

Name: KEY

Chem 1110, Spring 2011
Test 2A

Part 1: Multiple Choice (60 pts): Clearly circle the correct answer.

1. Which one of the following compounds is soluble in water?

- B
- A) FeCO_3
 - B) Na_2CO_3
 - C) CaSO_4
 - D) AgBr
 - E) None of these is soluble in water.

2. What is the net ionic equation for the reaction of H_2SO_4 with NH_3 ?

- E
- A) $\text{H}_2\text{SO}_4 + 2 \text{NH}_3 \rightarrow 2 \text{NH}_4\text{SO}_4$
 - B) $\text{H}_2\text{SO}_4 + 2 \text{NH}_3 \rightarrow 2 \text{NH}_4^+ + \text{SO}_4^{2-}$
 - C) $2 \text{H}^+ + \text{SO}_4^{2-} + 2 \text{NH}_3 \rightarrow 2 \text{NH}_4\text{SO}_4$
 - D) $\text{H}_2^+ + 2 \text{NH}_3 \rightarrow 2 \text{NH}_4^+$
 - E) $\text{H}^+ + \text{NH}_3 \rightarrow \text{NH}_4^+$
- SA WB
 $\text{H}^+ + \text{NH}_3 \rightarrow \text{NH}_4^+$

3. What volume of 0.450 M HCl is needed to make 250. mL of 0.112M HCl?

- A
- A) 62.2 mL
 - B) 16.1 mL
 - C) 10.0 mL
 - D) 250. mL
 - E) None of these.
- $M_{\text{dil}} V_{\text{dil}} = M_{\text{conc}} V_{\text{conc}}$
 $(250. \text{ mL})(0.112 \text{ M}) = (0.450 \text{ M})(V_{\text{conc}})$
 $V_{\text{conc}} = 62.2 \text{ mL}$

4. What is the molecular formula for a compound with molar mass of 360.3 g/mol and an empirical formula of $\text{C}_7\text{H}_4\text{O}_2$?

- E
- A) $\text{C}_7\text{H}_4\text{O}_2$
 - B) $\text{C}_{14}\text{H}_8\text{O}_6$
 - C) $\text{C}_{16}\text{H}_8\text{O}_{10}$
 - D) $\text{C}_{18}\text{H}_{16}\text{O}_8$
 - E) $\text{C}_{21}\text{H}_{12}\text{O}_6$
- $\text{MM of EF } (\text{C}_7\text{H}_4\text{O}_2) = 7(12.01) + 4(1.008) + 2(16.00) = 120.109/\text{mol}$
 $\frac{\text{MM of MF}}{\text{MM of EF}} = \frac{360.3 \text{ g/mol}}{120.109/\text{mol}} = 3$
 $\text{C}_7\text{H}_4\text{O}_2 \times 3 = \text{C}_{21}\text{H}_{12}\text{O}_6$

5. What is the percent of oxygen in $\text{Fe}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$? (MM of $\text{Fe}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} = 215.90 \text{ g/mol}$)

- D
- A) 7.411% O
 - B) 22.23% O
 - C) 44.47% O
 - D) 59.29% O
 - E) None of these
- $8 \text{ O} = 8(16.00) = 128.00 \text{ g/mol}$
 $\% \text{ O} = \frac{128.00 \text{ g/mol}}{215.90 \text{ g/mol}} \times 100 = 59.29\%$

6. Which one of the pairs of compounds below are all insoluble in water?

- B
- A) $\text{Fe}(\text{NO}_3)_2$ and PbCl_2
 - B) FePO_4 and CaSO_4
 - C) $\text{Mg}(\text{OH})_2$ and $\text{Ca}(\text{OH})_2$
 - D) MgCl_2 and NaCl
 - E) FeSO_4 and BaCO_3

7. What is the percent yield of a reaction that has a theoretical yield of 87.8g and an actual yield of 64.3g?

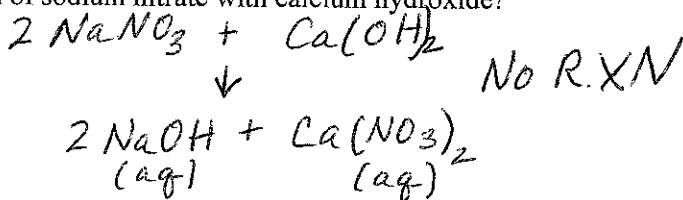
- A) 1.37%
 B) 13.7%
 C) 26.8%
 D) 36.5%
 (E) 73.2%

$$\frac{64.3g}{87.8g} \times 100 = 73.2\%$$

E

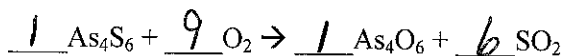
8. What is the net ionic equation for the reaction of sodium nitrate with calcium hydroxide?

- A) $\text{Ca}^{2+} + 2 \text{NO}_3^- \rightarrow \text{Ca}(\text{NO}_3)_2 (\text{s})$
 B) $\text{Na}^+ + \text{NO}_3^- \rightarrow \text{NaNO}_3 (\text{s})$
 C) $\text{Ca}^{2+} + 2 \text{OH}^- \rightarrow \text{Ca}(\text{OH})_2 (\text{s})$
 D) $\text{Na}^+ + \text{OH}^- \rightarrow \text{NaOH} (\text{s})$
 (E) There is no reaction.



E

9. Which of the following set of numbers balances the equation below?



- A) 1, 1, 1, 1
 B) 2, 1, 2, 1
 C) 2, 2, 2, 5
 (D) 1, 9, 1, 6
 E) None of these

D

10. How many atoms of oxygen are in 3.0 mol of SO_2 ?

- A) 3 atoms O
 B) 6 atoms O
 C) 1.8×10^{24} atoms O
 (D) 3.6×10^{24} atoms O
 E) 1.8×10^{23} atoms O

$$3.0 \text{ mol SO}_2 \times \frac{2 \text{ mol O}}{1 \text{ mol SO}_2} \times \frac{6.02 \times 10^{23} \text{ atoms O}}{1 \text{ mol O}} = 3.6 \times 10^{24} \text{ atoms O}$$

D

11. What is the concentration of a solution made by dissolving 0.525 mol NaCl in 125 mL of water?

- A) 0.0042 M
 (B) 4.20 M
 C) 0.238 M
 D) 2.38 M
 E) 65.6 M

$$\frac{0.525 \text{ mol NaCl}}{125 \text{ mL}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 4.20 \text{ M}$$

B

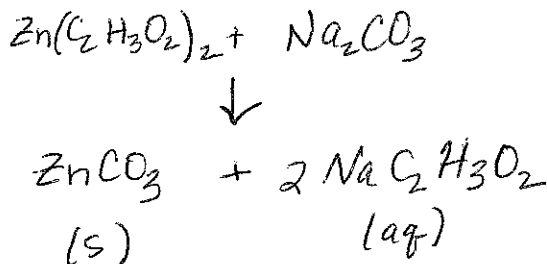
12. Which of the following is NOT a strong base?

- A) $\text{Ca}(\text{OH})_2$
 (B) $\text{Cu}(\text{OH})_2$
 C) $\text{Ba}(\text{OH})_2$
 D) $\text{Sr}(\text{OH})_2$
 E) LiOH

B

13. What are the spectator ions in the reaction of zinc(II) acetate with sodium carbonate?

- A) Zn^{2+} and $\text{C}_2\text{H}_3\text{O}_2^-$
 B) Na^+ and CO_3^{2-}
 C) Zn^{2+} and CO_3^{2-}
 (D) Na^+ and $\text{C}_2\text{H}_3\text{O}_2^-$
 E) CO_3^{2-} and $\text{C}_2\text{H}_3\text{O}_2^-$



D

14. When two ionic compounds react to form a compound, the solid is termed a(n) _____.

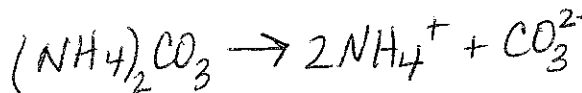
- A) coefficient
 B) precipitate
 C) supernatant
 D) filtrate
 E) acid

B

15. Which of the following is the correct dissociation equation of ammonium carbonate?

- A) $\text{NH}_4\text{CO}_3 \rightarrow \text{NH}_4^+ + \text{CO}_3^{2-}$
 B) $(\text{NH}_4)_2\text{CO}_3 \rightarrow 2\text{NH}_4^+ + \text{CO}_3^{2-}$
 C) $\text{NH}_4\text{CO}_3 \rightarrow \text{NH}_4^+ + \text{C} + \text{O}_3$
 D) $(\text{NH}_4)_2\text{CO}_3 \rightarrow 2\text{NH}_4^+ + \text{C} + \text{O}_3^{2-}$
 E) Ammonium carbonate does not dissociate.

B



Part 2: Calculations (40 pts): Clearly show all work for full credit.

1. (5 pts) Calculate the molar mass of $\text{Al}_2(\text{SO}_4)_3$? (Show all work!)

$$\begin{aligned} \text{Al} &= 2(26.98 \text{ g/mol}) = 53.96 \text{ g/mol} \\ \text{S} &= 3(32.06 \text{ g/mol}) = 96.18 \text{ g/mol} \\ \text{O} &= 12(16.00 \text{ g/mol}) = 192.00 \text{ g/mol} \\ \hline &342.14 \text{ g/mol} \end{aligned}$$

2. (10 pts) Cortisol is a steroid hormone involved in protein synthesis. Medically, it has a major use in reducing inflammation from rheumatoid arthritis. Cortisol is 69.6% C, 8.34% H and the rest is oxygen. What is the empirical formula of cortisol? $100\% - 69.6\% - 8.34\% = 22.1\% \text{ O}$

Assume 100. g

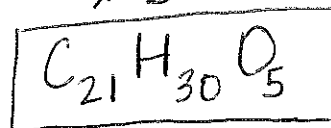
$$\begin{aligned} 69.6 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} &= 5.80 \text{ mol C} \\ 8.34 \text{ g H} \times \frac{1 \text{ mol H}}{1.008 \text{ g H}} &= 8.27 \text{ mol H} \\ 22.1 \text{ g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} &= 1.38 \text{ mol O} \end{aligned}$$

$$\begin{array}{ccc} \text{C}_{5.80} & \text{H}_{8.27} & \text{O}_{1.38} \\ \hline \text{C}_{4.20} & \text{H}_{5.99} & \text{O}_1 \end{array}$$

$$\text{C}_{4.20} \text{H}_{5.99} \text{O}_1$$

$$\text{C}_{4.20} \text{H}_6 \text{O}_1$$

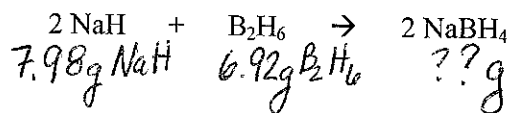
x 5



3. (10 pts) What mass (in grams) of potassium sulfate is needed to make 0.475 L of 0.00562 M K_2SO_4 ? (MM of $\text{K}_2\text{SO}_4 = 174.26 \text{ g/mol}$) $0.475 \text{ L} \times 0.00562 \text{ mol/L} = ?? \text{ g}$

$$0.475 \text{ L} \times \frac{0.00562 \text{ mol}}{\text{L}} \times \frac{174.26 \text{ g } \text{K}_2\text{SO}_4}{1 \text{ mol } \text{K}_2\text{SO}_4} = \boxed{0.465 \text{ g } \text{K}_2\text{SO}_4}$$

4. (15 pts) Sodium borohydride (NaBH_4) is used industrially in many organic syntheses. One way to prepare it is by reacting sodium hydride with gaseous diborane (B_2H_6). How many grams of NaBH_4 can be prepared by reacting 7.98 g of NaH with 6.92g of B_2H_6 . (MM of NaH = 24.00 g/mol, MM of B_2H_6 = 27.66 g/mol, MM of NaBH_4 = 37.83 g/mol)



$$7.98 \text{g NaH} \times \frac{1 \text{ mol NaH}}{24.00 \text{g NaH}} \times \frac{2 \text{ mol NaBH}_4}{2 \text{ mol NaH}} \times \frac{37.83 \text{g NaBH}_4}{1 \text{ mol NaBH}_4} = 12.6 \text{g NaBH}_4$$

$$6.92 \text{g B}_2\text{H}_6 \times \frac{1 \text{ mol B}_2\text{H}_6}{27.66 \text{g B}_2\text{H}_6} \times \frac{2 \text{ mol NaBH}_4}{1 \text{ mol B}_2\text{H}_6} \times \frac{37.83 \text{g NaBH}_4}{1 \text{ mol NaBH}_4} = 18.9 \text{g NaBH}_4$$

NaH is limiting reactant.

1	IA																										VIII
1	1															2											
	H															He											
	1.008															4.00											
2	IIA												III	IVA	VA	VIA	VIIA										
	3	4											5	6	7	8	9	10									
	Li	Be											B	C	N	O	F	Ne									
	6.94	9.01											10.81	12.01	14.01	16.00	19.00	20.18									
3	IIIB		IVB	VB	VIB	VII	VIII	IB	IIB		13	14	15	16	17	18											
	11	12											Al	Si	P	S	Cl	Ar									
	22.99	24.31											26.98	28.09	30.97	32.06	35.45	39.95									
4	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36									
	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									
5	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54									
	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									
6	55	56	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86									
	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]									
7	87	88	103	104	105	106	107	108	109	110	111	112	113	114	115	116		118									
	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]