Exam 1A
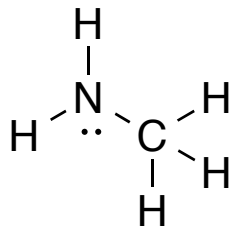# Chem 1142
Spring 2015

Name:_____

MULTIPLE CHOICE. [4 pts ea.] Choose the best response on the scantron sheet. [**60 pts total.**]

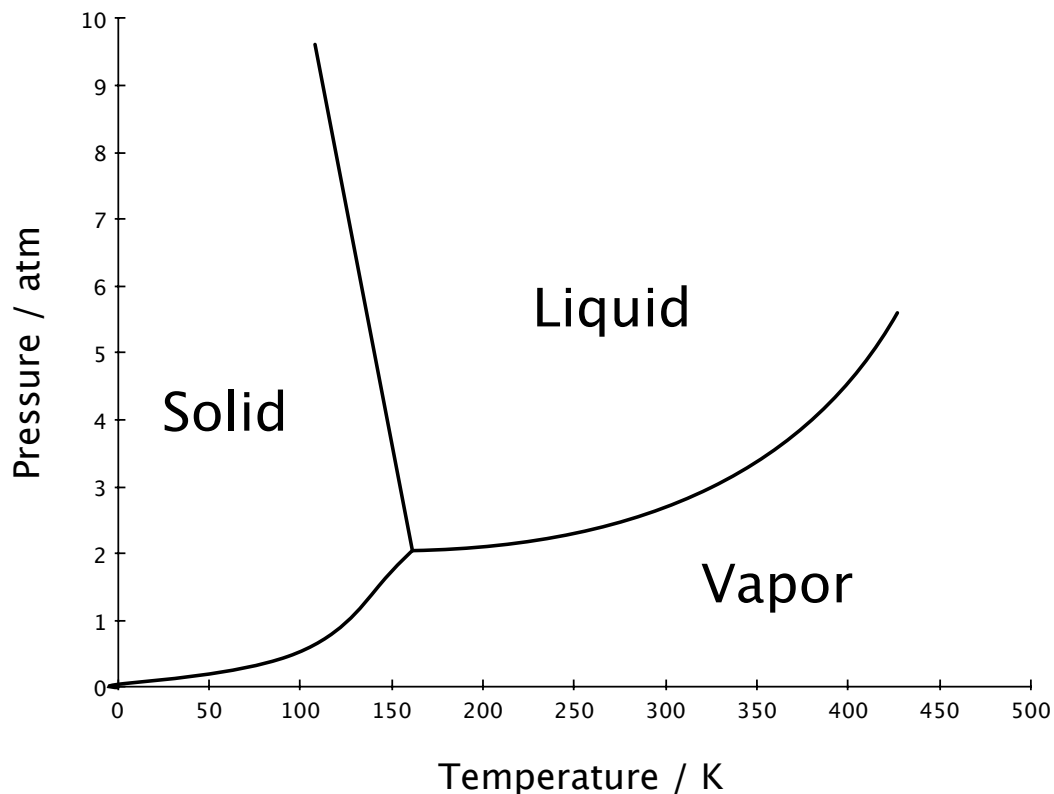Q1. Which of the following substances will have a dipole-dipole intermolecular force?
a) CCl_4 b) BF_3 c) NaCl   d) H_2O e) N_2

Q2. Predict which ionic compound should have the highest melting point:
a) LiF   b) NaCl   c) MgO   d) CaS   e) AlP

Q3. True or False: Hydrogen-Bonds are stronger than ionic-bonds.
a) TRUE   b) FALSE

Q4. Pick the correct statement about the following molecule:

a) it can hydrogen-bond donate, but not accept   b) it can hydrogen-bond accept, but not donate
c) it can neither accept nor donate hydrogen-bonds   d) it can both accept and donate hydrogen-bonds

Q5. An example of a network covalent crystal is:
a) ice   b) quartz   c) tar   d) aluminum   e) sodium chloride

Q6. The enthalpy of fusion, vaporization, and sublimation for a substance X has been determined. Which of the following possible sets of values is most likely to be correct?

	$\Delta H°_{fus}$ / kJ·mol^{-1}	$\Delta H°_{vap}$ / kJ·mol^{-1}	$\Delta H°_{sub}$ / kJ·mol^{-1}
a)	−10	−5	+15
b)	−20	+30	−10
c)	+5	+12	+14
d)	+10	+25	+35
e)	+20	+15	+5

Q7. Given the following phase diagram, what is the boiling point of the substance at 3 atm?

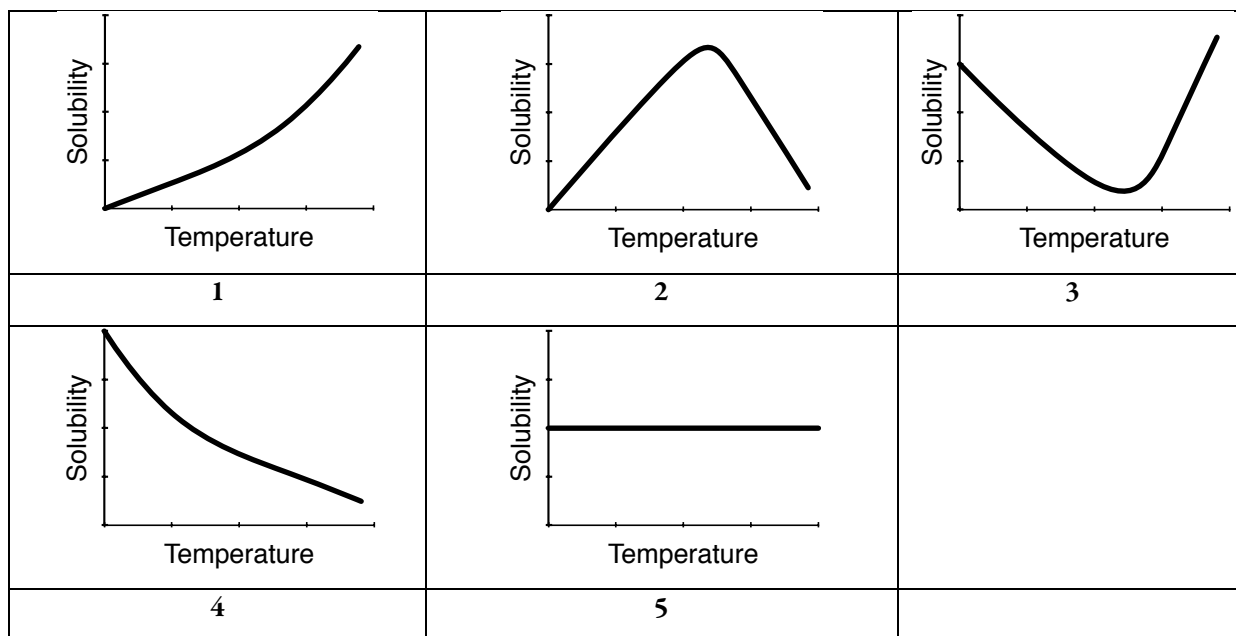a) 125 K   b) 150 K   c) 160 K   d) 350 K   e) 425 K

Q8. Which pair of substances would be most likely to mix and form a homogeneous solution?
a) $NaCl/C_4H_{10}$ b) C_8H_{18}/H_2O c) CH_3CH_2OH/CO_2
d) CH_3OH/NH_3 e) CH_4/NaH

Q9. 4.25 mL of a 0.281 M aqueous solution at 35 °C contains 0.117-g of an unknown solute. What is the molar mass of the solute?
a) 98.0 g/mol   b) 0.416 g/mol   c) 10.2 g/mol
d) 0.0980 g/mol   e) 102 g/mol

Q10. Which numbered graph shows the typical solubility of a **gas** in a liquid with changing temperature?

Solubility vs Temperature	Solubility vs Temperature	Solubility vs Temperature
1	**2**	**3**
Solubility vs Temperature	Solubility vs Temperature	
4	**5**	

a) 1   b) 2   c) 3   d) 4   e) 5

Q11. If the solubility of $He(g)$ in water at 25 °C is 6.6×10^{-4} M at a pressure of 1.75 atm, then what is the solubility when the pressure is changed to 9.8 atm?
a) 1.2×10^{-4} M   b) 3.7×10^{-3} M   c) 2.9×10^{-3} M
d) 3.7×10^{-3} M   e) 4.7×10^{-6} M

Q12. Which one of the following aqueous solutions would have a *different* boiling point than the other four?
a) 0.60 m NaCl   b) 0.30 m $Fe(NO_3)_3$ c) 0.60 m NH_4NO_3
d) 1.2 m $C_6H_{12}O_6$ e) 0.40 m $LiHCO_3$

Q13. A semi-permeable membrane separates pure water from a solution of 1.0 M NaCl(aq) at 32 °C. In order to **stop** osmotic flow, what must be done?
a) An additional pressure of 25 atm must be applied to the water side of the apparatus
b) An additional pressure of 25 atm must be applied to the NaCl side of the apparatus
c) An additional pressure of 50. atm must be applied to the water side of the apparatus
d) An additional pressure of 50. atm must be applied to the NaCl side of the apparatus

Q14. An aqueous solution of 3.0 m sodium phosphate boils at 105.3 °C. From this information, calculate the van't Hoff factor.
a) 67   b) 18   c) 3.4   d) 3.0   e) 0.85

Q15. Which of the following aqueous solutions would have the greatest osmotic pressure at the same temperature?
a) 0.10 M NaCl   b) 0.20 M $C_6H_{12}O_6$ c) 0.060 M $CaCl_2$
d) 0.050 M $(NH_4)_2CO_3$ e) 0.20 M NH_4NO_3

Short Response.

Show ALL work to receive credit.

Q16. [10 pts.] Silver crystallizes in a face-centered-cubic unit cell with an edge length of 408.7 pm. Calculate its density.

Q17. [10 pts.]   Order the following compounds by predicted melting points. Explain in detail how you arrived at the ordering. As part of your answer, be sure to identify the intermolecular forces that each substance contains, and be prepared to draw Lewis/VSEPR diagrams to support your answer.

CaO, CH_3NH_2, CH_3Cl, CS_2, LiF

~~Q18. [10 pts.]   Calculate the boiling point of an aqueous 34.5 % (w/w) solution of KBr with a density of 1.82 g/mL.~~

Sorry—this is an impossible problem that came from an earlier draft of the exam (not qhat was given in 2015!)

Q19. [10 pts.]   A 4.3 M aqueous solution of an unknown molecular compound X has a boiling point of 101.30 °C. If the density of the solution is 1.34 g/mL, calculate the molecular weight of X.
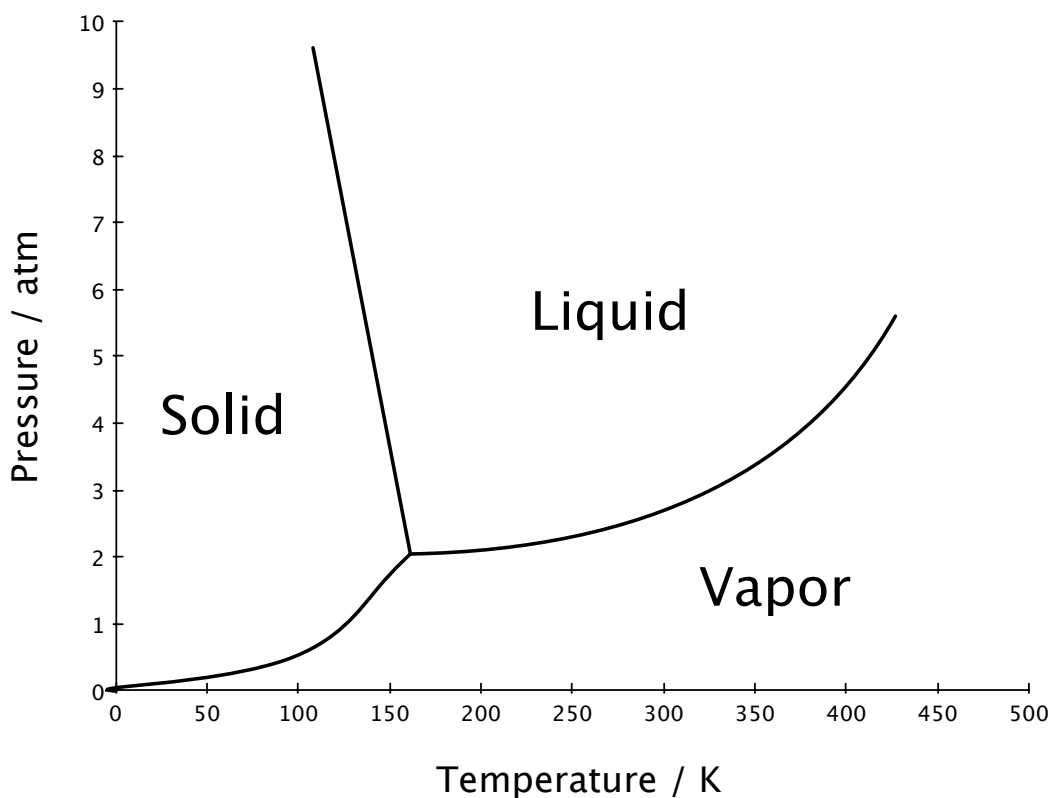
Exam 1B (50 minute)
Chem 1142
Spring 2015

Name:_____

MULTIPLE CHOICE. [4 pts ea.] Choose the best response on the scantron sheet. [**40 pts total.**]

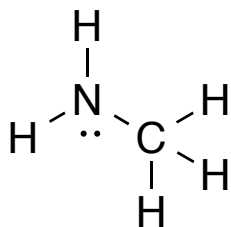Q1.   Given the following phase diagram, what is the boiling point of the substance at 3 atm?

a) 350 K   b) 425 K   c) >500 K   d) <150 K   e) 160 K

Q2.   Which pair of substances would be most likely to mix and form a homogeneous solution?
a) $NaCl/C_4H_{10}$ b) C_8H_{18}/H_2O c) CH_3CH_2OH/CO_2
d) CH_3OH/NH_3 e) CH_4/NaH

Q3.   An aqueous solution of 3.0 m sodium phosphate boils at 105.3 °C. From this information, calculate the van't Hoff factor.
a) 67   b) 18   c) 3.4   d) 3.0   e) 0.85

Q4.   Which of the following substances will have a dipole-dipole intermolecular force?
a) CCl_4 b) BF_3 c) H_2O d) NaCl   e) N_2

Q5.   True or False: Hydrogen-Bonds are stronger than ionic-bonds.
        a) TRUE   b) FALSE

Q6. Pick the correct statement about the following molecule:

        a) it can hydrogen-bond donate, but not accept   b) it can hydrogen-bond accept, but not donate
        c) it can neither accept nor donate hydrogen-bonds d) it can both accept and donate hydrogen-bonds

Q7.   Which one of the following aqueous solutions would have a *different* boiling point than the other four?
        a) 0.60 m NaCl   b) 0.30 m $Fe(NO_3)_3$ c) 0.60 m NH_4NO_3
        d) 1.2 m $C_6H_{12}O_6$ e) 0.40 m $LiHCO_3$

Q8.   A semi-permeable membrane separates pure water from a solution of 1.0 M NaCl(aq) at 32 °C. In order to
        stop osmotic flow, what must be done?
        a) An additional pressure of 25 atm must be applied to the water side of the apparatus
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        c) An additional pressure of 50. atm must be applied to the water side of the apparatus
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Q9.   An example of a network covalent crystal is:
        a) ice   b) quartz   c) tar   d) aluminum   e) sodium chloride

Q10.   If the solubility of He(g) in water at 25 °C is 6.6×10^{-4} M at a pressure of 1.75 atm, then what is the
        solubility when the pressure is changed to 9.8 atm?
        a) 1.2×10^{-4} M   b) 3.7×10^{-3} M   c) 2.9×10^{-3} M
        d) 3.7×10^{-2} M   e) 4.7×10^{-6} M

Short Response.

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Q11. [20 pts.] Order the following compounds by predicted melting points. Explain in detail how you arrived at the ordering. As part of your answer, be sure to identify the intermolecular forces that each substance contains, and be prepared to draw Lewis/VSEPR diagrams to support your answer.

CaO, CH_3NH_2, CH_3Cl, CO_2, LiF

Q12. [20 pts.] A 12.8 % (w/w) aqueous solution of an unknown molecular compound X has a boiling point of 101.30 ºC. Calculate the molecular weight of X.

Q13. [20 pts.] Silver crystallizes in a face-centered-cubic (FCC) unit cell with an edge length of 408.7 pm. Calculate its density in units of g/cm³. Be sure to sketch the FCC unit cell as part of your answer.

BONUS Question:

Explain what is meant by the critical point of a substance, T_c?

Exam 1A (2-hour)
Chem 1142
Spring 2015

Name: _____

MULTIPLE CHOICE. [3 pts ea.] Choose the best response on the scantron sheet. [**45 pts total.**]

Q1. Which of the following substances will have a dipole-dipole intermolecular force?
      a) CCl_4 b) BF_3 c) H_2O d) NaCl   e) N_2

Q2. Predict which ionic compound should have the highest melting point:
      a) LiF   b) NaCl   c) MgO   d) CaS   e) AlP

Q3. True or False: Hydrogen-Bonds are stronger than ionic-bonds.
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Q4. Pick the correct statement about the following molecule:

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Q6. The enthalpy of fusion, vaporization, and sublimation for a substance X has been determined. Which of the following possible sets of values is most likely to be correct?

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Q9. 4.25 mL of a 0.281 M aqueous solution at 35 °C contains 0.117-g of an unknown solute. What is the molar mass of the solute?
a) 98.0 g/mol   b) 0.416 g/mol   c) 10.2 g/mol
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Q10. Which numbered graph shows the typical solubility of a **gas** in a liquid with changing temperature?

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Short Response.

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Q16. [11 pts.] Silver crystallizes in a face-centered-cubic (FCC) unit cell and has a density of 10.50 g/cm³. Calculate the edge length of the unit cell in picometers. Be sure to sketch the FCC unit cell as part of your answer.

Q17. [11 pts.] Order the following compounds by predicted melting points. Explain in detail how you arrived at the ordering. As part of your answer, be sure to identify the intermolecular forces that each substance contains, and be prepared to draw Lewis/VSEPR diagrams to support your answer.

CaO, CH_3NH_2, CH_3Cl, CO_2, LiF

Q18. [11 pts.] Calculate the boiling point of an aqueous 34.5 % (w/w) solution of KBr with a density of 1.82 g/mL.

Q19. [11 pts.] A 12.8 % (w/w) aqueous solution of an unknown molecular compound X has a boiling point of 101.30 °C. Calculate the molecular weight of X.

Q20. [11 pts. total]

    a) [2 pts.]   Give an example of a network covalent solid.

    b) [3 pts.]   Sketch the molecular structure of the substance you identified in part a) above.

    c) [3 pts.]   Using complete sentences, explain why the van't Hoff factor is 1.3, rather than 2.0 for 0.0500 M $MgSO_4$(aq) at 25 °C.

    d) [3 pts.]   Sketch the hydrogen bonds between molecules of CH_3OH.

BONUS Question:

In general, the enthalpy of vaporization of a substance is greater than its enthalpy of fusion. Why?

Exam 1B (2-hour)
Chem 1142
Spring 2015

Name:_____

MULTIPLE CHOICE. [3 pts ea.] Choose the best response on the scantron sheet. [**45 pts total.**]

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1	2	3

4	5	

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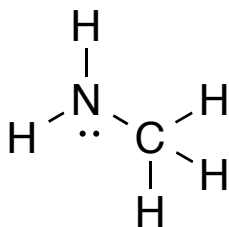a) 0.10 M NaCl   b) 0.20 M $C_6H_{12}O_6$ c) 0.060 M $CaCl_2$
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c)	+5	+12	+14
d)	+10	+25	+35
e)	+20	+15	+5

Short Response.

Show ALL work to receive credit.

Q16. [11 pts.] A 21.8 % (w/w) aqueous solution of an unknown molecular compound X has a boiling point of 101.10 °C. Calculate the molecular weight of X.

Q17. [11 pts.] Silver crystallizes in a face-centered-cubic (FCC) unit cell and has a density of 10.50 g/cm³. Calculate the edge length of the unit cell in picometers. Be sure to sketch the FCC unit cell as part of your answer.

Q18. [11 pts.] Order the following compounds by predicted melting points. Explain in detail how you arrived at the ordering. As part of your answer, be sure to identify the intermolecular forces that each substance contains, and be prepared to draw Lewis/VSEPR diagrams to support your answer.

MgS, CH_3CH_2OH, CH_3F, CO_2, KCl

Q19. [11 pts.] Calculate the boiling point of an aqueous 39.5 % (w/w) solution of KBr with a density of 1.89 g/mL.

Q20. [11 pts. total]

a) [2 pts.] Sketch the body-centered cubic (BCC) unit cell.

b) [3 pts.] If every lattice point in the BCC unit cell contains an atom, explain how to calculate how many atoms there are in the unit cell.

c) [3 pts.] Using complete sentences, explain why the van't Hoff factor is 1.3, rather than 2.0 for 0.0500 M $MgSO_4$(aq) at 25 °C.

d) [3 pts.] Sketch the hydrogen bonds between molecules of CH_3NH_2.

BONUS Question:

In general, the enthalpy of vaporization of a substance is greater than its enthalpy of fusion. Why?

$\mathcal{U}$seful Information

Periodic Table of the Elements

IA	IIA												IIIA	IVA	VA	VIA	VIIA	VIIIA
1 **H** 1.01	**2**																	**2** **He** 4.00
3 **Li** 6.94	**4** **Be** 9.01											**13**	**5** **B** 10.81	**6** **C** 12.01	**7** **N** 14.01	**8** **O** 16.00	**9** **F** 19.00	**10** **Ne** 20.18
11 **Na** 22.99	**12** **Mg** 24.31	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**		**13** **Al** 26.98	**14** **Si** 28.09	**15** **P** 30.97	**16** **S** 32.07	**17** **Cl** 35.45	**18** **Ar** 39.95
19 **K** 39.10	**20** **Ca** 40.08	**21** **Sc** 44.96	**22** **Ti** 47.87	**23** **V** 50.94	**24** **Cr** 52.00	**25** **Mn** 54.94	**26** **Fe** 55.85	**27** **Co** 58.93	**28** **Ni** 58.69	**29** **Cu** 63.55	**30** **Zn** 65.39		**31** **Ga** 69.72	**32** **Ge** 72.61	**33** **As** 74.92160	**34** **Se** 78.96	**35** **Br** 79.90	**36** **Kr** 83.80
37 **Rb** 85.47	**38** **Sr** 87.62	**39** **Y** 88.91	**40** **Zr** 91.22	**41** **Nb** 92.91	**42** **Mo** 95.94	**43** **Tc** [98]	**44** **Ru** 101.07	**45** **Rh** 102.91	**46** **Pd** 106.42	**47** **Ag** 107.87	**48** **Cd** 112.41		**49** **In** 114.82	**50** **Sn** 118.71	**51** **Sb** 121.76	**52** **Te** 127.60	**53** **I** 126.90	**54** **Xe** 131.29
55 **Cs** 132.91	**56** **Ba*** 137.33	**71** **Lu** 174.97	**72** **Hf** 178.49	**73** **Ta** 180.95	**74** **W** 183.84	**75** **Re** 186.21	**76** **Os** 190.23	**77** **Ir** 192.22	**78** **Pt** 195.08	**79** **Au** 196.97	**80** **Hg** 200.59		**81** **Tl** 204.38	**82** **Pb** 207.20	**83** **Bi** 208.98	**84** **Po** [210]	**85** **At** [210]	**86** **Rn** [222]
87 **Fr** [223]	**88** **Ra**** [226]	**103** **Lr** [262]	**104** **Rf** [261]	**105** **Db** [262]	**106** **Sg** [266]	**107** **Bh** [264]	**108** **Hs** [265]	**109** **Mt** [268]	**110** [269]	**111** [272]	**112** [277]	**113**	**114** [285]	**115**	**116** [289]	**117**	**118** [293]	

	57 **La** 138.91	**58** **Ce** 140.12	**59** **Pr** 140.91	**60** **Nd** 144.24	**61** **Pm** [145]	**62** **Sm** 150.36	**63** **Eu** 151.96	**64** **Gd** 157.25	**65** **Tb** 158.93	**66** **Dy** 162.50	**67** **Ho** 164.93	**68** **Er** 167.26	**69** **Tm** 168.93	**70** **Yb** 173.04
**	**89** **Ac** [227]	**90** **Th** 232.04	**91** **Pa** 231.04	**92** **U** 238.03	**93** **Np** [237]	**94** **Pu** [244]	**95** **Am** [243]	**96** **Cm** [247]	**97** **Bk** [247]	**98** **Cf** [251]	**99** **Es** [252]	**100** **Fm** [257]	**101** **Md** [258]	**102** **No** [259]

1 atm = 101,325 Pa = 760 mmHg = 760 torr

$$R = 0.08206 \frac{\text{atm} \cdot \text{L}}{\text{mol} \cdot \text{K}} \qquad\qquad R = 8.314\,\text{J/mol·K}$$

$\Delta T_b = ik_b m \qquad\qquad \Delta T_f = ik_f m \qquad\qquad \Pi = iMRT$

$k_f(H_2O) = 1.86\ ^\circ\text{C/m} \qquad\qquad k_b(H_2O) = 0.52\ ^\circ\text{C/m}$

$c = kP$