Last

First

MI

Chemistry 234-002 Exam 1

Spring 2017

Dr. J. Osbourn

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. 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.

1																	1 8
	1																2
H	2											13	14	15	16	17	He
1.01	IIA	Î.									1	IIIA	IVA	VA	VIA	VIIA	4.00
, Т:	4 Do											D	ĉ	N	Ô	F	No
6.94	9.01											10.81	12.01	14.01	16.00	19.00	20.18
11	12											13	14	14.01	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	Te	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Те	I	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
									-	-		04	0.0	0.0	12/10	12015	01
55	56	57	72	73	74	75	76	77	78	79	80	81	82 DI	83 D:	84 D	85	86
55 Cs	56 Ba	57 La*	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)
55 Cs 132.9 87	56 Ba 137.3 88 Ba	57 La* 138.9 89	72 Hf 178.5 104 Df	73 Ta 180.9 105	74 W 183.9 106	75 Re 186.2 107 Ph	76 Os 190.2 108	77 Ir 192.2 109	78 Pt 195.1 110 Dc	79 Au 197.0 111 Ba	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)
55 Cs 132.9 87 Fr	56 Ba 137.3 88 Ra (226)	57 La* 138.9 89 Ac^ (227)	72 Hf 178.5 104 Rf (261)	73 Ta 180.9 105 Db (262)	74 W 183.9 106 Sg (263)	75 Re 186.2 107 Bh (264)	76 Os 190.2 108 Hs (265)	77 Ir 192,2 109 Mt (268)	78 Pt 195.1 110 Ds (271)	79 Au 197.0 111 Rg (272)	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)
55 Cs 132.9 87 Fr (223)	56 Ba 137.3 88 Ra (226)	57 La* 138.9 89 Ac^ (227)	72 Hf 178.5 104 Rf (261)	73 Ta 180.9 105 Db (262)	74 W 183.9 106 Sg (263)	75 Re 186.2 107 Bh (264)	76 Os 190.2 108 Hs (265)	77 Ir 192.2 109 Mt (268)	78 Pt 195.1 110 Ds (271)	79 Au 197.0 111 Rg (272)	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)
55 Cs 132.9 87 Fr (223)	56 Ba 137.3 88 Ra (226)	57 La* 138.9 89 Ac^ (227)	72 Hf 178.5 104 Rf (261)	73 Ta 180.9 105 Db (262)	74 W 183.9 106 Sg (263)	75 Re 186.2 107 Bh (264)	76 Os 190.2 108 Hs (265)	77 Ir 192.2 109 Mt (268)	78 Pt 195.1 110 Ds (271)	79 Au 197.0 111 Rg (272)	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)
55 Cs 132.9 87 Fr (223)	56 Ba 137.3 88 Ra (226)	57 La* 138.9 89 Ac^ (227)	72 Hf 178.5 104 Rf (261)	73 Ta 180.9 105 Db (262) 59	74 W 183.9 106 Sg (263) 60	75 Re 186.2 107 Bh (264)	76 Os 190.2 108 Hs (265)	77 Ir 192.2 109 Mt (268)	78 Pt 195,1 110 Ds (271) 64	79 Au 197.0 111 Rg (272) 65	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)
55 Cs 132.9 87 Fr (223)	56 Ba 137.3 88 Ra (226)	57 La* 138.9 89 Ac^ (227)	72 Hf 178.5 104 Rf (261) 58 Ce	73 Ta 180.9 105 Db (262) 59 Pr	74 W 183.9 106 Sg (263) 60 Nd	75 Re 186.2 107 Bh (264) 61 Pm	76 Os 190.2 108 Hs (265) 62 Sm	77 Ir 192.2 109 Mt (268) 63 Eu	78 Pt 195.1 110 Ds (271) 64 Gd	79 Au 197.0 111 Rg (272) 65 Tb	80 Hg 200.6 66 Dy	81 Tl 204,4 67 Ho	82 Pb 207.2 68 Er	83 Bi 209 69 Tm	70 Yb	85 At (210) 71 Lu	86 Rn (222)
55 Cs 132.9 87 Fr (223)	56 Ba 137.3 88 Ra (226)	57 La* 138.9 89 Ac^ (227)	72 Hf 178.5 104 Rf (261) 58 Ce 140.1	73 Ta 180.9 105 Db (262) 59 Pr 140.9	74 W 183.9 106 Sg (263) 60 Nd 144.2	75 Re 186.2 107 Bh (264) 61 Pm (145)	76 Os 190.2 108 Hs (265) 62 Sm 150.4	77 Ir 192.2 109 Mt (268) 63 Eu 152.0 25	78 Pt 195.1 110 Ds (271) 64 Gd 157.3	79 Au 197.0 111 Rg (272) 65 Tb 158.9	80 Hg 200.6 66 Dy 162.5	81 Tl 204.4 67 Ho 164.9	82 Pb 207.2 68 Er 167.3	83 Bi 209 69 Tm 168.9	70 Yb 173.0	85 At (210) 71 Lu 175.0	86 Rn (222)
55 Cs 132.9 87 Fr (223)	56 Ba 137.3 88 Ra (226)	57 La* 138.9 89 Ac^ (227) *	72 Hf 178.5 104 Rf (261) 58 Ce 140.1 90 Th	73 Ta 180.9 105 Db (262) 59 Pr 140.9 91 D	74 W 183.9 106 Sg (263) 60 Nd 144.2 92 U	75 Re 186.2 107 Bh (264) 61 Pm (145) 93	76 Os 190.2 108 Hs (265) 62 Sm 150.4 94 Par	77 Ir 192.2 109 Mt (268) 63 Eu 152.0 95 Augustic formula for the formula formula for the formula for	78 Pt 195.1 110 Ds (271) 64 Gd 157.3 96	79 Au 197.0 111 Rg (272) 65 Tb 158.9 97 Pl -	80 Hg 200.6 66 Dy 162.5 98	81 Tl 204.4 67 Ho 164.9 99 E	82 Pb 207.2 68 Er 167.3 100	83 Bi 209 69 Tm 168.9 101	70 Yb 173.0 102	71 Lu 175.0 103	86 Rn (222)
55 Cs 132.9 87 Fr (223)	56 Ba 137.3 88 Ra (226)	57 La* 138.9 89 Ac^ (227) *	72 Hf 178.5 104 Rf (261) 58 Ce 140.1 90 Th	73 Ta 180.9 105 Db (262) 59 Pr 140.9 91 Pa	74 W 183.9 106 Sg (263) 60 Nd 144.2 92 U	75 Re 186.2 107 Bh (264) 61 Pm (145) 93 Np	76 Os 190.2 108 Hs (265) 62 Sm 150.4 94 Pu	77 Ir 192.2 109 Mt (268) 63 Eu 152.0 95 Am 240)	78 Pt 195.1 110 Ds (271) 64 Gd 157.3 96 Cm	79 Au 197.0 111 Rg (272) 65 Tb 158.9 97 Bk	80 Hg 200.6 66 Dy 162.5 98 Cf	81 Tl 204.4 67 Ho 164.9 99 Es	82 Pb 207.2 68 Er 167.3 100 Fm	83 Bi 209 69 Tm 168.9 101 Md	70 70 70 70 70 70 70 70 70 70 70 70 70 7	71 103 103 103 103	86 Rn (222)

The Periodic Table

Exams will be returned by placing them alphabetically on the table at the front of Ming-Hsieh G21. Your grade will not be visible as it is on the second page. If, however, you have a privacy concern, check the box below and your exams will be held back so that you can pick them up privately.

Hold Back My Exams

Please do not rip off this cover sheet

Name: _

Last

Grading Page (Exam 1):

Page	Points Possible	Points Earned
Multiple Choice (3-6)	36	
7	21	
8	24	
9	19	
TOTAL	100	

Multiple-Choice

Choose the one best answer for each of the following questions. Record this answer on your Scantron sheet. Additionally, circle your answer on this exam. (*2 points each*)

1. Arrange the following dienes in order of <u>increasing</u> stability.



2. What is the product of the intramolecular Diels-Alder reaction shown below?



- 3. Which one of the following statements is true regarding the kinetic and thermodynamic control of reactions?
 - a. The kinetic product is always lower in energy than the thermodynamic product.
 - b. The kinetic product is formed via a lower energy transition state than the thermodynamic product.
 - c. The kinetic product is favored at higher temperatures
 - d. Energetically, the thermodynamic product is less stable than the kinetic product.
- 4. Which one of the following dienophiles would you expect to be the least reactive in a normal Diels-Alder reaction?



5. Predict the product for the reaction shown below.



6. What is the hybridization of the oxygen atom in the structure below?



7. The compound shown below has _____ atoms in conjugation.



8. If the compound shown below were subjected to Br₂/FeBr₃, which position would be most rapidly brominated?



9. Which group shown below is inductively donating?



10. Which one of the statements is **incorrect** regarding the structure of benzene?

- a. Benzene is an aromatic compound.
- b. Benzene contains a cyclic array of conjugated p-orbitals.
- c. Benzene is unusually unreactive.
- d. The three double bonds in benzene are in rapid equilibrium around the six atoms of the ring.
- e. All of the above statements are correct.
- 11. Which one of the following is not a resonance structure of the compound shown in the box below?



12. In the reaction below, which product(s) would be considered theromodynamic products?



- b. C & D
- c. B, C, & D
- d. A, B, C, & D
- 13. Which statement regarding the oxygen lone pairs in furan (shown below) is correct?



- a. Both lone pairs are in p-orbitals.
- b. Both lone pairs are in sp³ orbitals.
- c. Both lone pairs are in sp² orbitals.
- d. One lone pair is an sp^2 orbital and one is in a p-orbital.
- e. One lone pair is an sp³ orbital and one is in a p-orbital.
- 14. Which "loss of a leaving group" would you expect to occur at the faster rate?



For questions 15-18, select the appropriate reagent from the reagent bank to accomplish each step in the synthetic sequence below. *Note that some answers may require you to bubble in two letters.* **Record** *each answer on your Scranton sheet!*



Reagent Bank

CI AICI ₃	NBS light (hv)	NaNO ₂ HCl	Na ₂ Cr ₂ O ₇ H ₂ SO ₄
а	b	C	d
Br ₂	Br ₂ FeBr ₃	AICI ₃	0 1) CI AICI ₃ 2) Zn(Hg), HCI
e	ab	ac	ad
HNO ₃ H ₂ SO ₄	Sn HCl	NaNH ₂	NaOH Br ₂
ae	bc	bd	be

Completion Section

Answer the questions below in the spaces provided.

19. Provide the IUPAC name or structure for each compound below. (3 points each)



c. meta-bromostyrene

20. For each compound below, determine if it is aromatic, anti-aromatic, or non-aromatic. For aromatic and anti-aromatic compounds, indicate the number of π -electrons. (2 points each)



21. The compound below can theoretically be prepared via a Diels-Alder reaction using two different sets of starting materials. Show both possible sets of starting materials. (2 points)



22. Predict the major product(s) for each reaction shown below. If the reaction does not proceed under the specified conditions, write "No Reaction" (2 points each)



23. Design a synthesis for the tri-substituted benzene below starting with benzene. (6 points)

0

24. Draw the complete electron pushing mechanism for the reaction shown below. Be sure to show all resonance structures. Using your resonance structures, <u>briefly</u> explain the regioselectivity. *(9 pts)* NH₂ **A. Electrophile Generation**:



B. Electrophilic Addition to the Benzene Ring:

25. Consider the molecule shown below and answer the following questions.

- **a.** Draw two additional resonance structures. (4 points)
- **b.** Circle the resonance structure that is the major contributor to the resonance hybrid. *(1 point)*

NH

c. Draw a picture of the molecule showing the location of every p-orbital. <i>(2 pts)</i>	d. How many atoms are in conjugation? (1 pt)
	e. What is the hybridization of the carbon bearing the negative charge? <i>(1 pt)</i>
	f. In what type of orbital does the nitrogen lone pair reside? <i>(1 pt)</i>

26. **Bonus:** The reaction shown below takes place via a Diels-Alder reaction and subsequent retro-Diels-Alder reaction with the loss of N₂ gas. What is the final product? *(2 bonus points)*

+ _____H