

CHEM 1032
PRACTICE
UNIT ASSESSMENT 3

SECTION: _____

NAME: _____

TUID:

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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(6)	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:

<i>H</i>	enthalpy
<i>v</i>	frequency
<i>M</i>	molar mass
mol	mole
<i>P</i>	pressure
<i>t</i>	time
<i>T</i>	temperature
<i>V</i>	volume

Constants:

<i>N_A</i>	Avogadro's number
<i>R</i>	ideal gas constant

SI (Metric) Prefixes:

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

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

Solid ammonium hydrogen sulfide (NH_4SH) is hypothesized to be the solid ice component of clouds on Jupiter and Saturn. However, on Earth the compound readily decomposes according to the reaction below which has a K_c of 1.8×10^{-4} . The two products of the decomposition have acid base properties if dissolved in water.



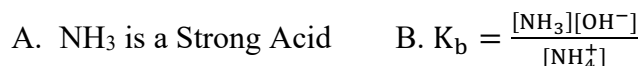
Part I – Multiple Choice Questions (1 pt each)

Excellent Answer = 1 pt

Fair Answer = 0.5 pts

Unsatisfactory Answer = 0 pts

____ 1. NH_3 is dissolved in water. The K_b expression is:



____ 2. NH_3 has a $\text{p}K_b = 4.74$. A researcher isolates NH_3 from the reaction and dissolves it in 500 mL of water. What is the pH of the solution when it is half neutralized with HCl?

- A. 4.74
- B. 5.04
- C. 8.96
- D. 9.26

____ 3. H_2S can be converted to H_2SO_4 by oxidizing bacteria. In equal volume solutions of 0.500 M H_2S and 0.500 M H_2SO_4 , which of the following is true?

- A. H_2S solution will have a higher pH because it has an equilibrium while H_2SO_4 does not.
- B. H_2S solution will have a lower pH because HSO_4^- is a stronger base than HS^- .
- C. H_2S solution will have a higher pOH because the HS^- concentration is higher than H_2SO_4^- .
- D. The solutions will have the same pH since both are diprotic acids.

____ 4. Another way to generate NH_3 in solution is by adding $\text{NH}_4\text{Cl}_{(s)}$ to water. What phrase would complete the sentence correctly: The pH of an NH_4Cl solution would be _____ the pH of an NH_3 solution.

- A. greater than
- B. less than
- C. equal to
- D. More information is needed.

____ 5. A 10.0 g sample NH_4SH of is placed in a closed vessel. What is the concentration of NH_3 ?

- A. 0.013 M
 - B. 1.8×10^{-4} M
 - C. 9.0×10^{-5} M
 - D. 3.0×10^{-8} M
-

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. After the decomposition, the products are separated and dissolved in water. In one container, H_2S dissolves. Write the equilibrium reactions for H_2S with water. Assign the two K values, 1.1×10^{-19} and 9.3×10^{-8} .

Show your work in this box.

7. In the other container, 0.250 M NH_3 is present in 250.0 mL of water. What is the pH of the solution? K_b of NH_3 is 1.8×10^{-5} .

Show your work in this box.

ANSWER IN THIS BOX →

Write the pH here.

8. You want to make a buffer of the **highest** buffering capacity by adding 250 mL of one of the solutions below to 250 mL of 0.250 M NH_3 . Clearly circle one solution and calculate the pH of the buffer.

<i>Circle ONE.</i>	0.500 M HBr	0.500 M $\text{CH}_3\text{NH}_4\text{Br}$	0.125 M HCl	0.125 M NaOH
<i>Justify your choice here...</i>				

9. Which is the stronger acid, H_2S or H_2O ? Justify your answer qualitatively.

<i>Justify your choice here...</i>	
CIRCLE THE STRONGER ACID	H_2S or H_2O

10. Consider instead of separating the gases, that they were allowed to dissolve in the same container of water, resulting in a mixture of 0.250 M H₂S and 0.250 M NH₃. Hypothesize and justify whether the solution would be acidic, basic, or neutral.

Show your work in this box.

CIRCLE pH CHARACTER→

ACIDIC or NEUTRAL or BASIC

END OF EXAM

!!! DON'T FORGET TO CHECK YOUR WORK !!!!

Useful information:

$$1 \text{ atm} = 760 \text{ mmHg} \quad 1 \text{ mmHg} = 1 \text{ torr} \quad 0 \text{ }^{\circ}\text{C} = 273 \text{ K}$$

$$R = 8.314 \text{ J}/(\text{mol K}) = 0.08206 \text{ (L atm)}/(\text{mol K})$$

$$K_P = K_C(RT)^{\Delta n}$$

$$K_a K_b = K_w$$

$$\text{pH} = -\log[\text{H}_3\text{O}^+]$$

$$\text{pOH} = -\log[\text{OH}^-]$$

$$\text{At } 25 \text{ }^{\circ}\text{C}: K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1.0 \times 10^{-14}$$

$$\text{pH} + \text{pOH} = 14.00$$

$$\text{p}K_a + \text{p}K_b = 14.00$$

$$\text{pH} = \text{p}K_a + \log\left(\frac{[\text{base}]}{[\text{acid}]}\right)$$

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

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