SECTION 1 (Maximum Marks: 12)

- This section contains **FOUR (04)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated **according to the following marking scheme**:

Full Marks : +3 If **ONLY** the correct option is chosen;
Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);
Negative Marks : −1 In all other cases.

Q.1 During sodium nitroprusside test of sulphide ion in an aqueous solution, one of the ligands coordinated to the metal ion is converted to

(A)	NOS^-	(B)	SCN^-	(C)	SNO^-	(D)	NCS^-

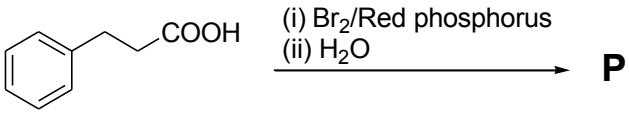
Answer: A

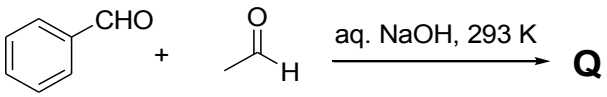
Q.2 The complete hydrolysis of ICl, ClF_3 and BrF_5, respectively, gives

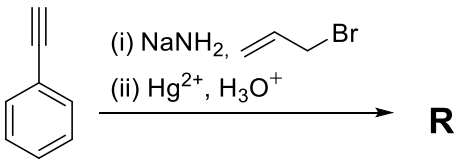
(A)	IO^-, ClO_2^- and BrO_3^-
(B)	IO_3^-, ClO_2^- and BrO_3^-
(C)	IO^-, ClO^- and BrO_2^-
(D)	IO_3^-, ClO_4^- and BrO_2^-

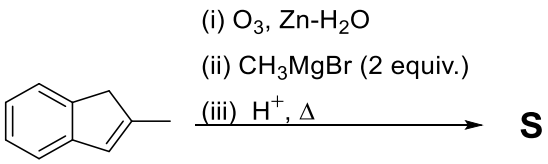
Answer: A

Q.3 Monocyclic compounds **P**, **Q**, **R** and **S** are the major products formed in the reaction sequences given below.







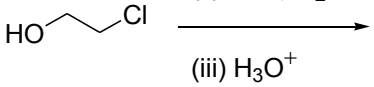
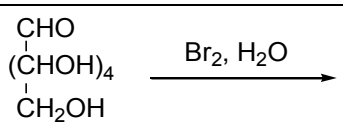
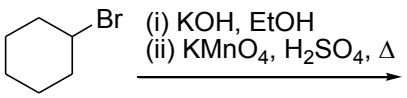
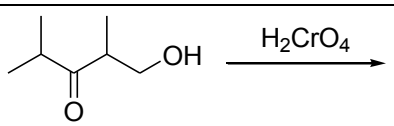


The product having the highest number of unsaturated carbon atom(s) is

(A)	**P**	(B)	**Q**
(C)	**R**	(D)	**S**

Answer: D

Q.4 The correct reaction/reaction sequence that would produce a dicarboxylic acid as the major product is

(A)	
(B)	
(C)	
(D)	

Answer: C

SECTION 2 (Maximum Marks: 16)

- This section contains **FOUR (04)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated **according to the following marking scheme**:

  Full Marks : $+4$ **ONLY** if (all) the correct option(s) is(are) chosen;
  Partial Marks : $+3$ If all the four options are correct but **ONLY** three options are chosen;
  Partial Marks : $+2$ If three or more options are correct but **ONLY** two options are chosen, both of which are correct;
  Partial Marks : $+1$ If two or more options are correct but **ONLY** one option is chosen and it is a correct option;
  Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);
  Negative Marks : -2 In all other cases.
- For example, in a question, if (A), (B) and (D) are the ONLY three options corresponding to correct answers, then
  choosing ONLY (A), (B) and (D) will get $+4$ marks;
  choosing ONLY (A) and (B) will get $+2$ marks;
  choosing ONLY (A) and (D) will get $+2$ marks;
  choosing ONLY (B) and (D) will get $+2$ marks;
  choosing ONLY (A) will get +1 mark;
  choosing ONLY (B) will get +1 mark;
  choosing ONLY (D) will get +1 mark;
  choosing no option (i.e. the question is unanswered) will get 0 marks; and
  choosing any other combination of options will get -2 marks.

Q.5 The correct statement(s) about intermolecular forces is(are)

(A)	The potential energy between two point charges approaches zero more rapidly than the potential energy between a point dipole and a point charge as the distance between them approaches infinity.
(B)	The average potential energy of two rotating polar molecules that are separated by a distance r has $1/r^3$ dependence.
(C)	The dipole-induced dipole average interaction energy is independent of temperature.
(D)	Nonpolar molecules attract one another even though neither has a permanent dipole moment.

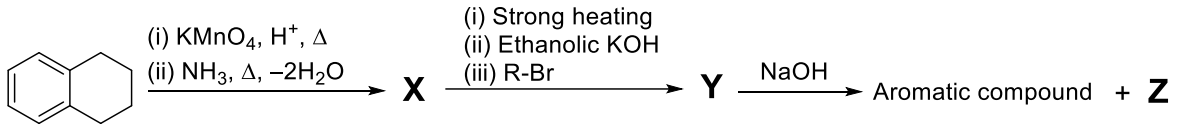
Answer: C, D

Q.6 The compound(s) with P–H bond(s) is(are)

(A)	H_3PO_4
(B)	H_3PO_3
(C)	$H_4P_2O_7$
(D)	H_3PO_2

Answer: B, D

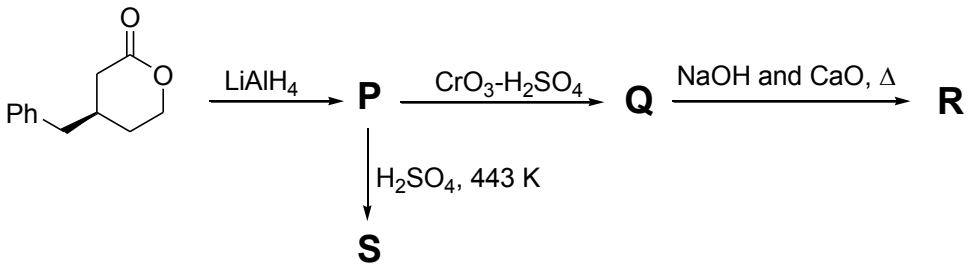
Q.7 For the reaction sequence given below, the correct statement(s) is(are)



(A)	Both **X** and **Y** are oxygen containing compounds.
(B)	**Y** on heating with $CHCl_3$/KOH forms isocyanide.
(C)	**Z** reacts with Hinsberg's reagent.
(D)	**Z** is an aromatic primary amine.

Answer: A, C

Q.8 For the reaction sequence given below, the correct statement(s) is(are)



(A)	**P** is optically active.
(B)	**S** gives Bayer's test.
(C)	**Q** gives effervescence with aq. $NaHCO_3$.
(D)	**R** is an alkyne.

Answer: B, C

SECTION 3 (Maximum Marks: 32)

- This section contains **EIGHT (08)** questions.
- The answer to each question is a **NUMERICAL VALUE.**
- For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.
- Answer to each question will be evaluated **according to the following marking scheme**:

Full Marks : +4 If ONLY the correct numerical value is entered in the designated place;
Zero Marks : 0 In all other cases.

Q.9 The density (in g cm^{-3}) of the metal which forms a cubic close packed (ccp) lattice with an axial distance (edge length) equal to 400 pm is _____.

Use: Atomic mass of metal = 105.6 amu and Avogadro's constant = 6×10^{23} mol^{-1}

Answer: [10.85 to 11.1]

Q.10 The solubility of barium iodate in an aqueous solution prepared by mixing 200 mL of 0.010 M barium nitrate with 100 mL of 0.10 M sodium iodate is $\boldsymbol{X} \times 10^{-6}$ mol dm^{-3}. The value of $\boldsymbol{X}$ is _____.

Use: Solubility product constant (K_{sp}) of barium iodate = 1.58×10^{-9}

Answer: [3.85 to 4.15]

Q.11 Adsorption of phenol from its aqueous solution on to fly ash obeys Freundlich isotherm. At a given temperature, from 10 mg g^{-1} and 16 mg g^{-1} aqueous phenol solutions, the concentrations of adsorbed phenol are measured to be 4 mg g^{-1} and 10 mg g^{-1}, respectively. At this temperature, the concentration (in mg g^{-1}) of adsorbed phenol from 20 mg g^{-1} aqueous solution of phenol will be _____.

Use: $\log_{10} 2 = 0.3$

Answer: [15.5 to 16.5]

Q.12 Consider a reaction $A + R \longrightarrow Product$. The rate of this reaction is measured to be $k[A][R]$. At the start of the reaction, the concentration of R, $[R]_0$, is 10-times the concentration of A, $[A]_0$. The reaction can be considered to be a pseudo first order reaction with assumption that $k[R] = k'$ is constant. Due to this assumption, the relative error (in %) in the rate when this reaction is 40 % complete, is _____.
[k and k' represent corresponding rate constants]

Answer: [4 to 4.25]

Q.13 At 300 K, an ideal dilute solution of a macromolecule exerts osmotic pressure that is expressed in terms of the height (h) of the solution (density $= 1.00$ g cm^{-3}) where h is equal to 2.00 cm. If the concentration of the dilute solution of the macromolecule is 2.00 g dm^{-3}, the molar mass of the macromolecule is calculated to be $\boldsymbol{X} \times 10^4$ g mol^{-1}. The value of $\boldsymbol{X}$ is _____.

Use: Universal gas constant (R) $= 8.3$ J K^{-1} mol^{-1} and acceleration due to gravity (g) $= 10$ m s^{-2}

Answer: [2.4 to 2.55]

Q.14 An electrochemical cell is fueled by the combustion of butane at 1 bar and 298 K. Its cell potential is $\frac{\boldsymbol{X}}{F} \times 10^3$ volts, where F is the Faraday constant. The value of $\boldsymbol{X}$ is _____.

Use: Standard Gibbs energies of formation at 298 K are: $\Delta_f G^o_{\mathrm{CO_2}} = -394$ kJ mol^{-1}; $\Delta_f G^o_{\mathrm{water}} = -237$ kJ mol^{-1}; $\Delta_f G^o_{\mathrm{butane}} = -18$ kJ mol^{-1}

Answer: [105.4 to 105.6]

Q.15 The sum of the spin only magnetic moment values (in B.M.) of $[Mn(Br)_6]^{3-}$ and $[Mn(CN)_6]^{3-}$ is _____.

Answer: [7.5 to 7.8]

Q.16 A linear octasaccharide (molar mass $= 1024$ g mol^{-1}) on complete hydrolysis produces three monosaccharides: ribose, 2-deoxyribose and glucose. The amount of 2-deoxyribose formed is 58.26 % (w/w) of the total amount of the monosaccharides produced in the hydrolyzed products. The number of ribose unit(s) present in one molecule of octasaccharide is _____.

Use: Molar mass (in g mol^{-1}): ribose $= 150$, 2-deoxyribose $= 134$, glucose $= 180$;
Atomic mass (in amu): H = 1, O = 16

Answer: 2

END OF THE QUESTION PAPER