NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
BACHELOR OF SCIENCE HONOURS DEGREE
END OF SECOND SEMESTER EXAMINATIONS – JUNE 2010
INDUSTRIAL ORGANIC CHEMISTRY I – SCH 2215
TIME: 3 HOURS

Instructions to candidates

Answer any Four (4) Questions from the Five (5) provided. Each question carries 25 marks.
Start your answers to each question on a new page.

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1. a) With the aid of the diagram of the coke oven explain the importance of the following coking coal properties indicating the practical methods of their measurement in a coke plant:

- Moisture content (4marks)
- Carbon content (4marks)
- Ash content (4marks)
- bulk density (4marks)
- volatile content (4marks)

b) Explain the difference between metallurgical coke and pitch. (3marks)

c) Name the machine used to mine coal at Hwange. (2marks)

2. a) Write a proper classification of Mopane wood. Explain! (2marks)

b) What useful chemicals would you get from mopane wood? Give details of how you can extract at least three of the chemicals. (15 marks)

c) Write the chemical composition of mopane wood ash. The mopane ash has found some application in reducing water hardness. Write the reactions that take place during the process. (8 marks)

3. Pitch finds use as a blend in road tar.

a) Draw a labeled process flow diagram of the manufacture of pitch from coal tar. (8marks)

b) State the 4 important properties of pitch that are relevant to its industrial application. (8 marks)

c) One of the biggest challenges facing Zimchem is the acid tars resulting from the benzene and toluene/xylene acid washing processes.

i) Name four constituents of this tar. (4 marks)

ii) Detail the process of how the tar can be converted to fertilizer. (5 marks)

4. a) You were recently hired by a pulp and paper company as a junior chemist because of your expertise in chemical pulping. The company is using sulphite liquor to digest the wood. On your first day of work (January 1, 2010), the company switched from a soft wood to hard wood feedstock. Paper production is halted just after lunch because the paper is brown. The company is loosing $10,000 for every hour that the paper mill is shut down. The senior chemist is unavailable (you suspect that his excessive drinking at the company New Years party may have something to do with this) and you are asked by the company president to trouble shoot the process. You are called to an emergency meeting and asked to give 5 reasons why the pulping process is not working? How would you respond? Justify your answers. (10 marks)

b) Explain, with sketches, the following terms in pulp and paper manufacturing:

i) Sizing
ii) Filling
iii) Calendaring
iv) Bleaching
v) Beating (15 marks)

5. Read the following information about Sarin and answer the questions that follow.

Sarin is a nerve gas that was used in 1988 by Iraq against its Kurdish population, and in 1995 by Japanese terrorists against Tokyo subway users. Sarin and its companion nerve gases (Tabun and Soman) were discovered in the late 1930s by Gerhard Schrader at I.G.Farben during research into pesticides. The lethal dose for humans may be as low as 0.01mg/kg, unless treated immediately. Sarin inhibits acetylcholinesterase, an enzyme that breaks down acetylcholine. Acetylcholine carries signals between nerves and muscles, and build-up causes over-stimulation of muscles (including the involuntary ones controlling eye, lungs, bowel), which then go into spasms. Treatment involves atropine (shuts down the overstimulated nerves), or oxime drugs (can prise Sarin off the enzyme), and must be immediate. There are many different methods of manufacture, but the Tokyo product appears to have been prepared using a procedure involving phosphorus trichloride and methyl iodide. The product was impure and diluted with acetonitrile to improve volatility. To stockpile Sarin, the product has to be pure (90-99% of the Iraqi Sarin degraded in < 2 years, whereas US Sarin only degraded a few % over 30 years). The standard US government procedure (aka "di-di") starts with dimethyl methylphosphonate (DMMP), and ends with a distillation to remove impurities.

a) Write the chemical equation of this reaction. (10 marks)
(Include reaction procedure and relevant process flow chart).

b) Complete the following table:

Table 1.1. Common Composite Explosives

Name	***Composition***	***Common Use***
	60% RDX: 39% TNT: 1% Wax	Projectiles, Shells, Grenades, Bombs
C-4	91% RDX: 9% plasticiser	
Octol		Shaped and Bursting Charges
	Ammonium Picrate, Picric Acid	Bombs, Projectiles
Tritonal	80% TNT: 20% Aluminum	
Composition A		Projectiles, Shells, Grenades, Bombs
	TNT: Ammonium Nitrate: RDX	Projectiles, Bomblets
Anatols	TNT: Ammonium Nitrate	
	TNT: Ammonium Nitrate: Aluminum	Bombs, Mines
Baratol		Bombs
Cycolotol	RDX: TNT	
	HMX: TNT: Aluminum	Shells, Bombs, Projectiles
Minol		Bombs, Depth Charges
Pentolite	Ammonium Pricrate: TNT	
	Tetryl: TNT	Bursting Charges
Torpex	RDX: TNT: Aluminum	

(15 marks)

……THE END……