# Rathnavali Balika Vidyalaya - Gampaha

02 | S | I

## General Certificate of (Adv. Level ) Examination - 2020

## Evaluation Test

## Chemistry I

Enu

## Grade 13

Two hours

★ Answer all the questions.

★ In each of the questions 1 - 50 pick one of the alternatives (1) , (2) , (3) , (4, (5) which is correct of most appropriate and mark your response on the answer sheet with a cross (x) on the number of the correct option.

★ Use of calculators is not allowed

★ Universal gas constant $R = 8.314\ J\ K^{-1}mol^{-1}$ ★ Plank's constant $h = 6.626 \times 10^{-34}\ J\ s$

★ Avogadro constant $N_A = 6.022 \times 10^{23}\ mol^{-1}$ ★ Velocity of light $C = 3 \times 10^{8}\ ms^{-1}$

(01) The scientist who presented collision theory

(1) Ostwald (2) Lewis (3) Arrhenius

(4) Boltsmann (5) none of the above

(02) Which one out of following has the highest tendency to dissolve in a nonpolar solvent such as tetrachloro methane ?

(1) NaCl (2) Water (3) $KMnO_4$

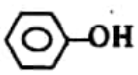
(4) Molecular Iodine (5) Tri iodide ion

(03) What is the coloured complex out of the given compound ?

(1) $[Cu(NH_3)_2]^+$ (2) $Ti(NO_3)_4$ (3) $K_3[VF_6)]$

(4) $[Cu(H_2O)_6]Cl$ (5) $[Ag(NH_3)_2]OH$

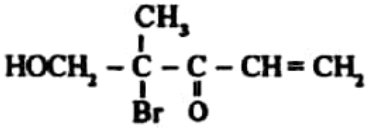
(04) What is the correct increasing order of the basic property of the compounds given below ?

(a)  (b) $CH_3NH_2$ (c) $CH_3CH_2OH$ (d) 

(1) A < B < C < D (2) C < D < A < B (3) D < C < A < B

(4) C < D < B < A (5) A < B < D < C

(05) IUPAC name of the compound given below ,



(1) 2 - bromo - 1 - hydroxy - 2 - methylpent - 4 - en - 3 - one

(2) 2 - bromo - 1 - hydroxy - 2 - methyl - 4 - pentene - 3 - one

(3) 4 - bromo - 5 - hydroxy - 4 - methylpent - 1 - en - 3 - one

(4) 4 - bromo - 5 - hydroxy - 4 - methyl - 1 - pentene - 3 - one

(5) 4 - bromo - 4 - methyl - 5 - hydroxypent - 1 - en - 3 - one

(06) Which out of the following gives 4 - bromo - 2 , 4 - dimethylpentan - 1 - ol as the major products when reacted with HBr ?

Enu

(1) $CH_3CH(CH_3)-CH=C(CH_3)-CH_2OH$

(2) $CH_3-C(CH_3)=CH-CH(CH_3)-CH_2OH$

(3) $CH_2=C(CH_3)-CH_2-CH(CH_3)-CH_2OH$

(4) $CH_3CH(CH_3)-CH_2-C(CH_3)=CH_2$

(5) $CH_3-C(CH_2)-CH_2CH(CH_3)-CH_2OH$

(07) Dissociation constant of the weak monobasic acid HCN in aqueous solution at 25 °C is $1 \times 10^{-5}$ mol dm$^{-3}$. The following solutions A and C prepared by mixing three 25 cm$^3$ portions of 0.1 mol dm$^{-3}$ acid with 25 cm$^3$ of each of the following.

Solution A - 0.05 mol dm$^{-3}$ HCl 25 cm$^3$

Solution A - 0.05 mol dm$^{-3}$ NaOH

Solution C - $H_2O$

What is the correct increasing order of the concentration of $CN^-$ in these three solutions ?

(1) A > B > C (2) B > A > C (3) C > A > B

(4) B > C > A (5) C < B < A

(08) What is the most acceptable Lewis structure for $CNO^-$ ?

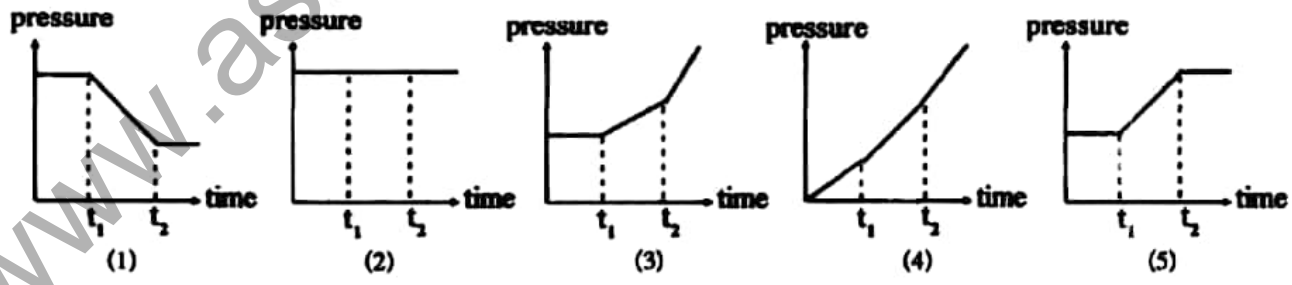
(1) $^{-}:\ddot{N}=C=\ddot{O}:$ (2) $:N\equiv C-\ddot{O}:^{-}$ (3) $^{2-}:\ddot{N}-C\equiv O^{+}:$

(4) $^{-}:\ddot{O}-N^{+}\equiv C^{-}:$ (5) $:\ddot{O}=N^{+}=\ddot{C}:^{2-}$

(09) $X^{2+}$ ion oxidizes into $X^{n+}$ by $MnO_4^-$ in acidic medium. $2 \times 10^{-3}$ mol of $MnO_4^-$ needed to oxidize 50 cm$^3$ of 0.1 mol dm$^{-3}$ $X^{2+}$ ions. What is the value of n ?

(1) 1 (2) 2 (3) 3 (4) 4 (5) 5

(10) The gaseous system $2\,SO_2(g) + O_2(g) \rightleftharpoons 2\,SO_3(g)$ $\Delta H < 0$ is at equilibrium under a certain constant temperature. At time $t_1$ temperature of the system was raised and at time $t_2$ the system was allowed to equilibrate. Which out of following is the most suitable variation for the pressure of the system ?




(11) Density of an aqueous solution of $H_2SO_4$ acid is 2.0 g cm$^{-3}$. Its assay (w/w%) is 98 %. Total amount (mol) of Hydrogen atoms in 18 cm$^3$ of this solution is, (S = 32 , O = 16 , H = 1 )

(1) 0.8 (2) 0.72 (3) 0.76 (4) 0.08 (5) 0.4

(12) A rigid vessel of 4.157 dm$^3$ volume under 27 °C temperature contains 1.5 g of $H_2$ and 8 g of $O_2$ gas. What is the total pressure of the system ? H = 1 O = 16

(1) $1 \times 10^5$ Nm$^{-2}$ (2) $2 \times 10^5$ Nm$^{-2}$ (3) $3 \times 10^5$ Nm$^{-2}$

(4) $6 \times 10^5$ Nm$^{-2}$ (5) $8 \times 10^5$ Nm$^{-2}$

(13) Which out of the following compound does not react with conc. $H_2SO_4$ ?

(1) $NaNO_2$ (2) $CuSO_4.5\,H_2O$ (3) $Na_2S_2O_3.10\,H_2O$ (4) $Cl_2$ (5) HBr

(14) Consider the elementary reaction given below,

$PQ\,(g) + QR\,(g) \longrightleftharpoons PQ_2R\,(g)$

- Standard enthalpy of formation of $PQ\,(g)$ = - 300 kJ mol$^{-1}$
- Standard enthalpy of formation of $QR\,(g)$ = - 500 kJ mol$^{-1}$
- Standard enthalpy of formation of $PQ_2R\,(g)$ = - 1400 kJ mol$^{-1}$
- Activation energy of forward reaction = + 900 kJ mol$^{-1}$

What is the activation energy of the reverse reaction ?

(1) - 1900 kJ mol$^{-1}$ (2) - 1700 kJ mol$^{-1}$ (3) + 1500 kJ mol$^{-1}$
(4) + 1300 kJ mol$^{-1}$ (5) + 1100 kJ mol$^{-1}$

(15) An atom has $n = 3$ and $l = 2$ quantum number in the valence shell at ground state. The two elements A and B follow the same quantum number pattern and have 6 and 4 unpaired electrons respectively. What could be A and B ?

(1) A = Cr B = Co (2) A = Fe B = Ni (3) A = Cr B = Fe
(4) A = Fe B = Cr (5) A = Ni B = Co

(16) An organic compound reacts with $C_2H_5MgBr$ in dry ether medium. The product is hydrolysed and seperated. It is reacted with PCC in anhydrous medium. The final product is $C_3H_6O$. What could be A ?

(1) HCHO (2) $CH_3CHO$ (3) $CH_3-\overset{\overset{O}{\|}}{C}-CH_3$
(4) $CH_3CH_2COCH_3$ (5) None of the above.

(17) A mass of 4.0 g of a mixture containing sodium carbonate and sodium bicarbonate was heated strongly. Mass reduced by 0.31 g. Mass percentage of $Na_2CO_3$ in the mixture is,
(H = 1 , C = 12 , O = 16 , Na = 23)

(1) 95 (2) 90 (3) 83 (4) 79 (5) 63

(18) Ionization of an indicator prepared by a weak acid is given below.

$HIn\,(aq) + H_2O\,(l) \longrightleftharpoons H_3O^+\,(aq) + In^-\,(aq)$

Ionization constant of HIn at 25 °C is $1 \times 10^{-10}$ mol dm$^{-3}$. Which out of the following is correct regarding a solution at pH = 6 ?

(1) $[In^-] > [HIn\,(aq)]$ (2) $[In^-] < [HIn\,(aq)]$
(3) $[In^-] = [HIn\,(aq)]$ (4) $[In^-] = [H_3O^+(aq)] = [HIn\,(aq)]$
(5) None of the above.

(19) The conjugate bases of the following species respectively.

$OH^-$ , $CH_3COOH$ , $\overset{+}{N}H_3$

(1) $H_2O$ , $CH_3COO^-$ , $\bar{N}H_4$ (2) $H_3O^+$ , $CH_3COO^-$ , $\overset{+}{N}H_2$
(3) $O^{2-}$ , $CH_3COO^-$ . $NH_2$ (4) $O^{2-}$ , $CH_3COO^-$ , $NH_4$
(5) No conjugate bases for $OH^-$ and $NH_3$.

(20) Solubility of $Hg_2Cl_2$ at 25 °C is $1.0 \times 10^{-4}$ mol dm$^{-3}$. It is dissolved in a HCl solution of $1.0 \times 10^{-2}$ mol dm$^{-3}$ concentration. What could be the solubility of $Hg_2Cl_2$ ?

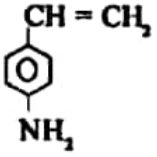
(1) $2 \times 10^{-6}$ mol dm$^{-3}$ (2) $1 \times 10^{-2}$ mol dm$^{-3}$ (3) $4 \times 10^{-8}$ mol dm$^{-3}$

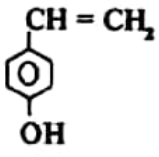
(4) $1 \times 10^{-4}$ mol dm$^{-3}$ (5) No sufficient data for the calculation.

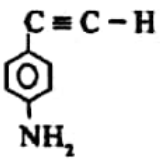
(21) What is the temperature in celcius at which the distillation takesplace when cinnamon oli is extracted by steam distillation ?

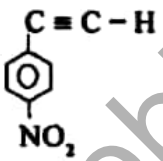
(1) 160 (2) 100 (3) 96 (4) 50 (5) 28

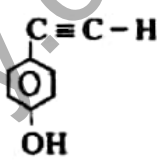
(22) An organic compound X decolourize liquid $Br_2$ and gives a white precipitate with ammoniacal $AgNO_3$. The product obtained by the addition of water molecule to X in the presence of $Hg^{2+}$ doesnot reduce tollen's reagent and answer for brady's reagent. The product of the reaction between X and $NaNO_2$ / HCl gives a coloured dye with β napthol. X could be,

(1) 


(2) 


(3) 


(4) 


(5) 


(23) Consider the reaction below.

A (g) ⟷ B (g)

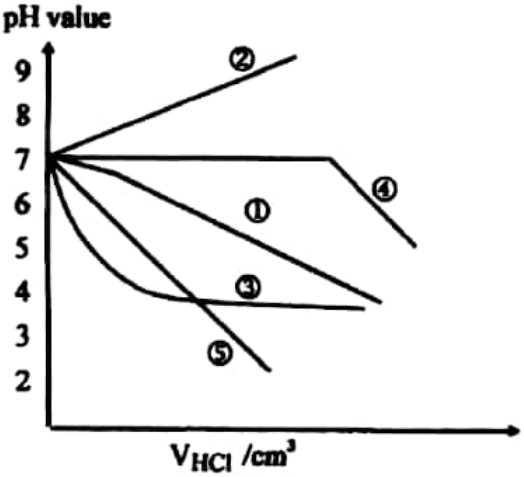
$\Delta G^\theta$ at 100 °C = - 196 kJ mol$^{-1}$

$\Delta G^\theta$ at 200 °C = - 310 kJ mol$^{-1}$

What is the most correct statement regarding this reaction ?

(1) Equilibrium constant at 200 °C is greater than that at 100 °C.
(2) Reaction is endothermic.
(3) Reaction has a positive ΔS value.
(4) Only (2) and (3) are correct.
(5) All above are correct.

(24) Dilute HCl is added to 100 cm$^3$ of a dilute buffer solution at pH 7.0. Which graph shows the proper variation of pH with the volume of HCl added ?




(25) A student did several titrations with 25.0 cm$^3$ volumes of an aqueous solution of KOH and an aqueous solution of 0.1 mol dm$^{-3}$ HBr. HBr was in the burrette. KOH is an old solution. In one titration he used methyl orange to determine the end point. In the next titration he used phenolphthalein. Difference between the two burrette regardings is 5 cm$^3$. Which statement given below is most correct regarding the difference between the above burrette regardings. This difference is there because

(1) HBr is a weak acid.
(2) KOH is a strong base.
(3) $K_2CO_3$ present along with KOH in the solution.
(4) $KHCO_3$ present along with KOH in the solution.
(5) Both $KHCO_3$ and $K_2CO_3$ present along with KOH.

(26) Which experiment out of below cannot explain using electro chemical series ?
(1) Reducing ability of K is greater than that of Na.
(2) $F_2$ is more feasible for redction than $Cl_2$ .
(3) $Cu^{2+}$ forms a complex with $Cl^-$ but $Mg^{2+}$ does not do like that.
(4) Fe can be oxidized by $H^+$.
(5) Mg can displate Cu from aqueous $CuSO_4$.

(27) Consider the electrochemical cell below
Mn (s) | $M^{2+}$ (aq , 1 mol $dm^{-3}$) | | $Cd^{2+}$ (aq , 1 mol $dm^{-3}$) | Cd (s)
$E^\theta$ values for Mn and Cd are - 1.19 V and - 0.14 V respectively.
What is correct regarding this electrochemical cell ?

(1) e. m. f. value is + 0.79 V.
(2) Cd is formed when Mn is added to $Cd^{2+}$ ion solution.
(3) e. m. f. value decreases when water is added to $M^{2+}$.
(4) Electrons flow from Cd and Mn when the electrodes are connected using a conducting wire.
(5) None of the above is correct.

(28) Which out of following is correct for a binary system consists the components A and B ?
This system shows a negative deviation from Rault's law.
(1) $P_A > X_A P_A^\bullet$ (2) $X_B P_B^\bullet > P_B$ (3) $P_T > P_A + P_B$
(4) $P_T < P_A + P_B$ (5) $P_T > X_A P_A^\bullet + X_B P_B^\bullet$

(29) Which out of following is most suitable for the product formed by the reaction between $BaD_2$ and $H_2O$ ?
(1) $H_2$ (2) $D_2$ (3) $H_2$ and $D_2$ (4) $Ba(OH)_2$ and HD (5) $(Ba(OD)_2$

(30) Which out of following is wrong regarding winckler test of determining dissolved oxygen in water ?
(1) Concentrated $H_2SO_4$ act as an oxidizing agent.
(2) This test needs $Na_2S_2O_3$.
(3) Atmospheric oxygen converts $Mn^{2+}$ ions into $MnO_2$ .
(4) $MnO_2$ acts as an oxidizing agent.
(5) Amount (mol) of oxygen dissolved in water is $\frac{1}{4}$ times as the amount (mol) of thiosulphate used in the titration.

★ Instructions for question number (31) to (40)

| (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|
| only (a) and (b) correct | only (b) and (c) correct | only (c) and (d) correct | only (d) and (a) correct | any other number or combination of responses are correct |

(31) Rate if a reaction increases when the concentration of reactants increases under constant temperature because ,
(a) the number of collisions between the molecules increases.
(b) the fraction of molecules with energy greater than the activation energy of the reaction, is very high.
(c) energy of collisions increases.
(d) fraction of collisions of proper orientation increases.

(32) An organic compound is burnt in excess oxygen. In anlyzing the products it has been found that the mass ratio between $CO_2$ and $H_2O$ is 44 : 9. Which compound /s out of given could be the organic compound.

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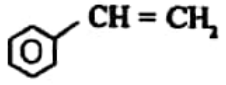
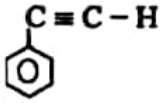
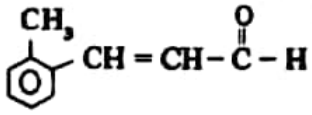
(a)  (b)  (c) $CH_2-\overset{O}{\overset{\|}{C}}-H$ (d) 

(33) Which compound /s give /s a solution which turns red litmus into blue , when dissolved in water ?

(a) LiF (b) $CH_3COOLi$ (c) LiCl (d) $LiNO_3$

(34) HCl is added to a solution containing metal ions which includes in group analysis. There was no precipitate. $H_2S$ gas was bubbled into this solution. A black precipitate obtained. The precipitate was filtered and removed. Then $H_2S$ was boiled off from the filtrate and $NH_4Cl$ and $NH_4OH$ were added. A green blue precipitate obtained. After filtering the solution a blue solution obtained. Which out of following is / are true ?

(a) $Ni^{2+}$ could present in the solution.
(b) $Cr^{3+}$ present in the solution.
(c) Definitely $Cu^{2+}$ present in the solution.
(d) $Ag^+$ could present in the solution.

(35) Which out of following can precipitate by adding $AgNO_3$?

(a) $C_6H_5Br$ (b) $C_6H_5CH_2Br$ (c) $(CH_3)_3C-Br$ (d) $C_6H_5CH=CH-Br$

(36) Which out of following is correct ?

(a) $F_2$ + hot concentrated KOH $\longrightarrow$ $KFO_3$ + other products
(b) Ag + $Cu(NO_3)_2$ $\longrightarrow$ Cu + other products
(c) $NH_3$ + $Br_2$ $\longrightarrow$ $N_2$ + other products
(d) $PlCl_2$ + $H_2O$ $\longrightarrow$ HI + other products

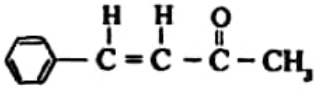
(37) Which out of following is /are true regarding A and B in the reactions given below ?

$$CH_3CH=CH_2 \xrightarrow{A} CH_2CH-CH_3 \quad (Br)$$

$$CH_3CH=CH_2 \xrightarrow{B} CH_3CH-CH_3 \quad (Br)$$

(a) A is an electrophilic substitution while B is an elemination reaction.
(b) A is a nucleophilic substitution while B is an electrophilic substitution.
(c) A is an electrophilic addition while B is an elemination.
(d) Hybridization changes from $sp^2 \rightarrow sp^3$ in A and $sp^3 \rightarrow sp^2$ in B.

(38) Which statement /s is / are true regarding the given molecule ?



(a) It shows stereoisomerism.
(b) The product from this molecule with $LiAlH_4$ followed by hydrolysis , decolourized $Br_2/CCl_4$ at room temperature.
(c) C – H bonds lengths are equal.
(d) It contains 16 $\sigma$ bonds.

(39) Bond in methylammonium chloride is / are

(a) Ionic bonds (b) Covalent bonds (c) Dative bonds (d) Hydrogen bonds

(40) What is / are true regarding the following equilibrium ?

$X_2(g) + 2Y(s) \rightleftharpoons 2XY(g)$ $\Delta H = +55\ kJ\ mol^{-1}$

(a) When temperature is increased the rate of the reaction decreases.

(b) Total pressure of the system does not change when an innert gas is added to the system.

(c) Increasing the concentration of Y does not affect the equilibrium.

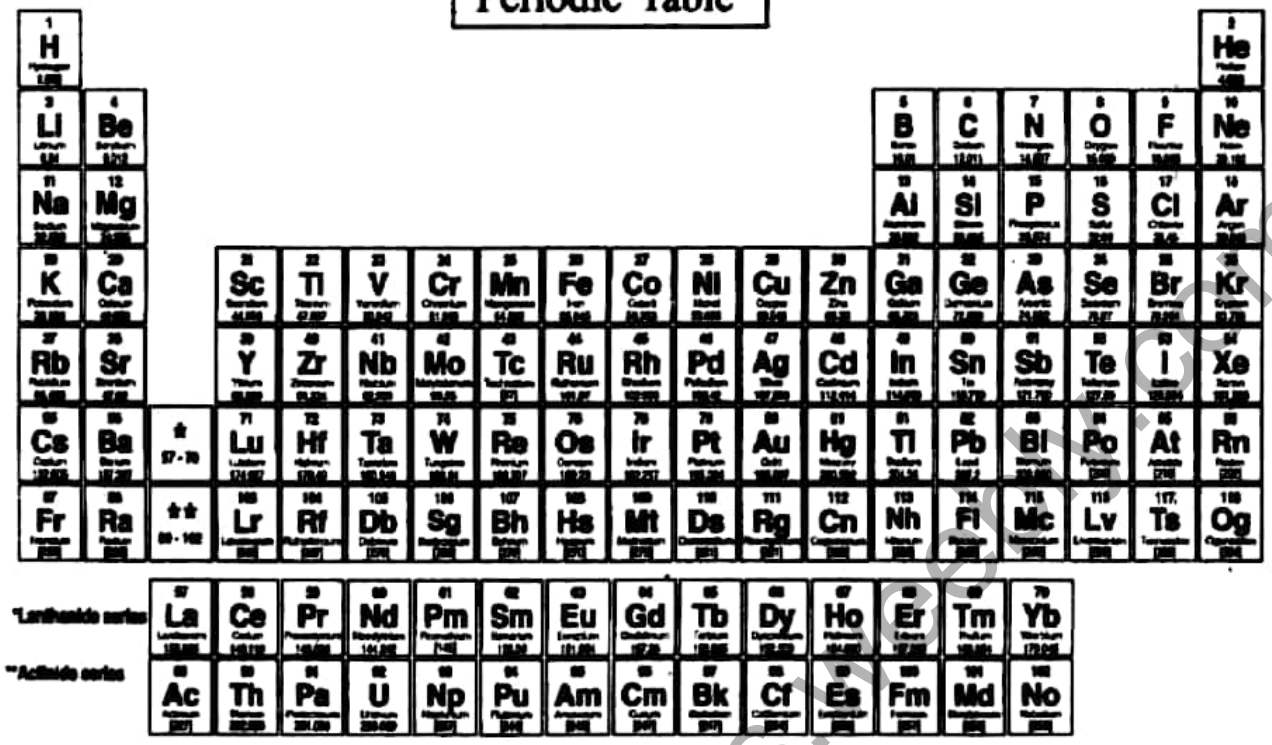
(d) Increasing the partial pressure of XY does not affect the equilibrium.

★ Instruction for the question number (41) to (50)

| Response | The First statement | The Second statement |
|---|---|---|
| (1) | True | True and correctly explains the first statement well |
| (2) | True | True but does not correctly explain the first statement well |
| (3) | True | False |
| (4) | False | True |
| (5) | False | False |

| | The first statement | The Second statement |
|---|---|---|
| (41) | Water cannot exist as a liquid at temperatures above 373 K. | The critical temperature of water is above 373 K. |
| (42) | $BaCO_3(s)$ is soluble in acid. | $BaCO_3(s) \rightleftharpoons Ba^{2+}(aq) + CO_3^{2-}(g)$ equilibrium is disturbed by acid. |
| (43) | In an aqueous solution of $H_2A$ $[H^+] = [OH^-] + [HA^-] + 2[A^{2-}]$ | The concentration of positive charges in aqueous solution is equal to concentration of negative charges in it. |
| (44) | The reaction of $CH_3CH=CH-CH_2Br$ with aqueous NaOH has one step mechanism. | $CH_3CH=CH-CH_2Br$ is a primary alkyl halide. |
| (45) | $Na_2CO_3$ cannot use to remove temparary hardness in water. | $Na_2CO_3$, does not react with $HCO_3^-$. |
| (46) | Cu (I) is more stable than Cu (II) in gaseous state. | Electron configuration of Cu (I) is $3d^{10}\ 4s^0$ Cu (II) is $3d^9\ 4s^0$. |
| (47) | $BiCl_3$ is formed by adding HCl to BiOCl. | BiOCl is formed by the oxidation of $BiCl_3$. |
| (48) | A white precipitate is formed when a small amount of $Pb(NO_3)_2$ is added to concentrated HCl solution. | The solubility of $PbCl_2$ is reduced in the presence of excess $Cl^-$ due to common ion effect. |
| (49) | 1 - bromobutane can be formed when ethene reacts with $Br_2$ (g) in difussed sunlight. | Reaction of the ether and $Br_2$ in difussed sunlight is a free radical substitution reaction. |
| (50) | The reaction of $S_2O_8^{2-}(aq)$ with $I^-$ is catalysed by $Fe^{2+}$. | There is a change in oxidation number where $S_2O_8^{2-} \longrightarrow SO_4^{2-}$ |

# Periodic Table



# Rathnavali Balika Vidyalaya - Gampaha

02 | S | II

## General Certificate of (Adv. Level) Examination - 2020

## Evaluation Test

## Chemistry II

**Grade 13**

*Enu*

Three hours

Name : ..... Grade : .....

**Instructions :-**

- ★ A periodic table is provided.
- ★ Use of calculators is not allowed.
- ★ Universal gas constant $R = 8.314\ J\ K^{-1}mol^{-1}$
- ★ Plank's constant $h = 6.626 \times 10^{-34}\ J\ s$
- ★ Avogadro constant $N_A = 6.022 \times 10^{23}\ mol^{-1}$
- ★ Velocity of light $C = 3 \times 10^{8}\ ms^{-1}$

## PART A - Structured Essay

- ★ Answer all four questions on this paper itself.
- ★ Write your answers in the space provided for each question. Note that the space provided is sufficient for your answers and extensive answers are not expected.

## PART B and PART C - Essay

- ★ Answer four questions. Use the papers supplied for this purpose.
- ★ At the end of the time allotted for this paper, tie the answers to the three parts A and B together so that part A is on top and hand them over to the supervisor.
- ★ You are permitted to remove only parts B and C of the question paper from the Examination Hall.

**For Examiner's Use only**

| Part | Q. No. | Marks |
|---|---|---|
| A | 1 | |
| | 2 | |
| | 3 | |
| | 4 | |
| B | 5 | |
| | 6 | |
| | 7 | |
| C | 8 | |
| | 9 | |
| | 10 | |
| Total | | |
| Percentage | | |

**Final Marks**

| | |
|---|---|
| In Numbers | |
| In words | |

## Part A - Structured Essay

★ **Answer all the questions.**

(01) (A) Consider the compounds given below.

| $H_2S$ , $XeF_4$ , $PCl_3$ , $Na_2O$ , $KO_2$ , $BCl_3$ |
|---|

Which out of following,

(i) Exist as a linear molecule .....

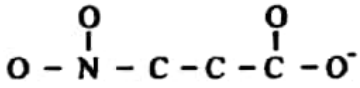
(ii) Has the same electron pair geometry and shape around the central atom .....

(iii) Isoelectronic with $N_2H_4$ .....

(iv) Has a zero dipolemoment .....

(v) Has orbitals with unpaird electrons .....

(B) (i) Skeletal structure of $C_3O_4N^-$ ion is given below.



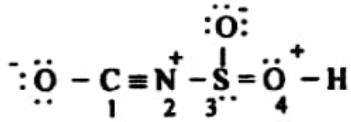
Draw the most stable Lewis dot - dash structure for this molecule.

(ii) Lewis dot - dash structure of $H_2PNO$ is given below.

Draw other two Lewis dot - dash structures for this molecule.

(C) (i) The following structure is an unstable resonance structure for a neutral molecule.

Draw the stable Lewis dot - dash structure for the molecule.



(ii) Fill the following table considering above stable molecule.

| | Atom | $C_1$ | $N_2$ | $S_3$ | $O_4$ |
|---|---|---|---|---|---|
| a. | VSEPR pairs | | | | |
| b. | Electron pair geometry | | | | |
| c. | Shape | | | | |
| d. | Hybridization | | | | |
| e. | Oxidation number | | | | |

(D) Explain the following observations using intermolecular forces among them.

(i) When $I_2$ dissolves in KI a brown clour solution is obtained.

.....

.....

.....

.....

.....

.....

(ii) When $Cl_2$ reacts with $H_2O$ a mixture of HCl and HOCl is obtained.

.....

.....

.....

.....

.....

.....

(02) (A) A and B are nontransitional metals in the same period in the periodic table. **Enu**

- Hydroxide of A is used as a raw material in the production of soap.
- Hydroxide of B is a component of antacid tablet.
- Hydroxide of B shows acidic properties as well as alkaline properties.

(Answer using chemical symbols of atoms)

(i) Identify the elements A and B.

A .....

B .....

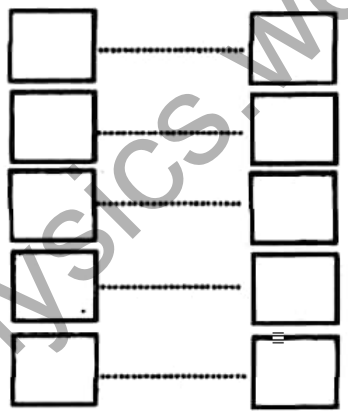
(ii) Write the electronic configurations of A and B in $1s^2$ , $2s^2$ ..... order.

A .....

B .....

(iii) Compare the following properties of A and B. Use the symbols " < " or " > "

- Atomic radius
- Density
- Reactivity
- Electronegativity
- Highest oxidation state



(iv) Write the balanced equation for the formation of the major product when A and B burnt in air.

A .....

.....

B .....

.....

(v) Chloride of B exist as a dimer in gaseous state. Write the formula of it and draw the structure.

(vi) Reaction of the aqueous solution of hydroxide of A with B is an oxidation reduction reaction. Write the half ionic equations below.

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Oxidation .....

Reduction .....

(vii) Special liquids are used to store A. Mention such suitable liquid for A and give 2 reasons for its suitability on this work.

Liquid .....

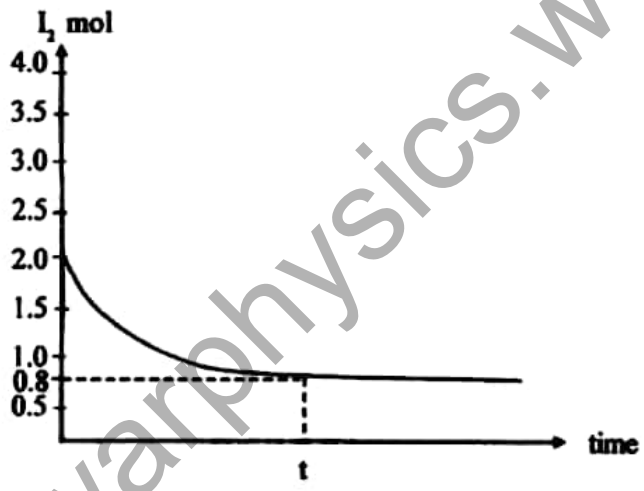
Reason .....

.....

(viii) When the hydroxide of A and Nitrate of A heated with B. reaction completed by the evolution of a gas. Write the balanced equation for this reaction.

.....

(03) (A) 2 mol from each of $H_2(g)$ and $I_2(g)$ were introduced into a closed vessel of 1 $dm^3$ volume under 77 °C and allowed to equilibrate. Variation of amount (mol) of $I_2(g)$ with time is given in the graph below.




(i) Write the balanced chemical equation for the above reaction.

.....

.....

(ii) Calculate the reacted amounts (mol) of $H_2$ and $I_2$.

.....

.....

(iii) What is the amount (mol) of HI produced at the equilibrium ?

.....

.....

(iv) Represent graphically the formation of HI produced with time in the above graph. Name the curve.

(v) Calculate Kc for this equilibrium.

(vi) State the relationship between Kp and Kc for the above equilibrium and calculate Kp.

(vii) Rate constant at the begining for the forward reaction is 0.1 $mol^{-1} dm^3 s^{-1}$. Calculate the initial rate for the forward reaction.

(viii) What are the rates of forward reaction and reverse reaction at equilibrium ?

(ix) What is the rate constant for the reverse reaction at 77 °C ?

(x) Write rate expressions for the forward and reverse reactions and show that $Kc = \frac{K_F}{K_B}$

(xi) Show that $Kc = \frac{K_F}{K_B}$ using the obtained informations above

(04) (A) (i) A , B , C , D and E are monosubstituted benzene compounds with formula $C_9H_{13}N$.

- All these compounds release $N_2$ (g) when reacted with $NaNO_2$ and dil. HCl.
- Out of these compounds A , C and E are optically active.
- A , C and E when reacted with $NaNO_2$ and dil. HCl produce F , G and H.
- G gives a quick trubidity with anhydrous $ZnCl_2$ and conc. HCl. F and G give a turbidity later.
- Identify the structures of A , C , E , F , G and H.

| | | |
|---|---|---|
| A | C | E |
| F | G | H |

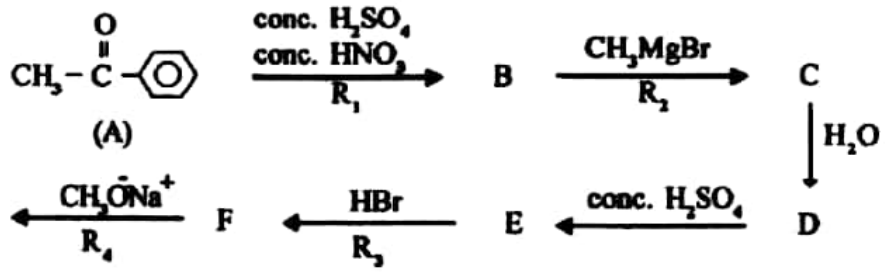
(ii) Products of B and D with $NaNO_2$ and dil. HCl are I and J. J decolourize acidified $KMnO_4$. Identify the structures of B , D and I , J.

| | |
|---|---|
| B | D |
| I | J |

(iii) J is reacted with PCC followed by the reaction with 2 , 4 - D.N.P. Write the structure of the final product and state its colour.

colour .....

(B) Consider the following reaction shceme of Acetophenone/ phenylethanone.




(i) Draw the structures from B to G.

| | | |
|---|---|---|
| B | C | D |
| E | F | G |

(ii) Complete the following table considering reactions from $R_1$ to $R_4$.

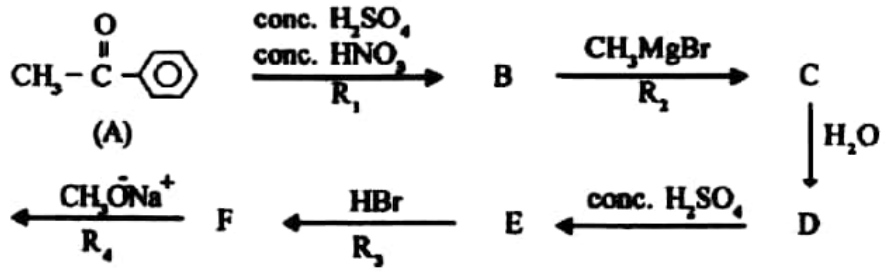
| Reaction | Type of the mechanism | Active species |
|---|---|---|
| $R_1$ | | |
| $R_2$ | | |
| $R_3$ | | |
| $R_4$ | | |

(C) (i) Write the major product of the reaction between  – $CH_2$ – OH and HBr.

.....

(ii) Present a suitable mechanism for the above reaction.

(B) Consider the following reaction shceme of Acetophenone/ phenylethanone.




(i) Draw the structures from B to G.

| | | |
|---|---|---|
| B | C | D |
| E | F | G |

(ii) Complete the following table considering reactions from $R_1$ to $R_4$.

| Reaction | Type of the mechanism | Active species |
|---|---|---|
| $R_1$ | | |
| $R_2$ | | |
| $R_3$ | | |
| $R_4$ | | |

(C) (i) Write the major product of the reaction between  – $CH_2$ – OH and HBr.

.....

(ii) Present a suitable mechanism for the above reaction.

# Rathnavali Balika Vidyalaya - Gampaha

## General Certificate of (Adv. Level) Examination - 2020

## Evaluation Test

## Chemistry II

### Grade 13

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## Part B - Essay

★ **Answer two questions only.**

(05) (a) (i) Define the standard Lattice enthalpy.

(ii) Several thermochemical information are given below.

- Standard enthalpy of formation of Ba (g) = 180 kJ mol$^{-1}$
- Standard enthalpy of atomization of $I_2$ (s) = 106 kJ mol$^{-1}$
- Sum of first and second inoization energies of Ba (g) = 1145 kJ mol$^{-1}$
- Standard enthalpy of hydration of $Ba^{2+}$ (g) = - 1309 kJ mol$^{-1}$
- Standard enthalpy of hydration of $I^-$ (g) = - 308 kJ mol$^{-1}$
- Standard enthalpy of first electron gain of I (g) = - 295 kJ mol$^{-1}$
- Standard enthalpy of dissolution of $BaI_2$ (s) = + 252 kJ mol$^{-1}$

(1) Write equations for each of the above information.

(2) Use above information to calculate the standard enthalpy of formation of $BaI_2$ (s)

(iii) Standard enthalpy of dissolution of $Ba(OH)_2$ (s) is - 28 kJ mol$^{-1}$.
Enthalpy associated with the formation of 1 mol of $H_2O$ (*l*) by the reaction between a strong and a strong base is - 57 kJ mol$^{-1}$.
Standard enthalpy associated in precipitating $BaSO_4$ (s) is - 18 kJ mol$^{-1}$.
What is the temperature change that takes place when 17.1 g of $Ba(OH)_2$ (s) is dissolved in 500.00 cm$^3$ of 1 mol dm$^{-3}$ $H_2SO_4$ (s) solution ?

(b) (i) Molar solubility of $BaCO_3$ (s) in water at 25 °C is 1.97 ppm. What is the Ksp value of $BaCO_3$ (s) (1 ppm = 1 mg dm$^{-3}$) ?

(ii) Ksp of $CaCO_3$ (s) is 1 x 10$^{-8}$ mol$^2$ dm$^{-6}$
0.5 mol of $Na_2CO_3$ is added gradually to 100.00 cm$^3$ solution which contains $Ca^{2+}$ (aq) and $Ba^{2+}$ (aq) in 1 mol dm$^{-3}$ concentration.

(a) Which carbonate precipitates first ?

(b) Once the addtion of 0.5 mol of $Na_2CO_3$ (s) finishes. What concentrations of $Ca^{2+}$, $Ba^{2+}$ and $CO_3^{2-}$ ions present in the solution. (Ba = 137 , C = 12 , O = 16)

(06) (a) Five different instances of a titration between 20 $cm^3$ of 0.1 mol $dm^{-3}$ HA (aq) and 0.1 mol $dm^{-3}$ NaOH are given below. ($Ka_{HA}$ = 1 x $10^{-6}$ mol $dm^{-3}$)

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(A) Initial solution of HA.
(B) Addition of 10 $cm^3$ of NaOH.
(C) Addition of 20 $cm^3$ of NaOH.
(D) Addition of 30 $cm^3$ of NaOH.
(E) Addition of 40 $cm^3$ of NaOH.

(i) Calculate the pH values of the solutions in each situation above.

(ii) Plot the pH of the solution against the burrete reading.


(iii) Indicator M - pH range (4.5 - 6.0)
Indicator N - pH range (8.2 - 10.0)
Select the most suitable indicator for the above titration. Give reasons for your answer.

(iv) Out of the above A, B, C, D and E instance one solution is a buffer.
Identify it and explain the buffer action with the following solutions.
I. addition of water II. addition of an acid III. addition of a base

(b) A volume of 100 $cm^3$ from the above mentioned acid (HA) solution of 0.1 mol $dm^{-3}$ concentration is mixed with 100 $cm^3$ of $CCl_4$ (*l*) and allowed to seperate the layers. Distribution coefficient of HA acid between water and $CCl_4$ is 9. Calculate the pH value of aqueous layer.

(c) Three 100 $cm^3$ samples of A (*l*) is taken seperately and mixed with 100 $cm^3$ pure B (*l*), C (*l*) and D (*l*) seperately in a graduated closed vessel.
Final volumes of the solutions were measured.

A - B solution 203.05 $cm^3$
A - C solution 200.00 $cm^3$
A - D solution 198.35 $cm^3$

(i) Mention seperately about each solution whether it is an ideal solution or deviated form of Rault's law. (Mention the deviation clearly).

(ii) Draw vapour pressure - composition diagrams for the mixtures A - B, A - C and A - D.

(iii) Mention the temperature changes taken place on each solution during mixing. (increase decrease or constant)

(iv) M and N form an ideal binary mixture of room temperature.
Saturated vapour pressure of liquid M at room temperature is 2 x $10^4$ Pa.
Saturated vapour pressure of liquid N at room temperature is 1.6 x $10^4$ Pa.
A mixture of MN containing, 0.2 mol of M and 0.4 mol of N was subjected to fractional distillation.
What is the mole fraction of N in the distillate of this process?

(07) (a) (I) A and B are two aqueous nitrates of the element X which belongs to 3 d series. A is light green colour and with time it converts into the colour of B.

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(i) Identify the element X.

(ii) Write the chemical formulae of A and B.

(iii) State the oxidation states of X in A and B.

Mention the electronic configurations of X in each of A and B.

| Compound | Oxidation state of X | Electronic configuration |
|---|---|---|
| A | | |
| B | | |

(iv) Write a balanced equation to show the conversion of the colour of A to that of B.

(II) A , B , C and D are four compounds of molecular formula $CrH_{12}O_6Cl_3$ .Geometry around Cr and oxidation state of it in each compound are the same. One mole of each compound is tested as below.

- addtion of acidified $AgNO_3$.

Observation :- A , B , C and D precipitated according to the following ratio 3 : 2 : 1 : 0

(i) Deduce the molecular formulae of A , B , C and D.

(ii) Write IUPAC name of A , B , C and D.

(iii) State the colours of A and D.

(iv) Draw A and D showing the geometry of coordination sphere.

(v) Present the chemical formula of a complex ion formed by the above central metal cation with $^-O-CH_2-CH_2-O^-$ having the same geometry. Draw the structure.

(b) (i) Explain the meaning of the following expression $E^\theta\ Zn^{2+}/Zn = -0.76$ V.

(ii) $E^\theta\ Cu^{2+}/Cu = +0.34$ V.

You are provided with the following items.

- aqueous solution of $ZnCl_2$ (aq) and $CuSO_4$ (aq) .
- Zn and Cu metal rods.
- A salt bridge with $NH_4NO_3$ (s) in it.
- A voltmeter.
- Conducting wires.

(a) Draw an electrochemical cell prepared using above items. Name the parts of it.

(b) Identify the cathode and anode reactions.

(c) Write the IUPAC notation of the cell.

(d) Calculate the e.m.f. of the cell.

(e) Identify two functions of the salt brdige.

(f) Identify the directions of mortions of the following ions in the cell.

$Zn^{2+}$, $NH_4^+$ , $NO_3^-$ , $Cu^{2+}$ , $SO_4^{2-}$

(iii) A dry cell of 1.5 V is connected to the left side of voltmetre in the above circuit. ( (-) ve end of dry cell to the Zn electrode and (+) end of it to the Cu electrode)

Write down (1) Cathode reaction.

(2) Anode reaction.

(3) IUPAC notation.

(4) Deduce the voltmeter reading.

(iv) Identify the changes occur in the following when the above dry cell is connected in opposite way.

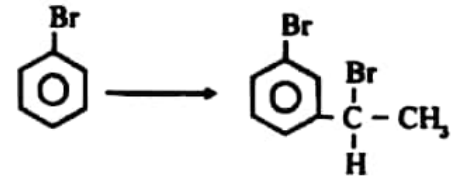
- On Zn rod.
- On Cu rod.
- Voltmeter reading.

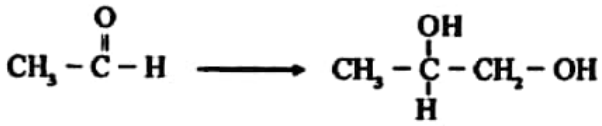
## Part B - Essay

★ **Answer two questions only.**

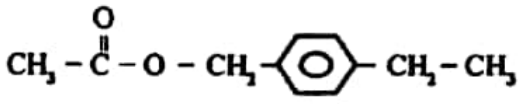
**Enu**

(08) (a) Do the following conversion in not more than 6 steps.

(1) 

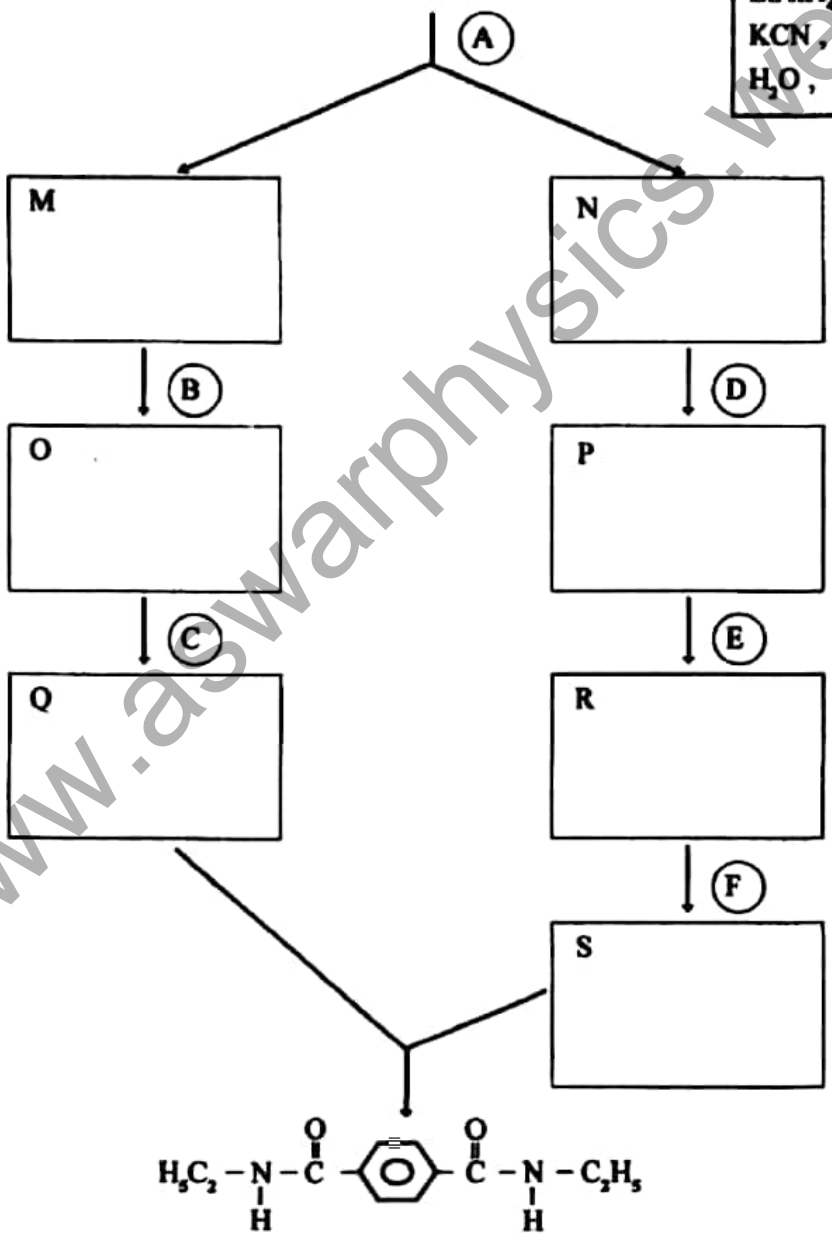
(2) 

(b) Complete the following conversion. Use reagents and compounds given in the list.



**List of reagents and compounds**

$LiAlH_4$ , $C_2H_5OH$ , dil. HCl ,
KCN , dil. NaOH , $NaNH_2$ ,
$H_2O$ , $KMnO_4$ , $PBr_3$

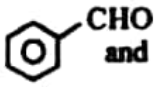


(c) The reaction between grignard reagent and aldehyde is considred as a reaction which increases the number of carbon atoms in a molecule by combining organic compounds with different number of carbon atoms. Enu

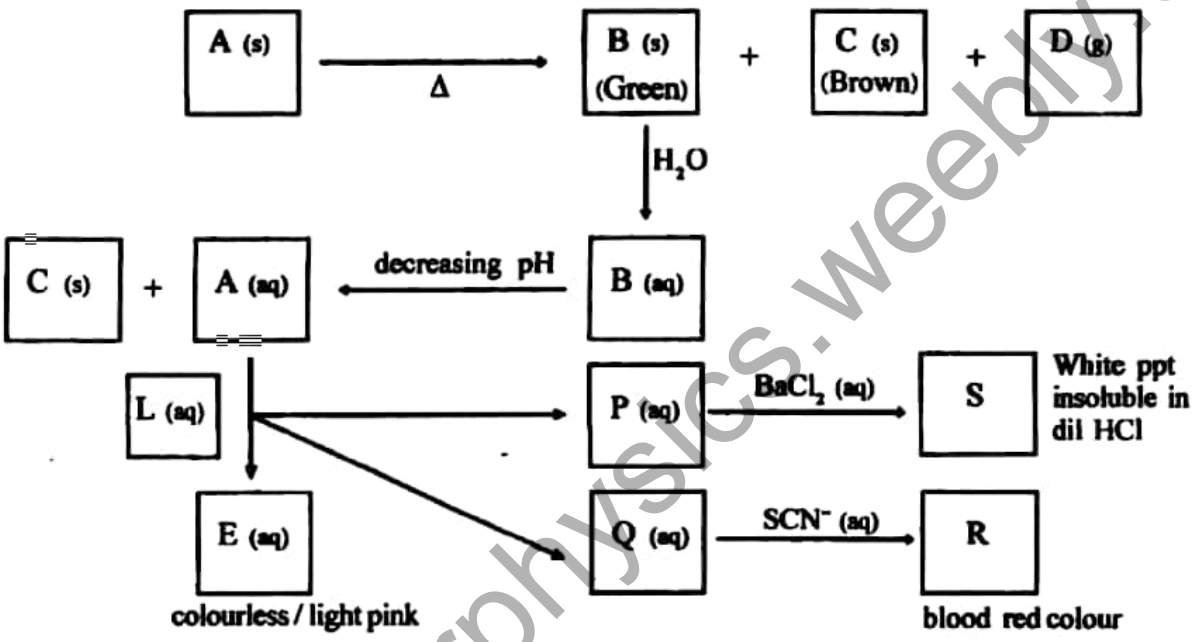
(i) Identify the type of reaction mechanism between the $CH_3 - CHO$ and $CH_3 - MgCl$.

(ii) Write the reaction mechanism of it.

(iii) Compare the rates of the following reaction and explain briefly.

1. Reaction between $CH_3 - CHO$ and $CH_3 - MgCl$
2. Reaction between  and $CH_3 - MgCl$

(09) (a) Consider the following flow chart of several reactions of a transition element.




(i) Identify the chemical species denoted by A, B, C, D and E.

(ii) Write balanced chemical equation for thermal decomposition of A.

(iii) Identify the following reaction type.

$$B \xrightarrow{\text{decreasing pH}} A + C$$

(iv) Identify the chemical species denoted by P, Q, R and S.

(iv) Write balanced chemical equation for the reaction between P and A in acidic medium.

(v) Consider the reaction between Q and $SCN^-$.

(a) Draw the coordination sphere of R with maximum $SCN^-$ ions, showing the proper shape.

(b) What is the shape of R.

(c) Write IUPAC name of R.

(b) When Na is heat in air, $Na_2O$ and $Na_2O_2$ are produced. A mass of 2.3 g of Na is heated in air. The solid residue is dissolved in excess dil $H_2SO_4$. Then the solution is diluted upto 250 $cm^3$. A volume of 25.0 $cm^3$ is pipetted out in to a titration flask and 1 g of KI is added. The solution thus obtained is titrated with 0.12 mol $dm^{-3}$ $Na_2S_2O_3$ solution. Burrette reading at the end point is 6.0 $cm^3$.

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(i) Write equation for the combustion of Na in air.
(ii) Write equations for the dissolution of solid residue in dil. $H_2SO_4$.
(iii) Write equations for the reactions occur when KI is added to the solution.
(iv) Write equation for the reaction occur during titration with $Na_2S_2O_3$.
(v) Calculate the mass percentage of $Na_2O$ and $Na_2O_2$ produced in combustion.
( Na = 23 , O = 16 )

(10) (a) Answer the following questions regarding the production of soap.
(i) What are the raw materials for the production of soap ?
(ii) Write a balanced equation to show the usage of above chemical compounds in the production of soap.
(iii) There are two processes in the production of soap as hot process and cold process.
(I) State the main steps in hot process. (no need to explain)
(II) What is the chemical compound which produces along with soap in cold process ?
(iv) What is the special chemical compound used in the production of baby soap ?
(v) What is meant by the TFM value of soap ? What is the TFM value of a cake of washing soap ?
(vi) Explain why soap is not dissolving and not lathering in hard water.
(vii) Explain briefly the cleaning action of soap.

(b) Following questions are based on Chloride process of production of $TiO_2$.
(i) What are the raw materials used in the production of $TiO_2$ ?
(ii) State the steps in this process.
Write balanced chemical equations for each steps.
(iii) What is the chemical compound which undergoes recycling in this process ?
(iv) What is the gas evolved in this process, which is responsible for environmental pollusion ? Mention one environmental effect of this gas ?
(v) State two uses of $TiO_2$.

(c) (i) State two properties of a gas which act as a green house gas.

(ii) Identify one chemical species from each of the following industries , which contribute to green house effect.
(I) Extraction of Mg by dow process.
(II) Agriculture
(III) Animal husbandry
(IV) Extraction of iron.

(iii) $SO_2$, $NO_2$ , NO and CO are not considered as green house gases. Give reasons for this.

(iv) Halagenated hydrocarbons synthesized by human contribute greately on green house effect.

(I) Give three examples for halagenated hydrocarbons.

(II) Explain why halagenated hydrocarbons have great effect on gobal warming , although they exist in small amounts in the environment.

(v) Water vapour is a green house gas. What is the reason for water vapour not contribute on global warming ?

(vi) Mention one step for each of the following human activities , that can be taken to reduce the evolution of green house gases from these activities.

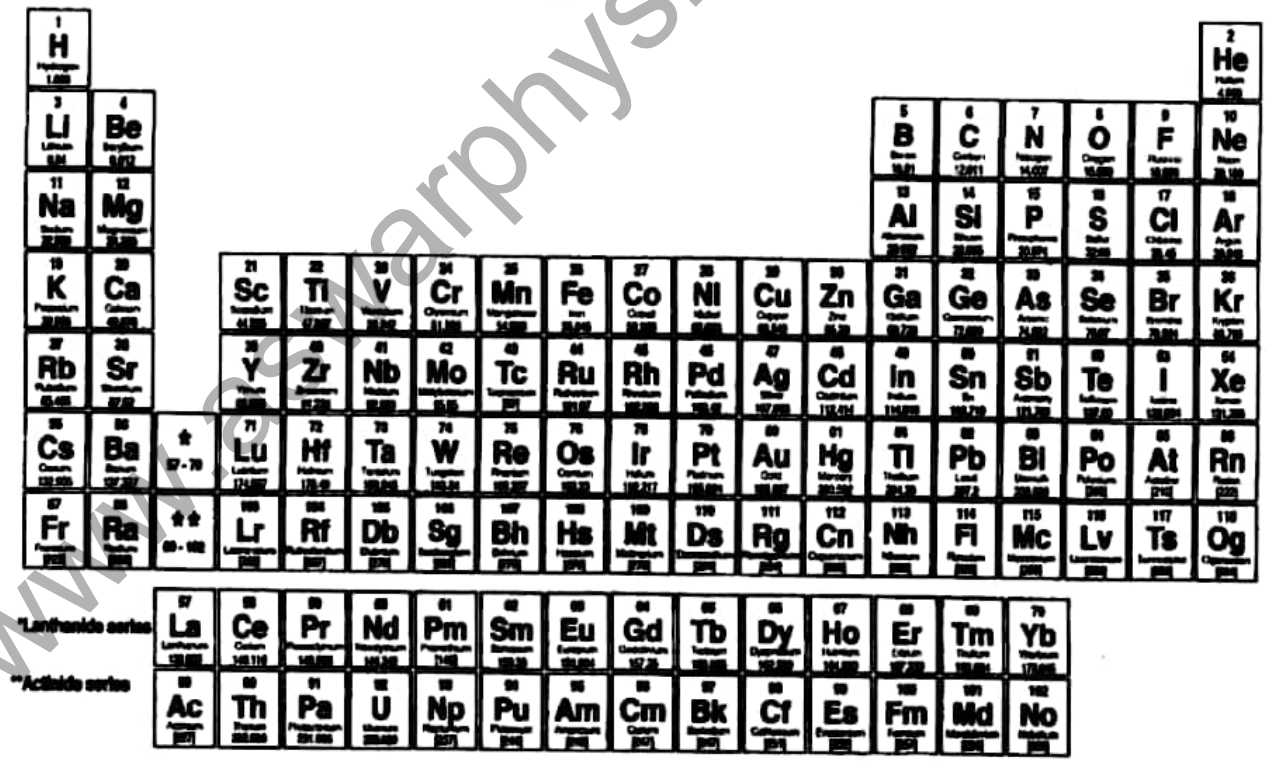
(I) $CO_2$ evolved in fossi fuel combution.

(II) $N_2O$ evolved in fertilizers.

(III) Halagenated hydrocarbons in refrigerators and air conditioners.

(iv) Mention two global climatic changes due to the global warming.

## Periodic Table



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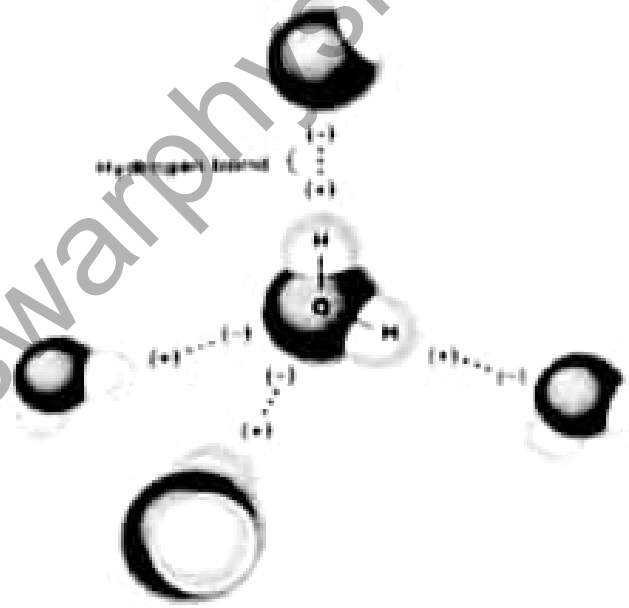
# Chemistry

## Grade 13- 2020 A/L

# Marking scheme



GM/Rathnavali Balika Vidyalaya

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## Part A - Structured Essay

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★ **Answer all the questions.**

(01) (A) Consider the compounds given below.

| $H_2S$ , $XeF_4$ , $PCl_3$ , $Na_2O$ , $KO_2$ , $BCl_3$ |
|---|

Which out of following,

(i) Exist as a linear molecule — $N_2O$

(ii) Has the same electron pair geometry and shape around the central atom — $BCl_3$

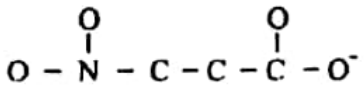
(iii) Isoelectronic with $N_2H_4$ — $H_2S$

(iv) Has a zero dipolemoment — $BCl_3$ , $XeF_4$

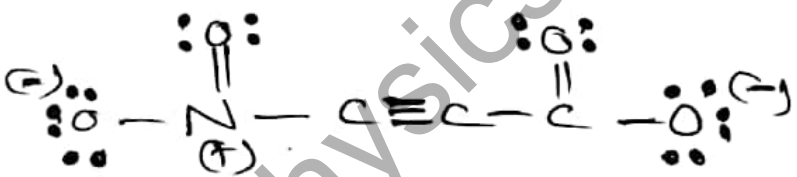
(v) Has orbitals with unpaird electrons — $KO_2$

(6) x5 = 30

(B) (i) Skeletal structure of $C_3O_4N^-$ ion is given below.



Draw the most stable Lewis dot - dash structure for this molecule.



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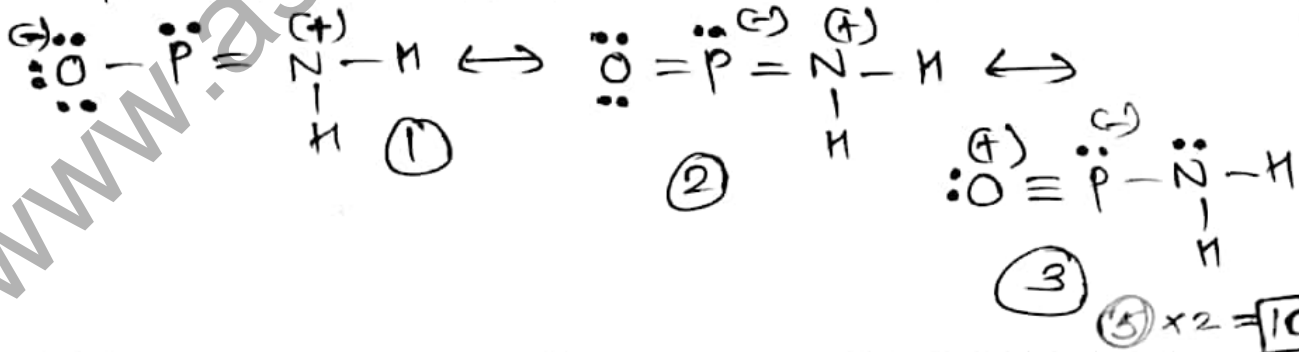
(ii) Lewis dot - dash structure of $H_2PNO$ is given below.

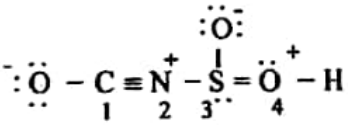
Draw other two Lewis dot - dash structures for this molecule.



(5) x2 = 10

(C) (i) The following structure is an unstable resonance structure for a neutral molecule.

Draw the stable Lewis dot - dash structure for the molecule.



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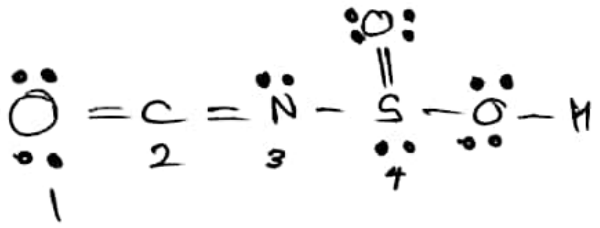


4

(ii) Fill the following table considering above stable molecule.

| | Atom | $C_1$ | $N_2$ | $S_3$ | $O_4$ |
|---|---|---|---|---|---|
| a. | VSEPR pairs | 2 | 3 | 4 | 4 |
| b. | Electron pair geometry | Linear | Trigonal planar | Tetrahe -dral | Tetrah -edral |
| c. | Shape | Linear | Angular | Pyramida | Angular |
| d. | Hybridization | sp | $sp^2$ | $sp^3$ | $sp^3$ |
| e. | Oxidation number | +4 | -3 | +4 | -2 |

16

(D) Explain the following observations using intermolecular forces among them.

(i) When $I_2$ dissolves in KI a brown clour solution is obtained.

$KI + I_2 \rightarrow KI_3$ ✓

KI dissolves in water and form $K^+$ and $I^-$. ✓
$I_2$ is a non-polar and covalent molecule ✓
$I_2$ forms an induced dipole. ✓
$I_3^-$ is formed between $I^-$ ions and (+)ve pole of induced dipole. ✓

(2) ×5 = 10

(ii) When $Cl_2$ reacts with $H_2O$ a mixture of HCl and HOCl is obtained.

$H_2O(l) + Cl_2 \longrightarrow HCl + HOCl$ ✓

$H_2O$ is a permanent dipole. $Cl_2$ is non-polar and forms induced dipole. HCl is formed ✓✓ between $H^+$ of $H_2O$ and (-)ve terminal of ✓ induced dipole of $Cl_2$. HOCl is formed ✓ when attractions occur between $OH^-$ of $H_2O$ and (+)ve terminal of induced dipole of $Cl_2$.

(2) ×5 = 10

(02) (A) A and B are nontransitional metals in the same period in the periodic table. Enu

- Hydroxide of A is used as a raw material in the production of soap.
- Hydroxide of B is a component of antacid tablet.
- Hydroxide of B shows acidic properties as well as alkaline properties.

(Answer using chemical symbols of atoms)

(i) Identify the elements A and B.

A Na / sodium [5]

B Al / Aluminium . [5]

(ii) Write the electronic configurations of A and B in $1s^2$, $2s^2$ ..... order.

A $1s^2\ 2s^2\ 2p^6\ 3s^1$ [5]

B $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$ [5]

(iii) Compare the following properties of A and B. Use the symbols "<" or ">"

- Atomic radius
- Density
- Reactivity
- Electronegativity
- Highest oxidation state

A > B
A < B
A > B
A < B
A < B

(5) x 5 = 25

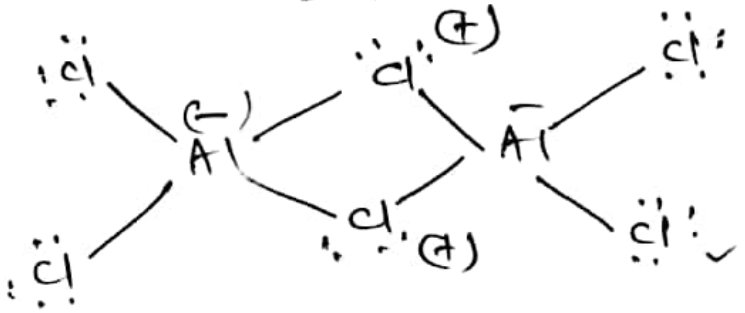
(iv) Write the balanced equation for the formation of the major product when A and B burnt in air.

A $2Na + O_2 \longrightarrow Na_2O_2$ [5]

B $4Al + 3O_2 \longrightarrow 2Al_2O_3$ [5]

(v) Chloride of B exist as a dimer in gaseous state. Write the formula of it and draw the structure.

$Al_2Cl_6$ ✓ [5]




[5]

(vi) Reaction of the aqueous solution of hydroxide of A with B is an oxidation reduction reaction. Write the half ionic equations below.

Enu

Oxidation $4OH^- + Al \longrightarrow AlO_2^- + 3e + 2H_2O$ 05

Reduction $2H_2O + 2e \longrightarrow H_2 + 2OH^-$ 05

(vii) Special liquids are used to store A. Mention such suitable liquid for A and give 2 reasons for its suitability on this work.

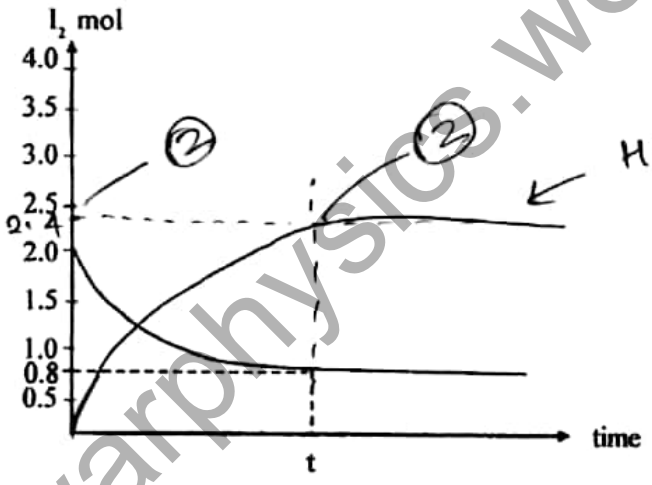
Liquid Paraffin / kerosene 05

Reason Na is very reactive, so it can react with water vapour and $O_2$. Density of Na is high than paraffin, so avoid contact with $O_2$ and $H_2O_{(g)}$

(viii) When the hydroxide of A and Nitrate of A heated with B. reaction completed by the evolution of a gas. Write the balanced equation for this reaction.

$5NaOH + 3NaNO_3 + 8Al + 18H_2O \longrightarrow 8Na[Al(OH)_4] +$

(03) (A) 2 mol from each of $H_2(g)$ and $I_2(g)$ were introduced into a closed vessel of 1 $dm^3$ volume under 77 °C and allowed to equilibrate. Variation of amount (mol) of $I_2(g)$ with time is given in the graph below.




6

(i) Write the balanced chemical equation for the above reaction.

$H_{2(g)} + I_{2(g)} \longrightarrow 2HI_{(g)}$ 5

(ii) Calculate the reacted amounts (mol) of $H_2$ and $I_2$.

1.2 mol 5

(iii) What is the amount (mol) of HI produced at the equilibrium ?

2.4 mol 5

(iv) Represent graphically the formation of HI produced with time in the above graph. Name the curve.

Enu

(v) Calculate Kc for this equilibrium.

$K_c = \frac{[HI(g)]^2}{[H_2(g)][I_2(g)]} = \frac{[2.4\ M]^2}{[0.8\ M]^2} = \frac{2.4 \times 2.4}{0.8 \times 0.8} = 9$

kc expression — 05 Answer — 05

substitution — 05 15

(vi) State the relationship between Kp and Kc for the above equilibrium and calculate Kp.

$K_p = K_c(RT)^{\Delta n}$ $\Delta n = 0$

$\therefore K_p = 9.$

expression — 05

$\Delta n$ value — 05

Answer — 05 15

(vii) Rate constant at the begining for the forward reaction is 0.1 $mol^{-1} dm^3 s^{-1}$. Calculate the initial rate for the forward reaction.

expression — 05

substitution — 05

Answer — 05

$R_{ini} = K_F[H_2(g)][I_2(g)]$

$= 0.1\ M^{-1}S^{-1} \times 2.4 \times 2\ M = 0.4\ MS^{-1}$ 15

(viii) What are the rates of forward reaction and reverse reaction at equilibrium ?

At equilibrium $\rightarrow R_F = R_B$ 05

$R_F = 0.1\ M^{-1}S^{-1} \times 0.8 \times 0.8\ M^2 = 0.064\ MS^{-1}$ 05 05 15

$= R_B$

(ix) What is the rate constant for the reverse reaction at 77 °C ?

$R_B = K_B[HI(g)]^2$ — 05

$K_B = \frac{0.064\ MS^{-1}}{(2.4\ M)^2} = 0.011\ M^{-1}S^{-1}$ 05 10

(x) Write rate expressions for the forward and reverse reactions and show that $K_c = \frac{K_F}{K_B}$

$R_F = K_f[H_2(g)][I_2(g)]$ — (1)

$R_B = K_B[HI(g)]^2$ — (2)

(2)/(1) $1 = \frac{[HI]^2}{[H_2(g)][I_2(g)]}$ $= \frac{K_B}{K_F}$

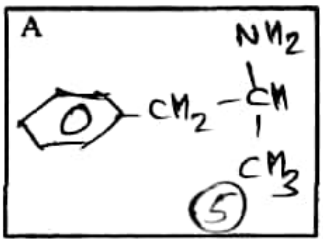
(xi) Show that $K_c = \frac{K_F}{K_B}$ using the obtained informations above

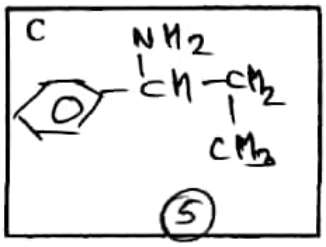
$\therefore \frac{K_F}{K_B} = K_c$ 05

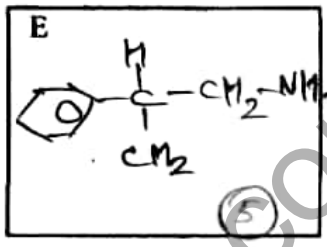
$\frac{K_F}{K_B} = \frac{0.1\ MS^{-1}}{0.011\ MS^{-1}} = 9$ 04

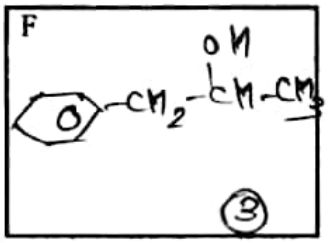
(04) (A) (i) A , B , C , D and E are monosubstituted benzene compounds with formula $C_9H_{13}N$.

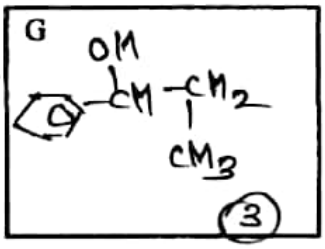
- All these compounds release $N_2$ (g) when reacted with $NaNO_2$ and dil. HCl.
- Out of these compounds A , C and E are optically active.
- A , C and E when reacted with $NaNO_2$ and dil. HCl produce F , G and H.
- G gives a quick trubidity with anhydrous $ZnCl_2$ and conc. HCl. F and G give a turbidity later.
- Identify the structures of A , C , E , F , G and H.

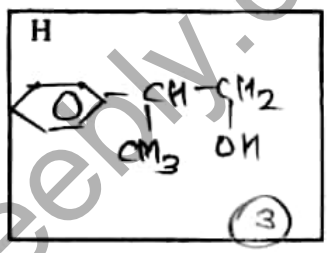
A  (5)

C  (5)

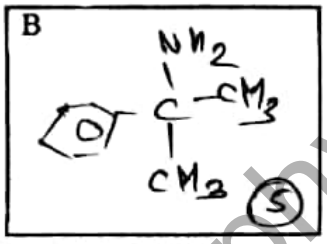
E  (5)

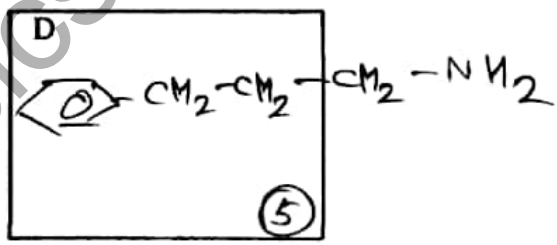
F  (3)

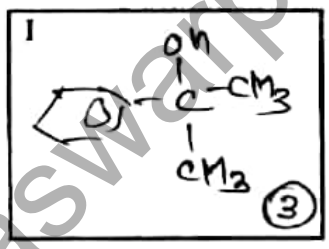
G  (3)

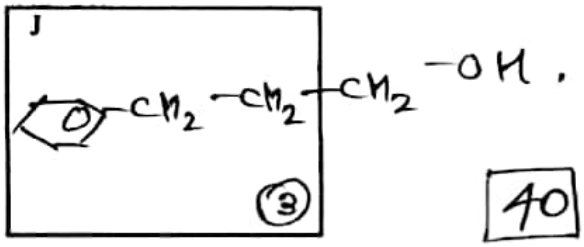
H  (3)

(ii) Products of B and D with $NaNO_2$ and dil. HCl are I and J. J decolourize acidified $KMnO_4$. Identify the structures of B , D and I , J.

B  (5)

D  (5)

I  (3)

J  (3)

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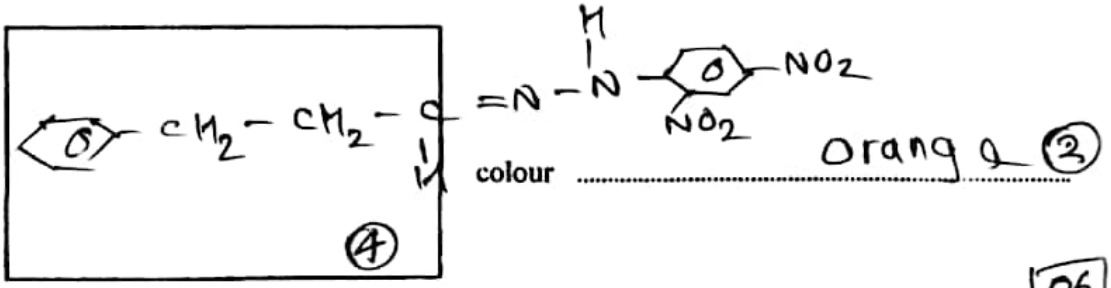
(iii) J is reacted with PCC followed by the reaction with 2 , 4 - D.N.P. Write the structure of the final product and state its colour.

 (4)

colour ..... orange (2)

06

(B) Consider the following reaction shceme of Acetophenone/ phenylethanone.

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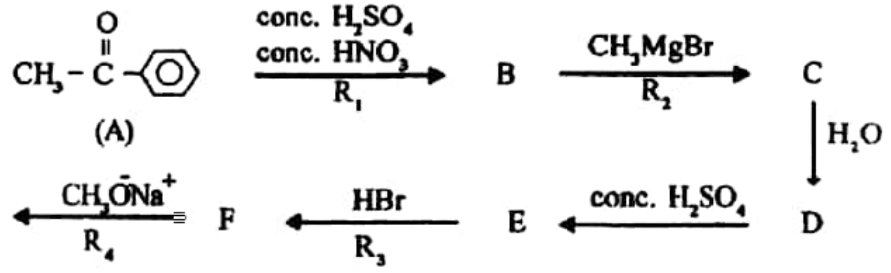
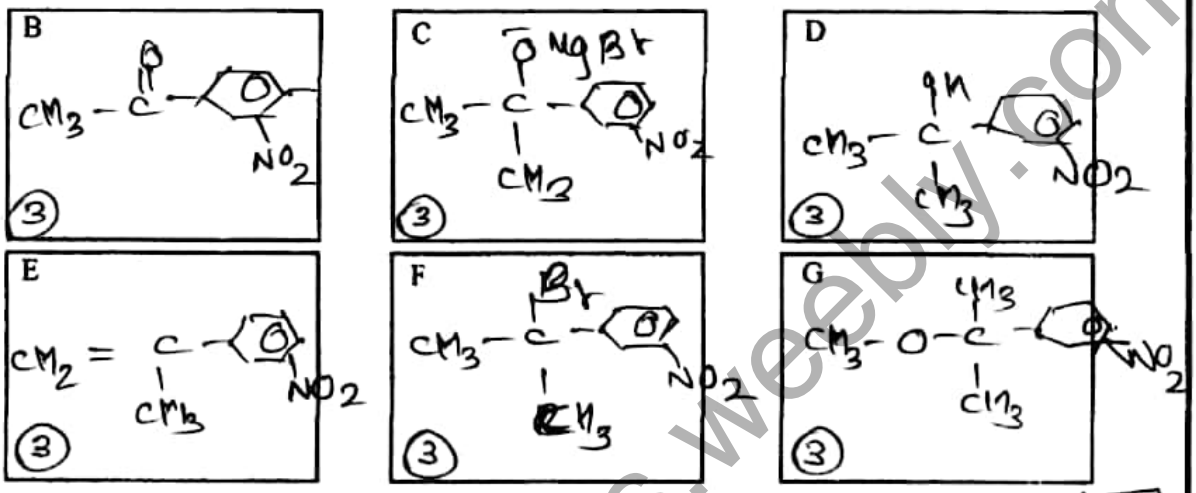



(i) Draw the structures from B to G.




18

(ii) Complete the following table considering reactions from $R_1$ to $R_4$.

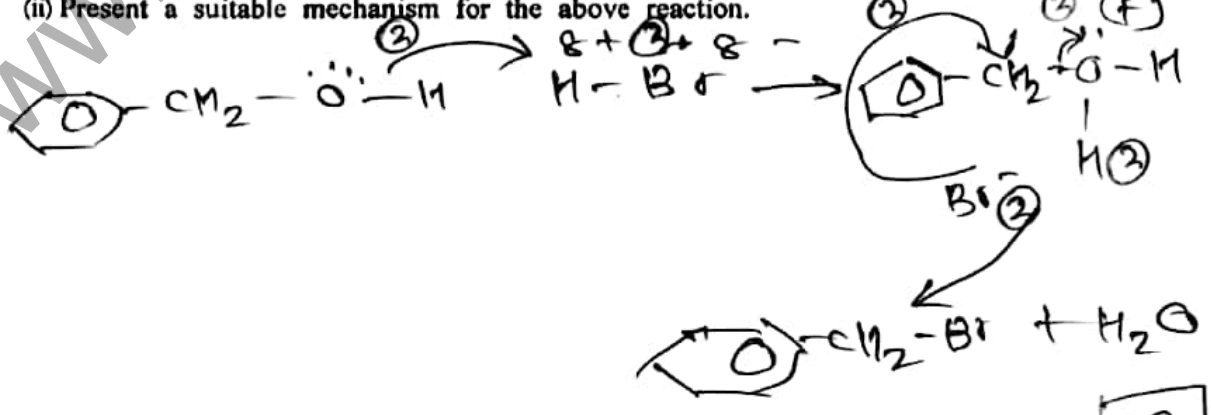
| Reaction | Type of the mechanism | Active species | |
|---|---|---|---|
| $R_1$ | Electr. substn. | $NO_2^+$ | 2+3 |
| $R_2$ | Nucleo. Addi. | $CH_3^-$ | 2+3 |
| $R_3$ | Electr. addn | $H^+$ | 2+3 |
| $R_4$ | nucleop. substn | $CH_3O^-$ | 2+3 |

20

(C) (i) Write the major product of the reaction between $C_6H_5-CH_2-OH$ and HBr.

$C_6H_5-CH_2-Br$. (4) 04

(ii) Present a suitable mechanism for the above reaction.

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# Chemistry

## Grade 13- 2020 A/L

# Marking scheme


GM/Rathnavali Balika Vidyalaya

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## Part A - Structured Essay

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★ **Answer all the questions.**

(01) (A) Consider the compounds given below.

| $H_2S$ , $XeF_4$ , $PCl_3$ , $Na_2O$ , $KO_2$ , $BCl_3$ |
|---|

Which out of following,

(i) Exist as a linear molecule — $N_2O$

(ii) Has the same electron pair geometry and shape around the central atom — $BCl_3$

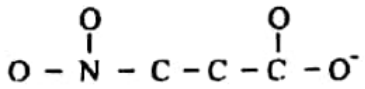
(iii) Isoelectronic with $N_2H_4$ — $H_2S$

(iv) Has a zero dipolemoment — $BCl_3$ , $XeF_4$

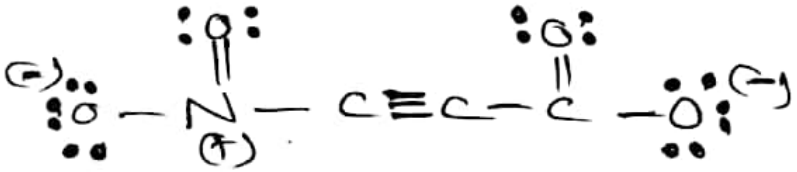
(v) Has orbitals with unpaird electrons — $KO_2$ .

(6) x5 = 30

(B) (i) Skeletal structure of $C_3O_4N^-$ ion is given below.

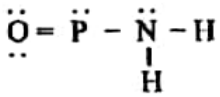


Draw the most stable Lewis dot - dash structure for this molecule.

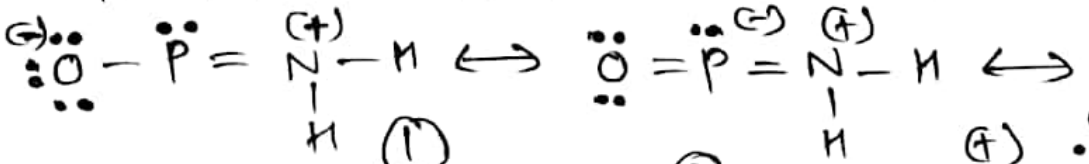


15

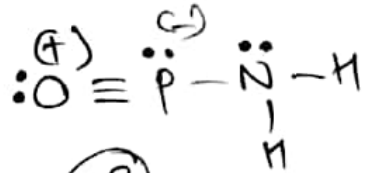
(ii) Lewis dot - dash structure of $H_2PNO$ is given below.



Draw other two Lewis dot - dash structures for this molecule.



(1) (2)

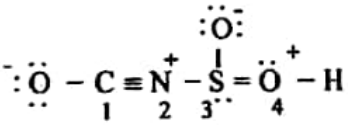


(3)

(5) x2 = 10

(C) (i) The following structure is an unstable resonance structure for a neutral molecule.

Draw the stable Lewis dot - dash structure for the molecule.



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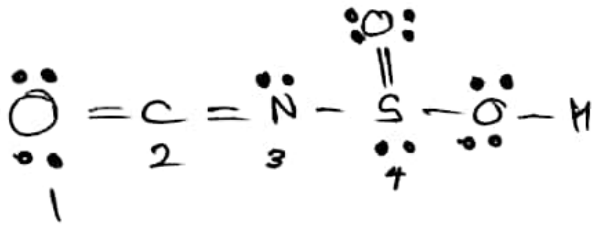

4

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16

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$I_2$ forms an induced dipole. ✓
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(2) ×5 = 10

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$H_2O_{(l)} + Cl_2 \longrightarrow HCl + HOCl$ ✓

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- Density
- Reactivity
- Electronegativity
- Highest oxidation state

| | | |
|---|---|---|
| A | > | B |
| A | < | B |
| A | > | B |
| A | < | B |
| A | < | B |

(5) x 5 = 2.5

(iv) Write the balanced equation for the formation of the major product when A and B burnt in air.

A $2Na + O_2 \longrightarrow Na_2O_2$ [5]

B $4Al + 3O_2 \longrightarrow 2Al_2O_3$ [5]

(v) Chloride of B exist as a dimer in gaseous state. Write the formula of it and draw the structure.

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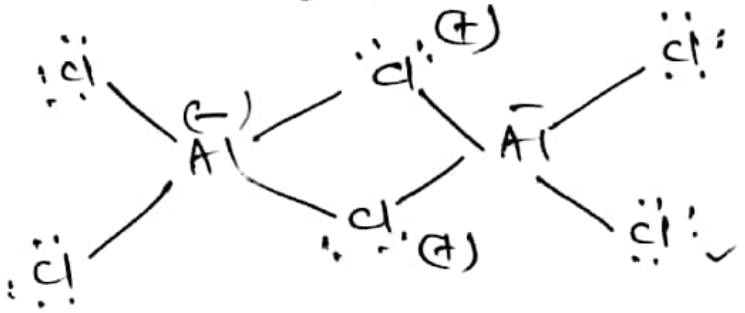


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Enu

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Liquid Paraffin / kerosene 05

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$5NaOH + 3NaNO_3 + 8Al + 18H_2O \longrightarrow 8Na[Al(OH)_4] +$

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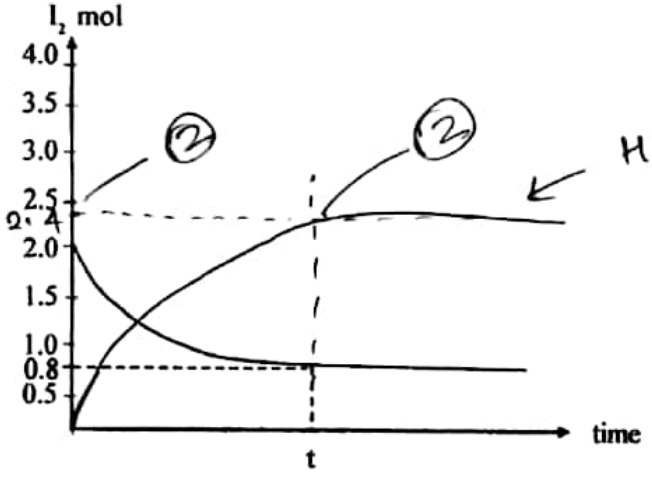


6

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$H_{2(g)} + I_{2(g)} \longrightarrow 2HI_{(g)}$ 5

(ii) Calculate the reacted amounts (mol) of $H_2$ and $I_2$.

1.2 mol 5

(iii) What is the amount (mol) of HI produced at the equilibrium ?

2.4 mol 5

(iv) Represent graphically the formation of HI produced with time in the above graph. Name the curve.

Enu

(v) Calculate Kc for this equilibrium.

$K_c = \frac{[HI_{(g)}]^2}{[H_{2(g)}][I_{2(g)}]} = \frac{[2.4\ M]^2}{[0.8\ M]^2} = \frac{2.4 \times 2.4}{0.8 \times 0.8} = 9$ //

Kc expression — (05) Answer — (05)

substitution — (05) 15

(vi) State the relationship between Kp and Kc for the above equilibrium and calculate Kp.

$K_p = K_c(RT)^{\Delta n}$ $\Delta n = 0$

$\therefore K_p = 9$.

expression — (05)

$\Delta n$ value — (05)

Answer — (05) 15

(vii) Rate constant at the begining for the forward reaction is 0.1 $mol^{-1}\ dm^3\ s^{-1}$. Calculate the initial rate for the forward reaction.

expression — (05)

substitution — (05)

Answer — (05)

$R_{ini} = K_F[H_{2(g)}][I_{2(g)}]$

$= 0.1\ M^{-1}s^{-1} \times 2M \times 2M = 0.4\ Ms^{-1}$ // 15

(viii) What are the rates of forward reaction and reverse reaction at equilibrium ?

At equilibrium $\rightarrow R_F = R_b$ (05)

$R_F = 0.1\ M^{-1}s^{-1} \times 0.8 \times 0.8\ M^2 = 0.064\ Ms^{-1}$ (05) (05) 15

$= R_B$.

(ix) What is the rate constant for the reverse reaction at 77 °C ?

$R_B = K_B[HI_{(g)}]^2$ — (05)

$K_B = \frac{0.064\ Ms^{-1}}{(2.4\ M)^2} = 0.011\ M^{-1}s^{-1}$ (05) 10

(x) Write rate expressions for the forward and reverse reactions and show that $K_c = \frac{K_F}{K_B}$

$R_F = K_f[H_{2(g)}][I_{2(g)}]$ — (1)

$R_B = K_B[HI_{(g)}]^2$ — (2)

(2)/(1) $1 = \frac{[HI]^2}{[H_{2(g)}][I_{2(g)}]} = \frac{K_B}{K_F}$

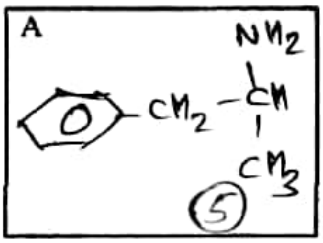
(xi) Show that $K_c = \frac{K_F}{K_B}$ using the obtained informations above

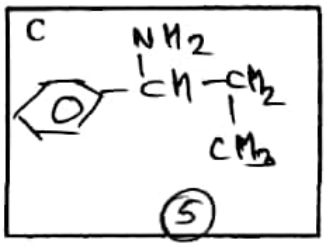
$\therefore \frac{K_F}{K_B} = K_c$ // 05

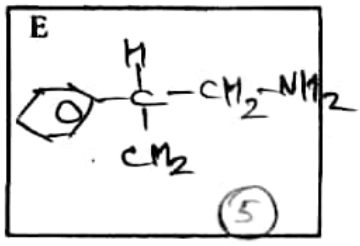
$\frac{K_F}{K_B} = \frac{0.1\ Ms^{-1}}{0.011\ Ms^{-1}} = 9$ // 04

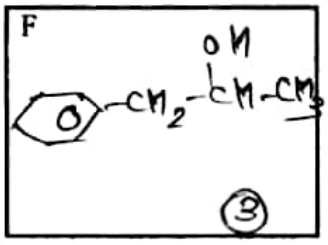
(04) (A) (i) A , B , C , D and E are monosubstituted benzene compounds with formula $C_9H_{13}N$.

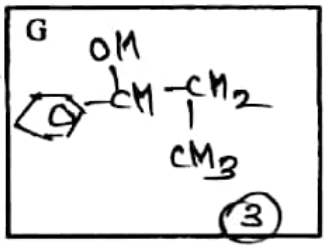
- All these compounds release $N_2$ (g) when reacted with $NaNO_2$ and dil. HCl.
- Out of these compounds A , C and E are optically active.
- A , C and E when reacted with $NaNO_2$ and dil. HCl produce F , G and H.
- G gives a quick trubidity with anhydrous $ZnCl_2$ and conc. HCl. F and G give a turbidity later.
- Identify the structures of A , C , E , F , G and H.

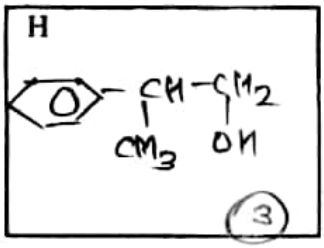
A  (5)

C  (5)

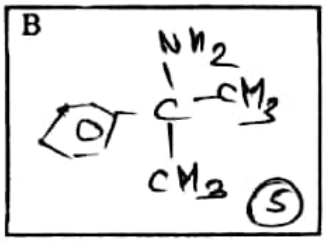
E  (5)

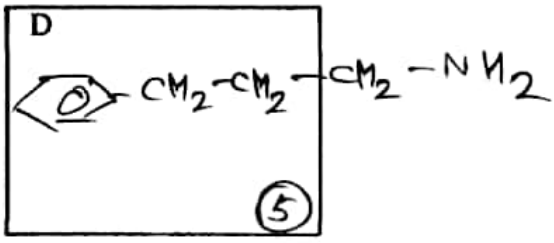
F  (3)

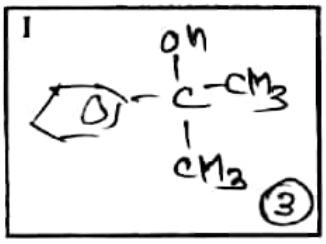
G  (3)

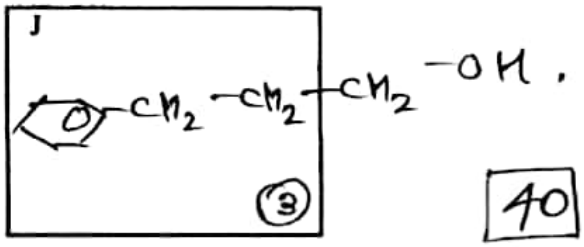
H  (3)

(ii) Products of B and D with $NaNO_2$ and dil. HCl are I and J. J decolourize acidified $KMnO_4$. Identify the structures of B , D and I , J.

B  (5)

D  (5)

I  (3)

J  (3)

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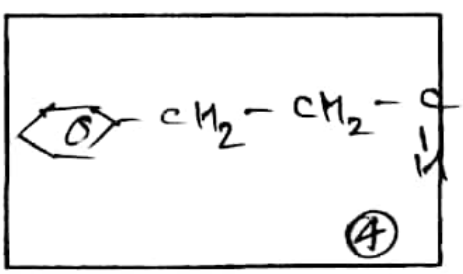
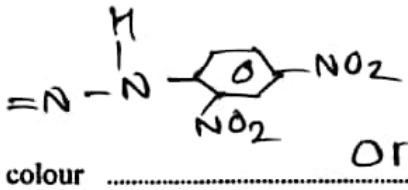
(iii) J is reacted with PCC followed by the reaction with 2 , 4 - D.N.P. Write the structure of the final product and state its colour.

 (4)

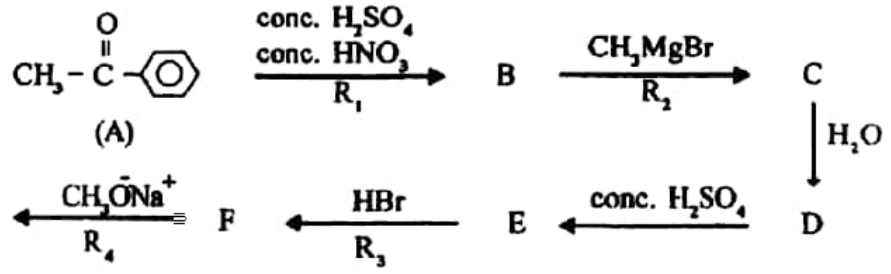


colour ..... orange (2)

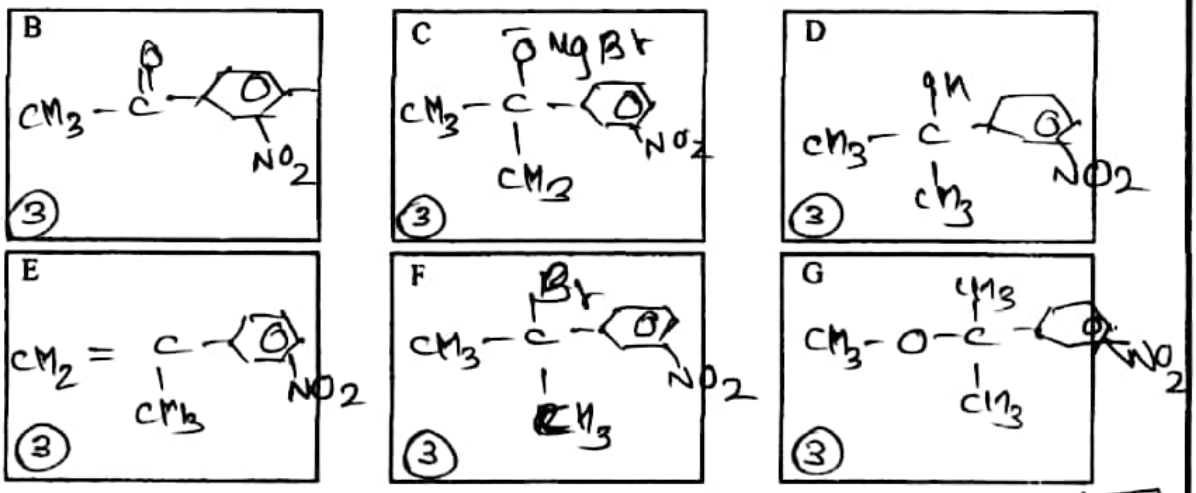
06

(B) Consider the following reaction shceme of Acetophenone/ phenylethanone.

Enu




(i) Draw the structures from B to G.

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(ii) Complete the following table considering reactions from $R_1$ to $R_4$.

| Reaction | Type of the mechanism | Active species | |
|---|---|---|---|
| $R_1$ | Electr. subst N. | $NO_2^+$ | 2+3 |
| $R_2$ | Nucleo. Addi. | $CH_3^-$ | 2+3 |
| $R_3$ | Electr. addit | $H^+$ | 2+3 |
| $R_4$ | nucleop. subst | $CH_3O^-$ | 2+3 |

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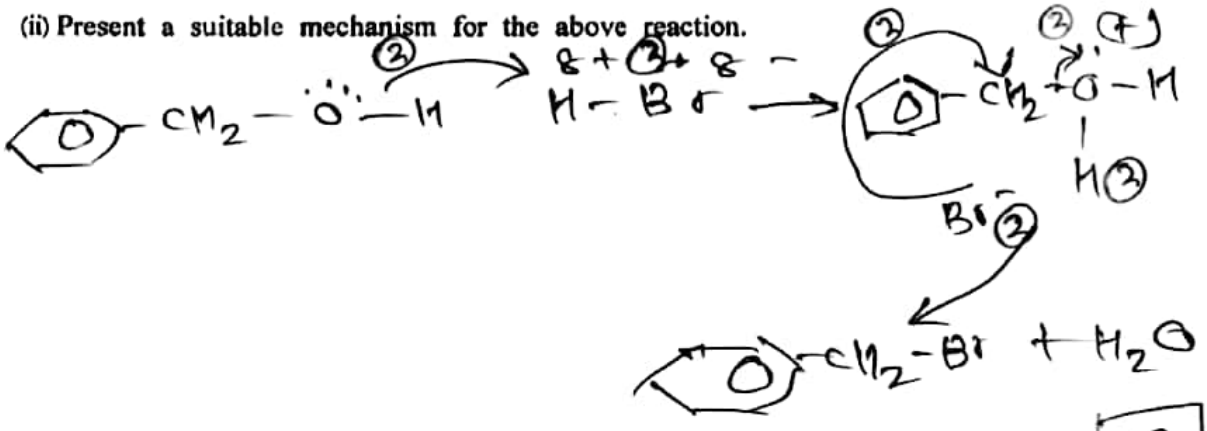
(C) (i) Write the major product of the reaction between  and HBr.



4 04

(ii) Present a suitable mechanism for the above reaction.

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