

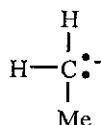
ORDRE DES INGÉNIEURS DU QUÉBEC

NOVEMBER 2009 SESSION

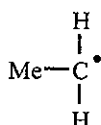
Open-book examination
Calculators : only authorized models
Duration : 3 hours

04-BS-12 Organic Chemistry

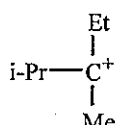
[Q1] (6 points) Rank the following radical intermediates in the order of increasing stability:



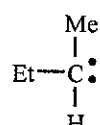
(a)



(b)



(c)

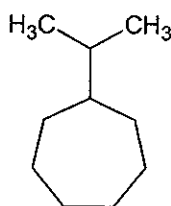


(d)

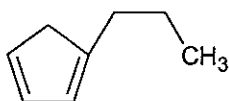
[Q2] (10 points) Anticipate and name the products following the catalytic addition of dihydrogen on *trans*-2,3-difluorobut-2-ene. Explicit the reaction mechanism and name it. Same question for Cl₂ addition on 2-methylbut-1-ene.

[Q3] (10 pts) Define spiranes and give their general formula. Write the general and structural formulae of the first four non-substituted members of the homologous series with the syntax [2.?.]. Name them.

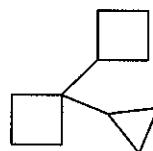
[Q4] (6 points) Name each of the following organic compound:



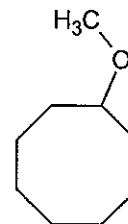
(a)



(b)



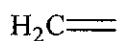
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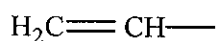
(d)

[Q5] (12 points) Draw the structural formulae of the following bicyclo compounds and indicate, if needed, their IUPAC names: (i) 2,2,4,4-tetramethylbicyclobutane (ii) three isomers of bicyclooctane.

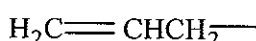
[Q6] (6 points) Indicate the systematic name, and if needed, the common name of the following alkenyl radicals:



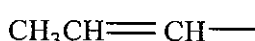
(a)



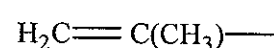
(b)



(c)



(d)

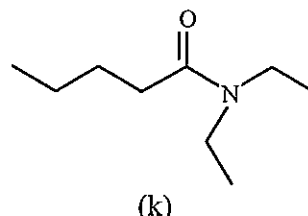
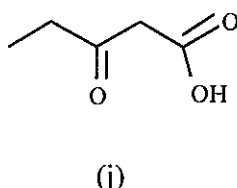
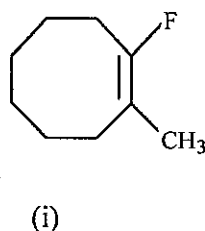
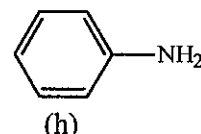
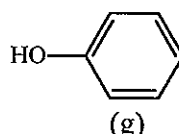
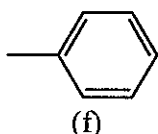
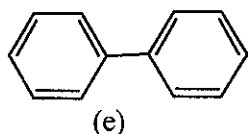
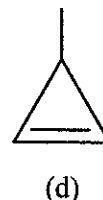
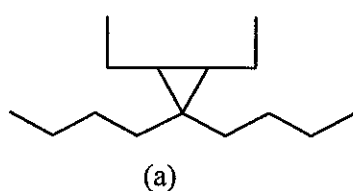


(e)



[Q7] (6 points) Write the structural formula of the smallest dimethylcyclyene that exhibits *cis-trans* isomerism. Name its isomers.

[Q8] (11 points) Name the following compounds following the IUPAC rules of nomenclature:



[Q9] (5 points) Indicate the formula of the alkanes with 16 carbon atoms and with 112 carbon atoms. What is the systematic name of their corresponding normal isomers?

[Q10] (5 points) In amine scrubbing processes, the abatement of CO_2 contained in natural gas necessitates 2 moles of diethanolamine (DEA) per mole of CO_2 , whereas one mole of methyldiethanolamine (MDEA) is required for reacting with one mole of CO_2 . Furthermore, the reactivity of CO_2 with DEA is more important than with MDEA. Which amine is adequate stoichiometrically? And which one is more adequate in terms of CO_2 abatement efficiency?

[Q11] (10 points) Write the reaction for the catalytic decomposition of methane. The standard enthalpy for this reaction is $\Delta H^\circ_r = 74850 \text{ J/mol}$, while its standard entropy is $\Delta S^\circ_r = 80.68 \text{ J/K/mol}$. Is there an advantage to run this reaction at low temperature? Calculate the Gibbs free enthalpy, ΔG° , for this reaction at 400 K and at 1000 K. What are the corresponding values of the equilibrium constant?
Ideal gas law constant, $R = 8.314 \text{ J/mol/K}$

[Q12] (8 points) Define the following terms: Paraffin; cycloparaffin; isoparaffin; olefin; arene; naphtha; naphthene; alicyclic hydrocarbon

[Q13] (5 points) Rank the following hydrocarbons in the order of increasing octane number: *n*-hexane, benzene, *n*-heptane, methylcyclopentane, 2,2,4-trimethylpentane.