COURSE OF "Introduction to Green and Sustainable Chemistry"

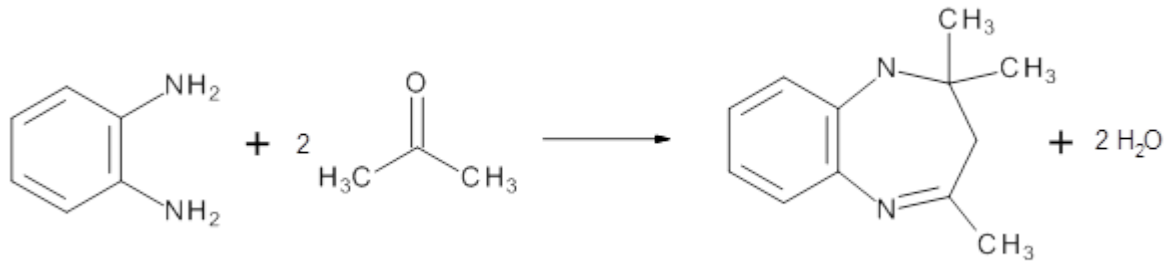
Written exam (29/11/2016 - part I)

1) Do You agree with this sentence about operators working in the Green Chemistry sector: "Green chemistry practitioners design new products and processes that reduce or eliminate the use or generation of hazardous substances in several phases: 1) when companies manufacture the products; 2) when consumers use the products; and 3) when the products (and their packaging) are disposed." Is some aspect of green chemistry been omitted?

2)* Which of the following is not one of the 12 Principle of Green Engineering? a) Design for Commercial "Afterlife" b) Conserve Complexity c) Circumstantial Rather than Inherent d) Minimize Material Diversity. Describe TWO of the above mentioned principles of Green Engineering in the essential details and explain with only two sentences why they are important.

3) What is a secondary pollutant? a) harmful chemical emitted directly into the air by natural events or human activities b) harmful chemical formed in the atmosphere when a primary air pollutant reacts with normal air components or other air pollutants c) interaction between ground water and surface water? Make two examples and provide examples of technologies for their control.

4) The Diazepine compound (III) can be obtained by interaction of orto-phenylendiamine (I) with excess of acetone (II) (10:1 molar ratio) without catalyst (in 2 h) or with catalyst (MW 382, 0.1 mol based on I in 0,5 h) in yield, respectively, 82 and 91%. No component of the reaction mixture was recycled in both cases.



(I) (II) (III)

Provide a preliminary evaluation of the main 5 Green Metric parameters (AE, E, RME, SF, MPR) involved in this process, assessing if the catalyzed or the uncatalysed process is better. Explain if it is possible to produce (III) by a greener approach.

5) What can green engineering improve to reduce impact? a) technology b) raw materials c) population. Provide examples for each term which correctly answer to the question.

6) "Industrial Symbiosis (IS) entails the coordinated work of manufacturing and service businesses to enhance environmental and economic performance in managing resources". Is this sentence an acceptable definition of IS? Eco-Industrial Parks

7)* A cleaning bath for electronic parts emits 0.5 g/sec of CFC -12 into a small work room of dimensions 3 m x 3 m x 2.45 m high. Calculate the concentration in the room under average and poor ventilation conditions if the air velocity in the room is 0.3 m/s and compare the results to the OSHA PEL (4950 mg/m3 TWA).

8) The biodegradability of a polymer has advantages and disadvantages. Which criteria are adopted to favor or moderate this property in a commercial new green product? Highlight two representative examples, one using a synthetic polymer and one using a bio-derived polymer.

9) LCA is considered a “powerful tool which provides an excellent knowledge-base for engineers and environmental managers in the assessment of potential improvements in the environmental performance of product process and systems". Do you agree with this opinion about LCA? How LCA works and why it has been introduced into environmental laws only very recently?

10) Which elements and techniques are used in the Industrial Ecology to emphasize the biophysical basis of human activities? How Industrial Ecopark can support sustainability? Explain with examples.

11)** Cellulose and starch have 3 hydroxyl groups every glucose residue. Why both compounds are not soluble in water? Are these groups responsible for the tertiary and quaternary structures of these natural polymers and for their quite different biodegradability?

12)** Polylactic acid (PLA) is a bio-derived plastic. Evidence the positive and negative aspects connected to its introduction in the packaging market. Do you think that, overall, the introduction of PLA goes in the direction of sustainability?

13)** Which are the main structural difference and roles of nucleic acids DNA and RNA? Why the genetic therapy and GMO normally involves DNA and not RNA?

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* Due for students in Chemical Engineering and Material Engineering

**Due for students in Environmental Engineering