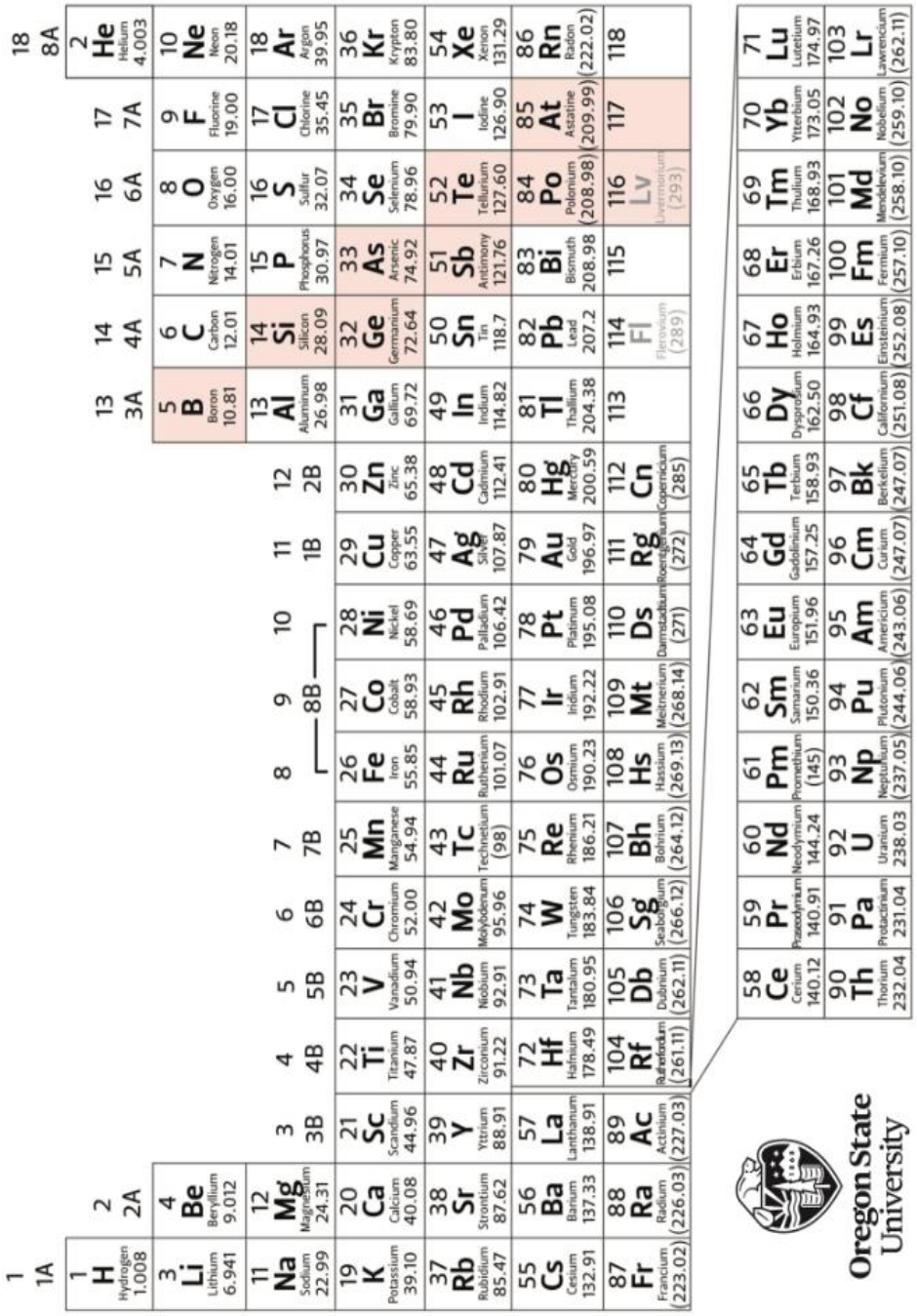
Name: _____

This is a practice test for CH 233 midterm I. There are 13 multiple choice/short answer and 7 free response questions and is representative of what could be expected on the actual midterm. Please treat it as a real examination, with no outside help from notes, internet, or peers. A lot of these questions will require you to reference the cover sheet for tabulated data. Take 80 + 20 minutes to complete this practice test and remember to keep in mind significant figures. Once done, let James know for the answer key. Good luck!



I. Ionization Constants for Acids at 25 °C

Name	Formula	K_{a_1}	K_{a_2}	K_{a_3}
Acetic	$HC_2H_3O_2$	1.8×10^{-5}		
Acetylsalicylic	$HC_9H_7O_4$	3.3×10^{-4}		
Adipic	$H_2C_6H_8O_4$	3.9×10^{-5}	3.9×10^{-6}	
Arsenic	H_3AsO_4	5.5×10^{-3}	1.7×10^{-7}	5.1×10^{-12}
Arsenous	H_3AsO_3	5.1×10^{-10}		
Ascorbic	$H_2C_6H_6O_6$	8.0×10^{-5}	1.6×10^{-12}	
Benzoic	$HC_7H_5O_2$	6.5×10^{-5}		
Boric	H_3BO_3	5.4×10^{-10}		
Butanoic	$HC_4H_7O_2$	1.5×10^{-5}		
Carbonic	H_2CO_3	4.3×10^{-7}	5.6×10^{-11}	
Chloroacetic	$HC_2H_2O_2Cl$	1.4×10^{-3}		
Chlorous	$HClO_2$	1.1×10^{-2}		
Citric	$H_3C_6H_5O_7$	7.4×10^{-4}	1.7×10^{-5}	4.0×10^{-7}
Cyanic	HCNO	2×10^{-4}		
Formic	$HCHO_2$	1.8×10^{-4}		
Hydrazoic	HN_3	2.5×10^{-5}		
Hydrocyanic	HCN	4.9×10^{-10}		
Hydrofluoric	HF	3.5×10^{-4}		
Hydrogen chromate ion	$HCrO_4^-$	3.0×10^{-7}		
Hydrogen peroxide	H_2O_2	2.4×10^{-12}		
Hydrogen selenate ion	$HSeO_4^-$	2.2×10^{-2}		
Hydrosulfuric	H_2S	8.9×10^{-8}	1×10^{-19}	

Name	Formula	K_{a_1}	K_{a_2}	K_{a_3}
Hydrotelluric	H_2Te	2.3×10^{23}	1.6×10^{-11}	
Hypobromous	HBrO	2.8×10^{-9}		
Hypochlorous	HClO	2.9×10^{-8}		
Hypoiodous	HIO	2.3×10^{-11}		
Iodic	HIO_3	1.7×10^{-1}		
Lactic	$HC_3H_5O_3$	1.4×10^{-4}		
Maleic	$H_2C_4H_2O_4$	1.2×10^{-2}	5.9×10^{-7}	
Malonic	$H_2C_3H_2O_4$	1.5×10^{-3}	2.0×10^{-6}	
Nitrous	HNO_2	4.6×10^{-4}		
Oxalic	$H_2C_2O_4$	6.0×10^{-2}	6.1×10^{-5}	
Paraperiodic	H_5IO_6	2.8×10^{-2}	5.3×10^{-9}	
Phenol	HC_6H_5O	1.3×10^{-10}		
Phosphoric	H_3PO_4	7.5×10^{-3}	6.2×10^{-8}	4.2×10^{-13}
Phosphorous	H_3PO_3	5×10^{-2}	2.0×10^{-7}	
Propanoic	$HC_3H_5O_2$	1.3×10^{-5}		
Pyruvic	$HC_3H_3O_3$	4.1×10^{-3}		
Pyrophosphoric	$H_4P_2O_7$	1.2×10^{-1}	7.9×10^{-3}	2.0×10^{-7}
Selenous	H_2SeO_3	2.4×10^{-3}	4.8×10^{-9}	
Succinic	$H_2C_4H_4O_4$	6.2×10^{-5}	2.3×10^{-6}	
Sulfuric	H_2SO_4	Strong acid	1.2×10^{-2}	
Sulfurous	H_2SO_3	1.6×10^{-2}	6.4×10^{-8}	
Tartaric	$H_2C_4H_4O_6$	1.0×10^{-3}	4.6×10^{-5}	
Trichloroacetic	$HC_2Cl_3O_2$	2.2×10^{-1}		
Trifluoroacetic acid	$HC_2F_3O_2$	3.0×10^{-1}		

3. Ionization Constants for Bases at 25 °C

Name	Formula	K_b
Ammonia	NH_3	1.76×10^{-5}
Aniline	$C_6H_5NH_2$	3.9×10^{-10}
Bicarbonate ion	HCO_3^-	2.3×10^{-8}
Carbonate ion	CO_3^{2-}	1.8×10^{-4}
Codeine	$C_{18}H_{21}NO_3$	1.6×10^{-6}
Diethylamine	$(C_2H_5)_2NH$	6.9×10^{-4}
Dimethylamine	$(CH_3)_2NH$	5.4×10^{-4}
Ethylamine	$C_2H_5NH_2$	5.6×10^{-4}
Ethylenediamine	$C_2H_8N_2$	8.3×10^{-5}
Hydrazine	H_2NNH_2	1.3×10^{-6}
Hydroxylamine	$HONH_2$	1.1×10^{-8}

Name	Formula	K_b
Ketamine	$C_{13}H_{16}ClNO$	3×10^{-7}
Methylamine	CH_3NH_2	4.4×10^{-4}
Morphine	$C_{17}H_{19}NO_3$	1.6×10^{-6}
Nicotine	$C_{10}H_{14}N_2$	1.0×10^{-6}
Piperidine	$C_5H_{10}NH$	1.33×10^{-3}
Propylamine	$C_3H_7NH_2$	3.5×10^{-4}
Pyridine	C_5H_5N	1.7×10^{-9}
Strychnine	$C_{21}H_{22}N_2O_2$	1.8×10^{-6}
Triethylamine	$(C_2H_5)_3N$	5.6×10^{-4}
Trimethylamine	$(CH_3)_3N$	6.4×10^{-5}

Multiple Choice Section (13 questions)

1)Which is not a Lewis base?

a) OH^-
b) F^-
c) $C_2O_4^{2-}$
d) Cu^{2+}
e) NH_3

2)What is the pH of 0.750 acetic acid, $CH_3COOH_{(aq)}$?

a) 0.750
b) 0.00367
c) 2.43
d) 1.75
e) 6.25

3)What is the conjugate acid of HCO_3^-?

a) H_3O^+
b) H_2O
c) CO_3^{2-}
d) OH^-
e) H_2CO_3

4) Which, if any, of the following species is in the greatest concentration in a 0.100-molar solution of H_2SO_4 in water?

a) H_2SO_4

b) H_3O^+

c) HSO_4^-

d) SO_4^{2-}

e) All species are in equilibrium and therefore have the same concentration.

5)Arrange by increasing basicity:

CH_3NH_3Br KOH KBr KCN $C_5H_5NHO_2$

6) A general chemistry students creates a buffer by adding 0.5 mol of solid sodium hydroxide to 1.0 L of 1.0 M acetic acid. What can be said about the pH of the buffer?

a) The pH will be equal to the pKa for acetic acid

b) The pH will be greater than the pKa for acetic acid

c) The pH will be less than the pKa for acetic acid

d) The pH will be equal to the pKa of acetic acid minus 0.30

e) The pH will be less than the value in answer d.

f) Not enough info

7)A student titrates 2.884 g of an unknown monoprotic acid to the equivalence point with 62.55 mL of 0.2447 M NaOH. What is the molar mass of the acid?

a) 0.005307 g/mol
b) 53.07 g/mol
c) 530.7 g/mol
d) 73.72 g/mol
e) 188.4 g/mol

8)What is the molar solubility of $Al(OH)_{3(aq)}$? $K_{sp} = 1.3*10^{-33}$

a) 6.0×10^{-9} M
b) 2.6×10^{-9} M
c) 4.6×10^{-9} M
d) 2.08×10^{-17} M
e) 6.9×10^{-10} M

9)Which of the following pairs will create a buffer system? There may be more than one.

a) HClO and $LiClO_2^-$
b) HF and KF
c) CH_3NH_2 and CH_3NH_3Cl
d) NH_3 and NH_4Cl
e) HNO_3 and $NaNO_3$
f) $HClO_4$ and $NaClO_4$

10) Which many of the following compounds are acidic? There may be more than one.

$FeBr_3$ $NH_4C_2H_3O_2$ $Ca(NO_3)_2$ Na_2CO_3 KNO_2

RbI $(NH_4)_2SO_4$

11) With respect to acids and bases, (select all that are true)

a) A CH_3NH_3Br solution is acidic

b) NO_2^- is a stronger base than $H_2AsO_3^-$

c) Adding some solid sodium acetate, $NaC_2H_3O_2$, to aqueous $HC_2H_3O_2$ will decrease the pH

d) Titration of a weak acid with a strong base will have a pH below 7 at the equivalence point

e) $CaCO_3$ is more soluble in an acidic solution than in pure water

12) Consider the titrations of the pairs of aqueous acids and bases listed on the left. For which pair is the pH at the equivalence point stated incorrectly?

Acid-Base Pair	**pH at Equivalence Point**
(a) $HCl + NH_3$	less than 7
(b) $HNO_3 + Ca(OH)_2$	equal to 7
(c) $HClO_4 + NaOH$	equal to 7
(d) $HClO + NaOH$	less than 7
(e) $CH_3COOH + KOH$	greater than 7

13)Carbon dioxide dissolves in water according to the equation:

$$CO_{2(g)} + H_2O_{(l)} \rightleftharpoons H_2CO_{3(aq)}$$

$$H_2CO_{3(aq)} + H_2O_{(l)} \rightleftharpoons HCO_3^-{}_{(aq)} + H_3O^+_{(aq)}$$

CO_2 levels in the atmosphere have increased about 20% over the last century. Given that Earth's oceans are exposed to atmospheric CO_2, which of the following best predicts the effects of increased CO_2 levels on the pH of the Earth's oceans now?

a) The pH of Earth's oceans now is higher than the pH of Earth's oceans a century ago
b) The pH of Earth's oceans now is the same than the pH of Earth's oceans a century ago
c) The pH of Earth's oceans now is lower than the pH of Earth's oceans a century ago
d) The increase in CO_2 levels in Earth's oceans has no effect on its pH

Free Response Questions (7 questions, multiple parts)

14) Find the Kb for some unknown weak base that is 0.150M and has a pH of 10.7.

15) A 52.60 mL aqueous Jamesonnium, HJ, acid solution has a pH of 6.6. How many hydronium ions are present in this solution?

16) Ammonium carbonate, $(NH_4)_2CO_3$, is a leavening agent sometimes used for cooking as a substitute for baking powder. What is the pH of 0.200 mol ammonium carbonate in a 0.800L solution?

17) A 100. mL sample of 0.35 M propanoic acid (C_2H_5COOH) is mixed with 0.50 M sodium propanoate.

a. What is the pH of this solution?

b. To this solution, 0.0040 moles of solid NaOH are added. Calculate the pH of the resulting solution.

c. If the concentrations of both the acid and the conjugate base were doubled, how would pH be affected? Explain how the capacity of the buffer is affected by this change in concentrations of the acid and base.

18) A student adds 4.40 grams of sodium formate, $NaCHO_2$ to 500. mL 0.250M formic acid, $HCHO_2$.

a) Will the pH increase, decrease or stay the same?

b) What is the final pH?

19) Blood is buffered by 0.012M carbonic acid, H_2CO_3, and 0.024M bicarbonate ion (HCO_3^-, pKa = 6.1). Assuming that the volume of blood in an adult is 5 liters, what mass of HCl can be neutralized by the buffer before the system reaches a fatal pH of below 7?

20) Consider 25.00 mL sample of 0.320M propanoic acid, $HC_3H_5O_2$, analyte being titrated by 0.750M LiOH.

a) Calculate the pH before any titrant is added

b) What is the pH of the solution after 5.00mL of titrant is added?

c) What is the pH at the equivalence point?