

Answer Key

Chemistry 233-001/002 Exam 2 – Version B

Fall 2019

Dr. J. Osbourn

Instructions: Answer the first 23 questions of this exam using the bubble sheet attached to the end of this exam booklet. You may detach this sheet if you wish. As a bonus for reading the instructions. The answer to question 6 is a. Answer the remaining questions directly on this exam. Show all work.

The Periodic Table

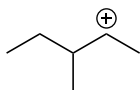
IA 1																	VIIIA 2
H 1.01																	He 4.00
3 Li 6.94	2 Be 9.01											13 B 10.81	14 C 12.01	15 N 14.01	16 O 16.00	17 F 19.00	18 Ne 20.18
11 Na 22.99	12 Mg 24.31	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 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*	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)

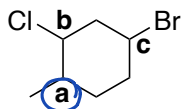
Multiple-Choice

Choose the best answer for each of the following questions. Record each answer on the attached bubble sheet. **Ensure you completely bubble in your answers.** (2 points each)

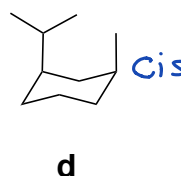
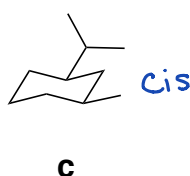
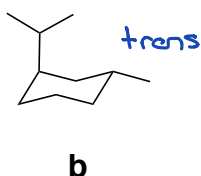
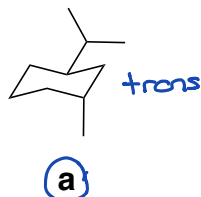
1. Will the following carbocation undergo rearrangement? If so, by which mechanism?



- a. No. This carbocation will not rearrange.
b. Yes. This carbocation will rearrange via a methyl shift.
c. Yes. This carbocation will rearrange via a hydride shift.
2. When determining the IUPAC name for the following compound, which carbon is carbon #1?

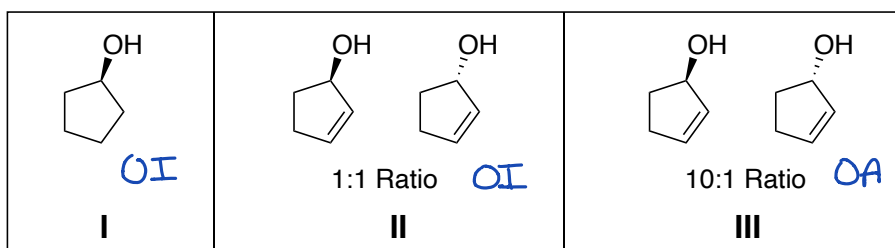


3. Which of the following is the most stable conformation of trans-1-isopropyl-3-methylcyclohexane?

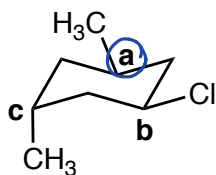


4. Which of the following would make up an optically inactive solution?

- a. III only
b. I and II
c. I only
d. II only
e. I, II, and III



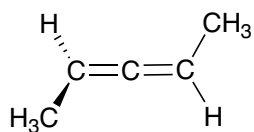
5. Which substituent on the following chair structure is drawn in an invalid fashion?



- d. None of the substituents are invalid

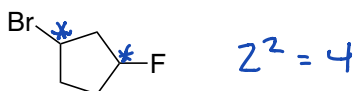
6. How would you classify the following molecule?

- a. Chiral
- b. Achiral
- c. Achiral Meso

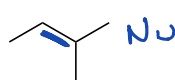
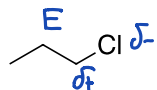
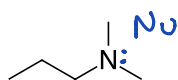


7. What is the maximum possible number of stereoisomers for the following compound?

- a. One
- b. Two
- c. Four
- d. Eight
- e. Cannot be determined

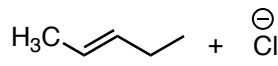
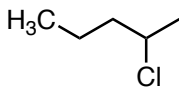
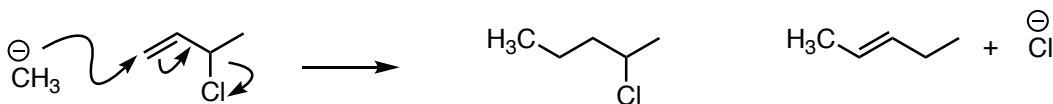


8. Classify each of the following as a nucleophile or electrophile.



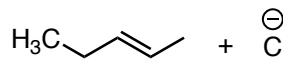
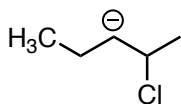
- | | | |
|------------------|---------------|-------------|
| a. Nucleophile | Nucleophile | Neither |
| b. Electrophile | Nucleophile | Neither |
| c. Both Nu and E | Electrophile | Nucleophile |
| d. Nucleophile | Electrophile | Nucleophile |
| e. Both Nu and E | Both Nu and E | Nucleophile |

9. What is the correct product from the following electron flow pattern?



a

b

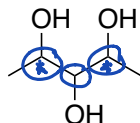


c

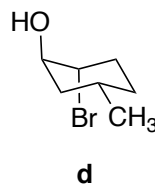
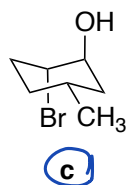
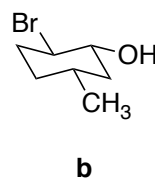
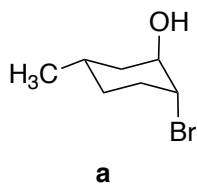
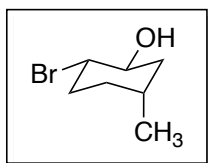
d

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

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

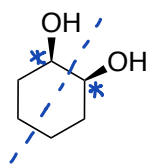


11. Which of the following is a correct ring-flip conformation of the chair cyclohexane in the box below?



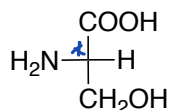
Chirality Assessment

For questions 12-15, identify each compound as: **a. Chiral**; **b. Achiral**; or **c. Achiral-Meso**. *Bubble each answer in on your bubble sheet for credit!*



12.

c



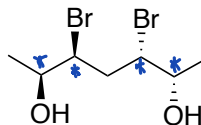
13.

a



14.

b

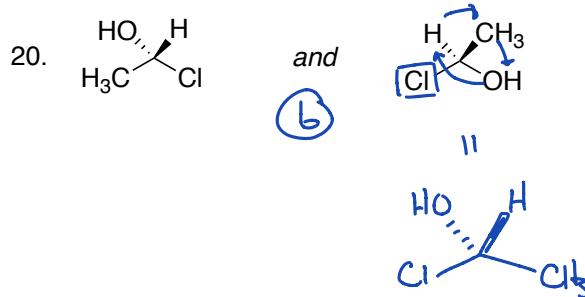
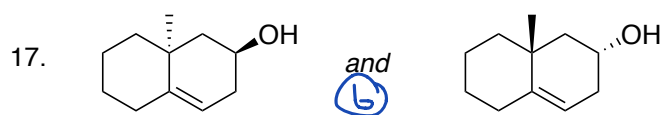
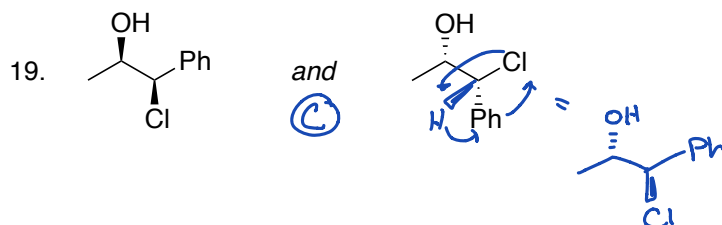
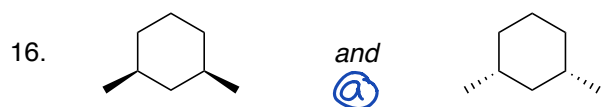


15.

a

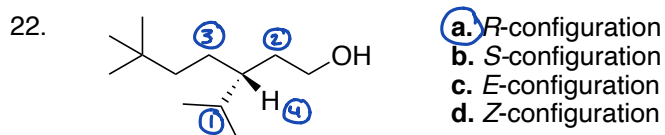
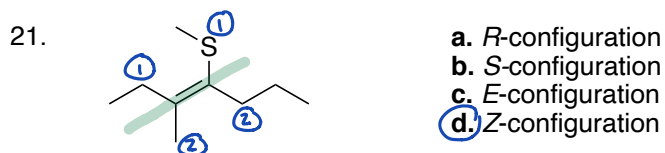
Molecule Relationships

For questions 16-20 identify each pair as: **a.** Identical; **b.** Enantiomers; **c.** Diastereomers; **d.** Constitutional Isomers; or **e.** Not Isomers. *Bubble each answer in on your bubble sheet for credit!*



Assigning Configurations

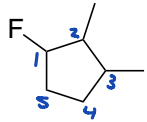
For questions 21-23, determine the configuration at the stereocenter in each molecule. *Bubble each answer in on your bubble sheet for credit!*



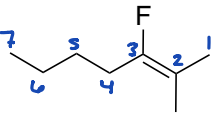
Completion Section

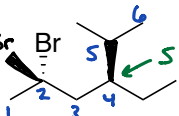
Answer the remaining questions directly on the exam itself. Please write neatly and **darkly** as your answers will be scanned for grading.

24. Write the IUPAC name for each molecule shown below. (3 points each)

I **a.**  1-fluoro-2,3-dimethylcyclopentane (+1) (+1) (+1)

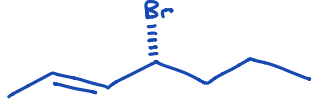
-1 wrong #
-1 if an R/S/E/Z is added where it doesn't belong.

II **b.**  3-fluoro-2-methyl-2-heptene or hept-2-ene (+1) (+1) (+1)

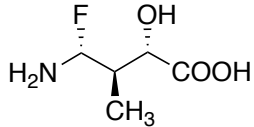
III **c.**  S-2,2-dibromo-4-ethyl-5-methylhexane (+1) (+1) (+1)

-1 for: S-2,2-dibromo 4-isopropyl hexane

25. Draw the structure of (2E,4R)-4-bromo-2-heptene. (3 points)

I  (+1) E-2-heptene chain
(+1) for 4-bromo
(+1) for correct R config

26. Convert the molecule shown below to a Fischer projection. Use the provided template, placing the COOH group at the top. (3 points)

II  (+3) No partial credit

Fischer projection:
 COOH
 HO — | — H
 H₂C — | — H
 F — | — H
 NH₂

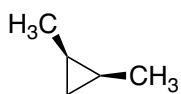
27. Using the template provided draw the structure of the chair cyclohexane that meets the following criteria. (3 points)

- Axial methyl at C2
- OH at C4 that is trans to the methyl
- Equatorial Cl at C6

III  (+1) (+1) (+1)

28. Identify the types of strain present in the following molecule. (3 points)

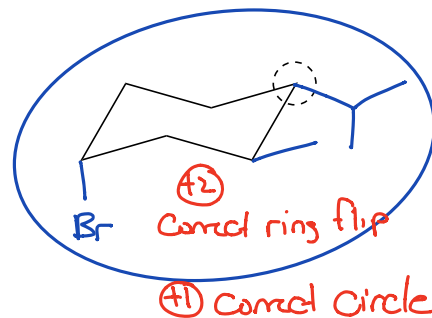
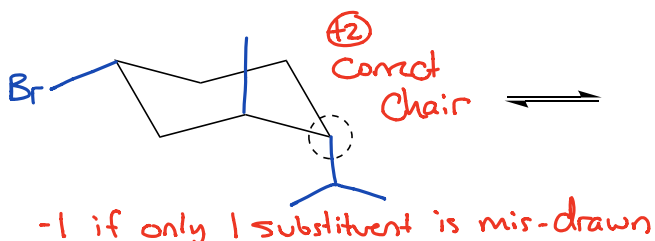
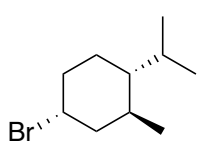
III



- Angle (rings) strain (+1)
- Torsional Strain (+1)
- Steric Strain (+1)

29. Draw both chair conformations for the compound shown below using the templates provided. Put the isopropyl on the carbon indicated by the circle and orient your other groups based on that reference point. Circle the chair conformation that is lowest in energy. (5 points)

I



30. Draw each of the following: (2 points each)

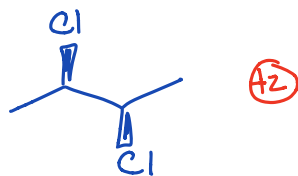
I

a. An optically inactive stereoisomer of 1,3-dibromocyclopentane.



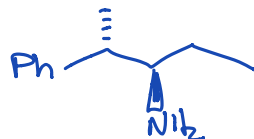
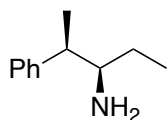
I

b. An optically active stereoisomer of 2,3-dichlorobutane.

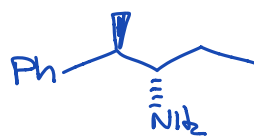


III

c. A diastereomer of:

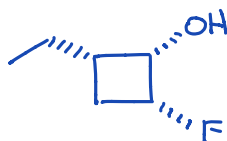
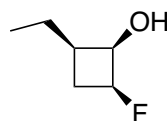


or

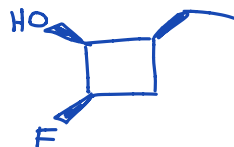


+2

d. An enantiomer of:



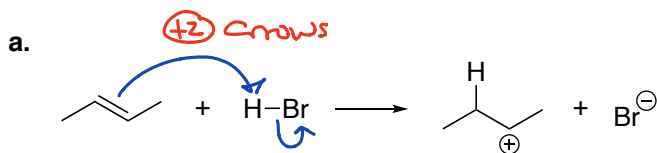
or



+2

31. For each of the following, draw in curved arrows in the reactants to show electron flow. Then, classify the pattern of electron flow (i.e. proton transfer). (3 points each)

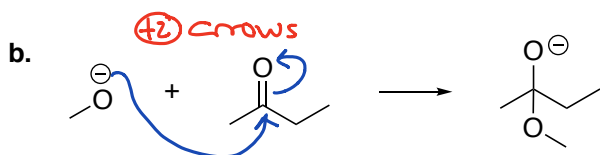
I



Pattern of Electron Flow:

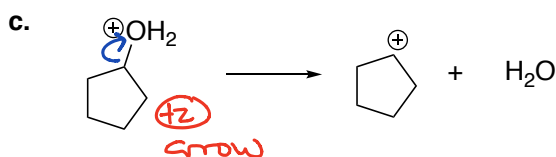
Proton Transfer (+1)

II



Nucleophilic Attack (+1)

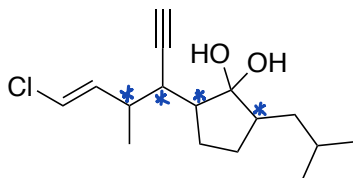
III



Loss of a Leaving Group (+1)

32. Identify every chiral center in the following molecule with an asterisk *. (4 points)

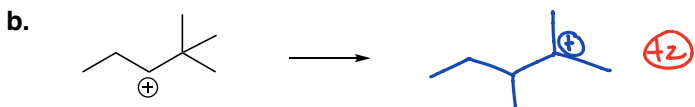
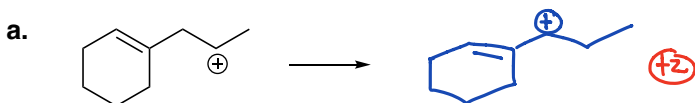
III



(+1) each correct * } max +4 min 0
 (-1) each incorrect *

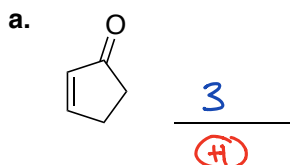
33. Draw the carbocation rearrangement product for each of the following. (2 points each)

II



34. Calculate the degree of unsaturation for each compound below. (1 point each)

II



b. C₁₁H₁₈

3 (+1)

$$\frac{11(2)+2-18}{2} = \frac{24-18}{2} = \frac{6}{2}$$

c. C₇H₁₁Br₂N

2 (+1)

$$\frac{7(2)+2-11-2+1}{2} = \frac{4}{2}$$