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- ammonia in the reaction? (a) 1 mole; (b) 2 moles; (c) 4 moles; (d) 8 moles; (e) 16 moles.
18. Which of the following is a strong acid in water? (a) H_2SO_3 ; (b) HClO_2 ; (c) HF ; (d) H_3PO_4 ; (e) HClO_3 .
19. The molar solubility of PbBr_2 is 0.010 M. What is K_{sp} for PbBr_2 ? (a) 1.0×10^{-6} ; (b) 3.0×10^{-6} ; (c) 4.0×10^{-6} ; (d) 2.0×10^{-6} ; (e) 1.0×10^{-2} .
20. The best way to ensure complete precipitation of ZnS from a saturated H_2S solution is to (a) add more H_2S ; (b) add a strong acid; (c) add a weak acid; (d) raise the pH; (e) heat the solution.

B. Short questions

1. What is the mass of H_2SO_4 in a 50 ml solution of sulfuric acid, which has a density of 1.55 g/cc and which consists of 65.0% of H_2SO_4 by weight? How many moles of H_2SO_4 are there in the solution? What is its molar concentration? (10%)
2. Balance the equations and write the expression of the equilibrium constants of the reactions: (10%)
- $$\text{C}_3\text{H}_7\text{OH}(\text{g}) + _ \text{O}_2(\text{g}) = _ \text{CO}_2(\text{g}) + _ \text{H}_2\text{O}(\text{g})$$
- $$2 \text{KHCO}_3(\text{s}) = \text{K}_2\text{CO}_3(\text{s}) + _ \text{H}_2\text{O}(\text{g}) + _ \text{CO}_2(\text{g})$$
3. Write the Lewis structure for the bonding of the following compounds: O_3 ; C_6H_6 ; Si_2H_6 ; HF ; N_2 . (10%)
4. Calculate the percentage dissociation of a 1.20 M acetic acid solution. Write the reaction equation first. (5%)
5. A 0.1 M solution of ammonia is used to titrate a 25 ml sample of 0.1 M HCl . At the equivalence point, what is the pH of the resulting solution? (10%)
6. How many moles of gas are in a gas sample occupying 0.750 L at 0.316 atm and 25 °C? (5%)