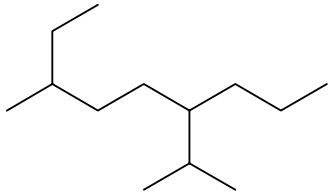
Chemistry 123 (UBC) Practice Exam

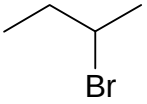
Part I: Organic Chemistry

1) Name the following compounds. Assign designation for stereochemistry if necessary.

A)



B)



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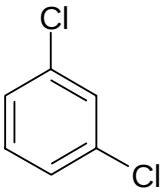
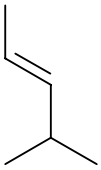
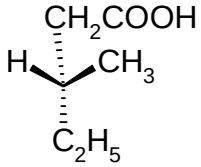
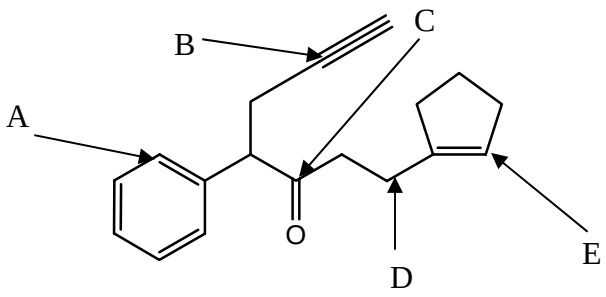




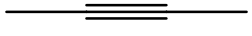


2) What is the hybridization at the sites indicated?

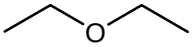


3) What functional groups are present in the following molecules?

A



B



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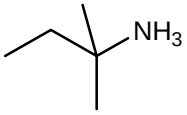
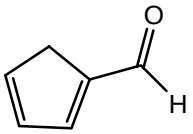
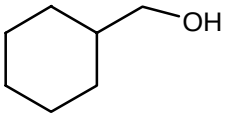


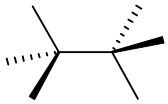
D



E

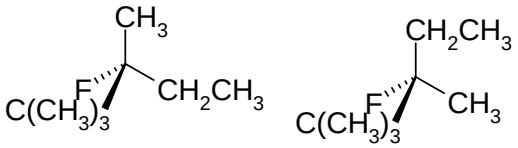


4) Draw three dimensional representations for the following:
   A) The most stable conformation of 2,3-dimethyl-butane. Use a Newman projection viewing along the C2-C3 bond.
   B) The least stable conformation of 2,3-dimethyl-butane. Use a Newman projection viewing along the C2-C3 bond.
   C) Complete the template below to clearly show the structure of (2S,3S)-2-bromo-3-chloro-butane. Show all atoms, including hydrogen and carbon, required to complete the structure.



5) For each pair of structures, state whether they are constitutional isomers (C), diastereomers (D), identical (I) or enantiomers (E). More than one term may apply to each structure.

A)



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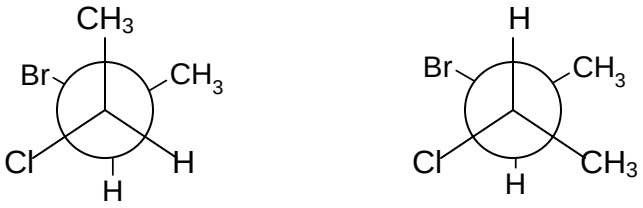
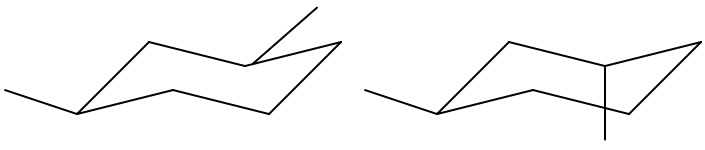
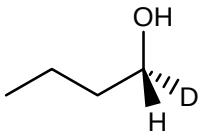


C)

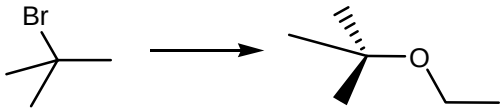


6) A) Draw both chair forms of cis-1-bromo-3-methylcyclohexane
   B) Which is more stable?

7) A) The structure below, (R)-1-deutero-1-butanol, is heated with sodium bromide in sulfuric acid. If the reaction undergoes S_N2 kinetics, draw and name the major product(s) formed.



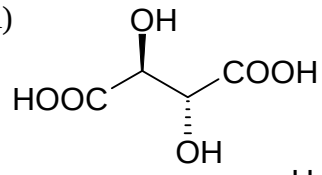
B) Propose & draw the mechanism for the following reaction:



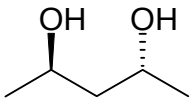
C) How would you confirm the mechanism proposed for part B using a kinetic study?

8) State whether the following compounds are chiral or achiral.

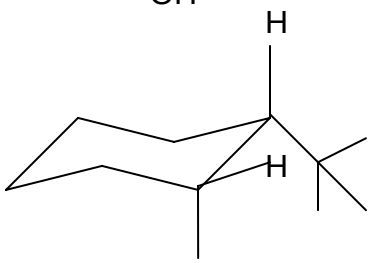
A)



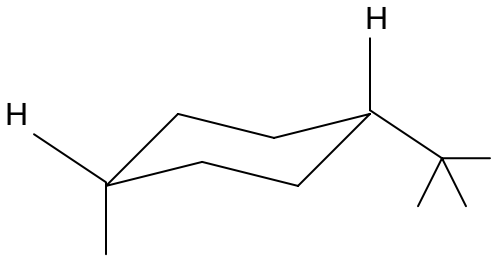
B)



C)



D)



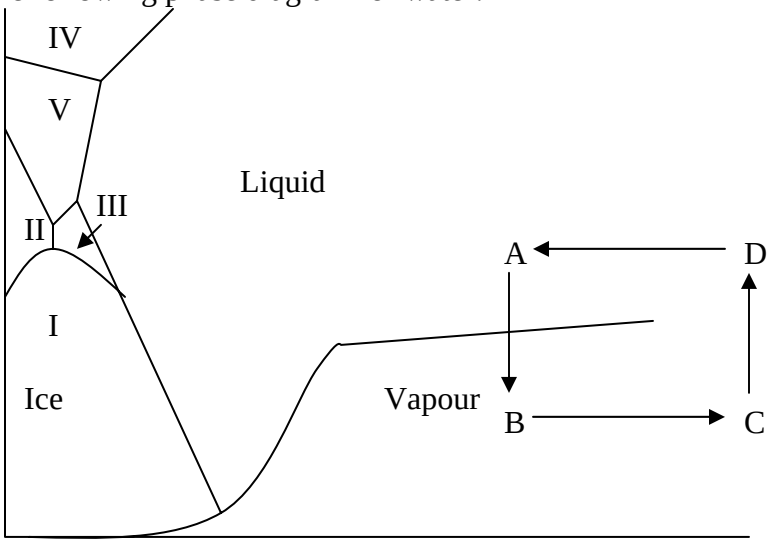
9) State the laws of thermodynamic and include relevant equations.

Part II: Review

10) A) A system cools while expanding against a constant external pressure. Give the signs of q, w, and ΔU for this process. Make sure you explain the sign of each quantity to get the full marks.

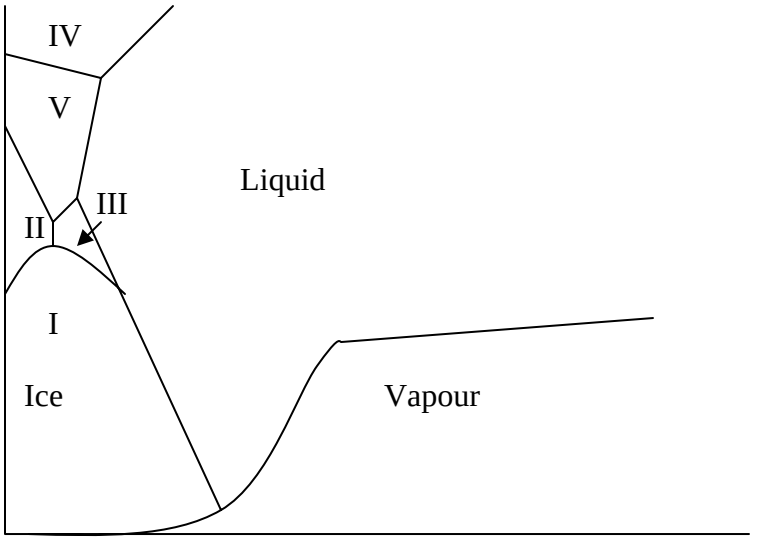
B) You know that a certain reaction, in which 3 moles of gaseous reactants were converted to 5 moles of liquid products, is endothermic. You measured the values of the equilibrium constant K at various temperatures and plan on obtaining ΔH and ΔS graphically. Sketch the appropriate graph for this task. Make sure you label your axes clearly including units and the zero point on each axis if neccessary.

11) For the following phase diagram for water:



A) Which phase of ice has the greatest density?

B) Draw in the boiling point and melting point at normal conditions (P = 1 atm). Label the axis and write in the proper temperatures.

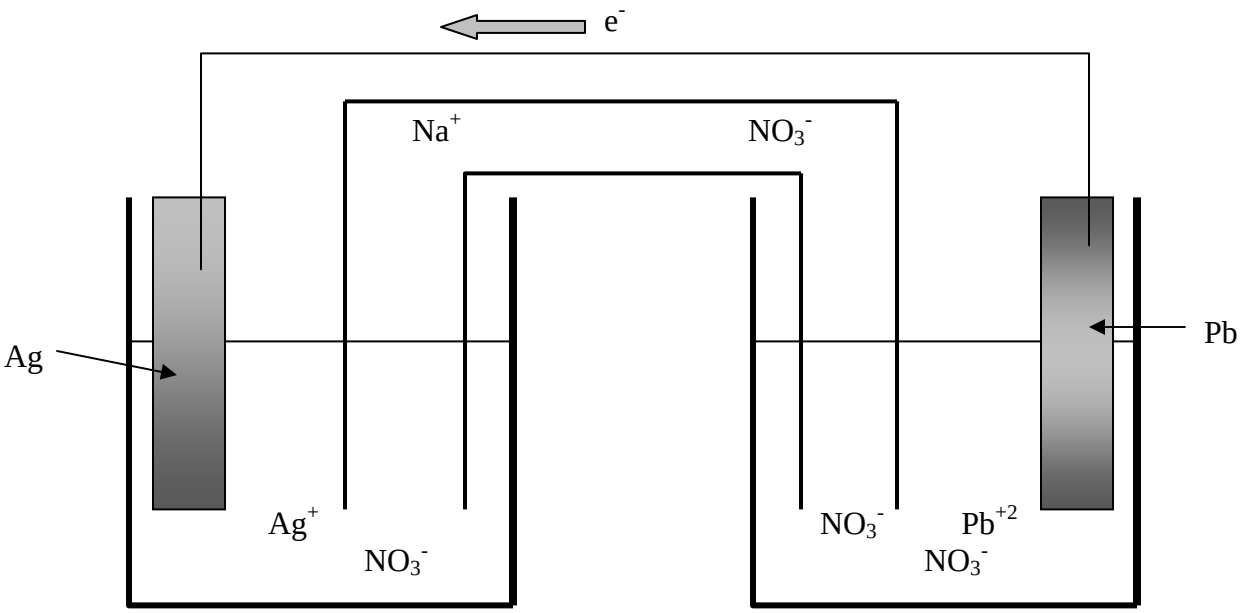


C) State the different phases of water as you move from point A, B, C to D.

12) A) What is the pH at the equivalent point when a solution of 100.0mL of 0.100M aniline is titrated with 0.500M HCl? (K_b of aniline = 4.2×10^{-10})
B) What is the pH when only half the necessary volume of HCl is added?

13) At a certain temperature lithium phosphate is only somewhat soluble in water, and was found to be 5.48g/L. Calculate the solubility product of lithium phosphate at that temperature.

14) Consider the following galvanic cell:



A) Based on the direction of electron flow, write the anodic half reaction.
B) Based on the direction of electron flow, write the cathodic half reaction.
C) Write the net cell reaction.
D) Calculate the cell potential at 25°C when $[Ag^{+}] = 1.0M$, $[Pb^{+2}] = 0.001M$.