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 |

  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 |

  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) $Mg(OH)_2$

(B) $Ca(OH)_2$

(C) $Sr(OH)_2$

(D) $Ba(OH)_2$

5. Correct thermal stability order is —

(A) $LiInH_4 > LiGaH_4 > LiAlH_4 > LiBH_4$

(B) $LiBH_4 > LiAlH_4 > LiInH_4 > LiGaH_4$

(C) $LiAlH_4 > LiBH_4 > LiGaH_4 > LiInH_4$

(D) $LiBH_4 > LiAlH_4 > LiGaH_4 > LiInH_4$

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, CH_3COOH behaves as a strong acid?

(A) THF

(B) Liquid NH_3

(C) Liquid 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) Gd^{3+}

(B) Lu^{3+}

(C) Eu^{3+}

(D) Yb^{3+}

10. In acidic medium green coloured MnO_4^{2-} readily disproportionates to —

(A) MnO_4^- and Mn^{2+}

(B) MnO_2 and Mn^{2+}

(C) MnO_4^- and MnO_2

(D) MnO_2 and Mn

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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.

(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

$$ClO_4^- + 2H^+ + 2e^- \rightleftharpoons ClO_3^- + H_2O$$

At pH = 0 $E^0 = +1.201$ V. Calculate E_{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

$$Cu^{2+} \xrightarrow{+0.15} Cu^{+} \xrightarrow{+0.50} Cu$$

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) $[Co(NH_3)_5ONO]Cl_2$

(ii) $[Cr(en)_2Cl_2]Cl$ 2

(d) In an aqueous solution containing Fe^{3+} and Fe^{2+} ions, the redox potential is +0.70V at 25°C. Taking the E^0 value of Fe^{3+}/Fe^{2+} couple as +0.77V, calculate the Fe^{3+}/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 NH_3 with liberation of 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 H_2O results in a vigorous reaction; addition of K to liquid NH_3 gives a bright blue solution, which over a period of time liberates H_2. 3

(c) Give an explanation for the following observations: AlF_3 has only a low solubility in liquid HF, but a combination of NaF and AlF_3 leads to dissolution of the reagents; when BF_3 is added to the solution, a precipitate forms. 2

(d) Which of the following compounds behave as acids in liquid HF : BF_3, SbF_5, SiF_4? Write equations to explain this behaviour. 2

8. (a) Show the variation of ionic radii of 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 acetylacetone will form innermetallic complex of first order with M^{3+} ion and of second order with M^{2+} ion. 3
