

# TEST 2, VERSION A

CHEM 1110.24492

KEY

Spring 2016, Dr. Potts

Put your NAME, TEST VERSION, and ALL YOUR ANSWERS on the SCANTRON and submit the scantron for grading. Do not wait until the end of the test to transfer your answers.

	IA																										VIII A																																																																											
1	1																	2																																																																																				
	H																	He																																																																																				
	1.008																	4.00																																																																																				
2	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	11	12																	13	14	15	16	17	18																																																																														
	Na	Mg																	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]																																																																																				
	<table border="1"> <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]
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]																																																																																									

**Part I (80pts).** 20 multiple-choice questions worth 4 points each. Choose the best answer from the options given, and record your final answer on your scantron.

same # electrons

1. Which of these pairs consists of *isoelectronic* species?

- A.  $\text{Na}^+$  and  $\text{K}^+$  D.  $\text{Cl}^-$  and S  
 B.  $\text{Mn}^{2+}$  and Ar E.  $\text{Zn}^{2+}$  and  $\text{Cu}^{2+}$   
 C.  $\text{K}^+$  and  $\text{Cl}^-$

2. Which of these choices is the electron configuration of the iron(III) ion?

- A.  $[\text{Ar}]4s^23d^6$  Fe:  $[\text{Ar}]4s^23d^6$  D.  $[\text{Ar}]4s^13d^5$   
 B.  $[\text{Ar}]3d^6$  Fe<sup>3+</sup>:  $[\text{Ar}]3d^5$  E.  $[\text{Ar}]4s^23d^3$   
 C.  $[\text{Ar}]3d^6$

3. Iron(III) chloride hexahydrate is used as a coagulant for sewage and industrial wastes. What is its formula?

- A.  $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$  D.  $\text{Fe}_3\text{Cl}(\text{H}_2\text{O})_6$   
 B.  $\text{FeCl}_3(\text{H}_2\text{O})_6$  E.  $\text{Fe}(\text{Cl} \cdot 6\text{H}_2\text{O})_3$   
 C.  $\text{Fe}_3\text{Cl} \cdot 6\text{H}_2\text{O}$

4. Which is the correct formula for copper(II) phosphate?

- A.  $\text{Cu}(\text{PO}_4)_2$  Cu<sup>2+</sup> PO<sub>4</sub><sup>3-</sup> D.  $\text{Cu}_2\text{PO}_4$   
 B.  $\text{Cu}(\text{PO}_3)_2$  E.  $\text{Cu}_3(\text{PO}_4)_2$   
 C.  $\text{Cu}_2\text{PO}_3$  Cu<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>

5. Which element has the largest first ionization energy?

- A. Te B. Ca C. Na D. Br E. Cl

6. Which of these atoms has the smallest radius?

- A. P B. Na C. As D. Te E. Al

7. The formula for sodium sulfide is

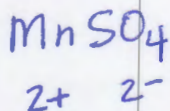
- A. SeS B. K<sub>2</sub>S C. NaS<sub>2</sub> D. NaS E. Na<sub>2</sub>S

8. The electron configuration of a ground-state copper atom is

- A.  $[\text{Ar}]4s^24d^4$  B.  $[\text{Ar}]4s^23d^9$  C.  $[\text{Ar}]3d^9$  D.  $[\text{Ar}]4s^24p^63d^3$  E.  $[\text{Ar}]4s^13d^{10}$

9. A red glaze on porcelain can be produced by using  $\text{MnSO}_4$ . What is its name?

- A. manganese sulfate B. manganese disulfate C. manganese(II) sulfate D. manganese(IV) sulfate E. manganese(I) sulfate





10. What types of elements undergo covalent bonding?

- B  A. a nonmetal and a metal  
 B. two nonmetals  
 C. two Group 1A elements  
 D. a metal and a noble gas  
 E. an actinide

11. Household sugar, sucrose, has the molecular formula  $C_{12}H_{22}O_{11}$ . What is the % of carbon in sucrose, by mass?

- E  A. 26.732%  $12(12.01) = 144.12 \text{ amu}$   
 B. 41.424%  $22(1.008) = 22.176 \text{ amu}$   
 C. 33.333%  $11(16.00) = 176.00 \text{ amu}$   
 D. 51.445%  $342.30 \text{ amu}$   
 E. 42.103%  $\%C = \frac{144.12}{342.30} \times 100 = 42.103\%$

12. Which element has the following ground-state electron configuration?  $[Kr]5s^24d^{10}5p^2$

- E  A. Pb  
 B. Ge  
 C. Sb  
 D. Te  
 E. Sn

13. What is the name of  $CBr_4$ ?

- C  A. tetrabromocarbide  
 B. carbon bromide  
 C. carbon tetrabromide  
 D. bromine tetracarbide  
 E. carbon bromine

14. Tetrasulfur dinitride decomposes explosively when heated. What is its formula?

- A  A.  $S_4N_2$   
 B.  $S_4N$   
 C.  $4SN_2$   
 D.  $S_2N_4$   
 E.  $S_2N$

15. The compound,  $P_4S_{10}$ , is used in the manufacture of safety matches. What is its name?

- E  A. phosphorus sulfide  
 B. phosphoric sulfide  
 C. phosphorus decasulfide  
 D. phosphorus sulfide  
 E. tetraphosphorus decasulfide

16. The correct name for  $Ba(OH)_2$  is

- D  A. barium hydrate.  
 B. beryllium hydroxide.  
 C. boron hydroxide.  
 D. barium hydroxide.  
 E. barium hydrogen oxide.

17. Which of the following is the empirical formula for hexane,  $C_6H_{14}$ ?

- A  A.  $C_3H_7$   
 B.  $C_{0.43}H$   
 C.  $CH_{2.3}$   
 D.  $C_{12}H_{28}$   
 E.  $C_6H_{14}$

18. How many unpaired electrons does a ground-state atom of sulfur have?

- A  A. 2  
 B. 1  
 C. 3  
 D. 4  
 E. 0

19. Calculate the formula mass of potassium permanganate,  $KMnO_4$ .

- C  A. 79.41 amu  
 B. 174.04 amu  
 C. 158.04 amu  
 D. 149.91 amu  
 E. 127.41 amu
- $1K = 39.10 \text{ amu}$   
 $1Mn = 54.94 \text{ amu}$   
 $4O = 64.00 \text{ amu}$   

---

 $158.04 \text{ amu}$



20. Which is a correct set of quantum numbers for an electron in a 3d orbital?

- A.  $n=3, l=2, m_l=3$   
B.  $n=3, l=2, m_l=-2$   
C.  $n=3, l=0, m_l=-1$

- D.  $n=3, l=1, m_l=+3$   
E.  $n=3, l=3, m_l=+2$

$$\begin{array}{ccc} n & l & m_l \\ 3 & 2 & -2, -1, 0, 1, 2 \end{array}$$

**Part 2 (20 pts).** Calculations: Clearly (**and legibly**) show all work on the blank space on the scantron answer sheet for full credit. Do not wait until the end of the test to transfer your answers.

1. (10 pts) Tin (II) fluoride is added to some toothpaste to aid in the prevention of tooth decay. How many ions of fluoride does 7.10 g  $\text{SnF}_2$  contain? (MM of  $\text{SnF}_2 = 156.71 \text{ g/mol}$ )

$$7.10 \text{ g SnF}_2 \times \frac{1 \text{ mol SnF}_2}{156.71 \text{ g SnF}_2} \times \frac{2 \text{ mol F}^-}{1 \text{ mol SnF}_2} \times \frac{6.022 \times 10^{23} \text{ ions F}^-}{1 \text{ mol F}^-} = 5.46 \times 10^{22} \text{ ions F}^-$$

2. (10 pts) Pheromones are a special type of compound secreted by the females of many insect species to attract the males for mating. One pheromone has the molecular formula  $\text{C}_{19}\text{H}_{38}\text{O}$ . Normally, the amount of this pheromone secreted by a female insect is about  $1.0 \times 10^{-12} \text{ g}$ . How many molecules of  $\text{C}_{19}\text{H}_{38}\text{O}$  does this contain? (MM of  $\text{C}_{19}\text{H}_{38}\text{O} = 282.494 \text{ g/mol}$ )

$$1.0 \times 10^{-12} \text{ g C}_{19}\text{H}_{38}\text{O} \times \frac{1 \text{ mol C}_{19}\text{H}_{38}\text{O}}{282.494 \text{ g C}_{19}\text{H}_{38}\text{O}} \times \frac{6.022 \times 10^{23} \text{ molecules C}_{19}\text{H}_{38}\text{O}}{1 \text{ mol C}_{19}\text{H}_{38}\text{O}} = 2.1 \times 10^9 \text{ molecules C}_{19}\text{H}_{38}\text{O}$$

3. (5 pts) Essay: In 4 – 6 sentences, explain the difference between core electrons and valence electrons in atoms and describe the effect that core electrons have on valence electrons in relation to the nucleus.

see attached sheet

**PUT ALL ANSWERS AND SHOW ALL WORK FOR PART 2 ON THE BLANK SPACE ON THE SCANTRON. DO NOT WAIT UNTIL THE END OF THE TEST TO TRANSFER YOUR ANSWERS.**

## Test 2 Essay

In multi-electron atoms, the valence electrons are the outermost electrons and the core electrons are in the completed shells. Specifically, the core electrons are defined as those in the highest  $n$ -value of the electron configuration (furthest from the nucleus) and any partially filled  $d$  or  $f$  orbitals. The valence electrons are attracted to the positive charge in the nucleus, but they are shielded by the core electrons, blocking them from the nucleus. The strength of the attraction or “pull towards the nucleus” is defined as the effective nuclear charge.

- Define core electrons
- Define valence electrons
- Explain shielding
- Discuss effective nuclear charge