NAME _____

ID # _____

ORGANIC CHEMISTRY I (2301)

9:30 – 10:20 am, July 21, 2011

Exam 3

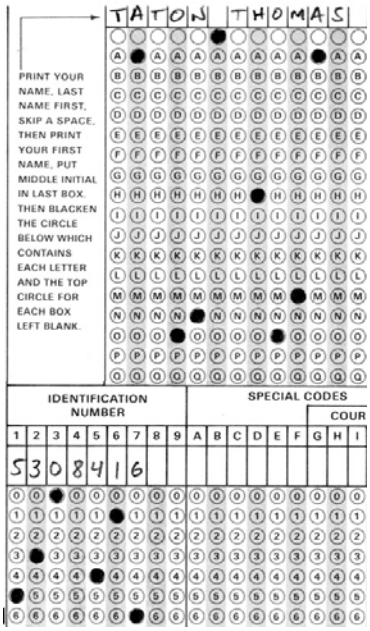
Form A

If you want to pick this exam up on Tuesday in class (in public), please check the box on the right: ☐

If you do not check the box, I will not bring your exam to class on Tuesday, and you will need to pick up your exam in private from Chemistry department staff in 115 Smith beginning Tuesday, July 26th. Exams that are not picked up within two weeks will be disposed of.

A periodic table and a chart of reaction conditions are attached to the back of this exam as aids. Otherwise, you are not permitted to use any other materials (including notes, books, or electronic devices of any kind).

Right now, write your name at the top of this page, and fill in the bubbles on the multiple-choice answer sheet for your name and your 7-digit student ID number (in columns 1-7 of the "Identification Number" section, as shown at right). When the exam begins, also write your name at the top of page 5.



You may use pen or pencil. However, re-grades will be considered only for exams completed in pen.

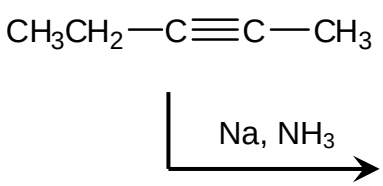
Please write your answers in the bubble sheet for the multiple choice portion of the exam, and in the boxes/spaces provided for the written portion. If your answer is not in the appropriate space in the written portion (say, for example, it's on the back of the page), draw us an arrow and/or note telling us where to look.

Multiple-Choice Problems

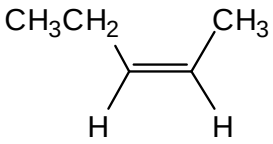
Please answer these problems on the bubble sheet.

(4 pts each) Each of the reactions below is drawn with two possible products, marked (a) and (b). If one of the two products predominates, answer with the letter corresponding to the correct product. If the two products are produced equally, answer (c) BOTH. If neither product would result from the reaction, answer (d) NEITHER.

1.



a.

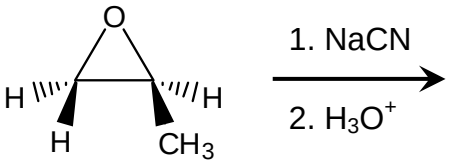


b. $CH_3CH_2CH_2CH_2CH_3$

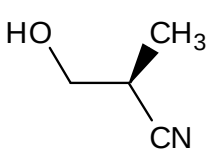
c. BOTH (equally)

d. NEITHER

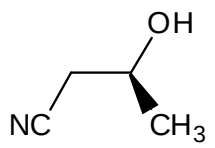
2.



a.



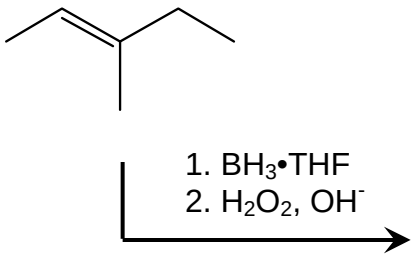
b.



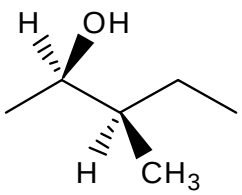
c. BOTH (equally)

d. NEITHER

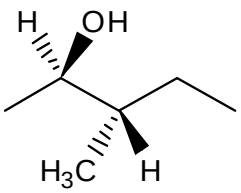
3.



a.



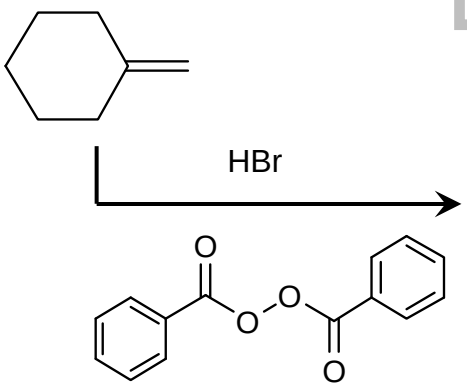
b.



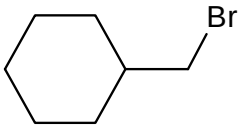
c. BOTH (equally)

d. NEITHER

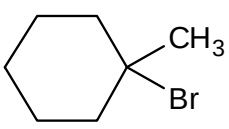
4.



a.



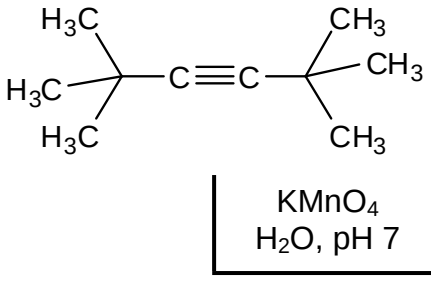
b.



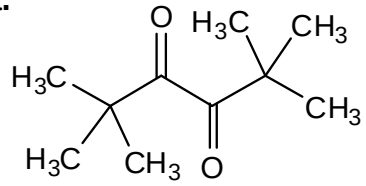
c. BOTH (equally)

d. NEITHER

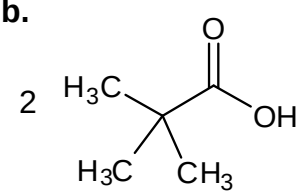
5.



a.



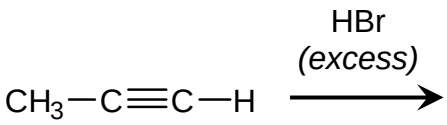
b.



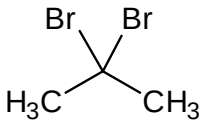
c. BOTH (equally)

d. NEITHER

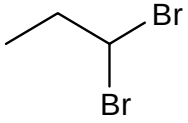
6.



a.



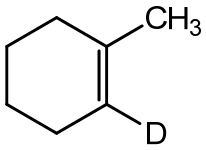
b.



c. BOTH (equally)

d. NEITHER

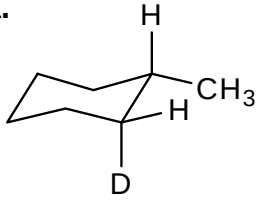
7.



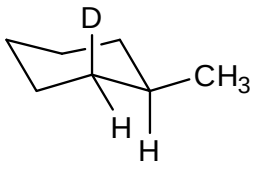
Pt/H_2

(D = deuterium, heavy isotope of hydrogen)

a.



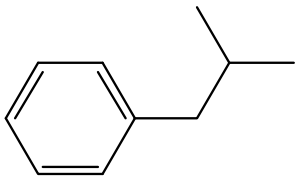
b.



c. BOTH (equally)

d. NEITHER

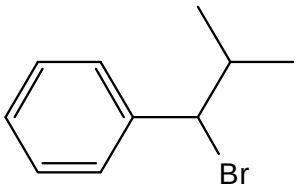
8.



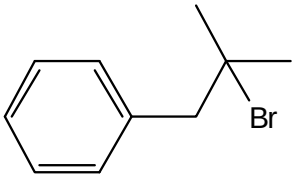
Br_2

$h\nu$

a.



b.

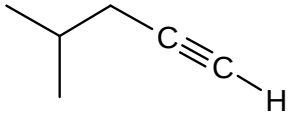


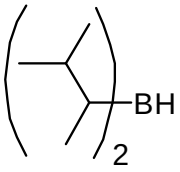
c. BOTH (equally)

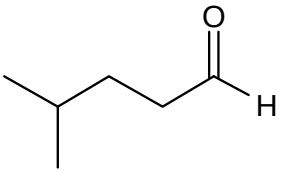
d. NEITHER

(4 pts each) Each of the reactions below is drawn with two possible reaction conditions. If only one of the two reaction conditions would generate the given molecule as the major product, answer with the corresponding letter. If both sets of conditions would accomplish the reaction, answer (c) "BOTH". If neither set of reaction conditions would succeed, answer (d) "NEITHER".

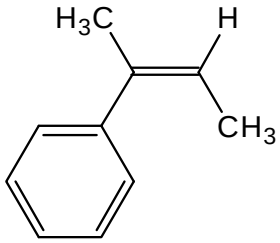
9.



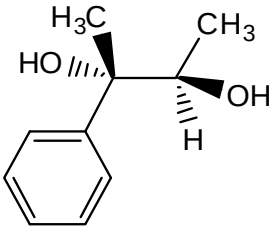
a. 1.  2. H_2O_2, NaOH	**b.** $HgSO_4$, H_2SO_4
c. BOTH would work	**d.** NEITHER would work



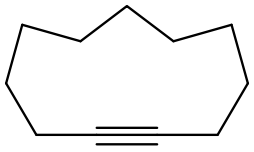
10.



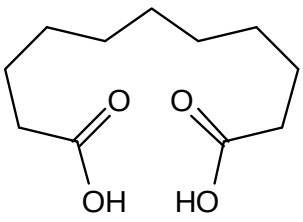
a. *m*CPBA, H_2O	**b.** $KMnO_4$, $H_2O/^-OH$
c. BOTH would work	**d.** NEITHER would work



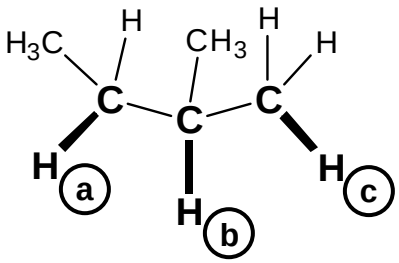
11.



a. 1. $KMnO_4$, KOH, Δ 2. H_3O^+	**b.** O_3, H_2O
c. BOTH would work	**d.** NEITHER would work



(3 pts each) The chemical structure of isopentane shown on the right has three C-H bonds labeled.



12. Which of the three bonds has the smallest bond dissociation energy (BDE)?

13. Which C-H would be most likely replaced by a C-Cl in a radical chlorination with Cl_2 and UV light?

NAME _____

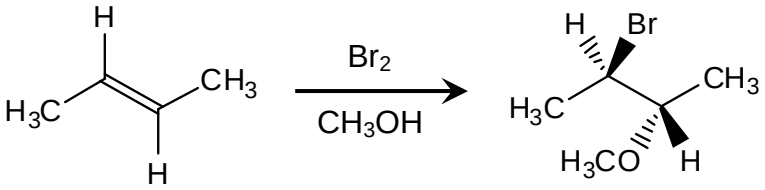
Scoring: 14. _____ / 20 16. _____ / 15

15. _____ / 15

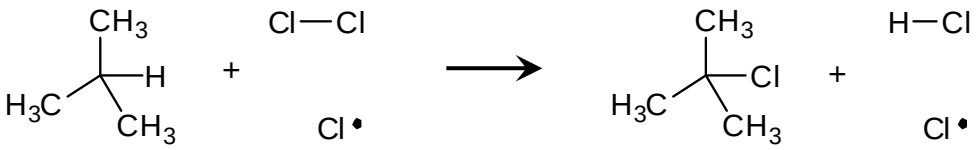
Total Score: _____ / 50

14. (20 pts) For each of the reactions shown below, draw a mechanism that explains how the product is generated from the starting material. In your answer, make sure that you:

- Draw each step of the mechanism separately;
- Use "electron pushing" to show where the electrons in each step go;
- Illustrate stereochemistry where appropriate;
- Use only the molecules that you are given; do not invoke reactants or solvents that aren't in the problem.

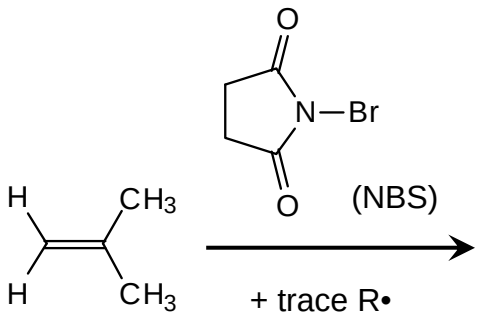


Mechanism:

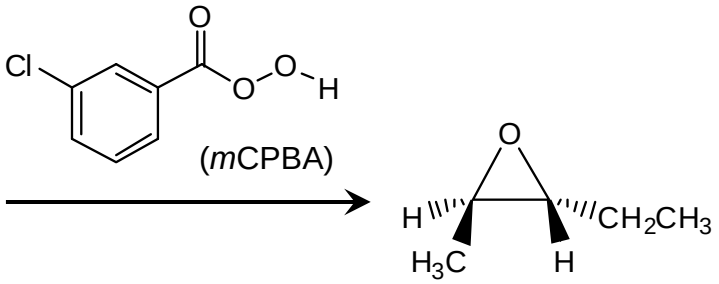


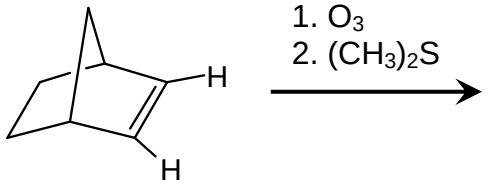
Mechanism:

15. (15 pts) Draw the missing reactant or product in the empty boxes. For products, give the predominant, most favored product. Illustrate stereochemistry in your answer where appropriate. For reactions that yield multiple enantiomers, draw only one enantiomer in the box, and include the note "+ enantiomer".

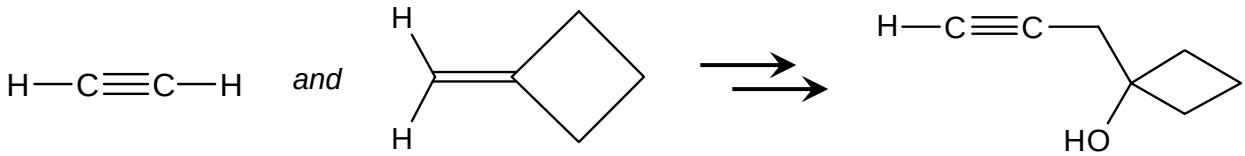


an alkene





16. (15 pts) For each set of starting materials and products shown below, **propose a multistep synthesis**. In addition to the molecules shown, you can use any reagents and reactions we've learned about in class. You might discover multiple answers to this problem; draw only your best (one) synthetic route. Feel free to draw an incomplete route—we will give you partial credit where we can.



Exam 3 Chart of Reaction Conditions

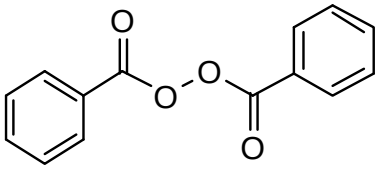
Reactions to consider from Ch. 6-7 (Exam 2): Acid-Base, S_N2, S_N1, E2, E1

Cl_2 *or* Br_2, *hν*

HBr

Br_2

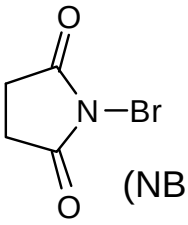
HBr



(benzoyl peroxide)

H_2SO_4
H_2O

1. $Hg(OAc)_2$
   H_2O *or* ROH
2. $NaBH_4$

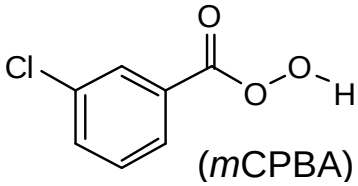


(NBS)

hν or AIBN

Br_2
H_2O *or* ROH

1. BH_3•THF
2. H_2O_2, OH^-



(*m*CPBA)

*m*CPBA
H_2O

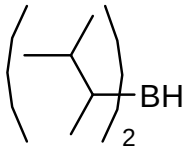
$Pt/H_2(g)$

$NaNH_2$

1. O_3
2. $(CH_3)_2S$

Na
NH_3

1.

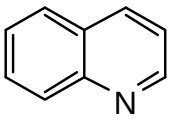


("Sia_2BH")

2. H_2O_2, NaOH

$KMnO_4$
(cold, dilute)
H_2O, OH^-

Pd, $BaSO_4$
$H_2(g)$



(quinoline)

$HgSO_4$
H_2SO_4

$KMnO_4$
H_2O, pH 7

1. O_3
2. H_2O

1. $KMnO_4$
   KOH, Δ
2. H_3O^+

Periodic Table of the Elements

Chemistry Reference Sheet

California Standards Test

	1 1A												13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1	1 **H** Hydrogen 1.01	2 2A																2 **He** Helium 4.00
2	3 **Li** Lithium 6.94	4 **Be** Beryllium 9.01											5 **B** Boron 10.81	6 **C** Carbon 12.01	7 **N** Nitrogen 14.01	8 **O** Oxygen 16.00	9 **F** Fluorine 19.00	10 **Ne** Neon 20.18
3	11 **Na** Sodium 22.99	12 **Mg** Magnesium 24.31	3 3B	4 4B	5 5B	6 6B	7 7B	8	9 8B	10	11 1B	12 2B	13 **Al** Aluminum 26.98	14 **Si** Silicon 28.09	15 **P** Phosphorus 30.97	16 **S** Sulfur 32.07	17 **Cl** Chlorine 35.45	18 **Ar** Argon 39.95
4	19 **K** Potassium 39.10	20 **Ca** Calcium 40.08	21 **Sc** Scandium 44.96	22 **Ti** Titanium 47.87	23 **V** Vanadium 50.94	24 **Cr** Chromium 52.00	25 **Mn** Manganese 54.94	26 **Fe** Iron 55.85	27 **Co** Cobalt 58.93	28 **Ni** Nickel 58.69	29 **Cu** Copper 63.55	30 **Zn** Zinc 65.39	31 **Ga** Gallium 69.72	32 **Ge** Germanium 72.61	33 **As** Arsenic 74.92	34 **Se** Selenium 78.96	35 **Br** Bromine 79.90	36 **Kr** Krypton 83.80
5	37 **Rb** Rubidium 85.47	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.91	40 **Zr** Zirconium 91.22	41 **Nb** Niobium 92.91	42 **Mo** Molybdenum 95.94	43 **Tc** Technetium (98)	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.91	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.87	48 **Cd** Cadmium 112.41	49 **In** Indium 114.82	50 **Sn** Tin 118.71	51 **Sb** Antimony 121.76	52 **Te** Tellurium 127.60	53 **I** Iodine 126.90	54 **Xe** Xenon 131.29
6	55 **Cs** Cesium 132.91	56 **Ba** Barium 137.33	57 **La** Lanthanum 138.91	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.95	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.21	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.22	78 **Pt** Platinum 195.08	79 **Au** Gold 196.97	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.38	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.98	84 **Po** Polonium (209)	85 **At** Astatine (210)	86 **Rn** Radon (222)
7	87 **Fr** Francium (223)	88 **Ra** Radium (226)	89 **Ac** Actinium (227)	104 **Rf** Rutherfordium (261)	105 **Db** Dubnium (262)	106 **Sg** Seaborgium (266)	107 **Bh** Bohrium (264)	108 **Hs** Hassium (269)	109 **Mt** Meitnerium (268)									

58 **Ce** Cerium 140.12	59 **Pr** Praseodymium 140.91	60 **Nd** Neodymium 144.24	61 **Pm** Promethium (145)	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.96	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.93	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.93	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.93	70 **Yb** Ytterbium 173.04	71 **Lu** Lutetium 174.97
90 **Th** Thorium 232.04	91 **Pa** Protactinium 231.04	92 **U** Uranium 238.03	93 **Np** Neptunium (237)	94 **Pu** Plutonium (244)	95 **Am** Americium (243)	96 **Cm** Curium (247)	97 **Bk** Berkelium (247)	98 **Cf** Californium (251)	99 **Es** Einsteinium (252)	100 **Fm** Fermium (257)	101 **Md** Mendelevium (258)	102 **No** Nobelium (259)	103 **Lr** Lawrencium (262)

Key

11 — Atomic number
Na — Element symbol
Sodium — Element name
22.99 — Average atomic mass*

* If this number is in parentheses, then it refers to the atomic mass of the most stable isotope.