Name:

Last

First

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Chemistry 233-002 Exam 2

Fall 2017

Instructions: The first 18 questions of this exam should be answered on the provided Scantron. You must use a pencil for filling in the Scantron sheet. Ensure all erasures are complete. Any questions left blank will be marked incorrect. Any question with multiple answers selected will be marked incorrect. Answer the remaining questions on the exam itself. Show all work and provide complete explanations.

Please write your name on:

- The first page (Exam Cover Page)
- The second page (Grading Page)
- The Scantron Sheet Circle your Last Name

Please bubble in your WVU Student ID Number on your Scantron sheet.

																	10
I IA																	VIIIA
1	1															1	2
н	2											13	14	15	16	17	He
1.01	IIA											IIIA	IVA	VA	VIA	VIIA	4.00
3	4											5	6	7	8	9	10
Li	Be											В	С	Ν	0	F	Ne
6.94	9.01											10.81	12.01	14.01	16.00	19.00	20.18
11	12										100	13	14	15	16	17	18
Na	Mg	3	4	5	6	7	8	9	10	11	12	Al	Si	Р	S	Cl	Ar
22.99	24.31	IIIB	IVB	VB	VIB	VIIB		VIIIB		IB	IIB	26.98	28.09	30.97	32.07	35.45	39.95
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
39.1	40.08	44.96	47.88	50.94	52.00	54.94	55.85	58.93	58.69	63.55	65.39	69.72	72.61	74.92	78.96	79.90	83.80
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	Ι	Xe
85.47	87.62	88.91	91.22	92.91	95.94	(98)	101.07	102.91	106.42	107.87	112.41	114.82	118.71	121.76	127.6	126.9	131.29
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs	Ba	La*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Ησ	Tl	Pb	Bi	Po	At	Rn
132.9	137.3	138.9	140 4	100.0													
-		15015	1/8.5	180.9	183.9	186.2	190.2	192.2	195.1	197.0	200,6	204.4	207.2	209	(209)	(210)	(222)
87	88	89	1/8.5	180.9	183.9 106	186.2 107	190.2 108	192,2 109	195.1 110	197.0 111	200.6	204.4	207.2	209	(209)	(210)	(222)
87 Fr	88 Ra	89 Ac^	178.5 104 Rf	105 Db	183.9 106 Sg	186.2 107 Bh	190.2 108 Hs	192.2 109 Mt	195.1 110 Ds	197.0 111 Rg	200.6	204.4	207.2	209	(209)	(210)	(222)
87 Fr (223)	88 Ra (226)	89 Ac^ (227)	178.5 104 Rf (261)	180.9 105 Db (262)	183.9 106 Sg (263)	186.2 107 Bh (264)	190.2 108 Hs (265)	192.2 109 Mt (268)	195,1 110 Ds (271)	197.0 111 Rg (272)	200.6	204.4	207.2	209	(209)	(210)	(222)
87 Fr (223)	88 Ra (226)	89 Ac^ (227)	178.5 104 Rf (261)	105 Db (262)	183.9 106 Sg (263)	186.2 107 Bh (264)	190.2 108 Hs (265)	192.2 109 Mt (268)	195.1 110 Ds (271)	197.0 111 Rg (272)	200.6	204.4	207.2	209	(209)	(210)	(222)
87 Fr (223)	88 Ra (226)	89 Ac [^] (227)	178.5 104 Rf (261) 58	105 Db (262)	183.9 106 Sg (263) 60	186.2 107 Bh (264) 61	190.2 108 Hs (265) 62	192,2 109 Mt (268) 63	195.1 110 Ds (271) 64	197.0 111 Rg (272)	200.6	204.4 67	207.2 68	209 69	(209)	(210)	(222)
87 Fr (223)	88 Ra (226)	89 Ac^ (227)	178.5 104 Rf (261) 58 Ce	180.9 105 Db (262) 59 Pr	183.9 106 Sg (263) 60 Nd	186.2 107 Bh (264) 61 Pm	190.2 108 Hs (265) 62 Sm	192,2 109 Mt (268) 63 En	195.1 110 Ds (271) 64 Gd	197.0 111 Rg (272) 65 Th	200.6 66 Dy	204,4 67 Ho	207.2 68 Er	209 69 Tm	(209) 70 Yb	(210) 71	(222)
87 Fr (223)	88 Ra (226)	89 Ac^ (227)	178.3 104 Rf (261) 58 Ce 140.1	180.9 105 Db (262) 59 Pr 140.9	183.9 106 Sg (263) 60 Nd 144.2	186.2 107 Bh (264) 61 Pm (145)	190.2 108 Hs (265) 62 Sm 150.4	192,2 109 Mt (268) 63 Eu 152,0	195,1 110 Ds (271) 64 Gd 157,3	197.0 111 Rg (272) 65 Tb 158.9	200.6 66 Dy 162.5	204.4 67 Ho 164.9	207.2 68 Er 167.3	209 69 Tm 168.9	(209) 70 Yb 173.0	(210) 71 Lu 175.0	(222)
87 Fr (223)	88 Ra (226)	89 Ac^ (227)	178.3 104 Rf (261) 58 Ce 140.1 90	180.9 105 Db (262) 59 Pr 140.9 91	183.9 106 Sg (263) 60 Nd 144.2 92	186.2 107 Bh (264) 61 Pm (145) 93	190.2 108 Hs (265) 62 Sm 150.4 94	192,2 109 Mt (268) 63 Eu 152,0 95	195,1 110 Ds (271) 64 Gd 157,3 96	197.0 111 Rg (272) 65 Tb 158.9 97	66 Dy 162.5 98	67 Ho 164.9 99	68 Er 167.3 100	69 Tm 168.9 101	(209) 70 Yb 173.0 102	(210) 71 Lu 175.0 103	(222)
87 Fr (223)	88 Ra (226)	89 Ac^ (227)	178.3 104 Rf (261) 58 Ce 140.1 90 Th	180.9 105 Db (262) 59 Pr 140.9 91 Pa	183.9 106 Sg (263) 60 Nd 144.2 92 U	186.2 107 Bh (264) 61 Pm (145) 93 Np	190.2 108 Hs (265) 62 Sm 150.4 94 Pu	192.2 109 Mt (268) 63 Eu 152.0 95 Am	195,1 110 Ds (271) 64 Gd 157,3 96 Cm	197.0 111 Rg (272) 65 Tb 158.9 97 Bk	66 Dy 162.5 98 Cf	67 Ho 164.9 99 Es	68 Er 167.3 100 Fm	69 Tm 168.9 101 Md	(209) 70 Yb 173.0 102 No	(210) 71 Lu 175.0 103 Lr	(222)

The Periodic Table

Dr. J. Osbourn

Name: ____

Last

First

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Grading Page (Exam 2):

Page	Points Possible	Points Earned
Multiple Choice (3-5)	36	
6	26	
7	18	
8	20	
TOTAL	100	

Multiple Choice

Choose the one best answer for each of the following questions. Using a pencil, record this answer on the provided Scantron sheet. (*2 points each*)

1. The total relative energy of the conformation shown below is 4.1 kcal/mol. What is the energy cost associated with the H/Cl eclipse?

- a. 2.4 kcal/mol
- b. 0.5 kcal/mol
- c. 1.7 kcal/mol
- d. 1.0 kcal/mol
- e. 1.4 kcal/mol
- 2. Arrange the compounds shown below in order of increasing boiling point.



3. Which one of the following molecules would you expect to be the most soluble in water?



4. How many unsaturations are present in the molecule shown below?



e. 9

5. Which molecule shown below contains ring strain, torsional strain, and steric strain?



6. Which of the following is the least stable chair conformation for the compound shown below?



- 7. A racemic mixture:
 - a. is optically inactive.
 - b. contains a 1:1 mixture of enantiomers.
 - c. contains a 1:1 mixture of diastereomers.
 - d. both a and b
 - e. both a and c
- 8. What is the configuration at the chiral center in the molecule below?

- a. *R*-configuration
- b. S-configuration
- 9. Which of the following molecules can hydrogen bond with water?



- a. I and IV
- b. II and III
- c. I, III, and IV
- d. All of these can H-bond with water

10. Which of the following contain *cis* substituents?



- b. II and III
- c. I, II, and III
- c. I, II, and II
- d. I and II
- e. I, II, III, and IV

For questions 11-14, determine whether each molecule is:

(a) Chiral, (b) Achiral, or (c) Meso-Achiral Bubble these answers in on your Scantron sheet for credit!



For questions 15-18, determine whether each pair of molecules represent: (a) Identical Compounds, (b) Constitutional Isomers, (c) Enantiomers, or (d) Diastereomers

Bubble these answers in on your Scantron sheet for credit!



Completion Section

Answer the remaining questions in the spaces provided. Show all work and provide complete explanations.

19. Provide IUPAC systematic names for each compound shown below. Include *R/S* for molecules c and d. (*3 points each*)



20. Convert the structure shown below to **a**) a Newman projection viewing along the C2-C3 bond and **b**) a Fischer projection. Use the templates provided. *(3 points each)*



21. Draw both chair conformations for the compound shown below using the templates provided. Put the –CH₃ on the carbon indicated with the circle and orient your other groups based on that reference point. <u>Circle the chair conformation that is lowest in energy.</u> (5 points)



22. Draw a chair cyclohexane that meets the following criteria: (3 points)

- Axial –CH₃ at C2
- OH with R-configuration at C1
- Br at C4 that is *trans* to OH



23. In each molecule shown below, circle: (4 points)



24. For each mechanistic step shown below, **a)** add curved arrows to show electron flow, and **b)** indicate the pattern of electron flow [Nu attack, loss of leaving group, proton transfer, or carbocation rearrangement]. (*3 points each*)



25. Show the carbocation rearrangement product for each. (1 point each)



26. Rank the following conformations from most stable/lowest energy (1) to least stable/highest energy (4). *(3 points)*



27. Identify every chiral center in cholesterol (below) with an asterisk (*). (3 points)



28. Answer the following questions regarding each molecule shown below. (4 points each)





Number of chiral centers	ohirol	ochirol	achiral(masa)
Number of stereocenters	Chirai	achirai	actinal(meso)
Max possible # of stereoisomers		circle	one

- 29. Draw each of the following (2 points each)
 - **a.** The enantiomer of:



b. A diastereomer of:



c. An achiral stereoisomer of:



30. Tartaric acid is a chiral molecule that can be obtained as the (+) or the (-) enantiomer. If you have a solution that contains a mixture of 10 g of the (+)-enantiomer and 5 g of the (-)-enantiomer, will this solution be optically active? Explain why or why not. (3 points)