



Carleton
UNIVERSITY

CHEM 1006 A
Winter 2018

Midterm #1: Thursday, February 1st, 2018

Test duration: 80 minutes

Instructor: Alyssa Nause

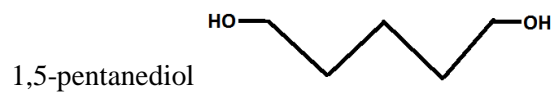
Student Name: _____

Student Number: _____

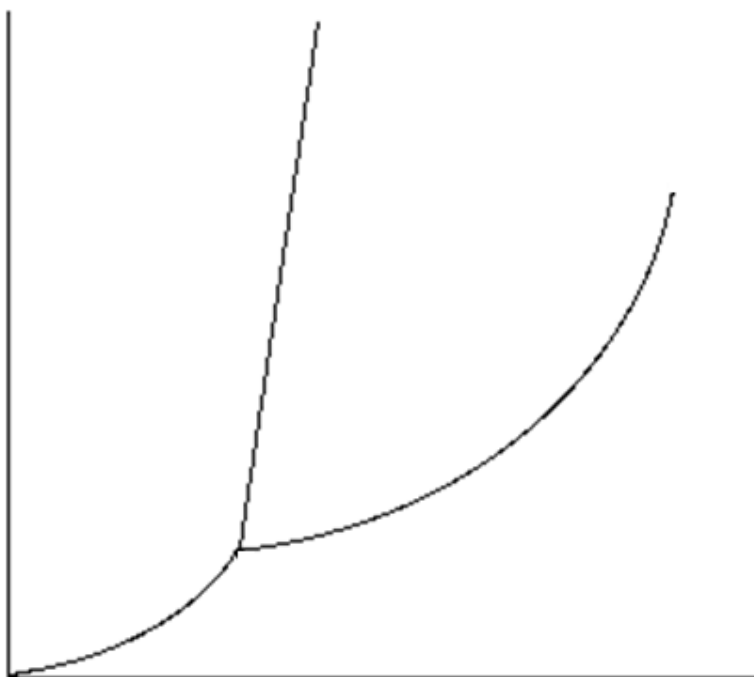
Answer the questions on the exam paper.

If more space is needed, use reverse of exam pages.

3. Using the structures provided and explaining your reasoning, determine if the two species below would be miscible.



4. On the phase diagram below, draw the effect on boiling and freezing points of a pure solvent when a solute is added.

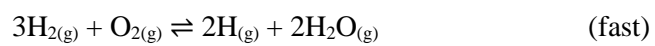
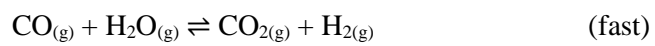


Part B: Long Answer Problems (10 marks each)

5. Using the constants provided on the Equations and Constants page, for a solution made by mixing 7.55g of potassium sulfate ($\text{K}_2\text{SO}_4(\text{s})$) in 750.0mL of acetic acid ($\text{C}_2\text{H}_4\text{O}_2(\text{l})$) at 25.0°C.
- determine the melting point of the solution.
 - determine the osmotic pressure (in kPa) of the system.

6. Neptunium (Np) was once thought to have a simple cubic unit cell. The side length of the unit cell was determined to be 400.p.m.
 - a. Determine the volume of the unit cell (in cm^3).
 - b. Determine the mass of neptunium within the unit cell.
 - c. Determine the volume of one neptunium atom (in cm^3).
 - d. Determine the density of the neptunium packing structure (in g/cm^3).

7. For the following mechanism,
- write the overall reaction,
 - label each compound as reactant, product, intermediate or catalyst,



Equations and Constants:

$$T_{b, \text{acetic acid}} = 118^{\circ}\text{C}$$

$$n = m/M$$

$$T_{f, \text{acetic acid}} = 17.0^{\circ}\text{C}$$

$$c = n/V$$

$$\rho_{\text{acetic acid}} = 1.049 \text{ g mL}^{-1}$$

$$b = n/m$$

$$K_{f, \text{acetic acid}} = 3.90 \text{ }^{\circ}\text{C kg mol}^{-1}$$

$$\rho = m/V$$

$$K_{b, \text{acetic acid}} = 3.07 \text{ }^{\circ}\text{C kg mol}^{-1}$$

$$V_{\text{sphere}} = (4/3)\pi r^3$$

$$p_{\text{vap, acetic acid, 25C}} = 2.07 \text{ kPa}$$

$$[\text{gas}_{(\text{aq})}] = K_{\text{H}}(p_{\text{gas}})$$

$$\Delta T_{\text{f}} = i(K_{\text{f}})b$$

$$R = 8.314 \text{ L kPa K}^{-1} \text{ mol}^{-1}$$

$$\Delta T_{\text{b}} = i(K_{\text{b}})b$$

$$R = 8.314 \times 10^{-2} \text{ L bar K}^{-1} \text{ mol}^{-1}$$

$$\Pi = icRT$$

$$R = 62.36 \text{ L Torr K}^{-1} \text{ mol}^{-1}$$

$$p_{\text{vap, soln}} = X_{\text{A}}p_{\text{vap, A}}$$

$$R = 8.206 \times 10^{-2} \text{ L atm K}^{-1} \text{ mol}^{-1}$$

$$p_{\text{vap, soln}} = X_{\text{A}}p_{\text{vap, A}} + X_{\text{B}}p_{\text{vap, B}}$$

$$X_{\text{C}} = n_{\text{C}}/n_{\text{total}}$$

$$N_{\text{Av}} = 6.022 \times 10^{23} \text{ mol}^{-1}$$

$$1 \text{ atm} = 1.01325 \times 10^5 \text{ Pa} = 760 \text{ Torr} = 1.01325 \text{ bar}$$

$$T(\text{K}) = T(^{\circ}\text{C}) + 273.15$$

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Hydrogen 1 H 1.008	Beryllium 4 Be 9.0122	Lithium 3 Li 6.94	Scandium 21 Sc	Titanium 22 Ti	Vanadium 23 V	Chromium 24 Cr	Manganese 25 Mn	Iron 26 Fe	Cobalt 27 Co	Nickel 28 Ni	Copper 29 Cu	Zinc 30 Zn	Boron 5 B 10.81	Carbon 6 C 12.011	Nitrogen 7 N 14.007	Oxygen 8 O 15.999	Fluorine 9 F 18.998	Helium 2 He 4.0026
	Magnesium 12 Mg 24.305	Sodium 11 Na	Yttrium 39 Y	Zincum 40 Zn	Niobium 41 Nb	Molybdenum 42 Mo	Ruthenium 44 Ru	Rhodium 45 Rh	Palladium 46 Pd	Silver 47 Ag	Cadmium 48 Cd	Aluminum 13 Al 26.982	Silicon 14 Si 28.086	Phosphorus 15 P 30.974	Sulfur 16 S 32.06	Chlorine 17 Cl 35.45	Neon 10 Ne 20.180	
	Calcium 20 Ca 40.078(4)	Potassium 19 K 39.098	Strontium 38 Sr 87.62	Zirconium 40 Zr	Tantalum 73 Ta	Tungsten 74 W	Rhenium 75 Re	Osmium 76 Os	Iridium 77 Ir	Platinum 78 Pt	Gold 79 Au	Mercury 80 Hg	Lead 82 Pb	Tin 82 Sn	Antimony 51 Sb	Tellurium 52 Te	Iodine 53 I	Xenon 54 Xe 131.29
	Strontium 38 Sr 87.62	Barium 56 Ba 137.33	Barium 56 Ba 137.33	Hafnium 72 Hf	Tantalum 73 Ta	Tungsten 74 W	Rhenium 75 Re	Osmium 76 Os	Iridium 77 Ir	Platinum 78 Pt	Gold 79 Au	Mercury 80 Hg	Lead 82 Pb	Tin 82 Sn	Antimony 51 Sb	Tellurium 52 Te	Iodine 53 I	Xenon 54 Xe 131.29
	Radium 88 Ra 226.025	Radium 88 Ra 226.025	Francium 87 Fr [223.02]	Rutherfordium 104 Rf	Dubnium 105 Db	Seaborgium 106 Sg	Bohrium 107 Bh	Hassium 108 Hs	Moscovium 109 Mt	Darmstadtium 110 Ds	Roentgenium 111 Rg	Copernicium 112 Cn	Ununnilium 113 Uut	Rutherfordium 114 Fl	Ununpentium 115 Uup	Livermorium 116 Lv	Ununseptium 117 Uus	Ununoctium 118 Uuo [294]

Key: Element Name
Atomic number
Symbol
Atomic weight (mean relative mass)

Lanthanum 57 La	Cerium 58 Ce	Praseodymium 59 Pr	Neodymium 60 Nd	Promethium 61 Pm	Samarium 62 Sm	Europium 63 Eu	Gadolinium 64 Gd	Terbium 65 Tb	Dysprosium 66 Dy	Erbium 67 Er	Thulium 69 Tm	Ytterbium 70 Yb
Lanthanum 57 La	Cerium 58 Ce	Praseodymium 59 Pr	Neodymium 60 Nd	Promethium 61 Pm	Samarium 62 Sm	Europium 63 Eu	Gadolinium 64 Gd	Terbium 65 Tb	Dysprosium 66 Dy	Erbium 67 Er	Thulium 69 Tm	Ytterbium 70 Yb
Actinium 89 Ac	Thorium 90 Th	Protactinium 91 Pa	Uranium 92 U	Nepthunium 93 Np	Plutonium 94 Pu	Americium 95 Am	Curium 96 Cm	Berkelium 97 Bk	Californium 98 Cf	Fermium 100 Fm	Mendelevium 101 Md	Nobelium 102 No [259-10]

*lanthanoids

**actinoids