1. VALENCY TRENDS IN PERIODIC TABLE

SOLUTIONS

TEACHING TASK

JEE MAINS LEVEL QUESTIONS

1. When carbon combines with hydrogen, what is the valency of carbon in methane (CH_4)?
   a) 1 b) 2 c) 3 d) 4

Answer:D

Solution:Carbon forms 4 bonds with hydrogen (CH4), showing tetravalency.

2. What is the valency of phosphorus when it combines with hydrogen to form phosphine (PH_3)?
   a) 1 b) 2 c) 3 d) 4

Answer:C

Solution:Phosphorus forms 3 bonds with hydrogen (PH3), showing trivalency.

3. When nitrogen reacts with oxygen to form nitrogen dioxide, what is the valency of nitrogen in the compound?
   a) 2 b) 4 c) 3 d) 5

Answer:B

Solution: In NO_2, nitrogen exhibits variable valency of 4 (total bonds = 4, considering coordinate bond).

4. When chlorine combines with oxygen to form chlorine dioxide (ClO_2), what is the valency of chlorine in the compound?
   a) 1 b) 2 c) 3 d) 4

Answer:D

Solution:Chlorine shows +4 oxidation state (total bonds = 4).

5. In the compound sulfur trioxide (SO_3), what is the valency of sulfur?
   a) 2 b) 4 c) 6 d) 8

Answer:C

Solution:Sulfur forms 6 bonds (double bonds with each oxygen), showing hexavalency.

6. What is the valency of phosphorus when it combines with oxygen to form phosphorus pentoxide (P_4O_{10})?
   a) 2 b) 3 c) 4 d) 5

Answer:D

Solution:Each phosphorus forms 5 bonds (average valency = 5).

7. What is the maximum number of electrons that can be accommodated in the third energy level of an atom?
   a. 2 b. 8 c. 18 d. 32

Answer:C

Solution:3rd shell has subshells (s,p,d) accommodating 2 + 6 + 10 = 18 electrons.

8. When sulfur combines with hydrogen to form hydrogen sulfide (H_2S), what is the

valency of sulfur?

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

Answer:B

Solution:Sulfur forms 2 bonds with hydrogen (H2S), showing divalency.

9. In the compound PCl_3 (phosphorus trichloride), what is the valency of phosphorus?

a. 1 b. 2 c. 3 d. 4

Answer:C

Solution:Phosphorus forms 3 bonds with chlorine (PCl3), showing trivalency

10. In the compound Cl_2O_7 (dichlorine heptoxide), what is the total valency of chlorine atoms?

a. 14 b. 7 c. 10 d. 5

Answer:A

Solution: Each Cl has +7 oxidation state (total valency = 7×2 = 14).

11. The valencies of the underlined elements or radicals in the following compounds.

$\underline{Na_2O}$, $\underline{PCl_5}$, $\underline{CaO}$, $\underline{Al(OH)_3}$

A) 1,5,2,1 B) 2,5,2,3 C) 2,3,2,1 D) 1,5,2,3

Answer:D

Solution:The valencies are: 1 (Na), 5 (P), 2 (Ca), 3 (Al).

JEE ADVANCED LEVEL QUESTIONS

MULTIPLE CORRECT ANSWER TYPE

1. Which elements from the alkali metal group are known to have a valency of 1 when forming hydrides? (Select all correct options)

a. Lithium b. Sodium c. Potassium d. Rubidium

Answer:A,B,C,D

Solution:Alkali metals (Group 1) all have 1 valence electron and form hydrides (e.g., LiH, NaH, KH, RbH) with valency = 1.

2. Elements with a valency of 3 when combining with hydrogen include:

a. Boron b. Aluminum c. Nitrogen d. Phosphorus

Answer:A,B,C,D

Solution:Boron (B) and Aluminum (Al) from Group 13 show valency = 3 in hydrides (e.g., BH_3, AlH_3).

Nitrogen (N) and Phosphorus (P) from Group 15 typically form hydrides (NH_3, PH_3) with valency = 3, but their primary valency is determined by their group (5). The question specifies combining with hydrogen, so N and P are also correct if considering their hydrides.

3. Which of the following atomic numbers shows Valency of 2

A) 4 B) 14 C) 12 D) 20

Answer:A,C,D

Solution:Atomic number 4 (Beryllium, Be): Group 2 → Valency = 2.

Atomic number 12 (Magnesium, Mg): Group 2 → Valency = 2.

Atomic number 20 (Calcium, Ca): Group 2 → Valency = 2.
Atomic number 14 (Silicon, Si): Group 14 → Valency = 4 (not 2)

REASON AND ASSERTION TYPE

4. Assertion: Valency is the combining capacity of an atom based on its electrons in the outermost shell.

Reason: The valency of oxygen is determined by its outermost electron shell, and it tends to form two bonds to achieve a stable electron configuration.

Answer:A

Solution:Assertion is true: Valency depends on the outermost (valence) electrons.

Reason is true and explains the Assertion: Oxygen (Group 16) has 6 valence electrons and gains 2 electrons (or shares 2 electrons) to achieve stability, showing a valency of 2.

5. Assertion: Oxygen generally exhibits a valency of 2.

Reason: Oxygen has six electrons in its outer shell, and to achieve a stable configuration, it tends to gain two electrons or share electrons with other atoms.

Answer:A

Solution:Assertion is true: Oxygen commonly forms 2 bonds (e.g., H_2O, CO_2).

Reason correctly explains why: Oxygen needs 2 more electrons to complete its octet (6 valence electrons + 2 = 8).

6. Assertion: Group 1 elements, such as sodium and potassium, exhibit a valency of 1 when combining with hydrogen.

Reason: Group 1 elements have one electron in their outer shell, and they readily lose this electron to achieve a stable configuration, forming compounds with a valency of 1.

Answer:A

Solution:Assertion is true: Alkali metals (Group 1) form hydrides (e.g., NaH, KH) with valency = 1.

Reason explains the Assertion: They lose 1 valence electron to achieve stability, resulting in +1 valency.

7. Assertion: Chlorine exhibits a valency of 1 when combining with other elements.

Reason: Chlorine has seven electrons in its outer shell and tends to gain one electron to achieve a stable octet, resulting in a valency of 1.

Answer:A

Solution:Assertion is true: Chlorine (Group 17) typically shows valency = 1 (e.g., HCl, NaCl).

Reason explains the Assertion: Chlorine gains 1 electron to complete its octet (7 + 1 = 8).

8. Assertion: Group 17 elements, including fluorine and bromine, share a similar valency trend with chlorine when combining with other elements.

Reason: Group 17 elements have seven electrons in their outer shell and generally gain one electron to achieve a stable octet, leading to a common valency trend of 1 when combining with other elements.

Answer:A

Solution:Assertion is true: All halogens (Group 17) typically show valency = 1 (e.g., HF, HBr).

Reason explains the Assertion: They all have 7 valence electrons and gain 1 electron to achieve stability.

STATEMENT TYPE

9. **Statement-I :** Halogens have 7 Valence electrons

Statement-II : Halogens shows valency 7

Answer:C

Solution:Statement-I is true: Halogens (Group 17: F, Cl, Br, I) have 7 valence electrons.

Statement-II is false: Halogens typically show a valency of 1, not 7, because they gain 1 electron to achieve a stable octet (7 + 1 = 8).

10. **Statement-I** : Elements having 1, 2 or 3 valency electrons are metals

Statement-II : Hydrogen has valency 1

Answer:B

Solution:Statement-I is true: Most metals (e.g., Na, Mg, Al) have 1, 2, or 3 valence electrons.

Exception: Hydrogen (1 valence electron) is a non-metal.

Statement-II is true: Hydrogen has valency 1, but this does not explain why elements with 1–3 valence electrons are metals.

COMPREHENSION TYPE

COMPREHENSION-1

A neutral atom of an element has a nucleus with nuclear charge 11 times and mass 23 times that of hydrogen.

11. Write the electronic configuration of the element

(A) 2, 1 B) 2, 8, 1 C) 2, 8 D) 2, 8, 8, 3

Answer:B

Solution:Atomic number = 11 $\rightarrow$ 11 electrons in a neutral atom.

Electronic configuration: $1S^2 2S^2 2P^6 3S^2 \rightarrow$2, 8, 1 (K, L, M shells).

12. Find the ratio of electrons to protons present in its stable ion

A) 1 : 1 B) 5 : 6 C) 10 : 11 D) 12 : 11

Answer:C

Solution:Stable ion of Na: Na^+ (loses 1 electron to achieve noble gas configuration).
Protons: 11 (unchanged).
Electrons: 11 - 1 = 10.
Ratio (electrons : protons) = 10:11

COMPREHENSION-II

16. When hydrogen combines with oxygen to form water, what is the ratio of hydrogen atoms to oxygen atoms?

A) 1:1 B) 2:1 C) 1:2 D) 2:2

Answer:B

Solution:Water (H_2O):2 hydrogen atoms combine with 1 oxygen atom.

Ratio (H : O) = 2 : 1.

17. When oxygen combines with chlorine, the common valency ratio is:

a) 1:1 b) 1:2 c) 2:1 d) 2:2

Answer:B

Solution:Oxygen (O) has a valency of 2 (from H_2O).

Chlorine (Cl) has a valency of 1 (from HCl).

To balance valencies in a compound:

1 O atom (valency 2) combines with 2 Cl atoms (valency 1 each) $\rightarrow$ Cl_2O.

Valency ratio (O : Cl) = 1 : 2.

INTEGER TYPE

18. Valency Exhibited by Nitrogen in N_2O_5 is _____

Answer:5

Solution: In N_2O_5, nitrogen has an oxidation state of +5, and its valency is 5 as it shares 5 electrons to form bonds.

19. Valency exhibited by metals are _____

Answer:1,2,3

Solution:Metals generally lose electrons to attain a stable noble gas configuration. Most metals show valencies of:1 (e.g., Na, K)

2 (e.g., Mg, Ca, Zn)

3 (e.g., Al, Fe^{3+})

MATRIX MATCHING TYPE

20. **Answer:A**

Column I (Element)		Column II (Valency)	
(A)	Lead	(R)	2,4
(B)	Carbon	(R)	2,4
(C)	Cobolt	(P)	2,3
(D)	Mercury	(Q)	1,2

A) A-R B-R C-P D-Q
B) A-R B-R C-S D-P
C) A-S B-P,Q C-R D-P
D) A-S B-P,Q,R,S C-R D-Q

Solution:Lead (Pb)
Common valencies: 2, 4
(e.g., PbO (lead(II) oxide) and PbO_2 (lead(IV) oxide))
Carbon (C)
Common valencies: 2, 4
(e.g., CO (carbon(II) oxide) and CO_2 (carbon(IV) oxide))
Cobalt (Co)
Common valencies: 2, 3
(e.g., CoCl2 (cobalt(II) chloride) and $CoCl_3$ (cobalt(III) chloride))
Mercury (Hg)
Common valencies: 1, 2
(e.g., Hg_2Cl_2 (mercury(I) chloride) and $HgCl_2$ (mercury(II) chloride))

LEARNERS TASK

CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ'S)

1. How many electrons can occupy the first energy level of an atom?
   a. 2 b. 4 c. 6 d. 8

Answer:A

Solution:The first energy level (K-shell) can hold a maximum of 2 electrons (as per the formula $2n^2$, where n=1).

2. The electronic configuration of calcium with atomic number 20, is
   A) 2, 8, 10 B) 2, 9, 9 C) 2, 8, 8, 2 D) 2, 10, 8

Answer:C

Solution:Calcium (Z=20) follows the 2, 8, 8, 2 configuration (since the third shell can hold up to 18 but stabilizes at 8 before filling the next shell).

3. Which of the following electronic configuration is not wrong ?
   A) Be (3) = 2, 1 B) O (8) = 2, 6
   C) S (16) = 2, 6, 8 D) Ca (20) = 2, 8, 10

Answer:B

Solution:(A) Be (4) = 2, 1 → (Be has 4 electrons, correct config: 2, 2)
(B) O (8) = 2, 6 → (Correct for oxygen)
(C) S (16) = 2, 6, 8 → (Correct config: 2, 8, 6)
(D) Ca (20) = 2, 8, 10 → (Correct config: 2, 8, 8, 2)

4. Valency electrons and valency respectively in Ar

A) 7,0 B) 8,0 C) 0,7 D) 0,82.

Answer:B

Solution:Argon is a noble gas with 8 valence electrons and 0 valency (stable octet).

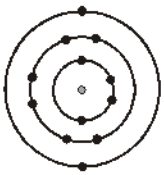
5. The valency of hydrogen is one in PH_3. What is the valency of nitrogen

A) 1 B) 2 C) 3 D) 4

Answer:C

Solution:In PH_3, hydrogen has a valency of 1, and phosphorus forms 3 bonds, so its valency is 3.

6. Given figure represents an atom of



A) chlorine B) magnesium C) calcium D) Wrong structure

Answer:D

Solution:Electron distribution wrong

1st shell only 2 electrons but there are 4 electrons.

7. Valence electrons and valency respectively in calcium

A) 2, 1 B) 2, 2 C) 8, 2 D) 2, 8

Answer:B

Solution:Calcium has 2 valence electrons (in the 4th shell) and a valency of 2 (loses 2 electrons to form Ca^{2+}).

8. Two atoms of hydrogen combine with one atom of oxygen to form a molecule of water. The valency of hydrogen is

A) 3 B) 1 C) 2 D) 4

Answer:B

Solution:In H_2O, each hydrogen forms 1 bond, so its valency is 1.

9. Which of the following elements (atomic number given in brackets) have valency 2 ?

A) C (6) B) P (15) C) Mg (12) D) Ar (18)

Answer:C

Solution:(A) C (6) → Valency 4

(B) P (15) → Valency 3 or 5

(C) Mg (12) → Valency 2 (loses 2 electrons) ?

(D) Ar (18) → Valency 0 (noble gas)

10. A neutral atom of an element has a nucleus with a nuclear charge 13 times and mass 27 time that of hydrogen nucleus. How many electrons would be in its stable positively charged ion

A) 27 B) 14 C) 13 D) 10

Answer:D

Solution:Nuclear charge = +13 →Atomic number (Z) = 13 (Aluminium).

Neutral Al has 13 electrons, but its stable ion is Al^{3+} (loses 3 electrons).

Electrons in Al^{3+} = 13 - 3 = 10.

JEE MAIN LEVEL QUESTIONS

1. In the compound ammonia (NH_3), what is the valency of nitrogen?
   a) 1 b) 2 c) 3 d) 4

Answer:C

Solution:In NH_3, nitrogen forms 3 covalent bonds with hydrogen.
Valency = Number of bonds formed = 3.

2. What is the valency of chlorine when it reacts with hydrogen to form hydrochloric acid (HCl)?
   a) 1 b) 2 c) 3 d) 4

Answer:A

Solution:In HCl, chlorine forms 1 covalent bond with hydrogen.
Valency = Number of bonds formed = 1.

3. When magnesium reacts with hydrogen to form magnesium hydride (MgH_2), what is the valency of magnesium?
   a) 1 b) 2 c) 3 d) 4

Answer:B

Solution:In MgH_2, magnesium forms 2 ionic bonds with hydrogen (H^-).
Valency = Number of electrons lost = 2.

4. When nitrogen reacts with oxygen to form nitrogen dioxide, what is the valency of nitrogen in the compound?
   a) 2 b) 4 c) 3 d) 5

Answer:B

Solution:In NO_2, nitrogen forms 4 covalent bonds (two double bonds with oxygen or resonance structures).
Valency = Number of bonds formed = 4.

5. In the compound $AlCl_3$ (aluminum trichloride), what is the valency of aluminum?
   a. 1 b. 2 c. 3 d. 4

Answer:C

Solution:In $AlCl_3$, aluminum forms 3 ionic bonds with chlorine (Al^{3+}).
Valency = Number of electrons lost = 3.

6. What is the valency of chlorine in the compound CCl_4 (carbon tetrachloride)?
   a. -1 b. 0 c. +1 d. +4

Answer:A

Solution:Chlorine is in Group 17 (halogens) and usually has a valency of -1 (it gains 1 electron to achieve stability).
In CCl_4, each chlorine forms one single bond with carbon, meaning it contributes 1 electron to the bond.
Thus, chlorine's oxidation state (valency) is -1 (since it is more electronegative than carbon).

7. Valency of sulphur in SO_2 and SO_3 is
   A) 4,6 B) 6,4 C) 2,3 D) 3,2

Answer:A

Solution:In SO_2, sulphur forms 4 bonds (2 double bonds or resonance structures).
In SO_3, sulphur forms 6 bonds (3 double bonds or resonance structures).

8. Valency of carbon in $CH_4, C_2H_6, C_2H_4, C_2H_2$ is

A) 1,2,3,4 B) 4,3,4,2 C) 4,6,4,2 D) 4,4,4,4

Answer:D

Solution:CH_4(Methane)
Carbon forms 4 single bonds with hydrogen.
Valency = 4 (since it shares 4 electrons).
C_2H_6(Ethane)
Each carbon forms:
3 bonds with hydrogen (1 single bond to the other carbon + 3 single bonds to hydrogen).
Valency = 4 (for each carbon).
C_2H_4(Ethylene/Ethene)
Each carbon forms:
2 single bonds with hydrogen + 1 double bond with the other carbon.
Total bonds = 4 (but valency is determined by the number of shared electrons, so 4).
C_2H_2 (Ethyne)
Each carbon forms:1 single bond with H
1 triple bond with the other C (triple bond = 3)
total = 4 bonds
Valency of Carbon = 4

9. If an atom has 17 electrons, how many electron shells does it have?

a. 1 b. 2 c. 3 d. 4

Answer:C

Solution:Electronic configuration: 2, 8, 7 (3 shells).

10. What is the maximum number of electrons that can occupy the outermost energy level of an atom?

a. 2 b. 4 c. 6 d. 8

Answer:D

Solution:The octet rule states that the outermost shell can hold a maximum of 8 electrons.

11. In which energy level do you find the valence electrons of an atom?

a. First energy level b. Second energy level
c. Third energy level d. Outermost energy level

Answer:D

Solution:Valence electrons are always in the outermost shell.

12. The electronic configuration of an element X is 2, 8,7.

A) O_2 B) H_2 C) Cl D) Ne

Answer:C

Solution:Atomic number = 17 $\rightarrow$ Chlorine (Cl).

13. Which of the following electronic configuration represents a noble gas ?

A) 2, 8, 2 B) 2, 8, 6 C) 2, 8 D) 2, 8, 8, 2

Answer:C

Solution:Noble gases have completely filled outer shells.

Neon (Ne) has configuration 2,8.

14. Name and atomic number of an element whose atom has the electronic configuration 2, 8, 4.

A) Aluminium - 13 B) Sulphur - 14

C) Silicon - 14 D) Phosphorus-15

Answer:C

Solution:Total electrons = 14 →Silicon (Si).

ADVANCED LEVEL QUESTIONS

MULTIPLE CORRECT ANSWER TYPE

1. Valency is a

A) Number of electrons gained B)Number of electrons lost

C) Number of electrons shared D) Valency electrons

Answer:A,B,C

Solution:Valency is determined by:

Electrons lost (for metals, e.g., Na loses 1 electron → valency = +1).

Electrons gained (for non-metals, e.g., Cl gains 1 electron → valency = -1).

Electrons shared (in covalent bonds, e.g., Carbon shares 4 electrons → valency = 4).

(D) Valency electrons is incorrect because "valency electrons" refers to the outermost electrons, not the valency itself.

2. Elements with a valency of 2 when combining with hydrogen include:

a. Oxygen b. Calcium c. Sulfur d. Magnesium

Answer:A,B,C,D

Solution:Oxygen (O): Forms H_2O (valency = 2, gains 2 electrons).

Calcium (Ca): Forms CaH_2 (valency = 2, loses 2 electrons).

Magnesium (Mg): Forms MgH_2 (valency = 2, loses 2 electrons).

(c) Sulfur (S) is typically forms H_2S (valency = 2) but can also show variable valency (2, 4, 6).

REASON AND ASSERTION TYPE

3. Assertion: Chlorine exhibits a valency of -1 when combining with hydrogen.

Reason: Chlorine has seven electrons in its outer shell and tends to gain one electron to achieve a stable octet, forming compounds with a valency of 1 when combining with hydrogen.

Answer:A

Solution:Assertion (True):

Chlorine forms HCl (hydrochloric acid), where its valency is -1 (it gains 1 electron from hydrogen).

Reason (True and Correct Explanation):

Chlorine has 7 valence electrons and needs 1 more to complete its octet (stable configuration).

Thus, it gains 1 electron, showing a valency of -1.

4. Assertion: Nitrogen can exhibit different valencies, including 3, when combining with hydrogen.

Reason: Nitrogen has five electrons in its outer shell and can gain three electrons when combining with hydrogen, resulting in a valency of 3.

Answer:C

Solution:Assertion (True):Nitrogen shows variable valency (e.g., 3 in NH_3, 5 in HNO_3).

Reason (Incorrect):Nitrogen does not gain electrons when forming NH_3 (ammonia). Instead, it shares 3 electrons via covalent bonding (not gaining).

COMPREHENSION TYPE

COMPREHENSION-1

A neutral atom of an element has a nucleus with nuclear charge 11 times and mass 23 times that of hydrogen.

5. The element can form a stable charged ion by

(A) losing 1 electron B) losing 2 electrons

(C) gaining 1 electron D) gaining 2 electrons

Answer:A

Solution:Nuclear charge = +11 (11 protons → atomic number Z = 11).

Mass number = 23 (protons + neutrons = 23 → A = 23).

The element is sodium (Na), with electronic configuration:

2, 8, 1 (1 valence electron in the outermost shell).

Sodium has 1 valence electron in its outermost shell.

To achieve a stable octet (like noble gas Neon), it can lose 1 electron, forming Na^+.

This ion has a +1 charge and a stable electron configuration (2, 8).

COMPREHENSION-II

Electron configurations describe the distribution of electrons in an atom's electron shells. The electron configuration 2,8,8,2 corresponds to three occupied electron shells. The first shell can hold a maximum of 2 electrons, the second shell can hold up to 8 electrons, and the third shell can also hold up to 8 electrons, and he fourth shell can also hold 2 electrons

6 Which of the following elements is likely to have the electron configuration 2,8,8?

a. Magnesium (Mg) b. Sulfur (S) c. Argon (Ar) d. Potassium (K)

Answer:C

Solution:Electron Configuration 2,8,8:

Total electrons = 2 + 8 + 8 = 18.

This matches the atomic number of Argon (Z = 18), a noble gas with a stable octet in its outermost shell.

7. Which of the following elements is likely to have the electron configuration 2,8,4?

a. Magnesium (Mg) b. Sulfur (S) c. Argon (Ar) d. Silicon (Si)

Answer:D

Solution:Electron Configuration 2,8,4:

Total electrons = 2 + 8 + 4 = 14.

This matches the atomic number of Silicon (Z = 14), a Group 14 element with 4 valence electrons.

INTEGER TYPE

8. _____ group elements exhibits the maximum valency with respect to chlorine

Answer:6

Solution:Group 1 (Alkali metals): +1 (e.g., NaCl).
Group 2 (Alkaline earth metals): +2 (e.g., $MgCl_2$).
Group 13 (Boron group): +3 (e.g., $AlCl_3$).
Group 14 (Carbon group): +4 (e.g., CCl_4).
PCl_5 (Phosphorus Pentachloride), where phosphorus exhibits +5 valency.
Group 16 (Oxygen group): +4/+6 (e.g., SCl_4/SCl_6)

MATRIX MATCHING TYPE

9.**Answer:A-R,B-S,C-Q,D-P**

Solution:

Column I		**Column II**	
Element		**Valence electrons**	
(A)	Sodium	(R)	1
(B)	Carbon	(S)	4
(C)	Magnesium	(Q)	2
(D)	Fluorine	(P)	7

KEY

				TEACHING TASK					
				JEE MAINS LEVEL QUESTIONS					
1	2	3	4	5	6	7	8	9	10
D	C	B	D	C	D	C	B	C	A
11									
D									
				JEE ADVANCED LEVEL QUESTIONS					
1	2	3	4	5	6	7	8	9	10
A,B,C,D	A,B,C,D	A,C,D	A	A	A	A	A	C	B
11	12	13	14	15	16	17	18	19	20
B	C				B	B	5	1,2,3	A
				LEARNERS TASK					
				CUQ'S					
1	2	3	4	5	6	7	8	9	10
A	C	B	B	C	D	B	B	C	D
				JEE MAIN LEVEL QUESTIONS					
1	2	3	4	5	6	7	8	9	10
C	A	B	B	C	A	A	D	C	D
11	12	13	14						
D	C	C	C						
				ADVANCED LEVEL QUESTIONS					
1	2	3	4	5	6	7	8	9	
A,B,C,D	A,B,C,D	A	C	A	C	D	6	A-R,B-S,C-Q,D-P	