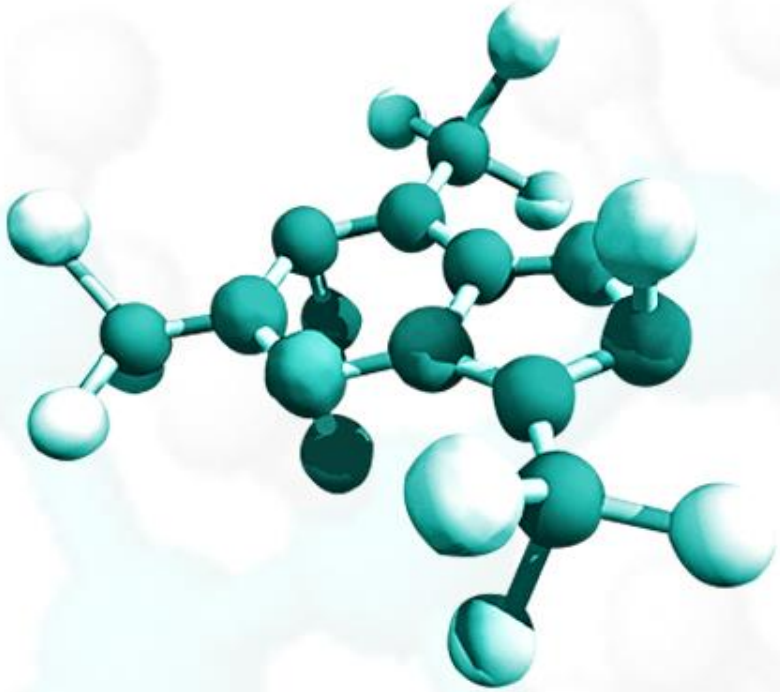
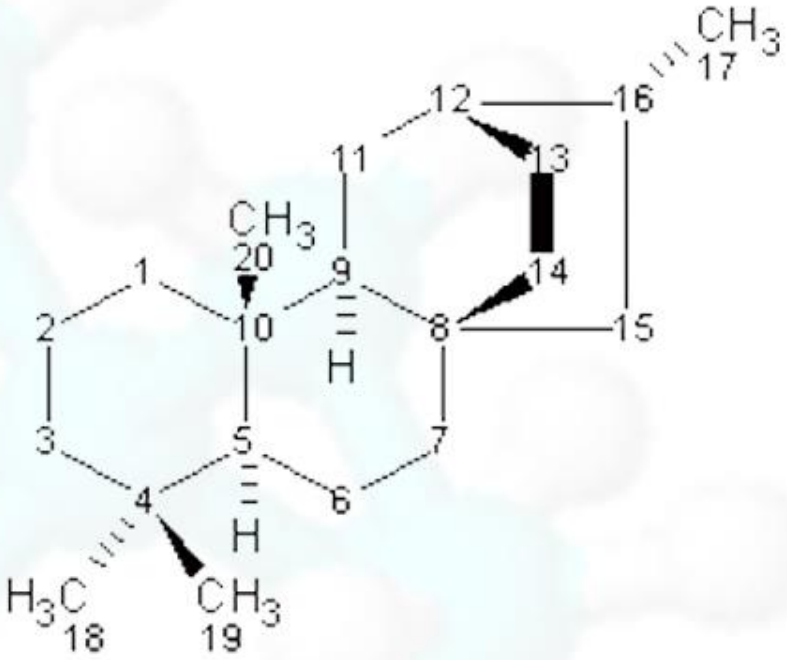




Chapter 7,8,9

Bohr's Theory of the Hydrogen Atom

- The journey from a lower step to a higher step is an energy-requiring process.
- Whereas movement from a higher step to a lower step is an energy releasing process.

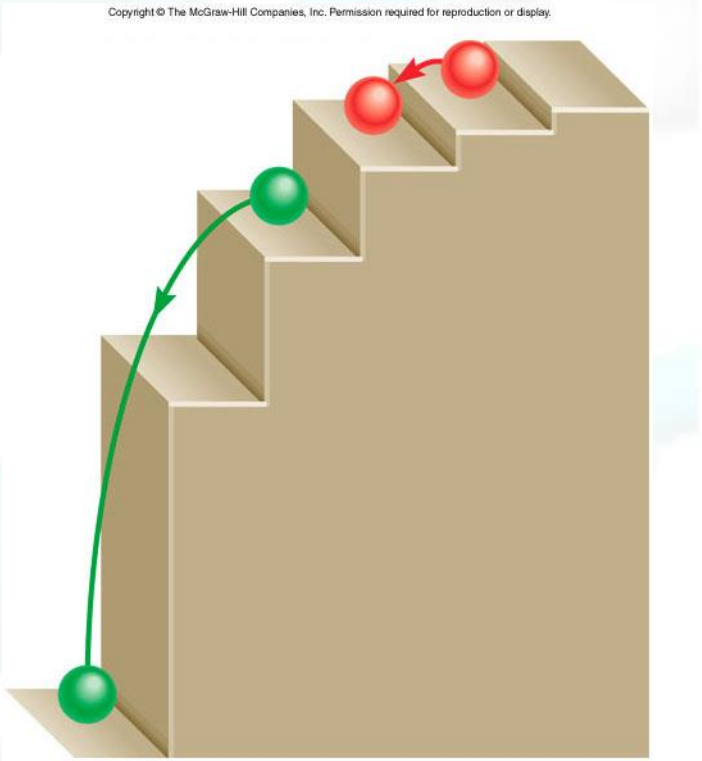
$$\Delta E = E_f - E_i$$

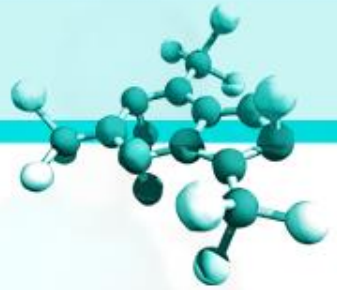
$$E_f = -R_H\left(\frac{1}{n_f^2}\right)$$

$$E_i = -R_H\left(\frac{1}{n_i^2}\right)$$

$$\Rightarrow \Delta E = \left(\frac{-R_H}{n_f^2}\right) - \left(\frac{-R_H}{n_i^2}\right)$$

$$\Delta E = R_H\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right)$$





Bohr's Theory of the Hydrogen Atom

$$\Delta E = R_H \left(\frac{1}{n_i^2} - \frac{1}{n_f^2} \right)$$

$$\Delta E = h\nu$$

$$\Delta E = h\nu = R_H \left(\frac{1}{n_i^2} - \frac{1}{n_f^2} \right)$$

- If $n_f > n_i$ → (+ve) → ΔE (+ve) → Energy is absorbed
- If $n_i > n_f$ → (-ve) → ΔE (-ve) → Energy is emitted

Bohr's Theory of the Hydrogen Atom

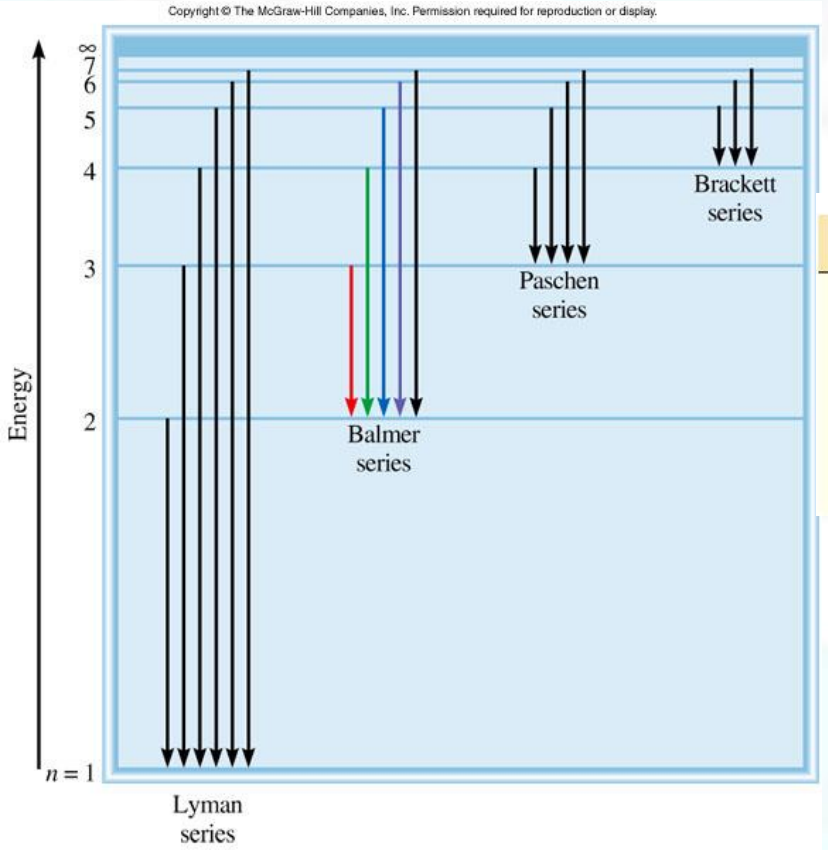
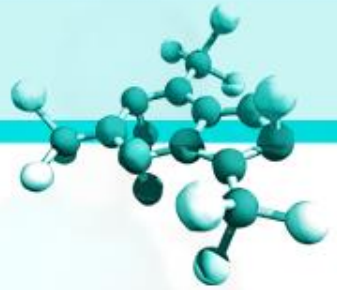


TABLE 7.1 The Various Series in Atomic Hydrogen Emission Spectrum

Series	n_f	n_i	Spectrum Region
Lyman	1	2, 3, 4, . . .	Ultraviolet
Balmer	2	3, 4, 5, . . .	Visible and ultraviolet
Paschen	3	4, 5, 6, . . .	Infrared
Brackett	4	5, 6, 7, . . .	Infrared



Bohr's Theory of the Hydrogen Atom

Example:

What is the wavelength of a photon (in nm) emitted during a transition from the $n_i = 5$ state to the $n_f = 2$ state in the hydrogen atom?

$n_i=5$, $n_f = 2$, $\lambda=?$

$$\Delta E = R_H\left(\frac{1}{n_i^2}-\frac{1}{n_f^2}\right)$$

$$\Delta E = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{\Delta E}$$

$$\Delta E = R_H\left(\frac{1}{n_i^2}-\frac{1}{n_f^2}\right)$$

$$= 2.18x10^{-18}\ \text{J}\left(\frac{1}{5^2}-\frac{1}{2^2}\right) = -4.58x10^{-19}\ \text{J}$$

$$\Delta E = \frac{hc}{\lambda} \Rightarrow$$

$$\lambda = \frac{hc}{\Delta E} = \frac{6.63x10^{-34}\ \text{x}\ 3.0\ \text{x}10^{8}}{4.58x10^{-19}}$$

$$= 4.34x10^{-7}\ \text{m} = 434\ \text{nm}$$

The Dual Nature of the Electron

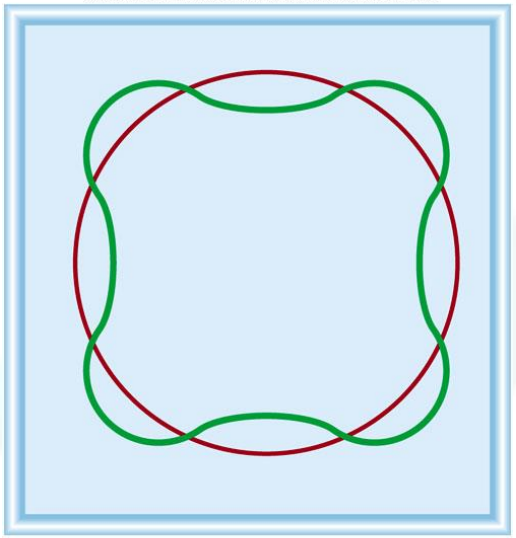
- De Broglie suggested that particles such as electron can posses wave properties.
- According to de Borglie, an electron bond to nucleus behave like a standing wave.
- De Broglie deduced that the particle and wave

prosperities are related by the expression

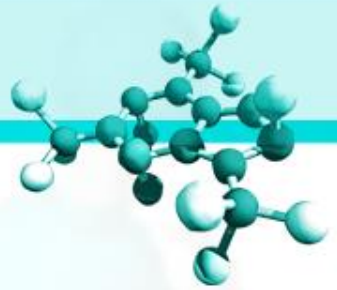
$$\lambda = \frac{h}{mu}$$

Where λ wavelenght of moving particle, m mass (kg),

u velocity of moving particle.



(a)



The Dual Nature of the Electron

Example

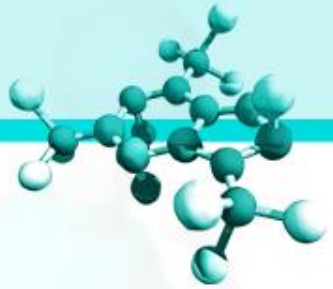
What is the de Broglie wavelength (in nm) associated with a 2.5 g Ping-Pong ball traveling at 15.6 m/s?

$$\lambda = \frac{h}{mu}$$

λ = ?, m= 2.5g = $2.5x10^{-3}$kg, u=15.6m/s

$$\lambda = \frac{6.63x10^{-34}}{2.5x10^{-3}\,x15.6}$$

λ=$1.7x10^{-31}$m = $1.7x10^{-22}$nm.



Quantum numbers

Example :

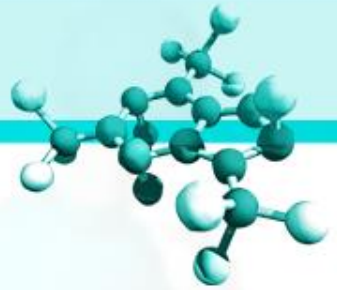
List the values of n, l and ml for orbitals in 4d subshell? What is the total number of orbital in 4d?

n= 4

for d l=2

m_l = -2,-1,0,1,2

Number of orbital = 5



Atomic Orbitals

Example

What is the total number of orbitals associated with the principal quantum number n = 3 ?

n=3

l=0,1,2

1- $m_l = 0$ ======> 1 orbital

2- $m_l = -1,0,1$ =====> 3 orbital

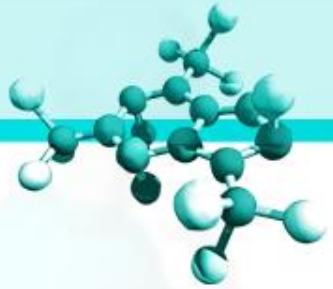
2- $m_l = -2,-1,0,1,2$ ======> 5 orbital

Total number of orbital 9

Or (2x0 +1) + (2x1 +1) + (2x2 +1) =1 + 3 + 5 = 9

OR

Number of orbital = $n^2 = 3^2 = 9$



Atomic Orbitals

- The four quantum number for specific electron can written as (n,l,m_l,m_s).

Example :

Write the four quantum numbers for an electron in a 3p orbital?

n=3 , l = 1, m_l= -1,0,1 , m_s= - ½ or ½

(3,1,-1,-1/2)

(3,1,0,-1/2)

(3,1,1,-1/2)

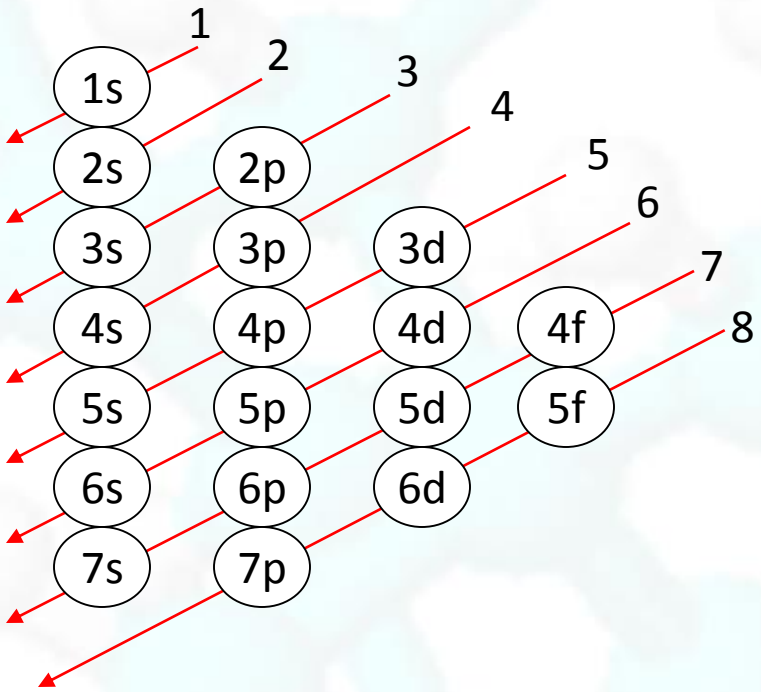
(3,1,-1,1/2)

(3,1,0,1/2)

(3,1,1,1/2)

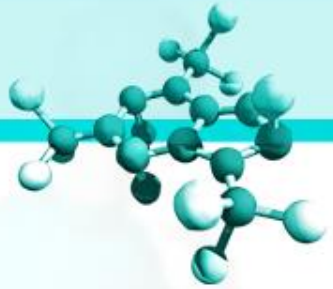
The Energies of Orbitals

Order of orbitals (filling) in multi-electron atom



s sublevel	2 electrons
p sublevel	6 electrons
d sublevel	10 electrons
f sublevel	14 electrons

1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < 5p < 6s < 4f < 5d < 6p < 7s < 5f < 6d < 7p



Electron configuration

Electron configuration: is how the electrons are distributed among the various atomic orbitals in an atom.

number of electrons in the orbital or subshell

$1s^1$

principal quantum number **n**

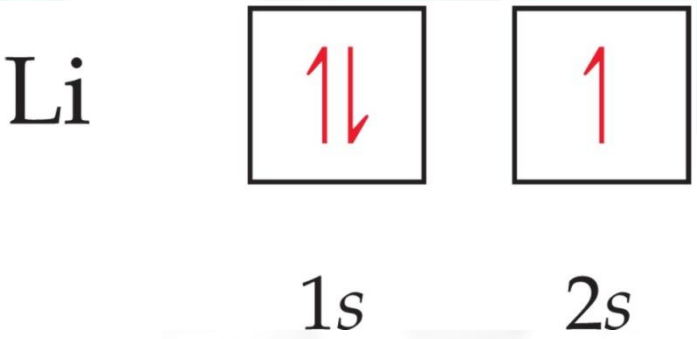
angular momentum quantum number **l**

Orbital diagram

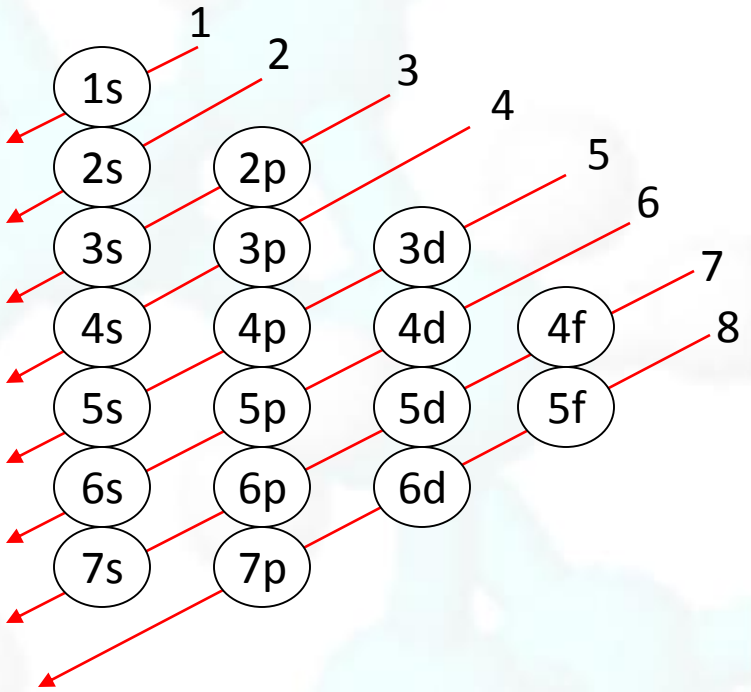
The electron configuration can also represented by the orbital diagram

In the Orbital Diagram:

- Each box represents one orbital.
- Half-arrows represent the electrons.
- The direction of the arrow represents the spin of the electron.



Orbital diagram



Example:

What is the electron configuration of Mg?

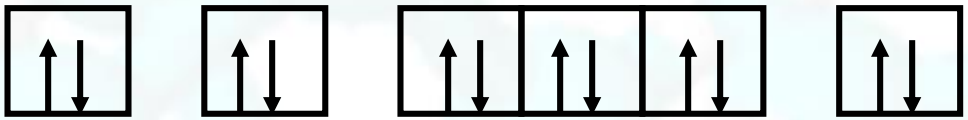
Mg atom has 12 electrons

(from Periodic table (atomic number))

The Electron Configuration: $1s^2 2s^2 2p^6 3s^2$

2 + 2 + 6 + 2 = 12 electrons

Orbital Diagram:



$1s^2$ $2s^2$ $2p^6$ $3s^2$

Orbital diagram

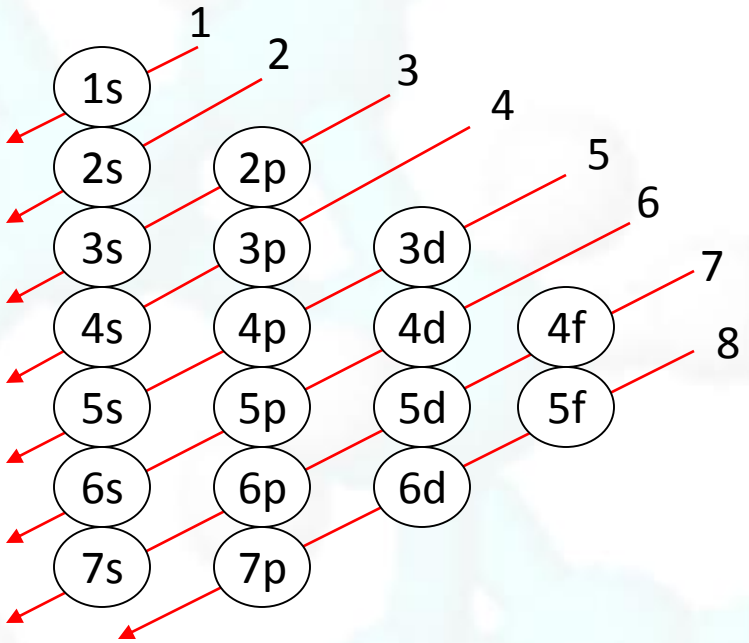
What is the electron configuration of K?

K atom has 19 electrons

(from Periodic table (atomic number))

The Electron Configuration: $1s^2 2s^2 2p^6 3s^2\ 3p^6\ 4s^1$

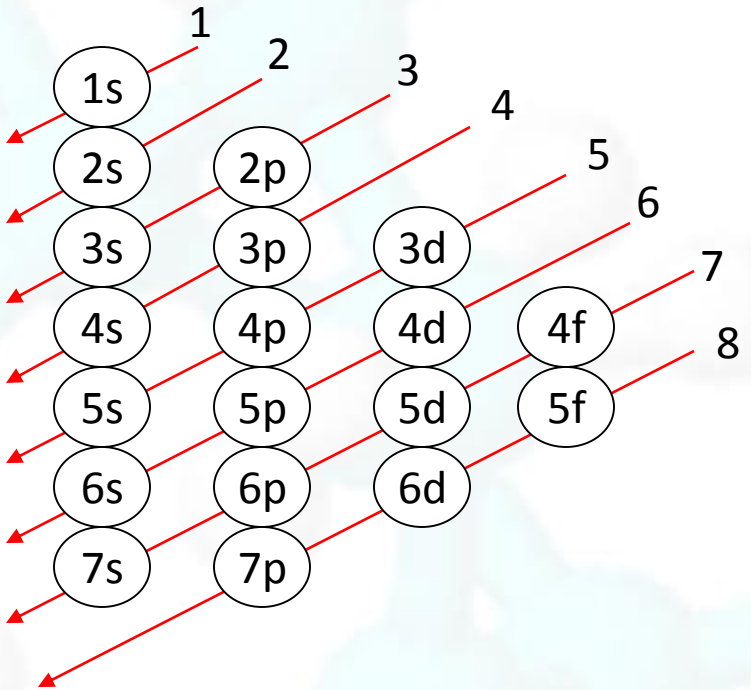
2 + 2 + 6 + 2 +6+1= 19 electrons



Orbital Diagram:

$1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $4s^1$

Orbital diagram



What is the electron configuration of K^{+1}?

Atomic number19

Electron 19 -1= 18

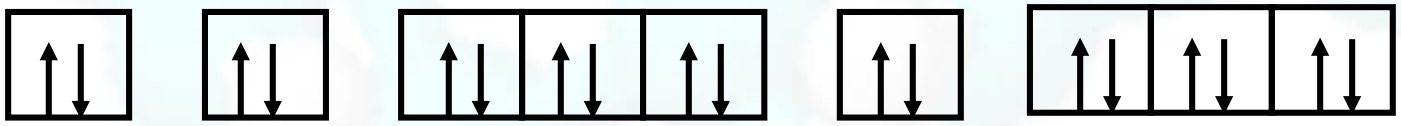
K atom has 18 electrons

(from Periodic table (atomic number))

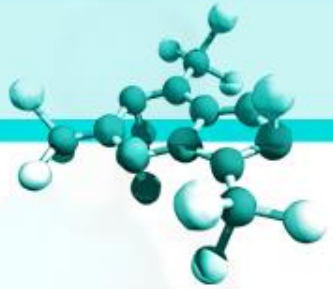
The Electron Configuration: $1s^2 2s^2 2p^6 3s^2\ 3p^6$

2 + 2 + 6 + 2 +6= 18 electrons

Orbital Diagram:



$1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$



Atomic Orbitals

Example

For Cl atom answer the following questions:

a) Write the electron configuration?

b) Draw the orbital diagram?

c) Write the electron configuration in short notation?

d) What are the possible quantum numbers for the last (outermost) electron in Cl?

Answer:

a) Cl atom has 17 electrons

(from Periodic table (atomic number))

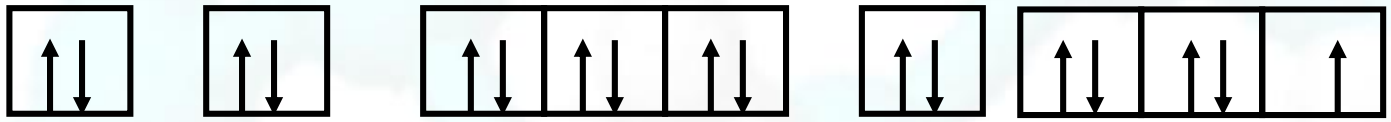
The Electron Configuration: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

2 + 2 + 6 + 2 + 5 = 17 electrons

Atomic Orbitals

b) Draw the orbital diagram?

Orbital Diagram:



$1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^5$

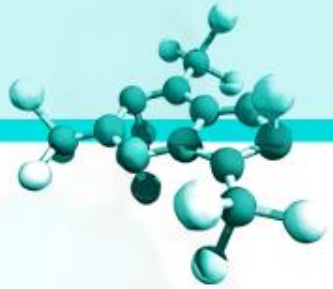
c) Short notation: [Ne] $3s^2$ $3p^5$

d) n= 3

l= 1

m_l= 0

m_s= - ½

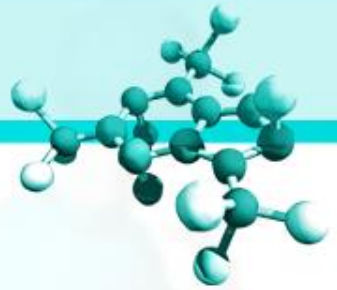


Atomic Orbitals

Example

What is The electron configuration of ^{11}Na ,^{12}Mg ,^{16}S ?

- ^{11}Na $1s^2\ 2s^2\ 2p^6\ 3s^1$ (OR) [Ne] $3s^1$
- ^{12}Mg $1s^2\ 2s^2\ 2p^6\ 3s^2$ (OR) [Ne] $3s^2$
- ^{16}S $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$ (OR) [Ne] $3s^2\ 3p^4$



Atomic Orbitals

- Paramagnetic substance: is the element that contain net unpaired electrons in the outermost subshell and is attracted by a magnet.

e.g. **Paramagnetic**

unpaired electrons

2p

- Diamagnetic substance: is the element that do not contain net unpaired electrons (all electrons are paired) in the outermost subshell and is repelled by a magnet.

e.g. **Diamagnetic**

all electrons paired

2p

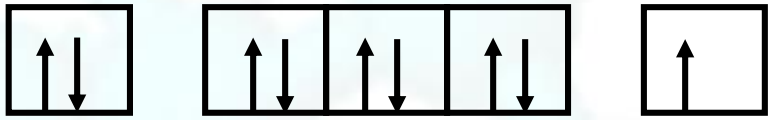
Atomic Orbitals

Example ^{19}K

Electronic configuration: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$

Short notation: [Ar] $4s^1$

Orbital diagram:



$3s^2$ $3p^6$ $4s^1$

Net one unpaired electron → Paramagnetic substance

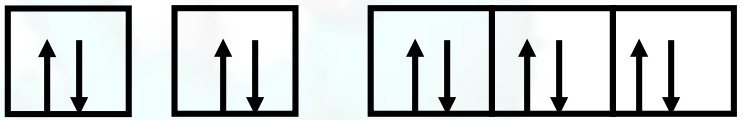
Atomic Orbitals

Example

^{10}Ne

Electronic configuration: $1s^2\ 2s^2\ 2p^6$

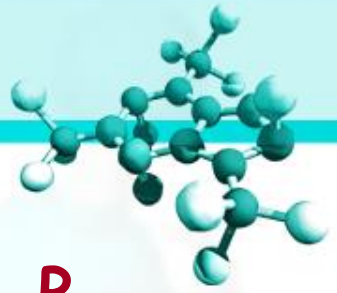
Orbital diagram:



$1s^2$ $2s^2$ $2p^4$

All electrons are paired →

Diamagnetic substance



Atomic Orbitals

P

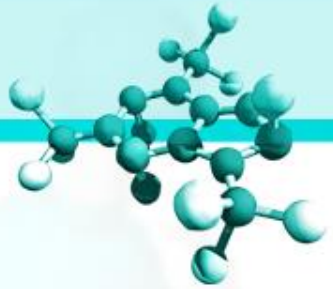
D

D

P P P P P

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

58 Ce $6s^24f^15d^1$	59 Pr $6s^24f^3$	60 Nd $6s^24f^4$	61 Pm $6s^24f^5$	62 Sm $6s^24f^6$	63 Eu $6s^24f^7$	64 Gd $6s^24f^75d^1$	65 Tb $6s^24f^9$	66 Dy $6s^24f^{10}$	67 Ho $6s^24f^{11}$	68 Er $6s^24f^{12}$	69 Tm $6s^24f^{13}$	70 Yb $6s^24f^{14}$	71 Lu $6s^24f^{14}5d^1$
90 Th $7s^26d^2$	91 Pa $7s^25f^26d^1$	92 U $7s^25f^36d^1$	93 Np $7s^25f^46d^1$	94 Pu $7s^25f^6$	95 Am $7s^25f^7$	96 Cm $7s^25f^76d^1$	97 Bk $7s^25f^9$	98 Cf $7s^25f^{10}$	99 Es $7s^25f^{11}$	100 Fm $7s^25f^{12}$	101 Md $7s^25f^{13}$	102 No $7s^25f^{14}$	103 Lr $7s^25f^{14}6d^1$



Atomic Orbitals

Example

What are the valence electrons of vanadium (V)?

^{23}V: [Ar] $4s^2$ $3d^3$

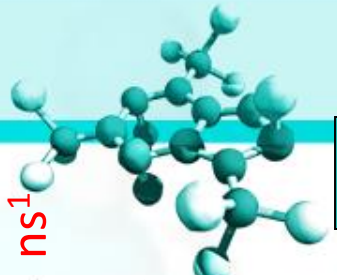
Example

What are the valence electrons of Gallium (Ga)?

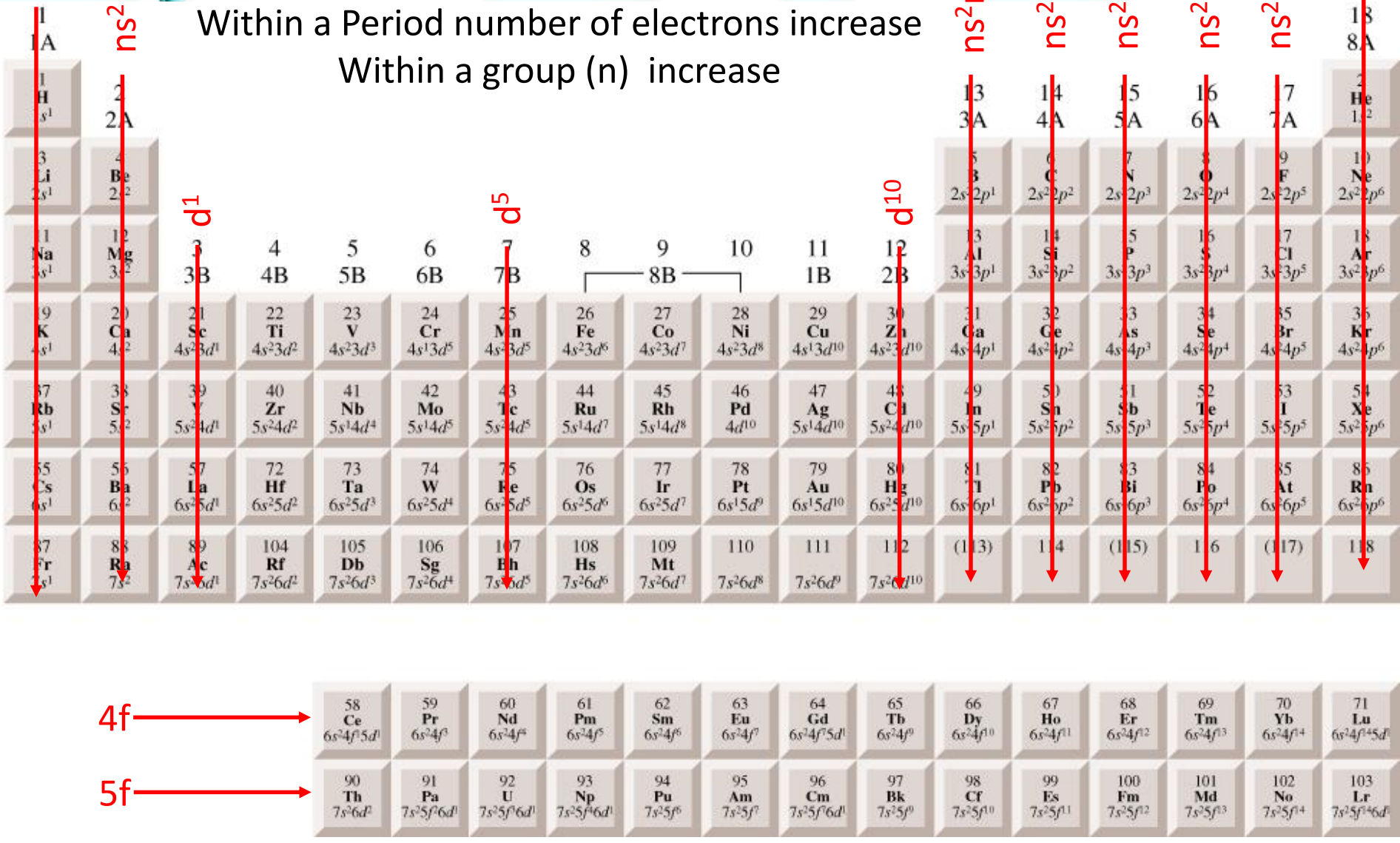
^{31}Ga: [Ar] $4s^2$ $3d^{10}$ $4p^1$

The valence electrons are $4s^2$ $4p^1$

Periodic Classification of the Elements



Within a Period number of electrons increase
Within a group (n) increase



امثلة مجلولة

Give a possible set of four quantum numbers {n, *l*, m_l, m_s } for the starred electron in the following diagram. Select the values of ml by numbering from – *l* to + *l* from left to right.

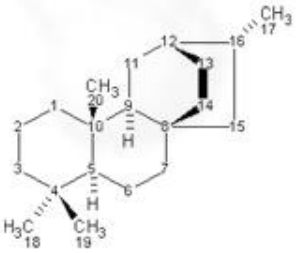
2p

a) n=1, l=1, m_l= 1, m_s = ½

b) n=2, l=2, m_l= 1, m_s = -½

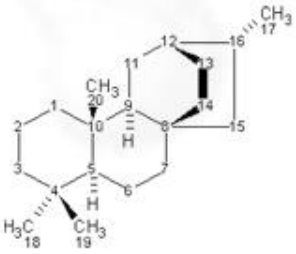
c) n=2, l=1, m_l= 0, m_s = -½

d) n=2, l=1, m_l= 2, m_s = ½



An electron in the hydrogen atom makes a transition from an energy state of principal quantum numbers n_i to the $n = 2$ state. If the photon emitted has a wavelength of 434 nm, what is the value of n_i?

a) 3 b) 4 c) 5 d) 6



An electron in a certain atom is in the $n = 2$ quantum level. List all possible values of l, and m_l, that it can have?

a) $l = 0, m_l = 0; l = 1, m_l = -1, 0, 1; l = 2; m_l = -2, -1, 0, 1, 2$

b) $l = 0, m_l = 0; l = 1, m_l = -1, 0, 1$

c) $l = 0, m_l = -1, 0, 1$

d) $l = 1, m_l = -1, 0, 1$

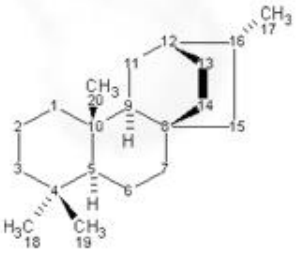
The electron configuration of S is :

a) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6{}_{4S}{}^2\ 3d^{10}\ {}_4p^2$

b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$

c) b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

d) d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3d^6$



Indicate which of the following sets of quantum numbers (n, l , m_l, m_s) in an atom are unacceptable: (A) (1, 0, ½, ½); (B) (3, 0, 0, +½); (C) (2, 2, 1, +½); (D) (4, 3, –2, +½); (E) (3, 2, 1, 1)?

a) (A) and (B) b) (B), (C) and (D) c) (A), (B), (C) and (E) d) (A), (C) and (E)

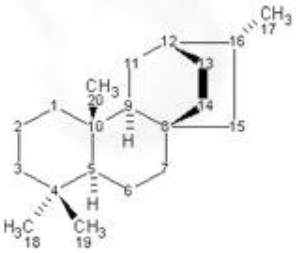
Oxygen is _____ and has _____ unpaired electrons?

a) Paramagnetic ,0 b) Paramagnetic ,2 c) diamagnetic ,1 d) diamagnetic ,0

Electronic configuration: $1s^2\ 2s^2\ 2p^4$

Orbital diagram:

$1s^2$ $2s^2$ $2p^4$



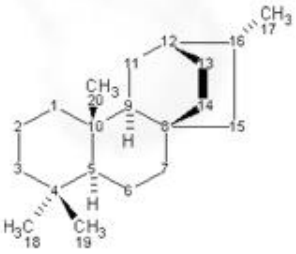
Which of the following elements is a representative element?

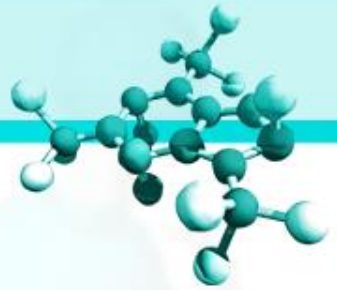
a) Li b) Ni c) Ag d) Sc

A police officer is measuring traffic speed with radar operating at a frequency of 1.0 x 10^9 Hz. What is the wavelength?

a) 3 x 10^{17} m b) 0.30 nm c) 3.30 m d) 0.30 m

$$\nu = \frac{c}{\lambda}$$





An alpha particle of mass 6.645×10^{-27} kg has a velocity of 10.0% of the speed of light.

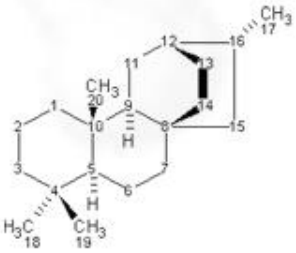
What is its de Broglie wavelength (in m)?

a) 3.70×10^{-16} m b) 3.32×10^{-15} m c) 3.30×10^{-18} m d) 3.50×10^{-21} m

$$\lambda = \frac{h}{mu}$$

$$C = 3 \times 10^{8} \times \frac{10}{100} = 3 \times 10^{7} \text{ m}$$

ثم نستخدم القانون



Which of the following electron transitions would absorb the lowest energy by the hydrogen atom?

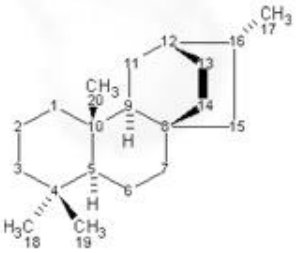
a) from n = 1 to n = 4 b) from n = 1 to n = 2 c) from n = 1 to n = 7 c) from n = 1 to n = 6

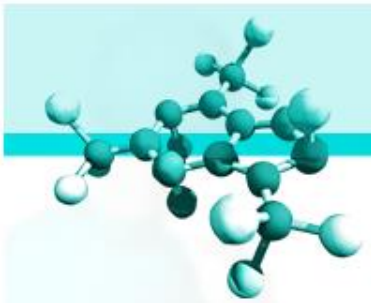
$$\Delta E = R_H\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right)$$

Which of the following electron transitions would absorb the highest energy by the hydrogen atom?

a) from n = 1 to n = 2 b) from n = 1 to n = 5 c) from n = 1 to n = 7

c) from n = 1 to n = 3





1- Calculate the wavelength of the line in Lyman series that results from the transation n=4 to n = 1

a) 90.5 nm b) 97.3 nm c) 121.6 nm d) 102.5 nm

$$\lambda = \frac{hc}{\Delta E}$$

$$\lambda = \frac{hc}{R_H\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right)} = \frac{6.63x10^{-34}\ \text{x}\ 3.0\ \text{x}10^{8}}{2.179x10^{-18}\left(\frac{1}{1} - \frac{1}{16}\right)} = 9.73x10^{-8}\,m = 97.3nm$$

2- Which of the following electronic transation would emit the highest energy photon?

a) n=1 to n=2 b) n=2 to n=1 c) n=5 to n= 4 d) n=3 to n=2

الانتقالة هي انبعاث لذلك نستبعد الاجابة الاولى وبالنظر الى مستويات الطاقة سنجد ان اعلى فرق سيكون بين :
n= 2 to n=1

Determine the total number of: *s* electrons in Si (*Z* = 14)?

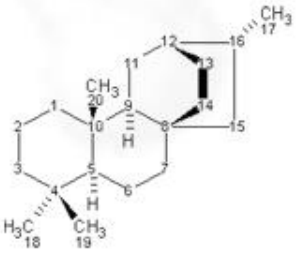
a) 3 b) 2 c) 4 d) 6

14 Si :$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$

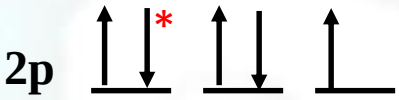
The outermost electron configuration $4s^2 4p^3$ can be found in :

a) Se b) Kr c) As d) P

عدد الالكترونات في المستوى الاخير 5 هذا يعني ان العنصر يقع في المجموعه 5 وهو
As



Give a possible set of four quantum numbers {n, *l*, m_l, m_s } for the starred electron in the following diagram. Select the values of ml by numbering from – *l* to + *l* from left to right.

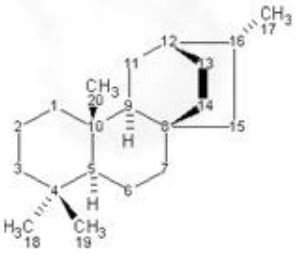


a) n=2, l=1, m_l= -1, m_s = -½

b) n=2, l=1, m_l= -3, m_s = ½

c) n=3, l=1, m_l= -1, m_s = -½

d) n=3, l=0, m_l= 0, m_s = -½



A photon has a frequency of 6.0 X 10^4 Hz. Calculate the energy (in joules) of the photon with this frequency?

a) 4.0 x 10^{-10} J

b) 6.6 x 10^{-15} J

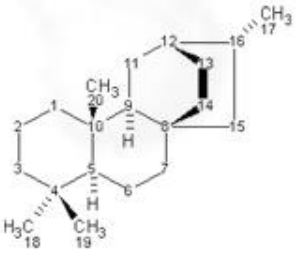
c) 4.0 x 10^{-29} J

d) 2.4 x 10^{-5} J

$$\nu = \frac{c}{\lambda}$$

$$E = h\frac{c}{\lambda}$$

نوجد الطول الموجي من العلاقة الاولى ثم نعوض في العلاقة الثانية



What is the maximum number of electrons in an atom that can have the following quantum numbers: $n = 2$, $m_s = +½$?

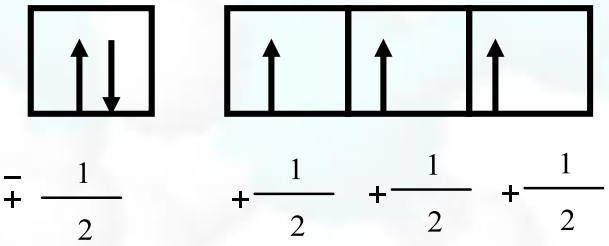
a) 4 b) 2 c)1 d) 3

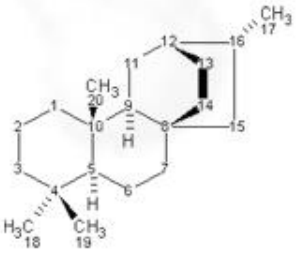
n= 2

L= 0 , 1

ml= 0 , -1,0,+1

ms=





Which of the following have the electron configuration [Ar]$3d^2$

a) Ca b) Zr c) Ti^{+2} d) Ca^{+2}

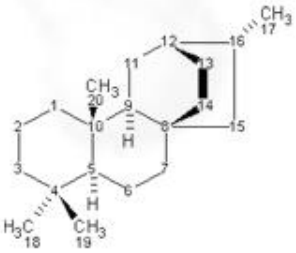
If an electron in hydrogen atom drop from n=3 to n=2 the resulted emission spectrum will be classified as part of :

a) Lyman series

b) Brackett series

c) Paschen series

d) Balmer series



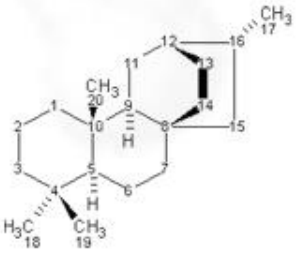
Indicate which of the following values of m_l would make this set of quantum number unacceptable (n=2, l =1, m_l = ___, m_s = ½)

a) $m_l = 2$ b) $m_l = 0$ c) $m_l = -1$ d) $m_l = 1$

1. **The following electron configuration violate**

$1s^2$ $2s^2$ $2p^4$

a) Bohr's equationc)
b) Aufbau principle
c) d) Hund's rule.
b) the Pauli exclusion principle



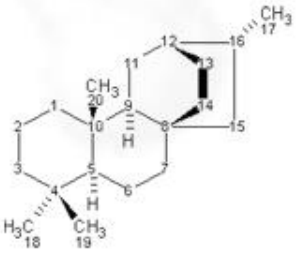
What process will be observed in a hydrogen atom when its electron drops from the $n = 6$ state to the $n = 2$ state.

a) A photon with energy 4.84×10^{-19} J will be emitted

b) A photon with energy 3.03×10^{-19} J will be emitted.

c) A photon with energy 4.84×10^{-19} J will be absorbed.

d) A photon with energy 3.03×10^{-19} J will be absorbed.



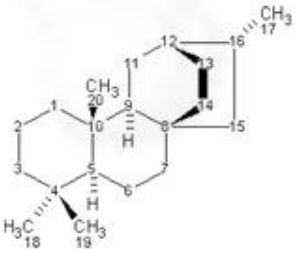
Consider the element with the electron configuration $[Kr]5s^2 4d^{10} 5p^5$. This element is

a) an alkali metal

b) a representative element.

c) transition metal

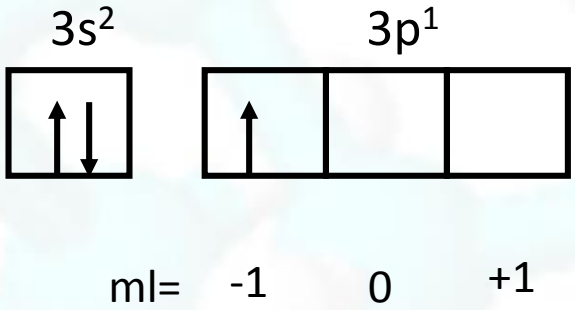
d) nobel gases

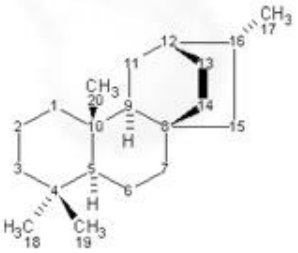


The electron configuration of a neutral atom is [Ne] $3s_2 3p_1$. The four quantum numbers of the last electron are:

a) (2, 1, -1, +1/2)
b) (3, 3, -1 , +1/2)
c) (3, 0, -1, +1/2)
d) (3, 1, -1, +1/2)

n=3
L=1
ml= -1,0,1
ms= +1/2





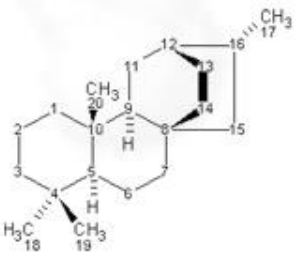
How many unpaired electrons does chromium (Cr) have?

a) 0

b) 2

c) 4

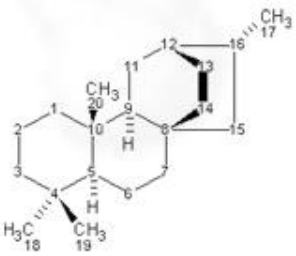
d) **6**



What is the maximum number of orbitals described by the quantum numbers: ***n* = 3 *l* = 2.**

a) 1
b) 3
c) **5**
d) 9

اذا اعطينا في السؤال قيمة
n,l
استخدم العلاقة
2l+1



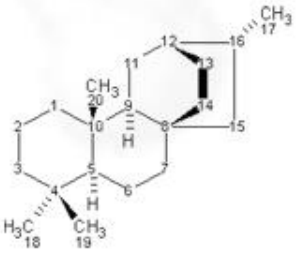
What is the maximum number of orbitals described by the quantum numbers: ***n* = 4.**

a) 7
b) 14
c) 16
d) 48

اذا اعطينا في السؤال قيمة
n
فقط
استخدم العلاقة
Number of orbitals = n^2

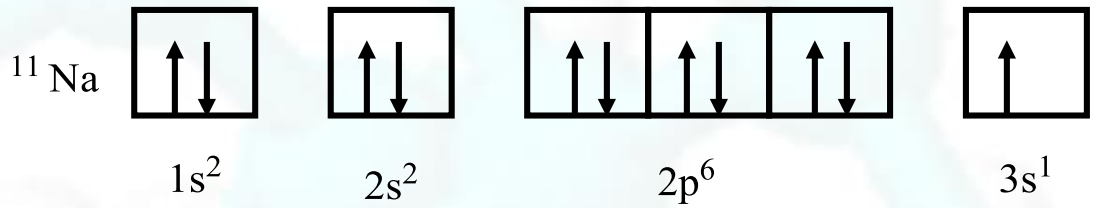
The maximum number of electrons that can occupy an energy level described by the principal quantum number, *n*, is:

a) *n* + 1
b) 2*n*
c) $2n_2$
d) n_2

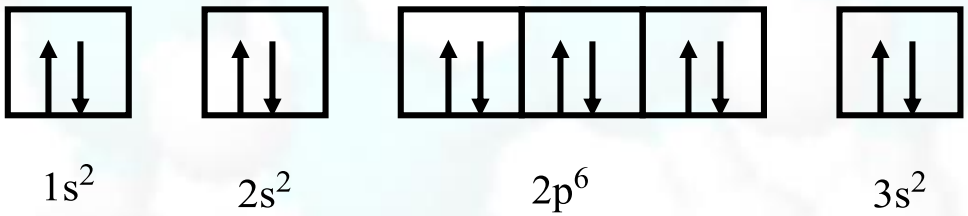


A possible set of quantum numbers for the last electron added to complete an atom of sodium Na in its ground state is:

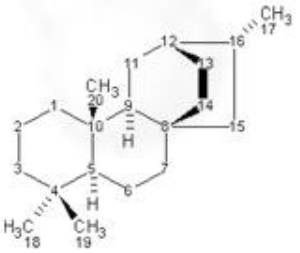
a) $n = 3$, $l = 1$, $m_l = 0$, $m_s = ½$
b) $n = 3$, $l = 0$, $m_l = 0$, $m_s = ½$
c) $n = 2$, $l = 1$, $m_l = -1$, $m_s = ½$
d) $n = 2$, $l = 0$, $m_l = -1$, $m_s = ½$



ms=+1/2



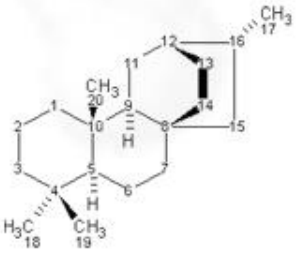
ms= $\pm$ 1/2



Which one of the following sets of quantum numbers is not possible?

	n	l	m_l	m_s
Row 1	4	3	−2	+1/2
Row 2	3	2	−3	−1/2
Row 3	3	0	0	+1/2
Row 4	4	1	1	−1/2
Row 5	2	0	0	+1/2

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



The outermost electron configuration $4s^2 4p^4$ can be found in :

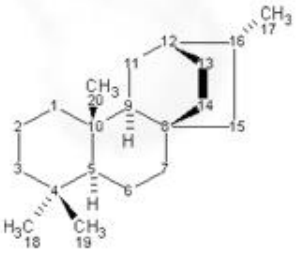
a) Se b)Kr c) As d) p

Rank the following five atomic species in order of increasing atomic radius (smallest to largest): Ge, Sr, Ca, Cl, S

a) Ca, Sr, Ge, S, Cl b) Cl, S, Ge, Sr, Ca c) Sr, Ca, Ge, S, Cl d) Cl, S, Ge, Ca, Sr

The Ca^{2+} ion is isoelectronic with which neutral atom?

a) Si b)Na c) Ne d) Ar



Which atom of the following has the lowest first ionization energy?

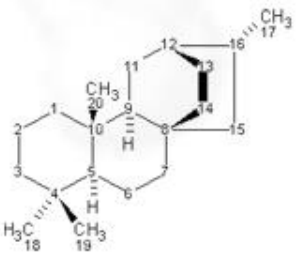
a) N b) F c) Na d) Li

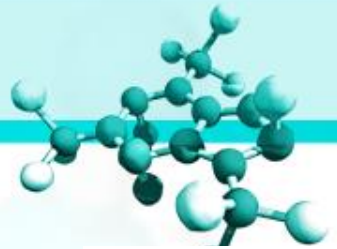
Which of these elements has the greatest attraction for electrons in a covalent bond?

a) S b) Cl c) Ar d) P

The ion not having Octet configuration in the outermost shell is _____.

a) V^{3+} b) O^{2-} c) Sr^{2+} d) Na^{+}





قواعد لرسم أشكال لويس

نحدد الذرة المركزية ودائما الذرة الاقل سالبية كهربائية هي الذرة المركزية

1- احسب عدد الالكترونات الكلية = عدد الذرات غير ذرات الهيدروجين X 8 + عدد ذرات الهيدروجين X 2

2- عدد الكترونات التكافؤ = عدد ذرات كل عنصر X رقم مجموعته ± شحنة الايون

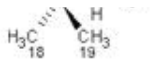
اذا كان الايون سالب نضيف قيمة الشحنة على الكترونات التكافؤ

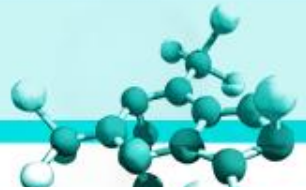
إذا كان الايون موجب نطرح قيمة الشحنة من الكترونات التكافؤ

3- عدد الالكترونات المشاركة في الربط = عدد الالكترونات الكلية - عدد الكترونات التكافؤ

4- عدد الروابط = $\frac{\text{عدد الالكترونات المشاركة في الربط}}{2}$

5- عدد الالكترونات الغير مشاركة = عدد الكترونات التكافؤ - عدد الالكترونات المشاركة





في الاختبار تحتاج الوقت وكتابة هذه الخطوات سيأخذ منك وقت لذلك اختصر الخطوات من 3 الى 5 كما يلي :

1- احسب عدد الالكترونات الكلية = عدد الذرات غير ذرات الهيدروجين X 8 + عدد ذرات الهيدروجين X 2

2- عدد الكترونات التكافؤ = عدد ذرات كل عنصر X رقم مجموعته ± شحنة الايون

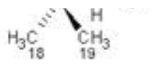
اذا كان الايون سالب نضيف قيمة الشحنة على الكترونات التكافؤ

إذا كان الايون موجب نطرح قيمة الشحنة من الكترونات التكافؤ

3- عدد الالكترونات المشاركة في الربط = الخطوة 1- الخطوة 2

4- عدد الروابط = $\frac{\text{الخطوة 3}}{2}$

5- عدد الالكترونات الغير مشاركة = الخطوة 2 - الخطوة 3



Examples of Lewis structure

Draw the Lewis structure for ClO_3^-

Where Cl is the central atom ?

نطبق الخطوات السابقة

1- احسب عدد الالكترونات الكلية = عدد الذرات غير ذرات الهيدروجين X 8 + عدد ذرات الهيدروجين X 2

$= 4 \times 8 = 32$

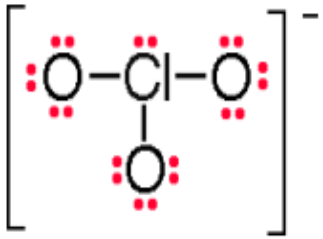
اذا كان الايون سالب نضيف قيمة الشحنة على الكترونات التكافؤ

إذا كان الايون موجب نطرح قيمة الشحنة من الكترونات التكافؤ

2- عدد الكترونات التكافؤ = عدد ذرات كل عنصر X رقم مجموعته ± شحنة الايون

الرقم 1 لأن المركب يحمل شحنة سالبة

$= 3 \times 6 + 1 \times 7 + 1 = 26$



3- عدد الالكترونات المشاركة في الربط = الخطوة 1- الخطوة 2

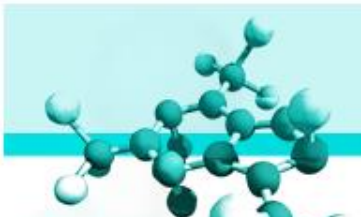
$= 32 - 26 = 6$

4- عدد الروابط = الخطوة 3 / 2

$3 = \frac{6}{2} =$

5- عدد الالكترونات الغير مشاركة = الخطوة 2 - الخطوة 3

$= 26 - 6 = 20$



Draw the Lewis structure for SO_2

Where S is the central atom ?

نطبق الخطوات السابقة

1- احسب عدد الالكترونات الكلية = عدد الذرات غير ذرات الهيدروجين X 8 + عدد ذرات الهيدروجين X 2

$$=3\times 8 = 24$$

2- عدد الكترونات التكافؤ = عدد ذرات كل عنصر X رقم مجموعته ± شحنة الايون

$$= 2\times 6 + 1\times 6 = 18$$

3- عدد الالكترونات المشاركة في الربط = الخطوة 1- الخطوة 2

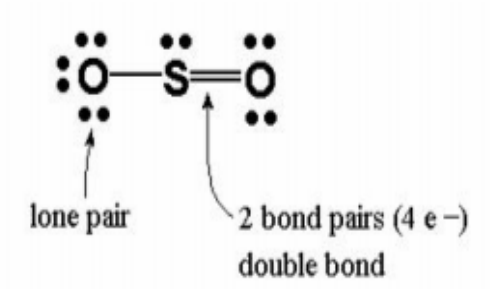
$$= 24 - 18 = 6$$

4- عدد الروابط = الخطوة 3 / 2

$$3 = \frac{6}{2} =$$

5- عدد الالكترونات الغير مشاركة = الخطوة 2 - الخطوة 3

$$= 18 - 6 = 12$$



Draw the Lewis structure for N_2O

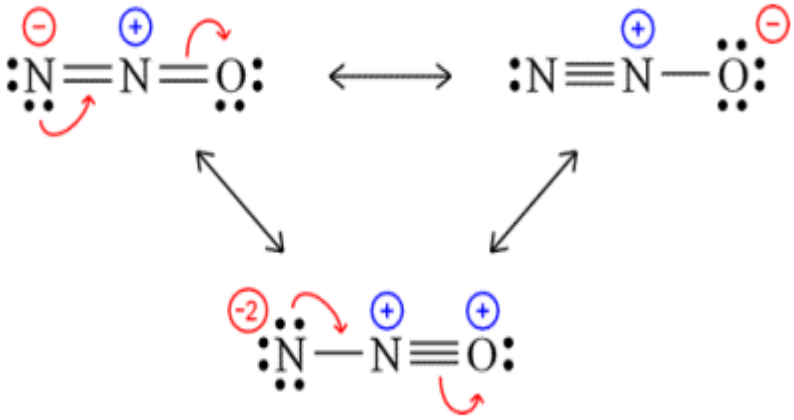
Where the order of atoms NNO?

1- احسب عدد الالكترونات الكلية = عدد الذرات غير ذرات الهيدروجين X 8 + عدد ذرات الهيدروجين X 2

$$=3\times 8 = 24$$

2- عدد الكترونات التكافؤ = عدد ذرات كل عنصر X رقم مجموعته ± شحنة الايون

$$= 1\times 6 + 2\times 5 = 16$$



3- عدد الالكترونات المشاركة في الربط = الخطوة 1- الخطوة 2

$$= 24 - 16 = 8$$

4- عدد الروابط = $\frac{\text{الخطوة 3}}{2}$

$$4 = \frac{8}{2} =$$

5- عدد الالكترونات الغير مشاركة = الخطوة 2 - الخطوة 3

$$= 16 - 8 = 8$$

Draw the Lewis structure for HNO_3

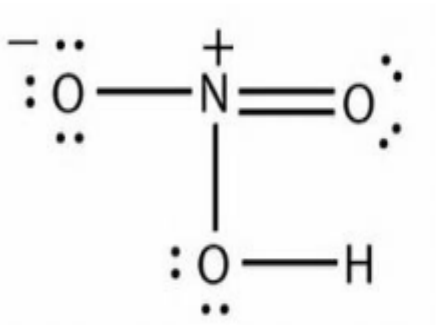
Where N is the central atom and H atom is bonded to on of the O atom ?

1- احسب عدد الالكترونات الكلية = عدد الذرات غير ذرات الهيدروجين X 8 + عدد ذرات الهيدروجين X 2

$$=4\times 8 + 1 \times 2 = 34$$

2- عدد الكترونات التكافؤ = عدد ذرات كل عنصر X رقم مجموعته ± شحنة الايون

$$= 3\times 6 + 1\times 5 + 1 \times 1 = 24$$



3- عدد الالكترونات المشاركة في الربط = الخطوة 1- الخطوة 2

$$= 34 - 24 = 10$$

4- عدد الروابط = $\frac{\text{الخطوة 3}}{2}$

$$5 = \frac{10}{2} =$$

5- عدد الالكترونات الغير مشاركة = الخطوة 2 - الخطوة 3

$$= 24 - 10 = 14$$

Draw the Lewis structure for NF_3

Where the N is the central atom ?

X 8 + عدد ذرات الهيدروجين X 2

=4× 8 = 32

2- عدد الكترونات التكافؤ = عدد ذرات كل عنصر X رقم مجموعته ± شحنة الايون

= 3× 7 + 1×5 = 26

3- عدد الالكترونات المشاركة في الربط = الخطوة 1- الخطوة 2

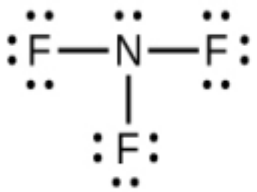
= 32- 26 = 6

4- عدد الروابط = الخطوة 3 / 2

$$3= \frac{6}{2} =$$

5- عدد الالكترونات الغير مشاركة = الخطوة 2 - الخطوة 3

= 26- 6= 20



Examples of Lewis structure

Draw the Lewis structure for CO_3^{2-} Where Cl is the central atom ?

نطبق الخطوات السابقة

1- احسب عدد الالكترونات الكلية = عدد الذرات غير ذرات الهيدروجين X 8 + عدد ذرات الهيدروجين X 2

$= 4 \times 8 = 32$

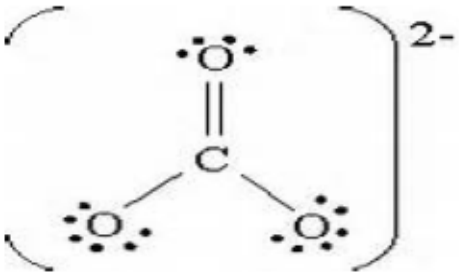
اذا كان الايون سالب نضيف قيمة الشحنة على الكترونات التكافؤ

إذا كان الايون موجب نطرح قيمة الشحنة من الكترونات التكافؤ

2- عدد الكترونات التكافؤ = عدد ذرات كل عنصر X رقم مجموعته ± شحنة الايون

$= 3 \times 6 + 1 \times 4 + 2 = 24$

الرقم 2 لأن المركب يحمل شحنتين سالبة



3- عدد الالكترونات المشاركة في الربط = الخطوة 1- الخطوة 2

$= 32 - 24 = 8$

4- عدد الروابط = $\frac{\text{الخطوة 3}}{2}$

$4 = \frac{8}{2} =$

5- عدد الالكترونات الغير مشاركة = الخطوة 2 - الخطوة 3

$= 24 - 8 = 16$

Draw the Lewis structure for NOCl Where the central atom is N?

1- احسب عدد الالكترونات الكلية = عدد الذرات غير ذرات الهيدروجين X 8 + عدد ذرات الهيدروجين X 2

=3× 8 = 24

2- عدد الكترونات التكافؤ = عدد ذرات كل عنصر X رقم مجموعته ± شحنة الايون

= 1× 7 + 1×6 + 1×5 = 18

3- عدد الالكترونات المشاركة في الربط = الخطوة 1- الخطوة 2

= 24- 18 = 6

4- عدد الروابط = $\frac{\text{الخطوة 3}}{2}$

$3= \frac{6}{2} =$

5- عدد الالكترونات الغير مشاركة = الخطوة 2 - الخطوة 3

= 18- 6= 12

Draw the Lewis structure for ClO_4^- Where the central atom is N?

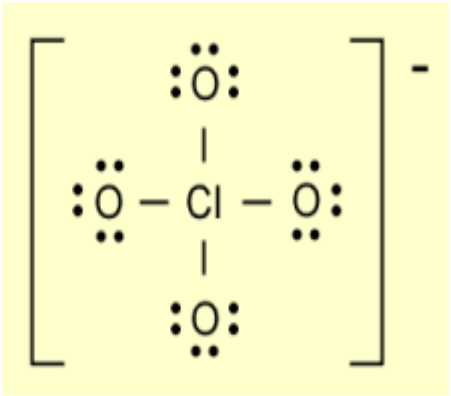
1- احسب عدد الالكترونات الكلية = عدد الذرات غير ذرات الهيدروجين X 8 + عدد ذرات الهيدروجين X 2

$= 5 \times 8 = 40$

2- عدد الكترونات التكافؤ = عدد ذرات كل عنصر X رقم مجموعته ± شحنة الايون

الرقم 1 لأن المركب يحمل شحنة سالبة

$= 4 \times 6 + 1 \times 7 + 1 = 32$



3- عدد الالكترونات المشاركة في الربط = الخطوة 1- الخطوة 2

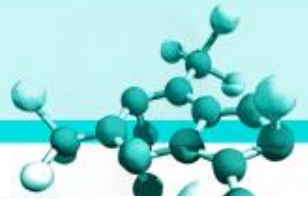
$= 40 - 32 = 8$

4- عدد الروابط = $\frac{\text{الخطوة 3}}{2}$

$= \frac{8}{2} = 4$

5- عدد الالكترونات الغير مشاركة = الخطوة 2 - الخطوة 3

$= 32 - 8 = 24$



Formal Charges and Lewis Structure

Sometimes there is more than one acceptable Lewis structure for a given species. In such cases, we can often select the most plausible Lewis structure by using formal charges and the following guidelines:

1. For molecules, a Lewis structure in which there are no formal charges is preferable to one in which formal charges are present.
2. Lewis structures with large formal charges (+2, +3, and/or -2, -3, and so on) are less plausible than those with small formal charges.
3. Among Lewis structures having similar distributions of formal charges, the most plausible structure is the one in which negative formal charges are placed on the more electronegative atoms.

Formal Charges and Lewis Structure

formal charge is the difference between the number of valence electrons in an isolated atom and the number of electrons assigned to that atom in a Lewis structure.

formal charge on an atom in a Lewis structure	=	total number of valence electrons in the free atom	-	total number of nonbonding electrons	-	total number of bond

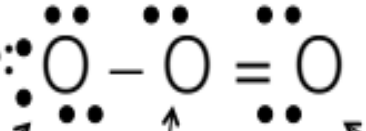
The sum of the formal charges of the atoms in a molecule or ion must equal the charge on the molecule or ion.

الشحنة الاسمية للذرة : رقم مجموعة العنصر - عدد الروابط حوله - عدد الالكترونات الغير مشاركة في الربط

Example:

Ozone molecule (O_3)

Lewis Structure:



Formal Charge:

6 - 6 - 1 = -1 6 - 2 - 3 = +1 6 - 4 - 2 = 0

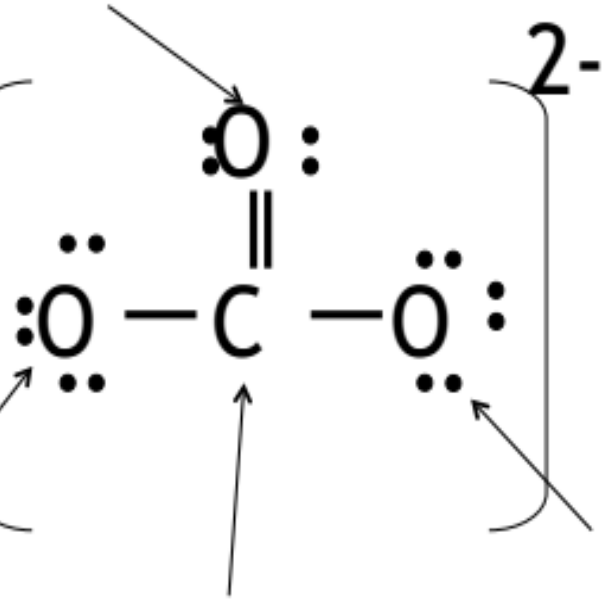
-1+1+0=0

formal charge on an atom in a Lewis structure	=	total number of valence electrons in the free atom	-	total number of nonbonding electrons	-	total number of bond

Example 2

Write the formal charges for the carbonate ion (CO_3^{2-})

6 - 4 - 2 = 0



-1+0 -1+0=-2

6 - 6 - 1 = -1

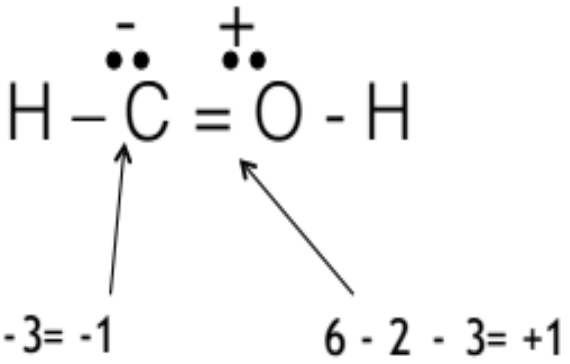
4 - 0 - 4 = 0

6 - 6 - 1 = -1

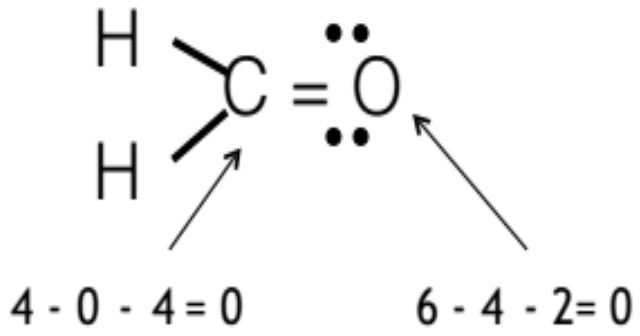
Example

Draw the most likely Lewis structure for formaldehyde (CH_2O).

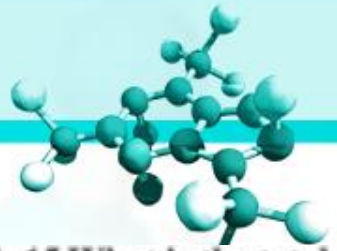
a



b



(b) is the more likely structure because it carries no formal charges

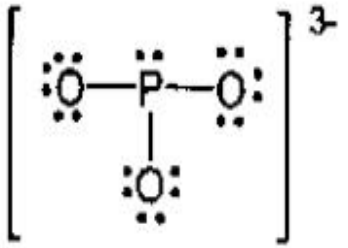


A-15 What is the total number of valence electrons in PO_3^{-3}

a) 12 b) 26 c) 20 d) 18

A-16 How many resonance structure for PO_3^{-3}

a) 1 b) 2 c) 0 d) 3



A-17 How many lone pair around the phosphorus atom in PO_3^{-3}

a) 2 b) 1 c) 0 d) 6

A-18 The formal charge on the phosphorus atom in PO_3^{-3}

a) -1 b) +1 c) 0 d) +2

الشحنة الاسمية للذرة : رقم مجموعة العنصر - عدد الروابط حوله - عدد الالكترونات الغير مشاركة في الربط

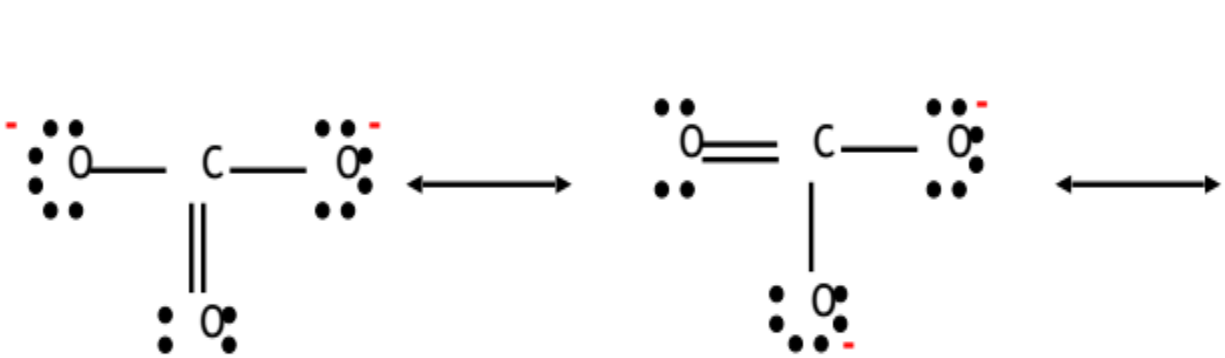
For phosphorus = 5-3-2= 0

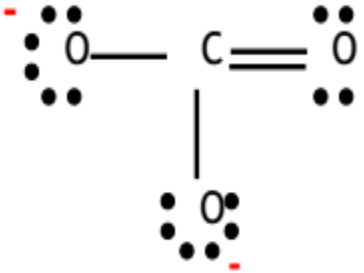
The Concept of Resonance

A resonance structure is one of two or more Lewis structures for a single molecule that cannot be represented accurately by only one Lewis structure.

Example

What are the resonance structures of the carbonate $(CO_3)^{-2}$ ion?

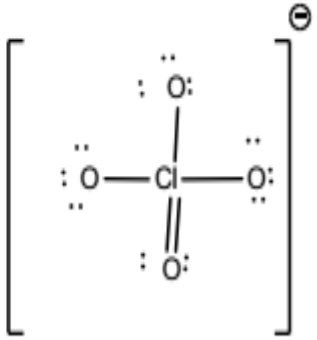




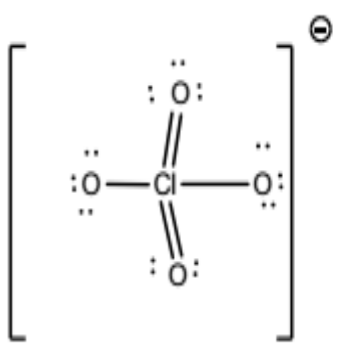
1- which of the following is the correct lewis structure for ClO_4^-

a)

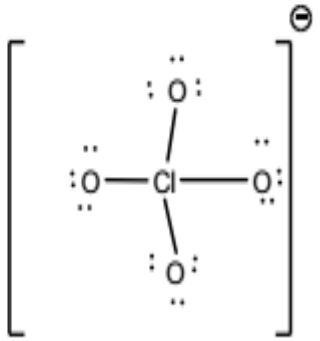
b)



c)



d)



How many lone pair around nitrogen atom in NO_2^{-1} ?

a) 3 b) 0 c) 1 d) 2