Grade 12 3rd
2018 July
Devi Balika

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දේවි බාලිකා විද්‍යාලය – කොළඹ
DEVI BALIKA VIDYALAYA – COLOMBO

12 වන ශ්‍රේණිය තෙවන වාර පරීක්ෂණය - 2018 ජූලි
Grade 12 Third Term Test July 2018

රසායන විද්‍යාව I
Chemistry I

පැය දෙකයි
Two hours

Important
- This paper consist of 8 pages
- Answer all the questions
- The use of calculators is not allowed
- Write your index number in the space provided in the answer sheet
- In each of the questions 1 to 50, pick one of the alternatives (1) (2) (3) (4) (5) which is correct as most appropriate and shade its number on the answer sheet provided

Universal gas constant	R	=	$8.314\ J\ K^{-1}\ mol^{-1}$
Avergadro's constant	N_A	=	$6.022 \times 10^{23}\ mol^{-1}$
Speed of light	C	=	$3.0 \times 10^{8}\ ms^{-1}$
Planck's constant	h	=	$6.626 \times 10^{-34}\ Js$

1. Increasing order of the number of unpaired electrons is,
   1) $K < C < Na^+ < Mn^{2+} < Fe^{2+}$ 2) $Na^+ < K < C < Mn^{2+} < Fe^{2+}$
   3) $Na^+ < Mn^{2+} < Fe^{2+} < C < K$ 4) $Fe^{2+} < Mn^{2+} < C < K < Na^+$
   5) $Fe^{2+} < Mn^{2+} < Na^+ < C < K$

2. Number of atomic orbitals possible as quantum numbers n = 3, $m_l = 0$
   1) 1 2) 2 3) 3 4) 4 5) 5

3. The electron pair geometry around the center atom is different to its shape in,
   1) CNO^- 2) NO_2F 3) NOF_3 4) PCl_6^- 5) XeO_2F_2

4. Incorrect statement regarding SO_2 and H_2S gases is,
   1) As oxidation number of in H_2S is –2, it cannot act as a oxidizing agent.
   2) When H_2S is bubbled through an aqueous solution of SO_2, S is precipitated.
   3) SO_2 shows bleaching properties but H_2S does not.
   4) SO_2 acts as an oxidizing agent as well as a reducing agent.
   5) H_2S is a colourless, poisonous gas with a pungent smell.

5. Mass of 1 g of a fertilizer sample containing $(NH_4)_2SO_4$ is heated with excess NaOH. NH_3 gas liberated was absorbed in to 50 cm^3 of 0.1 $moldm^{-3}$ H_2SO_4 solution. To neutralize the excess H_2SO_4 20.00 cm^3 of 0.1 $moldm^{-3}$ NaOH was required. Mass percentage of NH_3 evolved from the sample is,
   1) 8.0% 2) 8.25% 3) 13.6% 4) 15.2% 5) 17.3%

6. Rate determining step of a reaction is given below.
   $2A \longrightarrow B + C$
   Rate of the reaction is r, when the concentration of A is 0.6 $moldm^{-3}$
   Rate of the reaction in $moldm^{-3}s^{-1}$ when the concentration of A is 0.12 $moldm^{-3}$,
   1) 0.04r 2) 0.02r 3) 0.4r 4) 0.2r 5) 0.05r

7. Which of the following statement is correct regarding an experiment carried out to find the order with respect to Fe^{3+} in the reaction between acidic Fe^{3+} and I^-.
1) Rate of the reaction depends on the concentration of $Na_2S_2O_3$ added.
2) $Na_2S_2O_3$ is added to increase the time taken to turn the solution blue.
3) Phenolphthalein can be used as the indicator
4) When mixing the two solutions, acidic Fe^{3+} is added to one container and all the other solutions to another container.
5) Time taken to appear blue colour can be increased by increasing the temperature.

8. Reaction in which sign of ΔH, ΔS and ΔG can be negative under room temperature is,
1) $4Na(s) + O_2(g) \longrightarrow 2Na_2O(s)$
2) $H_2O_2(l) \longrightarrow 2H_2(g) + O_2(g)$
3) $6CO_2(g) + 6H_2O(g) \longrightarrow C_6H_{12}O_6(s) + 6O_2(g)$
4) $C(s) + O_2(g) \longrightarrow CO_2(g)$
5) $2HCl(aq) + 2Na(s) \longrightarrow 2NaCl(aq) + H_2(g)$

9. Two species showing the same colour is,
1) $[CoCl_4]^{2-}$ and $[MnCl_4]^{2-}$
2) $[Cu(NH_3)_6]^{2+}$ and $[Ni(NH_3)_6]^{2+}$
3) $[Mn(H_2O)_6]^{2+}$ and $[Ni(NH_3)_6]^{2+}$
4) $[CuCl_4]^{2-}$ and $[MnCl_4]^{2-}$
5) $[Co(NH_3)_6]^{3+}$ and $[Cr(NH_3)_6]^{3+}$

10. Correct statement regarding an ideal gas is,
a) $PV = nRT$ can be applied for ideal gases only under high temperatures and low pressures.
b) They can be liquified by compression by lowering the temperature.
c) Compressibility factor at any temperature or pressure is equal to 1.

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

11. Colourless (white) solid Z evolves a brown gas when heated with HCl and evolves an alkaline gas when heated with NaOH.
1) NH_4NO_3
2) NH_4Cl
3) NH_4NO_2
4) $NaNO_3$
5) $NaBr$

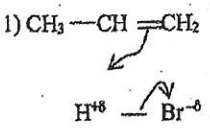
12. Consider the carbocations given below.

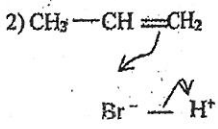
(A) $CH_3 - \overset{+}{C}H - CH_2 - CH_3$ (B) $CH_2 = CH - \overset{+}{C}H - CH_3$

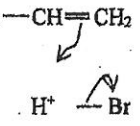
(C) $CH_3 - \overset{+}{C}(CH_3) - CH_2 - CH_3$ (D) $CH_3 - CH_2 - \overset{+}{C}(H) - CH_2 - CH_3$

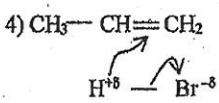
Increasing order of the stability of the above carbocations is,
1) A < B < C < D
2) D < C < B < A
3) A < D < C < B
4) D < A < C < B
5) A < B < D < C

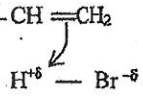
13. First step in the addition of HBr to $CH_3-CH=CH_2$ (Propene) is,

1) 

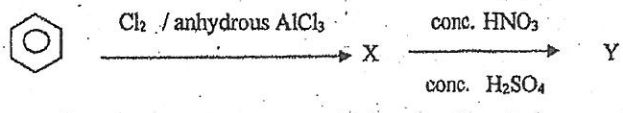
2) 

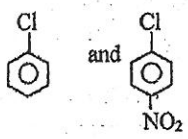
3) 

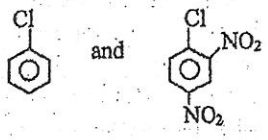
4) 

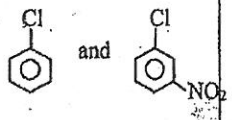
5) 

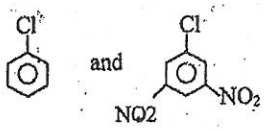
14. Compounds X and Y of the following reaction scheme can be,

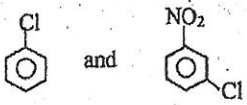


1) 

2) 

3) 

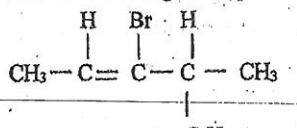
4) 

5) 

15. Temperature in which mean square speed of CH_4 at 27 °C becomes equal to that of O_2. (C-12 , H-1, O-16)

1) 177 °C 2) 327°C 3) 500 °C 4) 540 °C 5) 600 °C

16. IUPAC name of the given organic compound is,



1) 3 - bromo - 3 - methyl - 4 - hexene
2) 3 - methyl - 3 - brome - 4 - hexene
3) 3 - bromo - 2 - ethyl - 3 - pentene
4) 3 - bromo - 4 - methyl - 2 - hexene
5) 4 - bromo - 4 - ethyl - 2 - pentene

17. When a gas undergoes expansion under constant temperature.

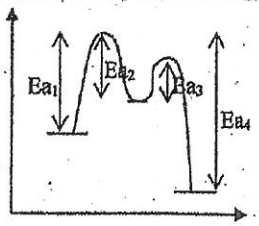
a) pressure reduces
b) kinetic energy is not changed.
c) mean kinetic energy increases.
d) density of the gas reduces.

Correct statement/s is/are,

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

18. $A + 2B \rightleftharpoons AB_2$

Given below is the potential energy diagram of the above reaction.



correct statement regarding the above reaction is,

a) First step is the slowest step.
b) activation energy of the reverse reaction is Ea_3
c) enthalpy change is given by the difference between the activation energies of forward and backward reactions.
d) Rate expression of the above reaction is $R \propto [A]\,[B]$.

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

19. Correct statement regarding equilibrium of Fe^{3+}/SCN^- system is,

1) Dark red turns pale when some Fe^{3+} aqueous solution is added to the above system at equilibrium.
2) Only Fe^{3+} and SCN^- ions are present in the system.
3) When a base is added complex is formed in excess and colour intensity increases.
4) Equilibrium constant (K_c) increases when a catalyst is added.
5) When excess SCN^- is added, rate of the forward reaction forming $[Fe(SCN)]^{2+}$ increases.

20. Which of the following reaction will not happen when a piece of Na is exposed to air,

1) $4Na + O_2 \longrightarrow 2Na_2O$
2) $Na_2O + H_2O \longrightarrow 2NaOH$
3) $Na_2O + CO_2 \longrightarrow 2Na_2CO_3$
4) $2Na + 2H_2O \longrightarrow 2NaOH + H_2$
5) $Na_2O_2 + 2\,H_2O \longrightarrow H_2O_2 + 2NaOH$

21. $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ $\Delta H = (-)$

Correct statement regarding the above system at equilibrium is,

1) Value of Kp can be changed by changing partial pressure.
2) In the above system $K_p = K_c$.
3) Equilibrium is disturbed by the addition of a catalyst.
4) When temperature is increased, the rate of the forward reaction is increased.
5) K_c of the above equilibrium is dm^6mol^{-2}.

22. At 600 K CO reacts with $H_2(g)$ gas forming $CH_3OH(g)$. Relationship between k_p / k_c of the following equilibrium is correctly given by,

$$CO(g) + H_2(g) \rightleftharpoons CH_3OH(g)$$

1) $k_p / k_c = 1$ 2) $k_p / k_c = (RT)^2$ 3) $k_p = \dfrac{k_c}{(RT)^2}$

4) $k_p / k_c = \dfrac{1}{(RT)}$ 5) $k_p / k_c = RT$

23. Which of the following group/s contain/s amphoteric oxides only.
a) Cr_2O_3 , MnO_2 b) FeO, CrO_3 c) Cr_2O_3, CuO d) ZnO, MnO_2

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

24. Increasing order of the water solubility of the following compounds is,
1) BaO < SrO < CaS < MgO 2) MgO < CaO < SrO < BaO
3) MgO < SrO < CaO < BaO 4) BaO < CaO < SrO < MgO
5) CaO < MgO < SrO < BaO

25. When20g of a sample of $MgCO_3$ which contains MgO as an impurity is decomposed completely, reduction of mass is 8.8 g. Mass percentage of $MgCO_3$ in the sample is, (Mg - 24, C - 12, O - 16)
1) 60% 2) 70% 3) 84% 4) 74% 5) 87%

26. Compound A
1. Shows steriolsomerism.
2. The product formed when A is heated to 170°C with conc. H_2SO_4, shows diasteriomerism.
3. The product formed when A is heated with alcoholic KOH, reacts with $NaNH_2$ forming NH_3 gas.
Structure of the compound A is,

1) $CH_2OH(CH_2)_3CH_2BrCH_2Br$ 2) $CH_3CHOH(CH_2)_2CHBrCH_2Br$
3) $CH_3CH_2CBr(OH)CH_2CHBrCH_3$ 4) $CH_2Br-CH_2-CH_2-CHBr-CH_2-CH_2OH$
5) $CH_3-CHOH-CH_2-CHBr-CH_3$

27. Incorrect statement regarding electro negativity is,
1) Electronegativity increases with S character of the hybrid orbital.
2) Electronegativity increases with increasing positive charge.
3) Electronegativity of C in $H-\overset{O}{\overset{\|}{C}}-OH$ is greater than that of $H-\overset{O}{\overset{\|}{C}}-H$
4) Electronegativity of N increases in the order of $NH_2^- < NH_3 < NH_4^+$.
5) Electronegativity increases when the oxidation number of the central atom.

28. Composition of Mg^{2+} in ppm, of a $1x\ 10^{-3}$ $moldm^{-3}$ $MgSO_4$ solution is,
1) 10 2) 20 3) 30 4) 40 5) 50

29. Which of the following reaction does not occur.
1) $3CuO + 2NH_3 \longrightarrow N_2 + 3Cu + 3H_2O$
2) $3Mg + NH_3 \longrightarrow Mg_3N_2 + 3H_2(g)$
3) $S + 6NaOH \longrightarrow 2Na_2S + Na_2S_2O_3 + 3H_2O$
4) $AsCl_3 + 3H_2O \longrightarrow H_3AsO_3 + 3HCl$
5) $Br_2 + 2KCl \longrightarrow 2KBr + Cl_2$

30. An lorganic solid X forms a colourless solution & a coloured gas when treated with dil. HCl. When the gas is compressed it turns colourless. The above solution gives purple colour in the flame test. X solid is,
1) K_2SO_3 2) $BaSO_3$ 3) KBr 4) KNO_2 5) $CuBr_2$

* **Instructions for question No 31 to 40**

For each of the questions 31 to 40, one or more responses (a), (b) , (c) and (d) given is/are correct. Select the correct response/responses. In accordance with the instructions given on your answer sheet, mark

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

Summary of above information				
(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	If any other number or combination of responses correct

31. Correct statement regarding group 15 is,
(a) NO_2 reacts with water forming a mixture of HNO_2 and HNO_3
(b) Basicity of AsH_3 is greater than that of SbH_3.
(c) Acidity of oxides increases down the group.
(d) PH_3 dissolves well in water as NH_3

32. Incorrect statement regarding the chemistry of Al is,
(a) An aqueous solutions of Al^{3+} is acidic.
(b) Both $AlCl_3$ and AlF_3 are covalent.
(c) $AlCl_3$ exist in dimeric form in aqueous solutions.
(d) Eventhough Al shows amphoteric properties , Al_2O_3 is a basic oxide.

33. Which of the following is correct regarding Gibbs free energy.
(a) Gibbs free energy is a extens.... properly state function.
(b) S° and G° of elements at standard state are zero.
(c) In a constant enthalpy system ΔG is negative only if ΔS is positive.
(d) A reaction having positive ΔH and ΔS can be made spontaneous by increasing temperature.

34. Correct statement regarding ideal gases,
a) collisions are perfectly elastic.
b) mean kinetic energy of an ideal gas under constant temperature, does not depend on molar mass.
c) Each gas molecule under same temperature has the same speed.
d) Ideal gases cannot be compressed.

35. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\Delta H < 0$
Concentration of NH_3 in the above system at equilibrium can be increased by,
a) removing $NH_3(g)$
b) decreasing the temperature.
c) adding a catalyst
d) reducing the pressure.

36. Correct statement regarding H_2O_2 is,
(a) H_2O_2 acts as an oxidizing agent.
(b) O atoms in H_2O_2 are sp^2 hybridized.
(c) H_2O_2 disproportionate to H_2O and H_2 in the presence of light.
(d) H_2O_2 is a disinfectant.

37. Correct statement regarding d block elements is / are,
(a) TiO_2 is a white compound.
(b) Stable oxidation number of all d block elements is +2.
(c) Boling points of transitional elements of 3d series is greater than that of s block elements of the same period.
(d) All metals of d block form stable ammine complexes.

38. Correct statement/s regarding s block element is/are,
(a) All elements of group I react with oxygen forming superoxide as the major product.
(b) All metal hydroxides of s block dissolve well in water.
(c) thermal stability of carbonates of s block increase down the group.
(d) All compounds s block elements form colourless solutions.

39. Which of the following is true regarding $KMnO_4$
(a) It is a strong oxidizing agent as well as a primary standard.
(b) Under high NaOH concentrations $KMnO_4$ disproportionate into K_2MnO_4 and O_2
(c) It is used to produce O_2 and Cl_2 in the laboratory.
(d) In the presence of reducing agent $KMnO_4$ reduces to Mn^{2+} the acidic medium and form brown coloured MnO_2 in basic medium.

40. Which of the following statement/s is/are correct.
(a) pure HNO_3 acid is a yellow color liquid.
(b) NO_2 is a brown gas.
(c) NO is a neutral gas.
(d) Concentrated HNO_3 is a strong reducing agent.

* **Instructions for question No. 41 to 50**

In question no. 21 to 25, two statements are given in respect of each question.
From the table given below, select the response out of the responses (1), (2), (3), (4), (5) that best fits the two statements given for each of the questions and mark appropriately on your answer sheet.

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.	When Na_2CO_3 is added to an aqueous solution of Al^{3+} gas bubbles are evolved.	Al is an amphoteric element.
42.	If the order with respect to one reactant is zero it does not involve in the mechanism of the reaction.	If order with respect to one reactant is zero, it is not seen in the rate expression.
43.	Reaction between Cl_2 and NaOH is an example for a disproportionation.	HOCl disproportionate to Cl^- and ClO_3^- in the presence of a strong base.
44.	MnO_2 reacts with H_2O_2 in the presence of dil. H_2SO_4 forming O_2 gas.	H_2O_2 is a heterogeneous catalyst which increases the rate of decomposition of H_2O_2.
45.	Acidic strength of HBr(aq) is greater than that of HCl(aq).	bond length of H – Br is greater than that of H – Cl
46.	A Catalyst increases the rate of a reaction.	A catalyst increases the negative value of ΔG of a reaction.
47.	$A_2B_2(s) \longrightarrow A_2(g) + B_2(g)$ $\Delta H^0 = 300$ kJmol^{-1} The above reaction is spontaneous at 25^{0}C.	$A_2B_2(s) \longrightarrow A_2(g) + B_2(g)$ $\Delta H^0 = 300$kgmol^{-1} If the above reaction happens in a closed system randomness of surrounding increase.
48.	 undergoes nitration easier than benzene.	When the electron density on benzene ring increases, electrophilic reagents easily react with benzene ring.
49.	Boiling point of HF is greater than that of H_2O.	Dipole moment of HF is greater than that of H_2O.
50.	Acidic $KMnO_4$ can be used to distinguish $CH_3C \equiv CCH_3$ and $CH_3 - CH_2 - C \equiv C - H$	Acidic $KMnO_4$ can oxidize terminal alkynes.

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Manasa Sanvurdha Dheera

දේවි බාලිකා විද්‍යාලය - කොළඹ
DEVI BALIKA VIDYALAYA – COLOMBO

Grade 12 Third Term Test – July 2018

රසායන විද්‍යාව II
Chemistry II

02 E II

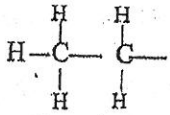
පැය තුනයි
Three hours

Name: ..... Grade: ..... Index No : .....

Instructions:

* Use of calculators is not allowed.
* A periodic table has been provided.
* Universal gas constant $R = 8.314\ JK^{-1}\ mol^{-1}$
* Avogadro constant $N_A = 6.022 \times 10^{23}\ mol^{-1}$
* Plank's constant $h = 6.626 \times 10^{-34}\ Js$
* Speed of light $c = 3 \times 10^{8}\ ms^{-1}$

* When you provide answers for 4th and 7th questions alkyl groups can be represented in a condensed form.

Example  group can be represented as $CH_3 - CH_2 -$

☐ **Part A – Structured Essay (pages 2 –8)**

* Answer **all the questions** on the question paper itself.
* Write your answer in the space provided for each question. Please note that the space provided is sufficient for the answer and that extensive answers are not expected.

☐ **Part B Essay (pages 9– 14)**

* Answer two questions Use the papers supplied for this purpose.
* At the end of the time allotted for this paper, tie the answers to the 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 Part B of the question paper from the Examination Hall.

For Examiner's Use Only

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

Final Marks

In numbers	
In letters	

Code Number

Marked By	
Checked By 1	
2	
Supervised by	

Part A – Structured Essay

Answer all questions on this paper it-self. (Each question carries 10 marks)

01) a) Arrange the following in increasing order of the property given in paranthesis.

i) H^-, He^+, Li^{2+}, Be^{2+} (ionic radius) :.....

ii) Li^+, Li, Be, Be^{4+} (effective nuclear charge) :.....

iii) NO_2^-, NO_2, NO_2^+, NOF_3, (bond length) :.....

iv) $CH_3CH_2NH_2$, CH_2CH_2OH, CH_3CH_2F, C_3H_8 (boiling point) :.....

v) NO_3^-, NO, CH_3NO_2, NH_2OH (N – O bond angle) :.....

vi) HCN, C_2H_2, C_2H_4, C_2H_6 (electronegativity on C atom) :.....

b) Many modern vehicles are installed with air bags to minimize injury caused to the passengets during any immergency accident. Air bags contain solid sodium acide. NaN_3 at a sudden pressure NaN_3 dissociates to sodium and nitrogen gas.

i) Write the balanced chemical equation for the dissociation of sodium acide.

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ii) In a crash on air bag was filled up with 72.0 dm^3 of nitrogen gas at room temperatuer and pressure.
Calculate the mass of sodium required to produce the above volume.
(The molar volume of a gas at room temperature and pressure is 24.0 dm^3 , Na = 23, N = 14, O = 16)

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iii) When sodium azide is reacted with dilute HCl, NaCl and another product "A" is formed. If A contains 2.3% H, and 97.70% N, find the molecular formular of A.

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iv) Write the balanced chamical equation between sodium azide and dilute HCl.

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v) Draw resonance structures for the azide ion (N_3^-)

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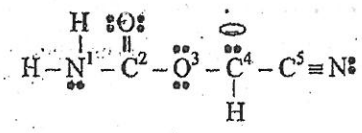
C) i) Based on the hypothetical Lewis structures given below, state the following regarding the numbered C, N and O atoms given in the table below.

I) VSEPR pairs around the atom
II) electron pair geometry around the atom.
III) shape
IV) hybridization
V) bond angle



		N^1	C^2	O^3	C^4	C^5
I	VSEPR pairs around the atom					
II	electron pair geometry around the atom.					
III	shape					
IV	hybridization					
V	bond angle					

ii) Identify atomic / hybrid orbital's involved in the formation of the following σ bonds in the Lewis structure given in part (C) (i) above.

I) $N^1 - C^2$: N^1 ..... C^2 .....
II) $C^2 - O^3$: C^2 ..... O^3 .....
III) $O^3 - C^4$: O^3 ..... C^4 .....
IV) $C^4 - C^5$: C^4 ..... C^5 .....

iii) Fill the table given below for an atom with principal quatum number n =2.

Azimuthal quantum number (*l*)	Corresponding subshell	Magentic Quantum number (m*l*)	Maximum number of electrons in each substell

iv) Identify the types of intermolecular forces present in I, II and III given below.

I) $C_2H_5OH(aq)$ solution :.....
II) a solution containing :.....
III) dilute NaCl solution :.....

v) 'The melting point of CCl_4 is greater than that of CH_3F' Giving reasons, state whether this statement is true or false.

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02) a) Sulphur is an active non metallic element which forms many allotropic forms.

i) State four oxidation states of S and give one example for each oxidation state.

Oxidation number				
Compound				

ii) X and Y are 2 stable oxides of sulphur. X is angular while Y is trigonal planer. Draw Lewis structures of X and Y.

X -

Y -

iii) Write balanced chamical equations for the reactions taking place when gas X identified in (ii) above, reacts with the following.

I) $H_2SO_4 + KMnO_4$

.....

II) Heating with excess Mg

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III) The oxide X bleaches the wet coloured spiecies (Y).Once bleached the coloured species has the form H_2X. Write balanced chemical equations for the reactions taking place.

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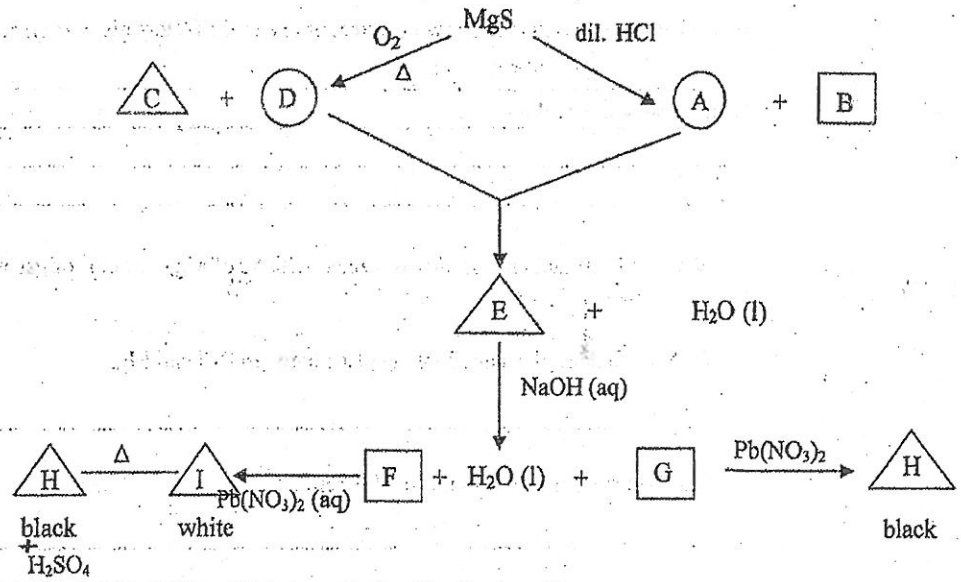
b) Identify compounds A to I given in the following reaction scheme, where solids, gases and liquids a represented as △ , ○ and □ respeotively.



A ..... B ..... C .....

D ..... E ..... F .....

I .....

C) An aqueous solution contains Na_2SO_3 and Na_2SO_4. The following procedure was used to determine the concentrations of the salts in the above solution.

1) A 25.0 cm^3 portion of solution was treated with 25.0 cm^3 dilute HCl and excess $BaCl_2$ solution was added, The dry mass of the precipitate was 466 mg.

2) Another 25.0 cm^3 portion of solution X was treated with dilute HCl as above and then treated with H_2O_2 followed by excess solution of $BaCl_2$. The dry mass of the precipitate was 699 mg. (Ba – 137 , S-32, O -16)

i) Write the balanced chemical equation for the reaction taking place when H_2O_2 is added.

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ii) Calculate the concentrations of Na_2SO_4 and Na_2SO_3 in solution X.

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03) i) State three factors that affect the rate of a reaction.

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ii) Briefly explain an experiment to show the effect of one of the factors given in (i) above.

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iii) When 100 cm^3 of 2.0 mol dm^{-3} HCl was reacted with 5g of Mg, 120 cm^3 of gas was collected at 27^{0}C and 4.157 x 10^5 Nm^{-2}.

a) Write the balanced equation taking place between HCl and Mg.

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b) Calculate the number of moles of H_2 liberated.

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c) Find the rate of consumption of HCl.

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d) Find the rate of the reaction.

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iv) Given below is an experiment designed to find the order with respect to Fe^{3+} in the reaction between Fe^{3+} and KI.

Exp. No.	Volume of 0.1 mol dm^{-3} Fe^{3+} (aq)	Volume of 0.005 mol dm^{-3} $Na_2S_2O_3$ (aql)	Volume of 1 mol dm^{-3} H_2SO_4 (aq)	1.0 mol dm^{-3} H_2SO_4 cm^3	1.0 mol dm^{-3} KI cm^3	Drops of starch	Time taken for the solution to turn blue
1	5.0	10.0	0.0	10.0	25.0	2	12
	4.0	10.0	1.0	10.0	25.0	2	15
3	3.0	10.0	2.0	10.0	25.0	2	21
4	2.0	10.0	3.0	10.0	25.0	2	31
5	1.0	10.0	0.4	10.0	25.0	2	T

i) Write the balanced chemical equation for the reaction taking place between KI and Fe^{3+}

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ii) If the rate of the reaction $[Fe^{3+}(aq)]^n$, Find the volume of n.

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iii) Why is the volume of $Na_2S_2O_3$ added a constant for all experiments?

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iv) What is the purpose of starch in this experiment

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v) Express the amount of Fe^{3+} left in experiment (4), as a percentage at the time when the solution turns blue.

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vi) Calculate the time taken for the blue colour to appear in experiment (s).

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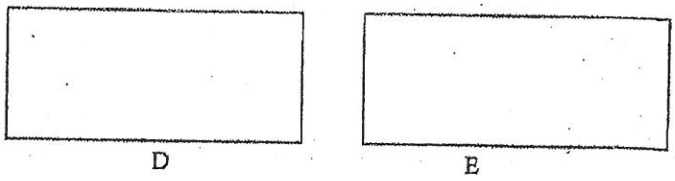
04) a) A, B and C are three isomeric alphatic hydrocarbos, where each isomer has two sp hybridized carbon atoms and three sp^3 hybridized carbon atoms.

- A and C form a white precipitate with ammonical $AgNO_3$
- When A, B and C undergo catalytic hydrogenation, A and B form the same compound D. where as C forms E.

i) Identify A, B, C, D and E and draw their strructures.

A B C



D E

ii) When C is reactal as follows, X is formed,

C $\xrightarrow[Y]{\text{Addition of water}}$ X

.....

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I. Draw product X.

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II. State reaction conditions Y.

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b) When 2-methyl-2-butene is reac8teud with HBr in a polar medium a mixture of two pruducts are formed where the percentage of one product is higher. Explain this observation using the reaction mechanism.

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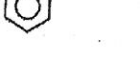
c) i) State `the major products and the reaction pathways for the reaction given in the following table. Choose the reaction pathways from the following list.

1) Exletrophilic addition
2) Radial substitution
3) Elimination
4) Electrophilic substitution
5) Acid – Base

Reaction No.	Reactant	Reagent	Major product	Reaction pathway
1	$CH_3 - CH = CH - CH_3$	Br_2 / CCl_4		
2	CH_4	Dispersed sunlight Cl_2		
3		Anhydrous $AlCl_3$ 		
4	$CH_3 - C \equiv C - H$	Ammonical Cu_2Cl_2		
5	$CH_3 - \underset{\displaystyle CH_3}{\underset{\vert}{CH}} - CHBr - CH_3$	Heating with alcoholic KOH		

ii) Complete the following reaction by giving the proper reagents and reaction conditions.

1) 

2) $CH_3 - CH_2 - CH = CH_2 \longrightarrow CH_3 - CH_2 - \overset{\displaystyle OH}{\underset{\vert}{CH}} - \overset{\displaystyle OH}{\underset{\vert}{CH_2}}$

3) $CH_3 - \underset{\displaystyle CH_3}{\underset{\vert}{C}} = CH - CH_3 \longrightarrow CH_3 - \underset{\displaystyle CH_3}{\underset{\vert}{CH}} - CH\,Br - CH_3$

4) $CH_3 - CH_2 - C \equiv C - CH_3 \longrightarrow CH_3 - CH_2 - \overset{\displaystyle O}{\overset{\Vert}{C}} - CH_2 - CH_3$

5) $CaC_2 \longrightarrow C_2H_2$

Part B – Essay

Answer two questions only. (Each question carries 15 marks)

05) a) i) Write Kc expressions for the following reactions.

I) $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

II) $NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl(g)$

ii) Derive an expression for the relationship betweren Kc and K_p.

b) i) State three factors that may change an equilibrium, in an equilibrium system.

ii) Give a simple experiment to show the effect of one of the factor mentioned above.

iii) Explain the observations of the above experiment using Le Chateliers principle.

iv) Consider the following equilibrium reaction.

$2A(g) + B(g) \rightleftharpoons A_2B(g) \quad \Delta H < 0$

State the change of the equilibrium position and the equilibrium constant that takes place when the following changes are done to the above dynamic equalibrium system.

I. addition of A_2B (g) when temperature and pressure are constant.

II. increasing the temperature when volume is constant.

III. decreasing the volume at constant temperature.

IV. addition of a catalyst of constant temperature.

c) Consider the following reaction

$2P(g) \rightleftharpoons Q(g) + R(g)$

0.5 mol of gas P was inserted into a vessel of volume 2.0 dm^3 and allowed to reach equilibrium at 27^0C.

It was found that 40% of P has dissociated at equilibrium.

i) Find the number of moles of P, Q and R. present in the equilibrium mixture at 27^0C.

ii) Calculate Kc at 27^0C

iii) Calculate Kp at 27^0C using Kc.

iv) The temperature of the initial system was raised to 127^0C. The equilibrium constant Kp at 127^0C is 4. Calculate the number of moles of P, Q and R in the new equailibrium system.

v) Using the answer in (iv) above state whether the forward reaction of the equlibrium is endothermic or exothermic.

vi) Calculate the total pressure and the partial pressure of each gas when 1.0 mole of He gas was introduced to the equilibrium mixture at 127^0C.

6) a) Using the following thermochemical data, answer the given below.

Standard lattice enthalpy of $MgCl_2(s)$	$-2520\ kJmol^{-1}$
Standard enthalpies of first and second ionization of Mg(g)	$+2185\ kJmol^{-1}$
Standard enthalpy of bond dissociation of $Cl_2(g)$	$+432\ kJmol^{-1}$
Standard enthalpy of electron affinity of Cl(g)	$-380\ kJmol^{-1}$
Standard enthalpy of sublimation of Mg(s)	$+140\ kJmol^{-1}$
Standard enthalpy of atomization of Mg(s)	$+165\ kJmol^{-1}$

i) Write thermochemical equations for the processes given above.

ii) Using required data from above , calculate the standard enthalpy of formation of $MgCl_2$ (s)

iii) At 27°C

$MgCl_2(s) \longrightarrow MgCl_2(aq)$ $\Delta H^\circ = -171.5\ kJ\ mol^{-1}$

Entropy of $MgCl_2(s)$ $S^\circ = +315.7\ JmoI^{-1}K^{-1}$

Entropy of $MgCl_2(aq)$ $S^\circ = +318.2\ JmoI^{-1}K^{-1}$

Show by a suitable calculation that following process is spontaneous at 27°C

$MgCl_2(s) \longrightarrow MgCl_2(aq)$

b) i) Give two differences between ideal gasses and real gasses.

ii) Using the Ideal gas equation , derive the Dalton's law of partial pressure .

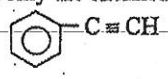
iii) A rigid container of V volume contains He gas and Ne gas at 27°C and 6.0×10^4 Pa pressure. Another container of V volume containing O_2 gas is connected to the above container. The temperature of these containers was maintained at 127 °C. Then the pressure of the combined container increased to 5.2×10^5 Pa. If the initial partial pressure of Ne was twice the initial partial pressure of He calculate the mole fraction of He in the combined container at127 °C.

iv) State two assumptions made in the above calculation.

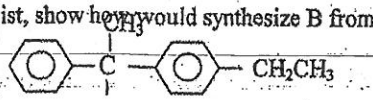
c) At 27°C a 10 dm^3 glass vessel contains 0.15 moles of H2 gas at $1.0 \times 10^5\ Nm^{-2}$ pressure. the compressibility factor of $H_2(g)$ at 27°C .

(At 27°C $RT = 25 \times 10^2\ Nm\ mol^{-1}$)

07) a) i) Using only the chemicals given below in the list, show how would synthesize B from A.



(A)



(B)

List of chemicals

HBr, H_2, Pd, Anhydrous $AlCl_3$, Quinoline, $BaSO_4$

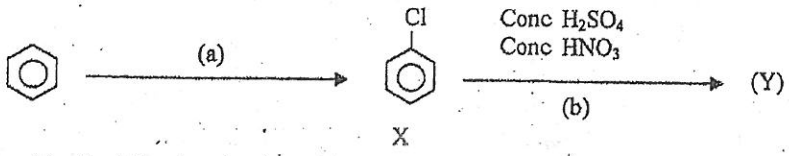
ii) Show how you would to the following convertion.

$BrCH_2CH_2CH_2OH \longrightarrow CH_3CH_2CH_3$

b) i) Write the mechanism for the nitration of benzene.

ii) State the electrophile of the above mechanism.

iii) What is the purpose of HSO_4^- in the above mechanism



Consider the following reaction scheme.

iv) State reagent (a)

v) Draw product (Y)

c) Show how you would distinguish the following chemical compounds.

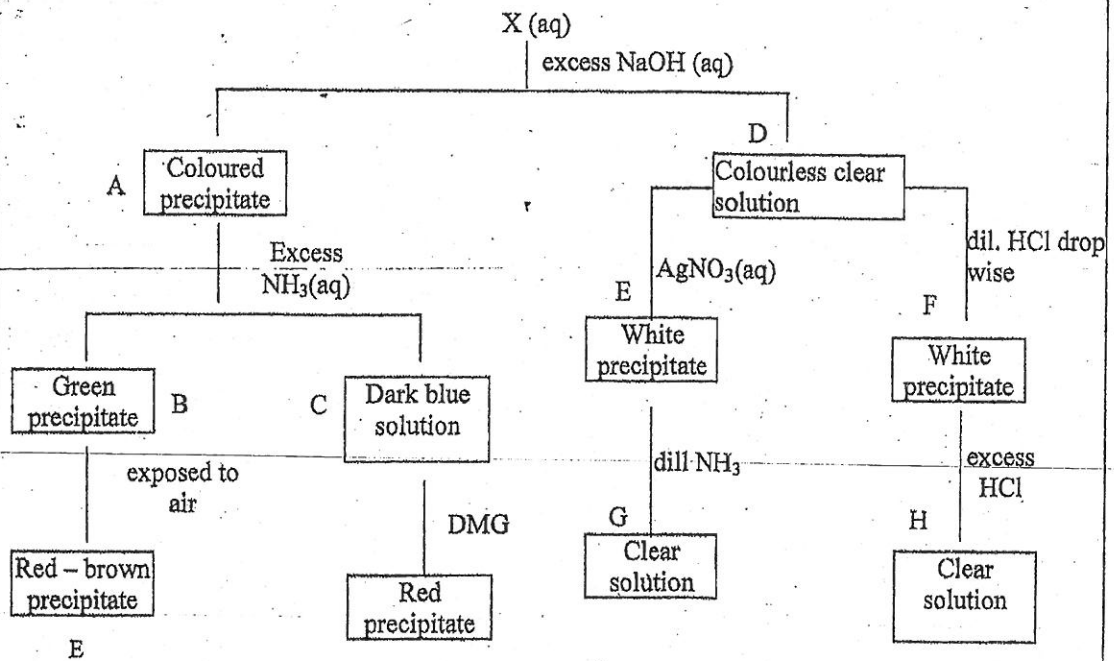
i) $CH_3CH_2CH = CH_2$ and $CH_3CH = CHCH_3$

ii) $CH_3\underset{OH}{C}HCH_2CH_2Cl$ and $CH_2CH_2CH_2\underset{Cl}{C}HOH$

Part C – Essay

Answer two questions only. (Each question carries 15 marks)

08) a) solution X contains 3 cations from the d – block and one anion. The folloiwing scheme was usel to analyse the ions.



i) Write chemical formulae for the compounds from A to I.

ii) Identify the three cations and the anion in solution X.

b) Aqueous solution S contains theree anions. The following tests were done to identify the anions.

	Test	Observation
I	$BaCl_2$ solution was added	A white precipitate was formed.
II	Dil. HCl was added to the precipitate in I.	The white precipitate dissolved evolving a colourless gas.
III	The gas evolved in II above was passes through H_2O_2 and $BaCl_2$ was added to the resultant solution	A precipitate was formed.
IV	Dil. HCl was added to the precipitate formed in (III) above	Precipitate did not dissolve.
V	Dill HCl was added to the filtrate in(I) above.	A colourless gas evolved.
VI	The gas obtained in (v) above was passed on to a filter paper soaked with $Pb(CH_3COO)_2$	Black spots were observed.
VII	A portion of solution S was heated with NaOH and Al powder.	A gas that turned Nessler's reagent brown was evolved.

i) Identify the three anions in solution S.

ii) Write balanced chamical equartion for the reactions taking place in (III) and (VII) above.

c) Identify the compounds given below by using the method prodide.

i) $ZnCl_2$ solution.
dil. NH_3 solution.
$Al(NO_3)_3$ solution.
} mixing in pairs

ii) NaOH (aq)
$MgCl_2$ (aq)
$ZnCl_2$ (aq)
} mixing in pairs.

09) A) M is a 3d transition element which forms two coloured oxianions X and Y having the same oxidation number. X is stable in basic medium where as Y is stable in acidic medium. M shows two more stable oxidation states. Aqueous solution of M with the lowest positive oxidation number (A) is blue violet in colour. When dilute NaOH is added drop wise to this blue violet solution a green precipitate (B)was formed which dissolved in excess NaIH forming a green solution. (C) When excess conc. NH_3 added to 9C the precipitate B, a blue violet solution (D) is formed.

i) Identify M.

ii) Write the electronic configuration of M.

iii) Write molecule formulae for the compounds given by A, B, C and D.

iv) Write the formular of X and Y and state their colours.

v) Write the balanced chemical equation for the transformation of X to Y.

vi) When H_2O_2 was added to an aqueous solution of M in basic medium, a yellow solution was obtained. Write balanced chemical equation for the reaction taking place.

b) Write balanced chemical equations for the followings.

i) $MnO_2 + H_2O_2 + H_2SO_4 \longrightarrow$

ii) $SO_2 + H_2SO_4 + K_2Cr_2O_7 \longrightarrow$

iii) Excess $H_2S + Na \longrightarrow$

iv) $Cl_2 + NH_3 \longrightarrow$

v) $PCl_3 + H_2O \longrightarrow$

c) i) A sample of $NaNO_3$ is contaminated with $NaNO_2$. This sample was dissolved in water and a solution at 250.00 cm^3 was prepared. 23.6 cm^3 of 0.1 mol dm^{-3} acidic $KMnO_4$ was used to react completely with 25 cm^3 of the above solution.
Find the mass of $NaNO_2$ in the sample.
(Na = 23, N = 1, O = 16)

ii) Test tubes labelled A to D contain the following solids (not in order) $MgCO_3$, NH_4NO_3, $NaNO_3$ and Na_2SO_3.
Identify the compounds by the test and observation given below.

A Insoluble in water and addition of dil. HCl to its aqueous solution evovles a gas which bleaches a wet, coloured flower petal.

B Insoluble in water.

C Soluble in water and forms a basic gas when heated with a strong base.

D Soluble in water and the product formed by thermal decomposition evolves a brown colour gas by the addition of HCl

10) A) A mass of 15.0 g of a sample containing KNO_3 and $Ba(NO_3)_2$ was heated until a constant mass was obtained, The residue formed, was dissolved in water and a 500.0 cm^3 solution was prepared. 20.00 cm^3 of 0.02 $moldm^{-3}$ acidified $KMnO_4$ was added to 10.00 cm^3 of the above solution.

i) Write balanced chemical equations for the decomposition reaqctions of KNO_3 and Ba $(NO_3)_2$

ii) Write t4he following for the reaction between $KMnO_4$ and the above aqueous solution.

a) Reduction half reaction.

b) Oxidation half reaction.

c) Balanced ionic equation.

After the reaction the resultant solution was poured in to a titration flask and titrated against 0.05 mol dm^{-3} $H_2C_2O_4$ acid. The voloume of $H_2C_2O_4$ consumed was 10.00 cm^3

iii) Write the balanced chemical equation for the reaction taking place between $H_2C_2O_4$ and $KMnO_4$.

iv) Propose an indicator for the titration.

v) Calculate the mass percentage of KNO_3 and $Ba(NO_3)_2$ in the sample.
(Ba-137, N-14, O-16, K-39)

b) A mass of 16.92g of a mixture containing $(NH_4)_2CO_3(s)$, $Na_2CO_3(s)$ and $CaCO_3(s)$ was heated until a constant mass of 7.72g was obtained. The residue was completely dissolved in dilute HCl and after the solution was neutralized and excess amount of $(NH_4)_2C_2O_4$ (aq) was added. The dry mass of the precipitate formed was 12.80 g.(Ca-40, N-14, C -12,Na -23 , O – 16 , H -1)

(i) Write balanced chemical equations for all the decomposition reactions taking place above.

(ii) Write balanced chemical equations for all the reactions taking place when dilute HCl is added to the residue.

(iii) What is the precipitate formed when $(NH_4)_2C_2O_4$ is added to the solution?

(iv) Calculate the mass of $CaCO_3$ in the sample.

(v) Calculate the masses of $(NH_4)_2CO_3(s)$ and $Na_2CO_3(s)$.

(vi) Calculate the mole ratio between $(NH_4)_2CO_3(s)$, $Na_2CO_3(s)$ and $CaCO_3(s)$.