*This question paper contains 5 printed pages.*

**5103-A** *Your Roll No.* .....

## B.Sc. (Prog.) / II

**B**

Paper CH-201 : Inorganic and Physical Chemistry

(Admissions of 2007 and before)

*Time* : 3 hours *Maximum Marks* : 75

*(Write your Roll No. on the top immediately on receipt of this question paper.)*

*You are allowed to use any type of calculator except mobile calculators but you cannot share it. However, log tables will be provided, if asked for.*

SECTION A

*(Inorganic Chemistry)*

*Attempt four questions in all.*
*Question No. 1 is compulsory.*

1. (*a*) What happens when (balanced chemical equations only):

   (*i*) Magnesium nitride is subjected to hydrolysis

   (*ii*) Chlorine gas is passed through hot NaOH solution

   (*iii*) Conc $H_2SO_4$ is heated with a mixture of NaCl and $K_2Cr_2O_7$.

P. T. O.

(*iv*) Hydrazine is treated with $FeCl_3$.

(*v*) Ammonia is subjected to catalytic oxidation. 1×5

(*b*) Draw the structures of the following:

(*i*) Phosphorous trichloride

(*ii*) Hypophosphoric acid

(*iii*) Dithionous acid

(*iv*) Perchloric acid

(*v*) Chain silicate. 2×5

(*c*) (*i*) Arrange the following isoelectronic ions in decreasing radius sequence:
$P^{3-}$, $Cl^-$, Ar, $S^{2-}$.

(*ii*) Give an example of a compound where nitrogen exhibits −2 oxidation state.

(*iii*) Make pairs with similar properties:
Li, Na, Mg, B, Al, Si.

(*iv*) Which is more basic: $NF_3$ or $NH_3$?

(*v*) What is the commercial name of $H_2SO_5$? 1×5

2. (*a*) What are hydrides? How do thermal stability, basic nature and reducing action vary down a group of hydrides? 6

(*b*) Discuss the role of $Mg^{2+}$ ions in energy production and chlorophyll. 4

3. (*a*) Discuss the structure and bonding in diborane. 6

(*b*) Write the name, formula and structures of *four* oxoacids of phosphorous. 4

4. Write short notes on any *two* of the following:

(*i*) Hydrometallurgy

(*ii*) Electrolytic refining of metals

(*iii*) Mond's process. 5×2

5. (*a*) What do you understand by Inert Pair Effect? Explain the concept by taking Gr. 14 elements as an example. 4

(*b*) With reference to Ellingham diagram, discuss the reducing action of carbon monoxide on metal oxides. 4

(*c*) Write a short account on the chemical toxicity of lead. 2

6. (*a*) Give *two* methods of preparing borazine. How is B-tribromoborazine obtained? 3

(*b*) Give the characteristics of different allotropic modifications of sulphur. 4

(*c*) Illustrate the hydrolysis followed by condensation of dimethyl chlorosilane. Write the name of the end product. 3

P. T. O.

## SECTION B

### *(Physical Chemistry)*

*Answer any two questions.*

7. (*a*) Define the terms, collision diameter and collision frequency. Derive the expression for the number of collisions per unit time per unit volume.

   (*b*) State the law of equipartition of energy.

   (*c*) Define Boyle's temperature. Show that Boyle's temperature $T_B = a/Rb$, where $a$ and $b$ are van der Waals' constants.

   (*d*) Calculate root mean square velocity of $CO_2$ molecule at 1000 K. 5,2,3,2½

8. (*a*) What is meant by surface tension? What are its units?

   (*b*) If the flow time for two liquids A and B through the same capillary is in the ratio of 4 : 5 and densities are in the ratio of 2 : 1, what is the ratio of their viscosities?

   (*c*) Discuss the temperature dependence of viscosity of a liquid.

   (*d*) What are the critical constants of a gas? Starting with van der Waals equation derive expressions for $P_c$, $V_c$ and $T_c$ in terms of the van der Waals constants. 3,2,2½,5

9. (*a*) Give the vapour-composition curve for different liquids which are completely miscible.

(*b*) What is meant by an azeotrope? Why is it called a mixture and not a compound?

(*c*) Discuss the physio-chemical principle involved in steam distillation and its application.

(*d*) Derive Gibb's-Duhem equation. 3,3,3$_{1/2}$,3

10. (*a*) Derive thermodynamically that elevation in boiling point is a colligative property. Also establish the relation:

$$M_2 = \frac{1000K_b \cdot W_2}{\Delta T_b \cdot W_1}$$

(*b*) Define:

(*i*) Ebulliometric constant

(*ii*) Cryoscopic constant.

(*c*) Show that:—

$$\mu_i = \mu_i^0 + RT \ln x_i$$

(*d*) With the help of equation explain the effect of temperature on chemical potential. 5,2,3$_{1/2}$,2