CHEM 1032
PRACTICE
UNIT ASSESSMENT 1

SECTION: _____

NAME: _____

TUID: | | | | | | | | | |

Before the Unit Assessment begins, read the rest of this page, and follow the instructions.

!!! Do not turn this page until given the signal to begin !!!

Put away everything besides pencil(s) and a scientific calculator.

- Non-programmable (scientific) calculators are permitted. Graphing calculators **are not permitted** (such as these models: TI-83, TI-84, TI-89, Casio FX-9750).
- Any other electronic devices - including cell phones, smart phones, and smart watches - **are not permitted**. If you are not sure what is permitted, ask *before* the exam begins.

When you are told to begin work, open the booklet and read the directions.

A periodic table and other useful information can be found on the next page.

Grading. Each question is graded by your instructor using the scale below.

1 - Excellent
- The student demonstrates a deep understanding of concepts and problem-solving techniques.
- Calculations are clear and legibly written.
- Any mistakes are minor or careless errors that do not indicate a major conceptual misunderstanding.

0.5 - Fair
- The student demonstrates a partial understanding of concepts and techniques.
- Calculations are clear and legibly written but contain errors.
  - The student may have started out correctly but gone on a tangent or not finished the problem.
  - The student may have used pattern matching to answer a different, more familiar question instead.

0 - Unsatisfactory/Incomplete
- The student did not demonstrate an understanding of the problem or has minimal understanding.
- Calculations are unclear, missing, or incomplete.
  - The student may have written some appropriate formulas or diagrams, but nothing further.
  - The student may have done something entirely wrong.
  - The student may have written almost nothing or nothing at all.

Unit Assessment Time: 50 minutes.
It is to your advantage to answer every question.

!!! Do not turn this page until given the signal to begin !!!

1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H 1.008																		2 He 4.0026
3 Li 6.94	4 Be 9.0122												5 B 10.81	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
11 Na 22.990	12 Mg 24.305												13 Al 26.982	14 Si 28.085	15 P 30.974	16 S 32.06	17 Cl 35.45	18 Ar 39.948
19 K 39.098	20 Ca 40.078(4)		21 Sc 44.956	22 Ti 47.867	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845(2)	27 Co 58.933	28 Ni 58.693	29 Cu 63.546(3)	30 Zn 65.38(2)	31 Ga 69.723	32 Ge 72.630(8)	33 As 74.922	34 Se 78.971(8)	35 Br 79.904	36 Kr 83.798(2)
37 Rb 85.468	38 Sr 87.62		39 Y 88.906	40 Zr 91.224(2)	41 Nb 92.906(2)	42 Mo 95.95	43 Tc	44 Ru 101.07(2)	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(3)	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57-70 *	71 Lu 174.97	72 Hf 178.49(2)	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23(2)	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po	85 At	86 Rn
87 Fr	88 Ra	89-102 **	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og

57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm [144.91]	62 Sm 150.36(2)	63 Eu 151.96	64 Gd 157.25(3)	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.05
89 Ac [227.03]	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No

Units:

amu	*atomic mass unit*
atm	*atmosphere*
g	*gram*
h	*hour*
J	*joule*
K	*kelvin*
mmHg	*unit of pressure*
M	*molarity*
K	*kelvin*
L	*liter*
mol	*mole*
s	*second*

Symbols:

H	*enthalpy*
ν	*frequency*
M	*molar mass*
mol	*mole*
P	*pressure*
t	*time*
T	*temperature*
V	*volume*

Constants:

N_A	*Avogadro's number*
R	*ideal gas constant*

SI (Metric) Prefixes:

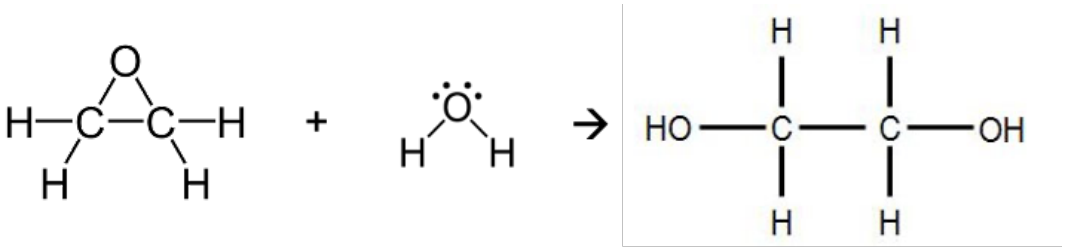
c	*centi-*
d	*deci-*
k	*kilo-*
m	*milli-*

!!!! FOR CREDIT, BE CLEAR AND WRITE LEGIBLY !!!!

Ethylene Glycol ($(CH_2OH)_2$ – 62.07 g/mol) is a liquid used in a series of real-world applications, like

- as a starting product in the synthesis of polymers.
- in ball point pens to help thicken the ink.
- to act as an antifreeze in cars.

The synthesis of the ethylene glycol can occur according to the reaction below…



ethylene oxide ethylene glycol

Part I – Multiple Choice Questions (1 pt each)

Excellent Answer = 1 pt *Fair Answer = 0.5 pts* *Unsatisfactory Answer = 0 pts*

____ 1. Which molecule in the reaction above would you expect to have the highest viscosity?

A. ethylene oxide
B. water
C. ethylene glycol
D. All three molecules have similar viscosity

____ 2. Compounds are considered hygroscopic if they absorb water from the air. Using intermolecular forces hypothesize if ethylene glycol is hygroscopic.

A. Ethylene glycol is hygroscopic, the IMF between ethylene glycol and water are similar.
B. Ethylene glycol is not hygroscopic, the IMF between ethylene glycol and water are too different.
C. Ethylene glycol is hygroscopic, the dispersion forces will pull in water from the air.
D. Ethylene glycol is not hygroscopic, the dispersion forces will repel water.

____ 3. Some pen inks are made from ethylene glycol and alcohol. Assuming an ideal solution, what is the vapor pressure of a solution that contains 52.3 g of ethylene glycol dissolved in 500.0 g of methanol (CH_3OH)? The vapor pressure of pure methanol is 97.68 mmHg at 20 °C.

A. 0.05 mmHg
B. 0.949 mmHg
C. 92.69 mmHg
D. 102.67 mmHg

____ 4. The normal boiling point of ethylene glycol is 197 °C and the enthalpy of vaporization is 65.6 kJ/mol. If an ethylene glycol sample is observed to boil in a lab apparatus at 105 °C, what is true?

A. The temperature is slightly higher in the apparatus.
B. The temperature is significantly higher in the apparatus.
C. The pressure is slightly lower in the apparatus.
D. The pressure is significantly lower in the apparatus.

____ 5. Ethylene glycol is used in the synthesis of many compounds, where it needs to be mixed with other reagents. Which compound would you expect to be <u>immiscible</u> in ethylene glycol?

A. Ethanol – CH_3CH_2OH.
B. Methyl amine – CH_3NH_2.
C. Acetic Acid – CH_3COOH.
D. Butane – $CH_3CH_2CH_2CH_3$.

Part II – Open Answer Questions – *See Page 1 for full grading details*

Excellent Answer = 1 pt *Fair Answer = 0.5 pts* *Unsatisfactory Answer = 0 pts*

6. The heating curve of pure ethylene glycol is an important tool for industrial chemists working with the compound. Sketch the curve below incorporating the boiling point (197 °C), freezing point (-12.9 °C), enthalpy of fusion (9.9 kJ/mol), and the enthalpy of vaporization (65.6 kJ/mol) into your plot. Be sure to label all components in detail.

Show your work in this box.

7. Ethylene glycol mixed with water is used as antifreeze in cars. Write the components that contribute to the enthalpy of solution, label the sign (+ or –) for each. Hypothesize the sign for the enthalpy of solution, explain your answer.

Show your work in this box.

8. Determine the mass of ethylene glycol present in 100.0 g of water if the antifreeze works until -15.0 °C.

Show your work in this box.

ANSWER IN THIS BOX → *Write mass of Ethylene Glycol here.*

9. <u>CLEARLY</u> draw a diagram which shows the changes on the molecular level of ethylene glycol transitioning from a gas to a liquid. Indicate whether heat is entering or exiting the system.

Draw diagram here…

10. Sodium chloride (NaCl) can be added to solvents to increase conductivity. A 1931 research paper found that 36.09 g NaCl can dissolve in 100 g of water but only 7.09 g NaCl can dissolve in 100 g of ethylene glycol. Using intermolecular forces, explain why this is observed.

Explain here…

END OF EXAM
!!! DON'T FORGET TO CHECK YOUR WORK !!!!

Useful information:

$1\ atm\ =\ 760\ mmHg\ =\ 101.3\ kPa$ $\qquad$ $R\ =\ 8.314\frac{J}{mol\cdot K} ==\ 0.08206\ \frac{L\cdot atm}{mol\cdot K}$

0 ºC = 273 K

$$\ln\left(\frac{P_2}{P_1}\right) = \frac{\Delta H_{vap}}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$S_{gas} = k_H P_{gas}$

$X_{solvent} + iX_{solute} = 1$

$P_{solution} = X_{solvent}P^o_{solvent}$

$\Delta T_f = (i)(m)(K_f)$ $\qquad$ $\Delta T_b = (i)(m)(K_b)$

$K_f\ H_2O = 1.84\ °C/m$ $\qquad$ $K_b\ H_2O = 0.512\ °C/m$

USE THIS PAGE FOR SCRAP. IT WILL NOT BE GRADED.

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