PART II

Useful data:

Gas Constant, $R = 8.314\ JK^{-1}\ mol^{-1}$

$1\ F = 96500\ C$

Atomic Numbers: H = 1, Li = 3, B = 5, C = 6, N = 7, O = 8, F = 9, Na = 11, P = 15, S = 16, Cl = 17, Ar = 18, K = 19, V = 23, Cr = 24, Mn = 25, Fe = 26, Co = 27, Ni = 28, Cu = 29, Zn = 30, Ge = 32, Br = 35, Ag = 47, I = 53, Xe = 54, Pt = 78, Hg = 80, Pb = 82.

SECTION – I

Straight Objective Type

This section contains 9 multiple choice questions numbered 23 to 31. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

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23. The species having bond order different from that in CO is

(A) NO^- (B) NO^+

(C) CN^- (D) N_2

24. Among the following, the paramagnetic compound is

(A) Na_2O_2 (B) O_3

(C) N_2O (D) KO_2

25. Extraction of zinc from zinc blende is achieved by

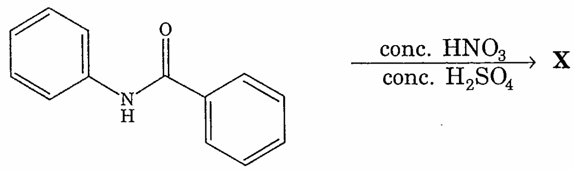
(A) electrolytic reduction

(B) roasting followed by reduction with carbon

(C) roasting followed by reduction with another metal

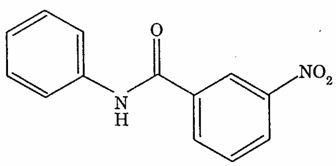
(D) roasting followed by self-reduction

26. In the following reaction,

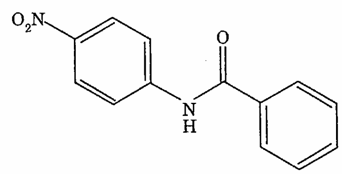


the structure of the major product '**X**' is

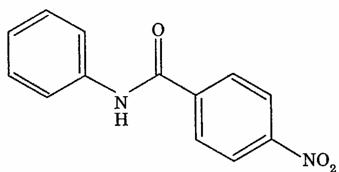
(A)



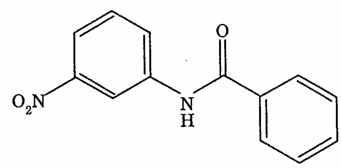
(B)



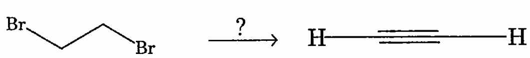
(C)



(D)



27. The reagent(s) for the following conversion,



is/are

(A) alcoholic KOH

(B) alcoholic KOH followed by $NaNH_2$

(C) aqueous KOH followed by $NaNH_2$

(D) Zn/CH_3OH

28. The number of structural isomers for C_6H_{14} is

(A) 3 (B) 4

(C) 5 (D) 6

29. The percentage of p-character in the orbitals forming P–P bonds in P_4 is

(A) 25 (B) 33

(C) 50 (D) 75

30. When 20 g of naphthoic acid ($C_{11}H_8O_2$) is dissolved in 50 g of benzene ($K_f = 1.72$ K kg mol^{-1}), a freezing point depression of 2 K is observed. The van't Hoff factor (i) is

(A) 0.5 (B) 1

(C) 2 (D) 3

31. The value of $\log_{10}K$ for a reaction $A \rightleftharpoons B$ is

(Given : $\Delta_r H^\circ_{298K} = -54.07$ kJ mol^{-1}, $\Delta_r S^\circ_{298K} = 10$ JK^{-1}mol^{-1} and $R = 8.314$ JK^{-1}mol^{-1}; $2.303 \times 8.314 \times 298 = 5705$)

(A) 5 (B) 10

(C) 95 (D) 100

SECTION – II

Assertion – Reason Type

This section contains 4 questions numbered 32 to 35. Each question contains STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

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32. STATEMENT-1 : Boron always forms covalent bond.

because

STATEMENT-2 : The small size of B^{3+} favours formation of covalent bond.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

33. STATEMENT-1 : In water, orthoboric acid behaves as a weak monobasic acid.

because

STATEMENT-2 : In water, orthoboric acid acts as a proton donor.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

34. STATEMENT-1 : *p*–Hydroxybenzoic acid has a lower boiling point than *o*-hydroxybenzoic acid.

because

STATEMENT-2 : *o*–Hydroxybenzoic acid has intramolecular hydrogen bonding.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

35. STATEMENT-1 : Micelles are formed by surfactant molecules above the critical micellar concentration (CMC).

because

STATEMENT-2 : The conductivity of a solution having surfactant molecules decreases sharply at the CMC.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

SECTION – III

Linked Comprehension Type

This section contains 2 paragraphs **C_{36-38}** and **C_{39-41}**. Based upon each paragraph, 3 multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

C_{36-38} : Paragraph for Question Nos. 36 to 38

The noble gases have closed-shell electronic configuration and are monoatomic gases under normal conditions. The low boiling points of the lighter noble gases are due to weak dispersion forces between the atoms and the absence of other interatomic interactions.

The direct reaction of xenon with fluorine leads to a series of compounds with oxidation numbers +2, +4 and +6. XeF_4 reacts violently with water to give XeO_3. The compounds of xenon exhibit rich stereochemistry and their geometries can be deduced considering the total number of electron pairs in the valence shell.

36. Argon is used in arc welding because of its

(A) low reactivity with metal

(B) ability to lower the melting point of metal

(C) flammability

(D) high calorific value

37. The structure of XeO_3 is

(A) linear (B) planar (C) pyramidal (D) T-shaped

38. XeF_4 and XeF_6 are expected to be

(A) oxidizing (B) reducing (C) unreactive (D) strongly basic

$C_{39\text{-}41}$: Paragraph for Question Nos. 39 to 41

Chemical reactions involve interaction of atoms and molecules. A large number of atoms/molecules (approximately 6.023×10^{23}) are present in a few grams of any chemical compound varying with their atomic/molecular masses. To handle such large numbers conveniently, the mole concept was introduced. This concept has implications in diverse areas such as analytical chemistry, biochemistry, electrochemistry and radiochemistry. The following example illustrates a typical case, involving chemical/electrochemical reaction, which requires a clear understanding of the mole concept.

A 4.0 molar aqueous solution of NaCl is prepared and 500 mL of this solution is electrolysed. This leads to the evolution of chlorine gas at one of the electrodes (atomic mass : Na = 23, Hg = 200; 1 Faraday = 96500 coulombs).

39. The total number of moles of chlorine gas evolved is

(A) 0.5 (B) 1.0 (C) 2.0 (D) 3.0

40. If the cathode is a Hg electrode, the maximum weight (g) of amalgam formed from this solution is

(A) 200 (B) 225 (C) 400 (D) 446

41. The total charge (coulombs) required for complete electrolysis is

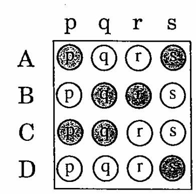
(A) 24125 (B) 48250 (C) 96500 (D) 193000

SECTION – IV

Matrix-Match Type

This section contains 3 questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column I** have to be matched with statements (p, q, r, s) in **Column II.** The answers to these questions have to be appropriately bubbled as illustrated in the following example.

If the correct matches are A-p, A-s, B-q, B-r, C-p, C-q and D-s, then the correctly bubbled 4×4 matrix should be as follows :



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42. Match the complexes in **Column I** with their properties listed in **Column II.** Indicate your answer by darkening the appropriate bubbles of the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) $[Co(NH_3)_4(H_2O)_2]Cl_2$	(p) geometrical isomers
(B) $[Pt(NH_3)_2Cl_2]$	(q) paramagnetic
(C) $[Co(H_2O)_5Cl]Cl$	(r) diamagnetic
(D) $[Ni(H_2O)_6]Cl_2$	(s) metal ion with +2 oxidation state

43. Match the chemical substances in **Column I** with type of polymers/type of bonds in **Column II**. Indicate your answer by darkening the appropriate bubbles of the 4×4 matrix given in the ORS.

Column I	Column II
(A) cellulose	(p) natural polymer
(B) nylon-6, 6	(q) synthetic polymer
(C) protein	(r) amide linkage
(D) sucrose	(s) glycoside linkage

44. Match gases under specified conditions listed in **Column I** with their properties/laws in **Column II**. Indicate your answer by darkening the appropriate bubbles of the 4×4 matrix given in the ORS.

Column I	Column II
(A) hydrogen gas ($P = 200$ atm, $T = 273$ K)	(p) compressibility factor $\neq 1$
(B) hydrogen gas ($P \sim 0$, $T = 273$ K)	(q) attractive forces are dominant
(C) CO_2 ($P = 1$ atm, $T = 273$ K)	(r) $PV = nRT$
(D) real gas with very large molar volume	(s) $P(V-nb) = nRT$