மொறட்டுவைப் பல்கலைக்கழக பொறியியற்பீட தமிழ் மாணவர்கள் நடாத்தும்
கல்விப் பொதுத் தராதர உயர்தர (கணித, விஞ்ஞான) மாணவர்களுக்கான 6 ஆவது
முன்னோடிப் பரீட்சை -2015

கல்விப் பொதுத் தராதரப் பத்திர(உயர் தர) முன்னோடிப் பரீட்சை - 2015
General Certificate of Education (Adv. Level) Pilot Examination - 2015

Chemistry I இரசாயனவியல் I	02	E	I	Two hours இரண்டு மணித்தியாலம்

- ✳ Periodic Table is provided.
- ✳ This paper consists of **08** pages and **50** questions
- ✳ Answer all the questions
- ✳ Use of calculators is not allowed
- ✳ Write your Index number in the space provided in the answer sheet
- ✳ In each of the questions **1-50,** pick one of the alternatives from (1),(2),(3),(4),(5) which is correct or most appropriate and mark your response on the answer sheet with a cross (X)

Universal gas constant R = 8.314 J $K^{-1}mol^{-1}$
Avogadro constant $N_A = 6.022 \times 10^{23} mol^{-1}$

1. Which of the following species has the highest e/m value?

   1. α 2. Proton 3. Electron 4. Neutron 5. Helium

2. In which of the given molecule, all atoms are in the same plane?

   1. ammonia 2. ethane 3. propene 4. H_3O^+ 5. 1, 3 - butadiyne

3. Which of the following has zero dipolar moment?

   1. $CHCl_3$ 2. H_2O 3. N_2O 4. SO_3 5. SO_2Cl_2

4. Which of the following is more suitable for the unit formula for bleaching powder?

   1. $Ca_3Cl_4O_6H_6$ 2. $Ca_2Cl_4O_2H_4$ 3. $CaOCl_2H_4$ 4. $CaOCl_2$ 5. $CaCl_2.Ca(ClO)_2$

5. Which of the following has no chemical change with H_2O_2?

   1. $MnO_2(s)$ 2. $KMnO_4/dilH_2SO_4$ 3. $Cr(OH)_3/NaOH(aq)$
   4. Ag_2O 5. $KI/dilH_2SO_4$

6. Which of the following is a disproportionation reaction?

   1. $K_2Cr_2O_7 + 3H_2SO_4 + 4KCl \longrightarrow 3K_2SO_4 + 3H_2O + 2CrO_2Cl_2$
   2. $Fe_3O_4(aq) + 8HCl(aq) \longrightarrow FeCl_2(aq) + 2FeCl_3(aq) + 4H_2O(\ell)$
   3. $NH_4NO_3(s) \longrightarrow N_2O(g) + 2H_2O(g)$
   4. $2H_2O_2(aq) \longrightarrow 2H_2O(\ell) + O_2(g)$
   5. $2HCl(aq) + Na_2S_2O_3(aq) \longrightarrow 2NaCl(aq) + SO_2(g) + S(s) + H_2O(aq)$

[See Page Two]

7. Composition of a 50 cm^3 aqueous solution of I_2 is 100ppm.Then 10 cm^3 $CHCl_3$ is added and shaken well. After the removal of $CHCl_3$ layer the composition of I_2 in the aqueous solution is 30 ppm. Then another 10 cm^3 of $CHCl_3$ is added to the aqueous layer and shaken well. The composition of I_2 in the remaining aqueous layer is

   1. 9 2. 3 3. 5 4. 20 5. 10

8. $2\ SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ $\Delta H^\theta = -196\ kJmol^{-1}$.
   The standard entropies of $SO_2(g)$, $O_2(g)$, $SO_3(g)$ are 248, 205, 256 $(Jmol^{-1}K^{-1})$ respectively.
   The minimum temperature (^0C) needed for this reaction to take place is

   1. 1037 2. 755 3. 1310 4. 450 5. 300

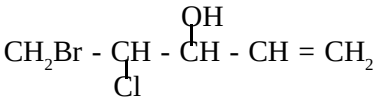
9. Which row of the following table gives the correct information with regard to NOCl molecule?

Electron pair geometry	Geometrical shape	Nature of N-Cl bond	ONCl bond angle
1. angular	trigonal planer	sp^2 - sp^3	120^0
2. trigonal planer	angular	sp^2(h.o) - 3p(a.o)	$< 120^0$
3. trigonal planer	angular	2p(ao) - 3p(ao)	180^0
4. linear	linear	sp^2 - sp^3	120^0
5. angular	angular	sp^2 - sp^3	$< 120^0$

10. The oxide of the metal M is M_2O_5. 1.60g of M_2O_5 was dissolved in dil H_2SO_4 and the sulphate of M was formed. The mass of dry sulphate is 4.00g. Therefore relative atomic mass of M is (S = 32, O = 16)

    1. 112 2. 168 3. 56 4. 28 5. 160

11. The IUPAC name of the following organic compound is

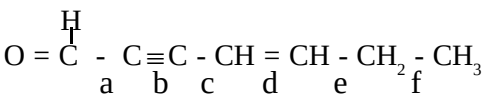


    1. 1 - bromo - 2 - chloropent - 4 - en - 3 - ol
    2. 1 - bromo - 2 - chloro - 4 - pentenol
    3. 5 - bromo - 4 - chloropent - 1 - en - 3 - ol
    4. 5 - bromo - 4 - chloropenten - 3 - ol
    5. 5 - bromo - 4 - chloro - 1 - enpent - 3 - ol

12. Which of the following expesses the four quantum numbers (n, ℓ, m_ℓ, m_s) of the outermost energy level electron of $_{29}Cu$, respectively?

    1. {3, 2, -2, +½} 2. {3, 3, -2, +½} 3. {4, 0, 0, +½} 4. {4, 2, -2, +½} 5. {4, 0, -1, +½}

13.



    Which of the following gives the carbon - carbon lengths in ascending order?

    1. a < b < c < d < e < f
    2. f < e < d < c < b < a
    3. b < d < a < c < e < f
    4. b < a < d < f < e < c
    5. b < d < a = d < e < f

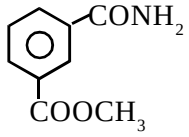
14. Which of the following statements is not true to express the pattern of the compounds of the 3rd period elements from left to right

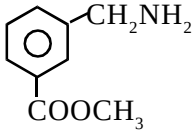
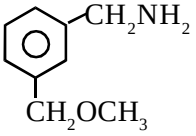
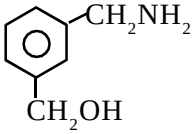
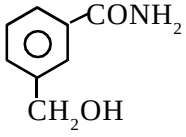
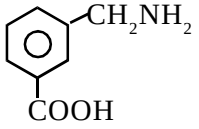
    1. Electron affinity increases along the period
    2. Valency relative to oxygen increases
    3. First ionization energies show a zig-zag change
    4. Acidity of the hydrides increases
    5. Covalent properties of the elements increases

[See Page Three]

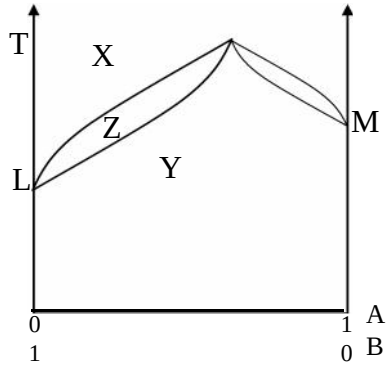
15. $2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g)$ is thermodynamically spontaneous at 300K, but not at high temperatures. Then which of the following is true about the reaction at 300K?

	ΔH^θ	$\Delta S^{\theta`}$	ΔG^θ
1.	< 0	< 0	< 0
2.	<0	> 0	< 0
3.	< 0	> 0	> 0
4.	> 0	> 0	< 0
5.	> 0	< 0	> 0

16. If  is reduced by $LiAlH_4$ and then hydrolysed, the product / products is / are

1. 
2. 
3.  , CH_3OH
4.  , CH_3OH
5.  , CH_3OH

17. Temperature - composition diagram of the mixture of two missible liquids A and B are shown



Which is the false statement regarding the above

1. Molecular interactions, A - A < A - B > B - B
2. Y is liquid phase
3. X is vapour phase
4. When A and Bare mixed, temperature increases
5. $p_A^0 > p_B^0$ (p^0 is pure vapour pressure}

18. Salt Z dissolves in con HCl forming a yellow solution. Then the solution is diluted by distilled water, forming a greenish blue solution. If excess $NH_3(aq)$ is added to the resulting solution, the observation is .

1. Dark blue solution
2. Reddish brown precipitate
3. Yellow solution
3. Yellowish brown solution
5. Blue precipitate

19. pH of a 0.01 $moldm^{-3}$ weak acid HA is 4.0. The Ka value of this acid HA in mol dm^{-3} is

1. 1×10^{-4}
2. 1×10^{-6}
3. 1×10^{-2}
4. 1×10^{-8}
5. 1×10^{6}

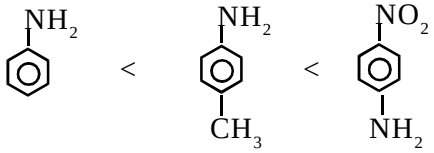
20. Three solutions of different cations A, B and C are given separately. They can be identified by using NaOH(aq) only. Then they are,

1. Al^{3+}, Fe^{3+}, Cr^{3+}
2. Al^{3+}, Zn^{2+}, Sn^{2+}
3. Mn^{2+}, Sn^{2+}, Pb^{2+}
4. Ag^{+}, Sn^{2+}, Zn^{2+}
5. Ba^{2+}, Mg^{2+}, Sr^{2+}

[See Page Four]

21. Which of the following is in the ascending order of basicity

1. $CH_3OH(aq) < H_2O(\ell) < NH_3(aq)$

2.  $<$ $<$

3. $(CH_3)_3N < CH_3CH_2NH_2 < (CH_3)_2NH$

4. $LiOH < Be(OH)_2 < Al(OH)_3$

5. $CH_3NH_2 < CH_3CH_2NH_2 < NH_3$

22. Which of the following reactions is not a redox reaction?

1. $NH_4NO_3 \longrightarrow N_2O + 2H_2O$

2. $K_2Cr_2O_7(aq) + 2KOH(aq) \longrightarrow 2K_2CrO_4 + H_2O$

3. $2H_2O_2 \longrightarrow 2H_2O + O_2$

4. $2Na + 2NH_3 \longrightarrow 2NaNH_2 + H_2$

5. $2Ag_2CO_3 \longrightarrow 4Ag(aq) + CO_2(aq) + O_2(g)$

23. Solution of a salt X is acidified by dil HCl and then excess $H_2S(g)$ is passed through the solution. There was no change. After that the resulting solution was diluted by distilled water. A yellow precipitate was formed. Then the cation of the salt X is

1. Cd^{2+} 2. Sn^{4+} 3. As^{3+}

4. all three above 5. none of the above

24. Which shows diastereomerism

a. $CH_3CH(OH)CH(OH)CH_3$ b. $CH_3CBr=CHCl$ c. $CH_3CH(OH)COOH$

d. $CH_3CH=\ddot{N}OH$ e. $CH_3CH(OH)CH=CHBr$

1. a, b only 2. a, b, d only 3. a, b, d, e only 4. all a, b, c, d, e 5. c only

25. W^{2+}, X^{2+}, Y^{2+}, Z^{2+} are four metallic ions.

a. All four do not form precipitate with excess NaOH(aq).

b. Only Y^{2+} does not form precipitate with excess $NH_3(aq)$

c. Only X^{2+} oxidises I^-

d. When $H_2S(g)$ is passed through $W^{2+}(aq)$ yellow precipitate is formed.

e. Z^{2+} forms precipitate with HCl

Then W, X, Y and Z are

1. Sn^{2+}, Zn^{2+}, Cu^{2+}, Cd^{2+} 2. Cd^{2+}, Ca^{2+}, Zn^{2+}, Sn^{2+} 3. Cd^{2+}, Cu^{2+}, Zn^{2+}, Pb^{2+}

4. As^{3+}, Sb^{3+}, Fe^{3+}, Al^{3+} 5. suitable answer is not given.

[See Page Five]

26. The product of reaction between CH_3CH_2CHO and dil NaOH is heated, which of the following statement regarding the above reaction is **false**?

1. Nucleophilic addition is followed by an elimination
2. The final product is $CH_3CH_2CH{=}CHCH_2\text{-}CHO$
3. A dimerization takes places first
4. Aldol forms first and then dehydration product enal is formed.
5. The first reactant species is $CH_3\ddot{C}H^{(-)}$ (CHO).

27. Decolourizes the alk $KMnO_4$ at room temperature

1. CH_3CO_2H 2. $C_6H_5CH_3$ 3. HCHO 4. $(CH_3)_3COH$ 5. $C_6H_5COCH_3$

28. $A \xrightarrow[(ii)H_3O^+]{(i)B} C_2H_5 - \underset{CH_3}{\overset{H}{C}} - \overset{OH}{C}(CH_3)_2$ Which are suitable for A and B

1. $C_2H_5CH(CH_3)COCl$, CH_3MgBr
2. $C_2H_5CH(CH_3)COCH_3$, CH_3MgBr ;
3. $C_2H_5CH_2CH_2MgBr$, CH_3COCH_3
4. $C_2H_5CH(CH_3)COOCH_3$, CH_3MgBr
5. all of the above

29. Consider the following reaction A + B + C $\longrightarrow$ P + Q. This is not a stochiometric reaction
This reaction takes place in the following steps,

I. A + B $\overset{fast}{\rightleftharpoons}$ X (equilibrium const K_1)

II. B + X $\overset{fast}{\rightleftharpoons}$ Y (equilibrium const K_2)

III. C + Y $\overset{slow}{\rightleftharpoons}$ P + Q

Which of the following is suitable for the above reaction?

1. R = K[A][B][C]
2. R = K[C][Y]
3. $R=KK_1K_2[A][B]^2[C]$
4. $R=K_1K_2[A][B]^2$
5. $R=KK_1K_2[A][B][C]$

30. Which of the following is true about a polymer whose repeating unit is $-\overset{O}{\overset{\|}{C}} - (CH_2)_4 - \overset{O}{\overset{\|}{C}} - O - (CH_2) - O -$

1. It is a cross chain polymer
2. It is an addition polymer
3. It is a condenzation, a linear polymer
4. It is a nylon type polymer
5. $Cl - \overset{O}{\overset{\|}{C}} - (CH_2)_4 - \overset{O}{\overset{\|}{C}} - Cl$ and $HOOC - CH_2CH_2 - COOH$ reacts together to give this

Instructions for questions from 31 - 40

1	2	3	4	5
only a, b are correct	only b,c are correct	only c,d are correct	only a, d are correct	any other combination

[See Page Six]

31. Which of the following reduces Fe^{3+} to Fe^{2+}

a. KI b. $C_2O_4^{2-}$ c. H_2O_2 / H^+ d. H_2S

32. The statements which is / are wrong regarding electrolysis and electro chemical cells

a. There is no colour change when $CuSO_4$ is electrolysed by Cu electrodes.
b. The equilibrium reaction of the electrode AgCl(s), Ag(s) / KCl(aq) is $AgCl(s) + e \rightleftharpoons Ag(s) + Cl^-(aq)$
c. If Zn^{2+} concentration is 2.0 $moldm^{-3}$, the e.m.f of the cell is more than its standard value.
d. Anode is always positive pole / positive electrode.

33. Which is / are true in the following?

a. The product of the alhaline hydrolysis of $CH_3CH_2CBr(CH_3)CH_2CH_2CH_3$ is a racemic mixture
b. When But - 1 - ene is heated with conc. H_2SO_4 But - 2 - ene is formed.
c. All reactions of benzene are electrophillic substitutions
d. A nucleophilic addition is followed by an elimination in the reaction of CH_3COCl and H_2O

34. $NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl(g)$ $\Delta H > 0$
Which is /are suitable for the above equilibrium.

a. For a particular temperature, the total pressure of the system is constant.
b. The value of K_C increases with increase of temperature.
c. In the above system $K_p = K_C$
d. At the chemical equilibrium $T = \frac{\Delta H^-}{\Delta S^-}$.

35. In which of the following a change can be observed when they reacts / react with water?

a. $PCl_5(s)$ b. $BiCl_3(s)$ c. C_6H_5COCl d. CaS

36. Which of the following is / are suitable expression for binary ideal solution

a. $p_A + p_B = p_{AB}$ b. $p_A = (1 - X_A)p_B^0$

c. $p_A \propto X_A$ d. $\frac{p_A^0 - p_A}{p_A^0} = (1 - X_A)$

37. Which of the following pair / pairs can be distinguished by $H_2S(g)$? (without using any other chemicals)

a. Hg^{2+}, Cu^{2+} in acidic media
b. AsO_4^{3-}, AsO_3^{3-}
c. Ni^{2+} , Bi^{3+}
d. Sn^{4+} , Cd^{2+} in alcoholic media

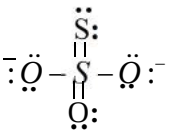
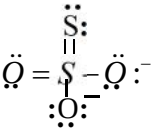
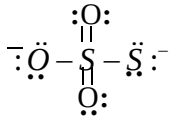
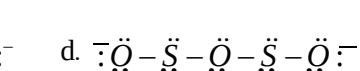
38. Consider the following std. electrode potentials.

(i) $NO_3(aq) + H^+(aq) + e \rightleftharpoons H_2O(l) + NO_2(g)$ $E^\theta = 0.79V$
(ii) $Fe^{3+}(aq) + e \rightleftharpoons Fe^{2+}(aq)$ $E^\theta = 0.77V$
(iii) $Cu^{2+}(aq) + e \rightleftharpoons Cu^+(aq)$ $E^\theta = 0.15V$
(iv) $I_2(aq) + 2e \rightleftharpoons 2I^-$ $E^\theta = 0.54V$

On the above basis which of the following is / are possible?
a. I^- can be oxidised by dil HNO_3 as I_2 .
b. Cu^{2+} oxidises I^- as I_2 and also CuI precipitates.
c. Fe^{2+} can be oxidised by dil HNO_3 as Fe^{3+} .
d. $Fe^{3+}(aq) + Cu^+(aq) \longrightarrow Fe^{2+}(aq) + Cu^{2+}(aq)$ is possible

[See Page Seven]

39. Resonance structure / structures of $S_2O_3^{2-}$ is /are

a.  b.  c.  d. 

40. Which of the following is / are thermosetting polymers?

*a.*Vulcanized rubber b. Bakelite
c. PTFE d. Urea - formaldehyde polymer

Instruction for questions from 41 to 50

First statement	Second statenent
1. true	true and explains the first statement
2. true	true , but is not a correct explantion for the 1st.
3. true	false
4. false	true
5. false	false

	First statement	Second statement
41.	The enthalpy of hydrogenation of benzene is greater than that of cyclic hexa- 1, 3, 5-triene	Benzene has lower enthalpy than cyclic hexa-1,2,3-triene
42.	Liquid NH_3(aq) is a weak electric conductor.	In liquid NH_3(aq), the equilibrium $NH_3(\ell) \rightleftharpoons NH_2^-(\ell) + H^+(aq)$ exists
43.	$CH \equiv CH$ is more acidic than $CH_3C \equiv CH$	Only $CH \equiv CH$ gives H_2(g) when it reacts with Na / $NH_3(\ell)$
44	Na^+(g) is more stable than Na(s)	Na^+ has noble gas configuration
45	The boiling point of p - nitrophenol is higher than that of o - nitrophenol	p - nitrophenol is more acidic than o - nitrophenol
46.	The compressibility factor of a real gas increases with increasing temperature	When the temperature increases $\frac{PV}{nRT}$ decerases
47.	Brine and H_2O are the electrolytes in the production of NaOH in membrane method.	In membrane method H_2O is reducted at the cathode
48	The s - block metals can be extracted by the electrolysis of their molten chlorides	The cations of the s- block metals are very stable

[See Page Eight]

49 $CH_3CH=CH_2$ has no electrophilic addition with HCN

As CN^- is a good nucleophile, it cannot react across the C=C bond

50. Phenolphthalein can be used as an indicator of the titration of $1x10^{-3}$ $moldm^{-3}$ NaOH with $1x10^{-3}$ mol dm^{-3} CH_3COOH

Generally phenolphthalein can be used as an indicator for strong base - weak acid titrations

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Periodic Table

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57-71 *	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89-103 #	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

மொறட்டுவைப் பல்கலைக்கழக பொறியியற்பீட தமிழ் மாணவர்கள் நடாத்தும்
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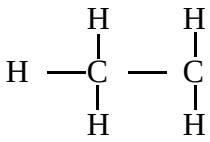
முன்னோடிப் பரீட்சை -2015

கல்விப் பொதுத் தராதரப் பத்திர(உயர் தர) முன்னோடிப் பரீட்சை – 2015

General Certificate of Education (Adv. Level) Pilot Examination - 2015

Chemistry II இரசாயனவியல் II	02	E	II	Three Hours மூன்று மணித்தியாலம்

- ✳ Periodic Table is provided.
- ✳ Use of calculators is prohibited
- ✳ Universal gas constant R = 8.314 $JK^{-1}mol^{-1}$
- ✳ Avogadro's constant L = 6.022 x 10^{23} mol^{-1}
- ✳ Alkyl groups can be written in short form as follows

Eg:  - can be written as CH_3 CH_2 -

PartA –Structured essay

- ✳ Answer all questions on this paper itself
- ✳ Answer each question on the allowed space. Consider that the given space is enough for the answer and elaborated answers are not required.

Part B and Part C - Essay

- ✳ Answer 4 questions altogether choosing 2 questions from each section.
- ✳ Use the provided answer sheets for this purpose
- ✳ Annex part B and C to A placing part A on top and hand it over to the examination supervisor at the end of the given time.
- ✳ Only B and C part of this question paper are allowed to be taken out of the exam hall.

Only for examiner

Part	Question	Marks
A	01	
	02	
	03	
	04	
B	05	
	06	
	07	
C	08	
	09	
	10	
Total		
Percentage		

Final Marks

In digits	
In Words	

Index No.

Examiner		
Marks checked by	1	
	2	
Supervised by		

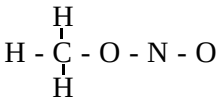
[See Page Two]

Part II (A)

1. (a) Consider the elements Xe, F, S, O, I. Give one compound formed among these elements for each of the following description. One molecule should have two elements only.

Shape	Dipole moment	Example
(i) Linear	0	.....
(ii) Square planar	0	.....
(iii) Square pyramid	present	.....
(iv) Angular	present, bond angle < 109^0	.....
(v) Trigonal planar	0	.....
(vi) Octahedral	0	.....

(b) CH_3O_2N is the molecular formula of the compound A, named methyl nitrite. The skeletal structure of the compound is



(i) Draw the most acceptable Lewis structure of A

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(ii) Give possible resonance structures and comment on their stablity.

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(iii) B is a structrural isomer of A. Give the possible Lewis structure of B

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[See Page Three]

(iv) Identify the type of orbital hybridization of N in both A and B

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(c) (i) NCl_3 could behave as a Lewis base. But NF_3 could not act as a Lewis base and also does not get hydrolyzed. Explain this briefly considering the concept of electronegativity.

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(ii) Both phenol and water could form hydrogen bond. But phenol mix partially with water and appears as turbid solution. Explain this briefly considering the concept of intermolecular forces.

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2. (a) A 3d series transition metal M has only two unpaired electrons in its stable tripositive ion

(i) Identify M mentioning its name.

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(ii) The following questions are regarding the highest oxidation state oxide of M.

(a) What is its chemical formula?

.....

(b) It is acidic / basic / amphotric / neutral in nature. Underline the appropriate answer.

(c) Give one of its industrial use.

.....

.....

(d) Write down the balanced equation for its reaction with NaOH.

.....

(e) M has the highest melting point among the 3d series elements. Give reason / reasons

.....

.....

[See Page Four]

(b) Complete the following table using the formulae of the stable hydroxides third period elements in their highest oxidation states acidic / basic behaviour and IUPAC names.

Element	Formula	Behaviour	IUPAC name
Na			
Mg			
Al			
Si			
P			
S			
Cl			

(c) A portion of the aqueous solution of water soluble salt of element L gave a precipitate with $BaCl_2$ / dil HNO_3. The precipitate dissolved in NH_3(aq). Another portion of the aqueous solution of salt L was boiled with excess Na_2CO_3(s) and was filtered. The filtrate did not give any precipitate with $BaCl_2$ / dil HNO_3 .

(i) What could be the element L?

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(ii) Explain the above observations briefly.

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(iii) When conc. H_2SO_4 is added to the salt of L and warmed, reddish brown gas evolved. Identify the salt.

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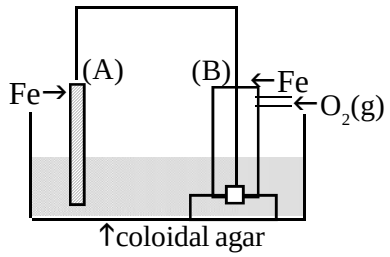
[See Page Five]

3. (a)



Colloidal agar has NaCl, phenolphthalein, $K_3[Fe(CN)_6]$ and gel

(i) What is the observation at electrode A?

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(ii) Give equations for the reactions in (i)

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(iii) What is the observation at electrode B?

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(iv) Write down the appropriate equations for the reactions in (iii)

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(b) Liquids A, B and C are miscible among them in all proportions

(*i*) $f_{A-A} = f_{A-B} = f_{B-B}$

(*ii*) $f_{B-B} > f_{B-C} < f_{C-C}$

(*iii*) $f_{A-A} < f_{A-C} > f_{C-C}$

(f - intermolecular force)

$p_A^0 < p_C^0$, $p_A^0 > p_B^0$

I. Draw the graphs of pressure Vs compositions of the above solutions

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[See Page Six]

II. Draw the labelled graph of boiling point (temerature) vs composition of solution AB.

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III. $p_B^0 = 4\times10^4\,Pa,\quad p_A^0 = 6\times10^4\,Pa$. Calculate the pressure of the vapour in equilibrium with equimolar solutions of A and B

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IV. In another solution of A and B pressure of the vapour in equilibrium with the solutions is $4x10^4$Pa. What is the composition of the vapour of the solution?

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(c) (i) Derive mathematically the Ostwald's dilution law for monobasic weak acid HA.

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(ii) pH of 0.4 moldm^{-3} monobasic weak acid HA is 3. Deduce the pH of 0.1 moldm^{-3} solution of this acid.

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[See Page Seven]

(iii) 0.1moldm^{-3}, 25.0cm^3 of NaOH solution is added to 0.1 moldm^{-3} , 50cm^3 mono basic acid HA. The pH of the resulting solution is 5. Calculate the equilibrium constant K_a .

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4. (a) Two organic compounds A and B have same molecular formula of $C_4H_8O_2$. A and B both decolourise Br_2(aq) and also show geometrical isomerism. They give white fume of HCl with PCl_5. But B is not a geometrical isomer of A. When A and B are reduced by Pt / H_2, two products D and E are formed respectively ($C_4H_{10}O_2$). D has four stereo isomers and E has only two. F is a linear chain isomer of A and B. F is neutral and forms silver mirror with $AgNO_3$ / NH_3 , but has no noticable change with 2, 4- DNPH.

(i) Draw the structures of A, B, D, E and F

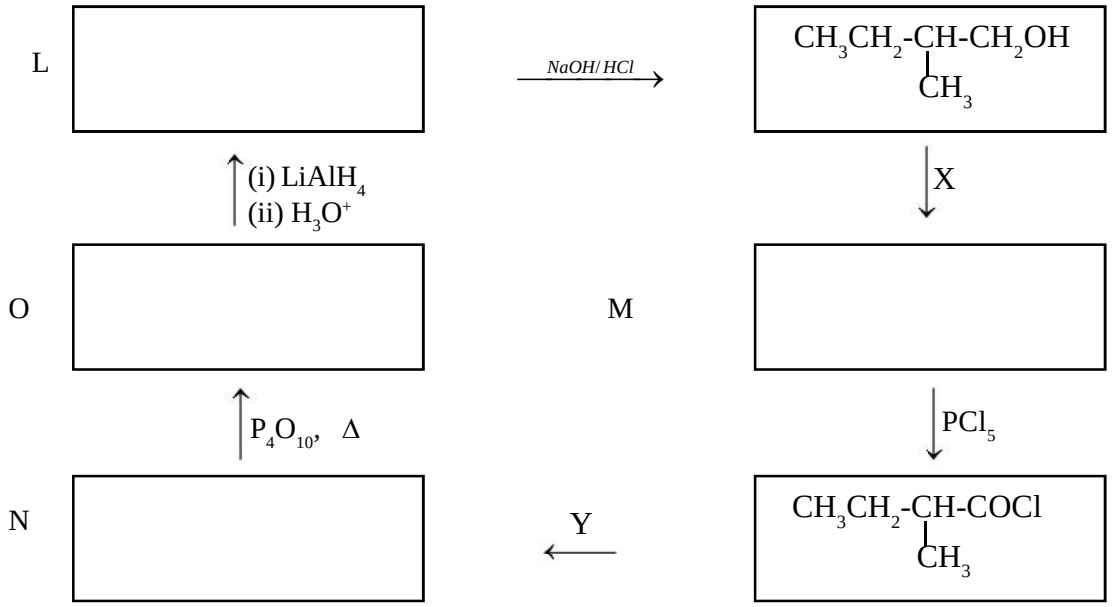
A B D

E F F

(ii) Name the class of isomerism exibited by A and B

.....

(b) A series of changes are given below in which L is formed again from the organic compound L.



[See Page Eight]

(i) Give the structures of L, M, N and O (in the boxes given)

(ii) Give the appropriate reagents X and Y (in the appropriate places)

(iii) Write the mechanism for the reaction of CH_3CH_2-$\underset{\underset{CH_3}{|}}{CH}$-COCl with Y

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(iv) Indicate the type of mechanism in the formation of O from N

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[See Page Nine]

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Chemistry II இரசாயனவியல் II	02	E	II

Part II (B)

Answer any two questions

5. (a) I. Define the following
   (i) Standard lattice enthalpy
   (ii) Standard enthalpy of formation.

   II. Standard atomisation enthalpy of Na = 109.0 $kJmol^{-1}$
   Standard atomisation enthalpy of Cl = 129.0 $kJmol^{-1}$
   Standard first ionisation enthalpy of Na = 494 $kJmol^{-1}$
   Standard second ionisation enthalpy of Na = 4556$kJmol^{-1}$
   Standard electron affinity of Cl = -364 $kJmol^{-1}$
   Standard lattice enthalpy of NaCl = -769 $kJmol^{-1}$
   Standard lattice enthalpy of $NaCl_2$ = -2300 $kJmol^{-1}$

   (i) Write down the appropriate chemical equations for the above changes
   (ii) Find the following using the suitable data given above.
   (a) Standard enthalpy of formation of NaCl(s)
   (b) Standard enthalpy of the following reaction

   $NaCl(s) + \frac{1}{2}Cl_2(g) \longrightarrow NaCl_2(s)$

   (c) Standard entropies of NaCl(s), $Cl_2(g)$ and $NaCl_2(s)$ are 72.4 $Jmol^{-1}K^{-1}$, 223 $Jmol^{-1}K^{-1}$ and 90 $Jmol^{-1}K^{-1}$ respectively. Is the reaction in (b) feasible at 300K? or at what temperature would it be feasible?

(b) Assume air has 75.0% of $N_2(g)$ and 25.0% of $O_2(g)$ by volume. The pressure of air at 27^0C is $1.0x10^5\ Nm^{-2}$

(i) Calculate the partial pressure of $N_2(g)$ and $O_2(g)$ in air.

(ii) Temnperature of the 1.0 dm^3 flask is raised to 727^0C and small amount of Pt particles are added. The equilibrium $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ is attained. Equilibrium mixture has 10% NO(g) by volume

(a) What is the total pressure of the system?

(b) Find the K_p of the system.

(c) The system is compressed and the volume is brought to one quarter of the initial volume and the temperature is maintained at 727^0C. What is the partial pressure of O_2 at this stage?

[See Page Ten]

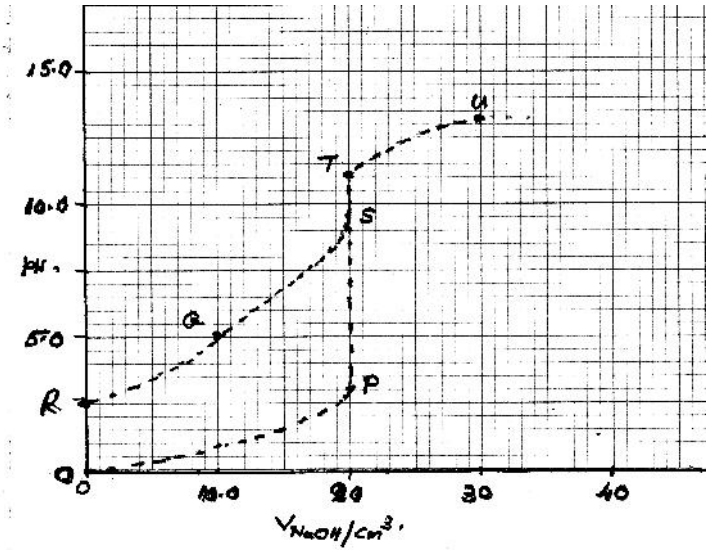
(c) An insecticide G is soluble in both water and benzene. 50 cm^3 of C_6H_6 is added to 0.5 $moldm^{-3}$,100.0 cm^3 aqueous solution of G and shaken thoroughly and allowed to attain equlibrium. The C_6H_6 layer is separated and the concentration of G remaining in the aqueous layer is 0.05 $moldm^{-3}$.

(i) Find the partition coefffient of G between C_6H_6 and water

(ii) After 24 hours of spraying the insecticide 100 g sample of leaves is powdered and shaken thoroughly with equivolume mixture of water and benzene and kept at rest. Assume 100.0 cm^3 of each benzene and water are used. The composition of G in the saturated benzene layer is 200 ppm

(iii) After 7 days of spraying the insecticide 100 g sample of leaves is subjected to the same procedure as in (ii) and the composition of G in benzene layer is found to be 20ppm. Assume that all the insecticide in the leaves are transferred tot he benzene-water system while shaking. 25 ppm composition of G does not affect the animals / man. Could we use these leaves after one day or after 7 days as food? Explain your answer.

6. a. I. Both acids HA and HB have concentrations 1.0$moldm^{-3}$ each. 20.0cm^3 of each acid is titrated separately using 1.0 $moldm^{-3}$ NaOH(aq) in the burette and the variation of pH (25^0C) are shown in the following graph.



(i) If the volume of NaOH(aq) added at point P is 19.95cm^3, what is the pH at this point?
(ii) If the pH at point Q is 5 , what is the K_a of HB?
(iii) What is the pH at point R?
(iv) What is the pH at point S? (V_{NaOH} = 20.0 cm^3)
(iv) What is the pH at point T? (V_{NaOH} = 20.05 cm^3)
(iv) What is the pH at point U? (V_{NaOH} = 30.0 cm^3)

II. 20.0cm^3 solution having HA and HB of concentration 1.0$moldm^{-3}$ each is given. 1.0$moldm^{-3}$ NaOH is allowed to get into this solution from burette. Deduce the pH in the following circumstances.
(i) Addition of 20.0 cm^3 NaOH(aq)
(ii) Addition of 40.0cm^3 NaOH(aq)

[See Page Eleven]

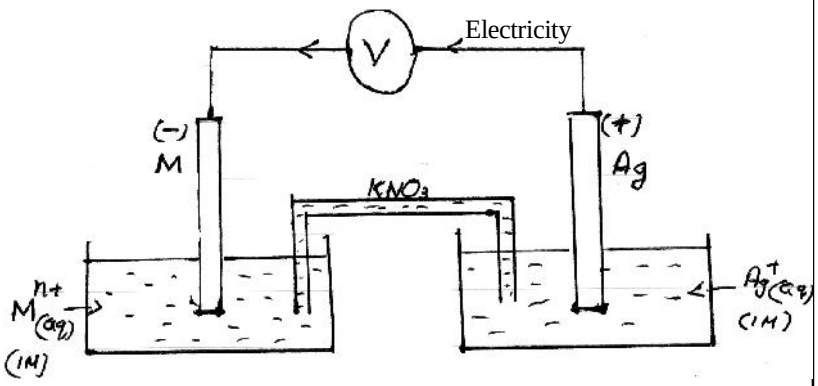
b. Find the minimum concentration of $NH_3(aq)$ to be added to prevent the precipitation of AgCl in the given solution containing $1x10^{-3}moldm^{-3}$ Cl^- and $4x10^{-3}moldm^{-3}$ Ag^+. For the above calculation proceed the following calculation steps. Assume all the calculations are for 1 dm^3 solution.

(i) What should be the maximum $Ag^+(aq)$ concentration to prevent the precipitation of $Cl^-(aq)$?
(ii) Find the concentration of $[Ag(NH_3)_2]^+$ formed when the Ag+ taken initially combine with NH_3?
(iii) Find the $[NH_3(aq)]$ concentration in $[Ag(NH_3)_2]^+$ at equilibrium.
(iv) Calculate the total concentration of $NH_3(aq)$ that should be added.

$$K_{d[Ag(NH_3)_2]^+} = 6.0\times10^{-8}\,dm^6mol^{-2},\quad K_{sp(AgCl)} = 1\times10^{-10}\,mol^2dm^{-6}$$

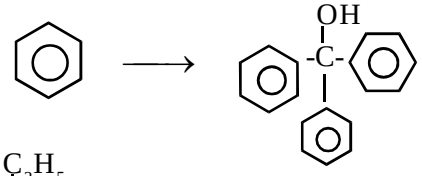
c.

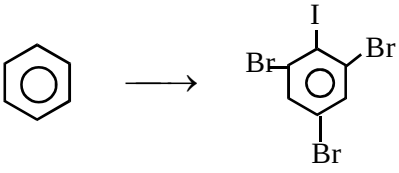
Voltmeter reading = 1.56V
$E^{\theta}_{Ag+/Ag}$ = 0.80V

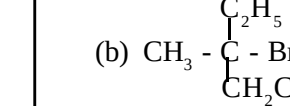


(i) Calculate the standard potential of $M^{n+}(aq) + ne \rightleftharpoons M(s)$
(ii) Which is the anode? What is the anodic reaction?
(iii) Which is the cathode? What is the cathodic reaction?
(iv) What is the cell reaction?
(v) When the cell functions, in the first 5 seconds mass of Ag displaced is 0.54 mg and mass of displaced M is 0.28 mg.
I. Find the amount of electricity required to displace 0.54mg Ag (Ag = 108, 1F = 96500 C)
II. Find the amount of electrons related in I.
III. If the relative atomic mass of M is 56 , find the number of moles of electrons required to deposit 56 g of M.
IV. What is the value of n?

7. (a) If benzene, Br_2, Fe, Mg, dry ether, dil H_2SO_4, CH_3COCl, HCHO, PCl_5, con H_2SO_4, con HNO_3, KI and $NaNO_2$ are the only chemical substances that could be used, how would you effect the following conversions?

(i) 

(ii) 

(b)  is warmed with aqueous KOH and three products A, B and D are obtained. A and B are obtained in equimolar amounts and the mixture of A and B is a racemic mixture. D is a hydrocarbon obtained in small amount. Indicate the mechanism of the above reaction and identify A, B and D

(c) A method of preparation of 2, 3, 4 -tribromoheptane starting from C_2H_5OH is given below

$$C_2H_5OH \xrightarrow{a} P \xrightarrow{b} Q \xrightarrow{c} R \xrightarrow{d} S \xrightarrow{CH_3CH_2CH_2MgBr} T \xrightarrow{e} \text{2, 3, 4 -tribromoheptane}$$

Identify the compounds P, Q, R, S, T and the reagents a, b, c, d and e .

[See Page Twelve]

Part II (C)
Answer any two questions

8. a. You are provided with the following particulars regarding a mixture having two salts A and B. Both the salts have the same anion.

Test	Observation
(i) A small portion of the solid mixture is heated strongly	yellow solid residue with evolution of reddish brown gas
(ii) Excess NaOH(aq) is added to the solid residue in (i)	residue dissolved completely
(iii) Excess dil HCl is added to solution in (ii) and shaken thoroughly	a white precipitate appeared.
(iv) The precipitate in (iii) is filtered and heated with water	precipitate dissolved and colourless solution is formed. On cooling, the crystals appeared.
(v) To the filtrate in (iv) NH_4Cl(aq) is added and then excess NH_3(aq) is added	no appreciable change
(vi) H_2S is passed into the solution of (v)	white precipitate appeared

b. A sample of $KMnO_4$ has MnO_2 as impurity. Little excess HI and dil H_2SO_4 are added to 3.32g of the above sample and the liberated I_2 is completely titrated with 2.0 mol dm^{-3} $Na_2S_2O_3$.

(i) Give balanced equations for all the reactions.
(ii) What is the percentage purity of $KMnO_4$ in the sample?

c. Vitamin C is Ascorbic acid ($C_6H_8O_6$) . It is a reducing agent. It reduces I_2 (aq) as follows

$$C_6H_8O_6(aq) + I_2(aq) \longrightarrow C_6H_6O_6(aq) + 2HI(aq)$$

Ascorbic acid is used to prepare a soft drink of orange flavour. 50.0cm^3 of this soft drink is shaken thoroughly with 10.0 cm^3 of 0.05moldm^{-3} KIO_3 aqueous solution and little excess KI. After the completion of reaction 0.030moldm^{-3}, 30.0cm^3 of Na_2SO_3 solution is required to react with the remaining I_2 in the resulting solution. Find the composition of the ascorbic acid in the soft drink.

9. (a) This question is related with the manufacture of sodium carbonate by Solvay process

(i) What are the raw materials used?

(ii) Give all the reactions related with this process.

(iii) Explain briefly the techniques used to increase the efficiency.

(iv) In salterns after the separation of salt, the mother liquor called bittern remains. Indicate a useful substance that could be produced using bittern and the byproduct in the manufacture of Na_2CO_3

[See Page Thirteen]

(b) (i) Indicate the difficulties that could arise in the usage of apatite directly as phosphate fertilizer for plants.

(ii) To increase the effectiveness of apatite it is converted into super phosphate ($Ca(H_2PO_4)_2$). If we use H_3PO_4 ,triple phosphate is formed. Give the chemical equation relevant to this process.

(iii) The given agriculture fertilizer contains 70.2% superphosphate by weight. The remaining are inert fillers . Calculate the mass of apatite required to prepare 100 kg of this fertilizer. (Assume the apatite sample is pure) (Ca=40, F=19, O=16, P=51, H=1.0)

(c) The smoke of a petrol vehicle plays an important role in environmental pollution

(i) Identify five gaseous pollutants in the above smoke. Mention one solid phase pollutant.

(ii) Among the above pollutants identify two which could give green house effect

(iii) Identify two factors which cause acid rain.

(iv) Identify a factor which cause photochemical smog.

(v) Identify two gases which affect the respiratory system. Why are these gases called respiratory resistant gases?

(vi) To reduce the above pollutants give two activities that should be introduced in petrol engines.

10. (a) You are provided a mixture containing sodium sulphate, sodium sulphite and sodium hydrogen sulphate which were mixed up accidentally

solution $\xrightarrow[\text{(ii)filtration}]{(i)\,BaCl_2(aq)}$ precipitate(dry mass) 0.450 g (A) $\xrightarrow[\text{(ii)filtration}]{(i)\,dilHNO_3}$ precipitate(dry mass) 0.230 g (B)

filtrate $\xrightarrow[\text{(ii)filtration}]{(i)\,excessNH_3(aq)}$ precipitate(dry mass)
(C) 0.466g (D)

(Ba = 137), S = 32, H = 1)

(i) Give the related reactions and the chemicals in A, B, C and D

(ii) Find the concentrations of the above components in the solution.

(b) Write balanced equations for the reactions of NaOH with the following. Identify the substance underlined as oxidant or reducing agent or none.

(i) $NaOH(aq) + \underline{I_2(s)}$

(ii) $NaOH(aq) + \underline{P_4(s)}$

(iii) $\underline{NaOH(aq)} + (NH_4)_2Cr_2O_7(aq)$

(iv) $NaOH(aq) + \underline{Al(s)}$

(v) $NaOH(aq) + \underline{NO_2(g)}$

[See Page Fourteen]

(c) Considering the reaction $2H_2O_2(aq) \longrightarrow 2H_2O(l) + O_2(g)$

The initial concentration of $H_2O_2(aq)$ is 3.0 moldm^{-3}. It is added into a bottle containing a transition metal ion. Transition metal ion is a catalyst. For every 5 minutes 10 cm^3 solution is taken and titrated with 0.1 moldm^{-3} acidic $KMnO_4$ in the burette and the burette readings are given below.

time / min.	0	5	10	15	20
burette reading / cm^3	30.0	23.4	18.3	14.2	11.1

(i) Write the equation for the reaction between $KMnO_4$ and H_2O_2 in acidic medium.

(ii) How does the rate of the above reaction is measured?

(iii) Rate of reaction $\propto [H_2O_2(aq)]^m$ What is the value of m?

(iv) Calculate the rate constant

(v) What is the half life period of the reaction?

***

Periodic Table

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57-71 *	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89-103 #	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr