

Name: KEY

**Chem 121, Fall 2009**  
**Test 2A**

Multiple Choice (24 pts): Clearly indicate the correct answer in the space provided.

- D 1. Which statement below states a true fact?
- A) All acids are strong electrolytes and ionize completely when dissolved in water.
  - B) All bases are weak electrolytes and ionize completely when dissolved in water.
  - C) All bases are strong electrolytes and ionize completely when dissolved in water.
  - D) All salts are strong electrolytes and dissociate completely when dissolved in water.
  - E) All salts are weak electrolytes and ionize partially when dissolved in water.
- E 2. In the reaction,  $\text{K}_2\text{SO}_4 + \text{Ba}(\text{NO}_3)_2 \rightarrow \text{BaSO}_4(s) + 2 \text{KNO}_3$ , which ions are the spectator ions?
- A)  $\text{Ba}^{2+}$  and  $\text{SO}_4^{2-}$
  - B)  $\text{Ba}^{2+}$  and  $\text{K}^+$
  - C)  $\text{Ba}^{2+}$  and  $\text{NO}_3^-$
  - D)  $\text{K}^+$  and  $\text{SO}_4^{2-}$
  - E)  $\text{K}^+$  and  $\text{NO}_3^-$
- C 3. Which is the net ionic equation for the reaction which takes place when  $\text{HC}_2\text{H}_3\text{O}_2(aq)$  is added to  $\text{Ba}(\text{OH})_2(aq)$ ?
- A)  $\text{HC}_2\text{H}_3\text{O}_2(aq) + \text{Ba}(\text{OH})_2(aq) \rightarrow \text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2(aq) + \text{H}_2\text{O}(l)$
  - B)  $\text{H}^+(aq) + \text{OH}^-(aq) \rightarrow \text{H}_2\text{O}(l)$
  - C)  $\text{HC}_2\text{H}_3\text{O}_2(aq) + \text{OH}^-(aq) \rightarrow \text{C}_2\text{H}_3\text{O}_2^-(aq) + \text{H}_2\text{O}(l)$
  - D)  $\text{H}^+(aq) + \text{Ba}(\text{OH})_2(aq) \rightarrow \text{Ba}^{2+}(aq) + \text{H}_2\text{O}(l)$
  - E)  $\text{HC}_2\text{H}_3\text{O}_2(aq) + \text{Ba}^{2+}(aq) \rightarrow \text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2(aq) + \text{H}^+(aq)$
- D 4. Which is NOT a strong acid?
- A) HBr
  - B) HCl
  - C)  $\text{HClO}_3$
  - D) HF
  - E) HI
- D 5. Which compound is insoluble in water?
- A)  $\text{KNO}_3$
  - B)  $\text{Pb}(\text{NO}_3)_2$
  - C)  $\text{Na}_2\text{SO}_4$
  - D)  $\text{PbSO}_4$
  - E)  $\text{MgCl}_2$
- B 6. Which set of compounds are all soluble in water?
- A)  $\text{BaCO}_3$ ,  $\text{NaBrO}_3$ ,  $\text{Ca}(\text{OH})_2$ , and  $\text{PbCl}_2$
  - B)  $\text{NaCl}$ ,  $\text{BaCl}_2$ ,  $\text{NH}_4\text{NO}_3$ , and  $\text{LiClO}_4$
  - C)  $\text{NiCO}_3$ ,  $\text{PbSO}_4$ ,  $\text{AgCl}$ , and  $\text{Mg}(\text{OH})_2$
  - D)  $\text{NaCl}$ ,  $\text{AgBr}$ ,  $\text{Na}_2\text{CO}_3$ , and  $\text{Hg}_2(\text{NO}_3)_2$
  - E)  $\text{PbCl}_2$ ,  $\text{Pb}(\text{NO}_3)_2$ ,  $\text{AgClO}_4$ , and  $\text{HgCl}_2$

Calculations (76 pts): Clearly show all work for full credit.

7. (5 pts) How many aluminum atoms are in a 4.55 g sample of aluminum?

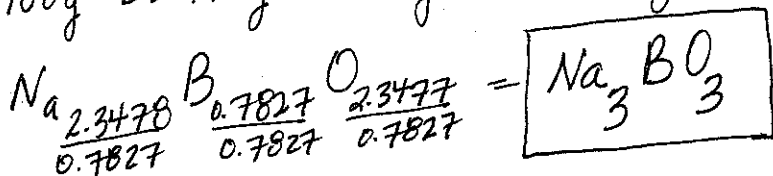
$$4.55 \text{ g Al} \times \frac{1 \text{ mol Al}}{26.98 \text{ g Al}} \times \frac{6.02 \times 10^{23} \text{ atoms Al}}{1 \text{ mol Al}} = 1.02 \times 10^{23} \text{ atoms Al}$$

8. (10 pts) A compound contains sodium, boron, and oxygen. An experimental analysis gave values of 53.976% sodium and 8.461% boron, by weight; the remainder is oxygen. What is the empirical formula of the compound? Assume exactly 100 g

$$53.976 \text{ g Na} \times \frac{1 \text{ mol Na}}{22.99 \text{ g Na}} = 2.3478 \text{ mol Na}$$

$$8.461 \text{ g B} \times \frac{1 \text{ mol B}}{10.81 \text{ g B}} = 0.7827 \text{ mol B}$$

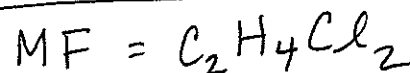
$$100 \text{ g} - 53.976 \text{ g} - 8.461 \text{ g} = 37.563 \text{ g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 2.3477 \text{ mol O}$$



9. (5 pts) A compound has an empirical formula of  $\text{CH}_2\text{Cl}$ . The molecular formula has a molar mass of 99.0 g/mol. What is the molecular formula of the compound?

$$\text{CH}_2\text{Cl} \quad 1 \text{ C} + 2 \text{ H} + 1 \text{ Cl} = (12.01 \text{ g/mol}) + (2 \times 1.008 \text{ g/mol}) + 35.45 \text{ g/mol} \\ = 49.48 \text{ g/mol}$$

$$\frac{\text{MM of MF}}{\text{MM of EF}} = \frac{99.0 \text{ g/mol}}{49.48 \text{ g/mol}} = 2$$



10. (6 pts) How many grams of iron are there in a sample of  $\text{Fe}_3\text{O}_4$  which weighs 8.338 grams? (MM of  $\text{Fe}_3\text{O}_4 = 231.54 \text{ g/mol}$ )

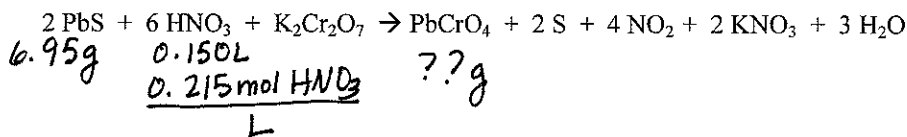
$$8.338 \text{ g Fe}_3\text{O}_4 \times \frac{1 \text{ mol Fe}_3\text{O}_4}{231.54 \text{ g Fe}_3\text{O}_4} \times \frac{3 \text{ mol Fe}}{1 \text{ mol Fe}_3\text{O}_4} \times \frac{55.85 \text{ g Fe}}{1 \text{ mol Fe}} \\ = 6.034 \text{ g Fe}$$

11. (10 pts) Calculate the molar mass of  $(\text{NH}_4)_2\text{SO}_4$  and determine the percent by mass of nitrogen in the compound.

$$\begin{aligned}
 2 \text{ N} &= 2(14.01 \text{ g/mol}) = 28.02 \text{ g/mol} \\
 8 \text{ H} &= 8(1.008 \text{ g/mol}) = 8.064 \text{ g/mol} \\
 1 \text{ S} &= 1(32.06 \text{ g/mol}) = 32.06 \text{ g/mol} \\
 4 \text{ O} &= 4(16.00 \text{ g/mol}) = 64.00 \text{ g/mol} \\
 &\hline
 &124.14 \text{ g/mol}
 \end{aligned}$$

$$\% \text{ N} = \frac{28.02}{124.14} \times 100 = 22.57\% \text{ N}$$

12. (15 pts) Lead sulfide, in ores, can be assayed by the reaction below. How much  $\text{PbCrO}_4$  is produced when 6.95 g  $\text{PbS}$  is reacted with 0.150 L of 0.215 M  $\text{HNO}_3$ ? (MM of  $\text{PbS}$  = 239.3 g/mol, MM of  $\text{PbCrO}_4$  = 323.2 g/mol)



$$6.95 \text{ g PbS} \times \frac{1 \text{ mol PbS}}{239.3 \text{ g PbS}} \times \frac{1 \text{ mol PbCrO}_4}{2 \text{ mol PbS}} \times \frac{323.2 \text{ g PbCrO}_4}{1 \text{ mol PbCrO}_4} = 4.69 \text{ g PbCrO}_4$$

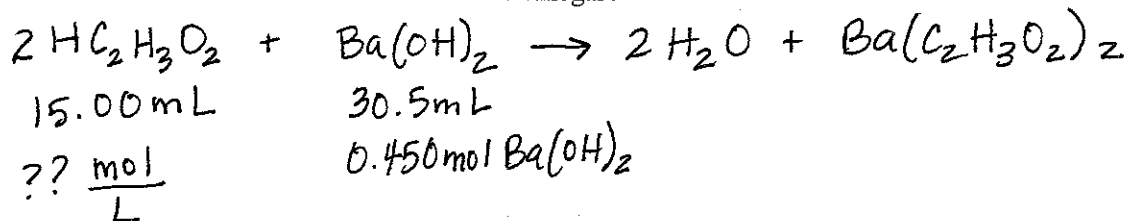
$$0.150 \text{ L} \times \frac{0.215 \text{ mol HNO}_3}{\text{L}} \times \frac{1 \text{ mol PbCrO}_4}{6 \text{ mol HNO}_3} \times \frac{323.2 \text{ g PbCrO}_4}{1 \text{ mol PbCrO}_4} = 1.74 \text{ g PbCrO}_4$$

13. (10 pts) What is the molar concentration of a solution prepared by dissolving 4.10 grams of sodium acetate in enough water to prepare 250.0 mL of the solution? (MM of  $\text{NaC}_2\text{H}_3\text{O}_2$  = 82.034 g/mol)     $?? \text{ mol/L}$

$$\frac{4.10 \text{ g NaC}_2\text{H}_3\text{O}_2}{250.0 \text{ mL}} \times \frac{1 \text{ mol NaC}_2\text{H}_3\text{O}_2}{82.034 \text{ g NaC}_2\text{H}_3\text{O}_2} \times \frac{1000 \text{ mL}}{1 \text{ L}}$$

$$= 0.200 \text{ M NaC}_2\text{H}_3\text{O}_2$$

14. (15 pts) Vinegar contains acetic acid ( $\text{HC}_2\text{H}_3\text{O}_2$ ), which is responsible for its acidity. In one analysis of a commercial vinegar brand, a 15.00 mL sample was titrated with 0.450 M  $\text{Ba}(\text{OH})_2$ . It required 30.5 mL of barium hydroxide to neutralize the acid in the vinegar sample. What is the molar concentration of acetic acid in the vinegar?



$$30.5 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{0.450 \text{ mol Ba}(\text{OH})_2}{\text{L}} \times \frac{2 \text{ mol HC}_2\text{H}_3\text{O}_2}{1 \text{ mol Ba}(\text{OH})_2} = 0.0275 \text{ mol HC}_2\text{H}_3\text{O}_2$$

$$\frac{0.0275 \text{ mol HC}_2\text{H}_3\text{O}_2}{15.00 \text{ mL}} \times \frac{1000 \text{ mL}}{\text{L}} = \boxed{1.83 \text{ M HC}_2\text{H}_3\text{O}_2}$$

IA																										VIIIA
1	H																									2
	1.008																									He
		IIA																								4.00
3	Li	Be																								Ne
	6.94	9.01																								20.18
5	B	C	N	O	F	Ne											Ar									
	10.81	12.01	14.01	16.00	19.00	20.18											39.95									
11	Na	Mg											Al	Si	P	S	Cl	Ar								
	22.99	24.31											26.98	28.09	30.97	32.06	35.45	39.95								
19	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr								
	39.10	40.08	44.96	47.90	50.94	52.00	54.94	55.85	58.93	58.71	63.55	65.37	69.72	72.59	74.92	78.96	79.90	83.80								
37	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe								
	85.47	87.62	88.91	91.22	92.91	95.94	[98]	101.1	102.9	106.4	107.9	112.40	114.8	118.7	121.8	127.60	126.90	131.30								
55	Cs	Ba	Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn								
	132.9	137.3	175	178.5	181	183.9	186.2	190.2	192.2	195.1	197	200.59	204.4	207.2	209	[209]	[210]	[222]								
87	Fr	Ra	Lr	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Uub	Uut	Uuq	Uup	Uuh		Uuo								
	[223]	[226]	[262]	[267]	[268]	[271]	[272]	[270]	[276]	[281]	[280]	[285]	[284]	[289]	[288]	[293]		[294]								

57	58	59	60	61	62	63	64	65	66	67	68	69	70
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
138.9	140.1	140.9	144.2	[145]	150.4	152	157.3	158.9	162.5	164.93	167.3	168.9	173
89	90	91	92	93	94	95	96	97	98	99	100	101	102
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No
[227]	232	[231]	238	[237]	[244]	[243]	[247]	[247]	[251]	[252]	[257]	[258]	[259]

Name: KEY

**Chem 121, Fall 2009**  
**Test 2B**

*Multiple Choice (24 pts): Clearly indicate the correct answer in the space provided.*

- D 1. Which statement below states a true fact?
- A) All acids are strong electrolytes and ionize completely when dissolved in water.
  - B) All bases are weak electrolytes and ionize completely when dissolved in water.
  - C) All bases are strong electrolytes and ionize completely when dissolved in water.
  - D) All salts are strong electrolytes and dissociate completely when dissolved in water.
  - E) All salts are weak electrolytes and ionize partially when dissolved in water.
- A 2. In the reaction,  $\text{Na}_2\text{CO}_3 + \text{NiCl}_2 \rightarrow \text{NiCO}_3 + 2 \text{NaCl}$ , which ions are the spectator ions?
- A)  $\text{Na}^+$  and  $\text{Cl}^-$
  - B)  $\text{Na}^+$  and  $\text{CO}_3^{2-}$
  - C)  $\text{Ni}^{2+}$  and  $\text{CO}_3^{2-}$
  - D)  $\text{Ni}^{2+}$  and  $\text{Cl}^-$
  - E)  $\text{Na}^+$  and  $\text{Ni}^{2+}$
- D 3. Which is the net ionic equation for the reaction which takes place when  $\text{HNO}_3$  is added to  $\text{Mg}(\text{OH})_2$ ?
- A)  $\text{HNO}_3(\text{aq}) + \text{Mg}(\text{OH})_2(\text{s}) \rightarrow \text{Mg}(\text{NO}_3)_2(\text{aq}) + \text{H}_2\text{O}(\text{l})$
  - B)  $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
  - C)  $\text{HNO}_3(\text{aq}) + \text{OH}^-(\text{s}) \rightarrow \text{NO}_3^-(\text{aq}) + \text{H}_2\text{O}(\text{l})$
  - D)  $\text{H}^+(\text{aq}) + \text{Mg}(\text{OH})_2(\text{s}) \rightarrow \text{Mg}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
  - E)  $\text{HNO}_3(\text{aq}) + \text{Mg}^{2+}(\text{aq}) \rightarrow \text{Mg}(\text{NO}_3)_2(\text{aq}) + \text{H}^+(\text{aq})$
- E 4. Which is NOT a strong base?
- A)  $\text{Ca}(\text{OH})_2$
  - B)  $\text{Ba}(\text{OH})_2$
  - C)  $\text{KOH}$
  - D)  $\text{NaOH}$
  - E)  $\text{NH}_3$
- C 5. Which compound is insoluble in water?
- A)  $\text{Na}_2\text{CO}_3$
  - B)  $\text{NH}_4\text{NO}_3$
  - C)  $\text{CaCO}_3$
  - D)  $\text{CaCl}_2$
  - E)  $\text{LiClO}_4$
- D 6. Which set of compounds are all insoluble in water?
- A)  $\text{BaCO}_3$ ,  $\text{NaBrO}_3$ ,  $\text{Ca}(\text{OH})_2$ , and  $\text{PbCl}_2$
  - B)  $\text{NaCl}$ ,  $\text{BaCl}_2$ ,  $\text{NH}_4\text{NO}_3$ , and  $\text{LiClO}_4$
  - C)  $\text{NaCl}$ ,  $\text{AgBr}$ ,  $\text{Na}_2\text{CO}_3$ , and  $\text{Hg}_2(\text{NO}_3)_2$
  - D)  $\text{NiCO}_3$ ,  $\text{PbSO}_4$ ,  $\text{AgCl}$ , and  $\text{Mg}(\text{OH})_2$
  - E)  $\text{PbCl}_2$ ,  $\text{Pb}(\text{NO}_3)_2$ ,  $\text{AgClO}_4$ , and  $\text{HgCl}_2$

Calculations (76 pts): Clearly show all work for full credit.

7. (5 pts) How many chromium atoms are there in a 5.44 g sample of chromium?

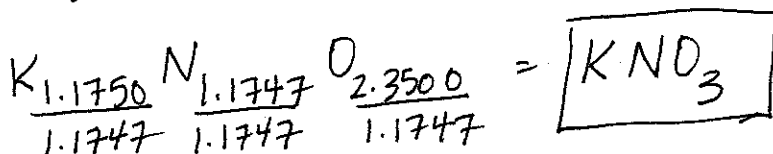
$$5.44 \text{ g Cr} \times \frac{1 \text{ mol Cr}}{52.00 \text{ g Cr}} \times \frac{6.02 \times 10^{23} \text{ atoms Cr}}{1 \text{ mol Cr}} = 6.30 \times 10^{22} \text{ atoms Cr}$$

8. (10 pts) A compound contains potassium, nitrogen, and oxygen. An experimental analysis gave values of 45.942% potassium and 16.458% nitrogen, by weight; the remainder is oxygen. What is the empirical formula of the compound? Assume exactly 100 g

$$45.942 \text{ g K} \times \frac{1 \text{ mol K}}{39.10 \text{ g K}} = 1.1750 \text{ mol K}$$

$$16.458 \text{ g N} \times \frac{1 \text{ mol N}}{14.01 \text{ g N}} = 1.1747 \text{ mol N}$$

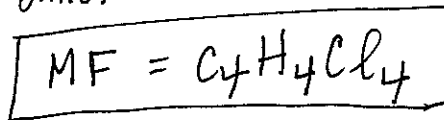
$$100 \text{ g} - 45.942 \text{ g} - 16.458 \text{ g} = 37.600 \text{ g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 2.3500 \text{ mol O}$$



9. (5 pts) A compound has an empirical formula of CHCl. An independent analysis gave a value of 194 g for its molar mass. What is the molecular formula of the compound?

$$\text{CHCl} \quad 1\text{C} + 1\text{H} + 1\text{Cl} = 12.01 \text{ g/mol} + 1.008 \text{ g/mol} + 35.45 \text{ g/mol} \\ = 48.47 \text{ g/mol}$$

$$\frac{\text{MM of MF}}{\text{MM of EF}} = \frac{194 \text{ g/mol}}{48.47 \text{ g/mol}} = 4$$



10. (6 pts) How many grams of iron are there in a sample of  $\text{Fe}_2\text{O}_3$ , which weighs 28.95 grams? (MM of  $\text{Fe}_2\text{O}_3 = 159.70 \text{ g/mol}$ )

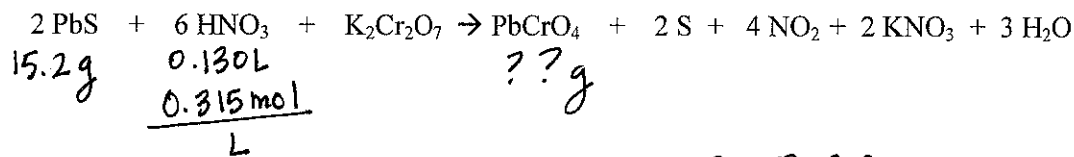
$$28.95 \text{ g Fe}_2\text{O}_3 \times \frac{1 \text{ mol Fe}_2\text{O}_3}{159.70 \text{ g Fe}_2\text{O}_3} \times \frac{2 \text{ mol Fe}}{1 \text{ mol Fe}_2\text{O}_3} \times \frac{55.85 \text{ g Fe}}{1 \text{ mol Fe}} \\ = 20.25 \text{ g Fe}$$

11. (10 pts) Calculate the molar mass of  $(\text{NH}_4)_3\text{PO}_4$  and determine the percent by mass of phosphorus in the compound.

$$\begin{aligned}
 3\text{N} &= 3(14.01\text{g/mol}) = 42.03\text{g/mol} \\
 12\text{H} &= 12(1.008\text{g/mol}) = 12.10\text{g/mol} \\
 1\text{P} &= 1(30.97\text{g/mol}) = 30.97\text{g/mol} \\
 4\text{O} &= 4(16.00\text{g/mol}) = 64.00\text{g/mol} \\
 \hline
 &149.10\text{g/mol}
 \end{aligned}$$

$$\% \text{P} = \frac{30.97}{149.10} \times 100 = 20.77\% \text{P}$$

12. (15 pts) Lead sulfide, in ores, can be assayed by the reaction below. How much  $\text{PbCrO}_4$  is produced when 15.2 g  $\text{PbS}$  is reacted with 0.130L of 0.315 M  $\text{HNO}_3$ ? (MM of  $\text{PbS}$  = 239.3g/mol, MM of  $\text{PbCrO}_4$  = 323.2 g/mol)



$$15.2\text{g PbS} \times \frac{1\text{mol PbS}}{239.3\text{g PbS}} \times \frac{1\text{mol PbCrO}_4}{2\text{mol PbS}} \times \frac{323.2\text{g PbCrO}_4}{1\text{mol PbCrO}_4} = 10.3\text{g PbCrO}_4$$

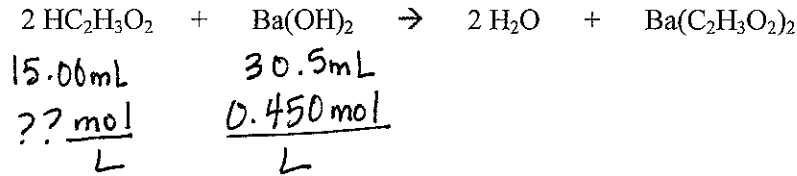
$$0.130\text{L} \times \frac{0.315\text{mol HNO}_3}{\text{L}} \times \frac{1\text{mol PbCrO}_4}{6\text{mol HNO}_3} \times \frac{323.2\text{g PbCrO}_4}{1\text{mol PbCrO}_4} = \boxed{2.21\text{g PbCrO}_4}$$

13. What is the molar concentration of a solution prepared by dissolving 7.58 grams of potassium nitrate in enough water to prepare 250.0 mL of the solution? (MM of  $\text{KNO}_3$  = 101.10 g/mol)

$$?? \frac{\text{mol}}{\text{L}}$$

$$\begin{aligned}
 &\frac{7.58\text{g KNO}_3}{250.0\text{mL}} \times \frac{1\text{mol KNO}_3}{101.10\text{g KNO}_3} \times \frac{1000\text{mL}}{1\text{L}} \\
 &= 0.300\text{M KNO}_3
 \end{aligned}$$

14. (15 pts) Vinegar contains acetic acid ( $\text{HC}_2\text{H}_3\text{O}_2$ ), which is responsible for its acidity. In one analysis of a commercial vinegar brand, a 15.00 mL sample was titrated with 0.450 M  $\text{Ba}(\text{OH})_2$ . It required 30.5 mL of barium hydroxide to neutralize the acid in the vinegar sample. What is the molar concentration of acetic acid in the vinegar?



$$30.5 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{0.450 \text{ mol Ba}(\text{OH})_2}{\text{L}} \times \frac{2 \text{ mol HC}_2\text{H}_3\text{O}_2}{1 \text{ mol Ba}(\text{OH})_2} = 0.0275 \text{ mol HC}_2\text{H}_3\text{O}_2$$

$$\frac{0.0275 \text{ mol HC}_2\text{H}_3\text{O}_2}{15.00 \text{ mL}} \times \frac{1000 \text{ mL}}{\text{L}} = \boxed{1.83 \text{ M HC}_2\text{H}_3\text{O}_2}$$

IA																											VIIIA																																																																																				
1	H 1.008																	He 4.00																																																																																													
2	Li 6.94	Be 9.01											B 10.81	C 12.01	N 14.01	O 16.00	F 19.00	Ne 20.18																																																																																													
3	Na 22.99	Mg 24.31											Al 26.98	Si 28.09	P 30.97	S 32.06	Cl 35.45	Ar 39.95																																																																																													
4	K 39.10	Ca 40.08	Sc 44.96	Ti 47.90	V 50.94	Cr 52.00	Mn 54.94	Fe 55.85	Co 58.93	Ni 58.71	Cu 63.55	Zn 65.37	Ga 69.72	Ge 72.59	As 74.92	Se 78.96	Br 79.90	Kr 83.80																																																																																													
5	Rb 85.47	Sr 87.62	Y 88.91	Zr 91.22	Nb 92.91	Mo 95.94	Tc [98]	Ru 101.1	Rh 102.9	Pd 106.4	Ag 107.9	Cd 112.40	In 114.8	Sn 118.7	Sb 121.8	Te 127.60	I 126.90	Xe 131.30																																																																																													
6	Cs 132.9	Ba 137.3	La 138.9	Ce 140.1	Pr 140.9	Nd 144.2	Pm [145]	Sm 150.4	Eu 152	Gd 157.3	Tb 158.9	Dy 162.5	Ho 164.93	Er 167.3	Tm 168.9	Yb 173	Lu 175	Hf 178.5	Ta 181	W 183.9	Re 186.2	Os 190.2	Ir 192.2	Pt 195.1	Au 197	Hg 200.59	Tl 204.4	Pb 207.2	Bi 209	Po [209]	At [210]	Rn [222]																																																																															
7	Fr [223]	Ra [226]	Ac [227]	Th 232	Pa [231]	U 238	Np [237]	Pu [244]	Am [243]	Cm [247]	Bk [247]	Cf [251]	Es [252]	Fm [257]	Md [258]	No [259]	Lr [262]	Rf [267]	Db [268]	Sg [271]	Bh [272]	Hs [270]	Mt [276]	Ds [281]	Rg [280]	Uub [285]	Uut [284]	Uuq [289]	Uup [288]	Uuh [293]	Uuo [294]																																																																																
																		<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>57</td><td>58</td><td>59</td><td>60</td><td>61</td><td>62</td><td>63</td><td>64</td><td>65</td><td>66</td><td>67</td><td>68</td><td>69</td><td>70</td> </tr> <tr> <td>La</td><td>Ce</td><td>Pr</td><td>Nd</td><td>Pm</td><td>Sm</td><td>Eu</td><td>Gd</td><td>Tb</td><td>Dy</td><td>Ho</td><td>Er</td><td>Tm</td><td>Yb</td> </tr> <tr> <td>138.9</td><td>140.1</td><td>140.9</td><td>144.2</td><td>[145]</td><td>150.4</td><td>152</td><td>157.3</td><td>158.9</td><td>162.5</td><td>164.93</td><td>167.3</td><td>168.9</td><td>173</td> </tr> <tr> <td>89</td><td>90</td><td>91</td><td>92</td><td>93</td><td>94</td><td>95</td><td>96</td><td>97</td><td>98</td><td>99</td><td>100</td><td>101</td><td>102</td> </tr> <tr> <td>Ac</td><td>Th</td><td>Pa</td><td>U</td><td>Np</td><td>Pu</td><td>Am</td><td>Cm</td><td>Bk</td><td>Cf</td><td>Es</td><td>Fm</td><td>Md</td><td>No</td> </tr> <tr> <td>[227]</td><td>232</td><td>[231]</td><td>238</td><td>[237]</td><td>[244]</td><td>[243]</td><td>[247]</td><td>[247]</td><td>[251]</td><td>[252]</td><td>[257]</td><td>[258]</td><td>[259]</td> </tr> </table>										57	58	59	60	61	62	63	64	65	66	67	68	69	70	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	138.9	140.1	140.9	144.2	[145]	150.4	152	157.3	158.9	162.5	164.93	167.3	168.9	173	89	90	91	92	93	94	95	96	97	98	99	100	101	102	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	[227]	232	[231]	238	[237]	[244]	[243]	[247]	[247]	[251]	[252]	[257]	[258]	[259]
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