

**UNIVERSITY OF SWAZILAND**  
**FINAL EXAMINATION 2014, DECEMBER**

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**TITLE OF PAPER** : Introductory Organic Chemistry  
**COURSE NUMBER** : C203  
**TIME** : Three Hours  
**INSTRUCTIONS** : **Answer any four questions.**  
Each question carries **25 Marks**

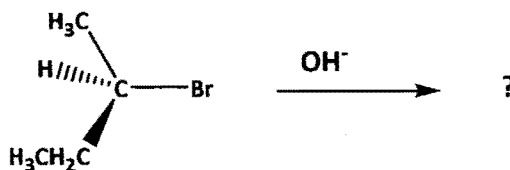
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This Examination Paper Contains 8 Printed Pages Including This Page

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the Chief Invigilator.***

### Question 1

- a. What product would you expect from the reaction of NaOH with (R)-2-bromobutane



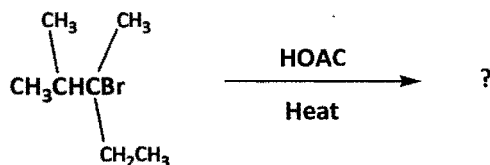
Formulate the reaction showing the stereochemistry of both reactant and product i.e. show the full S<sub>N</sub>2 mechanism **(5 Marks)**

- b. Which reagent in each pair will react faster in an S<sub>N</sub>2 reaction with hydroxide ion?

- (a) CH<sub>3</sub>Br or CH<sub>3</sub>I  
(b) CH<sub>3</sub>CH<sub>2</sub>I in ethanol (protic) or dimethyl sulfoxide (aprotic)  
(c) (CH<sub>3</sub>)<sub>3</sub>CCl or CH<sub>3</sub>Cl  
(d) H<sub>2</sub>C=CHBr or H<sub>2</sub>C=CHCH<sub>2</sub>Br

**(4 Marks)**

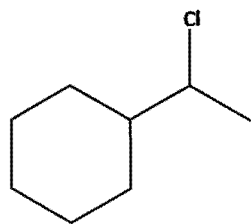
- c. Predict the major alkene product from this elimination:



**(2 Marks)**

- d. What alkenes would you start with to prepare these alkyl halides?

- i) bromocyclopentane  
ii) CH<sub>3</sub>CH<sub>2</sub>CHBrCH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>  
iii) 1-iodo-1-ethylcyclohexane

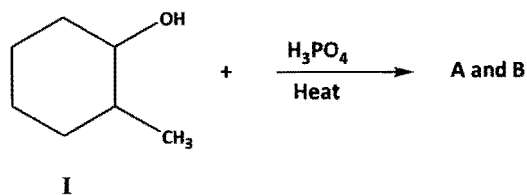


iv)

**(8 Marks)**

- e. Heating 2-methylcyclohexanol (I) in phosphoric acid (H<sub>3</sub>PO<sub>4</sub>) is known to convert compound (I) into two isomeric alkene products A and B. Write the mechanism

of this transformation and write the correct structures of A and B, indicating which is the major product



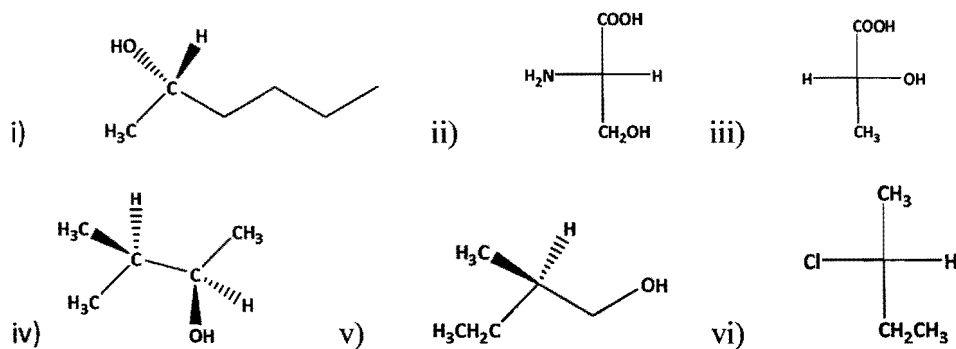
**(6 Marks)**

### Question 2

a. briefly explain the following terms and concepts and give suitable examples in each case to illustrate your answer: **(8 Marks)**

- i. Mesocompound
- ii. Racemic mixture
- iii. Diastereoisomers
- iv. Optical activity

b. Specify the configuration as (R) or (S) in each stereogenic centre in the following molecules: **(9 Marks)**



c. Enantiomerically pure amines such as pure (S)-1-phenylpropylamine (I) are often used to resolve racemic forms of acidic compounds such as ( $\pm$ ) lactic acid (II)

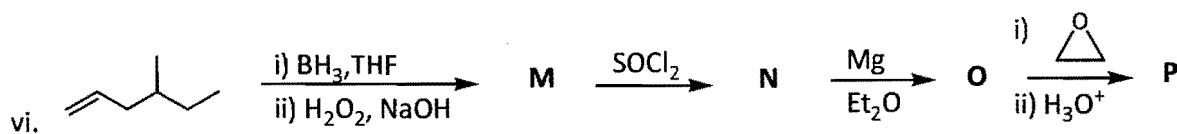
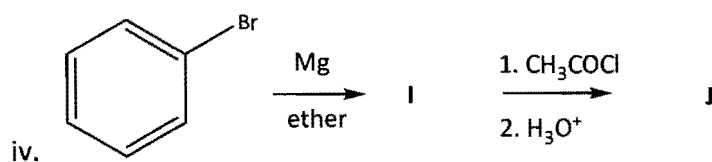
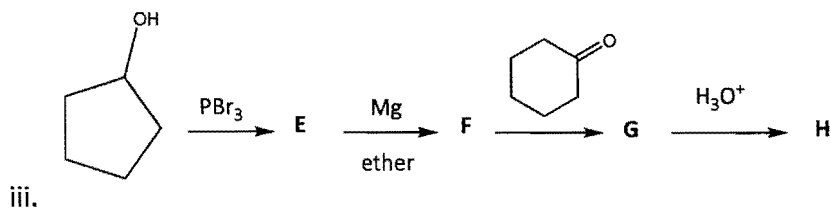
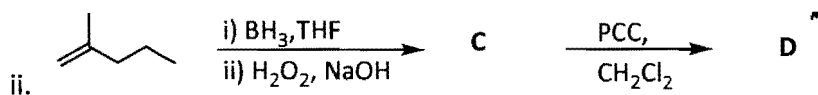
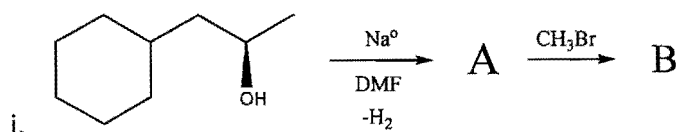


- i) Briefly describe how (S)-1-phenylpropylamine (I) may be used to resolve the racemic form of lactic acid (II) into enantiomerically pure acids

(8 Marks)

**Question 3**

- a) Complete the following reaction sequence, giving structures for the missing reagents or products (from A – P):

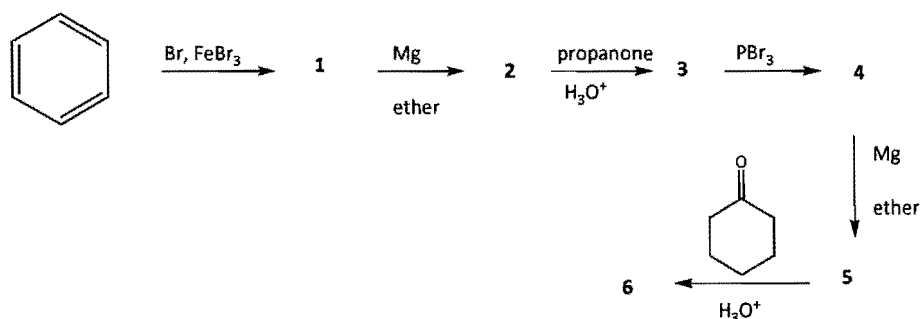


- b. Suggest a reasonable synthetic strategy for the synthesis of 4-methyl-1,4-pentanediol from 4-hydroxybutanone  $\text{HOCH}_2\text{CH}_2\text{CH}_2\text{COCH}_3$ .

(9 Marks)

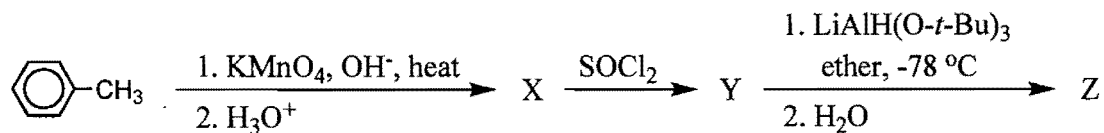
### Question 4

- a. Draw the structure corresponding to the following name: **(6 Marks)**
- 2-bromo-5-nitrophenol
  - 1,3-benzenediol
  - 2-hydroxy-benzoic acid
- b. Benzene, while unusually unreactive with electrophiles, will react under certain conditions. However, when it does react, it does so by \_\_\_\_\_ rather than by addition. **(3 Marks)**
- c. What product would result from the following series of reactions, **(16 Marks)**



### Question 5

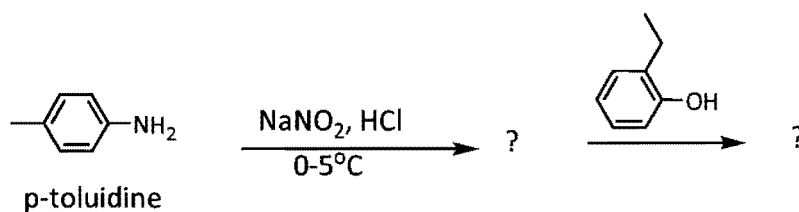
- a. A compound with an OH and CN group attached to the same carbon is known as a(n) \_\_\_\_\_. **(1Mark)**
- b. Complete the following reaction sequence, giving structural details of all significant intermediates and the final product. **(8 marks)**
- Benzene  $\xrightarrow[\text{FeCl}_3]{\text{Br}_2}$   $\xrightarrow[\text{ether}]{\text{Mg}}$   $\xrightarrow[2. \text{H}_3\text{O}^+]{1. \text{C}_6\text{H}_5\text{CHO}}$   $\xrightarrow[\text{acetone}]{\text{H}_2\text{Cr}_2\text{O}_4}$  ?
- c. Complete the following reaction sequence, giving structural details of all significant intermediates X, Y, and final product Z. **(6 Marks)**



- d. Given a mixture of benzylalcohol, phenol, and benzoic acid dissolved in ether, outline in a flow diagram an extraction method to separate each. **(10 Marks)**

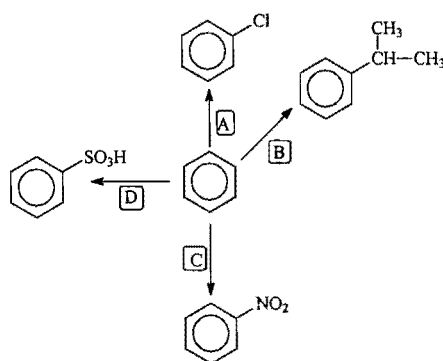
### Question 6

- a. Draw the structures for: **(4 Marks)**
- 3-oxo-5-bromohexanoic acid.
  - 2-Bromo-5-(3-methylpentyl)phenol
- b. The keto and enol forms of carbonyl compounds are a special type of \_\_\_\_\_ isomer called \_\_\_\_\_. **(2 Marks)**
- c. What is the principal product when *p*-toluidine is treated with sodium nitrite and hydrochloric acid at 0-5°C and this mixture is added to *o*-ethylphenol? **(5 Marks)**

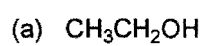


- d. Complete the following reactions by supplying the missing reagents only.

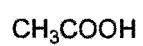
**(8 Marks)**



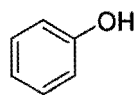
e. For the following series of compounds, arrange the molecules in order of decreasing acidity (most acidic to least acidic): **(6 Marks)**



I



II



III

hydrogen 1 <b>H</b> 1.0079																	helium 2 <b>He</b> 4.0026	
lithium 3 <b>Li</b> 6.941	beryllium 4 <b>Be</b> 9.0122											boron 5 <b>B</b> 10.811	carbon 6 <b>C</b> 12.011	nitrogen 7 <b>N</b> 14.007	oxygen 8 <b>O</b> 15.999	fluorine 9 <b>F</b> 18.998	neon 10 <b>Ne</b> 20.180	
sodium 11 <b>Na</b> 22.990	magnesium 12 <b>Mg</b> 24.305											aluminum 13 <b>Al</b> 26.982	silicon 14 <b>Si</b> 28.086	phosphorus 15 <b>P</b> 30.974	sulfur 16 <b>S</b> 32.065	chlorine 17 <b>Cl</b> 35.453	argon 18 <b>Ar</b> 39.948	
potassium 19 <b>K</b> 39.098	calcium 20 <b>Ca</b> 40.078	scandium 21 <b>Sc</b> 44.956	titanium 22 <b>Ti</b> 47.867	vanadium 23 <b>V</b> 50.942	chromium 24 <b>Cr</b> 51.996	manganese 25 <b>Mn</b> 54.938	iron 26 <b>Fe</b> 55.845	cobalt 27 <b>Co</b> 58.933	nickel 28 <b>Ni</b> 58.693	copper 29 <b>Cu</b> 63.546	zinc 30 <b>Zn</b> 65.39	gallium 31 <b>Ga</b> 69.723	germanium 32 <b>Ge</b> 72.61	arsenic 33 <b>As</b> 74.922	selenium 34 <b>Se</b> 78.96	bromine 35 <b>Br</b> 79.904	krypton 36 <b>Kr</b> 83.80	
rubidium 37 <b>Rb</b> 85.468	strontium 38 <b>Sr</b> 87.62	yttrium 39 <b>Y</b> 88.906	zirconium 40 <b>Zr</b> 91.224	niobium 41 <b>Nb</b> 92.906	molybdenum 42 <b>Mo</b> 95.94	technetium 43 <b>Tc</b> [98]	ruthenium 44 <b>Ru</b> 101.07	rhodium 45 <b>Rh</b> 102.91	palladium 46 <b>Pd</b> 106.42	silver 47 <b>Ag</b> 107.87	cadmium 48 <b>Cd</b> 112.41	indium 49 <b>In</b> 114.82	tin 50 <b>Sn</b> 118.71	antimony 51 <b>Sb</b> 121.76	tellurium 52 <b>Te</b> 127.60	iodine 53 <b>I</b> 126.90	xenon 54 <b>Xe</b> 131.29	
caesium 55 <b>Cs</b> 132.91	barium 56 <b>Ba</b> 137.33	57-70 *	lutetium 71 <b>Lu</b> 174.97	hafnium 72 <b>Hf</b> 178.49	tantalum 73 <b>Ta</b> 180.95	tungsten 74 <b>W</b> 183.84	rhenium 75 <b>Re</b> 186.21	osmium 76 <b>Os</b> 190.23	iridium 77 <b>Ir</b> 192.22	platinum 78 <b>Pt</b> 195.08	gold 79 <b>Au</b> 196.97	mercury 80 <b>Hg</b> 200.59	thallium 81 <b>Tl</b> 204.38	lead 82 <b>Pb</b> 207.2	bismuth 83 <b>Bi</b> 208.98	polonium 84 <b>Po</b> [209]	astatine 85 <b>At</b> [210]	radon 86 <b>Rn</b> [222]
francium 87 <b>Fr</b> [223]	radium 88 <b>Ra</b> [226]	89-102 * *	lawrencium 103 <b>Lr</b> [262]	rutherfordium 104 <b>Rf</b> [261]	dubnium 105 <b>Db</b> [262]	seaborgium 106 <b>Sg</b> [266]	bohrium 107 <b>Bh</b> [264]	hassium 108 <b>Hs</b> [269]	meitnerium 109 <b>Mt</b> [268]	ununnillium 110 <b>Uun</b> [271]	unununium 111 <b>Uuu</b> [272]	ununbium 112 <b>Uub</b> [277]		ununquadium 114 <b>Uuq</b> [289]				

∞

\* Lanthanide series

lanthanum 57 <b>La</b> 138.91	cerium 58 <b>Ce</b> 140.12	praseodymium 59 <b>Pr</b> 140.91	neodymium 60 <b>Nd</b> 144.24	promethium 61 <b>Pm</b> [145]	samarium 62 <b>Sm</b> 150.36	europium 63 <b>Eu</b> 151.96	gadolinium 64 <b>Gd</b> 157.25	terbium 65 <b>Tb</b> 158.93	dysprosium 66 <b>Dy</b> 162.50	holmium 67 <b>Ho</b> 164.93	erbium 68 <b>Er</b> 167.26	thulium 69 <b>Tm</b> 168.93	ytterbium 70 <b>Yb</b> 173.04
actinium 89 <b>Ac</b> [227]	thorium 90 <b>Th</b> 232.04	protactinium 91 <b>Pa</b> 231.04	uranium 92 <b>U</b> 238.03	neptunium 93 <b>Np</b> [237]	plutonium 94 <b>Pu</b> [244]	americium 95 <b>Am</b> [243]	curium 96 <b>Cm</b> [247]	berkelium 97 <b>Bk</b> [247]	californium 98 <b>Cf</b> [251]	einsteinium 99 <b>Es</b> [252]	fermium 100 <b>Fm</b> [257]	mendelevium 101 <b>Md</b> [258]	nobelium 102 <b>No</b> [259]

\*\* Actinide series