දේවි බාලිකා විදයාලය - කොළඹ
DEVI BALIKA VIDYALAYA – COLOMBO

13 වන ශ්‍රේණිය දෙවන වාර පරීක්ෂණය – 2022 අගෝස්තු
Grade 13 - Second Term Test - August 2022

රසායන විදාව I
Chemistry I

පැය දෙකයි
Two hours

Important
- This paper consist of 14 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. Consider the following discoveries regarding atomic structure,

   I) Scientist who experimentally proved the presence of positive charges in matter.

   II) Scientist who showed the emission of α, β and γ radiation from radioactive elements.

   III) Scientist who showed that electro static attraction between the nucleus and the electrons should be equal to the centrifugal force on the electrons inorder to settle an electron in an orbital.

   1) Ernest Rutherford, Henry Becquerel, Niels Bohr

   2) Eugen Golstein, Ernest Marsden, Ernest Rutherford

   3) Eugen Golstein, Ernest Rutherford, Niels Bohr

   4) William Crookes, Henry Becquerel, Ernest Rutherford

   5) William Crookes, Ernest Rutherford, Niels Bohr

2. Number of atomic orbitals possible for quantum numbers n = 3 and $m_l = +1$,

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

3. Energy required to eject an electron from a metal surface is 540 kJ per one mole of electrons. Wave length of the required radiation for the above process is,

   1) 85 nm   2) 221 nm   3) 382 nm   4) 400 nm   5) 542 nm

4. IUPAC name of the following compound is,

$$H - C \equiv C - CH_2 - \underset{\underset{OH}{|}}{\overset{\overset{CHO}{|}}{C}} - CH_2 - CH_2 - CH_2 - CH_3$$
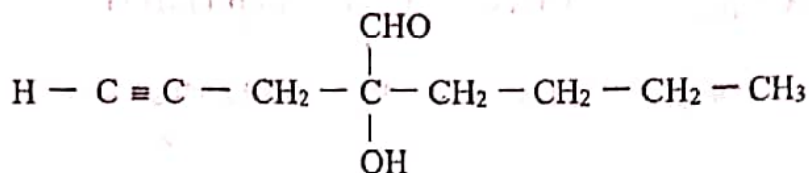
1) 4-formyl-oct-yn-4-ol

2) 4-formyl-4-hydroxyoct-1-yne

3) 2-butyl-2-hydroxypent-4-ynal

4) propyn-2-hydroxyhexanal

5) 2-hydroxy-2-butylpent-4-ynal

5. Electron pair geometry around N atom in BF_3NF_3 complex is,

1) Trigonal planar

2) Pyramidal

3) Tetrahedral

4) Octahedral

5) Trigonalbipyramidal

6. A certain mass of A_2B gas is kept in a rigid container and allowed to reach the following equilibrium at a constant temperature,

$$A_2B(g) \rightleftharpoons 2A(g) + B(g)$$

At equilibrium volume percentage of A is 20% and total pressure of the system is 1×10^5 Pa. Partial pressure of A_2B at equilibrium is,

1) 2×10^4

2) 5×10^4

3) 6×10^4

4) 7×10^4

5) 8×10^4

7. Which of the following statement is true regarding Mg and Mg^{2+} ion?

1) Third ionization energy of Mg is much greater than its second ionization energy.

2) First ionization of Mg is greater that of Al.

3) Mg shows the highest third ionization energy in the second period.

4) A large amount of energy is released during the process of $Mg(g) \rightarrow Mg^{2+}_{(g)} + 2e$
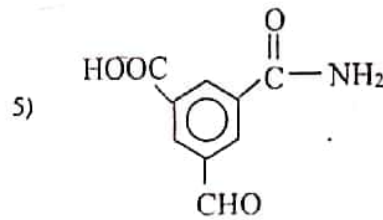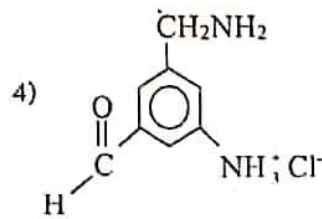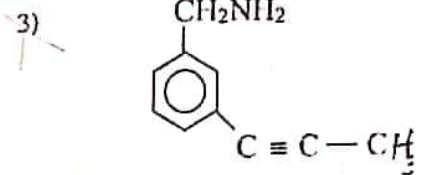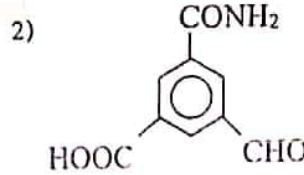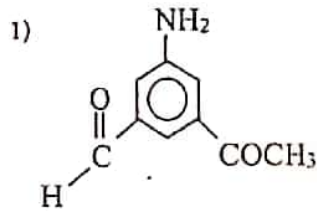
5) Second ionization of Mg is greater than that of Na.

8. In a solution containing NaCl and Na_2SO_4, composition of Cl^- is 71 ppm while composition of Na^+ is 92 ppm. Mole fraction of NaCl in the solution is, (Na-23 , Cl-35.5)

1) 1/2

2) 2/3

3) 1/3

4) 1/4

5) 3/5

9. Organic compound X,

   I) Evolves CO_2 with $NaHCO_3$ solution.

   II) Forms a silver mirror with NH_3 / $AgNO_3$.

   III) Can be reduced by $NaBH_4$

   IV) Evolves N_2 gas with $NaNO_2$

   X could be,

1)

NH₂ ... COCH₃ ... structure with CHO group

2)

CONH₂ ... HOOC ... CHO

3)

CH₂NH₂ ... C≡C—CH

4)

CH₂NH₂ ... NH₃⁺ Cl⁻

5)

HOOC ... C—NH₂ ... CHO

10. Heat change taking place when 36 g of ice at -10 °C is converted to steam at 100 °C is,

    Specific heat capacity of ice $= 2.0$ $Jg^{-1}K^{-1}$

    Specific heat capacity of liquid water $= 4.0$ $Jg^{-1}K^{-1}$

    Enthalpy of fusion of water (ΔH_{fus}) $= 6$ kJ mol^{-1}

    Enthalpy of vapourization of water (ΔH_{vap}) $= 44$ kJ mol^{-1}

    1) 115.16 kJ   2) 235.36 kJ   3) 110.25 kJ

    4) 220.35 kJ   5) 215.35 kJ

11. Solubility product of AgCl(s) in a given temperature is 1.6×10^{-11} mol^2 dm^{-6} . Solubility

    of AgCl(s) in gdm^{-3} at the given temperature is, (Ag=108 , Cl=35.5)

    1) 1.92×10^{-5} 2) 1.92×10^{-3} 3) 4×10^{-6}

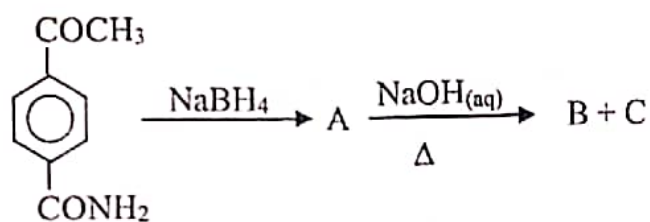   4) 1.34×10^{-3} 5) 5.74×10^{-4}

12. Equilibrium constants of the reactions given below are K_1 and K_2 respectively.

$$A(g) \rightleftharpoons 2B(g) + 2C(g) \quad K_1$$

$$D(g) \rightleftharpoons B(g) + C(g) \quad K_2$$
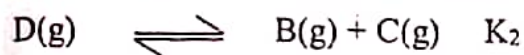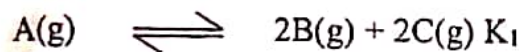
Equilibrium reaction in which equilibrium constant is given by $\dfrac{K_2^2}{K_1}$ is,

1) $\frac{1}{2}D(g) + A(g) \rightleftharpoons \frac{1}{2}B(g)$

2) $2A(g) \rightleftharpoons D(g)$

3) $2D(g) + A(g) \rightleftharpoons B(g) + C(g)$

4) $2D(g) \rightleftharpoons A(g)$

5) $D(g) \rightleftharpoons \frac{1}{2}A(g)$
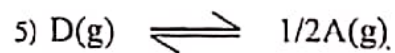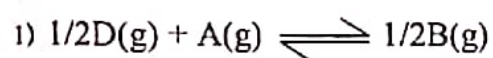
13. Consider the reaction scheme given below.

Correct Structures of A, B and C are given respectively by,

1)

$+$ H_2O

2)

$+ NH_3$

3)

$+ NH_3$

4)

$+ NH_3$

5)

$+ H_2O$
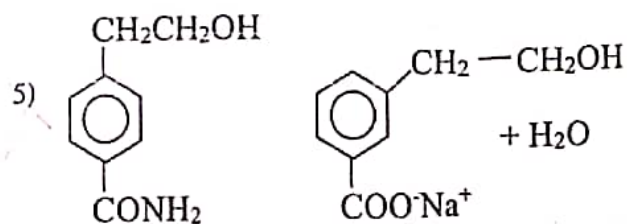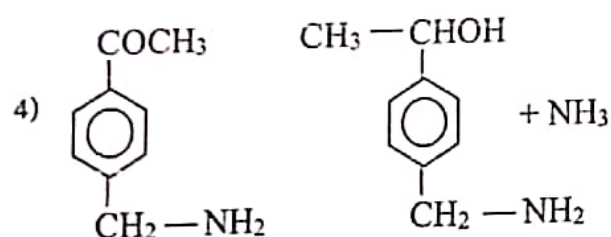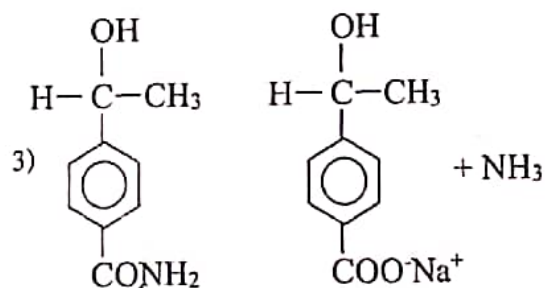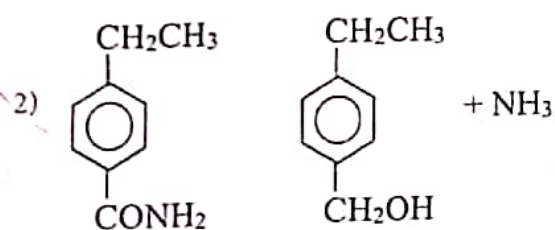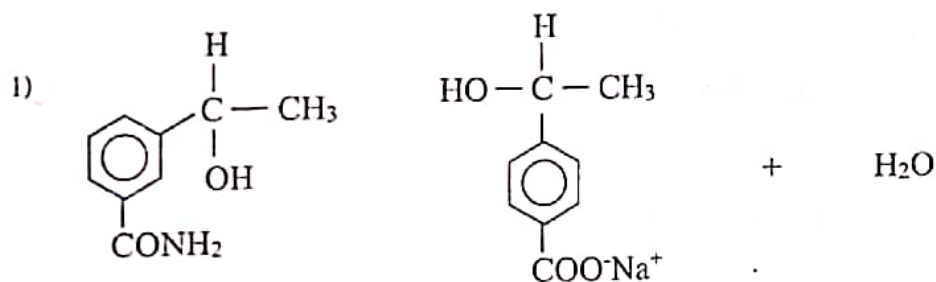
14. When a mixture containing $NaHCO_3$ and K_2CO_3 is completely decomposed volume of (heat) CO_2 obtained under STP is 112 cm³. When $BaCl_2(aq)$ is added inexcess to the above solid residue obtained after the decomposition, a precipitate of 3.94 g was formed. Mole ratio of $NaHCO_3$ and K_2CO_3 in the mixture is, (K-39 , Na-23 , C-12 , O-16 , Ba-137) Molar volume of a gas at STP =22.4 dm³)

1) 1:1 2) 1:2 3) 2:3 4) 3:2 5) 4:1

15. Which of the following statement is incorrect regarding elements of s block?

1) Strength of the metallic bond in group 2 elements is greater than that of group 1.

2) Reactivity of group 2 elements is less than that of group 1.
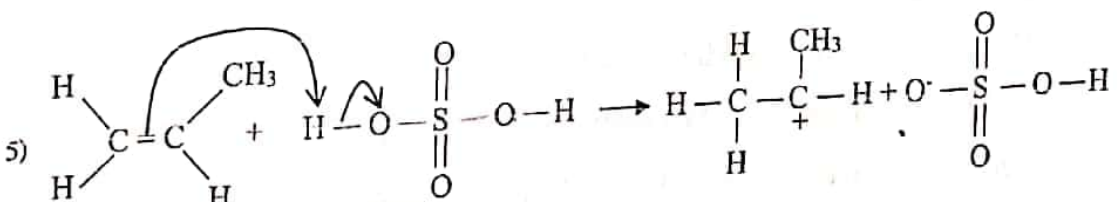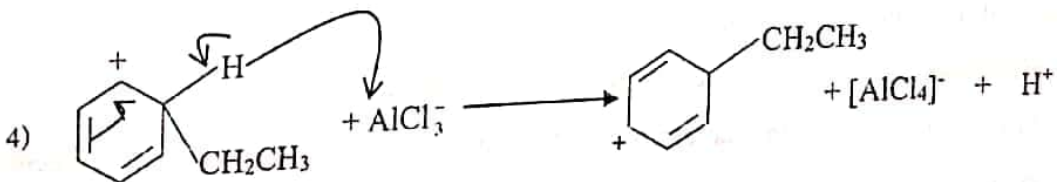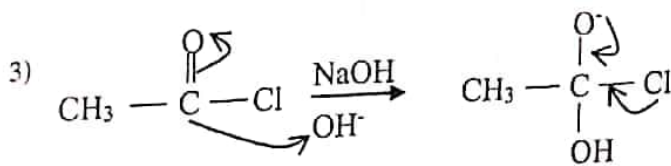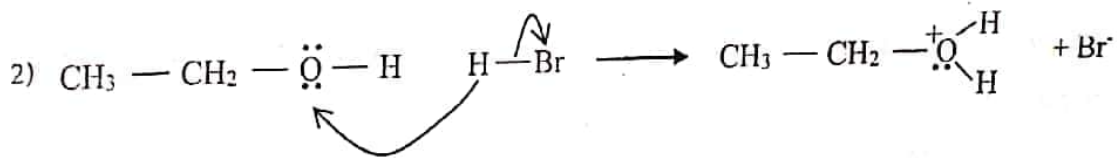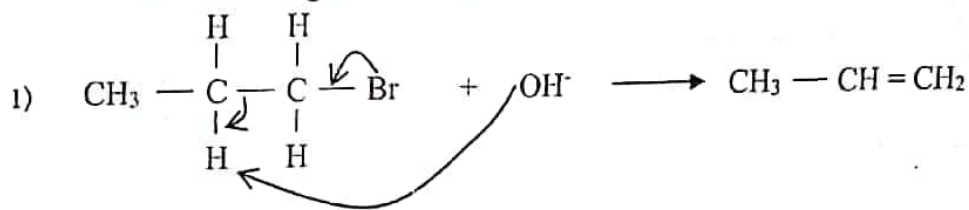
3) All compounds formed by Be are covalent.

4) Enthalpy of hydration of group 2 metal cations decreases down the group

5) Except $BeCO_3$ all the carbonates of group 2 are insoluble in water.

16. Which of the following shows a correct step of a reaction mechanism?

1) $CH_3 - \overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}} - \overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}} - Br + OH^- \longrightarrow CH_3 - CH = CH_2$

2) $CH_3 - CH_2 - \ddot{\underset{..}{O}} - H \quad H-Br \longrightarrow CH_3 - CH_2 - \overset{+}{O}\overset{H}{\underset{H}{\diagdown}} + Br^-$

3) $CH_3 - \overset{\overset{O}{||}}{C} - Cl \xrightarrow[OH^-]{NaOH} CH_3 - \overset{\overset{O^-}{|}}{\underset{\underset{OH}{|}}{C}} \overset{Cl}{\longleftarrow}$

4) [benzene with H and CH₂CH₃, + AlCl₃⁻] $\longrightarrow$ [ring with CH₂CH₃, + [AlCl₄]⁻ + H⁺]

5) $\overset{H}{\underset{H}{\diagup}}C = C\overset{CH_3}{\underset{H}{\diagdown}} + H-O-\overset{\overset{O}{||}}{\underset{\underset{O}{||}}{S}}-O-H \longrightarrow H-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-\overset{\overset{CH_3}{|}}{\underset{+}{C}}-H + O^- - \overset{\overset{O}{||}}{\underset{\underset{O}{||}}{S}}-O-H$

17. pH of a saturated solution of $Mg(OH)_2$ at 25 °C is 12. Ksp of $Mg(OH)_2$ at 25 °C in mol^3 dm^{-9} is,

   1) 4×10^{-6} 2) 2×10^{-6} 3) 5×10^{-6} 4) 5×10^{-7} 5) 4×10^{-7}

18. Correct statement regarding compounds formed by sulfur, is ,

   1) Only two oxoacids are formed by sulfur.

   2) H_2SO_4 can react with both metals and non metals forming SO_2 gas.

   3) H_2SO_4 can act as a dehydrating agent but not as a catalyst.

   4) An aqueous solution of $H_2S_2O_3$ does not undergo decomposition.

   5) NaOH, reacts with sulfur forming only $Na_2S_2O_3$ and water.

19. Progress of the reaction $A(g) \rightleftharpoons nB(g)$ with time is shown by the graph given below.
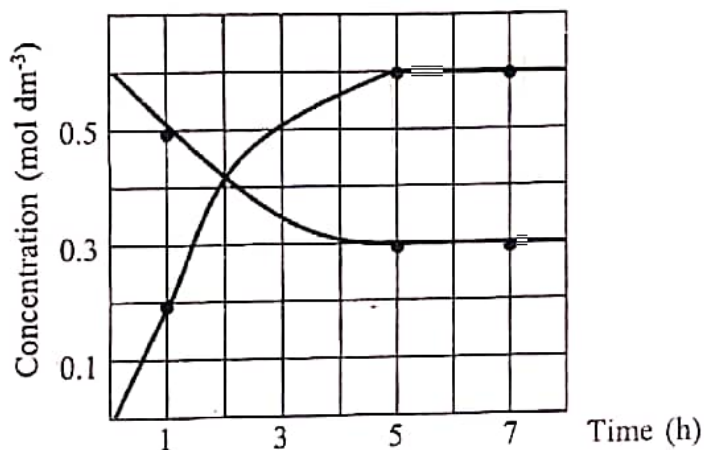
According to the graph n, equilibrium constant and initial rate of the reaction are given respectively,

   1) $2, 1.3, 0.1$ mol dm^{-3} h^{-1} 2) $2, 1.2, 0.1$ mol dm^{-3} h^{-1}

   3) $3, 1.2, 0.2$ mol dm^{-3} h^{-1} 4) $0.3, 0.3, 0.1$ mol dm^{-3} h^{-1}

   5) $2, 1.2, 0.3$ mol dm^{-3} h^{-1}

20. Which of the following is a false statement,

   1) Manganese is electropositive and dissolves in dilute acids.

   2) Mn^{2+} is formed in the reaction of permanganate ions with excess reducing agents in acidic medium.

   3) MnO_2 is amphoteric and MnO is basic.

   4) MnO_4^- is tetrahedral and $[Mn(H_2O)_6]^{2+}$ is octahedral.

   5) MnO_4^{2-} and MnO_2 are formed when MnO_4^- is acidified.

21. 75.2 g of $Fe_2(C_2O_4)_3$ is dissolved in 500.00 cm³ of water and 100.00 cm³ of it was titrated against acidified $K_2Cr_2O_7$ solution using diluted H_2SO_4. The number of moles of formed gas and consumed $K_2Cr_2O_7$ respectively are, (Fe-56, S-12, O-16, K-39, Mn-55)

1) 0.6 mol, 0.2 mol   2) 0.24 mol, 0.4 mol   3) 0.24 mol, 0.04 mol

4) 0.12 mol, 0.2 mol   5) 0.04 mol, 0.24 mol

22. True statement is,

  1) In a covalent molecule, more electro positive atom always attains the noble gas electron configuration.

  2) In an ionic bond, static electric forces between electrons hold the ions together.

  3) In an absorption spectrum, there are no set of line series with clear discrete dark lines.

  4) Number of protons in ·· isotopes of an element are different from each other.

  5) Positive rays are formed from removing electrons from atoms or molecules.

23. Following is an apparatus which can be used to clean an impure Cu sample. True statement regarding this process is,
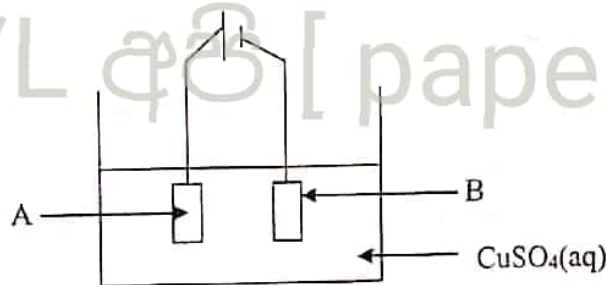
  a) Pure Cu should be connected as Electrode B.

  b) Electrode A should be the anode.

  c) Reaction $Cu(s) \rightarrow Cu^{2+}(g) + 2e$ occurs at the electrode B.

  d) At the end of the electrolysis, colour intensity of $CuSO_4$ decreases.

1) a,b   2) b, c   3) a,c,d

4) a,d   5) a,b,c,d

24. Ratio of the acid and the salt that should be maintained, inorder to prepare a buffer of pH 3 using a monoprotic weak acid HA ($Ka = 1 \times 10^{-5}$ M) and NaOH solution. is,

1) 3:5   2) 10:1   3) 1:100   4) 100:1   5) 1:10

25. Which statements of following are true?

    a) Standard enthalpy change of atomization of Mg is equal to its standard enthalpy change of sublimation.

    b) Standard enthalpy change of formation of Hg(g) is equal to standard enthalpy change of vaporization of Hg(l).

    c) Standard enthalpy change of atomization of $Br_2(l)$ is half the value of standard enthalpy change of bond dissociation of $Br_2(g)$.

    d) Standard enthalpy change of combustion of $H_2(g)$ is equal to standard enthalpy change of formation of $H_2O(l)$.

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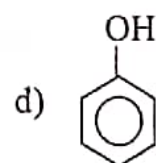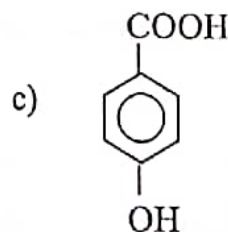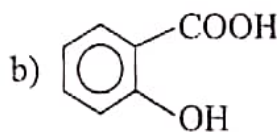
4) c,d   5) a,b,c,d

26. Select the true statement of the following.

    1) Half life of a first order reaction depends on the initial concentration of the reactant.

    2) Unit of rate constant is equal to the unit of rate of the reaction in a zeroth order reaction.

    3) Order of a reaction depends on the concentration of reactants.

    4) Rate constant of a reaction does not depend on any physical factor.

    5) Amount of the products obtained in a reaction depends on the activation energy.

27. Consider following compounds.

a) (benzene ring with COOH and NO₂ in para position)
b) (benzene ring with COOH and OH, ortho)
c) (benzene ring with COOH and OH, para)
d) (benzene ring with OH)
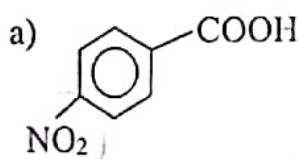
Increasing order of acidity is correctly given by,

1) b>a>c>d   2) a>b>d>c   3) c>b>d>a

4) b>a>d>c   5) a>b>c>d

Scanned with CamScanner

28. Following indicators are used in the acid base titrations.

Indicator	pH range
Phenophthalein	8.3 - 10.0
Methyl Orange	3.1 - 4.4
Methyl red	4.2 - 6.3
Bromothymol blue	6.0 - 7.6

Correct statement regarding selection of indicators for a titration is,

1) All of the above indicators can be used for the titration of NaOH and HCl with the concentrations of 1×10^{-3} mol dm^{-3} each .

2) Only bromothymol blue can be used for the titration mentioned (1) above.

3) Methyl red and phenolphthalein can be used for the titration of NH$_4$OH and HCl with the concentrations of 0.1 mol dm^{-3} each.

4) The most suitable indicator for the titration (3) is phenolphthalein.

5) As a neutral salt is formed, the most suitable indicator for the titration of NH$_3$ and CH$_3$COOH is bromothymol blue.

29. False statement regarding H$_2$O$_2$ is,

1) MnO$_2$ can be used as a catalyst in the decomposition of H$_2$O$_2$.

2) Disproportionation of H$_2$O$_2$ occurs spontaneously.

3) In the oxidation of H$_2$O$_2$, O$_2$ is formed.

4) H$_2$O$_2$ is a planar molecule.

5) H$_2$O$_2$ is used as an oxidizing agent in the oxidation of I$^-$.

30. What is the temperature at which the root mean square speed of N$_2$ molecule at 27°C is equal to that of H$_2$ molecule (N-14 , H-1),

1) 21.4 k

2) 21.4 °C

3) 25.5 k

4) 25.5 °C

5) 22.0 k

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. Following is an energy profile for the formation of product AB_3 from A and B. First step of this mechanism is a fast equilibrium.

Energy (kJmol^{-1})

Reaction Coordination
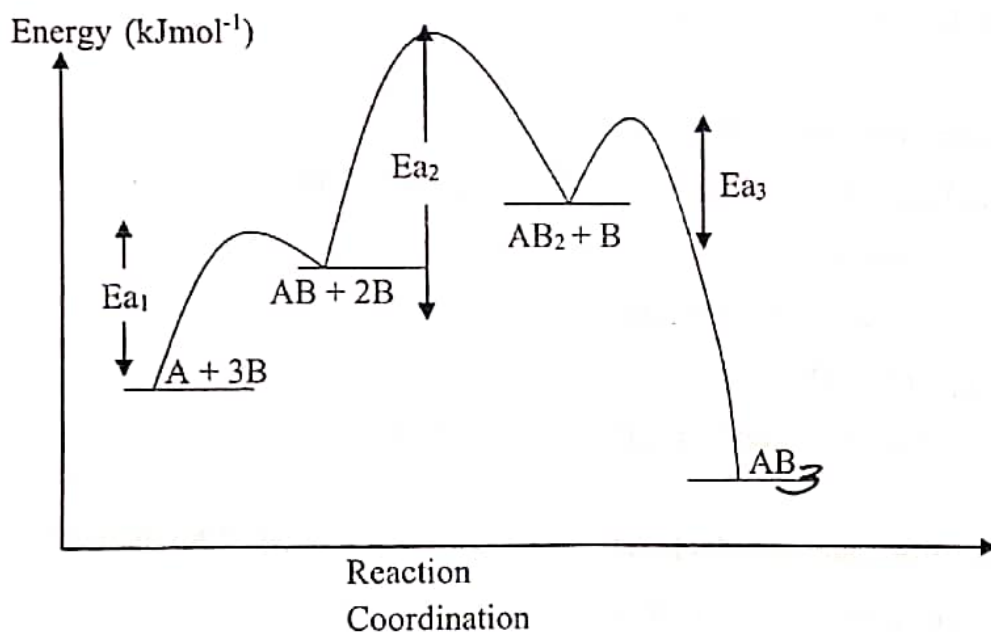
Which of the following statement/s is/are correct regarding the given energy profile,

a) Activation energy of the slowest step is EA_2

b) Rate law of the overall reaction can be written as $R = k[AB_1][B]$

c) Rate law of the rate determining step cannot be written as $R = k[AB_2][B]$

d) Rate law of the overall reaction is $R = k[A][B]^2$ and overall order is 3

32. Which of the following is/are true statement/s regarding the graph given below for the chemical reaction of $A(g) \rightleftharpoons B(g)$ which occurs in a closed container.
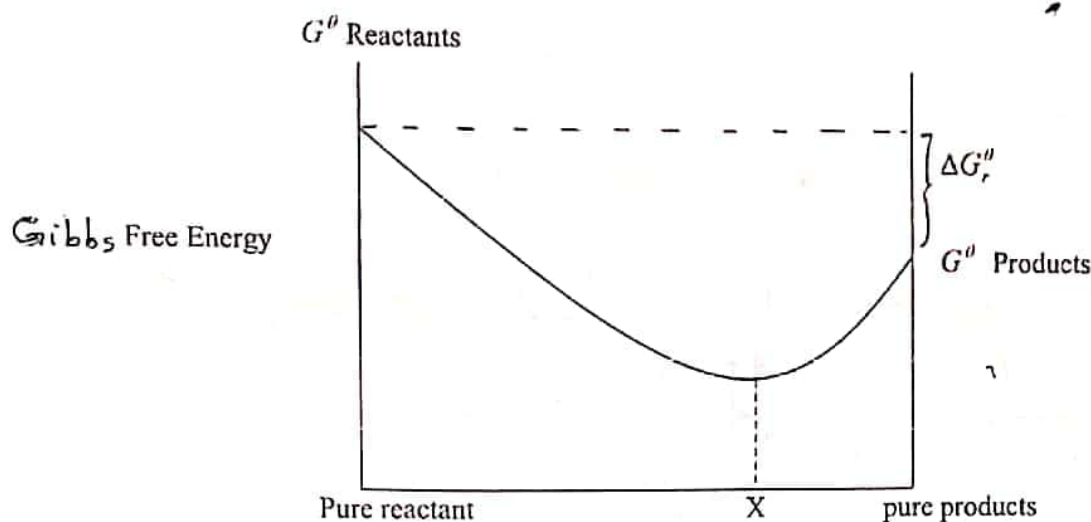
a) Equilibrium constant (K) at dynamic equilibrium is greater than 1 $(K > 1)$

b) When reaching equilibrium from reactants $-\Delta G$ value of forward reaction decreases and Qc value increases gradually.

c) Even if $\Delta G < 0$ when reaching equilibrium starting from the reactants, $\Delta G > 0$ when reaching the equilibrium starting from the products.

d) Equilibrium point is given by point X and $\Delta G = 0$ at that point.

33. Correct statement/s with respect to the d block elements in the forth period is/are,

a) Manganese has the lowest boiling point.

b) Atomic radius is higher than s block elements in the same period.

c) Cu has the highest electro negativity among those elements.

d) Vanadium has the highest boiling point.

34. False statement regarding $C_6H_5NH_2$ is,

a) NH_2 does not involve in the friedel crafts alkylation since NH_2 is not an activator.

b) Does not form a white precipitate with Br_2 water.

c) It can act as a nucleophile because of the lone pairs of electrons on the nitrogen atom.

d) It reacts with CH_3COCl.
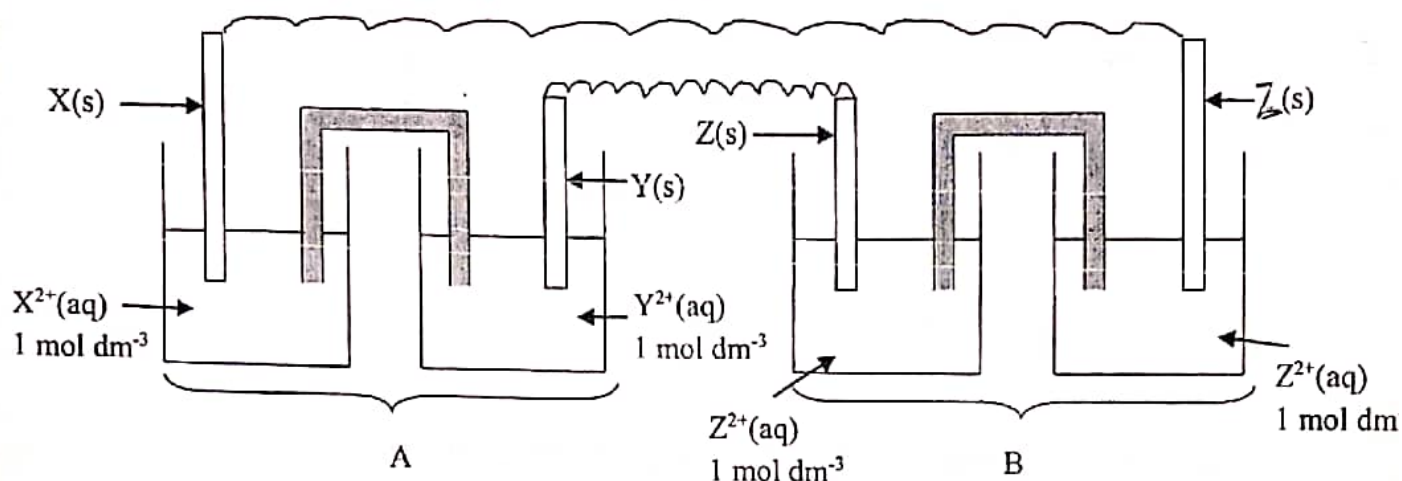
Scanned with CamScanner

35. Following apparatus was constructed using two salt bridges and four electrodes connected each other using conducting wires.

$E^0 (X_{(s)} / X^{2+}_{(g)}) = -1.0V$

$E^0 (Y_{(s)} / Y^{2+}_{(g)}) = 0.4V$

$E^0 (Z_{(s)} / Z^{2+}_{(g)}) = 0.34V$

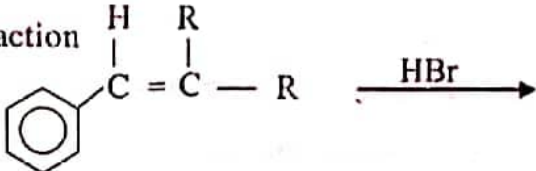correct statements regarding the following apparatus are,

a) A is the galvanic cell and B is the electrolytic cell.

b) In cell A, chemical energy is converted into electric energy.

c) Complete cell reaction that occurrs in cell B is a spontaneous process.

d) A stream of electrons flow along the external circuit from rod Z to the rod X.

36. Correct statement/s regarding nitrogen and its compounds is/are,
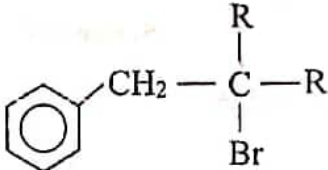
a) NO_2, H_2SO_4 and water are formed by hot concentrated HNO_3 with sulphur.

b) Nitrogen Monoxide (NO) dissolves well in water.

c) HNO_2 disproportionates easily into HNO_3 and NO.

d) The solution resulted from the hydrolysis of $NCl_3(l)$ acts as a bleaching agent.

37. False statement on halogens is,

a) Chlorine undergoes disproportionation when reacting with water and bases.

b) All hydrogen halides are strongly acidic.

c) Oxo acids are present for all the oxidation states of chlorine.

d) Oxidizing property of halogens decreases down the group.

38. True statement/s with regard to the reaction

$$\underset{\text{(with phenyl)}}{C} = \underset{|}{\overset{R}{C}} - R \quad \xrightarrow{\text{HBr}}$$

is/are,

a) It is a single step electrophilic addition reaction.

b) Major product is

$$CH_2 - \underset{|}{\overset{R}{\underset{Br}{C}}} - R$$

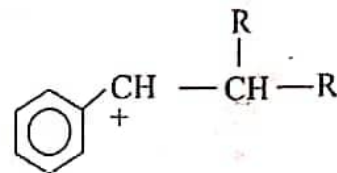c) Main organic intermediate in the reaction mechanism is

$$\underset{+}{CH} - \underset{|}{\overset{R}{CH}} - R$$

d) Major product formed shows enantiomerism.

39. True statement/s regarding catalyst is/are,

a) Although catalysts are not shown in chemical equation ,they are used always in rate expressions.

b) A catalyst increases the rate of both forward and backward reactions in a reversible reaction.

c) Product formed in a reaction can also act as a catalyst.

d) Catalysts can decrease the activation energy of a reaction but doesn't alter the enthalpy change.

40. Which of the following reaction/s has/have a negative sign for all the three parameters ΔH
. ΔS and ΔG,

a) $Ba(OH)_2(aq) + H_2SO_4(aq) \rightarrow BaSO_4(s) + 2H_2O(l)$

b) $4Na(s) + O_2(g) \rightarrow 2Na_2O(s)$

c) $6CO_2(g) + 6H_2O(g) \rightarrow C_6H_{12}O_6(s) + 6O_2(g)$

d) $2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$

.22 A/L යූ [papers grp].

Devi Balika Vidyalaya – Colombo

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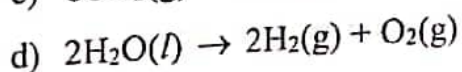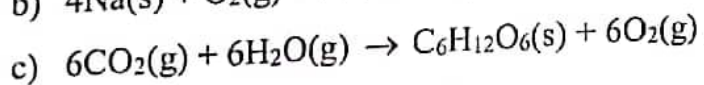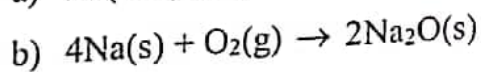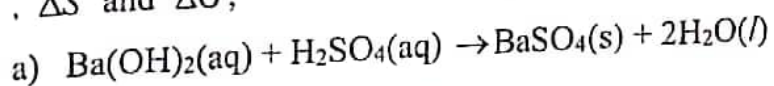
In question no. 21 to 25, two statements are given in respect of each question. From the table given below, select the response out of the responses (1), (2), (3), (4), (5) that best fits the two statements given for each of the questions and mark appropriately on your answer sheet.

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	
(4)	False	False
(5)	False	True
		False

		First statement	Second statement
41.		In atoms of isotopes, numbers of protons present are same but number of electrons are different.	Physical and chemical properties of isotopes are equal.
42.		All reactions in which $\Delta H < 0$ are spontaneous at any temperature regardless of ΔS	Entropy of any compound is zero at $0°C$.
43.		Charge density of $Na^+_{(aq)}$ is greater than that of $K^+_{(aq)}$	Mobility of $Na^+_{(aq)}$ is less than that of $K^+_{(aq)}$
44.		When HBr is added separately to the two compounds

CH_2CH_3 ... OH and OH ... $CH-CH_3$

CH_2CH_3 ... OH Undergoes a fast reaction. | When an OH group is connected to the aromatic ring, it acts as an activator which increases the electron density of the ring. |

45.	If $CO(g) + NO_2(g) \rightarrow CO_2(g) + NO(g)$ is an elementary reaction, C atom of $CO(g)$ and N atom of $NO_2(g)$ collide *in proper orientation* forming $CO_2(g)$ and $NO(g)$	Even if molecules have sufficient energy equal or greater than the activation energy, unless the collision does not take place in the proper orientation, reaction does not happen.
46.	The two Boltzmann curves obtained by plotting the fraction of molecules with a particular speed Vs speed of molecules of the gases H_2 and CO_2 coincide with each other.	Speed of molecules depend on absolute temperature.
47.	When sodium salt of a mono protic weak acid is titrated with HCl at 25 °C, pH at the equivalence point is 7.	pH of NaCl Solution at 25 °C is 7.
48.	Based on the reaction $RO^-Na^+ + H_2O \rightarrow ROH + NaOH$ water is more acidic than alcohol.	Alkoxide ion acts as a strong base.
49.	All ammonium salts react with strong bases.	NH_4^+ salts react with OH^- releasing protons.
50.	Both Ni^{2+} and Cu^{2+} ions cannot be precipitated as sulfides by passing H_2S under basic medium.	In the cation analysis Cu^{2+} is precipitated as sulfides in acidic medium where as Ni^{2+} is precipitated as sulfides in basic medium.

දේවි බාලිකා විදුහලය- කොළඹ
DEVI BALIKA VIDYALAYA– COLOMBO
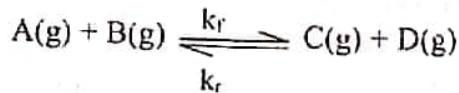
අධනා සංවුතා ධීරා
Manasa Sarvutha Dheera

13 වන ශ්‍රේණිය දෙවන වාර පරිකෂණය - 2022 අගෝස්තු

Grade 13 - Second Term Test - August 2022

Part B -Essay
Answer two questions only.(Each question carries 15 marks)

5. a) Consider the reaction given below.

$5, 6, 7$ $8, 9, 10$
2 2

$$A(g) + B(g) \underset{k_r}{\overset{k_f}{\rightleftharpoons}} C(g) + D(g)$$

k_f and k_r are the rate constants of forward and reverse reactions respectively. Using your knowledge on chemical kinetics, derive and expession for K_c in terms of k_f and k_r.

(2.5 marks)

b) At time t_0 0.48 mole of each $H_2(g)$ and $I_2(g)$ are kept in a rigid container of $1 dm^3$ at 400K and allowed to attain dynamic equilibrium. Number of moles of $HI(g)$ formed at equilibrium (time t_1) was 0.8 mol. To the above equilibrium system 0.4 mol of $HI(g)$ was injected instantly at time t_2. After a certain time(t_3) the system attains the equilibrium given below.

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

i) Find the K_c at equilibrium.

ii) Find K_p at equilibrium.

iii) Find Q_c of the system when 0.4 mol of HI was injected.

iv) From (iii) above predict the direction of the equilibrium.

v) Find the concentration of H_2, I_2 and HI in the new equilibrium.

vi) Draw the variation of concentration against timefrom t0 to t4 in one graph. Indicate the relationship between Q_c and K_c in the graph.

Concentration (mol dm^{-3})

Time (s)

t_1 t_2 t_3
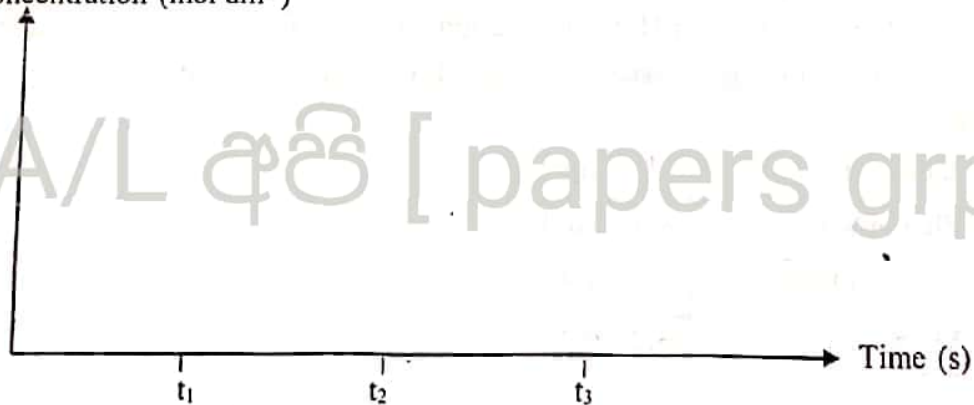
(5.0 marks)

c) Given below is a procedure followed to determine the solubility product of $Ca(OH)_2(s)$ in the laboratory.

I. $25.00 cm^3$ of a given NaOH(aq) solution is taken in to a titration flask and titrated with 0.1 mol dm^{-3} HCl solution in the presence of phenopthalein indicator. Required volume of HCl was 15.00 cm^3.
(Solution A)

II. 100 cm^3 of a saturated solution of $Ca(OH)_2$ was prepared by dissolving excess $Ca(OH)_2(s)$ in the above NaOH solution at 25 °C. 25.00 cm^3 of the above saturated solution was transferred to a titration flask and titrated against 0.1 mol dm^{-3} HCl solution using a suitable indicator. Volume of HCl required was 15.00 cm^3.20

i) Mention the colour change at the end point of the first titration.
ii) Find the concentration of the initial NaOH solution.
iii) How would you confirm that solution A is saturated with $Ca(OH)_2$?
iv) Write the expression for Ksp of $Ca(OH)_2(s)$.
v) Find the concentration of total OH$^-$ in the solution A.
vi) Find the concentration of Ca^{2+} in the solution.
vii) Find the Ksp of $Ca(OH)_2(s)$ at 25 °C.
viii) Find the solubility of $Ca(OH)_2(s)$ in the above NaOH solution in g dm^{-3}.
ix) Giving reasons compare the solubility of $Ca(OH)_2$ in water and in NaOH solution in (viii) above.
x) Explain if this method can be used to determine the Ksp of $Al(OH)_3$

(7.5 marks)

6. a) pH of 0.1 mol dm^{-3} CH_3COOH solution at 25°C is 3.25.
   i) Find concentration of H_3O^+ in the solution.

   ii) Find Ka and degree of dissociation (α) of CH_3COOH.

   iii) 0.05 mol of CH_3COOH is dissolved in 500 cm^3 of 0.1 mol dm^{-3} HCl solution.
   I) Find the concentration of CH_3COOH in the solution.
   II) Find the pH of the solution at 25 °C.
   III) Find the pH of the HCl solution at 25 °C and compare it with the value obtained in (II) above.

(5.0 marks)

b) 25.00 cm^3 of 0.1 mol dm^{-3} CH_3COOH was transferred to a titration flask and titrated against 0.1 mol dm^{-3} NaOH solution.
   i) Find the pH of the solution when the following volumes of NaOH are added.
   NaOH, 24.90 cm^3
   NaOH, 25.00 cm^3
   NaOH, 25.10 cm^3
   ii) Draw the variation of pH of the solution against volume of NaOH added.
   iii) Select the most appropriate indicator for the above titration among the indicators given below.

Indicator	pH range
Phenopthalein	8.3 - 10.0
Methyl Orange	3.1 - 4.4
Methyl Red	4.2 - 6.3

(4.0 marks)

c) Given below is an enthalpy diagram to calculate standard lattice enthalpy of Al_2O_3.
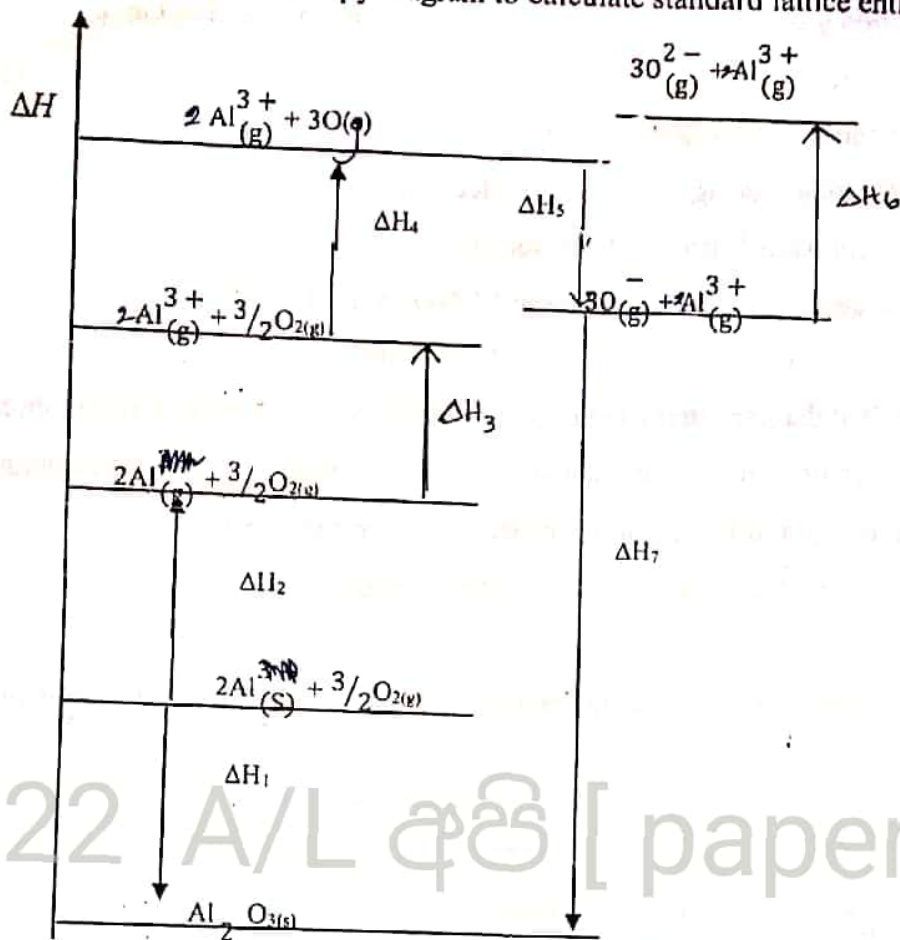
i) Name the enthalpy changes from ΔH_1 to ΔH_7.

ii) Consider the enthalpy values given below.

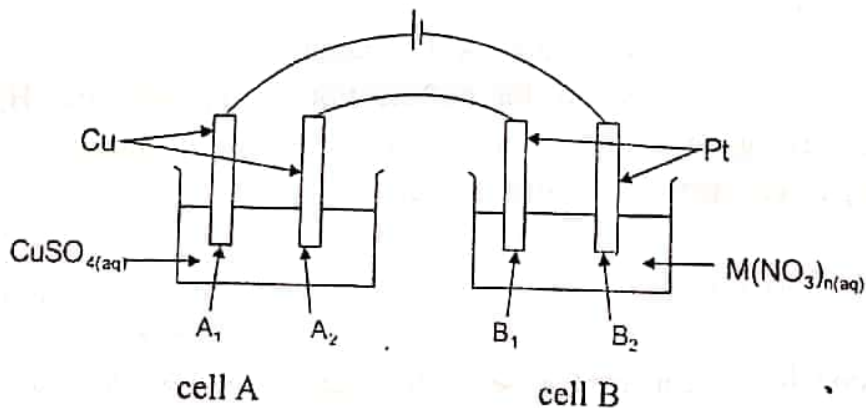|					
ΔH_1	=	- 1676 kJ mol^{-1}	ΔH_2	=	324 kJ mol^{-1}
ΔH_3	=	2644 kJ mol^{-1}	ΔH_4	=	250 kJ mol^{-1}
ΔH_5	=	-141 kJ mol^{-1}	ΔH_6	=	770 kJ mol^{-1}

Using the given data calculate the standard lattice enthalpy of Al_2O_3 (6.0 marks)

7. a) The cells A and B are connected according to the diagram given below and an electrolysis was carried out.

cell A   cell B

near the anode of cell B

i) Identify the anode and cathode in each cell A and B.

ii) Write half reactions taking place in each electrode.

iii) Find the current passed through the solution.

iv) Find the charge(n) of metal M in the salt $M(NO_3)n$ used in cell B.

(M = 197   Cu = 63.5   F = 96500 C mol^{-1})   (7.0 mark)

b) i) Draw a labelled diagram that can be used to electroplate silver on a given object.

ii) Ag has to be coated on a rectangular surface with an area of 12 cm^2 and thickness of 6 mm.
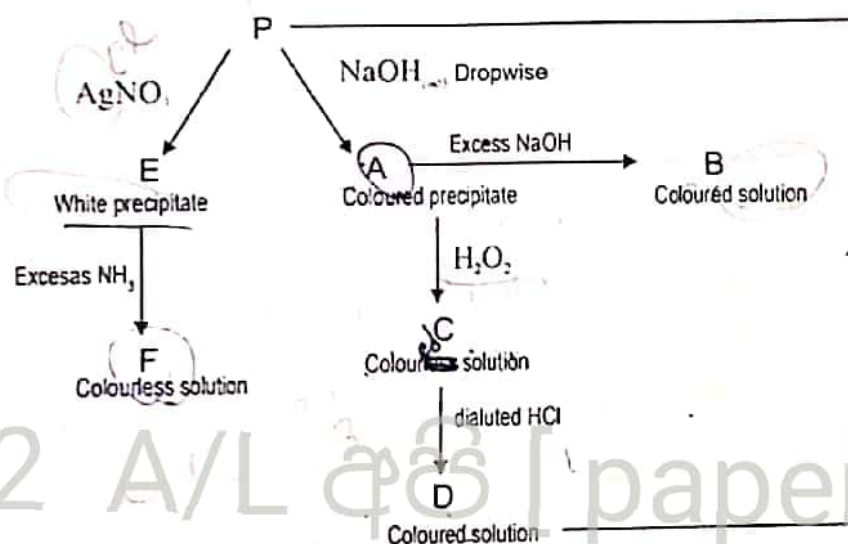Find the time required for the above process if a current of 5A is used.
(Density of Ag = 10.5 g cm^{-3}, Relative atomic mass of Ag=108)

(2.0 marks)

c) Given below is a flow chart regarding reactions shown by salt P formed by transitional element
X.

.22 A/L අ[papers grp].

i) Identify salt P.
ii) Write the electronic configuration of element X.
iii) Identify compounds from A to F.
iv) Mention the colours of compounds A,B,C and D.
v) Write balanced ionic equations for the 2 reactions taking place with H_2O_2.
vi) Draw the structure of the complex formed in water, by the cation present in salt P. Mention its
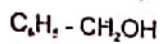electron pair geometry and IUPAC name.

(6.0 marks)

a) $C_6H_5CH_2 - OH$ is converted to compound F using the reaction scheme given below.
Complete the given reaction sequence by drawing the structures of compound A,B,C,D and E
and writing the reagents for the steps 1-6 selected only from those given in the list below.

Devi Balika Vidyalaya – Colombo

List of reagents,

[PCC , LiAlH₄ , dil. H₂SO₄ , PCl₅ , Mg/dry ether, KCN , NaBH₄]

$C_6H_5 - CH_2OH$

A $\longrightarrow$ B $\longrightarrow$ E

C

D $\longrightarrow$ F $\bigcirc$—CH_2—$\overset{\overset{O}{\|}}{C}$—$NH$—$CH_2$—$CH_2$—$\bigcirc$
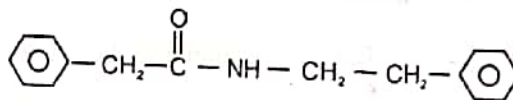
(8.0 marks)

b) i) Using $C_6H_5NH_2$ as the only organic compound show how would you synthesize the following compound $\bigcirc$—$\overset{\overset{O}{\|}}{C}$—$O$—$\bigcirc$. in not more than 6 steps.

ii) Do the following conversions in 3 steps without using a dehydrating agent.

1.

NH_2—$\overset{\overset{CH_3}{|}}{\underset{|}{C}}$—$\overset{\overset{H}{|}}{\underset{|}{C}}$—$CH_3$ $\longrightarrow$ CH_3—CH_2—$\overset{\overset{CH_3}{|}}{\underset{|}{C}}$—$CH_3$

with CH_3 and OH on first carbon, OH on product carbon

2. CH_3—CH_2—OH $\longrightarrow$ $CH_2 = CH_2$
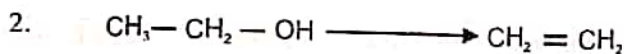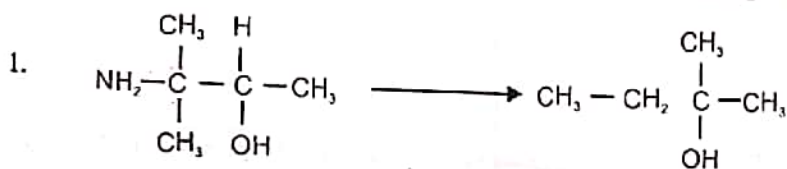
(4.0 marks)

c) i) Explain why alkenes undergo electrophilic addition reactions where as benzene undergo electrophilic substitution reactions.

ii) When Br—CH_2—CH_2—$\overset{\overset{O}{\|}}{C}$—$Br$ reacts with NH_3 Br—CH_2—CH_2—$\overset{\overset{O}{\|}}{C}$—$NH_2$ is formed as the major product and NH_2—CH_2—CH_2—$\overset{\overset{O}{\|}}{C}$—$Br$ is formed as the minor product. Explain the above statement by means of a suitable mechanism.

(3.0 marks)

9. a) An aqueous solution contains only CrO_4^{2-}, MnO_4^- and SO_4^{2-} ions. The following procedure was carried out to find the concentration of these ions.

I. When $BaCl_2$(aq) solution is added in excess to 100.00 cm³ of the above solution a precipitate M is formed. Then 25.00 cm³ of the filtrate was acidified and KI(aq) is added in excess. When the resultant solution was titrated with 1.2 mol dm⁻³ $Na_2S_2O_3$ solution, burette reading was 25.00 cm³.

II. When precipitate M was dissolved in exsess dilute HCl, part of the precipitate dissolved and the dry mass of the remaining precipitate (R) was 15.3 g. Excess KI(aq) was added to the filtrate of R and titrated with 1.2 mol dm^{-3} Na$_2$S$_2$O$_3$ solution. Burette reading was 20.00 cm^3.

(Mn-55, Ba-137, S-32, O-16, Cr-52, C-12, K-39, I-127)

i) Write balanced chemical equations for the reactions taking place in the above procedure.

ii) Find the concentrations of CrO_4^{2-}, MnO_4^- and SO_4^{2-} ions in the initial solution. (7.5 marks)

b) Solution B contains three metal cations and three anions. The following procedure was carried out to identify the ions present in the solution.

|	Test	Observation
1	• dilute HCl is added.	A colourless gas (a) evolved. No precipitate formed.
	• Excess BaCl$_2$ was added to the initial solution.	No precipitate was formed.
2	Gas (a) was passed through lime water	A milky colour solution was formed which turns colourless upon passage of excess gas.
3	H$_2$S gas is bubbled through resultant solution obtained in 1 above.	The colour of the solution changed and became turbid and an orange precipitate (P$_1$) was also formed.
4	P$_1$ precipitate was separated. 3 mol of freshly prepared FeSO$_4$ was added to the above filtrate and then concentrated H$_2$SO$_4$ was added slowly.	Brown ring was formed.
5	Another portion of the above filtrate was boiled, cooled and a mixture of NH$_4$Cl and NH$_4$OH were added.	A white gelatinous precipitate(P$_2$) was formed.
6	P$_2$ was separated and H$_2$S was passed through the filtrate.	Pink - black precipitate (P$_3$) was formed.

Following tests were carried out for the precipitates P$_1$, P$_2$ and P$_3$

Precipitate	Test	Observation
P$_1$	P$_1$ precipitate was dissolved in concentrated HCl and the resultant solution was diluted with water.	The colourless solution turned milky(solution 1)
P$_2$	Precipitate was dissolved in NaOH	The precipitate dissolved and a colourless solution was formed (solution 2)
P$_3$	To part of the precipitate P$_3$, dilute HNO$_3$ was added followed by excess concentrated NH$_4$OH	A precipitate and a yellow - brown solution were formed and the solution turned orange while the precipitate turned blackish brown with time (solution 3)
	To part of the precipitate P$_3$ dilute HNO$_3$ was added followed by $S_2O_8^{2-}$ (aq) **	A purple colour solution was obtained (solution 4)

** $S_2O_8^{2-}$ is a strong oxidizing agent ($S_2O_8^{2-} \rightarrow 2SO_4^{2-}$)

.22 A/L පසු [papers grp].

i) Find the three metal cations and three anions present in solution B.

ii) Identify the chemical species present in precipitate in P_1, P_2 and P_3 and solutions 1-4. (write only the chemical formula)

iii) Write the balanced chemical equations for the reactions taking place in solutions 1 & 2
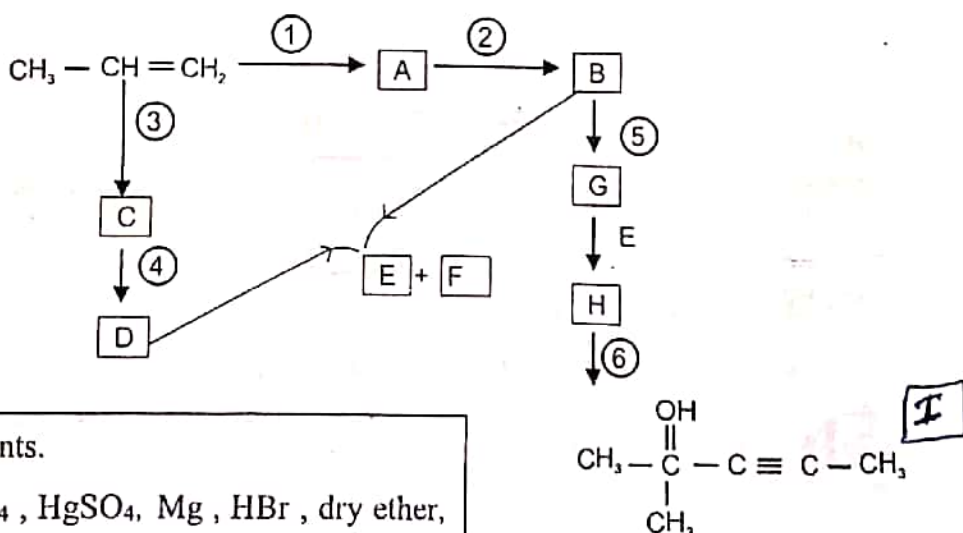
(7.5 marks)

10. a) i) Selecting the suitable reagents given in the list do the following conversion in a minimum number of steps.
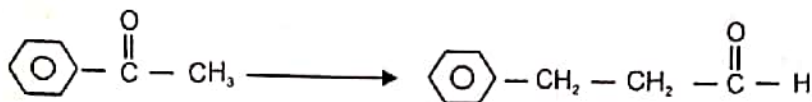
List of reagents :

dilute HCl, conc. H_2SO_4 , dry ether , HBr , Mg , PCC , $C_2H_5 - O - O - C_2H_5$, LiAlH4

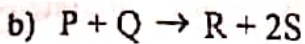ii) $CH_3 - CH = CH_2$ is converted to the compound I using the reaction scheme given below. Complete the given reaction sequence by drawing the structures of compounds from A to H and writing the reagents for the steps 1-6 using the reagents given in the list below.

List of reagents.

dilute H_2SO_4 , HgSO4, Mg , HBr , dry ether, alcoholic, KOH , Br2/CCl4

(7.5 marks)

b) $P + Q \rightarrow R + 2S$

Following experiments are done in order to study the kinetics of the above reaction at 25 °C.
Rate constant of the above reaction is 0.02 dm³ mol⁻¹ s⁻¹.

Experiment I -

    500 cm³ of 0.4 mol dm⁻³ solution P is mixed with 500 cm³ 0.8 mol dm⁻³ solution Q.
After 15 s it is found that 0.1 mol of P is left in the solution.

Experiment II -

    Variation of concentration of Q with time is plotted maintaining the concentration of P
constant 2 mol dm⁻³

[Q] / mol dm⁻³	time/s
0.08	0
0.04	60
0.02	120
0.01	180
0.005	240

i) Calculate the rate of reaction of P and rate of formation of S.
ii) Derive the order with respect to P and Q giving reasons.
iii) State the rate expression for the above reaction.
iv) Based on experiment II,
      I.   Plot the variation of concentration of Q against time using the above.
      II.   Calculate the initial rate of the reaction

(7.5 marks)

Periodic Table of the Elements

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	57-71	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	89-103	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og

Lanthanide Series	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Actinide Series	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr