

2020

## CHEMISTRY (Honours)

Paper Code : VI - A & B

[New Syllabus]

### Important Instructions for Multiple Choice Question (MCQ)

- Write Subject Name and Code, Registration number, Session and Roll number in the space provided on the Answer Script.

**Example** : Such as for Paper III-A (MCQ) and III-B (Descriptive).

Subject Code : 

III	A	&	B
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Subject Name :

- Candidates are required to attempt all questions (MCQ). Below each question, four alternatives are given [i.e. (A), (B), (C), (D)]. Only one of these alternatives is 'CORRECT' answer. The candidate has to write the Correct Alternative [i.e. (A)/(B)/(C)/(D)] against each Question No. in the Answer Script.

**Example** – If alternative A of 1 is correct, then write :

1. – A

- There is no negative marking for wrong answer.

### মাল্টিপল চয়েস প্রশ্নের (MCQ) জন্য জরুরী নির্দেশাবলী

- উত্তরপত্রে নির্দেশিত স্থানে বিষয়ের (Subject) নাম এবং কোড, রেজিস্ট্রেশন নম্বর, সেশন এবং রোল নম্বর লিখতে হবে।

উদাহরণ — যেমন Paper III-A (MCQ) এবং III-B (Descriptive)।

Subject Code : 

III	A	&	B
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Subject Name :

- পরীক্ষার্থীদের সবগুলি প্রশ্নের (MCQ) উত্তর দিতে হবে। প্রতিটি প্রশ্নে চারটি করে সম্ভাব্য উত্তর, যথাক্রমে (A), (B), (C) এবং (D) করে দেওয়া আছে। পরীক্ষার্থীকে তার উত্তরের স্বপক্ষে (A)/(B)/(C)/(D) সঠিক বিকল্পটিকে প্রশ্ন নম্বর উল্লেখসহ উত্তরপত্রে লিখতে হবে।

উদাহরণ — যদি 1 নম্বর প্রশ্নের সঠিক উত্তর A হয় তবে লিখতে হবে :

1. – A

- ভুল উত্তরের জন্য কোন নেগেটিভ মার্কিং নেই।

**Paper Code : VI - A**

Full Marks : 10

Time : Twenty Minutes

Choose the correct answer.

Answer *all* the following questions,  
each question carries 1 mark.

1. The set among the following in which all numbers are magic numbers of nucleons is —
  - (A) 20, 28, 50 and 126
  - (B) 24, 28, 82 and 126
  - (C) 20, 50, 80 and 184
  - (D) 28, 50, 82 and 180
2. According to MO theory the number of unpaired electrons in the  $B_2$  molecule is \_\_\_\_\_.
  - (A) 4
  - (B) 1
  - (C) 2
  - (D) 3
3. In polymeric  $(BeCl_2)_n$  there are —
  - (A) Three centre four electron bonds
  - (B) Three centre three electron bonds
  - (C) Two centre three electron bonds
  - (D) Two centre two electron bonds

4. Metals form basic hydroxides. Which of the following metal hydroxide is the least basic?
- (A)  $\text{Mg}(\text{OH})_2$
  - (B)  $\text{Ca}(\text{OH})_2$
  - (C)  $\text{Sr}(\text{OH})_2$
  - (D)  $\text{Ba}(\text{OH})_2$
5. Correct thermal stability order is —
- (A)  $\text{LiInH}_4 > \text{LiGaH}_4 > \text{LiAlH}_4 > \text{LiBH}_4$
  - (B)  $\text{LiBH}_4 > \text{LiAlH}_4 > \text{LiInH}_4 > \text{LiGaH}_4$
  - (C)  $\text{LiAlH}_4 > \text{LiBH}_4 > \text{LiGaH}_4 > \text{LiInH}_4$
  - (D)  $\text{LiBH}_4 > \text{LiAlH}_4 > \text{LiGaH}_4 > \text{LiInH}_4$
6. If three species lie approximately on a straight line in a Frost diagram then
- (A) Comproportionate species will predominate
  - (B) Disproportionate species will predominate
  - (C) No single species will predominate
  - (D) Any out of three species will predominate
7. In which medium,  $\text{CH}_3\text{COOH}$  behaves as a strong acid?
- (A) THF
  - (B) Liquid  $\text{NH}_3$
  - (C) Liquid  $\text{SO}_2$
  - (D) Liquid HF

8. EDTA may acts as —
- (A) Polydentate ligand only
  - (B) Flexidentate ligand only
  - (C) Chelating ligand only
  - (D) Polydentate / Flexidentate / Chelating ligand
9. Which one is diamagnetic?
- (A)  $\text{Gd}^{3+}$
  - (B)  $\text{Lu}^{3+}$
  - (C)  $\text{Eu}^{3+}$
  - (D)  $\text{Yb}^{3+}$
10. In acidic medium green coloured  $\text{MnO}_4^{2-}$  readily disproportionates to —
- (A)  $\text{MnO}_4^-$  and  $\text{Mn}^{2+}$
  - (B)  $\text{MnO}_2$  and  $\text{Mn}^{2+}$
  - (C)  $\text{MnO}_4^-$  and  $\text{MnO}_2$
  - (D)  $\text{MnO}_2$  and Mn
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P - II (1+1+1) H / 20 (N)

2020

## CHEMISTRY (Honours)

Paper Code : VI - B

[New Syllabus]

Full Marks : 40

Time : One Hour Forty Minutes

*The figures in the margin indicate full marks.*

Answer any *four* questions taking *two* from each group.

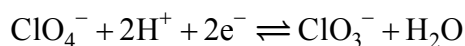
### Group - A

1. (a) Give the mathematical expression of the 'Radioactive Decay Law' and hence give the physical significance of decay constant. 2
- (b) Explain the concept of Nuclear Binding Energy and hence the binding energy curve. 2+1
- (c) A small amount of radioactive material got inadvertently spread in an area adjoining a nuclear power plant making the level of radiation 40 times the permissible safety level. If  $t_{1/2}$  of the radioactive species be 20 days, after how many days will the place be safe to life? 2
- (d) What do you mean by radio carbon dating? What is the use of this method? 3
2. (a) Mentions the conditions for linear combination atomic orbitals relating to the formation of molecular orbitals. 3
- (b) Construct the MO energy level diagram for HF molecule and discuss on which atom the bonding and anti-bonding are concentrated. 3

- (c) (i) Construct an MO diagram for the formation of  $O_2$ ; show only the participation of the valence orbitals of the oxygen atoms. 4
- (ii) Use the diagram to rationalize the following trend in O – O bond distances :  $O_2$ , 121 pm;  $[O_2]^+$ , 112 pm;  $[O_2]^-$ , 134 pm;  $[O_2]^{2-}$ , 149 pm.
- (iii) Which of these species are paramagnetic? 4
3. (a) Discuss the structure and bonding of Diborane. 4
- (b) The mobility of the alkali metal ions in aqueous solution follow the sequence  $Li^+ < Na^+ < K^+$  — explain. 2
- (c) Arrange  $BF_3$ ,  $BCl_3$ ,  $BBr_3$  and  $BI_3$  in order of the Lewis acidity with proper justification. 2
- (d) What are interhalogens? 2
4. (a)  $H_3BO_3$  is a very weak acid for which no suitable indicator is available for acid –base titration, but in presence of glycerol it can be titrated by using suitable indicator — Explain. 3
- (b) Complex forming ability of GrII A metal ion changes as  $Be^{+2} > Mg^{+2} > Ca^{+2} > Sr^{+2} > Ba^{+2}$  — Explain. 2
- (c) In between  $Na_2CO_3$  and  $NaHCO_3$  which one is more soluble in water and why? 2
- (d) Discuss the structure and bonding of phosphazene. 3

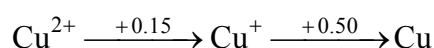
### Group - B

5. (a) The half reaction for  $ClO_4^- / ClO_3^-$  couple is



At pH = 0  $E^0 = +1.201$  V. Calculate  $E_{\text{cell}}$  values at pH = 7 and at pH = 10. At which pH perchlorate will act as better oxidizing agent. Justify your answer. 3

- (b) Draw a Frost diagram (qualitative) for copper from the following Latimer diagram. Mention also the reduction potentials ( $E^0$ ) of Cu(II)/Cu(0) couple. 3



Among three oxidation states of copper, which is most stable? Justify your answer.

- (c) Lanthanides exhibit more or less identical chemical behaviour while d-block elements differ widely — Explain. 2
- (d) What is Comproportionation reaction? Give one example of Comproportionation reaction. 2
6. (a) Point out two dissimilarities between lanthanides and actinides. 2
- (b) What are trans-uranium elements? Why the trans-uranium elements are not generally found in nature? 3
- (c) Write down the IUPAC names of
- (i)  $[\text{Co}(\text{NH}_3)_5\text{ONO}]\text{Cl}_2$
- (ii)  $[\text{Cr}(\text{en})_2\text{Cl}_2]\text{Cl}$  2
- (d) In an aqueous solution containing  $\text{Fe}^{3+}$  and  $\text{Fe}^{2+}$  ions, the redox potential is +0.70V at 25°C. Taking the  $E^0$  value of  $\text{Fe}^{3+}/\text{Fe}^{2+}$  couple as +0.77V, calculate the  $\text{Fe}^{3+}/\text{Fe}^{2+}$  ratio in the solution. 3
7. (a) Lanthanides usually exhibit +3 oxidation state — Explain. 3



- (b) Discuss the following observations :
- (i) Zinc dissolves in a solution of sodium amide in liquid  $\text{NH}_3$  with liberation of  $\text{H}_2$ ; careful addition of ammonium iodide to the resulting solution produces a white precipitate which dissolves if an excess of ammonium iodide is added.
  - (ii) Addition of K to  $\text{H}_2\text{O}$  results in a vigorous reaction; addition of K to liquid  $\text{NH}_3$  gives a bright blue solution, which over a period of time liberates  $\text{H}_2$ . 3
- (c) Give an explanation for the following observations:  $\text{AlF}_3$  has only a low solubility in liquid HF, but a combination of NaF and  $\text{AlF}_3$  leads to dissolution of the reagents; when  $\text{BF}_3$  is added to the solution, a precipitate forms. 2
- (d) Which of the following compounds behave as acids in liquid HF :  $\text{BF}_3$ ,  $\text{SbF}_5$ ,  $\text{SiF}_4$ ? Write equations to explain this behaviour. 2
8. (a) Show the variation of ionic radii of  $\text{M}^{3+}$  ions of the 3d-block elements and explain the variation. 3
- (b) Give one example of a redox indicator and explain its mechanistic role in redox titration. 4
- (c) Show that acetylacetonone will form innermetallic complex of first order with  $\text{M}^{3+}$  ion and of second order with  $\text{M}^{2+}$  ion. 3
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