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DEPARTMENT OF EDUCATION - CENTRAL PROVINCE

G.C.E.(A/L) Year End Test -2021(2022)

| Chemistry - I | 02 | S | I | Grade 12 | Two Hours |

Instructions.

- **Answer all the questions.**

$$R = 8.314 \ JK^{-1} \ mol^{-1}$$
$$N_A = 6.022 \times 10^{23} \ mol^{-1}$$
$$h = 6.626 \times 10^{-34} \ Js$$
$$c = 3 \times 10^8 \ ms^{-1}$$

1. Consider the following statements I, II and III.

   I. The charge of an election is 1.602×10^{-19} C.

   II. Number of positive charges in a nucleus increases by one unit of electron.

   III. The radiation emitted by a metal surface behaves as small packets of energy.

   The scientists who related with the statements I, II and III are respectively,

   (1) Milliken, Einstein, Rutherford

   (2) Milliken, Mosely, Einstein

   (3) Rutherford, Chadwick, Thomson

   (4) Thomson, Mosely, Roentgen

   (5) Goldstein, Rutherford, Plank

2. The number of electrons associated with Ti atom (atomic number - 22) with azimuthal Quantum number $l = 0$ and $l = 1$ are

   (1) 20   (2) 6   (3) 12   (4) 18   (5) 22

3. Which of the following gives the correct decreasing order of the second ionization energy values ?

   (1) $N > F > O > C$ (2) $O > F > C > N$ (3) $Li > B > C > Be$

   (4) $Ne > Na > F > Mg$ (5) $Be > C > B > Li$

4. The gaseous products given by the thermal decomposition of ammonium dichromate are,
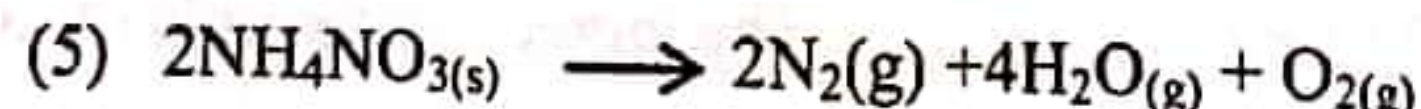
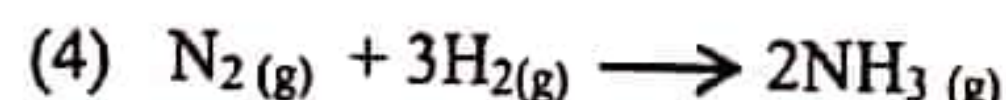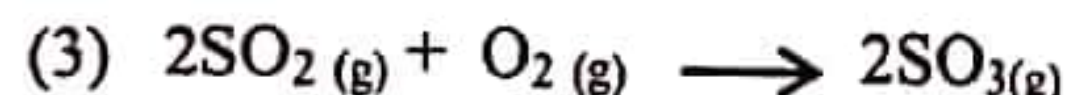   (1) N_2O and H_2O (2) N_2 and H_2O (3) NO_2 and H_2O

   (4) NO and N_2O (5) NO_2 and H_2

5. Which one of the following reactions has a positive (+) entropy change?

   (1) $H_2O_{(g)} \rightarrow H_2O_{(l)}$

   (2) $BF_{3(g)} + NH_{3(g)} \rightarrow F_3BNH_{3(s)}$

   (3) $2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$

   (4) $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

   (5) $2NH_4NO_{3(s)} \rightarrow 2N_{2(g)} + 4H_2O_{(g)} + O_{2(g)}$
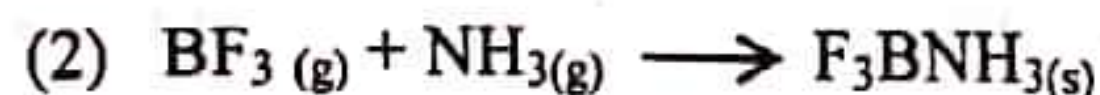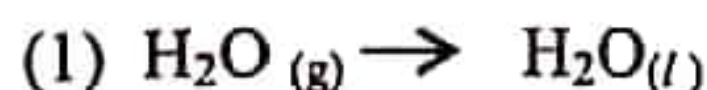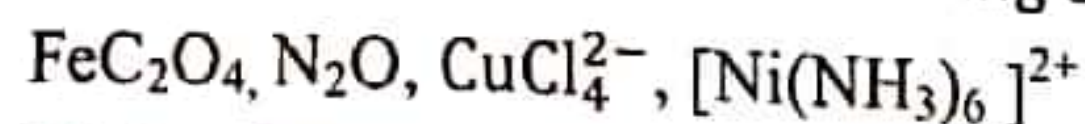
6. Bromine with the relative atomic mass 79.91 consist of two isotopes.

| Isotope	Atomic mass unit/U	Percentage abundance
^{79}Br	78.918	50.54%
^{81}Br	?	?

According to given information what would be the atomic mass of ^{81}Br in amu ?
(1) 80.14   (2)   80.92   (3)   81.23   (4) 81.13   (5) 80.54

7. The IUPAC names of the following compounds / ions are respectively,
FeC_2O_4, N_2O, $CuCl_4^{2-}$, $[Ni(NH_3)_6]^{2+}$

(1) iron(II) oxalate, dinitrogen monoxide, tetrachloridocuprate(II) ion, hexaamminenickel(II) ion

(2) iron(II) oxalate, nitrous oxide, tetrachloridocuprate(II), hexaamminenickel(II) ion

(3) ferrous oxalate, nitrous oxide, tetrachloridocuprate(II). Ion, hexaamminenickel(II)

(4) iron(II) oxalate, dinitrogen monoxide, tetramminecopper (II) ion, hexaamminenickel(II) ion

(5) ferrous oxalate, dinitrogen monoxide, tretrachloridocopper (II) ion, hexaamminenickel(II) ion

8.

22 A/L �ñ [papers grp]
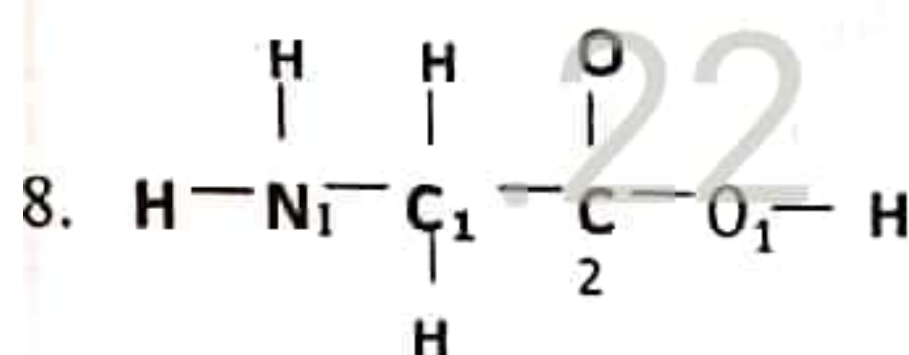
Which one gives the correct hybridization and shape of the atoms labeled as N_1, C_1, C_2 and O_1 respectivly.

	N_1	C_1,	C_2	O_1
(1)	sp^3- pyramidal	sp^2- pyramidal	sp - trigonal planar	sp^3 - angular
(2)	sp^2 trigonal planar	sp^2- pyramidal	sp - trigonal planar	sp^3 - angular
(3)	sp^2 trigonal planar	sp^3 - tetrahedral	sp - trigonal planar	sp^3 - angular
(4)	sp^3 - pyramidal	sp^3 - tetrahedral	sp^2- trigonal planar	sp^3 - angular
(5)	sp^3 pyramidal	sp^3 - tetrahedral	sp^2 - angular	sp^2 - angular

9. A 1.0 dm³ rigid closed vessel contains 0.03 mol of solid NH_4NO_3. When it is heated to 400K . It dissociates completely giving $N_2O(g)$ and $H_2O(g)$. Total pressure of the vessel after the decomposition is,
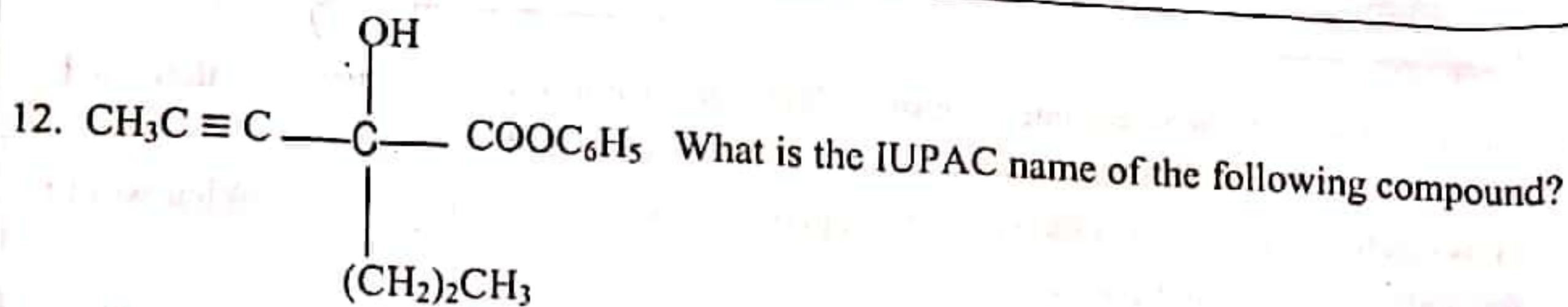(1) $3 \times 10^5 Pa$ (2) $1 \times 10^5 Pa$ (3) $0.5 \times 10^5 Pa$ (4) $0.1 \times 10^5 Pa$ (5) $0.03 \times 10^5 Pa$

10. A NaOH solution contains 12.0% of NaOH by mass. The density of the solution is 1.131 gcm⁻³. What is the volume that contains 5 mol of NaOH? (Na = 23, H = 1, O=16)
(1) 0.024 dm³   (2) 0.177 dm³   (3) 1.00 dm³
(4) 1.47 dm³   (5) 1.67 dm³

11. 1.71 g of metal Ba reacts completely with O_2 to form 2.11 g of an oxide X. The molecular formula of X Is, (Ba - 137, O =16),
(1) BaO   (2) BaO_2 (3) Ba_2O (4) Ba_2O_2 (5) Ba_2O_3

12. $CH_3C \equiv C$—$\overset{\overset{\displaystyle OH}{|}}{\underset{\underset{\displaystyle (CH_2)_2CH_3}{|}}{C}}$—$COOC_6H_5$ What is the IUPAC name of the following compound?

   (1) phenyl – 2 – hydroxy – 2 propylpent – 3 – ynoate
   (2) phenyl – 2 – propyl – 2 – hydroxypent – 3 – ynoate
   (3) phenyl – 2 – hydroxy – 2 propylpent – 3 – ynoate
   (4) phenyl – 2 – propyl – 2 hydroxypent – 3 – ynoate
   (5) benzyl – 2 – hydroxy – 2 propylpent – 3 – ynoate

13. He gas is in a $5 dm^3$ vessel at 300k and at 1×10^5 Pa . What is the amount of He that should be removed from the initial volume to keep pressure at the same value 1×10^5 Pa at 450 K temperature, if volume of the vessel remains constant ?

   (1) $\frac{1}{4}$ (2) $\frac{1}{2}$ (3) $\frac{1}{3}$ (4) $\frac{3}{4}$ (5) $\frac{2}{3}$

14. Which of the following gives the correct increasing order of water solubility of the following compounds?
   (1) $NaOH < Ba(OH)_2 < Ca(OH)_2 < Al(OH)_3$
   (2) $Al(OH)_3 < Ca(OH)_2 < Ba(OH)_2 < NaOH$
   (3) $Ca(OH)_2 < Al(OH)_3 < Ba(OH)_2 < NaOH$
   (4) $Al(OH)_3 < NaOH < Ca(OH)_2 < Ba(OH)_2$
   (5) $Ba(OH)_2 < NaOH < Al(OH)_3 < Ca(OH)_2$

15. A vessel contains 6.4g of O_2 gas at 50^0C and 2 Pa pressure . 3.2 g of gas X is in another vessel at the same temperature in a vessel with volume thrice as the earlier vessel . The relative molecular mass of X is,
   (1) 5.33   (2) 6.33   (3) 5.66   (4) 6.66   (5) 7.33

16. According to the structures given below X and Y elements are respectively,

   (a) $:\ddot{O}=\overset{..}{X}-\ddot{O}:^-$ (b) $:\overset{..}{F}-\overset{.\,.}{Y}_{.\,.}-\overset{..}{F}:$
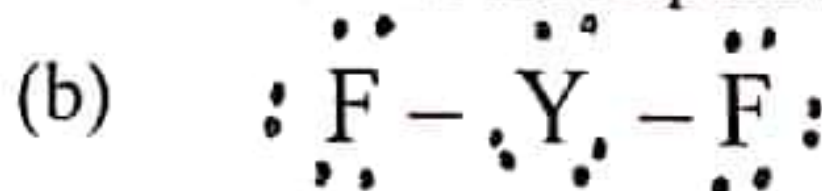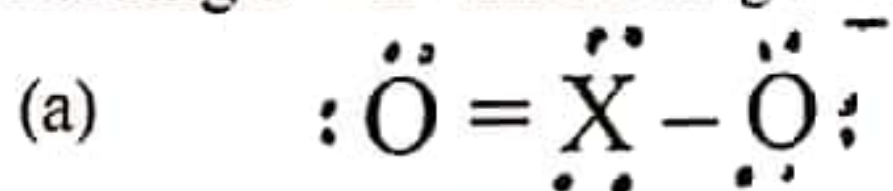
   (1) Si and P   (2) Cl and Xe   (3) Al and Ar   (4) B and P   (5) N and Cl

17. What can be decided about ΔH and ΔS according to the following graph?
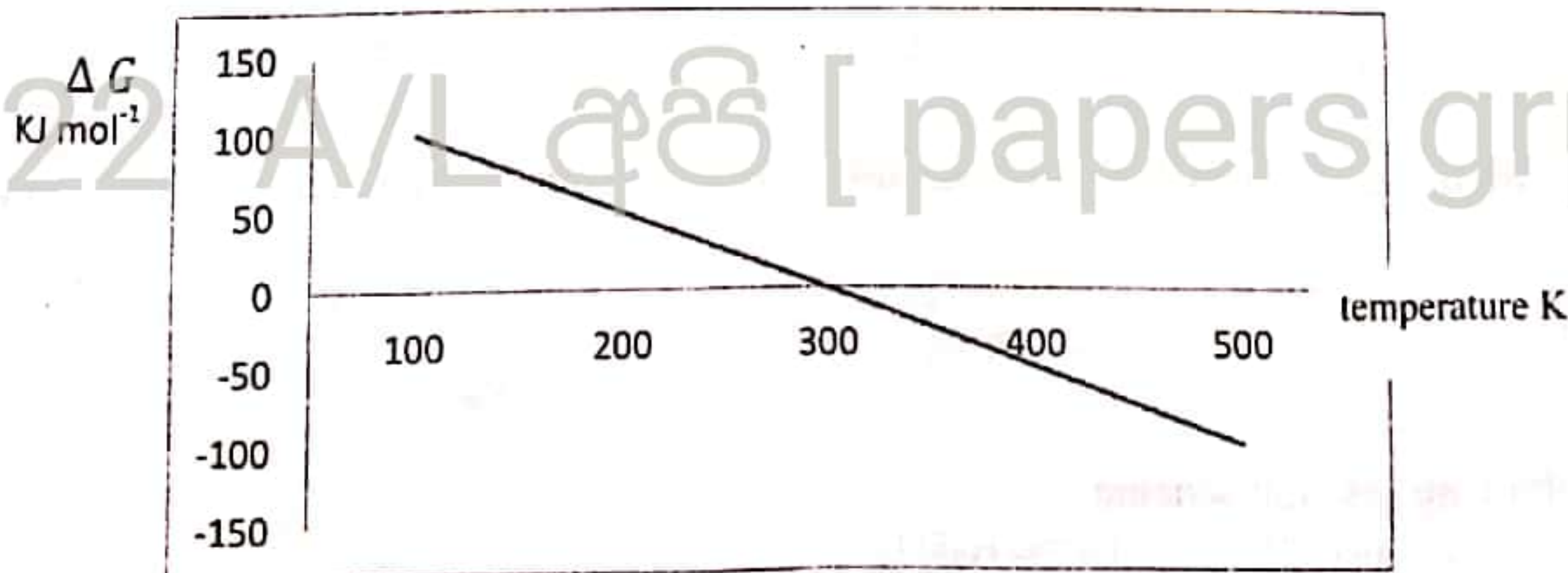
   (1) $\Delta H > 0, \Delta S > 0$ (2) $\Delta H > 0, \Delta S < 0$ (3) $\Delta H < 0, \Delta S > 0$
   (4) $\Delta H < 0, \Delta S < 0$ (5) Correct answer cannot be given

18. A 1mol of coordinated complex of cobalt contains 5 mol of NH_3 and 1mol of nitro groups. Further for 1 atom of cobalt, there are 2 atoms of Cl. In an aqueous solution 1mol of complex gives 3 mol of ions. When this solution is reacted with excess $AgNO_3$ solution, gives 2 mol of AgCl precipitate. What would be the formula of the above complex compound?

(1) $[CoCl (NO_2) (NH_3)_4] (NH_3)Cl$

(2) $[CoCl (NH_3)_5] Cl (NO_2)$

(3) $[Co (NO_2) ((NH_3)_5)]Cl_2$

(4) $[Co (N H_3) _5] (NO_2)_2 Cl_2$

(5) $[CoCl_2 (NH_3)_5] NO_2$

19. Gas X was dissolved in water to prepare a saturated solution of X. This solution forms a white precipitate with an aqueous $AgNO_3$ solution. This saturated solution evolves a colorless gas Y with a strip of Mg. X and Y respectively.
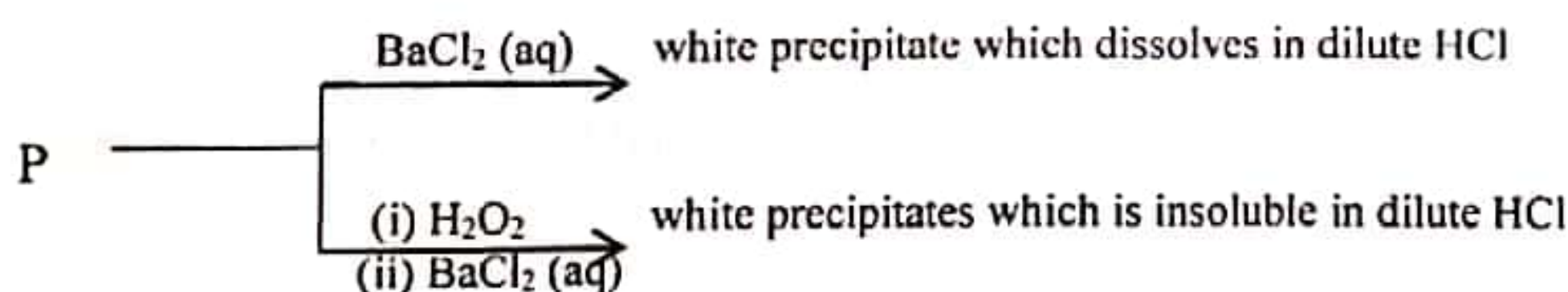
(1) CO_2, Cl_2
(2) Cl_2, CO_2
(3) Cl_2, H_2
(4) Br_2, H_2
(5) Cl_2, HCl

20. An ideal gas exists in the following temperatures(T_1, T_3) at pressure P_1 volumes (V_1 V_3). All the data are given in the standard units. What is the final pressure, when all the gas collected in to the middle vessel by pushing both pistons and maintaining the temperature at T_2. R- gas constant (Do not consider the volumes of onnected tubes).

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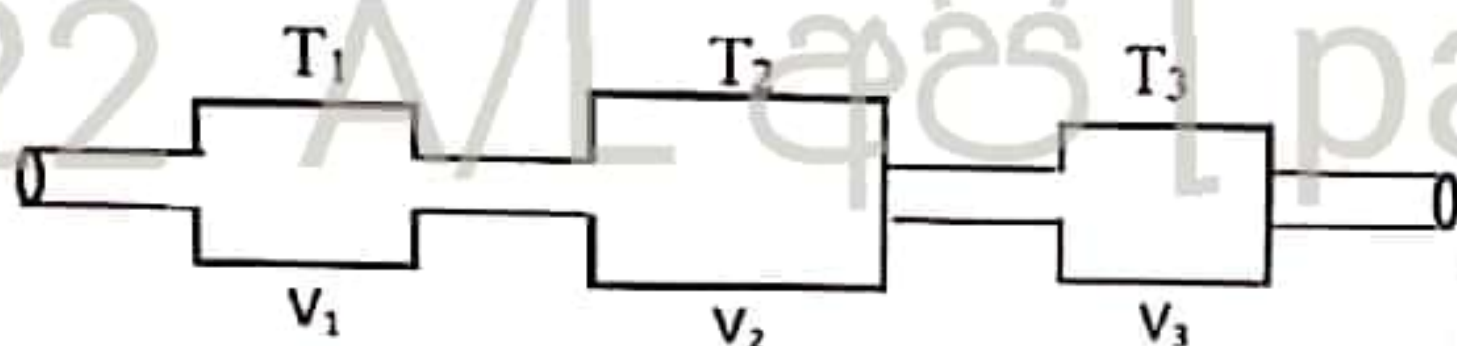
(1) $\left[P_1 \dfrac{T2}{V2} \left(\dfrac{V1}{T1} + \dfrac{V3}{T3}\right)+1\right]$

(2) $3P_c$

(3) $\dfrac{P1}{RV2}\left[\dfrac{V1}{T1} + \dfrac{V2}{T2} + \dfrac{V3}{T3}\right]$

(4) $\dfrac{P1T1R}{V}\left[\dfrac{T2}{V2} + \dfrac{V2}{T2} + \dfrac{V3}{T3}\right]$

(5) $\dfrac{P1T2}{V2}\left[\dfrac{V1}{T1} + \dfrac{V3}{T3} + \dfrac{2V3}{T2}+1\right]$

21. An aqueous solution of compound P shows the following properties.

P —
$BaCl_2$ (aq) → white precipitate which dissolves in dilute HCl

(i) H_2O_2
(ii) $BaCl_2$ (aq) → white precipitates which is insoluble in dilute HCl

The anion present in P is,

(1) CO_3^{2-}
(2) CrO_4^{2-}
(3) NO_3^-
(4) SO_3^{2-}
(5) SO_4^{2-}

22. The bond dissociation enthalpy of Cl_2 is 243.4kJ mol^{-1}. The frequency of the radiation required to break this bond is in Hz

(1). 2.543×10^{28}
(2). 4.521×10^{27}
(3). 36.73×10^{28}
(4). 3.673×10^{28}
(5). 3.853×10^{27}

23. Consider the following reaction scheme

$$Z \xrightarrow{PCl_3} X \xrightarrow[\Delta]{\text{alcoholic KOH}} Y \xrightarrow[\text{ii. } H_2O/\Delta]{\text{i. conc } H_2SO_4} Z$$
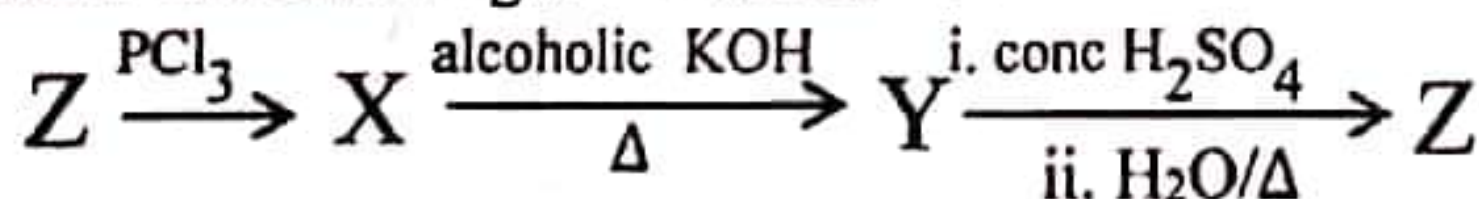
Z can be,

(1) CH_5CH_2CH I
(2) $CH_3CH(OH) CH_3$
(3) $(CH_3CH_2)_3COH$
(4) $CH_3 CH = CH_2$
(5) CH_3OH

24. Nitrobenzene $\xrightarrow{Cl_2/FeCl_3}$ the product of this reaction is,

(1) [structure: benzene ring with NO_2 at top and Cl ortho]

(2) [structure with NO_2 and substituent] (3) [structure: NO_2 top, ring connected, Cl bottom]
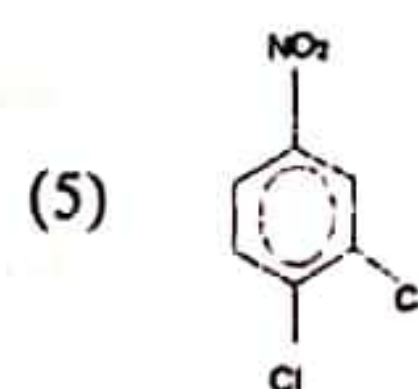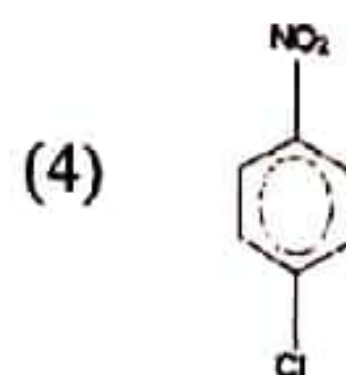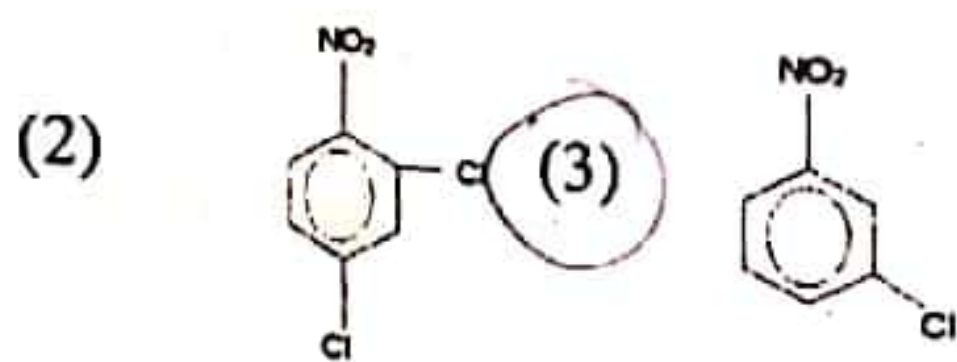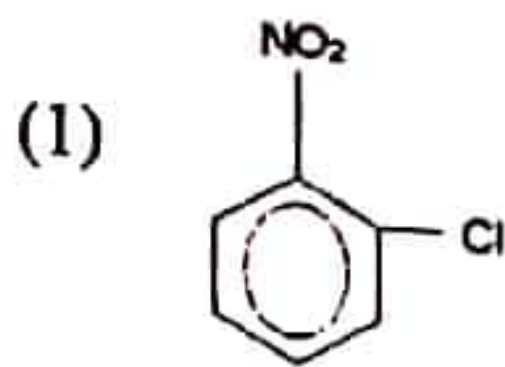
(4) [structure: benzene ring with NO_2 at top and Cl meta]

(5) [structure: benzene ring with NO_2 at top, Cl bottom and para]

25. "S" acts as an Oxidizing agent as well as a reducing agent. The most appropriate theoretical explanation for this statement is,

(1) S can form sulfur dioxide as well as calcium sulfide.
(2) Sulfur is a non-metal.
(3) Sulfur forms inorganic compounds as well as organic compounds.
(4) Since there are six electrons in the outermost shell of sulfur atom. It has the ability to take electrons from other atoms as well as the ability to share electron with other atoms
(5) Sulfur is soluble in CS_2 as well as alcohols.

26. The standard enthalpy changes for some reactions are given below.

i. $2CO(g) + O_2(g) \longrightarrow 2CO_2(g)$ $\Delta H^\ominus = -566$ kJmol^{-1}

ii. $CO_2(g) + 2H_2O_{(l)} \longrightarrow CH_3OH_{(l)} + \frac{3}{2}O_2(g),$ $\Delta H^\ominus = +715$ kJmol^{-1}

iii. $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O_{(l)}$ $\Delta H^\ominus = -286$ kJmol^{-1}
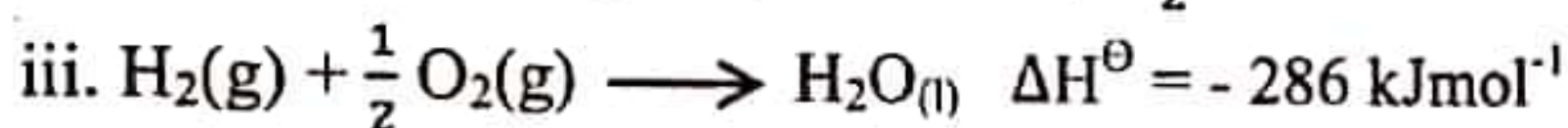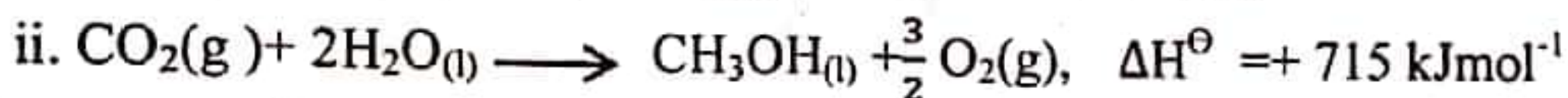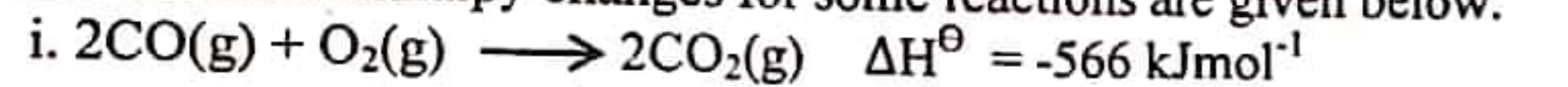
The enthalpy change of the following reaction is in kJmol^{-1}
$$CO_{(g)} + 2H_2(g) \longrightarrow CH_3OH_{(l)}, \Delta H^\ominus = ?$$

(1) +137   (2) -140   (3) +435   (4) +1582   (5) -270

27. Correct statements is /are,

a) The enthalpy and entropy of standard elements are zero under standard conditions.
b) An exothermic reaction with negative entropy change cannot be occurred spontaneously at any time
c) An endothermic reaction with positive entropy change cannot be occurred spontaneously at any time
d) The second ionization enthalpy of sodium is smaller than that of Ne.

(1) a and b only   (2) c and d only   (3) b only
(4) a, c and d only   (5) a only

28. Iodine and chlorine react with other to give compound ICl_n. When 1×10^3 mol of ICl_n is reacted with excess KI, all I^- converted to I_2. A 40.0 cm^3 of 0.1moldm^{-3} $Na_2S_2O_3$ solution was used for the complete reaction with liberated I_2. The value of n is,

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

29. The correct answer with regard to both $CH_3CH_2CH=CH_2$ and $CH_3CH=CHCH_3$ compound is,

(1) Both compounds show geometrical isomerism.
(2) Both compounds do not show enantiomerism.
(3) Both compounds undergo bromination with Br_2/CCl_4 and give 1,4 – dibromobutane.
(4) None of the above reacts with alkaline $KMnO_4$ to form diols.
(5) None of the above two compounds form butane by the catalytic hydrogenation.

30. The product obtained by the reaction between $CH_3COCH_2CH_3$ and HCN was hydrolysed and then dehydrated with conc H_2SO_4. What is the final product obtained in this process?

(1)
$$CH_3 - \overset{\overset{\displaystyle OH}{|}}{\underset{\underset{\displaystyle CN}{|}}{C}} - CH_2CH_3$$

(2)
$$CH_3 - \overset{\overset{\displaystyle COOH}{|}}{C} = CH\ CH_3$$

(3) $CH_3 - CH_2\ CH_2\ COOH$

(4) $CH_3 - C \equiv C - C\ H_3$

(5)
$$CH_3 - CH_2 - \overset{\overset{\displaystyle COOH}{|}}{C} = CH_2$$

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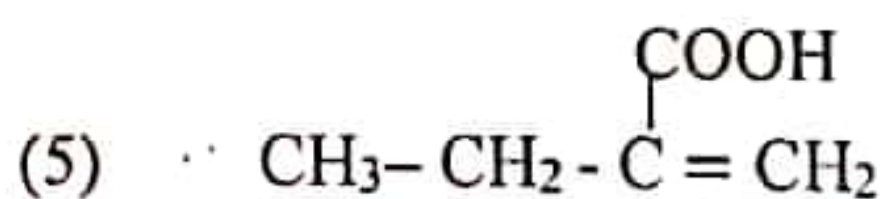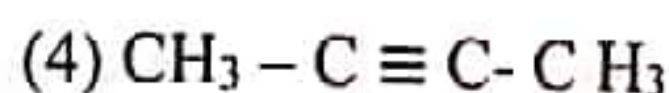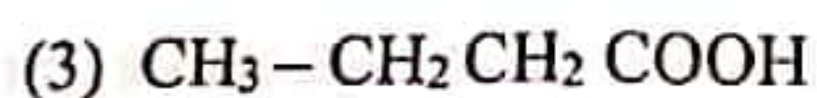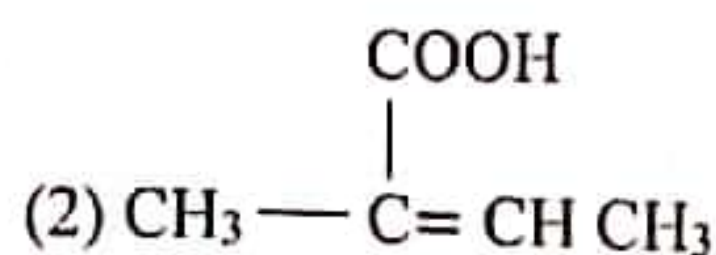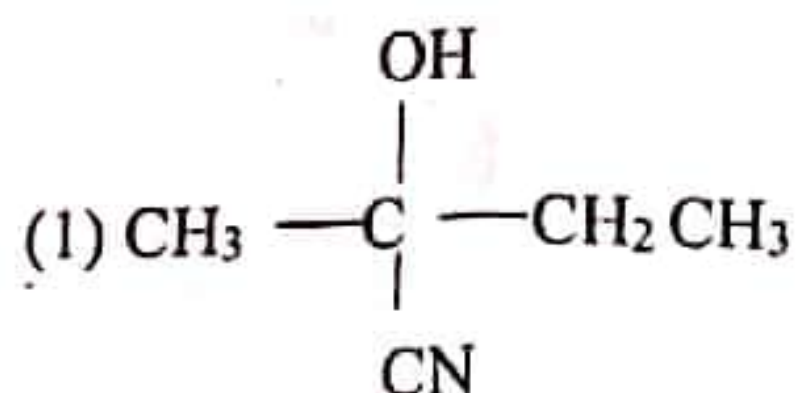
- Instructions for answering questions 31 to 40.

(1)	(2)	(3)	(4)	(5)
Only (a)and (b) are correct	Only (b)and (c) are correct	Only (c)and (d) are correct	Only (d)and (a) are correct	Any other number or combination of responses is correct

31. What is / are the correct statement/s with regard to the elements below atomic number 36 ?

(a) In an aqueous solution coloured cations formed by d- block elements only.

(b) Ampholeric hydroxides are formed by d block elements only .

(c) Complex ions are formed by d block elements only.

(d) Both M^{2+}(aq) and M^{3+} (aq) types cations are formed by the same element only the elements belong to d - block.

32. Consider the following reaction scheme

$$(CH_3)_2\ CCl\ CH_2CH_3$$

↓

$(CH_3)_2\ C= CHCH_3 \longleftarrow (CH_3)_2\ C(OH)CH_2\ CH_3$

↓

$(CH_3)_2\ CBr\ CH_2\ CH_3 \longrightarrow (CH_3)_2\ C(CN)CH_2\ CH_3$
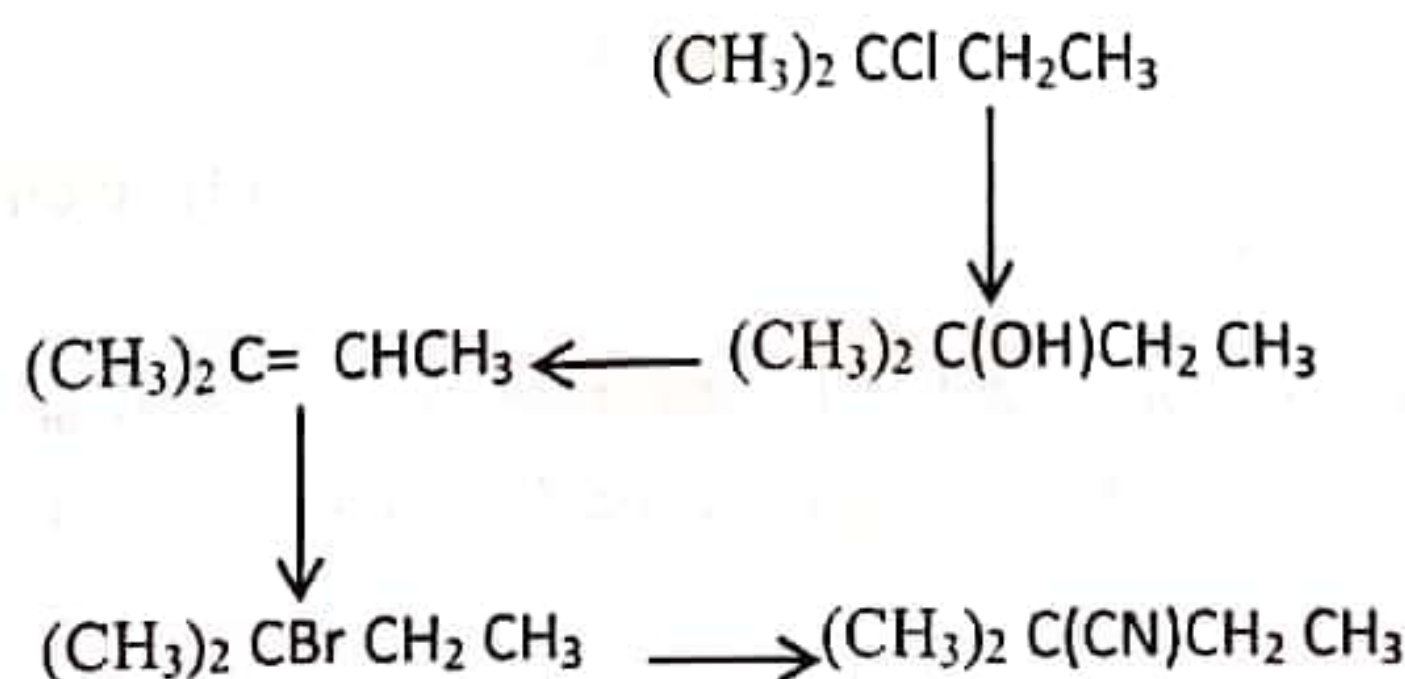
The mechanism / mechanisms involves/ involve in this reaction scheme is / are,

(a) Electrophilic addition.

(b) Nucleophilic substitution.

(c) Free radical substitution.

(d) Electrophilic substitution.

33. What is / are the correct statement/s with regard to this compound $[Co(NH_3)_5 Cl] SO_4$,
    (a) The coordination number of Co is 6.
    ✗(b) It is colorless in an aqueous solution.
    ✓(c) The oxidation number of Co is +3.
    ✗(d) It gives a white precipitate with an aqueous $BaCl_2$ solution which dissolves in dilute H_2SO_4.

34. σ bond can be formed by,
    ✗(a) Linear overlapping of two p - orbitals.
    ✓(b) Linear overlapping of two s - orbitals
    ✗(c) Lateral overlapping of two p - orbitals
   (d) Lateral overlapping of s and p - orbitals.

35. Pure Oxygen gas is in a rigid vessel with a constant volume. When this vessel was heated to get the mean kinetic energy of molecules as twice as the initial, which one of the following would be twice as the initial? ,
    (a) Mean speed of oxygen molecules.
    (b) Root mean square speed of oxygen molecules.
    (c) Mean square speed of oxygen molecules.
    (d) Pressure of the vessel.

36. Which of the following could be dimerize in the gaseous state?
    ✓(a) $AlCl_3$.   (b) N_2O_5 (c) N_2O_3 (d) NO_2

37. The correct statement/ s with regard to the following organic compound is/ are ,
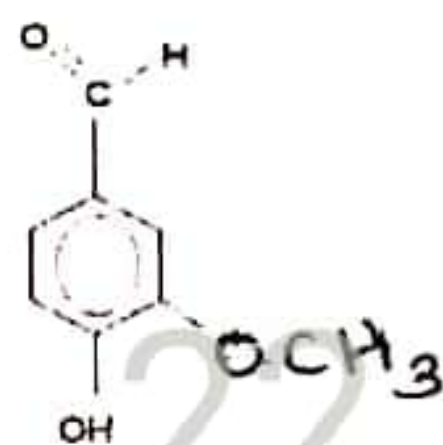
    (a) It has an ester functional group.
    (b) It reacts with Tollen's reagent to give a silver mirror.
    (c) It formes H bonds.
    (d) It undergoes nucleophilic substitiution reactions.

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38. The endothermic process/processes is / are?

    (a) $Na^+(g) + Cl^-(g) \longrightarrow NaCl(s)$

    (b) $Cl(g) + e \longrightarrow Cl^-_{(g)}$

    (c) $Na(g) \longrightarrow Na^+_{(g)} + e$

    (d) $Cl_{2\,(g)} \longrightarrow 2Cl_{(g)}.$

39. If ideal gas behavior is assumed 7g of N_2 gas,
    (a) has $5.6 cm^3$ volume at the standard temperature and pressure.
    (b) has 0.5 mol of N_2 gas.
    (c) volume can be doubled by increasing temperature from $100^0 C$ to $200^0 C$ at constant pressure.
    (d) gives 0.25atm partial pressure by mixing it in a $22.4dm^3$ vessel with 4g of hydrogen at the standard temperature and pressure.

40. Which of the following can be used to oxidize CH_3CHO?
    (a) K_2CrO_4 (b) $CuCl_2$ (c) $NiSO_4$ (d) $CoCl_2$

- **Instruction for Question no 41 – 50.**

Response	First statement	Second statement
1	True	True and correctly explains the first statement
2	True	True but does not explain the first statement correctly.
3	True	False
4	False	True
5	False	False

|	First statement	Second statement
41.	The first electron gain energy change of N is a positive value.	Electron – electron repulsion is stronger in nitrogen when giving an electron from outside due to the relative stability of outer subshell electron configuration of nitrogen.
42.	Compressibility factor of a gas increases with increasing the temperature.	Critical temperature of a substance increases with increasing the temperature.
43.	The amount of energy liberated in the complete neutralization of 2 mol of aqueous KOH by H_2SO_4 acid is same as the amount of energy liberated in the complete neutralization of one mole of aqueous $Ba(OH)_2$ with H_2SO_4 acid. Under the same conditions.	When strong acid is neutralized by strong base $H^+_{(aq)} + {}^-OH_{(aq)} \longrightarrow H_2O(l)$ reaction occurs.
44.	$CH = CHCH_2Br$ has higher probability to show one step nucleophilic substitution reactions.	$CH = CHCH_2Br$ is a primary alkyl halide.
45.	The bond angle of SO_2 molecule is 109.5^0.	SO_2 molecule is angular in shape.
46.	A stain of iodine in a cloth can be removed by washing it with a $Na_2S_2O_3$ solution.	$S_2O_3^{2-}$ reduces iodine into water soluble I^-
47.	Nitrogen gas cannot act as an oxidizing agent.	Electronegativity of N is lower than that of Oxygen.
48.	The behavior of real gases is not accordant with the equation $(P + \frac{n^2a}{v^2})V=nRT$	Modification for the volume of molecules should be included in the equation and it is $V- n^2b$.
49.	Enantiomers can be obtained by addition reactions of propene.	Propene does not exist as geometrical isomers.
50.	H_2O_2 is a planar molecule.	$O - O$ bond and $O - H$ bonds of H_2O_2 molecule lie on the same plane.

Part B - Essay
Answer two questions only (Each Question caries 15 marks)

05. a.(i)   Write down the Daltons law of partial pressure.

(ii)   Derive an expression for the partial pressure of a component in a gaseous mixture using mole fraction of that component and total pressure of the system .

(iii)   A certain gas X_2 is trapped in a rigid container at a temperature of $127^0 C$. A rigid piston is attached to the above rigid vessel using a valve A. 0.5 mol of gas Y_2 is trapped inside the rigid piston. Initialy the value A is closed.

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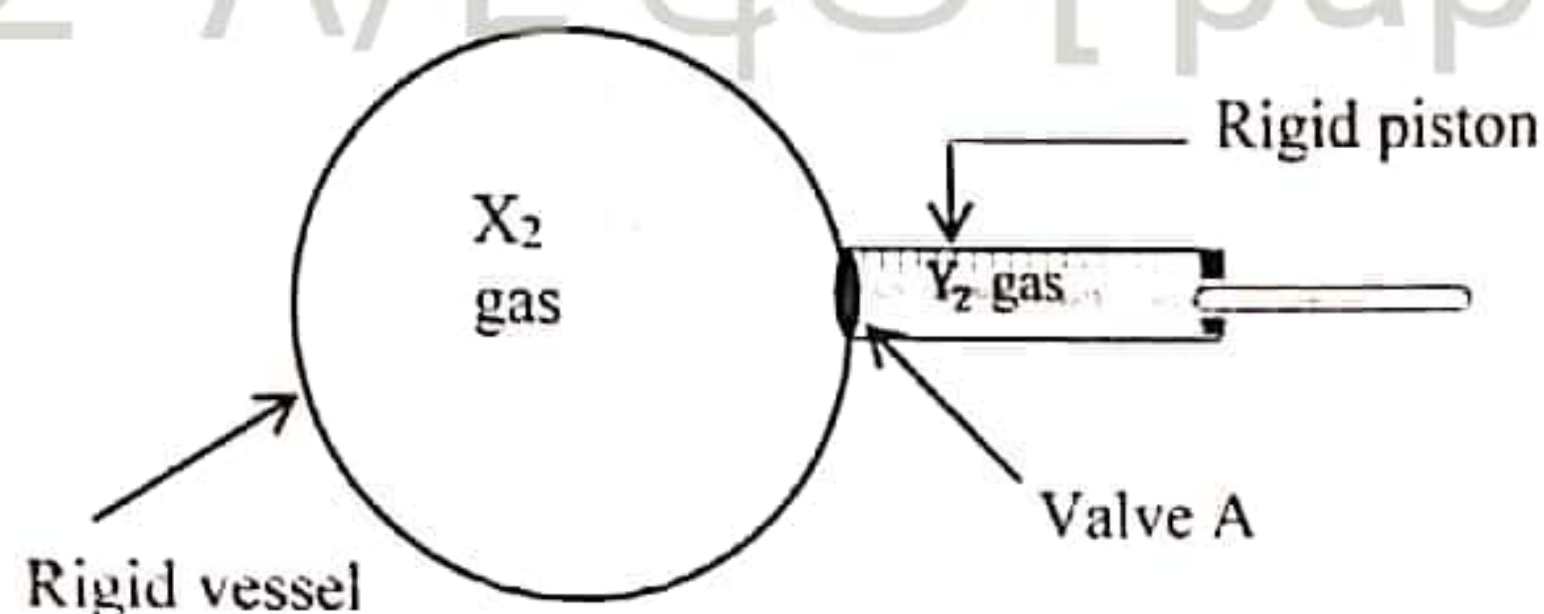
When A valve was opened in a very short time all the Y_2 gas was pumped into the rigid vessel, closing the valve A and allowing the rigid vessel to remain at the same temperature . When X_2 and Y_2 gases are mixed , they react at a ratio of 2:1 to form a gaseous compound X_2Y. It was found that the gas Y_2 had completely reacted and the X_2 and X_2Y gases still remained in the system.
[assume the value of product of PV = 8.314×10^3 J]

(I)   Find the initial number of moles of X_2 in the container.

(II)   Write the balanced chemical equation for the reaction that takes place after mixing X_2 and Y_2 gases.

(III)   If the total pressure in the system is 1×10^5 Pa after reacting with X_2 and Y_2 gases, calculate fallowing.
(a)   The number of moles of X_2 remaining in the system.

(b)   The number of moles of X_2Y remaining in the system.

(c)   Partial pressures of $X_2(g)$ and $X_2Y(g)$.

b.   I. Write the thermochemical reaction for enthalpy changes below.
(i)   Standard enthalpy of atomization   of Al (s) = + 326.4 kJ mol $^{-1}$

(ii)   Standard enthalpy of first ionization of Al (g) = +577.5 kJ mol $^{-1}$

(iii)   Standard enthalpy of second ionization of Al (g) = +1816.7 kJ mol $^{-1}$

(iv)   Standard enthalpy of third ionization of Al (g) =+2744.4 kJ mol $^{-1}$

(v)   Standard enthalpy of bond dissociation O = O (g) +496 kJ mol.$^{-1}$

(vi)   Standard enthalpy of first electron gain of O (g)= -149 kJ mol $^{-1}$

(vii)   Standard enthalpy of second electron gain of O (g) +758 kJ mol $^{-1}$

(viii) Standard enthalpy of Lattice dissociation $Al_2O_3(s)$ = +15916 kJ mol $^{-1}$

II. Draw a Born Haber cycle to find the standard enthalpy of formation of $Al_2O_3(s)$ using the above data. Calculated the standard enthalpy of formation of $Al_2O_3c(s)$.

6. (a) An Acid HY is ionized in the aqueous medium as follows.

$$HY \ (aq) \longrightarrow H^+(aq) + Y^- \ (aq)$$
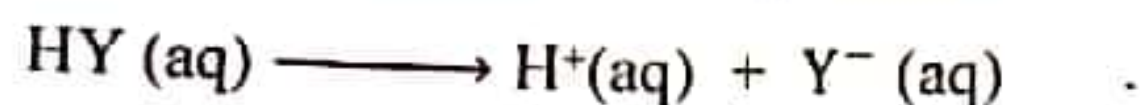
The change in enthalpy (ΔH) is 1.0 kJ mol^{-1} and the change in entropy (ΔS) is 95 Jmol^{-1}K^{-1} of this reaction. The enthalpy and entropy changes of several thermochemical processes are given below.

Process	ΔH/kJmol^{-1}	ΔS/ Jmol^{-1}K^{-1}
Y$^-$(g) hydration	- 200	-2000
H$^+$(g) hydration	- 1100	-1200
HY(g) $\longrightarrow$ HY(aq)	- 150	-100

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i. Write the reaction for ionization of HY in the gaseous state.

ii. Answer the following questions using a thermochemical cycle.

    a) Calculate the enthalpy change for the ionization process of $HY_{(g)}$

    b) Calculate the entropy change for the ionization process of $HY_{(g)}$

    c) Show that the ionization of $HY_{(g)}$ is spontaneous or non-spontaneous at 27^0 C.

(b) The shape of a certain coordinate complex compound formed by chromium is octahedral and the oxidation state of chromium is +3. The ligands present here are Cl and H_2O molecules. When 0.230g of this compound is treated with a silvernitrate solution, 0.143g white precipitate is obtained. (Ag-108, Cl-35.5) the molar mass of the compound is 230.5gmol^{-1}.

  i. Calculate the number of moles of ionic chlorine present in the compound.

  ii. Write down the formula of the complex cation part of the compound.

  iii. Draw structural formula of the coordinated complex with all the ligands.

  iv. Write down the formula of the complex and IUPAC name.

  v. If the above compound explained did not give a precipitate with AgNO₃, what is the chemical formula related with the compound?

(c) Explain the following statements based on chemical principles.

i. Boiling point of HF is 19^0C and the boiling point of HCl is -35^0 C .

ii. The first electron gain energy of F is less than that of Cl.

iii. The electronegativity of the oxygen in the species of OH⁻, H_2O and H_3O^+ increases respectively.

07. (a) C and D are two cations formed from two elements belongs to d block. In an aqueous solution C is light pink and B is brownish yellow. Both the cations C and D have 5 unpaired electrons in each. Cation C forms oxo anions but cation D does not.

  i. Identify the cations C and D.

  ii. Write the electron configuration of the cations C and D and state the number of electrons in the outermost shell.

  iii. Write the formulae of the oxoanions formed by C.

  iv. Derive the balanced ionic equation for the reaction between oxo anion which is formed by the highest oxidation state of C and SO_2 gas in an acidic medium.

  v. X,Y,Z are the three coordinate complex compounds that contain D complex compounds of X,Y and Z have octahedral geometry. All three compounds of X,Y and Z have D ion with the above oxidation state, three bromine atoms that can be covalent and / or ionic. The number of water molecules in the compounds varies. The charges of the coordination part of X,Y,Z are +2, +1 and 0 respectively.

  a. Write the formulae of X, Y and Z.
  b. Write the IUPAC names of X, Y, Z.

  vi Write the chemical reactions along with the observations obtained when the following chemicals are added to an aqueous solution of D cation separately.
  (i) NaOH(aq)   (ii) NH_3(aq)   (iii) HCl (aq)

  vii Write down with the relevant equations to identify the cation D in an aqueous solution.

(b) 5.13g of $Ba(OH)_2$ was dissolved in 100.0 ml of water to form a solution at 25^0C. 20.00 cm^3 of The solution was accurately measured into a titration flask and two drops of phenolphthalein indicator were added to it. Then it was titrated with HCl acid in a burette. The volume of HCl acid required for the colour change of the indicator was 18.70 cm^3. K_w of water is 1×10^{-14} mol^{-2} dm^{-6} at 25^0C.
  (Ba = 137, 0=16 H-1)

  i. Write the balanced chemical equation for the relevant neutralization reaction.

  ii. Calculate the concentration and pH of $Ba(OH)_2$ solution which is prepared at the beginning.

  iii. Calculate the number of moles of $Ba(OH)_2$ which is used for the titration.

  iv. How many moles of HCl were spent in neutralization.

 v. Calculate the concentration of HCl acid.

Answers two questions only.

08. (a) Using given two organic compounds and inorganic reagents only show how you would do the following conversion.
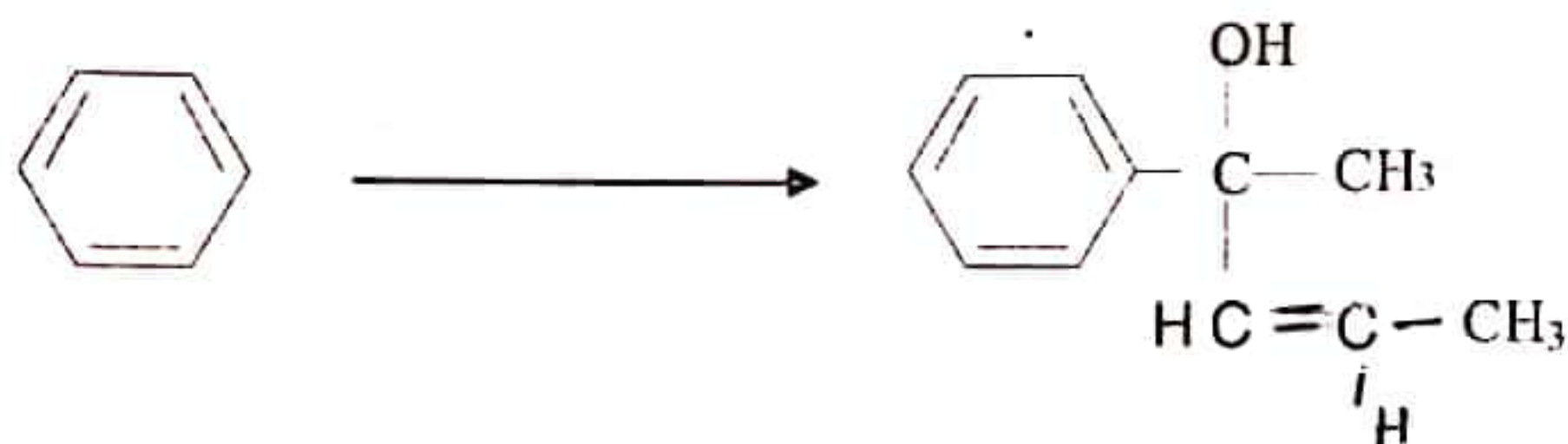
Organic Compounds : CH_3COOH, $CH_3C \equiv C\,MgBr$

Inorganic compounds : · Dil HCl, H_2, $BaSO_4$, anhydrous $AlCl_3$, Pd, PCl_5 and quinoline.

(b) Do the following conversion (your conversion should not exceed 5 steps)

(c) .22 A/L � [papers grp]
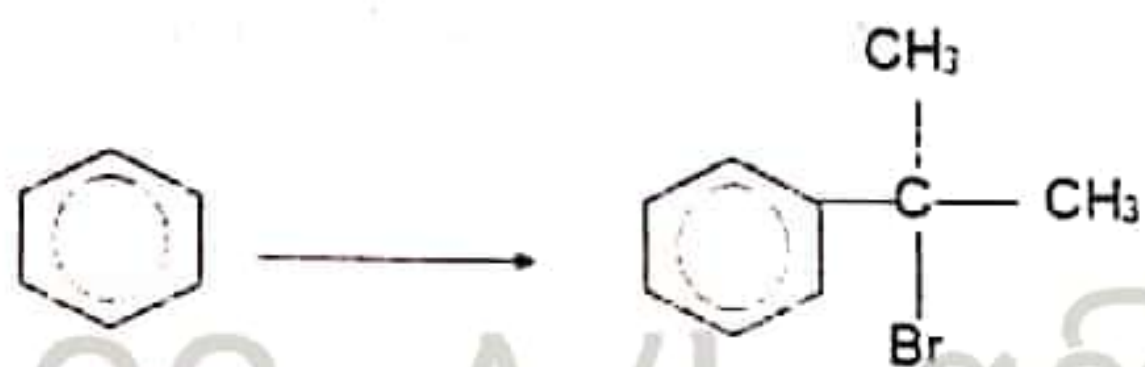
i. Give reaction mechanism related with the elimination reaction of $CH_3CH_2CH_2Br$ with alcoholic KOH

ii. What is the action of OH- group in the above (i) reaction?

iii. Write reaction mechanism for the reaction between $(CH_2)_3CBr$ with aqueous KOH .

iv. What is the action of OH- group in the above (iii) reaction?

9. (a) X is a p block element having atomic number less than 20. Y is a compound formed by X. It exists as polar molecules and as a viscous liquid at room temperature.

A summery regarding to some reactions related to Y is given below.
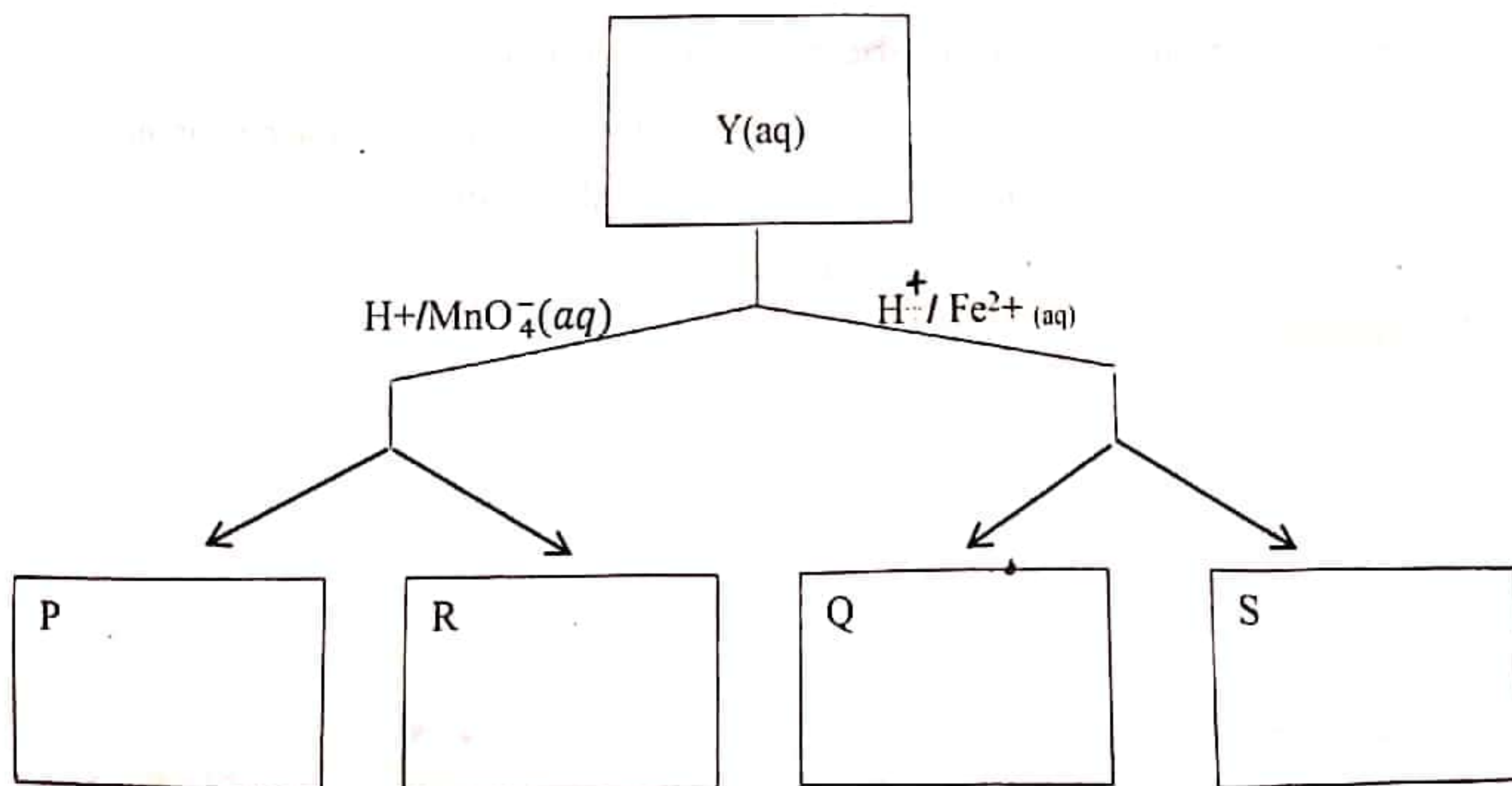
Acidified aqueous MnO_4^- (aq) solution and aqueous Fe^{2+} (aq) solution were added separately two an aqueous solution of compound Y. The obtained products were named as P, Q, R and S. R and S are products respectively obtained due to the action of Y compound as a reducing agent and as an oxidizing agent.

i. Identify element X.

ii. State the two allotropic forms of X.

iii. Identify compound Y.

iv. Give chemical formulae of chemical species P,Q,R and S with their physical state.

v. Write down the above balanced ionic equation to show the action of Y as an oxidizing agent.

vi. Write down the above balanced ionic equation to show the action of Y as a reducing agent..

(b) 12 g of ammonium iron (II) sulphate was dissolved in water to form 250 cm³ of acidic aqueous solution. 25.5 cm³ of 0.02 moldm⁻³ $K_2Cr_2O_7$ was needed to oxidize 25.0 cm³ of this solution.

   (i). Write down the balanced ionic equation for the titration reaction.
   (ii).If the formula of Ammonium iron (II) sulphate is $FeSO_4(NH_4)_2 SO_4. xH_2O$.
     Calculate the value of x.
     $FeSO_4 = 152$ gmol⁻¹ $(NH_4)_2SO_4 = 132$ gmol⁻¹

(c) An alloy contains Mg, Al and Cu . The volume of H_2 obtained after the reaction of 0.60 g of the alloy with excess NaOH was 336 cm³ at the standard temperature and pressure. The volume of H_2 obtained at the standard temperature and pressure after reacting the remaining metal residue with excess HCl was 112 cm³ . Find the mass percentage of each metal in the alloy. (Al-27, Mg-24, Cu- 63.5)

Molar volume of gas at stp is 22.4 dm³

10.

(a) M and N are two elements in the s block of the periodic table Some chemical properties of M and N are given below.

M Element	→	• Oxide is formed when burnt in air . • Bright yellow flame is formed in flame test. • Reacts with dilute acids vigorously giving H_2 gas.

N Element	→	• Oxide and nitride are formed when burnt in air. • No answer for the flame test. • Liberates H_2 with dilute acids and bases .

i. Identify elemnts M and N with their groups.

ii. Write down the balanced chemical equations of the above identified elements with the following species. If there is no reaction with the given species indicate that.

   I.   With excess O_2.
   II. With aqueous NaOH.
   III. With dilute HCl.

   IV. With cold water.
   V.   Heated with N_2 gas in air.

iii Give balanced chemical equations to show the thermal decomposition reaction of nitrates and carbonates of M and N. State if not decomposed.

iv. The water solubility of salts of M and N varies with the salt formed. Compare the water solubility of the salt of M and N given below. Use the terms "completely soluble" "Insoluble" and 'slightly soluble' in the comparison. .

Salt of M and N ,

    I. bromides

    II. bicarbonates

    III. hydroxides.

    IV. sulphites

    V. carbonates

(b)

i. State three assumption of molecular kinetic theory .

ii. Derive an expression for root mean square speed of a gas with temperature, universal gas constant and molar mass of the gas using kinetic equation and ideal gas equation.

iii. Calculate the root mean square speed of Oxygen gas at 27^0 C . (O = 16)

iv. Derive an expression for mean kinetic energy of a molecule of O_2 gas using kinetic molecular equation.

v. Then calculate the mean kinetic energy of a molecule of O_2 at 27^0 C.

vi. Draw a labeled Maxwell Boltzman curve to show the variation of molecules of oxygen gas at 27^0 C and when it is raised to 35^0 C. Briefly explain your answer.

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