2006 IITJEE Paper - chemistry

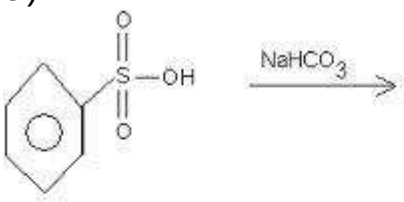
1) $B(OH)_3 + NaOH \rightarrow NaBO_2 + Na[B(OH)_4] + H_2O$ To keep the above reaction in forward direction, which reagent should be used.

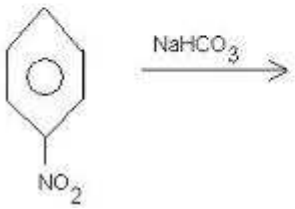
a) Cis 1, 2, diol
b) trans 1, 2 diol
c) Borax
d) Na_2HPO_4

2) An aqueous solution of metal salt is given. NH_4Cl and NH_4OH are added to it and white precipitate is formed. Some part of precipitate remains in dissolved state as well. The above solution that dissolves in NH_4OH is of

a) $Zn(OH)_2$
b) $Al(OH)_3$
c) $Mg(OH)_2$
d) $Ca(OH)_2$

3)





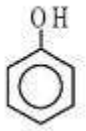
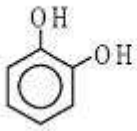
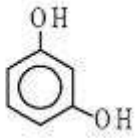
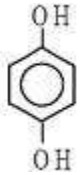
The gases produced are respectively

a) SO^2 , CO^2
b) SO^2 , CO
c) SO^2 , NO^2
d) SO^2 , SO^2

4) The molar heat capacity of a monoatomic gas for which the ratio of pressure and volume is one

a) 3/2 R
b) 4/2 R
c) 5/2 R
d) zero

5)

I. 
II. 
III. 
IV. 

Arrange the following compounds according to decreasing boiling points.

a) (IV) > (III) > (II) > (I)
b) (III) > (IV) > (II) > (I)
c) (I) > (II) > (III) > (IV)
d) (II) > (III) > (I) > (IV)

6)

$$CH_2 = CH - CH_3 \xrightarrow{NOCl} X,\ X \text{ is}$$

a) $CH_2(Cl) - CH(NO) - CH_3$
b) $CH_2(NO) - CH(Cl) - CH_3$
c) $ON - CH_2 - CH_2 - CH_2 - Cl$
d) $ON - CH(Cl) - CH_2 - CH_3$

7) The IUPAC name of C_6H_5COCl is

a) Benzoyl chloride
b) Benzene chloro ketone
c) Benzene carbonyl chloride
d) Chloro phenyl ketone

8) $Ag^+ + NH_3 \rightleftharpoons [Ag(NH_3)]^+$; $k_f = 6.8 \times 10^3$

$[Ag(NH_3)]^+ + NH_3 \rightleftharpoons [Ag(NH_3)_2]^+$; $k_f = 1.6 \times 10^3$

Overall formation constant of the complex $[Ag(NH_3)_2]^+$ would be

a) 1.08×10^3
b) 1.08×10^7
c) 6.8×10^6
d) 6.8×10^7

9) $CH_3NH_2 + CHCl_3 + KOH \rightarrow$ Nitrogen containing compound + KCl + H_2O.

Nitrogen containing compound is

a) $CH_3 - C \equiv N$
b) $CH_3 - NH - CH_3$
c) $CH_3\overset{+}{N}\equiv\overset{-}{C}$
d) $CH_3-\overset{-}{N}\equiv\overset{+}{C}$

10) In blue solution of copper sulpahte excess of KCN is added then solution becomes colourless due to the formation of

a) $[Cu(CN)_4]^{2-}$
b) Cu^{2+} get reduced to form $[Cu(CN)_4]^{3-}$
c) $Cu(CN)_2$
d) CuCN

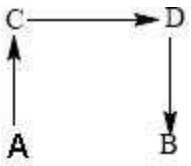
11) The direct conversion of A to B is difficult, hence it is carried out by the following shown path:

$\triangle S_{A \to C}$ = 50 e.u

$\triangle S_{C \to D}$ = 30 e.u

$\triangle S_{B \to D}$ = 20 e.u

where e.u. is entropy unit then $\triangle S_{A \to B}$ is



a) +100 e.u

b) +60 e.u

c) -100 e.u

d) -60 e.u

12) In the Haber Basch process, for the preparation of ammonia, in presence of activated ferrous and molybdenum, which of the following is correct

$N_2 + 3H_2 \rightleftharpoons 2NH_3$; $\triangle H < 0$

Pick the correct answer :

a) The condition for equilibrium is
$2\triangle G_{NH_3} = 3\triangle G_{H_2} + \triangle G_{N_2}$
where G is Gibbs free energy per mole of the gaseous species measured at that partial pressure. The condition of equilibrium is unaffected by the use of catalyst, which increases the rate of both the forward and backward reactions to the same extent.

b) The equilibrium will shift to forward direction because according to 2^{nd} law of thermodynamics the entropy must increases in the direction of spontaneous reaction.

c) Catalyst will not alter the rate of either of the reaction.

d) Catalyst at 298 K doesn't affect reaction rate as it increase, the forward and backward reaction by 2 and catalyst at 443 K increase reaction rate in the forward direction by 2 and backward direction by 1.7

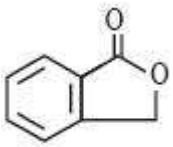
13) Section-B (May have more than one option correct)
If the bond length of CO bond in carbon monoxide is 1.128 Å , then what is the value of CO bond length in $Fe(CO)_5$?

a) 1.158 Å
b) 1.128 Å
c) 1.178 Å
d) 1.118 Å

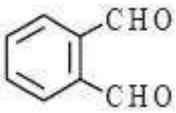
14) Section-B (May have more than one option correct)
The species present in solution when CO_2 is dissolved in water are

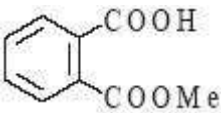
a) CO_2 , H_2CO_3 , HCO^-_3 , CO^{2-}_3
b) H_2CO_3 , CO^{2-}_3
c) CO^{2-}_3 , HCO^-_3
d) CO_2 , H_2CO_3

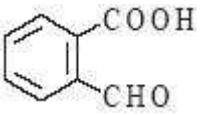
15) Section-B (May have more than one option correct)

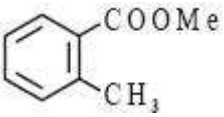


Lactone
is produced on heating a compound with conc. alkali. Which of the compound will only give this lactone ?

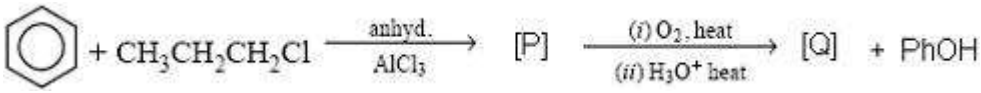
a) 

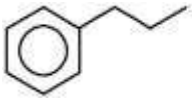
b) 

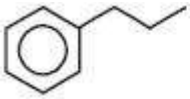
c) 

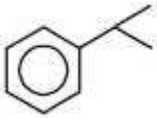
d) 

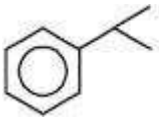
16) Section-B (May have more than one option correct)
Identify the major products [P] and [Q] in th efollowing reaction



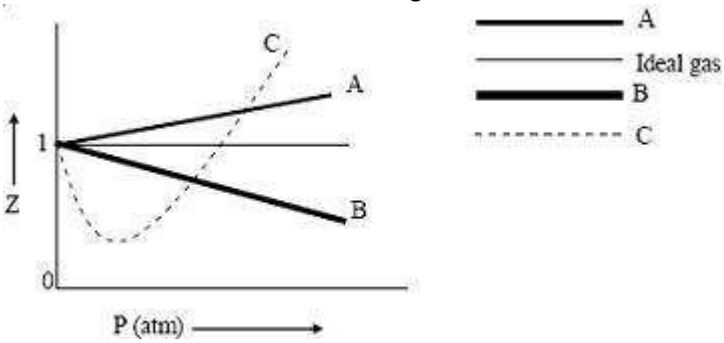
a)  and CH_3COCH_3

b)  and CH_3CH_2CHO

c)  and CH_3COCH_3

d)  and CH_3CH_2CHO

17) Section-B (May have more than one option correct)
The given graph represents the variation of Z(compressibility factor = (PV)/(nRT) versus P, at a particular temperature for three real gases A, B and C.
Which of the following statement is incorrect.



a) For the gas A, a = 0 and its dependence on P is linear at all pressure

b) For the gas B, b = 0 and its dependence on P is linear at all pressure.

c) For the gas C, which is typical real gas for which neither a nor b = 0. By knowing the minima and the point of intersection, with Z = 1, a and b can be calculated.

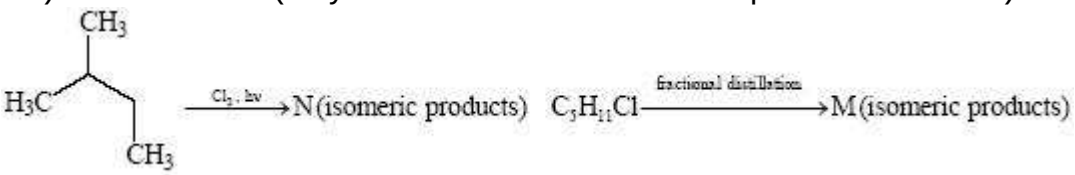
d) At high pressure, the slope is positive for all real gases.

18) Section-B (May have more than one option correct)
There is a mixture of lowest molecular weight ketone and its next homologue. It is treated with hydroxyl amine when a mixture of

oximes is obtained.

a) Two different oximes are formed
b) Three different oximes are formed
c) Two oximes are optically active
d) All oximes are optically active

19) Section-B (May have more than one option correct)



What are M and N ?

a) 6,6
b) 3,3
c) 4,4
d) 6,4

20) Section-B (May have more than one option correct)
Ammonical solution of $MgSO_4$ in presence of NH_4Cl is heated with Na_2HPO_4. The white precipitate formed is of

a) $MgSO_4$. $MgPO_4$
b) $Mg_3(PO_3)_2$
c) $MgNH_4PO_4$
d) $MgSO_4$. $MgCl_2$

21) Section-C (Comprehension-1)
The coordination number of Ni^{2+} is 4.
$NiCl_2$ + KCN (excess) → A (cyano complex)

The IUPAC name of A and B are

a) Potassium tetracyanonickelate (II), potassium tetrachloronickelate (II)
b) Tetracyanopotassiumnickelate (II), teterachlorpotassiumnickelate (II)

c) Tetracyanornickel (II), tetrachloronickel (II)

d) Potassium tetracyanonickel (II), potassium tetrachloronickel (II)

22) Section-C (Comprehension-1)

The coordination number of Ni^{2+} is 4.

$NiCl_2$ + KCN (excess) → A (cyano complex)

Which of the following is correct ?

a) Complex (A) is paramagnetic and complex (B) is diamagnetic

b) Complex (A) is diamagnetic and complex (B) is paramagnetic

c) Complex (A) with cyano is paramagnetic with two unpaired electrons and complex (B) is diamagnetic

d) Complex (A) with cyano is diamagnetic and complex (B) with chloro is paramagnetic with two unpaired electrons.

23) Section-C (Comprehension-1)

The coordination number of Ni^{2+} is 4.

$NiCl_2$ + KCN (excess) → A (cyano complex)

Hybridisation of the central atom iof complex(A) and complex(B) are

a) both are dsp^2

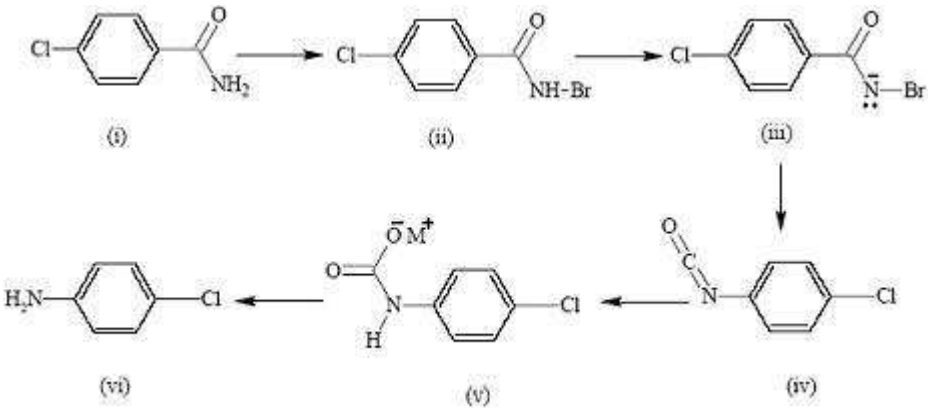
b) both are sp^3

c) complex(A):dsp^2 and complex(B): sp^3

d) complex(A): sp^3 and complex(B): dsp^2

24) Section-C (Comprehension-2)

$RCONH_2$ is converted into RNH_2 by means of Hofmann bromamide degradation.



In this reaction, RCONHBr is formed from which this reaction has derived its name. Electron donating group at phenyl activates the reaction. Hofmann degradation reaction is an intramolecular reaction.

Which reagent (X) is used to convert I to II

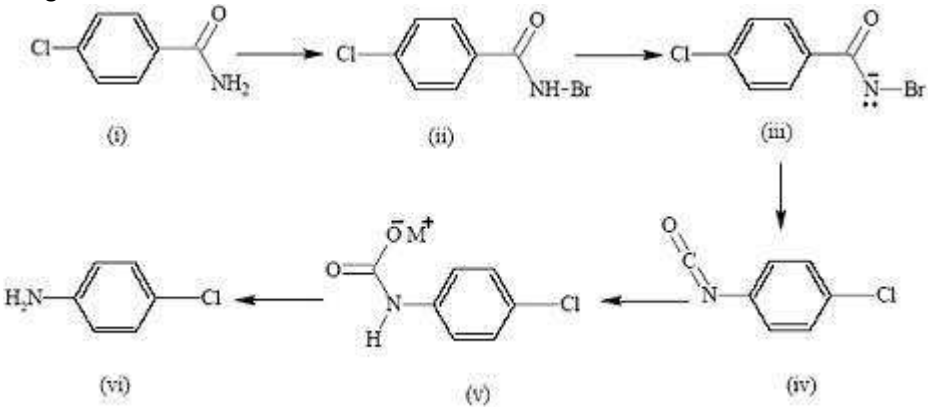
a) Br_2 / NaOH

b) Kbr / NaOH

c) KBr / $NaHCO_3$

d) N-Bromo succinamide

25) Section-C (Comprehension-2)
$RCONH_2$ is converted into RNH_2 by means of Hofmann bromamide degradation.



In this reaction, RCONHBr is formed from which this reaction has derived its name. Electron donating group at phenyl activates the reaction. Hofmann degradation reaction is an intramolecular reaction.

Which is the rate determining step in Hofmann bromamide degradation?

a) Formation of (i)

b) Formation of (ii)

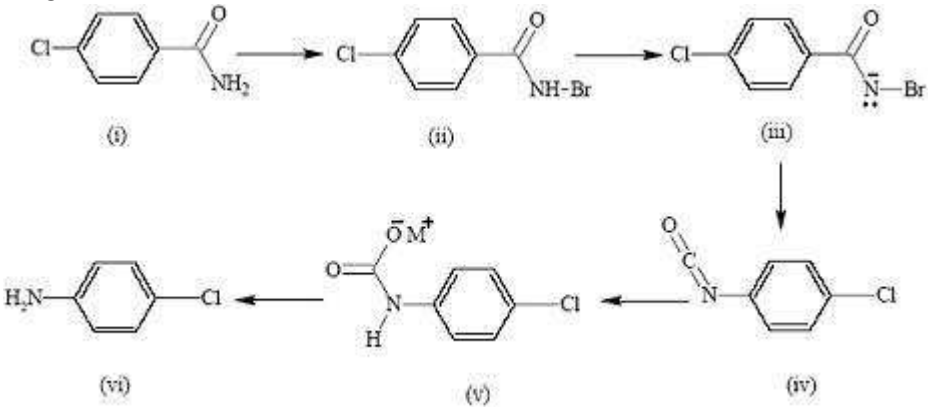
c)

Formation of (iii)

d) Formation of (vi)

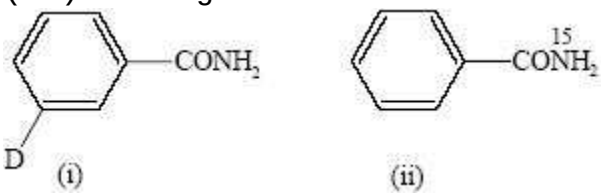
26) Section-C (Comprehension-2)

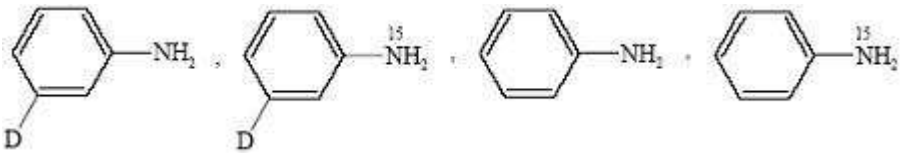
$RCONH_2$ is converted into RNH_2 by means of Hofmann bromamide degradation.

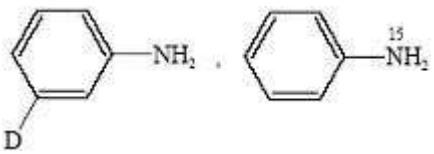


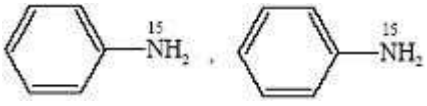
In this reaction, RCONHBr is formed from which this reaction has derived its name. Electron donating group at phenyl activates the reaction. Hofmann degradation reaction is an intramolecular reaction.

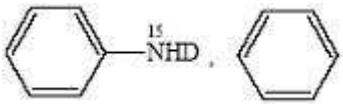
What are the constituent amines formed when the mixture of (i) and (ii) undergoes Hofmann bromamide degradation?



a) 

b) 

c) 

d) 

27) Section-C (Comprehension-3)
Due to the neutron prsent in cosmic rays, the following reaction takes place by the bombardment of nitrogen with neutrons

$_7N^{14} + _0n^1 \rightarrow _6H^{14} + _1H^1$;

$_6C^{14} \rightarrow \beta^-$

Cosmic rays from $_6C^{14}$ which get circulated in the atmosphere as well as in living species. Whenever there is a nuclear explosion , the concentration of $_6C^{14}$ increases. both in the atmosphere as well as in living species. When a species dies the C-14 concentration decreases and hence the decrease can be measured and the time estimated as to when the organism died. For this we require

(1) half life of $_6C^{14}$ (i.e. 5760 years).

(2) Activity of $_6C^{14}$ in living species.

(3) Activity of $_6C^{14}$ in fossil.

Beyond 30000 years the age of fossil cannot be determined as the activity then would be too low.

In radio carbon dating for finding the age of fossils , the most appropriate statement is

a) In living organisms, circulation of C-14 from atmosphere is high so the carbon content is constant in organism

b) Carbon dating can be used to find out the age of earth crust and rocks

c) Radioactive absorption due to cosmic radiation is equal to the rate of radioactive decay, hence the carbon content remains constant in living organism

d) Carbon dating can not be used to determine concentration of C-14 in dead beings.

28) Section-C (Comprehension-3)
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Beyond 30000 years the age of fossil cannot be determined as the activity then would be too low.

What should be the age of fossil for meaningful determination of its age?

a) 6 years

b) 6000 years

c) 60,000 years

d) It can be used to calculate any age

29) Section-C (Comprehension-3)

Due to the neutron prsent in cosmic rays, the following reaction takes place by the bombardment of nitrogen with neutrons

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Beyond 30000 years the age of fossil cannot be determined as the activity then would be too low.

A nuclear explosion has taken place leading to increase in concentration of C14 in nearby areas. C14 concentration is C1 in nearby areas and C2 in areas far away. If the age of the fossil is determined to be T1 and T2 at the places respectively then

a) The age of the fossil will increase at the place where explosion has taken place and

$$T_1 - T_2 = \frac{1}{\lambda} \ln \frac{C_1}{C_2}$$

b) The age of the fossil will decrease at the place where explosion has taken place and

$$\frac{1}{} \quad \frac{C_1}{}$$

$T_1 - T_2 = \lambda \ln C_2$

c) The age of fossil will be determined to be same

d) $\frac{T_1}{T_2} = \frac{C_1}{C_2}$

30) (Comprehension-4)
Tollen's reagent is used for the detection of aldehyde when a solution of $AgNO_3$ is added to glucose with NH_4OH then gluconic acid is formed

$Ag^+ + e^- \rightarrow Ag$; $E°_{red} = 0.8$ V

$C_6H_{12}O_6 + H_2O \rightarrow$ Gluconic acid ($C_6H_{12}O_7$) $+ 2H^+ + 2e^-$; $E°_{oxd} = -0.05$ V

$Ag(NH_3)_2^+ + e^- \rightarrow Ag(s) + 2NH_3$; $E°_{red} = 0.337$ V

[Use 2.303 x $\frac{R\,T}{F} = 0.0592$ and $\frac{F}{R\,T} = 38.92$ at 298 K]

$2Ag^+ + C_6H_{12}O_6 + H_2O \rightarrow 2Ag(s) + C_6H_{12}O_7$
Calculate lnK for of this reaction.

a) 66.13
b) 58.38
c) 28.30
d) 46.29

31) (Comprehension-4)
Tollen's reagent is used for the detection of aldehyde when a solution of $AgNO_3$ is added to glucose with NH_4OH then gluconic acid is formed

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$C_6H_{12}O_6 + H_2O \rightarrow$ Gluconic acid ($C_6H_{12}O_7$) $+ 2H^+ + 2e^-$; $E°_{oxd} = -0.05$

V

$Ag(NH_3)_2^+ + e^- \rightarrow Ag(s) + 2NH_3$; $E°_{red} = 0.337$ V

[Use $2.303 \times \frac{R\,T}{F} = 0.0592$ and $\frac{F}{R\,T} = 38.92$ at 298 K]

When ammonia is added to the solution, pH is raised to 11. Which half-cell reaction is affected by pH and by how much?

a) E_{oxd} will increase by a factor of 0.65 from $E°_{oxd}$

b) E_{oxd} will decrease by a factor of 0.65 from $E°_{oxd}$

c) E_{red} will increase by a factor of 0.65 from $E°_{red}$

d) E_{red} will decrease by a factor of 0.65 from $E°_{red}$

32) (Comprehension-4)

Tollen's reagent is used for the detection of aldehyde when a solution of $AgNO_3$ is added to glucose with NH_4OH then gluconic acid is formed

$Ag^+ + e^- \rightarrow Ag$; $E°_{red} = 0.8$ V

$C_6H_{12}O_6 + H_2O \rightarrow$ Gluconic acid ($C_6H_{12}O_7$) $+ 2H^+ + 2e^-$; $E°_{oxd} = -0.05$ V

$Ag(NH_3)_2^+ + e^- \rightarrow Ag(s) + 2NH_3$; $E°_{red} = 0.337$ V

[Use $2.303 \times \frac{R\,T}{F} = 0.0592$ and $\frac{F}{R\,T} = 38.92$ at 298 K]

Ammonia is always is added in this reaction. Which of the following must be incorrect?

a) NH_3 combines with Ag^+ to form a complex.

b) $Ag(NH_3)_2^+$ is a stronger oxidising reagent than Ag^+ .

c) In absence of NH_3 silver salt of gluconic acid is formed.

d) NH_3 has affected the standard reduction potential of glucose/gluconic acid electrode.

33) 75.2 g of C_6H_5OH(phenol) is dissolved in a solvent of K_f = 14. If the depression in freezing point is 7 K then find the % of phenol that dimerises.

a)
b)
c)
d)

34) For the reaction, $2CO + O_2 \rightarrow 2CO_2$; $\triangle H$ = -560kJ . Two moles of CO and one mole of O_2 are taken in a container of volume 1 L. They completely form two moles of CO_2, the gases deviate appreciably from ideal behaviour. If the pressure in the vessel changes from 70 to 40 atm, find the magnitude (absolute value) of $\triangle U$ at 500 K. (1 L atm = 0.1 kJ)

a)
b)
c)
d)

35) We have taken a saturated solution of AgBr. K_{sp} of AgBr is 12 x 10-14 . If 10^{-7} mole of $AgNO_3$ are added to 1 litre of this solution find conductivity (specific conductance) of this solution in terms of 10^{-7} S m^{-1} units.
Given $\lambda^\circ_{(Ag^+)}$ = 6 x 10^{-3} Sm^2mol^{-1}
$\lambda^\circ_{(Br^-)}$ = 8 x 10^{-3} Sm^2mol^{-1}
$\lambda^\circ_{(NO^-_3)}$ = 7 x 10^{-3} Sm^2mol^{-1}

a)
b)
c)
d)

36) The edge length of unit cell of a metal having molecular weight 75 g/mol is 5 Å which crystallizes in cubic lattice. If the density is 2 g/cc then find the radius of metal atom. (N_A = 6 x 10^{23}). Give the answer in pm.

a)
b)
c)
d)

37) Match the extraction processes listed in Column I with metals listed in Column II:

	Column I		Column II
(A)	Self reduction	(P)	Lead
(B)	Carbon reduction	(Q)	Silver
(C)	Complex formation and displacement by metal	(R)	Copper
(D)	Decomposition of iodide	(S)	Boron

a)
b)
c)
d)

38) Match the following:

	Column I		Column II
(A)	$Bi^{3+} \rightarrow (BiO)^{+}$	(P)	Heat
(B)	$[AlO_2]^{-} \rightarrow Al(OH)_3$	(Q)	Hydrolysis
(C)	$SiO_4^{4-} \rightarrow Si_2O_7^{6-}$	(R)	Acidification

(D)	$(B_4O_7^{2-}) \rightarrow [B(OH)_3]$	(S)	Dilution by water

a)
b)
c)
d)

39) According to Bohr's theory,
E_n = Total energy
K_n = Kinetic energy
V_n = Potential energy
r_n = Radius of nth orbit
Match the following:

	Column I		Column II
(A)	V_n/K_n = ?	(P)	0
(B)	If radius of n^{th} orbit $\propto E_n^x$, x = ?	(Q)	-1
(C)	Angular momentum in lowest orbital	(R)	-2
(D)	$1/r_n \propto Z^y$, y=?	(S)	1

a)
b)
c)
d)

40) Match the following:

	Column I		Column II
(A)	CH_3-CHBr-CD_3 on treatment with alc. KOH gives CH_2=CH-CD_3 as a major product.	(P)	E1 reaction
(B)	Ph-CHBr=CH_3 reacts faster than Ph-CHBr-CD_3.	(Q)	E2 reaction
(C)	Ph-CH_2-CH_2Br on treatment with $C_2H_5OD/C_2H_5O^-$ gives Ph-CD=CH_2 as the major product.	(R)	E1cb reaction
(D)	$PhCH_2CH_2Br$ and $PhCD_2CH_2Br$ react with same rate.	(S)	First order reaction

a)
b)
c)
d)

ANSWERS

1) a	2) a	3) d	4) b
5) a	6) c	7) c	8) b
9) c	10) b	11) b	12) b
13) d	14) a	15) a	16) c
17) b	18) b	19) d	20) c
21) a	22) b	23) c	24) a
25) d	26) c	27) c	28) c
29) a	30) b	31) a	32) d
33)	34)	35)	36)
37)	38)	39)	40)