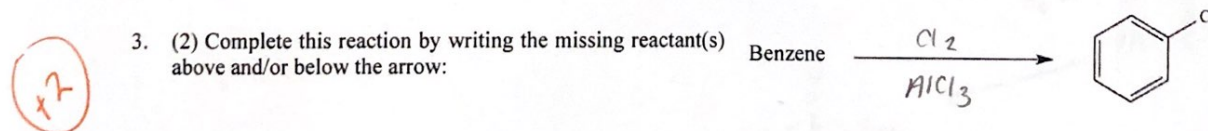
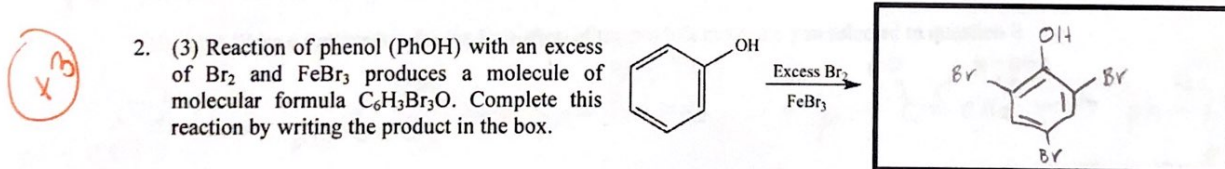
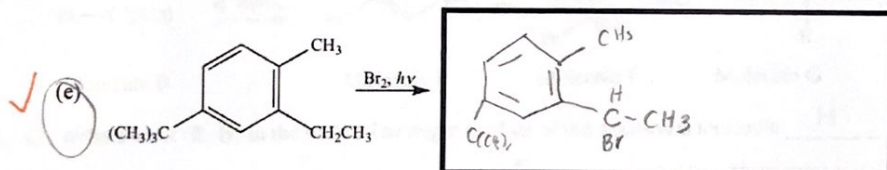
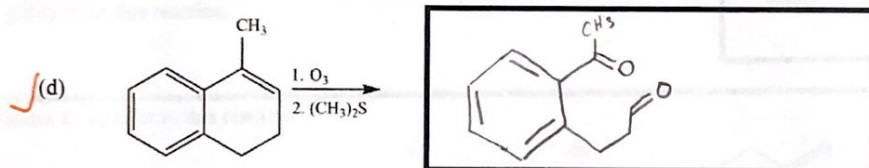
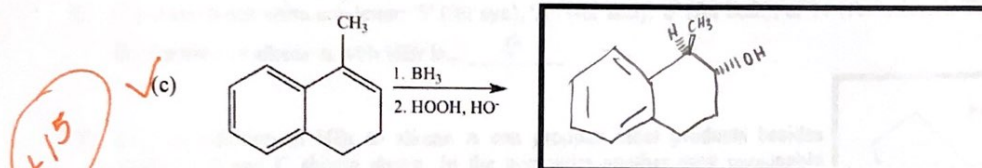
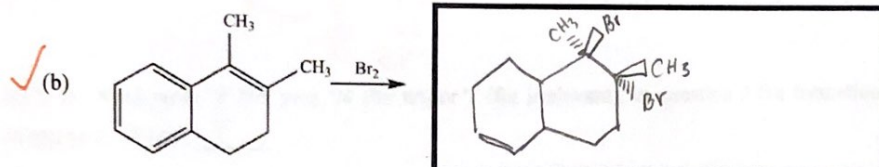
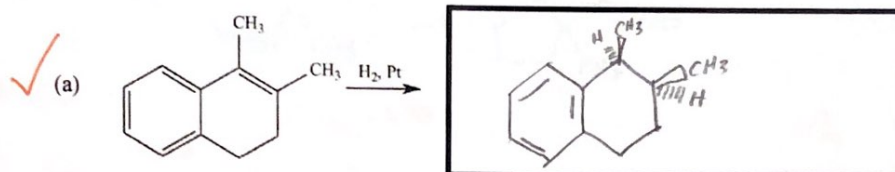


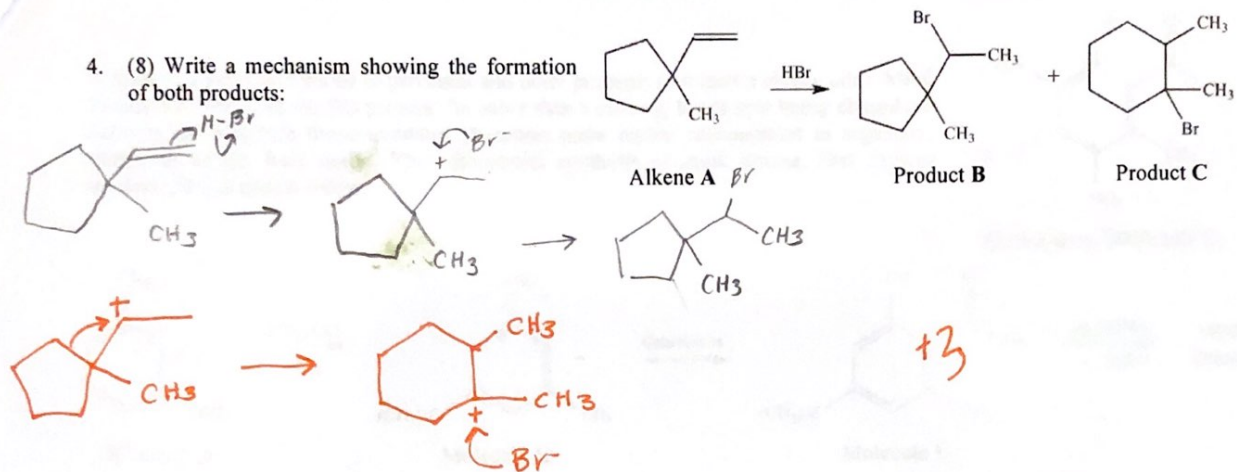
Chemistry 14D Winter 2017 Exam 2 Page 1

OK to use "Ph" anywhere on this exam where appropriate.
Exceeding the specified word limit on an answer will result in a point deduction for that answer.

1. (15) For the reactions shown below, write *the* (i.e., one) major organic product in the corresponding box. Do not include any mechanism details. If no reaction occurs, write "NR" in the product box. *Hint: Organic products contain carbon.*



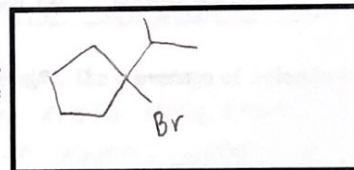
4. (8) Write a mechanism showing the formation of both products:



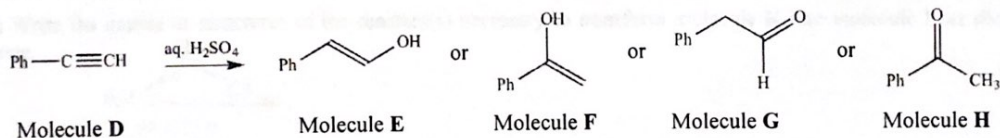
5. (1) In the blank write 'Y' (for yes), 'N' (for no) or 'I' (for irrelevant): In question 4 the formation of product B obeys Markovnikov's rule: Y

6. (1) In the space write one letter: 'S' (for syn), 'A' (for anti), 'B' (for both), or 'N' (for neither): The stereochemistry of the reaction of alkene A with HBr is... B

7. (3) The addition of HBr to alkene A can produce other products besides products B and C shown above. In the box write another very reasonable product for this reaction.



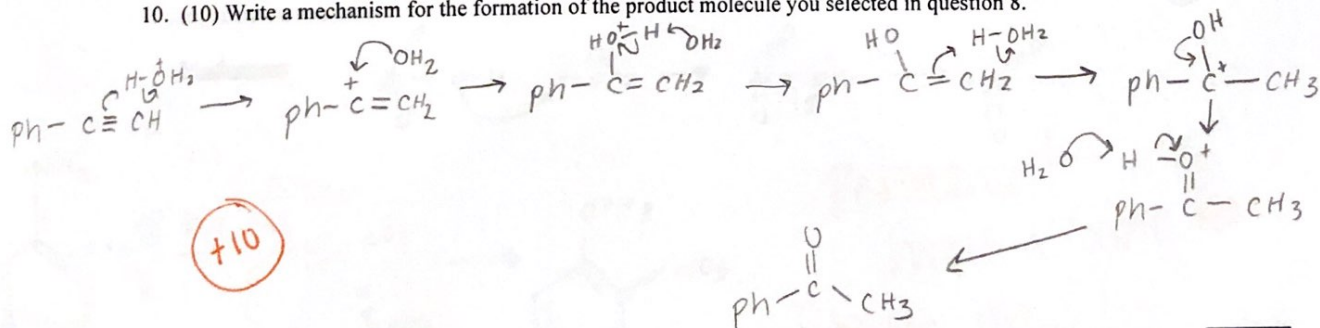
Questions 8–10 refer to this reaction:



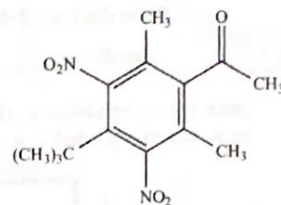
8. (2) Write a letter (E–H) in the blank: The major product of this reaction is molecule H.

9. (2) Write one letter (D–H) in each blank: Molecule F and molecule H are a set of tautomers.

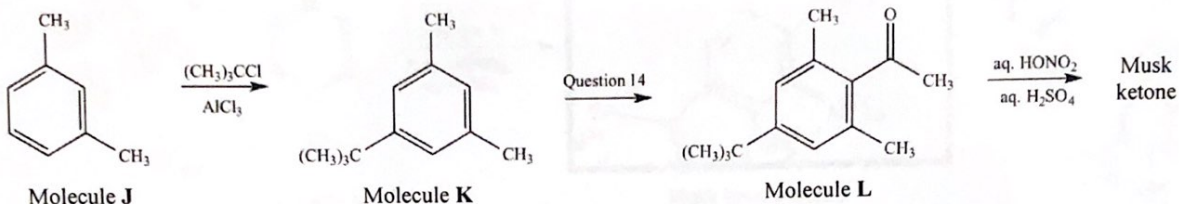
10. (10) Write a mechanism for the formation of the product molecule you selected in question 8.



A musk is a substance added to perfumes and other products to impart a musky odor. Musk ketone has been used for this purpose for more than a century, but is now being phased out because the molecule bioaccumulates (becomes more highly concentrated in organisms higher up in the food chain). The commercial synthesis of musk ketone, first devised around 1880, is shown below.



Musk ketone (Molecule I)



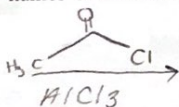
11. (2) Complete this sentence by writing one word in the blank: The term describing the relationship of the methyl groups in molecule J is co directors *meta → position relation*

12. (2) Complete this statement by writing no more than three words in the blank. *Be very specific.* The name of the reaction that converts molecule J into molecule K is called Friedel Craft Alkylation.

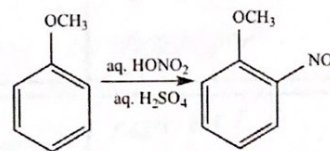
13. (3) Complete this sentence by adding *no more than twenty words.* *Be very specific.* The conversion of molecule J into molecule K as shown above is unusual/unpredicted in that... *Friedel Kraft Alkylation*

typically requires a strongly nucleophilic ring with strong arenium ion stabilizers. DUH! new group was added meta but both are ortho/para

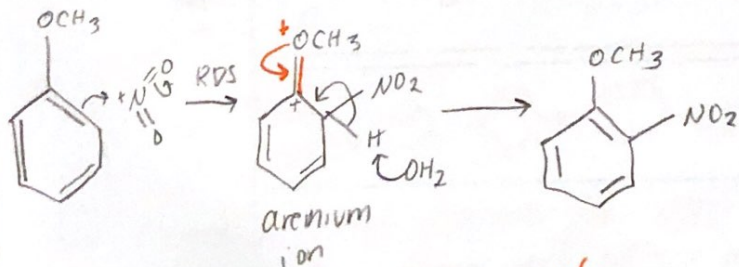
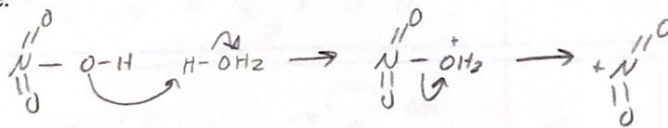
14. (2) Write the names or structures of the reactant(s) necessary to transform molecule K into molecule L as shown above.



15. (10) The mechanism for conversion of molecule L into musk ketone is the same as for the nitration of anisole shown here. Write the mechanism for the following reaction. If any structures have resonance, write only the most significant resonance contributor. Label the rate-determining step(s) by writing 'rds' above the reaction arrow(s). Label any arenium ions by writing 'arenium ion' below the arenium ion structure.



Mechanism:



*Resonance!
most stable has
charge on O!*

Page 3 score =

10

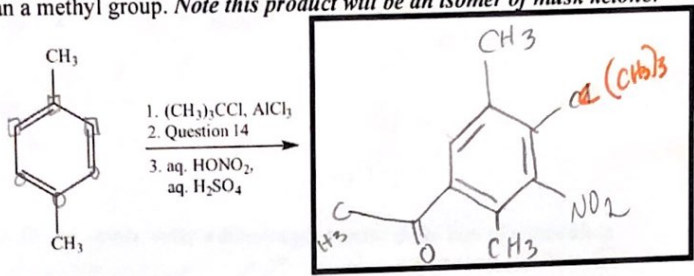
+2

16. (2) In the blank rank the musk ketone synthesis reactions by writing one molecule letter (I-L) in each blank.

Fastest K into L > J into K > L into I Slowest

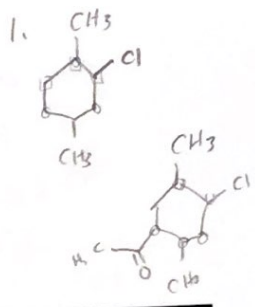
17. (3) What musk ketone isomer is produced if a molecule M (an isomer of molecule J) is subjected to the same reaction sequence as shown on page 3? Write the product in the box below. Assume a *tert*-butyl group has more directing influence than a methyl group. Note this product will be an isomer of musk ketone.

Why 2 NO₂?
+2

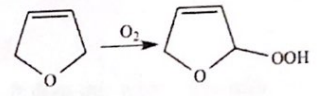


Molecule M

Musk ketone isomer



Questions 18-20 concern autoxidation, a free radical chain reaction in which a molecule reacts with molecular oxygen (from air) to form a hydroperoxide, as shown in this example:



18. (2) In the box write the best structure for O₂. Show all electrons.



+2

19. (12) (a) In the space below write the mechanism for the sample autoxidation reaction. Write just one mechanism step in each mechanism step box. One or more of these boxes might be left blank.

(b) In the I/P/T column boxes, write 'I' if the mechanism step is a radical chain initiation step, 'P' if it is a propagation step, or 'T' for a termination step. Write 'N' if the step is none of these.

(c) In the radical fate column boxes, write the name of the three common radical fate illustrated by the corresponding mechanism step. Write 'not a fate' if the mechanism step is not a radical fate as described in lecture.

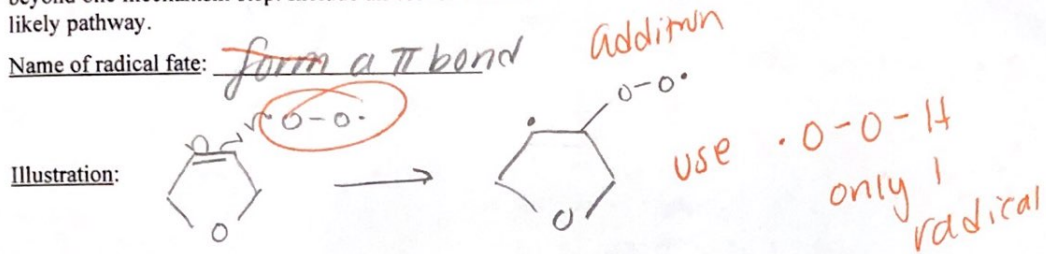
+9

	Mechanism step (part a)	I/P/T (part b)	Radical fate (part c)
Step 1:		I	atom transfer
Step 2:		P	radical combo
Step 3:		P	atom transfer
Step 4:			

Q: Would my answer for step 3 be sufficient or must you attack w/ other molecule?

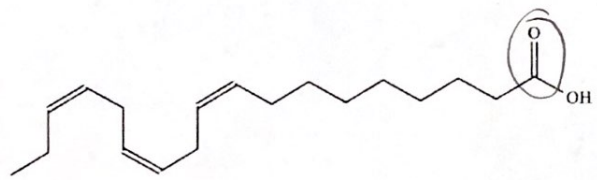
Page 4 score = 15

20. (3) Are all of the common radical fates illustrated in question 19? If yes, write 'all shown above' in the blank. If one or more fates are not included in the question 19 mechanism, write the name of one of these fates in the blank below. Illustrate the fate you've named by using any molecule(s) shown in your question 19 mechanism. Do not go beyond one mechanism step. Include all curved arrows. If the fate can occur more than one way write only the most likely pathway.



21. (3) Using no more than fifteen words, write a concise yet precise definition of antioxidant.
- prevent oxidation of radical a molecule that consumes reactive oxygen species like hydroxyl radical preventing oxidative damage

22. (5) Olive oil is thought to have many health benefits, including antioxidant properties. It does this when olive oil's polyunsaturated fatty acids react with molecular oxygen to form a hydroperoxide, very much like the sample autoxidation reaction shown above. Circle the carbon atom of α -linolenic acid (structure shown below; one antioxidant component of olive oil) where a hydroperoxide is most likely to be formed. *If more than one site of reaction is likely, circle just one.*



23. (4) Complete this sentence by writing no more than six words total in the two blanks: When released into the atmosphere, a small amount of a chlorofluorocarbon such as Freon-12 can destroy many molecules of ozone because the chemical reaction involved is a radical chain reaction.
- +4