



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
BACHELOR OF SCIENCE HONOURS DEGREE
END OF FIRST SEMESTER EXAMINATIONS – DECEMBER 2005
INDUSTRIAL INORGANIC CHEMISTRY I – SCH 2114
TIME: 3 HOURS

INSTRUCTIONS TO CANDIDATES

Answer **ALL** questions from Section A and **ANY THREE** questions from Section B.

SECTION A

Select the correct answer by ticking the appropriate box. Each question carries 2 marks.

1. The separation of oxygen from nitrogen in the rectifier unit is made possible by:
 - (a) differences in pressure between the columns of the unit
 - (b) differences between the boiling points of oxygen and nitrogen
 - (c) differences in molecular weight between the two gases
 - (d) differences in critical temperature between them
 - (e) non of the above

2. The main purpose of heat exchanger for the rectifier unit is:
 - (a) to re boil nitrogen
 - (b) to re boil oxygen
 - (c) to condense nitrogen
 - (d) to condense oxygen
 - (e) to act as a gel trap

3. Which of the following is not an industrial application of nitrogen?
 - (a) used as a gaseous blanket
 - (b) used in heat treatments of steel
 - (c) used for refrigeration

- (d) used in sport arena
- (e) used in underground gasification
4. Hydrogen cannot be manufactured by the following method.
- (a) reformation and conversion of hydrocarbons
- (b) electrolytic decomposition of water
- (c) coal gasification
- (d) pressure swing adsorption
- (e) non of the above
5. $2\text{NH}_2\text{CH}_2\text{CH}_2\text{OH} + \text{CO}_2 + \text{H}_2\text{O} \rightleftharpoons (\text{HOCH}_2\text{CH}_2\text{NH}_3)_2\text{CO}_3$
This reaction represents:
- (a) the urea formation reaction
- (b) the gibbottal reaction
- (c) the carbonation of ethanol
- (d) the hydration of ethanol amine
- (e) non of the above
6. The following reactions may occur simultaneously during the cracking of natural gas to produce acetylene.
- (i) $2\text{CH}_4(\text{g}) \longrightarrow \text{C}_2\text{H}_2(\text{g}) + 3\text{H}_2(\text{g})$
- (ii) $\text{CH}_4(\text{g}) \longrightarrow \text{C} + 2\text{H}_2(\text{g})$
- The problem can be resolved by:
- (a) increasing reaction temperature above 578°C
- (b) reducing reaction temperature below 578°C
- (c) increasing partial pressure of CH_4
- (d) increasing temperature to 1773k and water quenching
- (e) non of the above

7. Ice cream vendors prefer to use "dry" ice to water ice because:
- (a) its specific gravity is higher
 - (b) sublimation point is lower
 - (c) has a high latent heat of fusion
 - (d) weighs less
 - (e) it is cheaper
8. Which of the following statements is true for helium?
- (a) volume in air is 1,0%
 - (b) critical temperature is 6K
 - (c) critical pressure is 5,04 Kpa
 - (d) boiling point is 87,3K
 - (e) non of the above
9. Which of the following statements is not true of sulphur?
- (a) occurs in nature in the form of pyrite (FeS_2)
 - (b) can be mined as free sulphur from an ore deposit
 - (c) has a melting point of 115°C
 - (d) reacts with oxygen to form SO_3
 - (e) can be sourced directly from natural gas
10. The concentration of 66 Bé° sulphuric acid is:
- (a) 77,67%
 - (b) 62,18%
 - (c) 33,33%
 - (d) 98,17%
 - (e) non of the above

11. The following is the catalyst used in the conversion of SO_2 to SO_3 :
- (a) V_2O_3
 - (b) Al_2O_3
 - (c) Fe_2O_3
 - (d) Pt/Rh
 - (e) non of the above
12. The controlling operation of the contact process is:
- (a) sulphur melting
 - (b) absorption of SO_3
 - (c) conversion of SO_2
 - (d) oleum extraction
 - (e) non of the above
13. The following are similarities in the manufacture of H_2SO_4 and HNO_3 except:
- (a) employ gaseous inputs
 - (b) employ acid-proof lined absorbers
 - (c) both use packed absorbers
 - (d) employ catalysts
 - (e) both reactions are spontaneous
14. $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$
- Which of the following statements on the above reaction is untrue?
- (a) this is the synthetic reaction of ammonia
 - (b) a catalyst is required for this reaction
 - (c) the equilibrium constant increases with increase in temperature
 - (d) increased pressure is beneficial to the reaction
 - (e) all are true

15. Which of the following reactions may not occur during the manufacture of nitric acid?
- (a) $4\text{NH}_3 + 5\text{O}_2 \longrightarrow 4\text{NO} + 6\text{H}_2\text{O}$
- (b) $2\text{NO} + \text{O}_2 \longrightarrow 2\text{NO}_2$
- (c) $2\text{NO} \longrightarrow \text{N}_2 + \text{O}_2$
- (d) $2\text{NH}_3 + 3\text{NO} \longrightarrow 2\text{N}_2 + 3\text{H}_2\text{O}$
- (e) $3\text{NO}_3 + \text{H}_2\text{O} \longrightarrow 2\text{HNO}_3$
16. The following are the properties of phosphorus except:
- (a) atomic No. 15
- (b) electronic configuration $3s^2 3p^3$
- (c) melting point 44°C
- (d) non-metallic
- (e) boiling point 279°C
17. The basic raw materials for making ceramic products are:
- (a) clay, fluorspar, sand
- (b) sand, clay, kaolin
- (c) montmorillonite, kaolin, quartz
- (d) kaolin, quartz, feldspar
- (e) limestone, clay, feldspar
18. The most important properties of ceramics in the refractory industry are:
- (a) heat capacity, thermal expansion, refractoriness
- (b) refractoriness, thermal conductivity, fracture toughness
- (c) heat capacity, refractoriness, friability
- (d) refractoriness, friability, thermal expansion
- (e) non of the above

19. The following is not a ceramic material.

- (a) clinker
- (b) glass
- (c) porcelain
- (d) floor tiles
- (e) flint

20. Cermets are:

- (a) high alumina ceramics
- (b) vitreous enamel
- (c) nitrate-metallic composites
- (d) forsterites
- (e) alumina-noble metal composites

SECTION B

Answer **ANY THREE** questions from the four provided. Each answer carries 20 marks.

1. With the help of a process flow chart, illustrate the way hydrogen is produced from fuel oil. (20 marks)
2. During the analysis of the lower gas off-take from the coal gasifier you are alarmed to notice that the hydrogen content has fallen to as low as 15%.
 - (a) Comment on the implication of this to the process. (5 marks)
 - (b) Make a trouble shooting check list on the gasifier. (10 marks)
 - (c) Propose solutions to the likely process problems. (5 marks)
3.
 - (a) What are high alumina cements? (3 marks)
 - (b) Give a general chemical composition of Zimbabwe's portland cement. (14 marks)
 - (c) What is refractoriness of a cement? (3 marks)
4. Write short notes on the manufacture of the following:
 - (a) Forsterite (5 marks)
 - (b) Gypsum (5 marks)
 - (c) Argon (5 marks)
 - (d) Ammonium Nitrate (5 marks)

End of question Paper!!!