

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
END OF SEMESTER EXAMINATIONS – DECEMBER 2001
INORGANIC INDUSTRIAL CHEMISTRY I – SCH 2114
TIME – (3) THREE HOURS

INSTRUCTIONS TO CANDIDATES

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Answer ALL questions from Section A and B and ANY TEN questions from Section C.
Each question in every Section carries equal marks.

SECTION A (Multiple Choice Questions – 20 Marks)

Instruction: Encircle the letter that corresponds to your best choice among the alternatives given.

- Sulphuric acid is nowadays obtained mainly:
 - From sulphur by the Frasch process
 - From iron pyrite and zinc sulphide
 - From single contact process
 - From sulphur as a by-product from natural gas and petroleum.
- Which of the following statements about phosphorus is correct?
 - Phosphorus occurs in nature only in compounds
 - Red phosphorus is toxic
 - Elemental phosphorus is a liquid at room temperature
 - White phosphorus is self-igniting and thus has to be stored under kerosine.
- Which one of the following better expresses the overall reaction for the manufacture of nitric acid?
 - $3\text{NO}_2 + \text{H}_2\text{O} \longrightarrow 2\text{HNO}_3 + \text{NO}$
 - $\text{NH}_3 + 2\text{O}_2 \longrightarrow \text{HNO}_3 + \text{H}_2\text{O}$
 - $4\text{NH}_3 + 5\text{O}_2 \longrightarrow 4\text{NO} + 6\text{H}_2\text{O}$
 - $2\text{NO}_2 + \text{H}_2\text{O} \longrightarrow \text{HNO}_3 + \text{HNO}_2$
- The ore, among the following minerals, which can be used as a raw material for the manufacture of triple superphosphate, is:
 - Hydroxyapatite
 - Fluorapatite
 - Chloroapatite
 - None of the above.

5. Which of the following process steps is *NOT TRUE* of modern ammonia synthesis plants?
- Conversion of CO_2 into CO
 - Removal of CO_2 and H_2S
 - Removal of the NH_3 formed from the synthesis gas
 - Final purification of the synthesis gas.
6. What is the purpose of phase-rule studies in the ceramic industries?
- To determine the degree of shrinkage on burning
 - To interpret empirical observations and make improvements
 - To determine the plasticity and purity of the ceramic products
 - Phase-rule study is not applicable in ceramic industries.
7. The compounds, among the following species, that are *not desired* in the production of Portland Cement are:
- CaO and Fe_2O_3
 - SiO_2 and Al_2O_3
 - Fe_2P and CaO
 - Al_2O_3 and Fe_2O_3
8. For which of the following industrial gases air can be used as a source?
- N_2 , O_2 , CO and CO_2
 - H_2 , CO , CO_2 and N_2
 - Kr , Xe , CO and O_2
 - CO_2 , Ne , Ar and N_2
9. Which of the industrial gases is the most abundant in the universe?
- O_2
 - N_2
 - CO_2
 - H_2
10. The raw materials used in making classic ceramic products are:
- Silica, alumina and limestone
 - Silica, clay and feldspar
 - Soda ash, clay and feldspar
 - Limestone, feldspar and clay

SECTION B (Short answer questions - 30 marks)

Instruction: Write very short and precise answers. Give balanced chemical equations where required.

11. Indicate *ONLY* the differences between single absorption and double absorption sulphuric acid plants.
12. What is multiple effect evaporation? Give examples. Where do you use these type of evaporators?
13. Write the chemical equation for the production of mullite from kaolinite.
14. Which compound, among the constituents of Portland Cement, is the major and most important? What is its percentage composition?
15. List down the nitrogen containing chemicals that are included in the top fifteen "high-volume" industrial chemicals produced in the United States. Why is it difficult to extract nitrogen from the air?
16. Which one of the industrial gases can be used as an automobile fuel? Why is it advantageous over other fuels?
17. What are the wide uses of H_2SO_4 . Give as many examples as possible.

Complete and balance the following chemical equations:

18. $Ca_3(PO_4)_2 + \text{---} \rightarrow H_3PO_4 + \text{---}$
19. $CnH_{2n+2} + \xrightarrow{1200-1500^\circ C} CO + \text{---}$
20. $K_2O \cdot Al_2O_3 \cdot 6SiO_2 + \text{---} \rightarrow K_2CO_3 + \text{---}$

SECTION C (Descriptive Questions - 50 marks)

21. Explain the possible mechanisms for the production of phosphorus from phosphate rock.
22. Sketch the block scheme of a single-train plant for the synthesis of ammonia using the steam reforming process.
23. Write down the chemical equations involved in the manufacture of urea from ammonia and carbon dioxide.

24. List down the general important steps in the manufacture of ceramic products.
25. What are the characteristic properties of refractory ceramic; upon which the choice of suitable refractory materials depends?
26. Enumerate the properties of quartz glass which made it industrially most important.
27. Explain the basic types of activities of a chemical industry by providing suitable examples.
28. How do you classify industrial gases on the basis of their liquefaction and compressibility? Provide their general applications.
29. Show the mechanisms that are involved in the production of nitrous oxide, N_2O from NH_4NO_3 .
30. Describe the Frasch process for the production of elemental sulphur from caprock by giving an appropriate schematic diagram.
31. What are the major sources of SO_2 pollution? Provide the appropriate percentage composition of these sources.
32. Sketch the summarized and present approximate pattern for the production and uses of H_3PO_4 from phosphate rock.
33. Sketch the flow diagram for the production of superphosphate from phosphate rock.

END OF QUESTION PAPER!!!