THE COLLEGE OF THE BAHAMAS

EXAMINATION

SEMESTER 01-2004

FACULTY OF PURE AND APPLIED SCIENCES

SCHOOL OF NATURAL SCIENCES AND ENVIRONMENTAL STUDIES

X NASSAU
☐ FREEPORT
☐ EXUMA
☐ ELEUTHERA

DATE AND TIME OF EXAMINATION: Tuesday, 20th April, 2004 at 7:00 p.m.
DURATION: 3 HOURS

COURSE NUMBER: Chem 230

COURSE TITLE: Organic Chemistry I

STUDENT NAME:

STUDENT NUMBER:

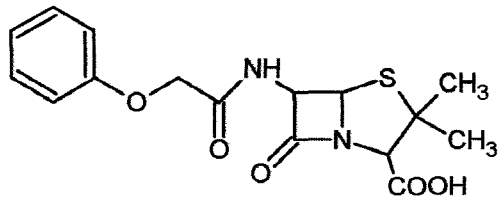
LECTURER'S NAME: Dr. D. Davis

INSTRUCTIONS TO CANDIDATES:

This examination paper consists of 12 questions on 6 pages (excluding this instruction page). Answer ALL questions in the spaces provided on the examination paper.

Only handheld calculators are allowed during this examination. The use of any other electronic device, *e.g.*, cellular phones or PDA's, is strictly prohibited.

1. Shown below is the structure of the antibiotic penicillin V. With regard to the structure answer the questions below

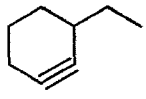


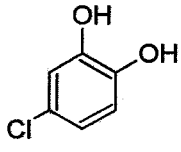
(a) Identify and label with an asterisk all of the stereocenters in the molecule. Ensure that your asterisks are not ambiguously placed. You will lose 0.25 marks for each incorrectly labeled atom.

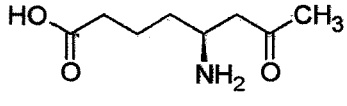
(b) What is the maximum number of possible stereoisomers for penicillin V?

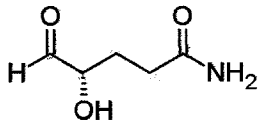
[3 marks]

2. Give the systematic names, including stereochemical designation (*R*, *S*, *cis* or *trans*, *etc.*) where required for the following molecules:

(a) 

(b) 

(c) 

(d) 

[4 marks]

3. Draw the chemical structure, showing stereochemical designation (*R*, *S*, *cis* or *trans*, *etc.*) where required, for the following molecules:

(a) 2-nitro-4-propyltoluene

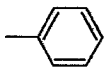
(b) (2*R*,3*S*)-3-bromo-2-chlorobutanamide

(c) *cis*-oct-4-en-2-one

(d) ethyl-2-[(3*R*,4*R*)-3,4-dihydroxycyclohexyl]ethanoate

[4 marks]

4. Assign priority numbers to the following groups. Let the number 4 represent the group of lowest priority and the number 1 represent the group of highest priority.

	-COOH	$-CH_2N(CH_3)_2$	$-CH_2NHCH_3$	$-\overset{O}{\overset{\|}{C}}OOH$
(a)	☐	☐	☐	☐
	-SH	$-SCH_3$	$-CH_2OH$	-OH
(b)	☐	☐	☐	☐
		$-CH_2CH=CH_2$	$-C\equiv N$	$-CH=CH_2$
(c)	☐	☐	☐	☐
	-OH	-F	$-NH_2$	$-CH_3$
(d)	☐	☐	☐	☐

[4 marks]

5. Write the complete chemical name that represent the following:

   (a) enantiomer of (2*S*,4*R*)-2,4-dichlorooctane

   (b) two diastereomers of (2*S*,4*R*)-2,4-dichlorooctane

[3 marks]

6. A solution of (2*R*,3*S*)-2,3-dibromocyclohexanone has a specific rotation of -42.7° at 25°C.

   (a) What is the specific rotation of a solution of (2*R*,3*S*)-2,3-dibromocyclohexanone and its enantiomer at 25°C in which the %ee of the (2*R*,3*S*) enantiomer is 15%?

   (b) What is the percentage of each enantiomer in the solution in part (a)?

[4 marks]

☐

7. Add reagents and/or products as required to complete the following reactions. Show stereochemistry where applicable.

(a) 

(b) 

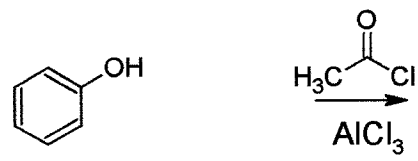
(c) 

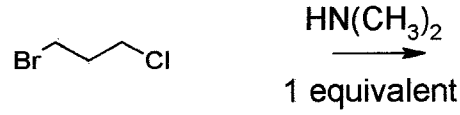
(d) 

(e) 

(f) 

(g) 

(h) 

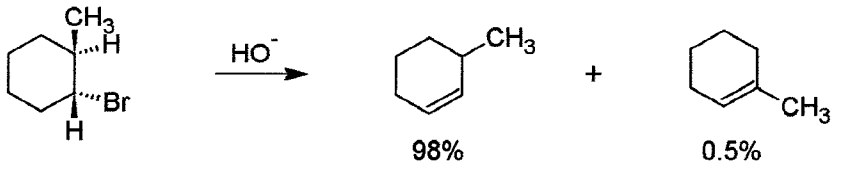
(i) 

(j) 

[10 marks]

8. Explain the product ratios shown below. A few sentences may provide the best answer to this question. An abbreviated curved arrow mechanism may help but it is not required.

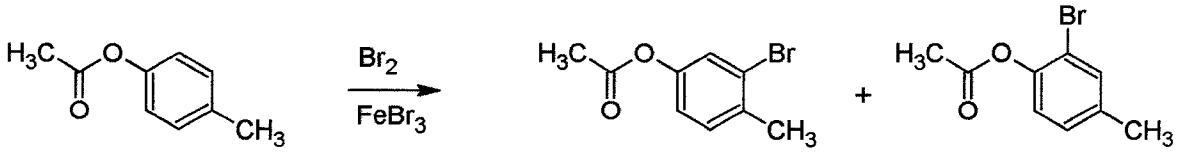
(a)



98% 0.5%

[3 marks]

(b)

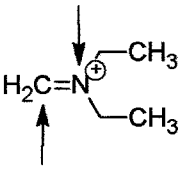


minor product major product

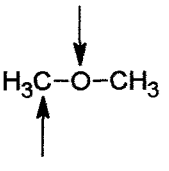
[3 marks]

9. In regard to the two molecules shown below:

(i)



(ii)

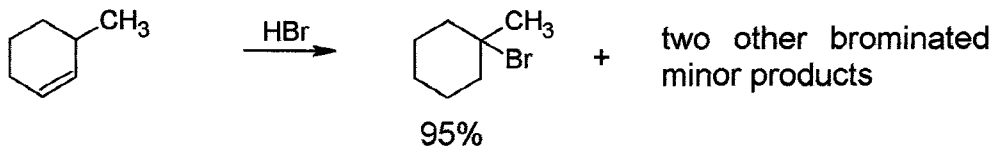


(a) Indicate the hybridization of the carbon, oxygen and nitrogen atoms highlighted in the molecules.

(b) What is the shape (with reasoning) of the molecule around the nitrogen atom?

[4 marks]

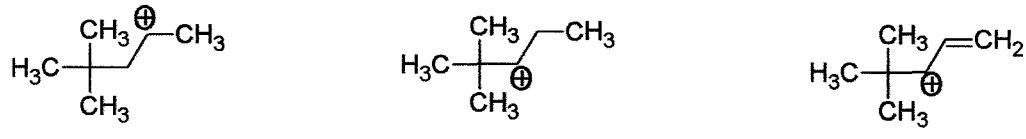
10. Draw the curved arrow mechanism to show the formation of the major product and the two minor products as indicated below.



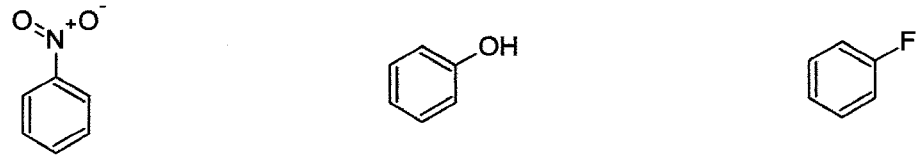
[4 marks]

11. Rank the following species according to the stated criteria.

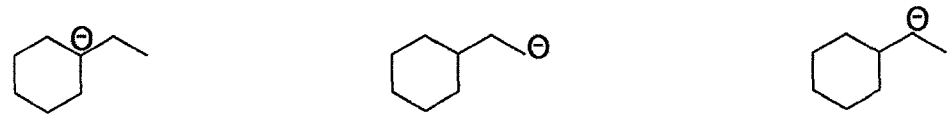
(a) Stability of the carbocation



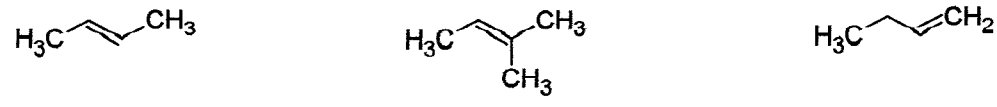
(b) Rate of aromatic electrophilic substitution



(c) Stability of the carbanion

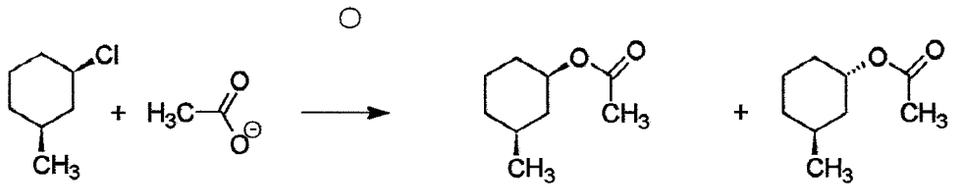


(d) Relative stability of the alkene

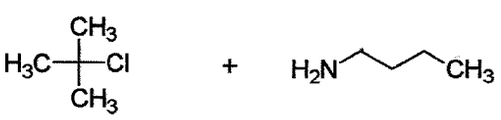


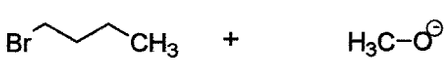
[4 marks]

12. For each reaction assign the most likely mechanistic route, *i.e.*, S_N1, S_N2, E1 or E2.

(a) 

(b) 

(c) 

(d) 

[4 marks]

******** End of Examination ********

PERIODIC TABLE OF THE ELEMENTS

I	II										III	IV	V	VI	VII	0
1 H hydrogen 1·0																2 He helium 4·0
3 Li lithium 6·9	4 Be beryllium 9·0										5 B boron 10·8	6 C carbon 12·0	7 N nitrogen 14·0	8 O oxygen 16·0	9 F fluorine 19·0	10 Ne neon 20·2
11 Na sodium 23·0	12 Mg magnesium 24·3										13 Al aluminium 27·0	14 Si silicon 28·1	15 P phosphorus 31·0	16 S sulfur 32·1	17 Cl chlorine 35·5	18 Ar argon 39·9
19 K potassium 39·1	20 Ca calcium 40·1	21 Sc scandium 45·0	22 Ti titanium 47·9	23 V vanadium 50·9	24 Cr chromium 52·0	25 Mn manganese 54·9	26 Fe iron 55·8	27 Co cobalt 58·9	28 Ni nickel 58·7	29 Cu copper 63·5	30 Zn zinc 65·4	31 Ga galium 69·7	32 Ge germanium 72·6	33 As arsenic 74·9	34 Se selenium 79·0	35 Br bromine 79·9	36 Kr krypton 83·8
37 Rb rubidium 85·5	38 Sr srontium 87·6	39 Y yttrium 88·9	40 Zr zirconium 91·2	41 Nb niobium 92·9	42 Mo molybdenum 95·9	43 Tc technetium 98·9	44 Ru ruthenium 101·1	45 Rh rhodium 102·9	46 Pd paladium 106·4	47 Ag silver 107·9	48 Cd cadmium 112·4	49 In indium 114·8	50 Sn tin 118·7	51 Sb antimony 121·8	52 Te tellurium 127·6	53 I iodine 126·9	54 Xe xenon 131·3
55 Cs cesium 132·9	56 Ba barium 137·3	57 La lanthanum 138·9	72 Hf hafnium 178·5	73 Ta tantalum 180·9	74 W tungsten 183·85	75 Re rhenium 186·2	76 Os osmium 190·2	77 Ir iridium 192·2	78 Pt platinum 195·1	79 Au gold 197·0	80 Hg mercury 200·6	81 Tl thallium 204·4	82 Pb lead 207·2	83 Bi bismuth 209·0	84 Po polonium	85 At astatine	86 Rn radon
87 Fr francium	88 Ra radium	89 Ac actinium														

58 Ce cerium	59 Pr praseodymium	60 Nd neodymium	61 Pm promethium	62 Sm samarium	63 Eu europium	64 Gd gadolinium	65 Tb terbium	66 Dy dysprosium	67 Ho holmium	68 Er erbium	69 Tm thulium	70 Yb ytterbium	71 Lu lutetium
90 Th thorium	91 Pa protoactinium	92 U uranium	93 Np neptunium	94 Pu plutonium	95 Am americium	06 Cm curium	97 Bk berkelium	98 Cf californium	99 Es einsteinium	100 Fm fermium	101 Md mendelevium	102 No nobelium	103 Lr lawrencium