

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY <u>DEPARTMENT OF APPLIED CHEMISTRY</u> <u>BACHELOR OF SCIENCE HONOURS DEGREE</u> <u>END OF SECOND SEMESTER EXAMINATIONS – MAY 2014</u> <u>INDUSTRIAL ORGANIC CHEMISTRY I – SCH 2215</u> <u>TIME: 3 HOURS</u>

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. This Paper comprises 2 printed pages.

- 1. a) With the aid of process flow charts, explain the route followed in the manufacture of the following products from coal:
 - benzene
 - carbon black
 - vinyl
 - metallurgical coke
 - Ammonium sulphate

(25 marks)

- 2. You are a process chemist at Chochoma Coal Works. Upon analysis of the flue gas from the coke oven batteries you notice a sudden increase in the concentration of CH_4 and homologs and sharp drop in H_2 content.
 - a) Design a troubleshooting checklist for the oven operation. (8 marks)
 - b) What corrective action will you propose to the plant manager? (4 marks)
 - c) Show the composition of the flue gas expected from a properly functioning oven producing high quality metallurgical coke. (8 marks)
 - d) With a chemical equation illustrate the process of aromatization of n-Heptane (5 marks)
- 3. You are given the following statistics on explosives;

Where:

- $\Delta E_{\rm f}$ Heat of formation
- CO, CO₂ and H₂O are assumed to be in gaseous form.
- ΔE_f for N₂, H₂, O₂ and all other elements are all zero.

Name	Formula	MW (g/mol)	$\Delta E_f(kJ/mol)$
	СО	28	-111.8
	CO ₂	44	-393.5
	H ₂ O	18	-240.6
Nitroglycerin	$C_3H_5N_3O_9$	227	-333.66
RDX	$C_3H_6N_6O_6$	222	+83.82
HMX	$C_4H_8N_8O_8$	296	+104.77
PETN	$C_5H_8N_4O_{12}$	316	-514.63
TNT	$C_7H_5N_3O_6$	227	-54.39
TETRYL	$C_7H_5N_5O_8$	287	+38.91

a) Calculate the heat of explosion of 1kg of each explosive.

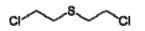
(14 marks)

b) Which explosive would you select among those shown in the table to demolish a steel-reinforced masonry structure? Explain your answer.

(4 marks)

- c) Use a sketch to explain a High explosive train. (3 marks)
- d) Explain the mechanism of toxicity of the weapon whose structure is shown below;

(4 marks)



4. a) Identify wood extractives used in the following processes. Explain their use.

- Rock drilling
- Paper sizing
- Tablet coating
- Solvent
- Bactericide
- Candle makingDietary supplement (21 marks)
- b) Draw the structure of a nitrocellulose molecule (4 marks)
- 5. Using process flow diagrams and examples explain any *five* of the following processes
 - Calendering
 - Wood hydrolysis
 - Rocket propulsion
 - Fractional distillation
 - Sulphite pulping
 - Cellulose beating
 - Benzene acid washing

(25 marks)

.....*THE END*.....