Name: Answer Key

Last First MI

Chemistry 233-001/002
Exam 2 – Version Green

Fall 2018 Dr. J. Osbourn

Instructions: The first 21 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.

The Periodic Table

1 IA												13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 H 1.01	2 IIA																2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.1	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.6	53 I 126.9	54 Xe 131.29
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)
87 Fr (223)	88 Ra (226)	89 Ac^ (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (264)	108 Hs (265)	109 Mt (268)	110 Ds (271)	111 Rg (272)							

*	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
^	90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

****Please do not rip off this exam cover page****

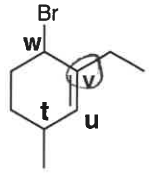
Name: _____
Last First MI

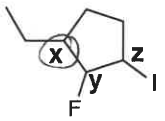
Grading Page (Exam 2)

Page	Points Possible	Points Earned
Multiple Choice (3-5)	42	
6	22	
7	19	
8	17	
TOTAL	**100**	

Multiple-Choice
Choose the best answer for each of the following questions. Record each answer on the provided Scantron sheet. Also, circle each answer directly on the exam. *(2 points each)*

1. Which carbon in each cyclic molecule below would be designated as C#1 when determining the IUPAC names.

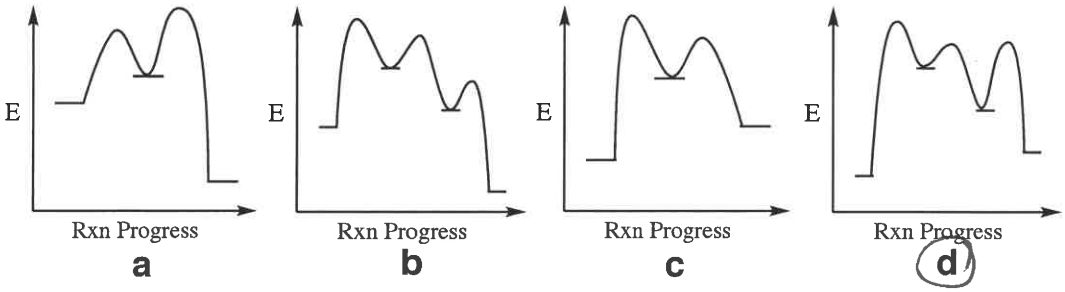




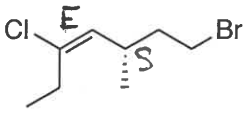
e vs i

	Structure I C#1	Structure II C#1
a.	w	z
b.	w	x
c.	v	z
(d.)	v	x
e.	u	x

2. Which one of the following energy diagrams represents an endergonic reaction with two intermediates?

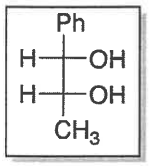


3. When writing the IUPAC name for the following compound, what is the appropriate stereochemical designation?

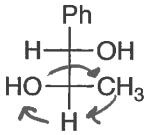


a. 3Z, 5S
b. 3Z, 5R
(c.) 3E, 5S
d. 3E, 5R

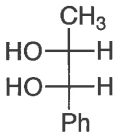
4. Which of the following Fischer projections are identical to the molecule shown in the box? *Bubble in the letter for all that apply!*



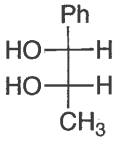
rotate 180



a

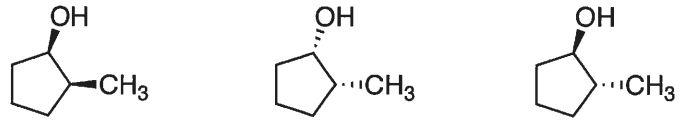


b



c

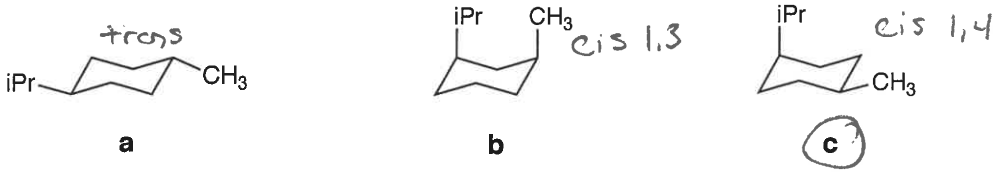
5. Consider the three stereoisomers shown below then choose the correct statement.



Compound I Compound II Compound III

a. Compound I and compound III will have different optical rotations.
b. Compound I and compound II will rotate light in opposite directions.
c. The magnitude of the optical rotation for compounds I and II will be the same.
d. The magnitude of the optical rotation for compounds II and III will be different.
e. All of the above statements are correct

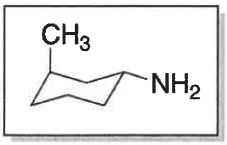
6. Which one of the following is the **least stable** chair conformation of *cis*-1-isopropyl-4-methylcyclohexane?

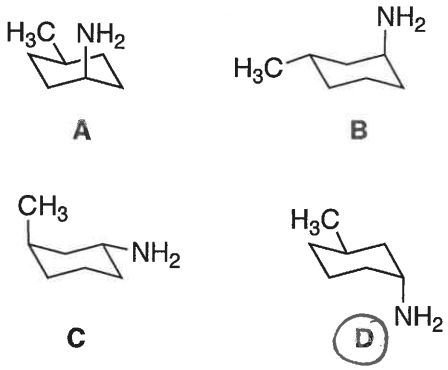


a b c

d e

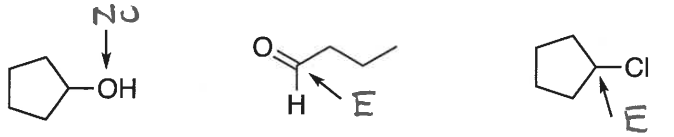
7. Which one of the following is the correct ring flip conformation of the compound shown in the box?





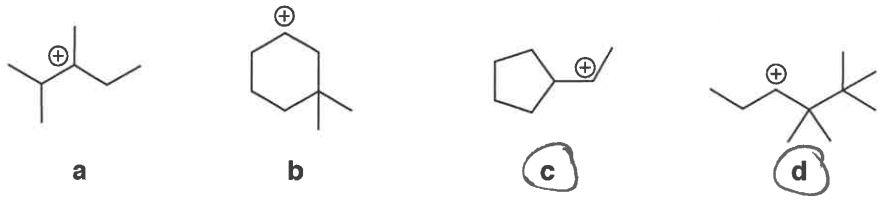
A B C D

8. How would you best classify each of the indicated atoms?

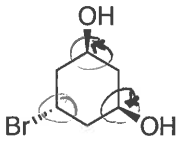


a.	Nucleophile	Electrophile	Electrophile
b.	Nucleophile	Nucleophile	Electrophile
c.	Electrophile	Electrophile	Electrophile
d.	Electrophile	Nucleophile	Electrophile
e.	Nucleophile	Electrophile	Nucleophile

9. Which of the following carbocations will undergo rearrangement to become more stable. *Bubble in the letter for all that apply!*



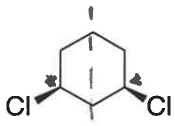
10. The compound shown below contains 2 chiral centers and 3 stereocenters.



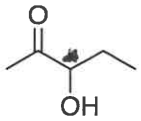
* = CC
○ = SC

a. 3, 3
b. 2, 3
c. 3, 2
d. 2, 2
e. 2, 1

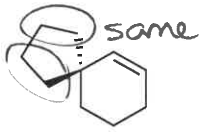
For questions 11-15, determine whether each molecule is:
(a) Chiral, **(b)** Achiral, or **(c)** Meso-Achiral
Bubble these answers in on your Scantron sheet for credit!



11. c

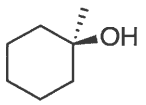


12. a



13. b

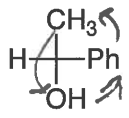
14. a



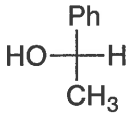
15. b

For questions 16-21, 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!

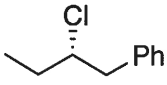
16.



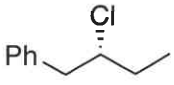
and c



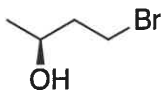
17.



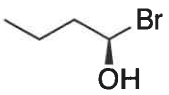
and c



18.

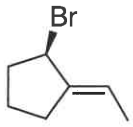


and b

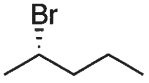


19.

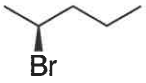
and d



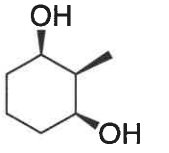
20.



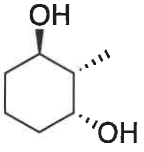
and a



21.

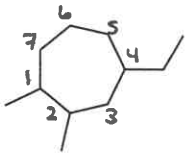


and d

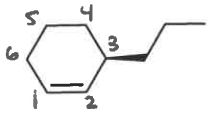


Completion Section
Answer the remaining questions in the spaces provided.

(9) 22. Provide the IUPAC name for each. Include *R, S, E,* and *Z* where appropriate. *(3 points each)*

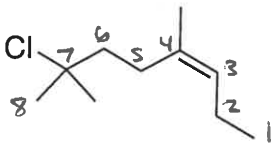
a. 

4-ethyl-1,2-dimethylcycloheptane (+1) (+1) (+1)

b. 

R-3-propylcyclohexene (+1) (+1) (+1)

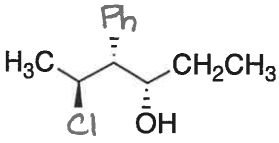
-1 Wrong #
-1 Wrong substituent order

c. 

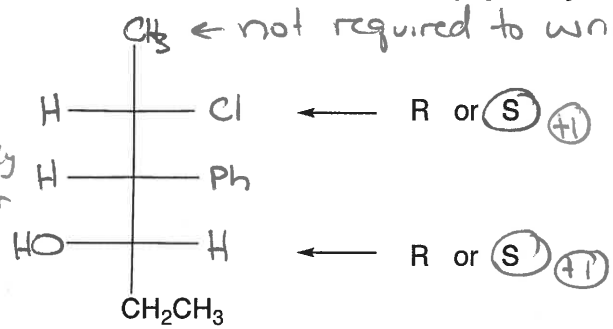
(+1) Z- (+0.5) 7-Chloro- (+0.5) 4,7-dimethyl- (+1) 3-octene
or
3Z
or
(3Z)
or
Oct-3-ene

See back for partial credit

(4) 23. **a.** Draw the molecule shown below as a Fischer projection using the template provided. **b.** Determine the R/S configuration at the indicated chiral centers. *(4 points)*



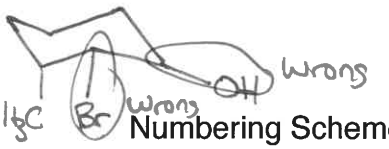
(+2) Must be Completely right for Credit



Note: *You can also use the original molecule to determine the R/S assignments.*

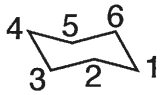
(3) 24. Using the template below, draw a structure that meets the following criteria. *(3 points)*

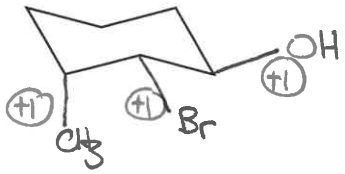
- Axial CH_3 at C3
- Equatorial Br at C2
- OH at C1 that is *trans* to the CH_3



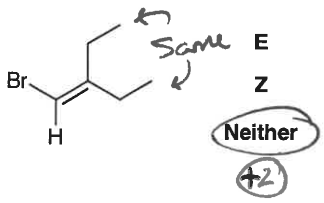
or IIII on Chair wrong!

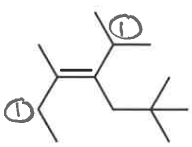
Numbering Scheme:



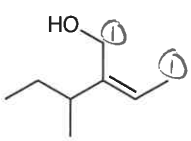


(6) 25. Determine if each alkene is E/Z or neither E nor Z. *(2 points each)*

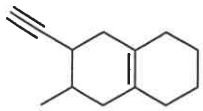




E (+2)
Z
Neither



(3) 26. Determine the degree of unsaturation for each. *(1 point each)*



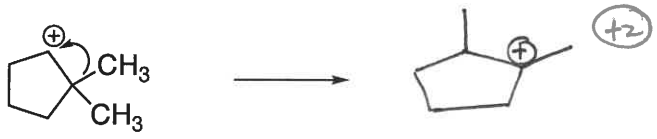
$C_7H_{12}Cl_2O$

$C_{10}H_{12}$

5 (+1) 1 (+1) 5 (+1)

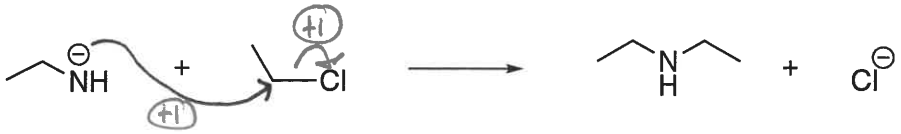
(8) 27. Complete each reaction below by drawing in the missing curved arrows in the reactants or the missing product(s). *(2 points each)*

a.

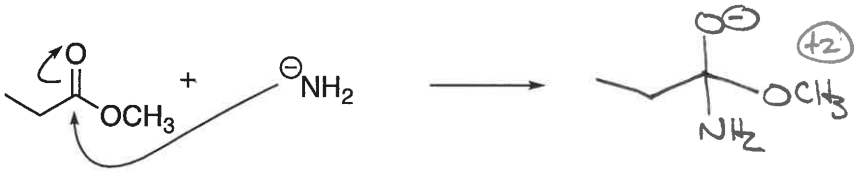


-1 if they forget the CH_3

b.

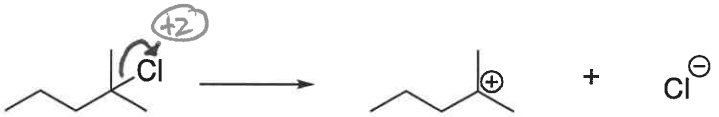


c.

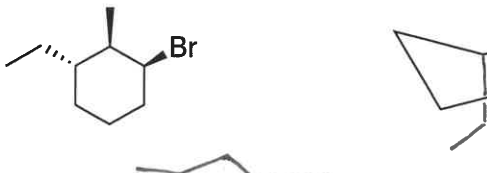


-1 for missing formal charge

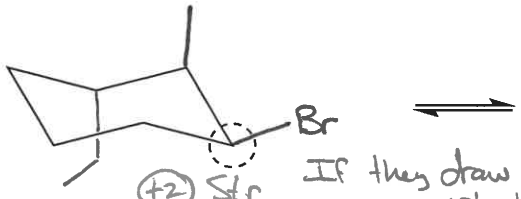
d.



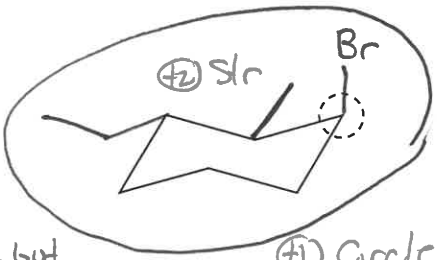
(5) 28. Draw both chair conformations for the compound shown below using the templates provided. Put the Br on the carbon indicated by the circle and orient your other group based on that reference point. <u>Circle the chair conformation that is lowest in energy.</u> *(5 points)*



no points



If they draw an incorrect 1st chair, but do a correct ring flip, give credit for the 2nd str



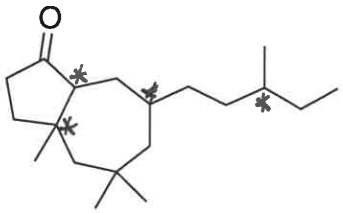
-1

(3) 29. Identify every chiral center in the following molecule with an asterisk *. *(3 points)*

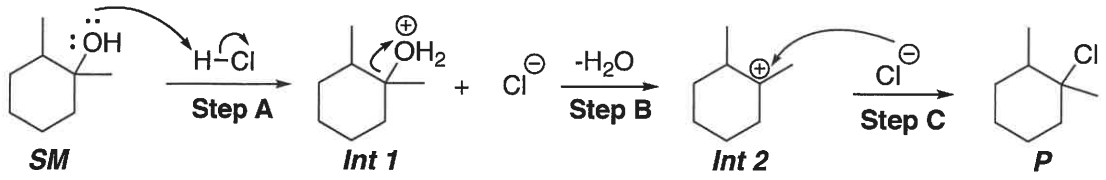
All 4 Correct = (+3)

Partial: +1 for each Correct *

-1 for each incorrect *



(3) 30. For the reaction shown below, label each step as a nucleophilic attack, loss of a leaving group, proton transfer or carbocation rearrangement. *(3 points)*

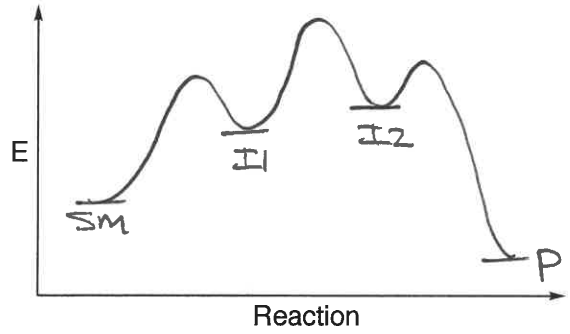


Step A: Proton Transfer (+1)

Step B: Loss of Leaving Group (+1)

Step C: Nucleophilic Attack (+1)

(4) 31. Draw a reaction coordinate (energy diagram) for the reaction in question 30. Label the starting material (SM), product (P), and Intermediates (Int 1 & Int 2) on the coordinate. *(4 points)*



Notes:
-Step B is the rate determining step
-The reaction is exothermic/exergonic
-Int 2 is less stable than Int 1

-1 if SM, I1, I2, and P not labeled

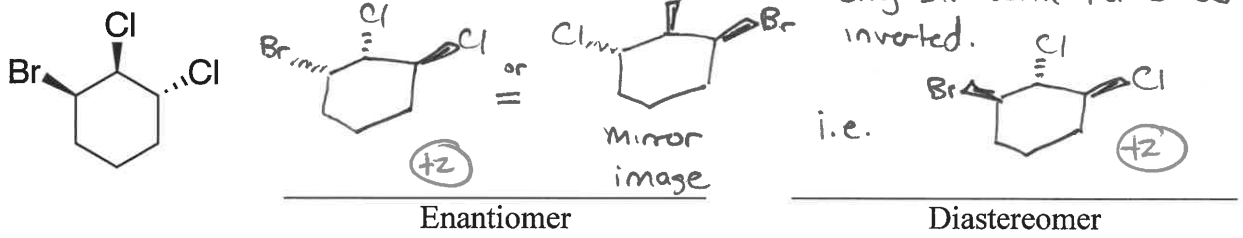
(+1) P lower than SM
(+1) I1 & I2 both higher than SM & P
(+1) I1 lower than I2
(+1) 3 transition states w/ 2nd being highest E

(6) 32. Consider **1-bromo-2,3-dichlorocyclohexane**. *(6 points)*

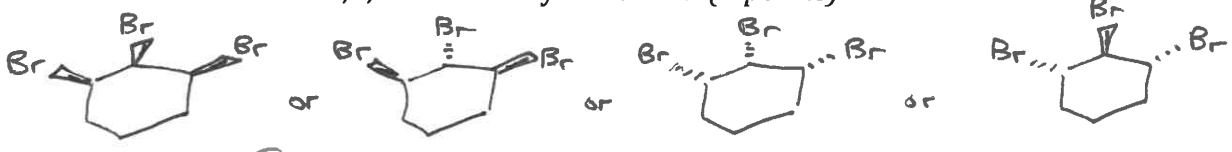
a. What is the maximum possible number of stereoisomers for this compound?

$2^3 = 8$ (+2)

b. One stereoisomer is shown below. Draw the enantiomer and a diastereomer of this compound.



(2) 33. Draw an achiral stereoisomer of 1,2,3-tribromocyclohexane. *(2 points)*



(+2) for any of these

(2) 34. Explain why cyclopropane has significant torsional strain. *(2 points)*

It is planar which forces eclipsed H (+2)

/17