OSDAV Public School, Kaithal

Half Yearly Exams (2024-25)

Subject: Chemistry (043)

Class: XII

SET-A

Time: 3:00 Hours **M.M : 70**

General Instructions:-

All questions are compulsory.

(a) There are 33questions in this question paper.

(b) SECTION A consists of 16 multiple -choice questions carrying 1 mark each.

(c) SECTION B consists of 5 short answer questions carrying 2 marks each.

(d) SECTION C consists of 7 short answer questions carrying 3 marks each.

(e) SECTION D consists of 2 case-based questions carrying 4 marks each.

(f) SECTION E consists of 3 long answer questions carrying 5 marks each.

(g) All questions are compulsory.

(h) Use of log tables and calculators is not allowed.

SECTION-A

Q.No.	Questions	Marks
1.	On dissolving sugar in water at room temperature, solution feels cool to touch. Under which of the following cases dissolution of sugar will be most rapid? a. Sugar crystals in cold water. b. Sugar crystals in hot water. c. Powdered sugar in cold water. d. Powdered sugar in hot water.	1
2.	Elevation of boiling point is inversely proportional to: a. molal elevation constant(K_b). b. molality	1

	c. molar mass of solute. d. Weight of solute	
3.	Corrosion of iron is: a. A decomposition process b. A photochemical process c. An electrochemical process d. A reduction process	**1**
4.	Which of the following solutions of KCl will have highest value of molar conductivity? a. 0.01 M. b. 1M. c. 0.5 M. d. 0.1 M	**1**
5.	In a reaction, the initial concentration of the reactants increases four fold and rate becomes 16 times its initial value. The order of the reaction is: a.0 b. 1 c. 2 d. 4	**1**
6	The role of catalyst is to change: a. Gibbs free energy of reaction. b. Enthalpy of reaction c. Activation energy of reaction. d. Equlibrium constant	**1**
7	What is the secondary valency of Cobalt in $[Co(en)_2 CL_2]Br$? a. 2. b. 4. c. 5. d. 6	**1**
8	Which of the following ligands is an ambidentate ligand? a. CO. b. NO_2. c. NH_3. d. H_2O	**1**
9	Inversion of configuration occurs in: a. S_N2 Reaction. b. S_N1 reaction. c. S_N1 and S_N2. d. none of these	**1**
10	Enantiomers differ only in **:** a. boiling point. b. rotation of polarised light c. melting point d. solubility	**1**
11	Which of the following group increases the acidic strength of phenol? a.Methoxy b.Methyl c.Nitro d. all of these	**1**
12	Ethyl alcohol can be converted into acetaldehyde by... a. Catalytic Hydrogenation b.Treatment with LiAlH4 c. Treatment with KMnO4. d.Treatment with pyridinium chlorochromate	**1**
13	In the following questions (13to16) a statement of Assertion(**A**) is followed by a statement of Reason(**R**) is given.	**1**

	Choose the correct answer out the following choices: a. Both A and R are true and R is correct explanation. b. Both A and R are true but R is not correct explanation of A. c. A is true but R is false. d. A is false but R is true. **Assertion (A**): Neopentyl alcohol on treaent with HCl gives Neopentyl chloride. **Reason (R):** Neopentyl alcohol is a primary alcohol.	
14	**Assertion (A):** KCN reacts with methyl chloride to give methyl isocyanide**.** **Reason (R):** CN- is an ambident nucleophile**.**	**1**
15	**Assertion (A):** EDTA is used to determine hardness of water**.** **Reason(R):** EDTA is a bidentate ligand**.**	**1**
16	**Assertion (A):** Mercury cell does not give steady potential**.** **Reason(R):** In the cell reaction, ions are not involved in solution**.**	**1**
	SECTION-B	
17	What type of deviation from Raoult's Law is shown by a mixture of ethanol and acetone? Give reason.	**1+1**
18	The standard electrode potential of daniell cell is 1.1 V. Calculate the standard Gibbs Energy and $Log(K_c)$for the following reaction: $Zn(s) + Cu^{2+}(aq) \text{--------} \rightarrow Zn^{2+}(aq) + Cu(s)$	**1+1**
19	A reaction is first order in A and second order in B: (a) Write down rate law expression. (b) How is rate affected when concentration of both A and B are doubled?	**1+1**
20	Give the formulae of the following compounds: (a) Potassium tetrahydroxozincate(II) (b) hexaammineplatinum(IV) chloride**.**	**1+1**
21	Why is chlorobenzene is resistant to nucleophilic substitution reaction? Explain it with two reasons.	**1+1**
	SECTION-C	
22	Write the mechanism of acid dehydration of ethanol to yield ethene.	**3**

23	Write the chemical equation involved in the following : (a) Kolbe's reaction (b) Swarts Reaction (c) Reimer Tiemann Reaction	**1+1+1**
24	An alkyl halide (A) of molecular formula $C_6H_{13}Cl$ on treatment with alcholic KOH gives two isomerism alkenes(B) and (C) of molecular formula C_6H_{12} . Both alkenes on hydrogenation give 2,3-dimethylbutane.Write the structures of A ,B and C.	**1+1+1**
25	**(**a) What do you mean by osmotic pressure? (b)For a 5% solution of urea(molar mass=60), calculate the osmotic pressure at 300 K. [R=0.0821 atm/Kmol]	**1** **2**
26	Write down cell reaction and calculate the emf of the following cell at 25°C: $Al(s)/Al^{3+}$ (0.001M) // Ni^{2+} (0.1M)/Ni(s) Given: E^0 (Ni^{2+} /Ni)= -0.25 V E^0(Al^{3+} /Al)= -1.66 V. Log(10)=1	**3**
27	A first order reaction is 50% complete in 80 minutes at 300 K and in 10 minutes at 320 K. Calculate activation energy for the reaction. R= 8.314 JK/mol Log2=0.3010, Log3= 0.4771 , Log4= 0.6021	**3**
28	Explain on the basis of VBT that $[Ni(CN)_4]^{2-}$ ion with square planar structure is diamagnetic and $[Ni(Cl)_4]^{2-}$ ion with tetrahedral geometry is paramagnetic.	**3**
	SECTION-D (Case Based Questions)	
29	Read the following passage and answer the following questions: The four colligative properties of dilute solutions help in calculating the molecular mass of the solute which is often called observed molecular mass. It may be same as the theoretical molecular mass if the solute behaves normally in solution. In case, it undergoes association or dissociation, the observed molar mass gives different results. The nature of the solute in solution is expressed in terms of van't hoff factor(i), which may be 1(if solute behaves normally), less than 1 (if solute associate) and more than 1(if the solute dissociates). The extent of association or dissociation is represented by α which is: For Dissociation $\alpha = i-1/n-1$. For association $\alpha = (1-i)n/n-1$	
29(a)	What is common in all the four colligative properties?	**1**
29(b)	What is expected value of van't hoff factor for $K_4[Fe(CN)_6]$ when it is completely dissociates in water?	**1**
29(c)	In the determination of molar mass of $A^+ B^-$ using colligative property, what will be the	**2**

<table>
<tr><td></td><td>van't hoff factor if the solute is 40% dissocited?</td><td></td></tr>
<tr><td>30</td><td>Read the passage carefully and answer the questions that follow:

Crystal field splitting by various ligands

Metal complexes show different colours due to d-d transitions. The complex absorbs light of specific wavelength to promote the electron from t2g to eg level. The colour of the complex is due to the transmitted light, which is complementary of the colour absorbed. The wave number of light absorbed by different complexes of Cr ion are given below:

<table>
<tr><td>Complex</td><td>Wave number of light absorbed (cm-1)</td><td>Energy of light absorbed(kJ/mol)</td></tr>
<tr><td>$[CrA_6]^{3-}$</td><td>13640</td><td>163</td></tr>
<tr><td>$[CrB_6]^{3+}$</td><td>17830</td><td>213</td></tr>
<tr><td>$[CrC_6]^{3+}$</td><td>21680</td><td>259</td></tr>
<tr><td>$[CrD_6]^{3-}$</td><td>26280</td><td>314</td></tr>
</table></td><td></td></tr>
<tr><td>30(a)</td><td>Out of the ligands “A”, “B”, “C” and “D”, which ligand causes maximum crystal field splitting? Why?</td><td>1</td></tr>
<tr><td>30(b)</td><td>Which of the complexes will be violet in colour? $[CrA_6]^{3-}$ or $[CrB_6]^{3+}$ and why?

(Given: If 560 - 570 nm of light is absorbed, the colour of the complex observed is violet.)</td><td>1</td></tr>
<tr><td>30(c)</td><td>Calculate the CFSE for the complexes:

$[Fe(CN)_6]^{4-}$ It is given that CN^- is strong field ligand.

$[CoF_6]^{3-}$ It is given that F^- is weak field ligand.</td><td>1+1</td></tr>
<tr><td></td><td>SECTION-E</td><td></td></tr>
<tr><td>31(a)</td><td>Write the name of the cell which is generally used in investors. Write the reactions taking place at the anode and cathode of this cell during discharging</td><td>2</td></tr>
<tr><td>31(b)</td><td>The electrical resistance of a column of 0.05 mol/L NaOH solution of diameter 1cm and length 50cm is 5.55×10^3 ohm. Calculate it's restivity, conductivity and molar conductivity.</td><td>1+1+1</td></tr>
<tr><td>32(a)</td><td>A first order reaction takes 40 minutes for 30% decomposition. Calculate t1/2.

Log(7)= 0.8451</td><td>2</td></tr>
<tr><td>32(b)</td><td>Explain how and why will the rate of reaction for a given reaction be affected when:(i) a catalyst is added.</td><td>1</td></tr>
</table>

	(ii) the temperature at which the reaction was taking place is decreased. (iii)Concentration of reactant is increased	**1** **1**
33(a)	Describe the Stereochemistry of S_N1 reactions in detail.	**3**
33(b)	What will happen when :(I)Ethyl alcohol is heated with Cu at 573 K. (Ii) Phenol is treated with Br2(aq.)	**2**

Marking Scheme

Set-A

SECTION A

Ans.1 D) powdered sugar in hot water.

2. C) molar mass of the solute

3 C) electrochemical process

4. A) 0.01 M

5. C) 2

6.C) activation energy of the reaction

7.D) 6

8.B) NO2

9.C) SN2 and SN1

10. B) rotation of polarised light

11.C) nitro group

12.D.Treatment with pyridinium chlorochromate

13.D

14.D

15.C

16.D 1×16= 16

SECTION B

17. A mixture of ethanol and acetone exhibits a positive deviation from Raoult's Law; this is because when acetone is added to ethanol, it disrupts the hydrogen bonds present in pure ethanol, leading to weaker intermolecular interactions within the mixture, resulting in a higher vapor pressure predicted by Raoult's Law. 1+1

18. For the reaction n = 2
F = 96500 C/mol and E = 1.1 V
$\because \Delta_r G^\circ = -2 \times 1.1 \times 96500$
$= -212300$ J/mol $= -212.3$ kJ/mol 1

E°cell= 0.0591/2Log Kc. LogKc= 37.21. 1

19(a) Rate of Reaction= K[A]2[B]. 1

(b) Increases 8 times. 1

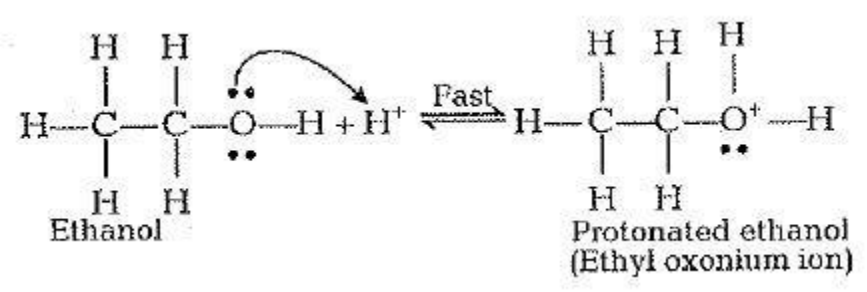
20. The chemical formulae for potassium tetrahydroxozincate(II) and hexaammineplatinum(IV) chloride are:

Potassium tetrahydroxozincate(II): $K_2[Zn(OH)_4]$. 1

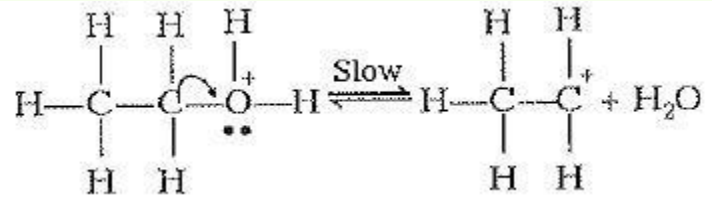
Hexaammineplatinum(IV) chloride: $[Pt(NH_3)_6]Cl_4$. 1

21. Chlorobenzene is resistant to nucleophilic substitution reactions primarily due to resonance stabilization which gives the carbon-chlorine bond a partial double bond character, making it difficult to break, and the sp2 hybridization of the carbon atom attached to the chlorine, which further strengthens the bond and hinders nucleophilic attack. 1+1

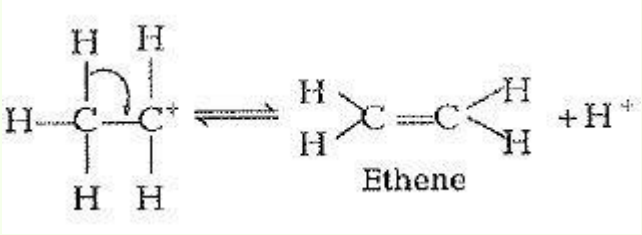
22. Mechanism of acid catalysed dehydration of ethanol
Step I: Protonation of ethanol



Step II: Formation of carbocation

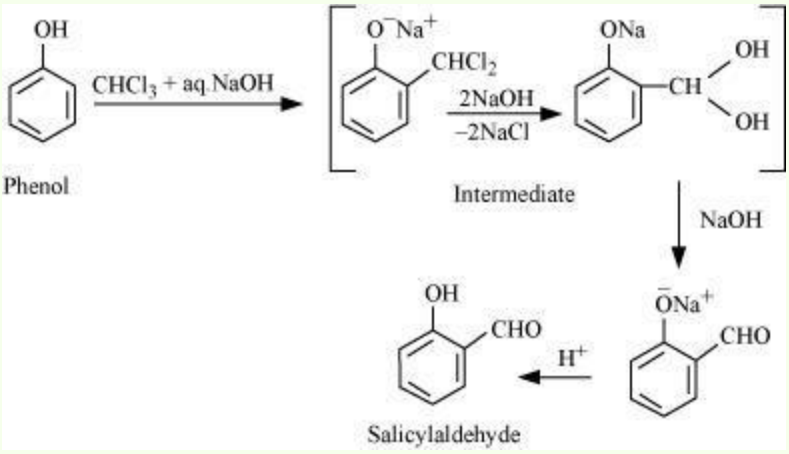


Step III: Elimination of a proton



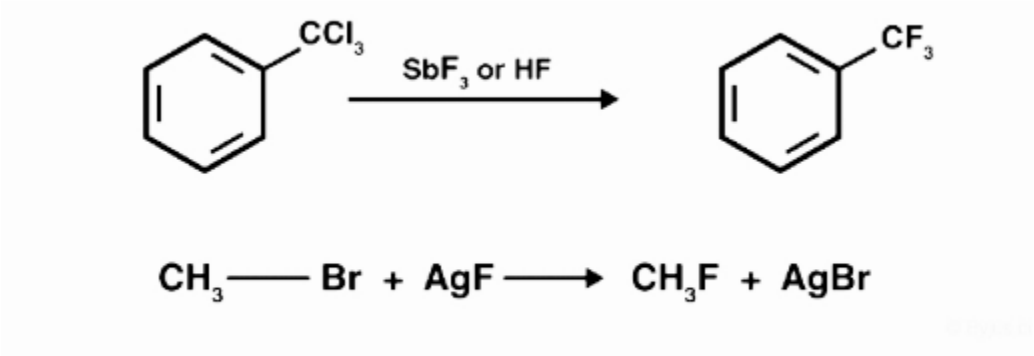
1+1+1

23. Reimer-Tiemann reaction.



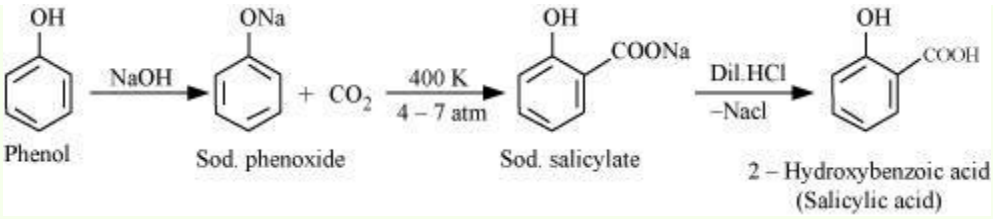
1

II Swarts Reaction



1

III Kolbe's reaction



1

24. Explanation:

$C_6H_{13}Cl \overset{alc,KOH}{\rightarrow}$

$CH_3 - CH(CH_3) - C(CH_3) = CH_2 + CH_3 - C(CH_3) = C(CH_3) - CH_3$. 1

Structure of B:2,3 dimethy but-2-ene

$CH_3 - CH(CH_3) - C(CH_3) = CH_2 \overset{H_2}{\rightarrow} CH_3CH(CH_3) - CH(CH_3) - CH_3$. 1

Structure of C:2,3 dimethy but-1-ene

$CH_3 - C(CH_3) = C(CH_3) - CH_3 \overset{H_2}{\rightarrow} CH_3CH(CH_3) - CH(CH_3) - CH_3$. 1

Structure of A: 2-chloro-2,3-dimethyl butane

$CH_3 - CH(CH_3) - CCl(CH_3) - CH_3$

25. A) Osmotic pressure is the minimum amount of pressure needed to stop the flow of solvent molecules through a semipermeable membrane. It's also a measure of how much a solution wants to take in its pure solvent through osmosis. 1

B)

Osmotic presuure$= i * C * R * T$

where, C=concentration of solute(in terms of Molarity)

R= Gas constant $= 0.082\ L(atm)(mol)^{-1}K^{-1}$

T=temperature (in Kelvin)

i=Van't-Hoff factor(=1 for non-electrolyte)

5% urea solution means $5\ g$ urea is present in 100ml of solution.

mole of urea=weight

given/Molecular weight of urea

$$= \frac{5\ g}{60\ g\ mol^{-1}} = \frac{1}{12}$$

Hence Concentration of urea

(in terms of Molarity)

= (moles of urea(n) /volume of solution) $\times 1000$

$$= \{(\frac{1}{12})/100\} * 1000$$

$$= \frac{10}{12}$$

Hence Osmotic pressure $= 1 \times (10/20) \times 0.082 \times 300$ atm

$$= 20.52\ atm$$

2

26.

At anode: $Al\ (s) \longrightarrow Al^{3+}\ (aq) + 3e^-\ ] \times 2$

At cathode: $Ni^{2+} + 2e^- \longrightarrow N_i(s)\ ] \times 3$

Cell reaction: $2Al(s) + 3Ni^{2+}\ (aq) \longrightarrow 2Al^{3+}(aq) + 3Ni\ (s)$

1/2

$$E_{cell} = 1.41\ V - \frac{0.0591}{6}\log\frac{(10^{-3})^2}{(0.5)^3} = 1.41\ V - \frac{0.0591}{6}\log\ (8\times10^{-6})$$

$$= 1.41\ V - \frac{0.0591}{6}(\log 2^3 + \log\ 10^{-6})$$

$$= 1.41\ V - \frac{0.0591}{6}[\ 3 \times \log 2 + (-67)\ \log 10]$$

$$= 1.41\ V - \frac{0.0591}{6}[3 \times 0.3010 - 6]$$

$$= 1.41\ V + 0.050\ V$$

$$E_{cell} = 1.46\ V$$

2.5

27. (t1/2)1 =80 T1= 300 K. K1= 0.693/80. 1

(t1/2) 2= 10. T2= 320 K. K2= 0.693/10.

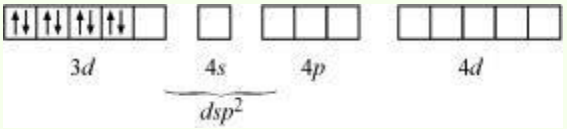
LogK2/K1= Ea/ 2.303R [T2-T1]/ T1T2. 1

Log8= Ea/2.303× 8.314[320-300]/320×300

Ea=82900J/mol. 1

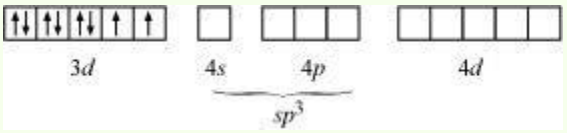
28. Ni is in the +2 oxidation state i.e., in d8 configuration.

There are 4 CN− ions. Thus, it can either have a tetrahedral geometry or square planar geometry. Since CN− ion is a strong field ligand, it causes the pairing of unpaired 3d electrons.
1.5



It now undergoes dsp2 hybridization. Since all electrons are paired, it is diamagnetic.

In case of [NiCl4]2−, Cl− ion is a weak field ligand. Therefore, it does not lead to the pairing of unpaired 3d electrons. Therefore, it undergoes sp3 hybridization.



Since there are 2 unpaired electrons in this case, it is paramagnetic in nature. 1.5

29(A) The common feature in all four colligative properties is that they depend solely on the number of solute particles present in a solution, not on the nature of the solute particles themselves. 1

29 B) When completely dissociated in water, the expected value of the van't Hoff factor for K4[Fe(CN)6] is 5. 1

29 C) To determine the Van't Hoff factor (i) for the electrolyte A+B− when it is 40% dissociated, we can follow these steps:

1. **Understanding Dissociation**:
The electrolyte A+B− dissociates into two ions: A+ and B−. When it dissociates, it produces 1 mole of A+ and 1 mole of B−, resulting in a total of 2 moles of ions from 1 mole of the electrolyte.

2. **Degree of Dissociation**:
The degree of dissociation (α) is given as 40%. This can be expressed as a decimal:
$\alpha = 40100 = 0.4$

3. **Using the Van't Hoff Factor Formula**:
The Van't Hoff factor (i) can be calculated using the formula:
$i = 1 + (n-1) \cdot \alpha$
where n is the number of particles produced upon dissociation. In this case, since A+B− produces 2 ions, n=2. 1

4. **Substituting Values**:
Now, substitute n and α into the formula:
$i = 1 + (2-1) \cdot 0.4$
Simplifying this gives:
$i = 1 + 1 \cdot 0.4 = 1 + 0.4 = 1.4$

5. **Final Result**:
Therefore, the Van't Hoff factor i for the electrolyte A+B− when it is 40% dissociated is:
$i = 1.4$. 1

30.a) Energy is directly proportional to the wave number. Maximum energy of light is required for an electron to jump from t2g to eg in case of [CrD6]3-

OR

A, The splitting caused in least in this case as the energy required for electron to jump from t2g to eg., is minimum. 1

[CrB6]3+, wavelength of light absorbed is 1/17830 = 560nm for the complex while 1/13640 = 733 nm for [CrA6]3- complex. 1

i) Hybridisation of Fe in ground state: $3d^8\ 4s^2$

Hybridisation of Fe^{2+} in excited state: $3d^8$. Since it is low spin complex

Hence, $Fe^{2+}: t_{2g}^6$

CFSE = Number of electrons in $t_{2g} \times (-0.4)\Delta_o$ + Number of electrons in $e_g \times (0.6)\Delta_o$
$\Rightarrow$CFSE = $6 \times (-0.4)\Delta_o + 2 \times (0.6)\Delta_o$
$\Rightarrow$CFSE = $-2.4\Delta_o$. 1

ii)Hybridisation of Co in ground state: $3d^7\ 4s^2$
Hybridisation of Co^{3+} in excited state: $3d^6\ 4s^0$. Since it is high spin complex
Hence, $Co^{3+}: t_{2g}^4\ e_{2g}$
CFSE = Number of electrons in $t_{2g} \times (-0.4)\Delta_o$ + Number of electrons in $e_g \times (0.6)\Delta_o$
$\Rightarrow$CFSE = $4 \times (-0.4)\Delta_o + 2 \times (0.6)\Delta_o$
$\Rightarrow$CFSE = $-1.6\Delta_o + 1.2\Delta_o = -0.4\Delta_o$. 1

31. a) The cell commonly used in inverters is a lead storage battery.

Reactions during discharging:

Anode: Pb (s) + SO4^2- (aq) → PbSO4 (s) + 2e- 1

Cathode: PbO2 (s) + SO4^2- (aq) + 4H+ (aq) + 2e- → PbSO4 (s) + 2H2O (l). 1

b) Given:
Concentration (c) =0.05 mol L^{-1},

Diameter (d)=1 cm

Length (l)=50 cm,

Resistance (R)=5.55 × 10^3 ohm

Resistivity of NaOH solution

We know, area (A)=πr^2

A=3.14×$(0.5)^2 cm^2$

We know that resistance (R)=ρlA

So, resistivity (ρ)=RAl

ρ=5.55×$10^3\Omega$×0.785 $cm^2$50 cm

=87.135 Ω cm. 1

Conductivity of NaOH solution

We know that conductivity (k)

=1resistivity(ρ)

k=(187.135)S cm^{-1}=0.01148 S cm^{-1}. 1

Molar conductivity of NaOH solution

We know that molar conductivity

Λ_m=conductivity(k)concentration(c)

Λ_m=0.01148 S $cm^{-1}0.05\times10^{-3}$mol cm^{-3}

{1L=10^3 cm^3}

Λ_m=229.6 S cm^2mol^{-1}. 1

32 a) **Step 1: Understand the given data**
We know that in a first-order decomposition reaction, 30% of the reactant decomposes in 40 minutes. This means that 70% of the reactant remains.

Step 2: Define the variables
Let:
- A = initial amount of the reactant
- X = amount decomposed = 30% of A = 0.3A
- Remaining amount = $A-X=A-0.3A=0.7A$

Step 3: Use the first-order rate equation
For a first-order reaction, the rate constant K can be calculated using the formula:
$K=2.303T\log(AA-X)$
Substituting the known values:
- T=40 minutes
- A=A
- $A-X=0.7A$

The equation becomes:
$K=2.30340\log(A0.7A)$

Step 4: Simplify the logarithmic expression
The logarithm simplifies as follows:
$\log(A0.7A)=\log(10.7)=-\log(0.7)$
Thus, we can rewrite K:
$K=2.30340\log(1.4286)$(since $10.7\approx1.4286$). 1

Step 5: Calculate K
Using a calculator, we find:
$\log(1.4286)\approx0.155$
Now substituting this value into the equation for K:
$K=2.30340\times0.155\approx0.00892$ min^{-1}

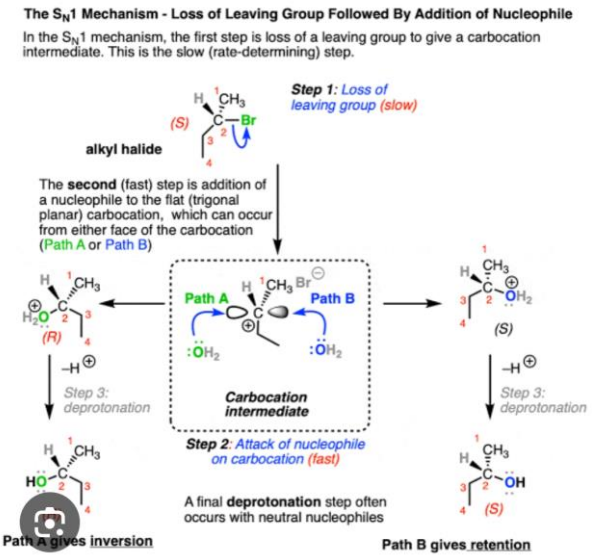
Step 6: Calculate the half-life $t_{1/2}$
The half-life for a first-order reaction is given by:
$t_{1/2}=0.693K$
Substituting the value of K:
$t_{1/2}=0.6930.00892\approx77.7$ minutes. 1

32 a) The catalyst decreases the activation energy of the reaction therefore the reaction becomes faster. The rate of reaction will decrease. 1

b) At lower temperatures the kinetic energy of molecules decreases thereby the collisions decrease resulting in a lowering of rate of reaction. 1

c) As per the law of mass action, the chemical reaction rate is directly proportional to the concentration of reactants. This implies that the chemical reaction rate increases with the increase in concentration and decreases with the decrease in the concentration of reactants.1

33. a)

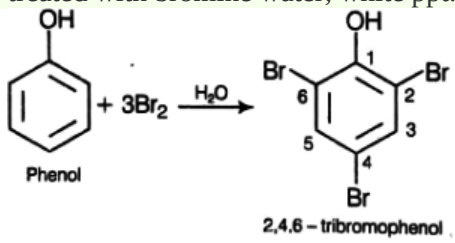


1+1+1

33 b) i)When ethyl alcohol is heated with copper at 573 K, it undergoes catalytic dehydrogenation to produce acetaldehyde. The reaction is as follows:

$CH_3CH_2OH \xrightarrow{---} CH_3CHO + H_2$. 1

ii) When phenol is treated with bromine water, white ppt. of 2, 4, 6 – tribromophenol is obtained.



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OSDAV Public School, Kaithal

Half Yearly Exam(2024)

Subject: Chemistry(043)

Class: XII

SET-B

Time: 3:00 Hours **M.M : 70**

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(g) All questions are compulsory.

(h) Use of log tables and calculators is not allowed.

SECTION-A

Q.No.	Questions	Marks
1.	Value of Henry's constant K_H: a.Increases with decreases in temperature. b. decreases with increases in temperature. c. Increases with increases in temperature. d.remains constant	**1**
2.	Which one of the following pairs will not form an ideal solution? a.benzene and toluene b. Nitric acid and water c.hexane and heptane d.Ethyl chloride and ethyl bromide	**1**
3.	How many Faradays are required to reduce 1 mol of MnO_4^- to Mn^{2+}? a.3 b.4 c.5 d.6	**1**
4.	Gibbs free Energy and E^0_{Cell} for a spontaneous reaction will be: a.positive, negative b.negative,negative c.positive,positive d.negative,positive	**1**
5.	Which of the following is affected by Catalyst? a.Enthalpy of a reaction. b.Gibbs free energy. c.Entropy d.Activation Energy	**1**
6	The half life of a reaction is doubled when the initial concentration of reactant is doubled. The order of the reaction is: a.0 b.1 c.2 d.3	**1**
7	What is the oxidation state of Cobalt in $[Co(en)_2 CL_2]Br$? a.+1 b. +2 c.+3 d.+6	**1**

8	Which of the following ligands is a monodentate ligand? a. CO b. DMG c. Oxalate ion d. $EDTA^{4-}$	**1**
9	Which of the following has highest boiling point? a.C_2H_5F b. C_2H_5Cl c. C_2H_5Br d. C_2H_5I	**1**
10	The conversion of an alkyl halide into an alkene by alcoholic KOH is classified as a.substitution reaction b. addition reaction c.Elimination reaction d.Dissociation	**1**
11	Which of the following reaction is used to prepare salicyladehyde? a.Kolbe's reaction b. Etard reaction c.Stephen's reduction d.Reimer-Tiemann rxn	**1**
12	Lucas reagent is: a.Conc.HCL+anhyd.$ZnCL_2$ b. Pd+$BaSO_4$ c. dil.HCL+anhyd.$ZnCL_2$ d.none of these	**1**
13	In the following questions (13to16) a statement of Assertion(**A**) is followed by a statement of Reason(**R**) is given. Choose the correct answer out the following choices: a. Both A and R are true and R is correct explanation. b. Both A and R are true but R is not correct explanation of A. c. A is true but R is false. d. A is false but R is true. **Assertion (A**): The bond angles in alcohols is slightly less than the normal tetrahedral angle. **Reason (R):** Lone pair-lone pair repulsions decreases the bond angle.	**1**
14	**Assertion (A):** Nucleophilic substitution of iodoethane is easier than chloroethane. **Reason (R):** Bond enthalpy of C-I bond is less than that of C-Cl bond**.**	**1**
15	**Assertion (A):** Linkage isomerism arises in coordination compounds containing ambidentate ligand**.** **Reason(R):** Ambidentate ligandhas two different donor atoms.	**1**
16	**Assertion (A):** Cu is less reactive than hydrogen. **Reason(R):** $E^0_{Cu2+/Cu}$ is negative.	**1**
	SECTION-B	
17	Define azeotrope. What type of azeotrope is formed by negative deviation from Raoult's Law? Give an example	**1+1/2+1/2**
18	Calculate the potential of hydrogen electrode in contact with a solution, pH of which is	**2**

	10.	
19	A reaction is second order in A and zero order in B: (a) Write down rate law expression. (b) How is rate affected when concentration of both A and B are doubled?	**1+1**
20	Give the formulae of the following compounds: (a) Iron(III) hexacyanidoferrate(II). (b) tetraamminediaquacobalt(III) chloride**.**	**1+1**
21	Which compounds in the following couples will react faster in S_N2 displacement and why?(a)1-Bromopentane or 2-Bromopentane (b)1-Bromo-2-methylbutane or 2-Bromo-2-methylbutane	**1+1**
	SECTION-C	
22	Write down cell reaction and calculate the emf of the following cell at 25°C: Al(s)/Al^{3+}(0.001M) // Ni^{2+}(0.1M)/Ni(s) Given: $E^0_{Ni2+/Ni}$= -0.25 V $E^0_{Al3+/Al}$= -1.66 V. Log(10)=1	**1+2**
23	A first order reaction is 50% complete in 80 minutes at 300 K and in 10 minutes at 320 K. Calculate activation energy for the reaction. R= 8.314 JK/mol Log2=0.3010, Log3= 0.4771 , Log4= 0.6021	**3**
24	Primary alkyl halide C_4H_9Br (A) is treated with alcholic KOH to give compound (B). The compound B is treated with HBr to give (C) which is an isomer of compound (**A).** Write the structures of the compounds A ,B and C.	**1+1+1**
25	**(**a) What do you mean by osmotic pressure? (b)For a 5% solution of urea(molar mass=60), calculate the osmotic pressure at 300 K. [R=0.0821 atm/Kmol]	**1** **2**
26	Write the mechanism of hydration of ethene to yield ethanol.	**3**
27	Write down chemical equations for the following naming reactions: (a) Dow Process (b) Fitting Reaction (c) Kolbe's reaction	**1+1+1**
28	Explain on the basis of VBT that $[Ni(CN)_4]^{2-}$ ion with square planar structure is diamagnetic and $[Ni(Cl)_4]^{2-}$ ion with tetrahedral geometry is paramagnetic.	**3**
	SECTION-D (Case Based Questions)	
29	Read the following passage and answer the following questions:	

<table>
<tr><td></td><td>The four colligative properties of dilute solutions help in calculating the molecular mass of the solute which is often called observed molecular mass. It may be same as the theoretical molecular mass if the solute behaves normally in solution. In case, it undergoes association or dissociation, the observed molar mass gives different results. The nature of the solute in solution is expressed in terms of van'thoff factor(i), which may be 1(if solute behaves normally), less than 1 (if solute associate) and more than 1(if the solute dissociates). The extent of association or dissociation is represented by α which is:

For Dissociation α = i-1/n-1. For association α = (1-i)n/n-1</td><td></td></tr>
<tr><td>29(a)</td><td>In the determination of molar mass of A^+B^- using colligative property, what will be the van'thoff factor if the solute is 40% dissociated?</td><td>2</td></tr>
<tr><td>29(b)</td><td>What is expected value of van'thoff factor for $K_4[Fe(CN)_6]$ when it is completely dissociates in water?</td><td>1</td></tr>
<tr><td>29(c)</td><td>What is common in all the four colligative properties?</td><td>1</td></tr>
<tr><td>30</td><td>Read the passage carefully and answer the questions that follow:

Crystal field splitting by various ligands

Metal complexes show different colours due to d-d transitions. The complex absorbs light of specific wavelength to promote the electron from t2g to eg level. The colour of the complex is due to the transmitted light, which is complementary of the colour absorbed. The wave number of light absorbed by different complexes of Cr ion are given below:

<table>
<tr><td>Complex</td><td>Wave number of light absorbed (cm-1)</td><td>Energy of light absorbed(kJ/mol)</td></tr>
<tr><td>$[CrA_6]^{3-}$</td><td>13640</td><td>163</td></tr>
<tr><td>$[CrB_6]^{3+}$</td><td>17830</td><td>213</td></tr>
<tr><td>$[CrC_6]^{3+}$</td><td>21680</td><td>259</td></tr>
<tr><td>$[CrD_6]^{3-}$</td><td>26280</td><td>314</td></tr>
</table></td><td></td></tr>
<tr><td>30(a)</td><td>Calculate the CFSE for the complexes:

$[Fe(CN)_6]^{4-}$ It is given that CN^- is strong field ligand.

$[CoF_6]^{3-}$ It is given that F^- is weak field ligand.</td><td>2</td></tr>
<tr><td>30(b)</td><td>Which of the complexes will be violet in colour? $[CrA_6]^{3-}$ or $[CrB_6]^{3+}$ and why? (Given: If 560 - 570 nm of light is absorbed, the colour of the complex observed is violet.)</td><td>1</td></tr>
<tr><td>30(c)</td><td>Out of the ligands “A”, “B”, “C” and “D”, which ligand causes maximum crystal field splitting? Why?</td><td>1</td></tr>
</table>

	SECTION-E	
31(a)	Write the name of the cell which is generally used in hearing aids. Write the reactions taking place at the anode and cathode of this cell.	**2**
31(b)	The electrical resistance of a column of 0.1 mol/L KCl solution is 100 ohm. If the resistance of the same cell when filled with 0.02 mol/L KCl solution is 520 ohm, calculate the conductivity and molar conductivity of 0.02 mol/L KCl solution. The conductivity of 0.1 mol/L KCl solution is 1.29 S/m.	**1+1+1**
32(a)	For a first order reaction, show that time required for 99% completion is twice the time required for the completion of 90% of the reaction.	**2**
32(b)	Give any three differences between order of reaction and molecularity of reaction	**3**
33(a)	Describe the Stereochemistry of SN2 reactions in detail.	**3**
33(b)	What will happen when (i) tert-Butyl alcohol is heated with Cu at 573 (ii) Phenol is treated with Br2(CS2)	**2**

OSDAV Public School, Kaithal

Marking Scheme

Half Yearly Exams (2024-25)

Subject: CHEMISTRY(043)

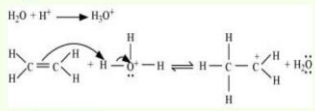
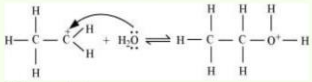
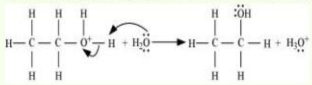
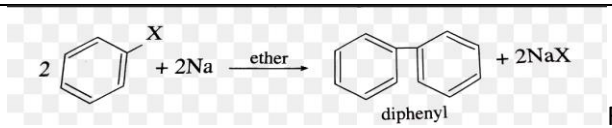
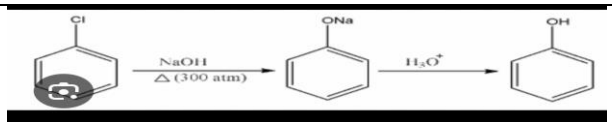
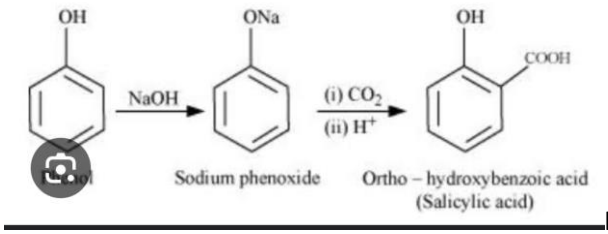
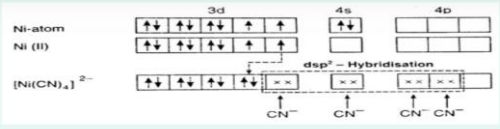
Class:XII. Set-B

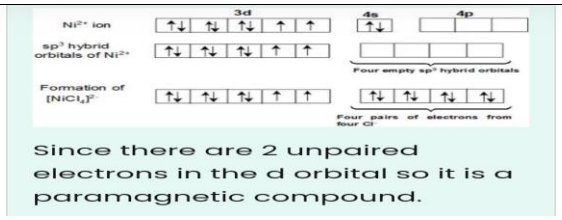
1	**c**	
2	b	1
3	c	1
4	d	1
5	d	

		1
6	a	1
7	c	1
8.	a	1
9	d	1
10	c	1
11	d	1
12	a	1
13	a	1
14	a	1
15	a	1
16	c	1
17	Azeotropes are binary liquid mixtures having the same composition in liquid and vapour phase and boil at a constant temperature. Maximum boiling azeotrope is formed by negative deviation from Raoult's law. A mixture of 68 % nitric acid and 32 % water by mass is an example of the maximum boiling azeotrope.	1 1/2 1/2

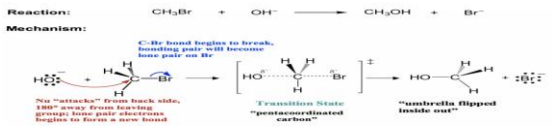
18	$H^+ + e \rightarrow \frac{1}{2}H_2$ $E = E^\circ - \frac{0.0591}{1}\log\frac{1}{[H^+]} = -0.0591 \times pH$ $= 0 - 0.0591 \times 10 = -0.591V.$	1 1
19	(a) Rate= K[A]2 [B]0 (b) Rate of reaction becomes four times.	1 1
20	(a)Fe4[Fe(CN)6]3 (b) [Co (H 2 O) 2 (NH 3) 4] Cl 3	1 1
21	(a) 1-Bromopentane because it is 1° Haloalkane. (b) 1-Bromo-2-methylbutane because it is 1° haloalkane.	1/2,1/2
22	In the voltaic cell, Al will act anode while Ni as the cathode $Al(s) \xrightarrow{aq} Al^{3+}(aq) + 3e^-] \times 2$ $[Ni^{2+}(aq) + 2e^- \rightarrow Ni(s)] \times 3$ $2Al(s) + 3Ni^{2+}(aq) \rightarrow 2Al^3 + (aq) + 3Ni(s)$ $E^o_{cell} = E^o_{Ni^{2+}/Ni} - E^o_{Al^{3+}/Al}$ $= (-0.25V) - (-1.66V)$ $= 1.41V$ $E^o_{cell} = E^o_{cell} - \frac{0.0591V}{6}\log\frac{[Al^{3+}(aq)]^2}{[Ni^{2+}(aq)]^3}$ $= (1.41V) - \frac{0.0591V}{6}\log\frac{(10^{-3})^2}{(5\times10^{-1})^3}$ $= (1.41V) - \frac{0.0591V}{6}\log(8 \times 10^{-6})$ $= 1.41V - 0.0098(09031 - 6)V$ $= 1.41V + 0.0098 \times 0.0098 \times 5.0969V$ $= (1.41 + 0.05)V$ $= 1.46V$	1/2 1/2 1/2

		1/2 1
23	$\log \frac{K_2}{K_1} = \frac{E_a}{2.303\ R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$ $K = \frac{0.693}{t_{1/2}}$ K_1 at 300 K $= \frac{0.693}{30}\ min^{-1}$ K_2 at 320 K $= \frac{0.693}{10}\ min^{-1}$ $\log\left(\frac{K_2}{K_1}\right) = \frac{E_a}{2.303\ R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$ $\log\left(\frac{\frac{0.693}{10}}{\frac{0.693}{30}}\right) = \frac{E_a}{2.303\ R}\left[\frac{1}{300} - \frac{1}{32}\right.$ $\log(3) = \frac{E_a}{2.303\ R}\left[\frac{20}{300 \times 320}\right]$ $E_a = 0.4771 \times 2.303 \times 8.314 \times 300 \times 16$ $E_a = 43.8\ kJ$	1/2 1/2 1/2 1/2 1
24	A: 1-Bromo-2- methyl propane. B: 2-Methylprop-1-ene C: 1-Bromo-1-methylpropane	1+1+1
25	(a) Osmotic pressure is the minimum amount of pressure needed to stop solvent molecules from moving through a semipermeable membrane into a solution with a higher concentration of solute.	1 1/2

	(b) $\pi = CRT$ (Volume of solution = 100 mL) $\pi = \frac{n}{V}RT$ $\pi = \frac{5}{60} \times \frac{0.0821 \times 300}{0.1}$ $\pi = 20.5$ atm	1/2 1
26	**Step 1:** Protonation of ethene to form carbocation by electrophilic attack of H_3O^+:  **Step 2:** Nucleophilic attack of water on carbocation:  **Step 3:** Deprotonation to form ethanol: 	1 1 1
27(b)	 Fitting Reaction	1
27(a)	 Dow Process	1
27(c))	 Koble Reaction	1
28	 It undergoes dsp^2 (one d orbital, one s and two p orbitals used by the ligands) hybridization and forms square planar structure. Since all the electrons are paired so it is diamagnetic.	1.5

		1.5
		1
29(a)	produces 1 mole of A^+ and 1 mole of B^-, resulting in a total of 2 moles of ions from 1 mole of the electrolyte. 2. **Degree of Dissociation**: The degree of dissociation (α) is given as 40%. This can be expressed as a decimal: $\alpha = \frac{40}{100} = 0.4$ 3. **Using the Van't Hoff Factor Formula**: The Van't Hoff factor (i) can be calculated using the formula: $i = 1 + (n - 1) \cdot \alpha$ where n is the number of particles produced upon dissociation. In this case, since A^+B^- produces 2 ions, $n = 2$. 4. **Substituting Values**: Now, substitute n and α into the formula: $i = 1 + (2 - 1) \cdot 0.4$ Simplifying this gives: $i = 1 + 1 \cdot 0.4 = 1 + 0.4 = 1.4$	1/2 1/2 1/2 1/2
29(b)	I= 5 Because it gives 5 ions.	1
29(c)	All colligative properties depend upon no. Of particles.	1
30(a)	(I)	
30	(a) (I) CFSE= -2.4 Δ. (ii) CFSE = -0.4 Δ (b) [CrB6]3+ will be violet because its energy lies in this range. (c) D , because it absorb maximum energy.	1+ 1 1 1

31(a)	A mercury battery, used for hearing aids and electric watches, delivers a constant voltage of 1.35 V for long periods. The half-reactions are **Anode:** $Zn\ (Hg) + 2\ OH^- \rightarrow ZnO\ (s) + H_2O + 2e^-$ **Cathode:** $HgO + H_2O + 2e^- \rightarrow Hg\ (l) + 2\ OH^-$	1 1
31(b)	The cell constant is given by the equation: Cell constant = G^* = conductivity × resistance = 1.29 S/m × 100Ω = 129 m^{-1} = 1.29 cm^{-1} Conductivity of 0.02 mol L^{-1}KCl solution = cell constant / resistance = $\frac{G^*}{R} = \frac{129\ m^{-1}}{520\Omega}$ = 0.248 S m^{-1} Concentration = 0.02 mol L^{-1}= 1000 × 0.02 mol m^{-3} = 20 mol m Molar conductivity = $\Lambda_m = \frac{\kappa}{c} = \frac{248\times10^{-3}\ S\ m^{-1}}{20\ mol\ m^{-3}}$ = 124 × 10^{-4} S m^2 mol^{-1} Alternatively. $\kappa = \frac{1.29\ cm^{-1}}{520\Omega}$ = 0.248 × 10^{-2} S cm^{-1} and $\Lambda_m = \kappa \times 1000\ cm^3\ L^{-1}$ molarity $^{-1}$= $\frac{0.248\times10^{-2}\ S\ cm^{-1}\times1000\ cm^3\ L^{-1}}{0.02\ mol\ L^{-1}}$ = 124 S cm^2 mol^{-1}	1 1 1

32(a)	$$\text{or} \quad t_{99\%} = \frac{2.303}{k} \log \frac{100}{100-99}$$ $$\text{or} \quad t_{99\%} = \frac{2.303}{k} \log 100$$ $$\text{or} \quad t_{99\%} = \frac{2.303}{k} \times 2$$ Time required for the completion of 90% reaction, $$t_{90\%} = \frac{2.303}{k} \log \frac{[A]_0}{[A]}$$ $$t_{90\%} = \frac{2.303}{k} \log \frac{100}{100-90}$$ $$t_{90\%} = \frac{2.303}{k} \log \frac{100}{10}$$ $$t_{90\%} = \frac{2.303}{k} \log 10$$ $$t_{90\%} = \frac{2.303}{k}$$ Divide eq. (1) eq. (2) $$\frac{t_{99\%}}{t_{90\%}} = \frac{\left(\frac{2.303}{k}\right) \times 2}{\frac{2.303}{k}}$$ $$\frac{t_{99}\%}{t_{90\%}} = 2$$	1 1
32(b)	<table><tr><th>Molecularity</th><th>Order</th></tr><tr><td>(1) It is the number of reacting species undergoing simultaneous collision.</td><td>It is the sum of the powers of the concentration terms in the rate law expression.</td></tr><tr><td>(2) It is a theoretical concept.</td><td>It is experimentally determined.</td></tr><tr><td>(3) It has integral values only.</td><td>It can have fractional values also</td></tr><tr><td>(4) It cannot be zero.</td><td>It can be zero.</td></tr></table>	1 1 1
33(a)	 Inversion of configuration.	1 1 1
33(b)	(I) Hence when the vapours of tertiary butyl alcohol are passed over heated copper at 573K, the product formed is 2-Methyl propene.	1

	(ii)o-Bromo phenol and p-bromophenol will be formed and para product is major product.	1