

國立清華大學 命題紙

九十學年度 化學、生科、原科 系轉學生招生考試
科目 普通化學 科號 042, 152, 162 共 2 頁第 1 頁 *請在試卷【答案卷】內作答

1. Write formulas for the following compounds.
(9%)
 - (a) tin(IV) chloride
 - (b) potassium perchlorate
 - (c) sulfur trioxide
2. What are the systematic names for the following compounds?
(9%)
 - (a) BaBr_2
 - (b) N_2O
 - (c) CaO
3. Each of the following statements below is true. Give explanations for the following statements.
(18%)
 - (a) Ethyl alcohol and dimethyl ether have the same composition by mass (52% carbon, 13% hydrogen, and 35% oxygen), yet the two have different melting points, boiling points, and solubility in water.
 - (b) Two samples of gas are separated in two rectangular 1.00-L chambers by a thin metal wall. One sample is pure helium and the other is pure radon. Both samples are at 10°C and show a pressure of 1.00×10^{-2} atm originally. If the metal wall separating the gases suddenly develops a small hole of radius 1 pm. After 10 hours, one chamber exerts a larger pressure.
 - (c) Burning wood leaves an ash that is only a small fraction of the mass of the original wood.
 - (d) Atoms can be broken down into smaller particles.
 - (e) One sample of lithium hydride is 85.5% lithium by mass while another sample of lithium hydride is 67.5% lithium by mass. However, the two samples have the same properties.
 - (f) The H_2O is a small and light molecule, yet its vapor pressure is far away from an ideal gas.
4. Magnesium oxide MgO has the same structure as NaCl , that is that the anions (12%) form a face center cubic packing and the cations occupy all the octahedral holes.
 - (a) Giving that the density of MgO is 3.56 g/cm^3 , calculate the edge length of the unit cell.
 - (b) The ionic radii of Mg^{2+} and O^{2-} are 65 and 140 pm, respectively. Calculate the edge length of the unit cell from these data.
 - (c) Explain the difference between the results of parts (a) and (b). (You can do this without actually calculated the numbers out).

5. A solution is made by mixing 60.0 g of acetone (CH_3COCH_3) and 60.0 g of (12%) methanol (CH_3OH). Assuming ideal solution and gas behavior. (At 25°C the vapor pressure of pure acetone and pure methanol are 271 and 143 torr, respectively. $1 \text{ atm} = 760 \text{ torr}$).

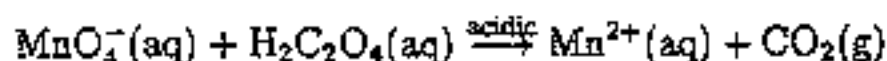
- (a) What is the composition of the vapor pressure of this solution at 25°C ?
 (b) What is the composition of the vapor expressed as a mole fraction?

6. Estimate ΔH for the following reaction using bond energies, (5%)



Bond energies (kJ/mol): H - H 432, C - H 413, C - C 347,
 C = C 614.

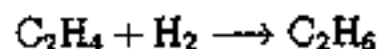
7. A solution of permanganate is standardized by titration with oxalic acid ($\text{H}_2\text{C}_2\text{O}_4$). (12%) It required 70.22 mL of the permanganate solution to react completely with 0.9822 g of oxalic acid. The unbalanced equation for the reaction is



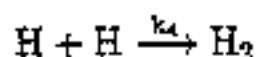
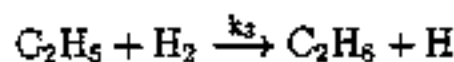
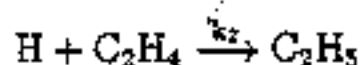
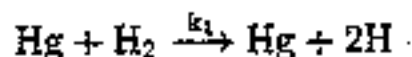
What is the molarity of the permanganate solution?

8. Write the Lewis structure for the azide ion, N_3^- , with an $\text{N} = \text{N} = \text{N}^-$ structure. (8%) Do we expect this to be a linear molecule? Since it is observed that the acid HN_3 is not linear, propose a hybridization and localized-molecular-orbit diagram that are consistent with a bent HN_3 molecule.

9. For the reaction in the presence of mercury vapor (15%)



a possible mechanism is



Determine the rate law for the production of C_2H_6 using the steady-state approximation.