

Chemistry 39

Final Exam

Tuesday, May 7, 2005

Name (printed) _____

11:10 am

S.S. # _____

Signature _____

Please show your picture I.D. to a proctor when you hand in your exam.

TOTAL _____

There are 25 questions on this exam. Check that you have done all of the problems and filled in the first 25 bubbles on the scantron. All questions are worth 4 points. The maximum score on this exam is 100 points.

Instructions

Answer sheet

- 1) On the scantron, you need to clearly fill:
 - your **name** and your **student number**,
 - **section number** (Section 2, 10:10 am)
- 2) Use a #2 pencil

Exam policy

- 1) Molecular models are allowed, calculators are not allowed.
- 2) The back of the test can be used for scratch paper.
- 3) Relevant tables, including the periodic table, are attached at the end of this exam.
- 4) Numerical values given in one question apply only to this question, and should not be used in other questions, unless there is a specific instruction to do so. If necessary, the values from the provided tables should be used, even if they differ from values that you may remember from different sources.
- 5) You can take the copy of the examine away

Hints

- 1) As you read the question, underline or circle key words to highlight them for yourself.
- 2) Questions have only one acceptable answer. No partial credit will be given.
- 3) There is no penalty for guessing

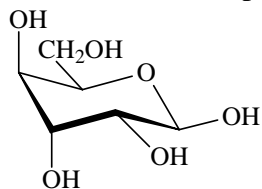
1 H 1.008	2 He 4.003											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3 Sc 44.96	4 Ti 47.88	5 V 50.94	6 Cr 52.00	7 Mn 54.94	VIII B 8 Fe 55.85 9 Co 58.93 10 Ni 58.70			11 Cu 63.55	12 Zn 65.38	13 Ga 69.72	14 Ge 72.59	15 As 74.92	16 Se 78.96	17 Br 79.90	18 Kr 83.80
19 K 39.10	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 58.70	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	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 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
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 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226.0)	89 Ac** (227)	104 (261)	105 (262)	106 (263)	107	108	109									

*Lanthanides	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
**Actinides	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)

TABLE 22.1 Acidity Constants for Some Organic Compounds

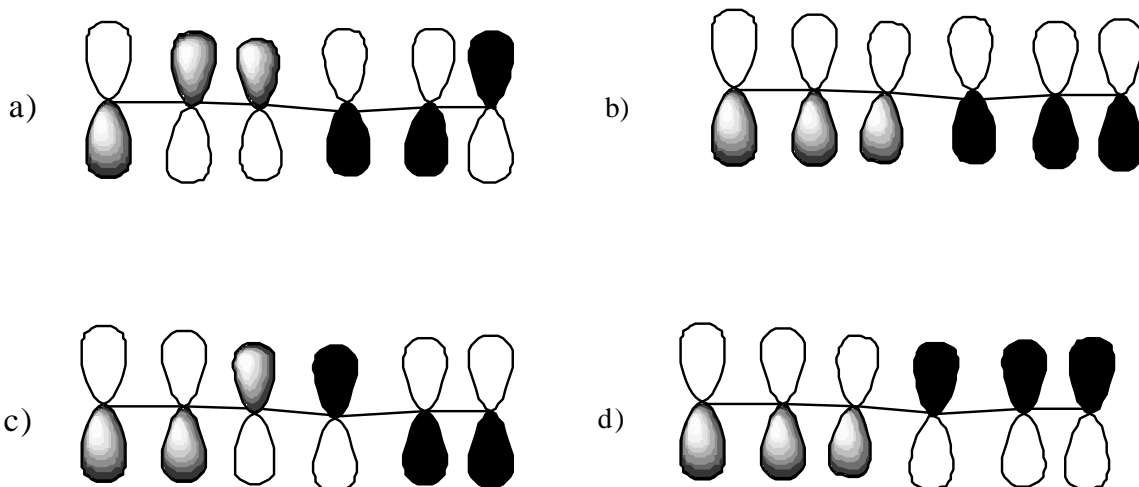
Compound type	Compound	pK _a
Carboxylic acid	CH ₃ COOH	5
1,3-Diketone	CH ₂ (COCH ₃) ₂	9
1,3-Keto ester	CH ₂ COCH ₂ CO ₂ C ₂ H ₅	11
1,3-Dinitrile	CH ₂ (CN) ₂	11
1,3-Diester	CH ₂ (CO ₂ C ₂ H ₅) ₂	13
Water	HOH	16
Primary alcohol	CH ₃ CH ₂ OH	16
Acid chloride	CH ₃ COCl	16
Aldehyde	CH ₃ CHO	17
Ketone	CH ₃ COCH ₃	19
Ester	CH ₃ CO ₂ C ₂ H ₅	25
Nitrile	CH ₃ CN	25
Dialkylamide	CH ₃ CON(CH ₃) ₂	30
Ammonia	NH ₃	35
Dialkylamine	HN(<i>i</i> -C ₃ H ₇) ₂	40
Alkyne	HC≡CH	25
Alkene	CH ₂ =CH ₂	49
Alkane	CH ₃ CH ₃	60

1. (4 pts) The following structure is that of gulose (Do not assume that it is a naturally occurring sugar). What is the correct description of this sugar?

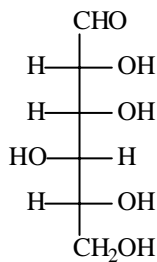


- a) α -D-pyranose b) α -L-pyranose c) β -D-pyranose d) β -L-pyranose

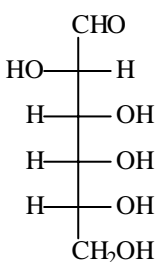
2. (4 pts) Which orbital is the LUMO of the conjugated triene?



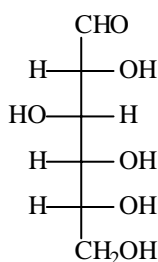
3. (4 pts) Which of the following sugars when subjected to the Wohl degradation would yield the same pentose?



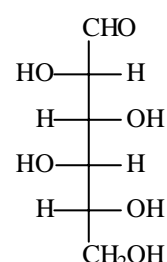
I



II



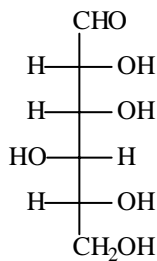
III



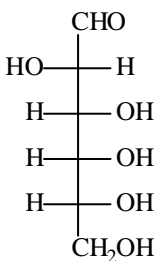
IV

- a) **I** and **II** b) **I** and **III** c) **I** and **IV** d) **II** and **III**

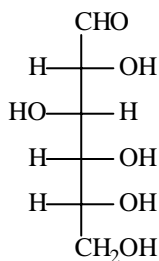
4. (4 pts) Which of the following sugars when oxidized with HNO_3 would yield the same aldaric acid?



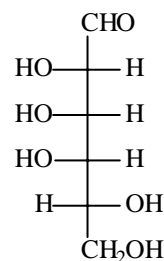
I



II



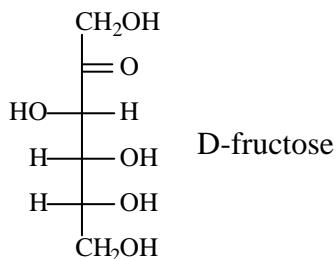
III



IV

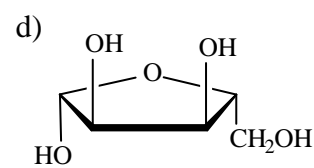
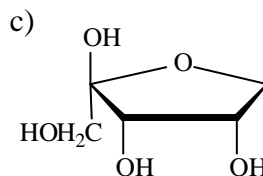
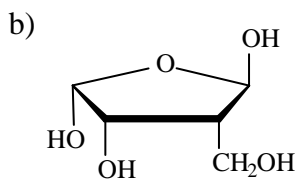
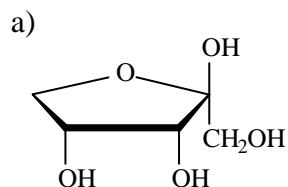
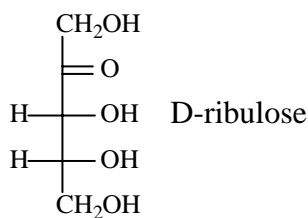
a) **I** and **II** b) **I** and **III** c) **I** and **IV** d) **II** and **IV**

5. (4 pts) Fructose is a 2-ketohexose. The Fischer projection of D-fructose is shown below. What is the largest possible number of **stereoisomers** for a 2-ketohexose?

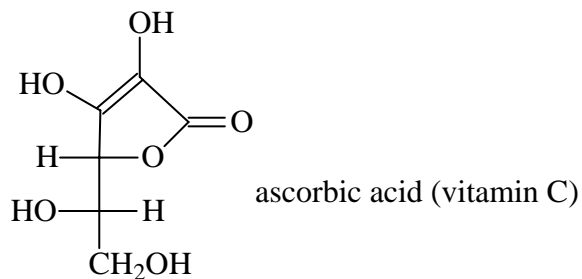


a) 4 b) 6 c) 8 d) 10

6. (4 pts) Which of the following is the correct Haworth projection of β -furanose form of D-ribose?



7. (4 pts) Simple natural sugars are D - sugars. They assume pyranose or furanose structures via formation of **hemiacetals**. Thus, they may be called D-hemiacetals. The structure of ascorbic acid in a Fischer projection is shown below. How would you classify this cyclic form of ascorbic acid?

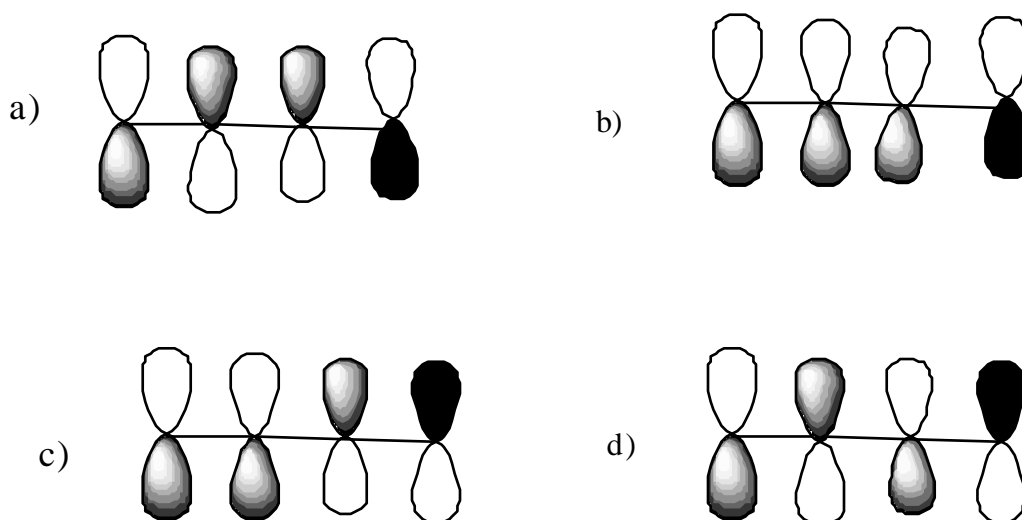


- a) D-acetal b) L-acetal c) D-ester d) L-ester

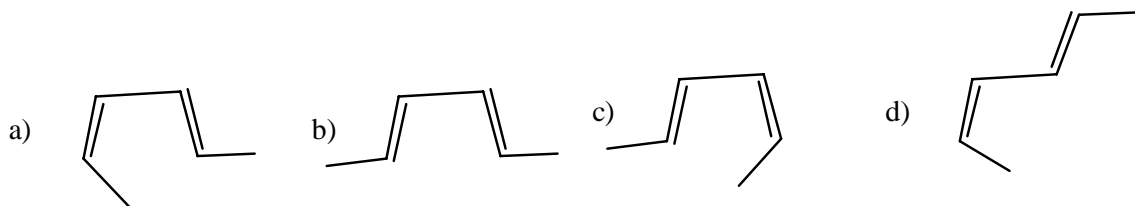
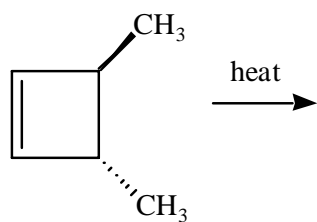
8. (4 pts) What is the mechanistic basis of mutarotation?

- a) reversible formation of a stereogenic hemiacetal center
- b) tautomeric equilibration of two enolic forms of aldehyde functionality
- c) reversible intramolecular Fischer esterification (with the internal -OH group)
- d) reversible formation of mixture of glycosides that have different optical rotation in the pure form

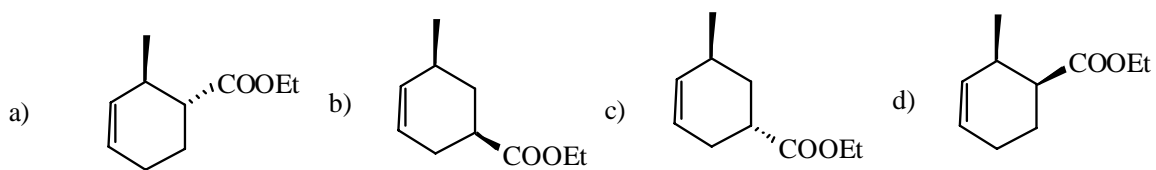
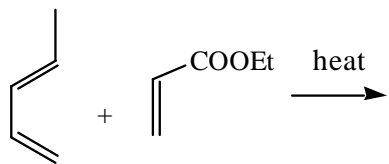
9. (4 pts) Which orbital is the HOMO of the conjugated diene



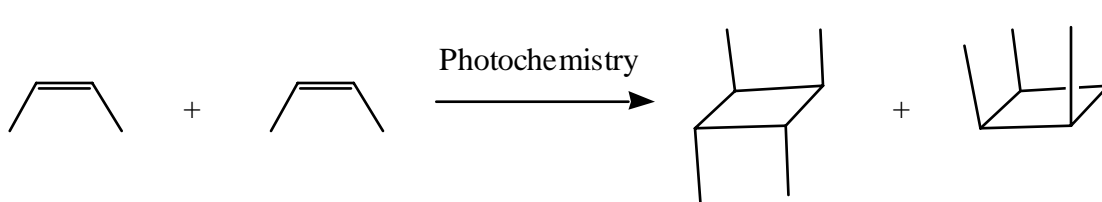
10. (4 pts) Draw the product from heat decomposition of the cyclic compound.



11. (4 pts) Which is the favored product of Diels-Alder reaction?



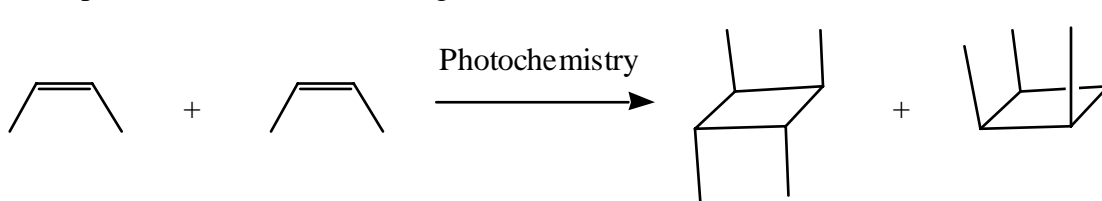
12. (4 pts) To answer the following reaction, consider the reaction below:



what type of pericyclic reaction is involved in this transformation?

- a) sigmatropic rearrangement
- b) reverse cycloaddition reaction
- c) electrocyclic reaction
- d) cycloaddition reaction

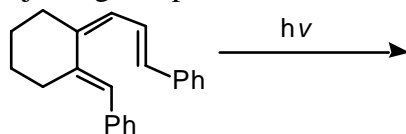
13. (4 pts) To answer the following reaction, consider the reaction below:



How many pairs of electrons are involved in this pericyclic reaction?

- a) two
- b) four
- c) eight
- d) sixteen

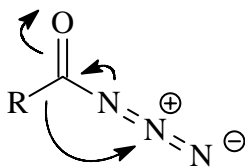
14. Identify the major organic product.



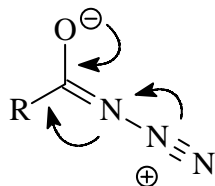
- a)
- b)
- c)
- d)

15. (4 pts) Which of the following mechanisms describes the Curtius rearrangement?

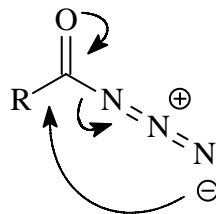
a)



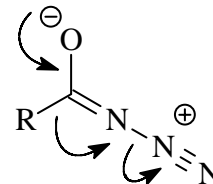
b)



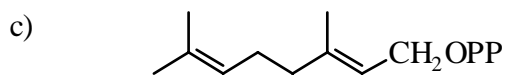
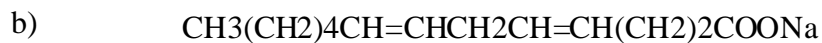
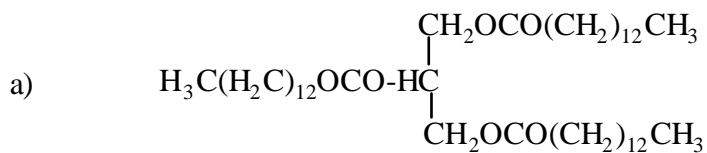
c)



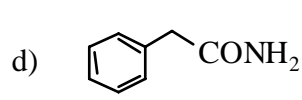
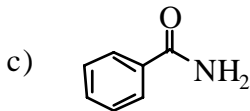
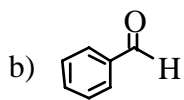
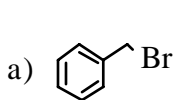
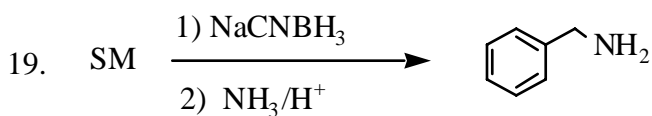
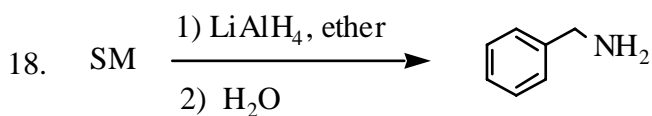
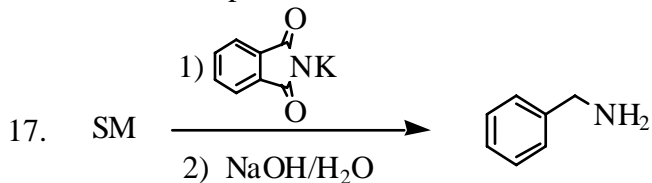
d)



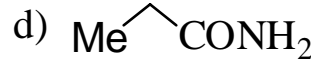
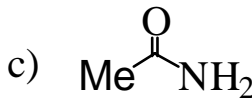
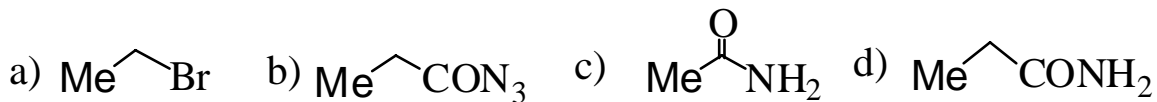
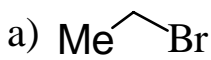
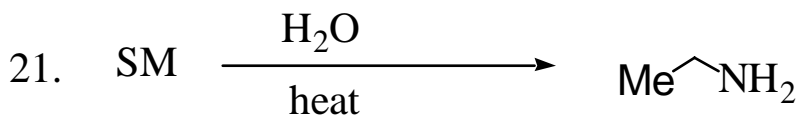
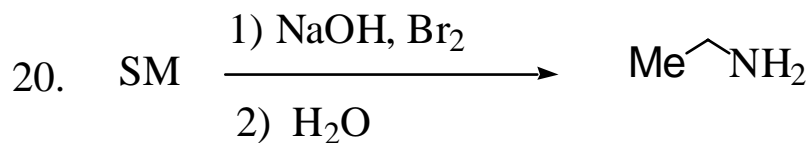
16. (4 pts) Match each of the following terms to a structure from the list below: which is the glyceryl triester.



17-19 (4 pts each) Select the appropriate **starting material** (SM) that would afford the indicated product.



20-21 (4 pts each) Select the appropriate **starting material** (SM) that would afford the indicated product.



22-24 (4 pts each) Select the appropriate reagents (from list below) to carry out the following transformation.

