



General Instructions

- (i) **Duration:** The total duration of the examination is 1 hours (60 minutes).
- (ii) **Total Marks:** The complete Chemistry paper carries a maximum of 100 marks.
- (iii) **Structure:** The paper consists of two sections:
 - **Section A:** 20 Multiple Choice Questions (MCQs).
 - **Section B:** 5 Numerical Value Type Questions.
- (iv) **Compulsory Questions:** All 25 questions are compulsory.
- (v) Each question has four options. Only **one** option is correct.
- (vi) **Correct Answer:** +4 marks.
- (vii) **Incorrect Answer:** -1 mark (Negative marking).
- (viii) **Unanswered/Marked for Review:** 0 marks.

Chemistry Section - A

1. The ratio of mass percentage (w/w) of C : H in a hydrocarbon is 12 : 1. It has two carbon atoms. The weight (in g) of $\text{CO}_2(\text{g})$ formed when 3.38 g of this hydrocarbon is completely burnt in oxygen is : (Given : Molar mass in g mol^{-1} C : 12, H : 1, O : 16)

- (A) 5.68
- (B) 11.44
- (C) 22.74

(D) 17.05

2. The first and second ionization constants of a weak dibasic acid H_2A are 8.1×10^{-8} and 1.0×10^{-13} respectively. 0.1 mol of H_2A was dissolved in 1L of 0.1 M HCl solution. The concentration of HA^- in the resultant solution is :

- (A) 0.1 M
 - (B) 9.53×10^{-6} M
 - (C) 8.1×10^{-8} M
 - (D) 1.0×10^{-13} M
-

3. SF_4 is isostructural with :

- A. BrF_4^-
- B. CH_4
- C. IF_4^+
- D. XeF_4
- E. XeO_2F_2

Choose the correct answer from the options given below :

- (A) C Only
 - (B) C and E Only
 - (C) A and D Only
 - (D) B and E Only
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4. Gas 'A' undergoes change from state 'X' to state 'Y'. In this process, the heat absorbed and work done by the gas is 10 J and 18 J respectively. Now gas is brought back to state 'X' by another process during which 6 J of heat is evolved. In the reverse process of 'Y' to 'X',

- (A) 18 J of the work is done by the gas 'A'.
 - (B) 2 J of the work is done by the gas 'A'.
 - (C) 12 J of the work is done on the gas 'A' by the surrounding.
 - (D) 14 J of the work is done on the gas 'A' by the surrounding.
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5. Solution A is prepared by dissolving 1 g of a protein (molar mass = 50000 g mol^{-1}) in 0.5 L of water at 300 K. Its osmotic pressure is x bar. Solution B is made by dissolving 2 g of same protein in 1 L of water at 300 K. Osmotic pressure of solution B is y bar. Entire solution of A is mixed with entire solution of B at same temperature. The osmotic pressure of resultant solution is z bar. x , y and z respectively are : ($R = 0.083 \text{ L bar mol}^{-1} \text{ K}^{-1}$)

- (A) 9.96×10^{-4} ; 9.96×10^{-4} ; 9.96×10^{-4}
 (B) 9.96×10^{-4} ; 9.96×10^{-4} ; 19.92×10^{-4}
 (C) 4.98×10^{-4} ; 4.98×10^{-4} ; 9.96×10^{-4}
 (D) 4.98×10^{-4} ; 4.98×10^{-4} ; 4.98×10^{-4}

6. At 25°C , 20.0 mL of 0.2 M weak monoprotic acid HX is titrated against 0.2 M NaOH. The pH of the solution (a) at the start of the titration (when NaOH has not been added) and (b) when 10 mL of NaOH is added respectively, are :

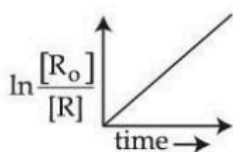
Given : $K_a = 5 \times 10^{-4}$, $\text{p}K_a = 3.3$, $\alpha \ll 1$

- (A) 0.7, 2.0
 (B) 2.0, 3.3
 (C) 1.1, 2.2
 (D) 3.0, 2.2

7. Consider the reaction $aX \rightarrow bY$, for which the rate constant at 30°C is $1 \times 10^{-3} \text{ mol}^{-1} \text{ L s}^{-1}$.

Which of the following statements are true ?

- A. When concentration of 'X' is increased to four times, the rate of reaction becomes 16 times.
 B. The reaction is a second order reaction.
 C. The half-life period is independent of the concentration of X.
 D. Decomposition of N_2O_5 is an example of the above reaction.



E. is valid for the above reaction.

Choose the correct answer from the options given below :

- (A) A and B Only
 - (B) A, B and C Only
 - (C) A, B, D and E Only
 - (D) C and D Only
-

8. The correct set that contains all kinds (basic, acidic, amphoteric and neutral) of oxides is :

- (A) Na_2O , K_2O , Al_2O_3 and As_2O_3
 - (B) Al_2O_3 , As_2O_3 , CO and NO
 - (C) K_2O , Cl_2O_7 , As_2O_3 and NO
 - (D) Na_2O , N_2O , Al_2O_3 and CO
-

9. Given below are two statements :

Statement I : The second ionization enthalpy of B, Al and Ga is in the order of $\text{B} > \text{Al} > \text{Ga}$.

Statement II : The correct order in terms of first ionization enthalpy is $\text{Si} < \text{Ge} < \text{Pb} < \text{Sn}$.

In the light of the above statements, choose the correct answer from the options given below :

- (A) Both Statement I and Statement II are true
 - (B) Both Statement I and Statement II are false
 - (C) Statement I is true but Statement II is false
 - (D) Statement I is false but Statement II is true
-

10. Given below are two statements :

Statement I : Among Zn, Mn, Sc and Cu, the energy required to remove the third valence electron is highest for Zn and lowest for Sc.

Statement II : The correct order of the following complexes in terms of CFSE is $[\text{Co}(\text{H}_2\text{O})_6]^{2+} < [\text{Co}(\text{H}_2\text{O})_6]^{3+} < [\text{Co}(\text{en})_3]^{3+}$.

In the light of the above statements, choose the correct answer from the options given below :

- (A) Both Statement I and Statement II are true
 - (B) Both Statement I and Statement II are false
 - (C) Statement I is true but Statement II is false
 - (D) Statement I is false but Statement II is true
-

11. Which of the following complexes will show coordination isomerism ?

- A. $[\text{Ag}(\text{NH}_3)_2][\text{Ag}(\text{CN})_2]$
- B. $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$
- C. $[\text{Co}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$
- D. $[\text{Fe}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$
- E. $[\text{Co}(\text{NH}_3)_6][\text{Fe}(\text{CN})_6]$

Choose the correct answer from the options given below :

- (A) B, C and D Only
- (B) B, D and E Only
- (C) A, C and D Only
- (D) C, D and E Only

12. Complete combustion of X g of an organic compound gave 0.25 g of CO_2 and 0.12 g of H_2O . If the % of carbon is 25% and of hydrogen is 4.89%, then $X = \text{_____} \times 10^{-3}$ g. (Nearest integer) (Molar mass of C, H and O are 12, 1 and 16 g mol^{-1} respectively.)

- (A) 273
- (B) 27
- (C) 2730
- (D) 227

13. Given below are two statements :

Statement I : In $\text{O}_2\text{N}-\text{C}_6\text{H}_4-\text{CH}^+-\text{C}_6\text{H}_4-\text{OCH}_3$, the carbocation is stabilised by +R effect of $-\text{OCH}_3$ group.

Statement II : In $\text{O}_2\text{N}-\text{C}_6\text{H}_4-\text{CH}^--\text{C}_6\text{H}_4-\text{OCH}_3$, the carbanion is stabilised by -R effect of $-\text{NO}_2$ group.

In the light of the above statements, choose the correct answer from the options given below :

- (A) Both Statement I and Statement II are true

- (B) Both Statement I and Statement II are false
(C) Statement I is true but Statement II is false
(D) Statement I is false but Statement II is true
-

14. The compound (X) on

- (i) heating in the presence of anhydrous AlCl_3 and HCl gas gives 2,4-dimethyl pentane
(ii) aromatization gives toluene and
(iii) cyclisation gives methyl cyclohexane

The correct name of compound (X) is :

- (A) Hept-2-ene
(B) Hept-1,3,5-triene
(C) Heptane
(D) Hept-2,4,6-triene
-

15. Correct statements regarding alkyl halides (R-X) among the following are :

- A. Alcohol being less polar solvent as compared to water, alcoholic KOH favours elimination reaction with R-X.
B. Order of reactivity towards $\text{S}_{\text{N}}1$ mechanism is $\text{C}_6\text{H}_5 - \text{CH}_2 - \text{Cl} > \text{C}_6\text{H}_5 - \text{CHCl} - \text{C}_6\text{H}_5$.
C. Non substituted aryl halides exhibit properties similar to alkyl halides.
D. Vinyl chloride is an example of haloalkene and allyl chloride is an example of haloalkyne.
E. R-Cl can be prepared by reacting R-OH with SOCl_2 but Ar-Cl cannot be prepared by reacting Ar-OH with SOCl_2 .

Choose the correct answer from the options given below :

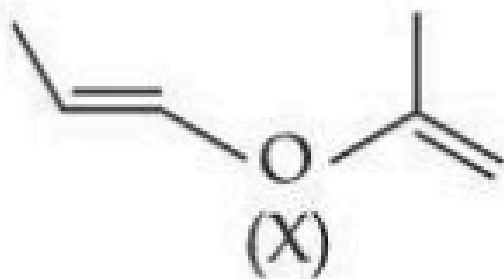
- (A) A, B and C Only
(B) B and D Only
(C) A and E Only
(D) D and E Only
-

16. An organic compound "x" where molar ratio of C, O and H are equal, on treatment with 50% KOH under reflux followed by acidification produced "y". The most likely structure of "y"

is :
Molar mass of 'x' is 58 g mol^{-1}

- (A) $\text{CH}_2 = \text{CH} - \text{C}(=\text{O}) - \text{OH}$
(B) $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH} = \text{O}$
(C) $\text{O} = \text{C}(\text{OH}) - \text{CH}_2 - \text{OH}$
(D) $\text{CH}_3 - \text{C}(=\text{O}) - \text{OH}$
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17. A molecule (X) with following structure under mild acidic condition is hydrolysed to produce (Y) and (Z). Identify the correct statements about (Y) and (Z).

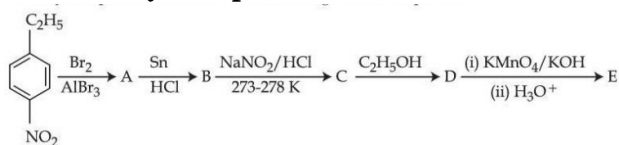


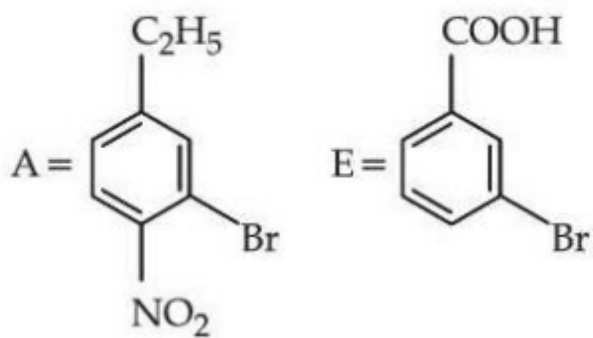
- A. Both (Y) and (Z) have same molar mass.
B. (Y) and (Z) can be distinguished from each other by NaHCO_3 .
C. (Y) and (Z) react with HCN with same rates.
D. (Y) and (Z) undergo addition reaction with 2,4-DNP

Choose the correct answer from the options given below :

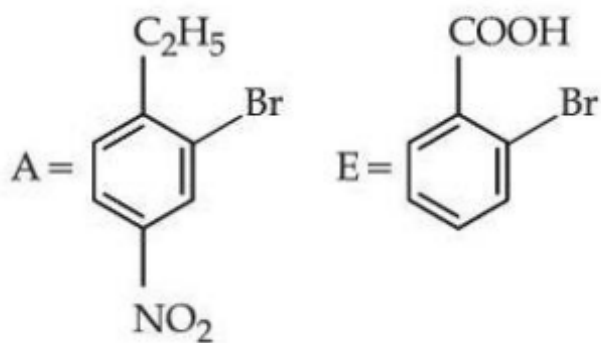
- (A) A, B and C Only
(B) B and C Only
(C) C and D Only
(D) A and B Only
-

18. Identify compounds A and E in the following reaction sequence.

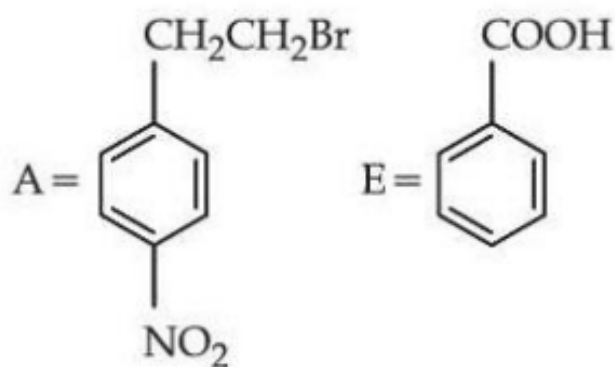




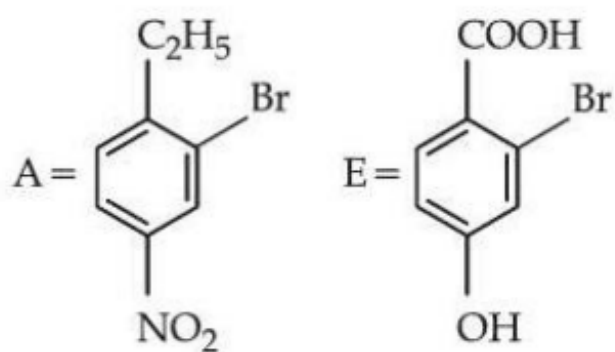
(A)



(B)



(C)



(D)

19. Identify the correct pair having amino acid (A) and the hormone (B) that is iodinated derivative of the amino acid (A).

(T and Y represent one letter code for amino acids)

Amino acid (A) Hormone (B)

- (A) T Insulin
(B) T Thyroxine
(C) Y Thyroxine
(D) Y Insulin

20. Among Fe^{2+} , Fe^{3+} , Cr^{2+} and Zn^{2+} , the ion that shows positive borax bead test and with highest ionisation enthalpy is :

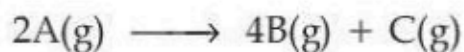
- (A) Fe^{2+}
(B) Zn^{2+}
(C) Cr^{2+}
(D) Fe^{3+}

Chemistry Section - B

21. The surface of sodium metal is irradiated with radiation of wavelength x nm. The kinetic energy of ejected electrons is 2.8×10^{-20} J. The work function of sodium is 2.3 eV. The value of x is _____ $\times 10^2$ nm. (Nearest integer)

(Given : $h = 6.6 \times 10^{-34}$ J s; 1 eV = 1.6×10^{-19} J; $c = 3.0 \times 10^8$ m s $^{-1}$)

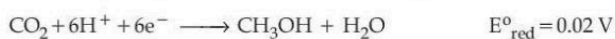
22. Consider the following gas phase reaction being carried out in a closed vessel at 25°C.



<u>time</u> (min)	<u>total pressure of the</u> <u>system</u> (mm Hg)
30	300
∞	600

The pressure of C(g) at 30 minutes time interval would be _____ mm Hg. (nearest integer)

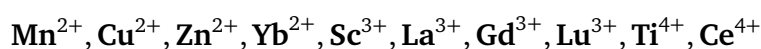
23. Consider the following two half-cell reactions along with the standard reduction potential given :



A fuel cell was set up using the above two reactions such that the cell operates under the standard condition of 1 bar pressure and 298 K temperature. The fuel cell works with 80% efficiency. If the work derived from the cell using 1 mol of CH_3OH is used to compress an ideal gas isothermally against a constant pressure of 1 kPa, then the change in the volume of the gas, $\Delta V =$ _____ m^3 . (nearest integer)

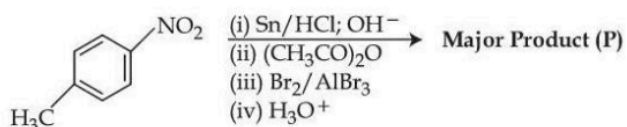
Given : $F = 96500 \text{ C mol}^{-1}$

24. Number of paramagnetic ions among the following d- and f-block metal ions is _____.



(Atomic number of Mn = 25, Cu = 29, Zn = 30, Yb = 70, Sc = 21, La = 57, Gd = 64, Lu = 71, Ti = 22, Ce = 58)

25. Consider the following reactions sequence



When the product (P) is subjected to Carius analysis using AgNO_3 , 1.0 g of the product (P) will produce _____ g of the precipitate of AgBr. (Nearest Integer)

(Given : molar mass in g mol^{-1} C : 12, H : 1, O : 16, N : 14, Br : 80, Ag : 108)
