



Carleton
UNIVERSITY

CHEM 1006 A
Winter 2018

Midterm #1: Deferred Midterm

Test duration: 80 minutes

Instructor: Alyssa Nause

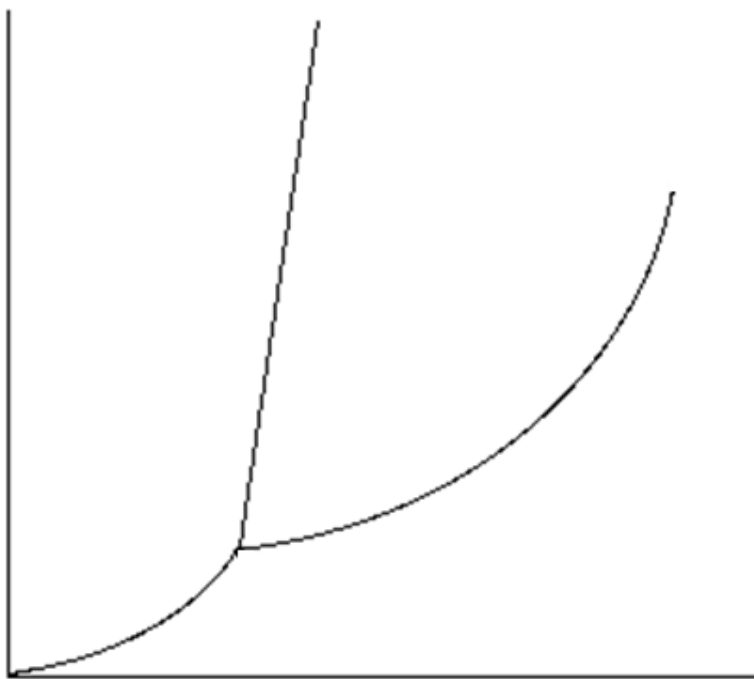
Student Name: _____

Student Number: _____

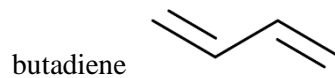
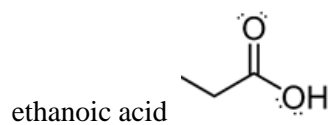
Answer the questions on the exam paper.

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

3. Label all parts of the solvent phase diagram below.



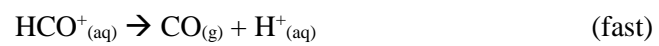
4. Using the structures provided and explaining your reasoning, determine which of these two species would likely be miscible with water.



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 5.25g of sodium hydroxide ($\text{NaOH}_{(s)}$) in 400.0mL of acetic acid ($\text{C}_2\text{H}_4\text{O}_2(l)$) at 25.0°C .
 - a. determine the boiling point of the solution.
 - b. determine the vapour pressure (in kPa) of the solution.

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



7. A Simple Cubic unit cell has a side length equal to two radii of the atoms making up the structure. What is the packing efficiency of a simple cubic unit cell (in percent)?

Equations and Constants:

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

$$n = m/M$$

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

$$c = n/V$$

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

$$b = n/m$$

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

$$\rho = m/V$$

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

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

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

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

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

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

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

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

$$\Pi = icRT$$

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

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

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

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

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

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

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

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

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Hydrogen 1 1.008	Helium 2 4.0026	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
Lithium 3 6.94	Beryllium 4 9.0122	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
Sodium 11 22.990	Lithium 3 6.94	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
Potassium 19 39.098	Magnesium 12 24.305	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
Rubidium 37 85.468	Calcium 20 40.078(4)	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
Rb 87.62	Strontium 38 87.62	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
Cesium 55 132.91	Yttrium 39 88.906(2)	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
Barium 56 137.33	Zirconium 40 91.224(2)	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
Francium 87 [223.02]	Niobium 41 92.906(3)	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Molybdenum 42 95.94(2)	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Rhenium 75 186.21	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Ruthenium 44 101.07(2)	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Rhodium 45 102.91	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Palladium 46 106.42	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Silver 47 107.87	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Cadmium 48 112.41	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Indium 49 114.82	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Tin 50 118.71	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Antimony 51 121.76	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Tellurium 52 127.60(3)	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Iodine 53 126.90	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Xenon 54 131.29	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Radium 88 [226.025]	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Actinium 89 [227.028]	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36
	Francium 87 [223.02]	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36

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

Lanthanum 57	Cerium 58	Praseodymium 59	Neodymium 60	Promethium 61	Samarium 62	Europium 63	Gadolinium 64	Terbium 65	Dysprosium 66	Hoium 67	Erbium 68	Thulium 69	Ytterbium 70
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
138.91	140.12	140.91	144.24	[144.91]	150.36(2)	151.96	157.25(3)	158.93	162.50	164.93	167.26	168.93	173.05
Actinium 89	Thorium 90	Protactinium 91	Uranium 92	Nephtunium 93	Plutonium 94	Americium 95	Curium 96	Berkelium 97	Californium 98	Einsteinium 99	Fermium 100	Mendelevium 101	Nobelium 102
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No
[227.028]	232.04	231.04	238.03	[237.05]	[244.06]	[243.06]	[247.07]	[247.07]	[251.08]	[252.08]	[257.10]	[258.10]	[259.10]

*lanthanoids

**actinoids