

# Chemistry 3371: Organic Chemistry

Instructor: Hubert Yin/TA: Adam Csakai

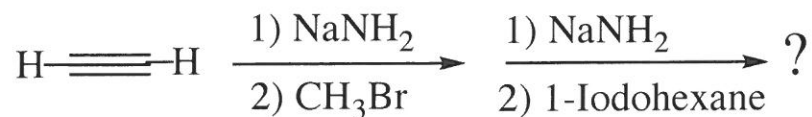
Tuesday: Feb. 8 @ 7:00 - 9:00 PM /1<sup>st</sup> Exam

Name: Key (please print, 1 pt)

Page	Possible Points	Score
1	<u>1</u>	<u>          </u>
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6	<u>10</u>	<u>          </u>
7	<u>18</u>	<u>          </u>
8	<u>9</u>	<u>          </u>
9	<u>6</u>	<u>          </u>
10	<u>10</u>	<u>          </u>
11	<u>10</u>	<u>          </u>
12	<u>Appendix: Periodic Table, common NMR, IR absorption</u>	
TOTAL	<u>100</u>	<u>          </u>

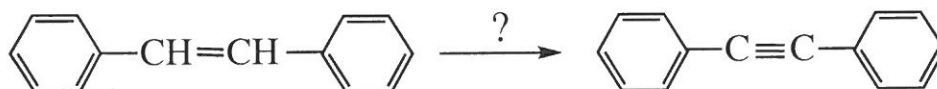
1. (3 pts each) *Clickers* in action:

a) What is the final major product after the reaction sequence shown below?



- A) 1-Nonyne
- B) 2-Nonyne
- C) *cis*-2-Nonene
- D) *trans*-2-Nonene

b) Which sequence of reactions works best for this transformation? Assume workup with water after reaction (2) as necessary.



- A) (1) HBr and (2) excess NaNH<sub>2</sub>
- B) (1) Br<sub>2</sub> and (2) excess NaNH<sub>2</sub>
- C) (1) Br<sub>2</sub>, H<sub>2</sub>O and (2) excess NaNH<sub>2</sub>
- D) (1) H<sub>2</sub>O, H<sub>2</sub>SO<sub>4</sub>(cat) & (2) excess NaNH<sub>2</sub>

c) What is the electrophile in the nitration of benzene?

- A) H<sub>3</sub>O<sup>+</sup>
- B) NO<sub>2</sub><sup>+</sup>
- C) NO<sub>3</sub><sup>-</sup>
- D) HSO<sub>4</sub><sup>-</sup>

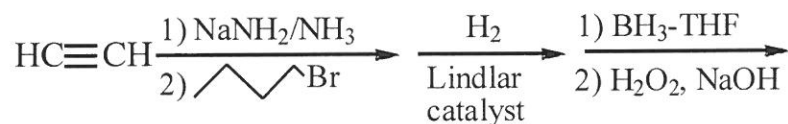
d) What is the product in the reaction between benzene and propyl chloride in the presence of  $\text{AlCl}_3$ ?

- A) Propylbenzene
- B) Isopropylbenzene**
- C) *o*-Chloropropylbenzene
- D) *o*-Chloroisopropylbenzene

e) In the Friedel-Crafts alkylation of benzene, dialkylation often produces significant amounts of a byproduct. In the Friedel-Crafts acylation of benzene, diacylation does not lead to significant amounts of a byproduct. What is the best reason to explain this observation?

- A) Alkyl groups activate the ring to further substitution, acyl groups deactivate it.**
- B) Alkyl groups are less sterically hindered than acyl groups.
- C) Acyl cations are more difficult to form with Lewis acids.
- D) Unlike acyl cations, carbocations undergo rearrangement.

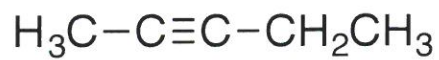
f) What is the final product after the reaction sequence depicted below?



- A) 1-Hexanol**
- B) 2-Hexanol
- C) 1,2-Hexanediol
- D) 1-Hexene

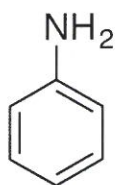
2. (8 pts) Provide the common names for the following molecules

a)



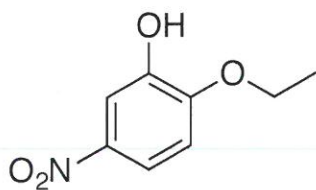
ethyl methyl acetylene

b)



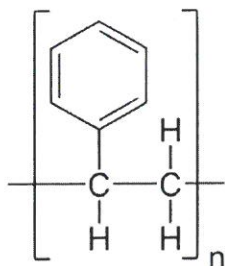
aniline

c)



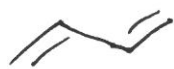
2-ethoxy-5-nitrophenol

d)



polystyrene

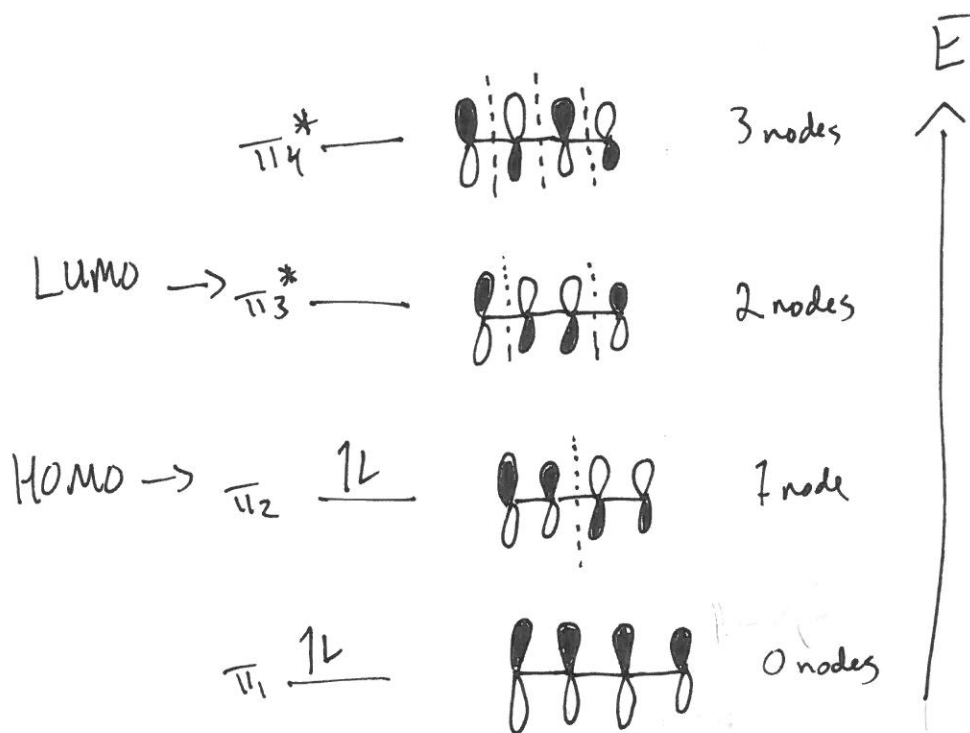
4. (10 pts) Sketch the form of the four  $\pi$  and  $\pi^*$  molecular orbitals of 1,3-butadiene and indicate their relative energies on a vertical scale.



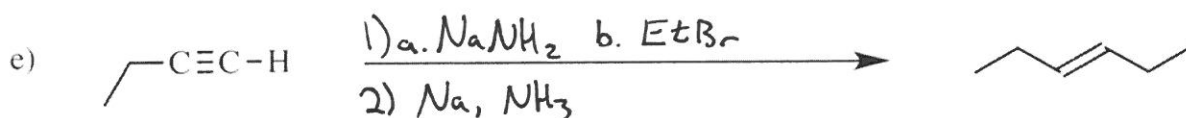
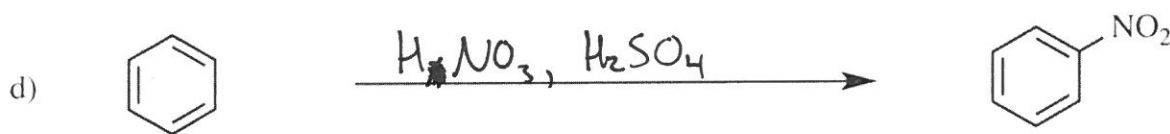
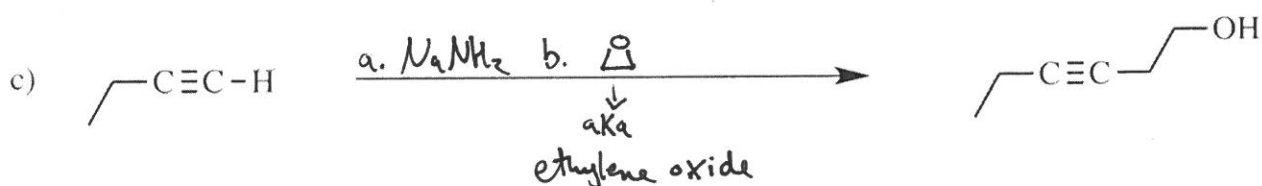
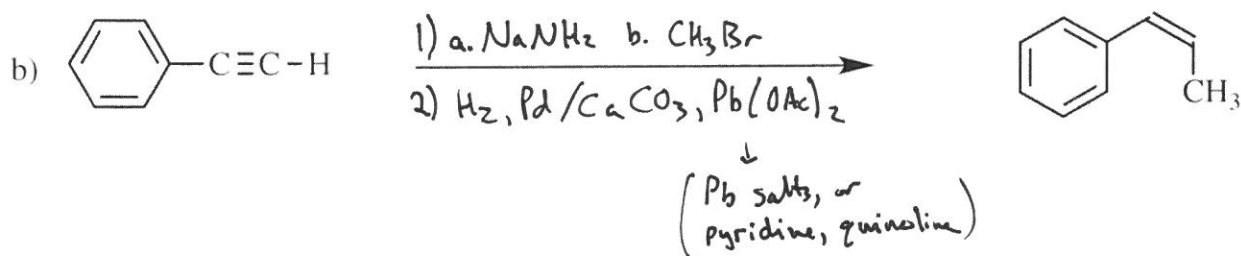
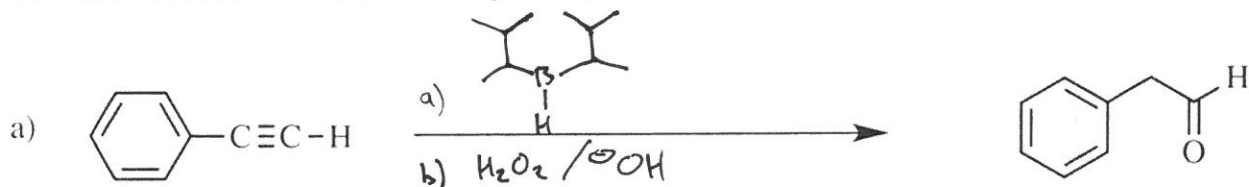
$4\pi e^-$

$\Downarrow$

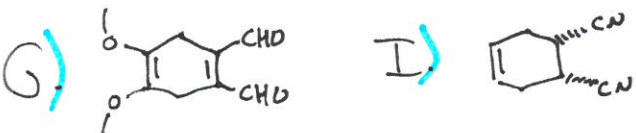
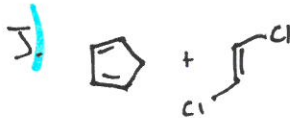
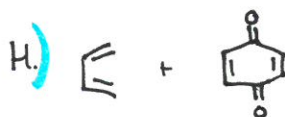
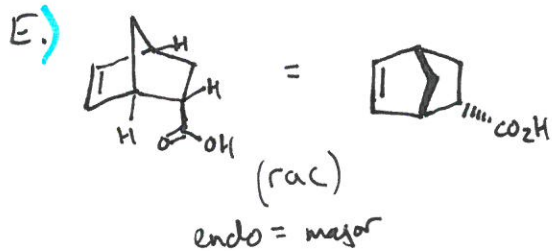
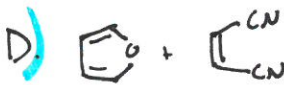
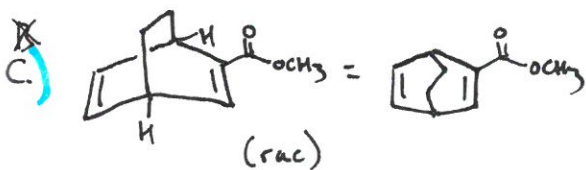
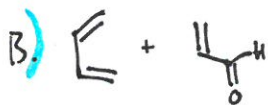
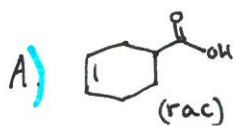
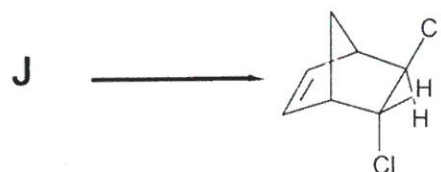
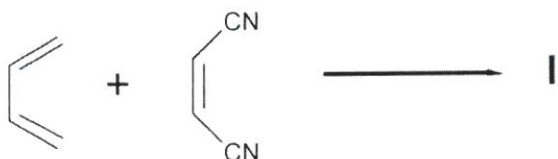
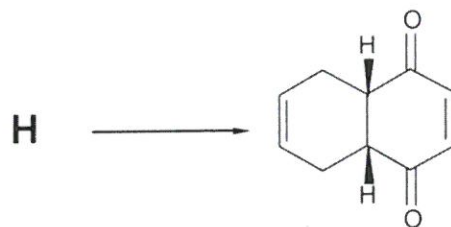
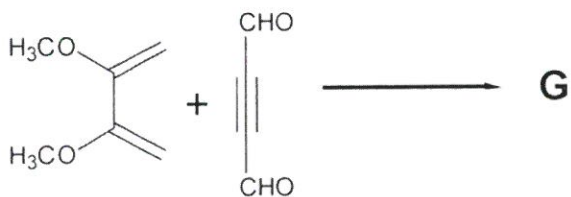
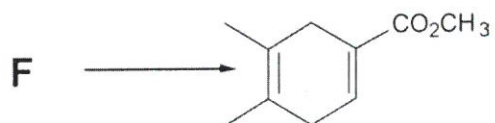
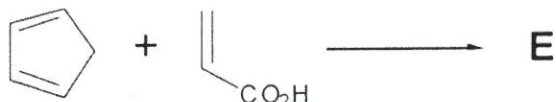
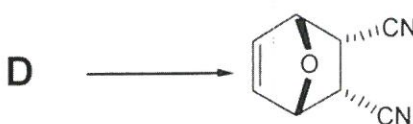
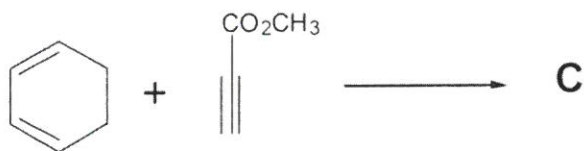
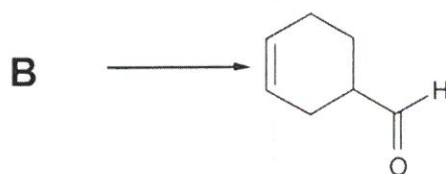
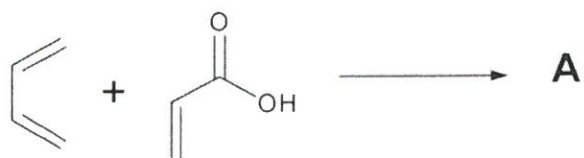
$4 MO_s$



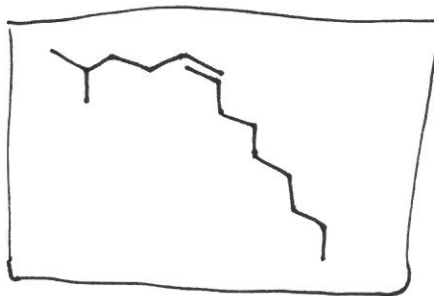
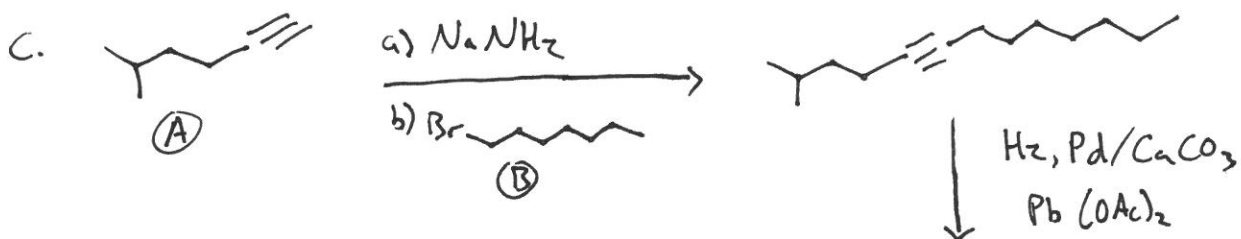
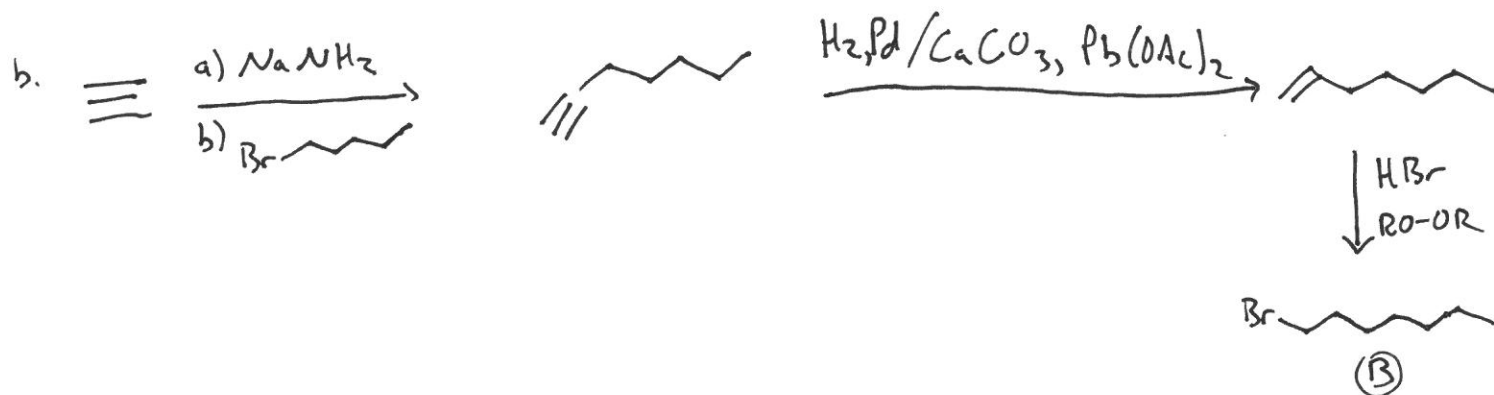
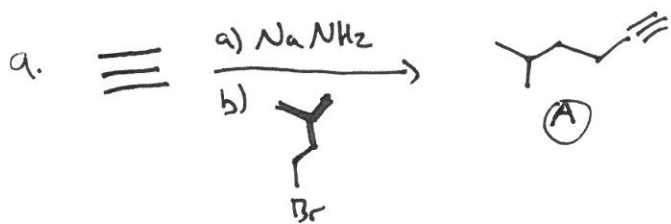
5. (10 pts) Propose reagents for accomplishing each of the following transformations. Make your reactions efficient (i.e. the target product should be the major product). Some of these transformations may require more than one step with isolation of intermediate products in between. Use letters to indicate sequential addition of reagents for one step, and use numbers to indicate multiple steps.



6. (18 pts) Fill in either the appropriate final product or necessary starting materials.



7. (9 pts) Outline a synthesis of *cis*-2-methyl-5-tridecene from acetylene and any other compounds containing no more than five carbons.

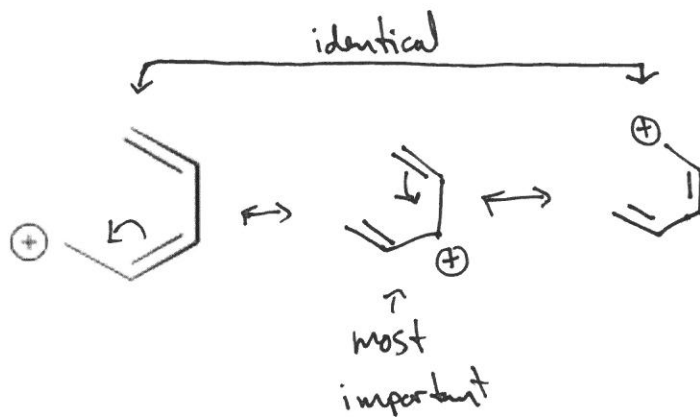


8. (6 pts) Use the curved-arrow or fishhook notation to derive the major resonance structures for each of the following species. Determine which, if any, structure is the most important one in each case.

(a)

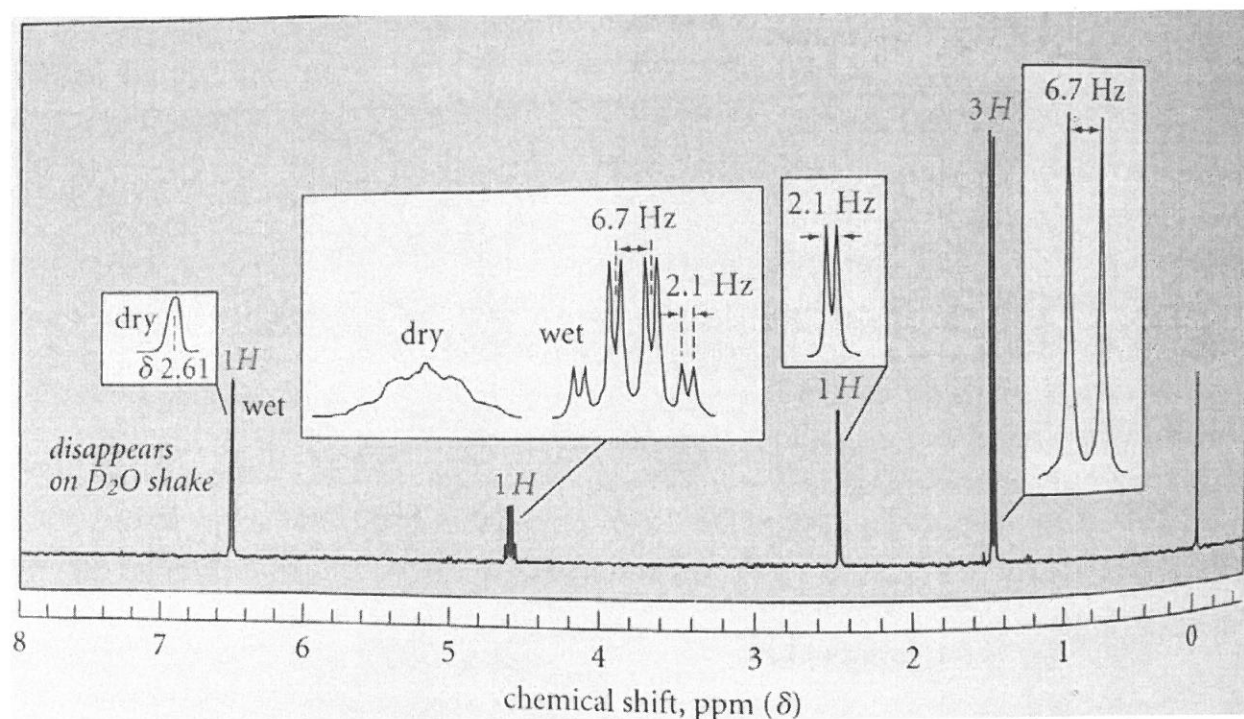


(b)

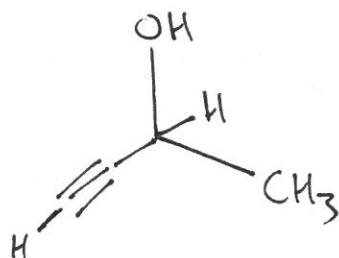


9. (10 pts) Identify the following compound,  $C_4H_6O$ , from the IR and proton NMR spectra:

IR:  $2100, 3300\text{ cm}^{-1}$  (sharp), superimposed on a broad, strong band at  $3350\text{ cm}^{-1}$



A trace of aqueous acid was added to the compound before the NMR spectrum was obtained. The integral (as the number of protons) is shown over each absorption peak. The absorption labeled "dry" was obtained on a very dry sample before addition of the acid. The absorption labeled "wet" was obtained in the presence of aqueous acid.



10. (10 pts) Outline a synthesis of *p*-bromonitrobenzene, starting from benzene. Add curved arrows to show the formation of new bonds and the breaking of old bonds.

