

لجنة طب الأسنان



Dental  
Committee

معاً نرسم الإبتسامة

فريق اللجنة الأكاديمي ☺



# اكاديمية القرص

دورات مساعدة واستشارات متخصصة لطلاب الجامعات في التخصصات الطبية والهندسية والعلمية  
عمان : 078 570 6006 إربد : 078 570 6008



## اكاديمية القرص

نبارك لطلابنا النجاحات المميزة التي حقوها في الفصل الدراسي الماضي  
وكلما نبارك للطلبة المستجدين لقبولهم في جوهرة الجامعات الاردنية  
أملين ان تكونون قد قضيتم اجازة ممتعة  
تنهى الفرصة لنطعكم بأننا نفتح ابوابنا لكم لمستقبلكم في  
**الفصل الدراسي الأول**

وبأننا وكلما عهديتمونا داتما على أهبة الاستعداد لتقديم دورات مساعدة لكافة مواد

**الطب البشري طب الأسنان**

**الصيغة الهندسة**

**العلوم الطبيعية المساعدة**

**مع نخبة من المحاضرين المتميزين**

**الذين يتمتعون بخبرة عالية في مسالتكم وارشادكم**

## 8.1: Types of Chemical Bonds

Mg, Cs, Pd: are examples of metals معدن

Si, As, Sb: are examples of semi-metals (metalloids) نصف معدن

Cl, I, N: are examples of non-metals غاز

مساعدات بالوعاء



### Ionic Bond:

Due to electrostatic forces between opposite charges (metal<sup>+</sup> nonmetal) Ex.: (K<sup>+</sup>) - O bond

### Covalent Bond:

Sharing of electrons between two atoms (nonmetal + nonmetal)

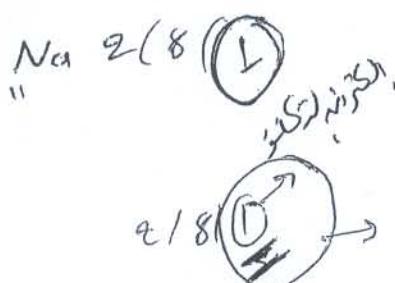
Ex.:  $(F-C)$  bond

## Metallic Bond

In metals where each atom is bonded to several atoms and bonding electrons move freely around them (metal + metal) Ex.:  $(Fe - Fe)$  bond

## الكروماتات، لكتافونات Valence Electrons

The outer shell (valence shell) electrons (that participate in chemical bonding)





# أكاديمية ألوسورة

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٢١/٨/٢٠١٧

Na =

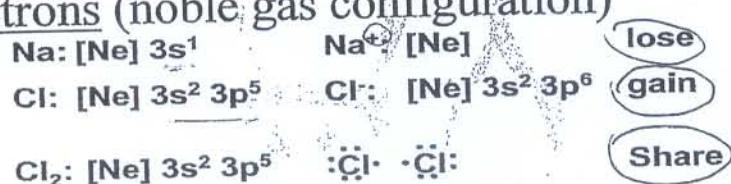
## Valence Electrons

Group	e <sup>-</sup> configuration	# of valence e <sup>-</sup>
1A	(ns) <sup>1</sup>	1
2A	(ns) <sup>2</sup>	2
3A	(ns) <sup>2</sup> np <sup>1</sup>	3
4A	(ns) <sup>2</sup> np <sup>2</sup>	4
5A	(ns) <sup>2</sup> np <sup>3</sup>	5
6A	(ns) <sup>2</sup> np <sup>4</sup>	6
7A	(ns) <sup>2</sup> np <sup>5</sup>	7

لقد انتهيت

## Octet Rule:

Atoms tend to gain, lose, or share electrons until they are surrounded by 8 valence electrons (noble gas configuration)



صفر لوسين

## Lewis Symbols

Chemical symbol for the element plus a dot for each valence electron

1 IA	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8	9	10	11	12	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
H	Be											B	C	N	O	F	He
Li		Mg										Al	Si	P	S	Cl	Ar
		K	Ca									Ga	Ge	As	Se	Br	Kr
		Rb	Sr									In	Sn	Sb	Tl	I	Xe
		Cs	Ba									Tl	Pb	Bi	Po	At	Rn
		Fr	Ra														



## 7.3 Sizes of ions:

حجم الأنيونات

Ionic Size (Radius)

Ions	
Cation (+ve)	Anion (-ve)
$K^+$	$Cl^-$

Note:

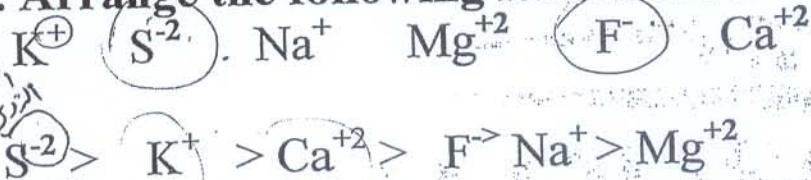
⊕ Cation Smaller size than its neutral atom

$K > K^+$  (more attraction)

⊖ Anion Larger size than its neutral atom

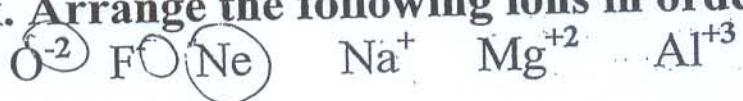
$Cl^- > Cl$  (more repulsion)

Ex. Arrange the following ions in order to decreasing ionic radius?



Since same charge we go to atomic radius ( $K > Na & Ca > Mg$ )

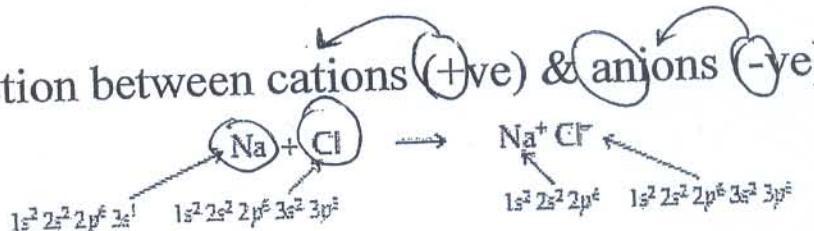
Ex. Arrange the following ions in order to decreasing ionic radius?





## 8.2 Ionic Bond

Electrostatic attraction between cations (+ve) & anions (-ve)



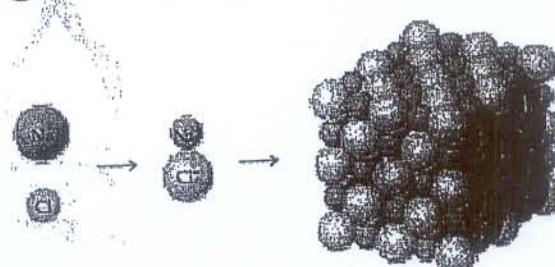
How Strong is the Ionic Bond?

Strength measured by the lattice energy of the ionic compound.

محزن

### Lattice Energy ( $E_l$ )

Energy required to completely separating one mole of a solid ionic compound into gaseous ions.



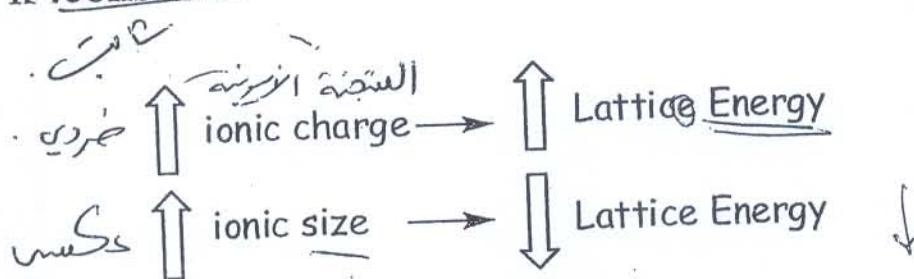
For the lattic energy we can make comparison ionic compound by:

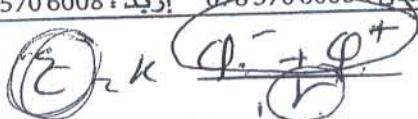
النسبة المئوية

$$E \cdot I = k \frac{Q_+ \cdot Q_-}{r}$$

Where,  $Q_+$ ,  $Q_-$  : ionic charges (+ve, -ve)  
CH.8),  $k$  : constant

,  $r$  : ionic radius (see  
النسبة المئوية





تأثير الشحنة على القوى

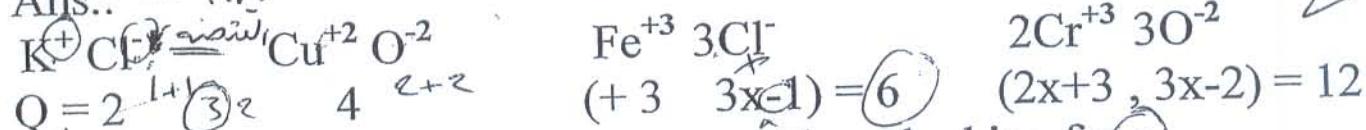
القوى

\*\*\*\* Ionic Charge effect more than ionic radius.

Ex. Arrange the following in order of decreasing lattice energy?

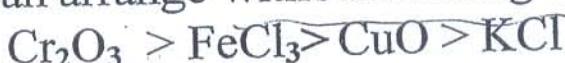


Ans.:



Since, Q is different we can arrange without looking for r

>>>



لذلك فالقوى  
تختلف

\*\* Cations (+ve): Within a series of compounds that have the same anion but different cations,

Lattice energy increases as the cation size decreases

Ex. Comparing LiF, NaF, KF, cation size order  $K^+ > Na^+ > Li^+$

Since, Q is same we compare d, since K larger size than Na than Li

So lattice energies order (d inversely proportional to E.l.):

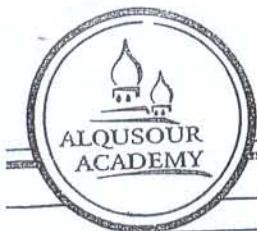
>>> LiF > NaF > KF

دورة العلوم والتكنولوجيا

\*\* Anion (-ve): Within a series of compounds that have the same cation but different anions,

Lattice energy increases as anion size decreases

Ex. Comparing LiF, LiCl, LiBr, LiI, anion size follows the order I<sup>-</sup> > Br<sup>-</sup> > Cl<sup>-</sup> > F<sup>-</sup> so lattice energies follow the reverse order LiF > LiCl > LiBr > LiI

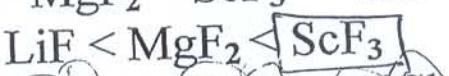


**Ex. Which has the larger lattice energy, NaCl or CsI?**

Since,  $\text{Na}^+$  smaller than  $\text{Cs}^+$  &  $\text{Cl}^-$  smaller than  $\text{I}^-$  the distance between ions is smaller in NaCl than in CsI  $\rightarrow$  NaCl has larger Lattice Energy

**Ex. Arrange the following in order of increasing lattice energy?**

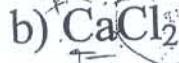
- A)  $\text{MgF}_2$     $\text{ScF}_3$     $\text{LiF}$



- B)  $\text{LiI}$     $\text{LiF}$     $\text{LiCl}$

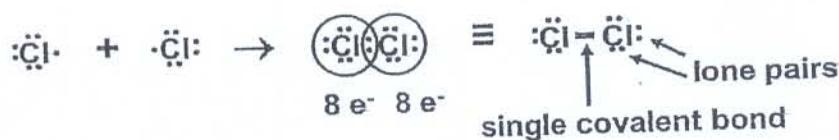


**Q. One of the following has the highest lattice energy:**



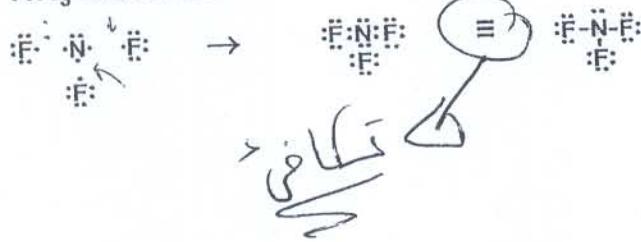
### 8.3: Covalent Bond

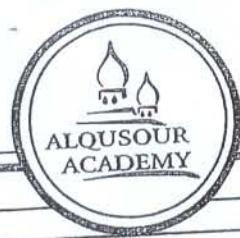
Two atoms in a molecule share a pair of  $e^-$  (one  $e^-$  from each atom)



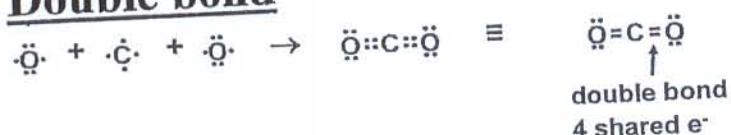
#### Single bond

$\text{NH}_3$  molecule:





### Double bond



### Triple bond



#### Note:

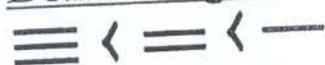
As the number of shared  $e^-$  between the two atoms increases bond strength increases & length decreases

#### Bond Strength:



Triple > double > single

#### Bond Length:



Triple < double < single

Q. Number of single covalent bonds must Magnesium (Mg) form to complete octet is:

a) 1

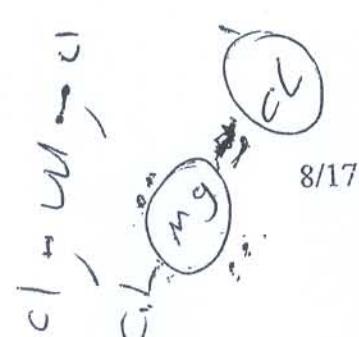
b) 2

c) 3

d) 4

(a)

MgCl<sub>2</sub>



Mg<sup>2+</sup>

O<sup>2-</sup>

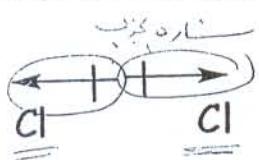
### 8.4: Electronegativity (E.N)

خاصية ذهب  
الإلكترونات  
(الكمبراسانية)

The ability of atom to attract ( $e^-$ ) toward itself in a chemical bond

$\text{Cl}_2 e^- \rightarrow \text{covalent bond} \rightarrow \text{shared equally (non-polar)}$

$\text{HCl} e^- \rightarrow \text{not equally shared between H and Cl atoms due difference}$   
in Electronegativity



non-polar (No difference in E.N.)

polar (difference in E.N.)

Note: إذا كان الاختلاف في

If difference in E.N.

$1 \geq 2 \gg \text{Ionic Bond}$

$< 2 \gg \text{Covalent polar}$

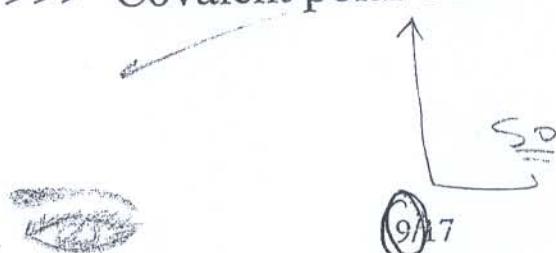
$= 0 \gg \text{Covalent Non-polar}$



Ex.: What is the type of bond between  $X = 1.2$ ,  $Y = 2.8$ ?

Ans.:

$2.8 - 1.2 = 1.6 \gg \text{Covalent polar bond}$



$$2.8 - 1.2 = 1.6$$

(2) أندس (1.6)

$$1.2 \cdot 4 + 1 = 5.8$$



The figure shows a periodic table with several annotations:

- Vertical Axis (Left):** An upward-pointing arrow labeled "increase E.N.".
- Horizontal Axis (Top):** An arrow pointing to the right labeled "increase E.N.".
- Group 1A:** Labeled "IA".
- Group 2A:** Labeled "2A".
- Transition Metals:** Groups 3B through 7B, labeled "3B", "4B", "5B", "6B", and "7B".
- Group 8B:** Labeled "8B".
- Actinides:** Labeled "1U".
- Post-transition Metals:** Labeled "2B".
- Lanthanides:** A circular bracket groups the lanthanide elements (Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu).
- Periodic Trends:** Arrows indicate increasing Electronegativity (E.N.) from bottom-left to top-right across the table.

Note: كما في المذكرة السابقة عن سعف.

- As atoms far away each to other in periodic table they are more polar, because difference in E.N. becomes larger

**Q. Which is the highest polarity?**

9.5 C-S 9.5 9.5 C-F 9.5

Br-N<sub>3</sub>

Na-I

2.5

116

Q. The most polar covalent bond would form in which of these pairs:

- a) Al-I

- b) P-Cl

- c) Si-Cl

- d) O-F



تركيب لويس

## 9.6 Lewis Structure

لرسم لفطاط بتركيبة  
A general method of drawing electron-dot structures that works for any compound is to use the following steps:

### Step 1.

Find the total number of valence electrons for all atoms in the molecule. Add one additional electron for each negative charge in an anion & subtract one electron for each positive charge in a cation.

Ex.: Draw lewis structure for  $\text{NF}_3$

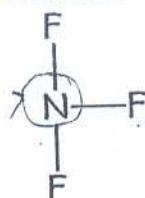
The total valence electrons is 26 (5 from N & 7 from each of 3 F)

### Step 2.

Write the (skeleton structure) of the compound

- Put least E.N. as central atom & surround with other atoms
- H & F atoms will always be outer atoms

>>> make one bond to sulfur, which occurs as the central atom

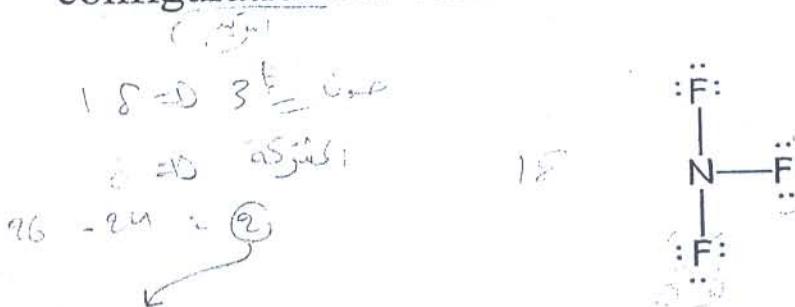


### Step 3.

Subtract the number of valence electrons used in bonding from the total number calculated in step 1 to find the number that remain. Assign as many of these remaining electrons as necessary to the



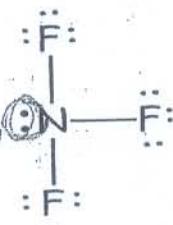
terminal atoms (other than H) so that each has an octet. In  $\text{NF}_3$ , 8 of 26 total valence electrons are used in covalent bonding >>>  $(26) - 8 = 18$  24 e<sup>-</sup>s of 26 are assigned to 3-F atoms to reach an octet configuration for each:



#### Step 4.

If unassigned electrons remain after step 3, place them on the central atom,

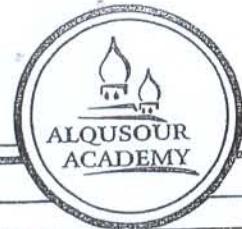
In  $\text{NF}_3$ , 24 of 26 e<sup>-</sup>s have been assigned, leaving the final 2 to be placed on the central N atom



#### Step 5.

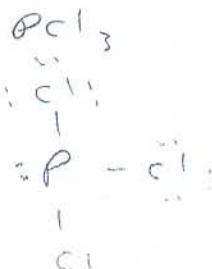
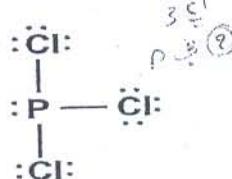
If no unassigned electrons remain after step 3 but the central atom does not yet have an octet, use one or more lone pairs of electrons from a neighboring atom to form a multiple bond (either double or triple). O, C, N, & S often form multiple bonds.





### Ex. Draw Lewis structure for $\text{PCl}_3$

Valence e<sup>-</sup>    1 (5) + 3 (7) = 26 e<sup>-</sup>  
 in structure = 24 e<sup>-</sup>  
 Short by 2 e<sup>-</sup>,  
 add to central  
 Check octets

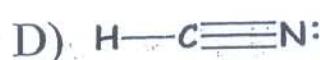
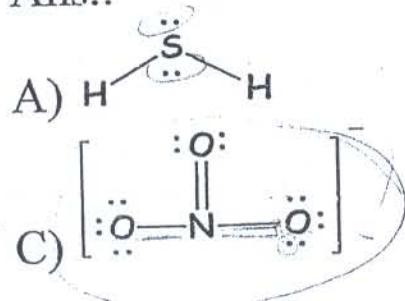


### Q. Give the Lewis structure for the following:

- a)  $\text{H}_2\text{S}$   
 c)  $\text{NO}_3^-$  (Hint: add one electron to the valence)

- b)  $\text{N}_2$   
 d)  $\text{HCN}$

Ans.:



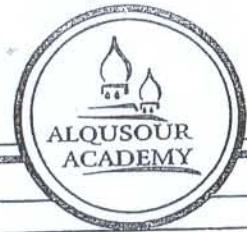
### Q. The Lewis structure for, $\text{ClO}_3^-$ , have --- single bonds, and ----

double bond(s)

- A) 3, 1      B) 3, 0

- C) 2, 1

- D) 2, 0



# الكلية الفنية الجامعية

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## >> Exceptions to the Octet Rule

### 1- Less than octet

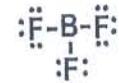
H      2 electrons (1 bond)



Be      4 electrons (2 bonds)

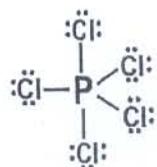


B      6 electrons (3 bonds)



### 2- More than octet (expanded octet)

Elements in the 3<sup>rd</sup> period or higher can have more than 8 e<sup>-</sup> (expanded octet) due to empty orbitals.



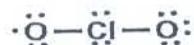
8A						
13 3A	14 4A	15 5A	16 6A	17 7A	2 He	
13 Al	14 Si	15 P	16 S	17 Cl	18 Ar	n=3
31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr	n=4
49 In	50 Sb	51 Te	52 Po	53 At	54 Xe	n=5
81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn	n=6

### 3- Odd number of electrons

NO      11 e<sup>-</sup>



ClO<sub>2</sub>      19 e<sup>-</sup>



Ex. Draw the Lewis structure for the following molecules?

a) BeCl<sub>2</sub>

b) BH<sub>3</sub>

c) NO<sub>2</sub>

d) I<sub>3</sub><sup>-</sup>

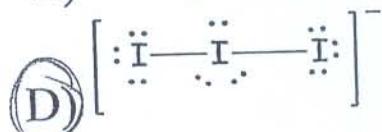
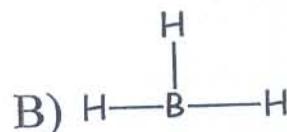
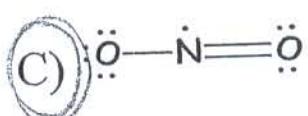


# أكاديمية القرص

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عمان : 078 570 6006 اربد : 078 570 6008



Ans.:



## Q. The Lewis dot structure of HCN (H bonded to C):

- a) Gives C one nonbonding pair
- b) Gives H one nonbonding pair
- c) Gives C two nonbonding pairs
- d) Gives N one nonbonding pair



# أكاديمية القرص

نستقبلكم و نستقبل إتصالاتكم

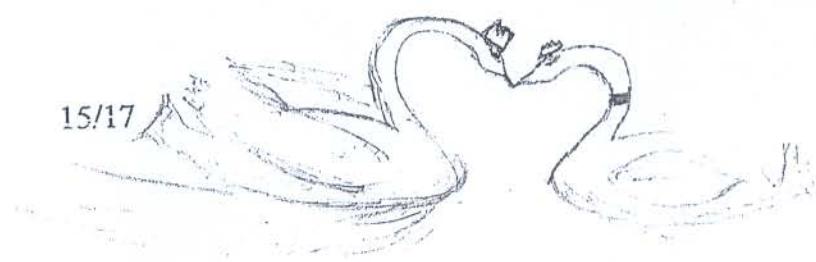
يومياً من الساعة 12:30 ظهراً و لغاية الساعة 12:30 ليلاً

عدا يوم الجمعة من الساعة 2:00 ظهراً و لغاية الساعة 11:00 ليلاً

للتتسجيل بالدورات والاستفسار عن التفاصيل \* 0785706008 اربد

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## Questions

Q1. The most polar covalent bond would form in which of these pairs:

- a) C-F      b) N-F      c) Cl-F      d) O-F

2) Which of these atoms is the least electronegative?

- a) Cs      b) Li      c) P      d) As

Q3. In which of these pairs of atoms would the bond have the greatest percent ionic character (i.e., most polar)?

- a) O-F      b) N-F      c) C-F      d) Cl-F

Q4. In which of the following molecule the carbon-carbon distance shorter:

- a)  $\text{H}_2\text{C}=\text{CH}_2$       b)  $\text{H}_3\text{C}-\text{CH}_3$   
c)  $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_3$       d)  $\text{H}-\text{C}\equiv\text{C}-\text{H}$

Q5. Which one of the following bonds would be the most polar:

- a) Na-S      b) P-S      c) C-F      d) Si-Cl

Q6. Of the bonds C-N, C=N and C≡N, the C-N bond is

- a) strongest/ shortest  
c) weakest/ longest  
b) strongest/ longest  
d) weakest/ shortest



## Answers

Questions	Answer
1	A
2	A
3	C
4	D
5	A
6	C

نعتز بتفانيكم