النظرية الكمية والذرة – الدرس الثاني من الوحدة الرابعة

تم تحميل هذا الملف من موقع المناهج الإماراتية

موقع المناهج ⇦ المناهج الإماراتية ⇦ الصف العاشر ⇦ كيمياء ⇦ الفصل الأول ⇦ ملفات متنوعة ⇦ الملف

تاريخ إضافة الملف على موقع المناهج: 13-11-2026 23:39:00

المزيد من مادة كيمياء: ملفات ا كتب للمعلم ا كتب للطالب ا اختبارات الكترونية ا اختبارات ا حلول ا عروض بوربوينت ا أوراق عمل منهج انجليزي ا ملخصات وتقارير ا مذكرات وبنوك ا الامتحان النهائي ا للمدرس

إعداد: Mouad

التواصل الاجتماعي بحسب الصف العاشر

صفحة المناهج الإماراتية على فيسبوك

المزيد من الملفات بحسب الصف العاشر والمادة كيمياء في الفصل الأول

1	كيمياء أوراق عمل شاملة
2	كيمياء المصطلحات العلمية علل قوانين الكيمياء الكمية
3	كيمياء بنك أسئلة بإشراف الأستاذة فتوح الشمالي (ملف مكون من 53 صفحة)
4	كيمياء بنك أسئلة (ملف مكون من 54 صفحة)
5	كيمياء أسئلة اختبارات + إجاباتها النموذجية

تحميل تطبيق المناهج للهواتف الذكية

تطبيق المناهج على App Store (آبل) | تطبيق المناهج على Play Google (أندرويد)

Inspire Chemistry

Module 4_Lesson 2:
“Quantum Theory and the Atom”
By Mr. Mouad

Review your physics knowledge:True or False?

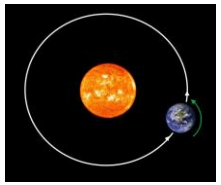


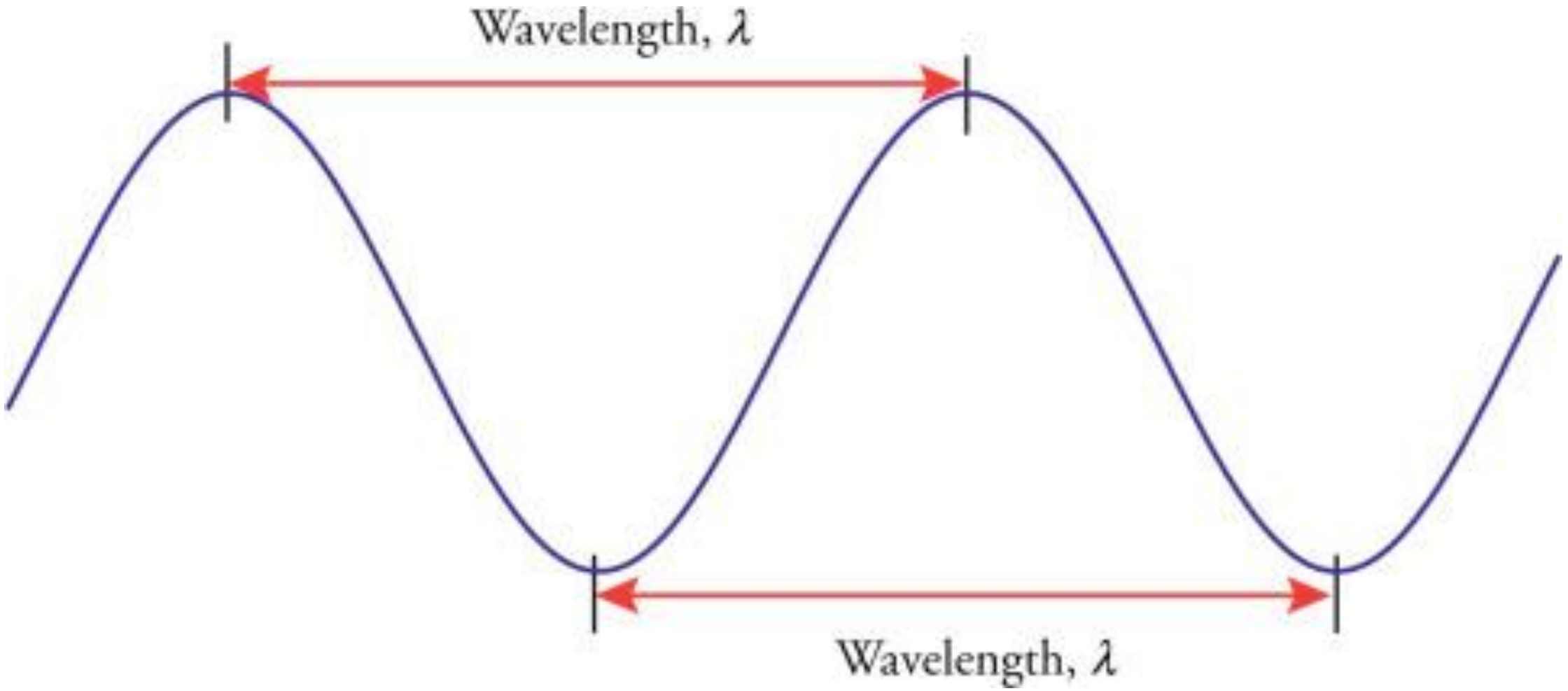
1- Our skin becomes hot under the sun because we **absorb (نمتص)** the energy that is in the light. In other words, Light is Energy.

True

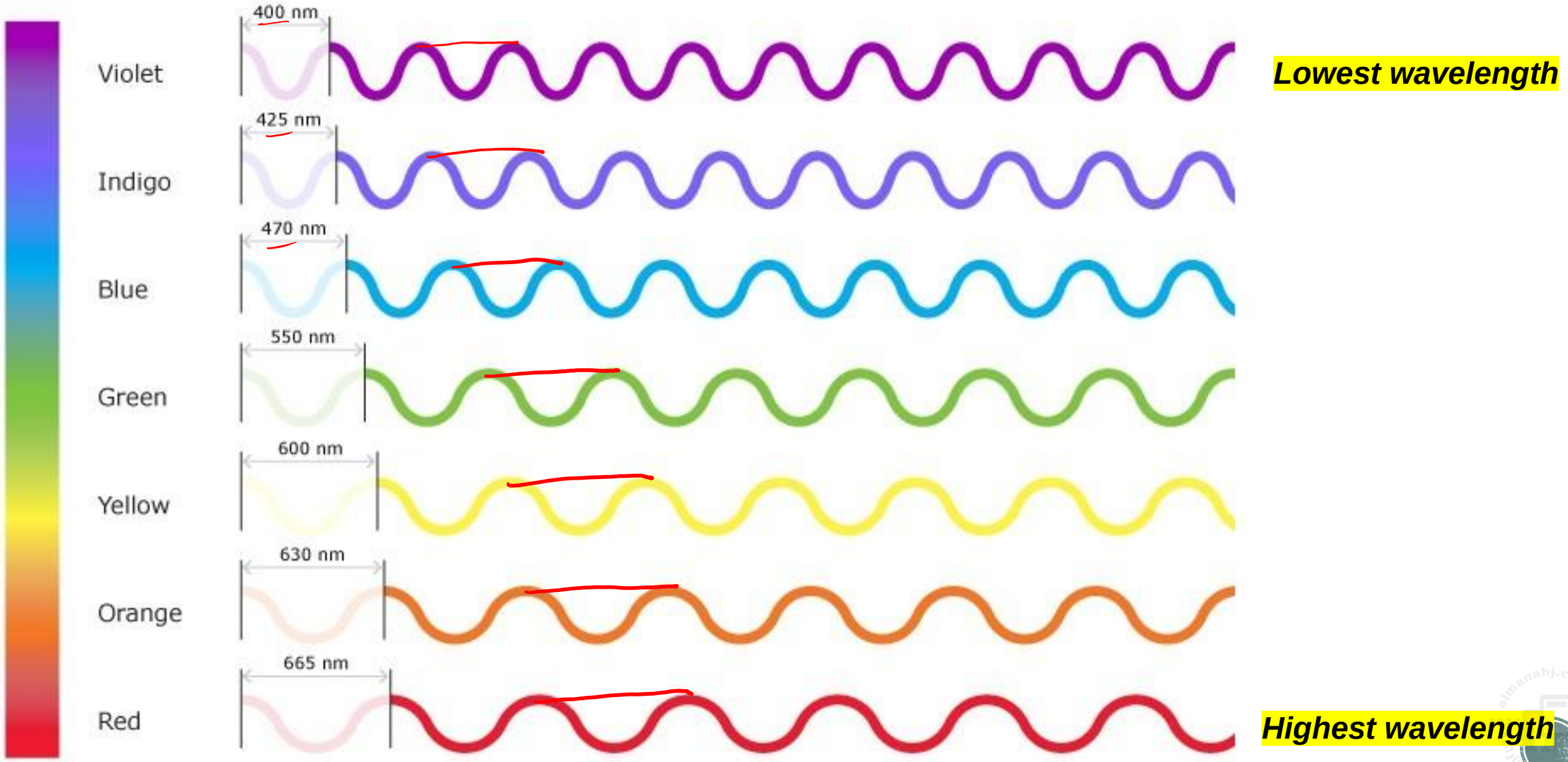
2- Light has both **wave-like (مثل الموجة)** and **particles/Energy-like (مثل الطاقة أو جسيمات بها طاقة)** nature. ***True***

Keywords:

Matter	*المادة/ Anything that has a mass and occupies space (has a volume) (an object(*
Stuff	*Things الأشياء/*
Substance	*A physical material or item (Also a matter)*
atom	الذرة
Model	Prototype or نموذج
Particles “Par-ti-kels”	الجسيمات الصغيرةcan be atoms, protons neutrons or any tiny objects 
Orbit 	A circular path (مدار دائري)


Wavelength, λ
Wavelength, λ

The different wavelengths of colors.



Lowest wavelength

Highest wavelength

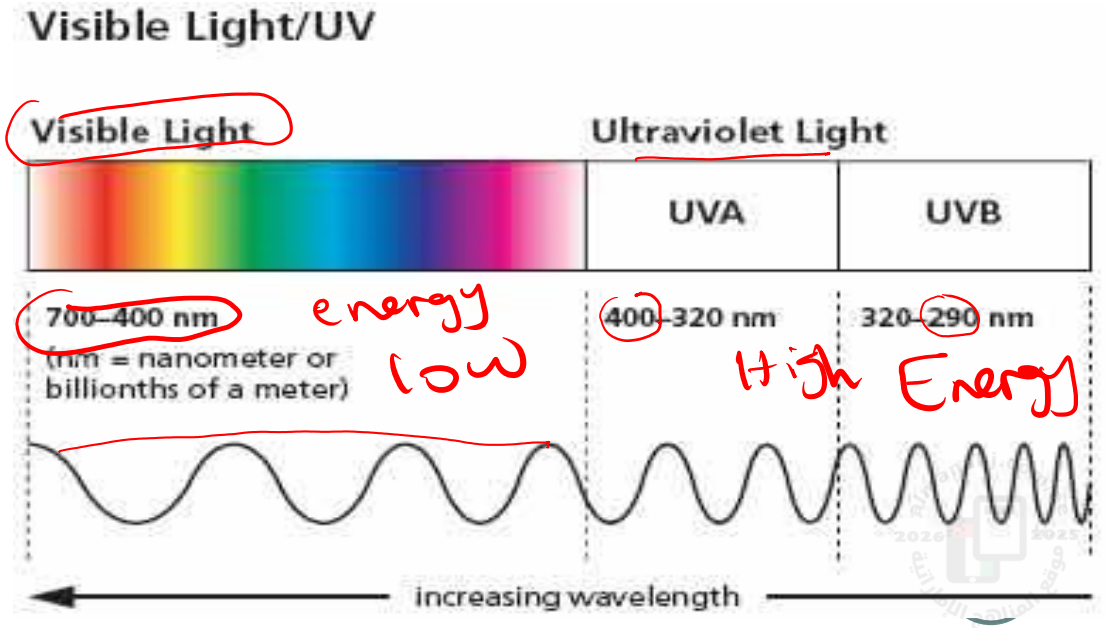
Critical Thinking: التفكير النقدي



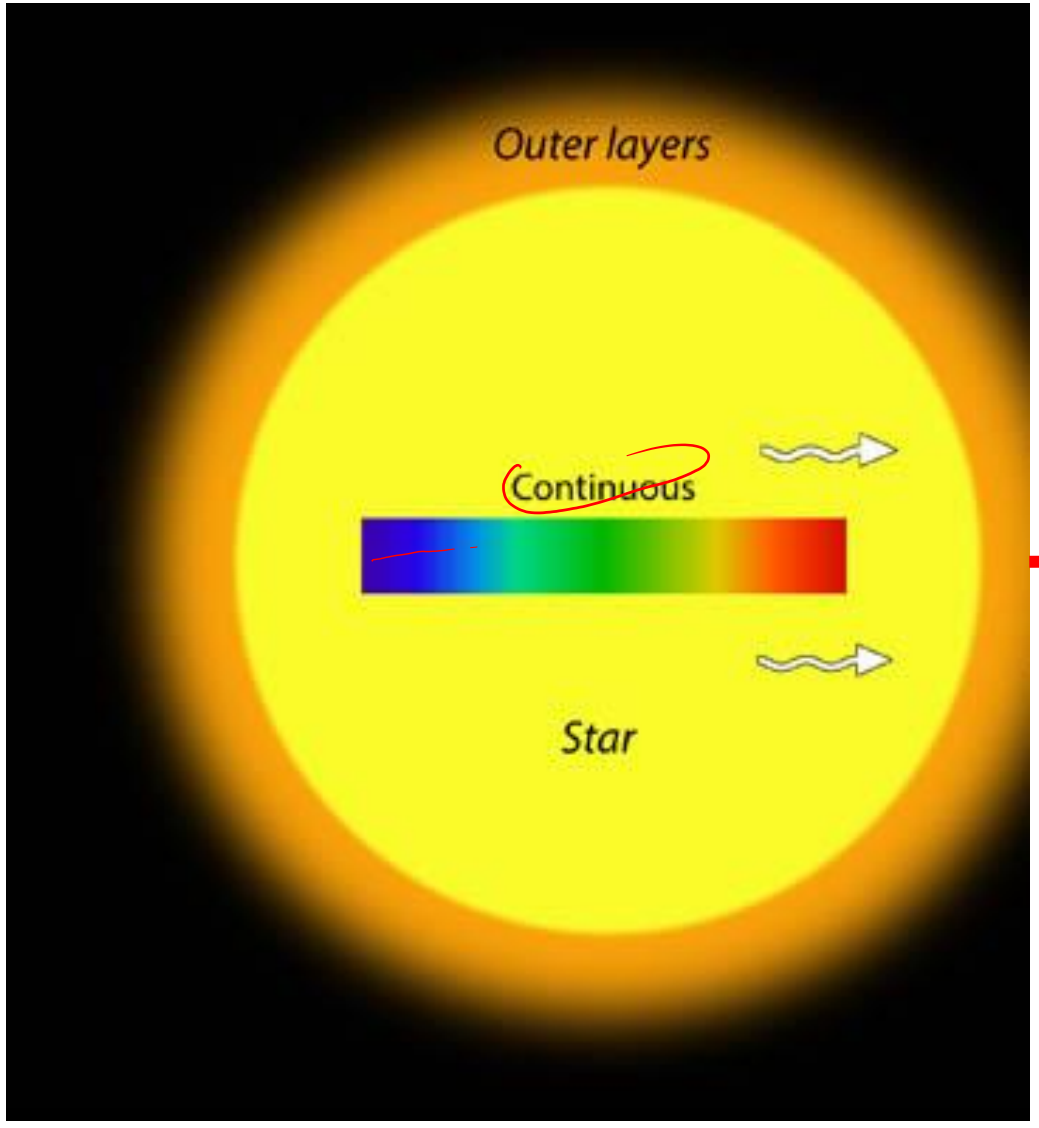
Is UV (Ultraviolet) light الأشعة فوق البنفسجية safe or dangerous?

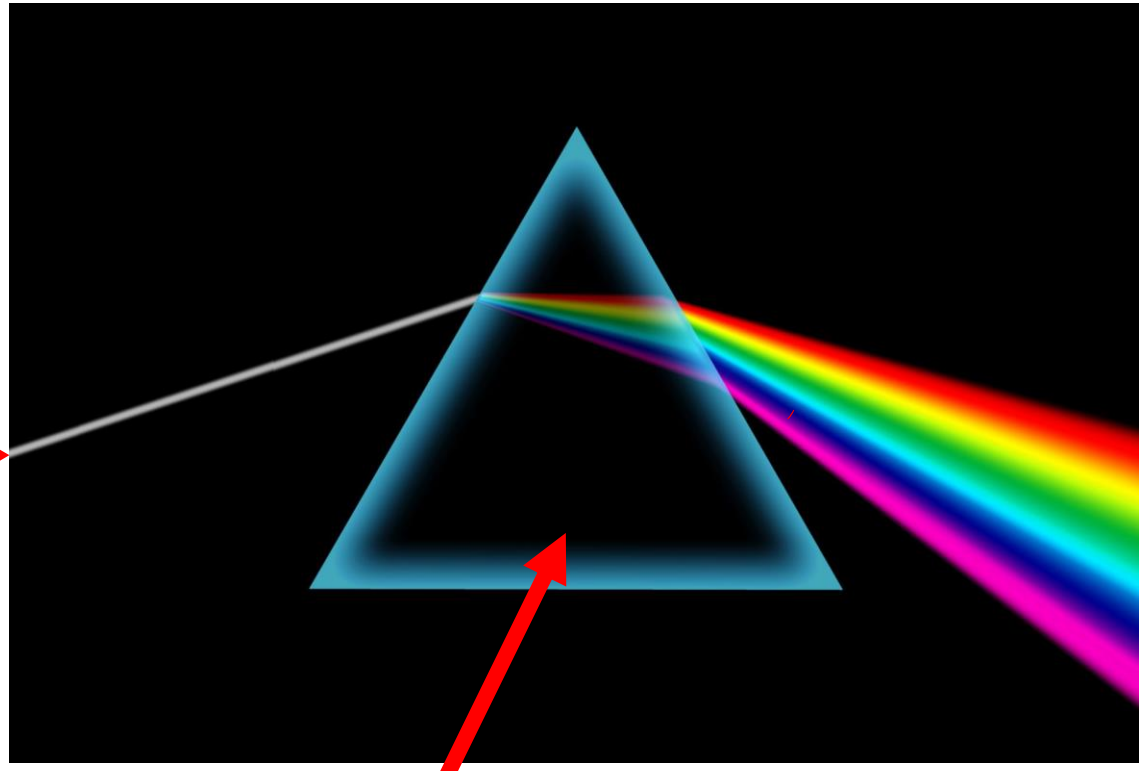
Why? How can we explain that it is dangerous? (Hint: Energy)

Different wavelength = Different energy
That's why UV light is dangerous **(High energy).**
***Lower* wavelength=*Higher* energy**



The continuous spectrum (s-pekt-rum)
(السلسلة أو الطيف المتصل)



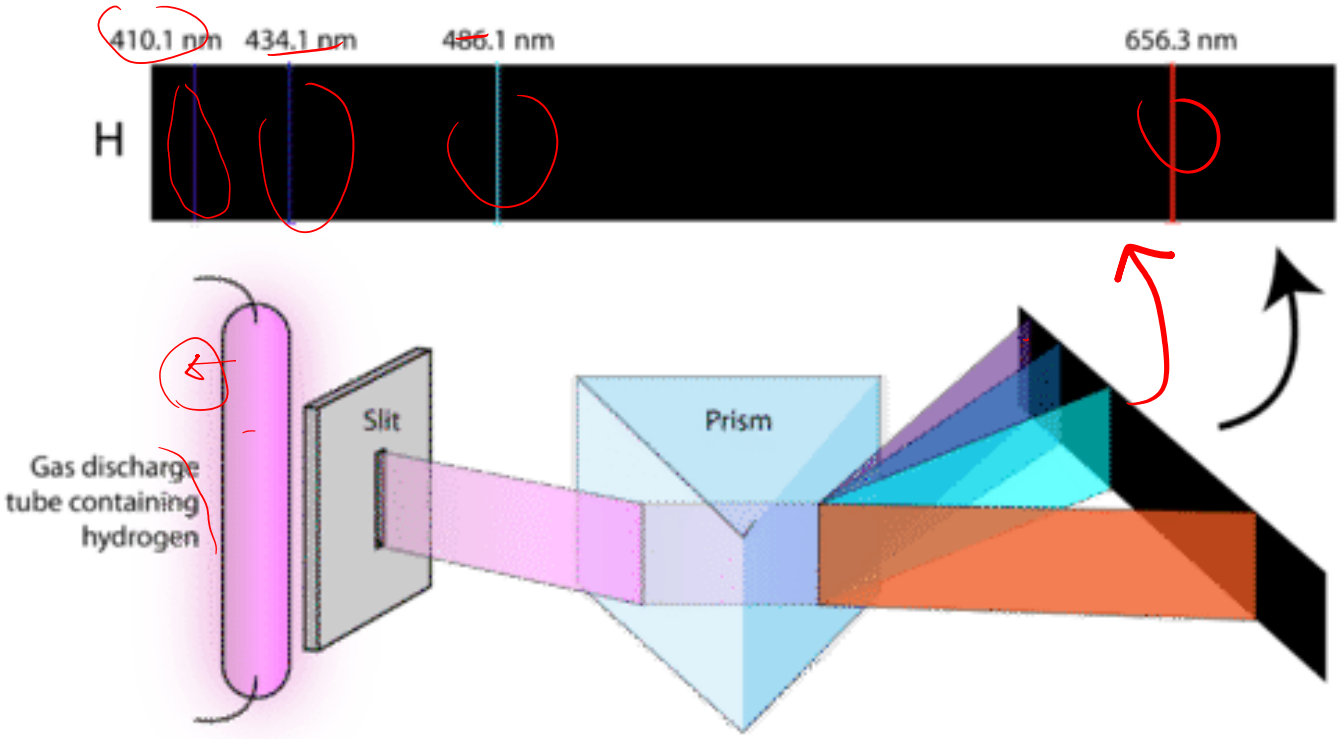


Prism المنشور

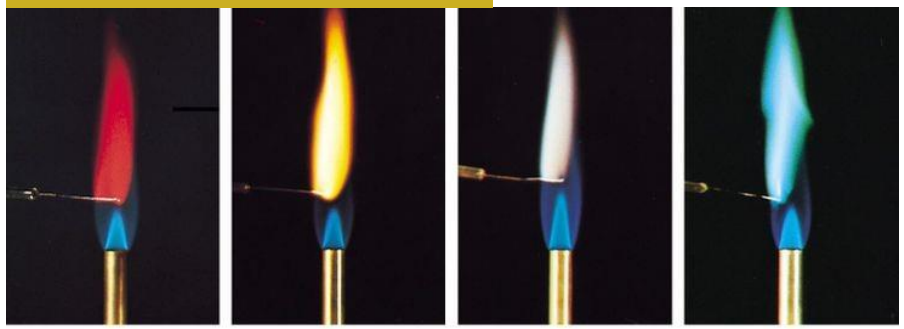
Lesson 1

Emission or atomic Spectrum of elements
الطيف المنبعث أو الذري

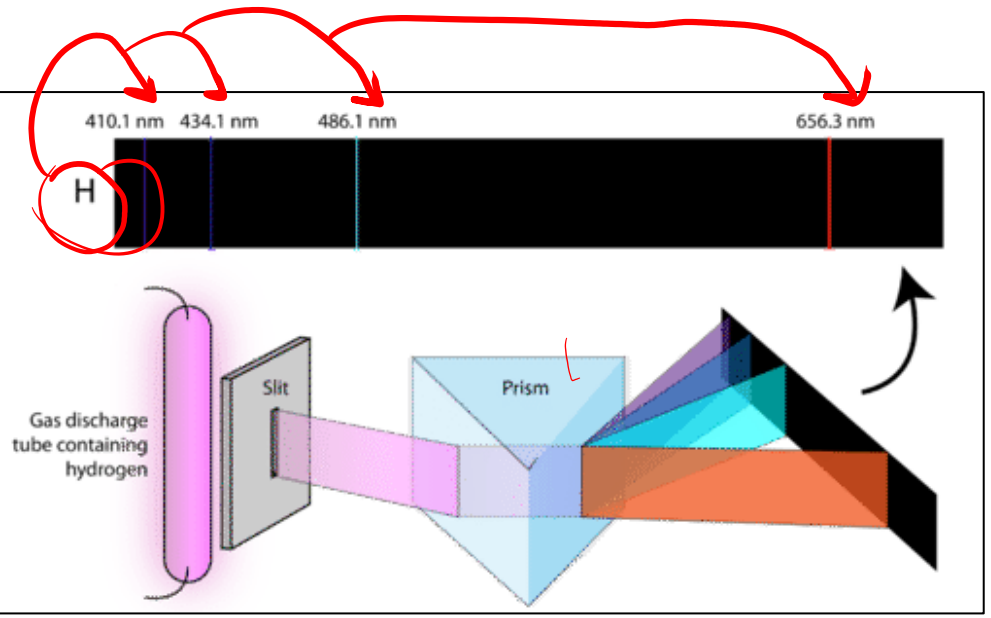
To get the “emission” spectrum of an element, you must heat it up (give energy until it glows تتوهج)

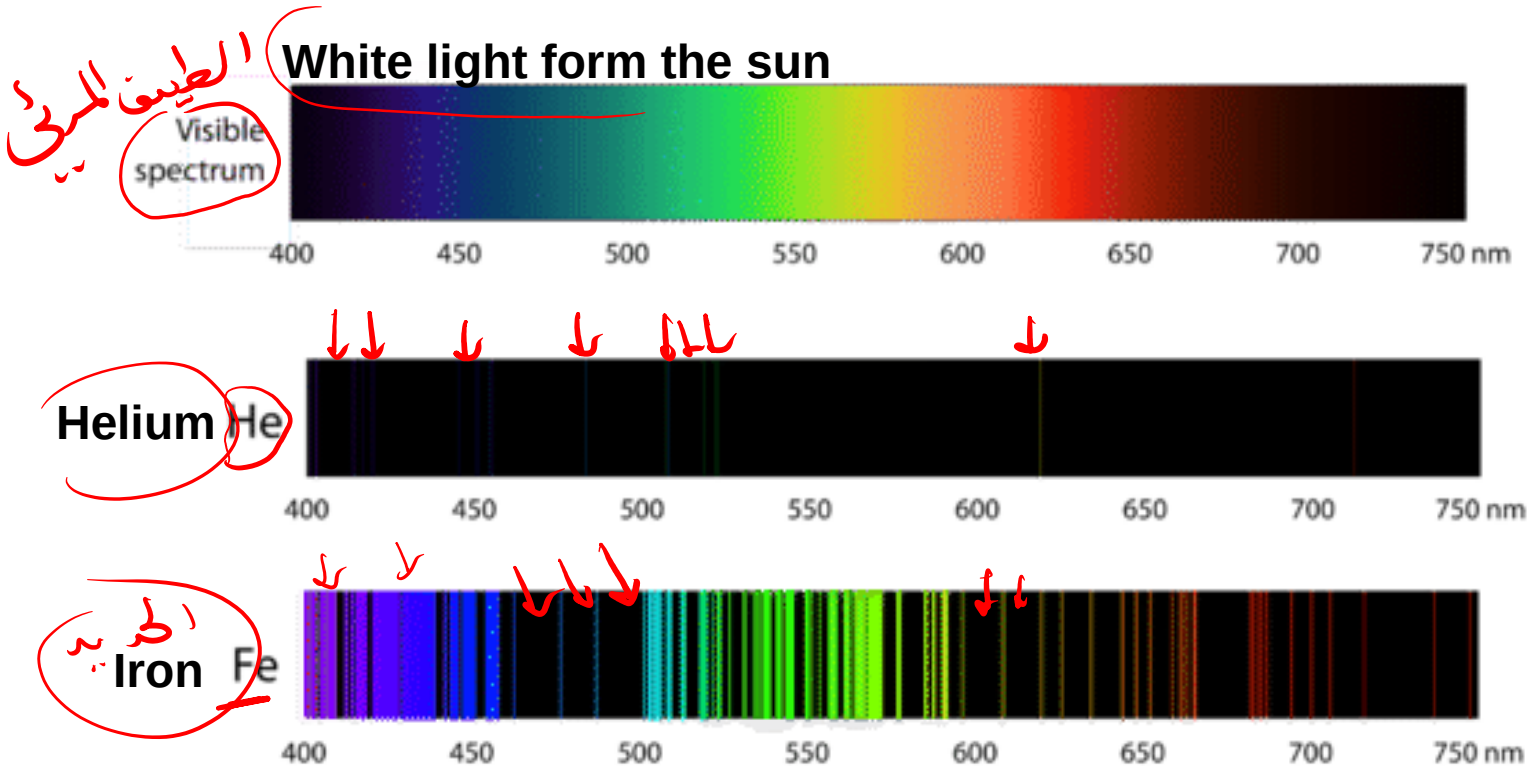


Remember



Emission or atomic Spectrum of elements





Different elements have different emission spectrum or atomic spectrum. Why??

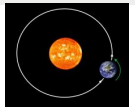
THE MAIN QUESTION OF THE LESSON



Why does every element produce a **unique(special مميز)** atomic emission spectrum?

It has to do with the atomic models and the **electrons around the atom**.

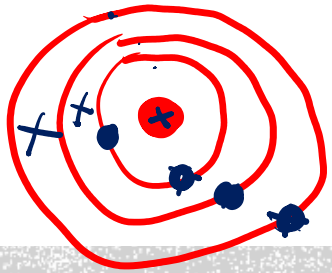
Keywords: (2 min)

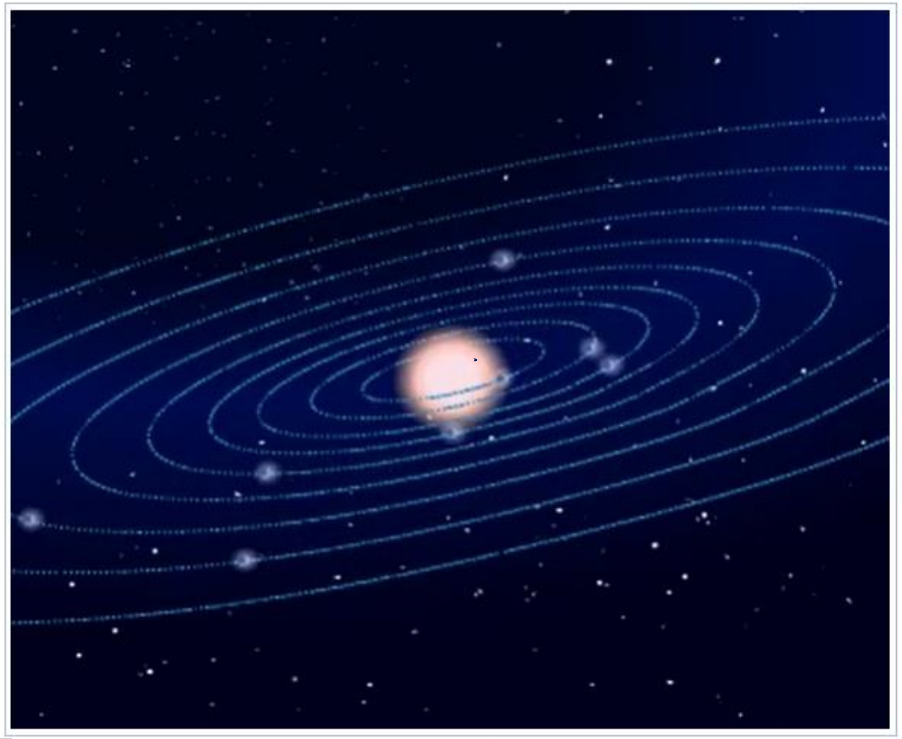
Matter, Stuff, Substance	*المادة/Anything that has a mass and occupies space (has a volume)* ***A physical material or item (Also a matter)***
Particles "Par-ti-kels"	الجسيمات الصغيرةcan be atoms, protons neutrons or any tiny objects 
Orbit	A circular path (مدار دائري) 
Ground State	الحالة Status, **Low Energy الحالة الأرضية**
Excited State	**High Energy الحالة المثارة**
Quantum (*Kwa-n-tum*)	**The minimum amount of energy gained or lost by an atom.**
Photon (*Fo-to-n*)	**A particle of light that has the smallest amount of energy possible (the energy of a quantum)**

Bohr’s Model of the atom

Bohr's Model of the Atom

A Danish physicist, Niels Bohr, proposed a model of the atom consisting of two regions: a positively charged nucleus and a surrounding space in which electrons travel.

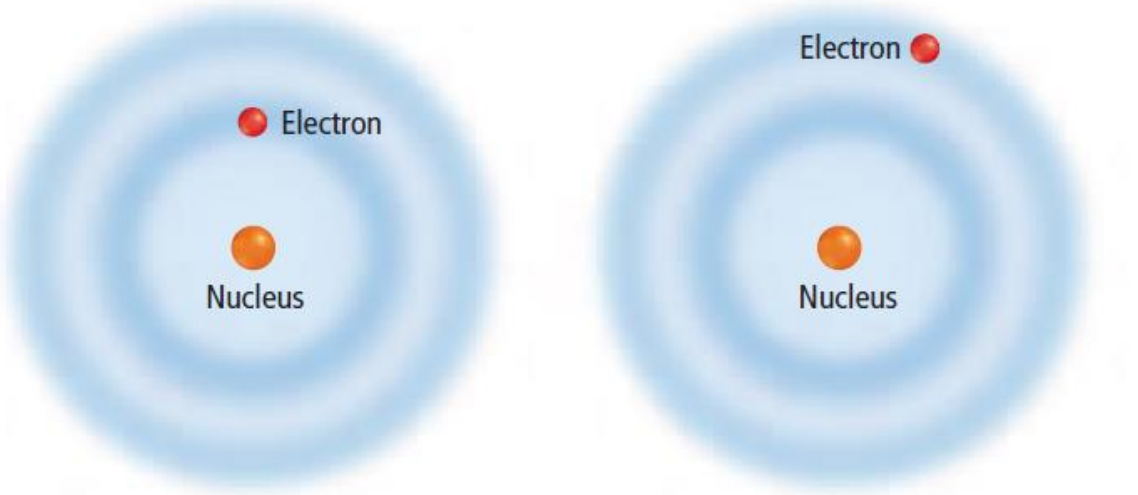


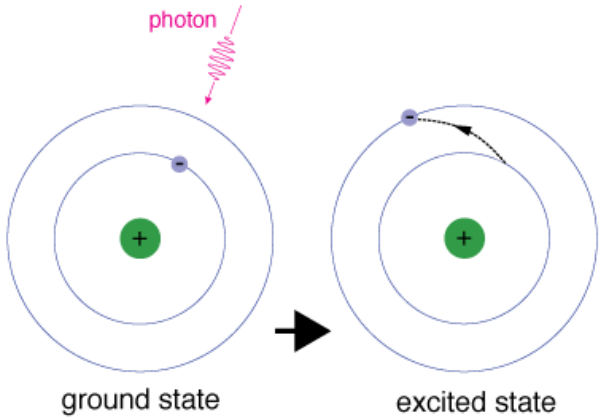


https://edushare.moe.gov.ae/Uploads/Resources/560ac28d-53f1-4481-b3b3-e6a9f90c11de/6467158/index.html

Ground state Vs. Excited State

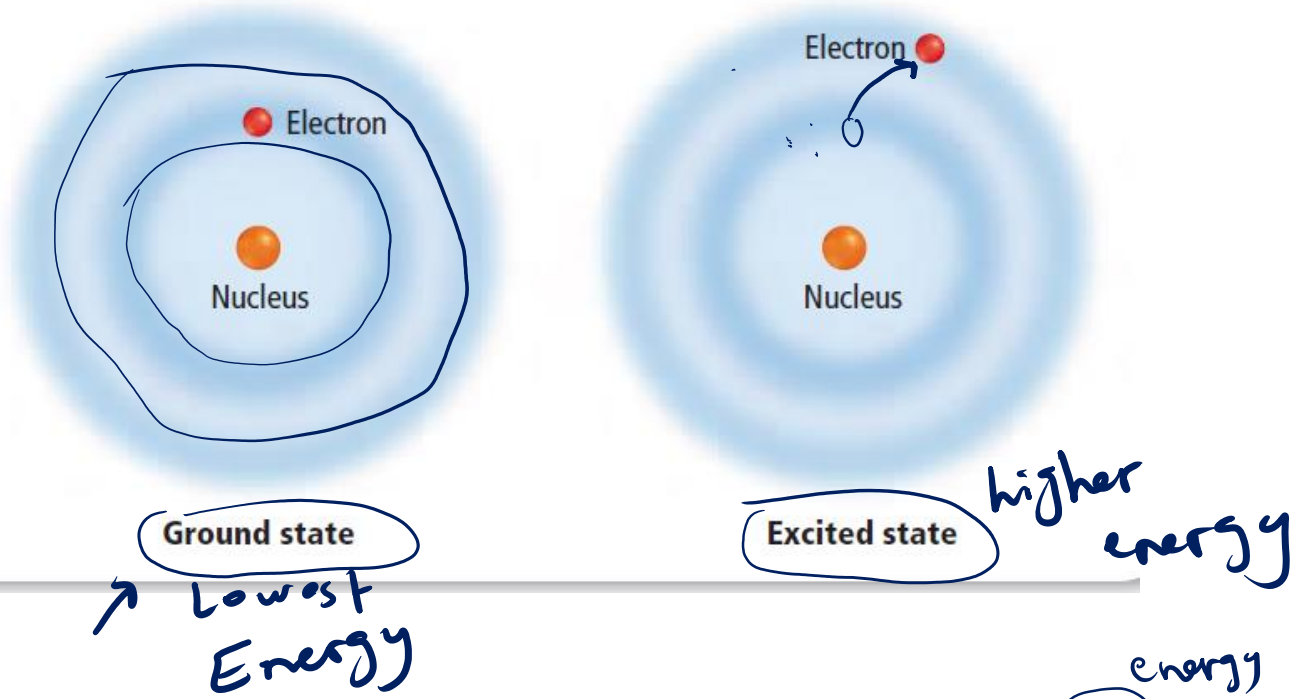
■ **Figure 5.10** The figure shows an atom that has one electron. Note that the illustration is not to scale. In its ground state, the electron is associated with the lowest energy level. When the atom is in an excited state, the electron is associated with a higher energy level.

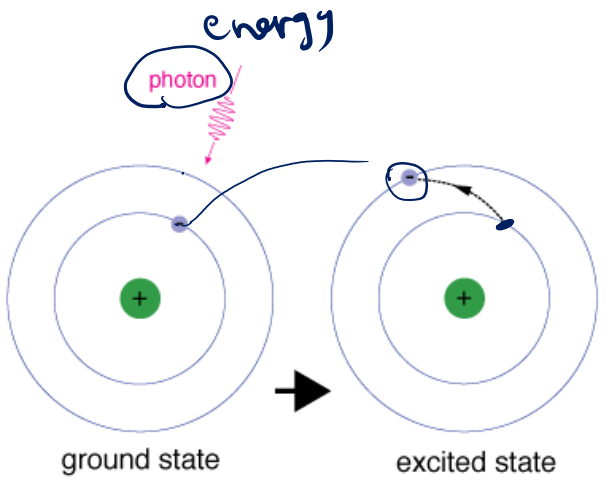




Ground state Vs. Excited State

■ **Figure 5.10** The figure shows an atom that has one electron. Note that the illustration is not to scale. In its ground state, the electron is associated with the lowest energy level. When the atom is in an excited state, the electron is associated with a higher energy level.

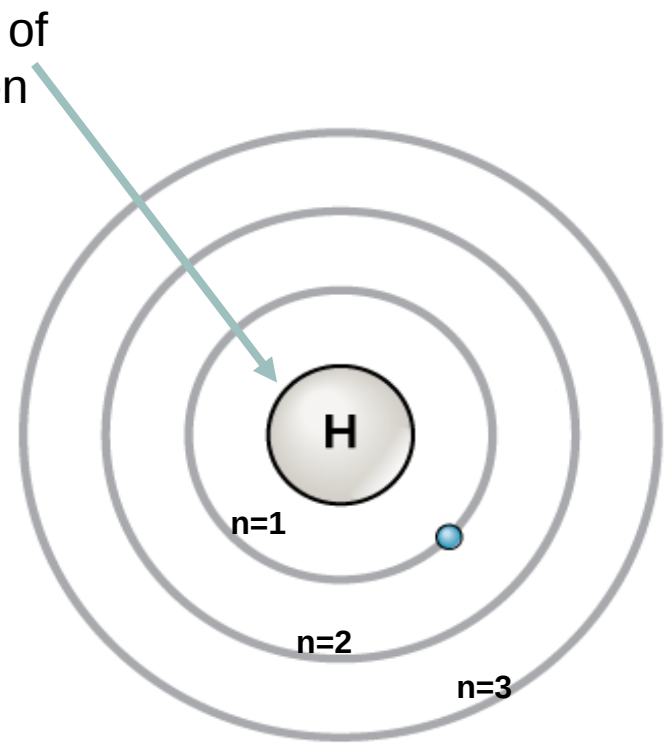




Bohr's Model of the Hydrogen Atom

Table 1 Bohr's Description of the Hydrogen Atom

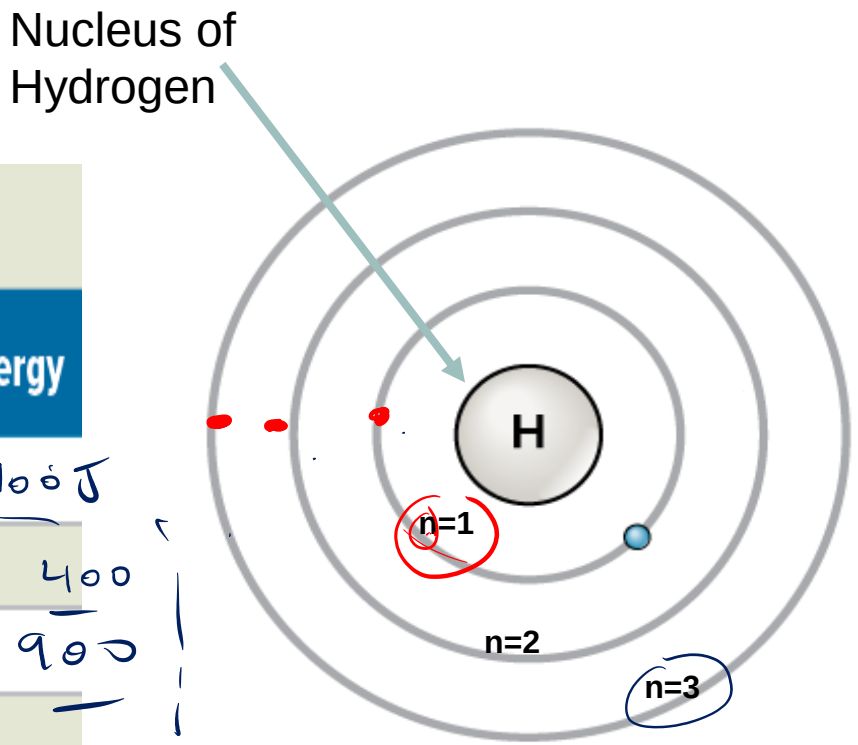
Bohr's Atomic Orbit	Quantum Number	Orbit Radius (nm)	Corresponding Atomic Energy Level	Relative Energy
First	$n = 1$	0.0529	1	E_1
Second	$n = 2$	0.212	2	$E_2 = 4E_1$
Third	$n = 3$	0.476	3	$E_3 = 9E_1$
Fourth	$n = 4$	0.846	4	$E_4 = 16E_1$
Fifth	$n = 5$	1.32	5	$E_5 = 25E_1$

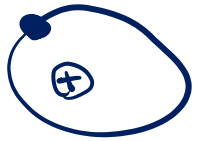


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Activity

The model of the atom that has electron going around the nucleus in an orbit (circle) is called: Bohr's Model



Lowest energy

Which atom is in the ground state? Image A or B? A (lowest energy)

Which atom is in the excited state? Image A or B? B (Higher energy)

Image : A

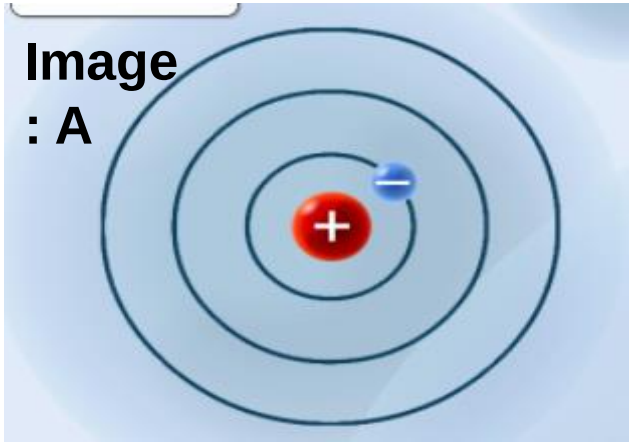
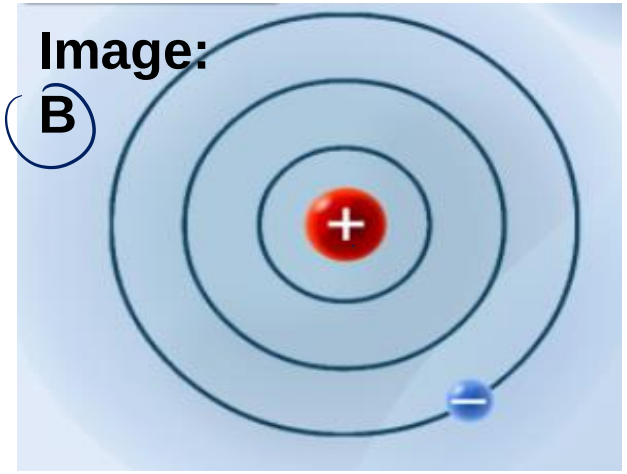
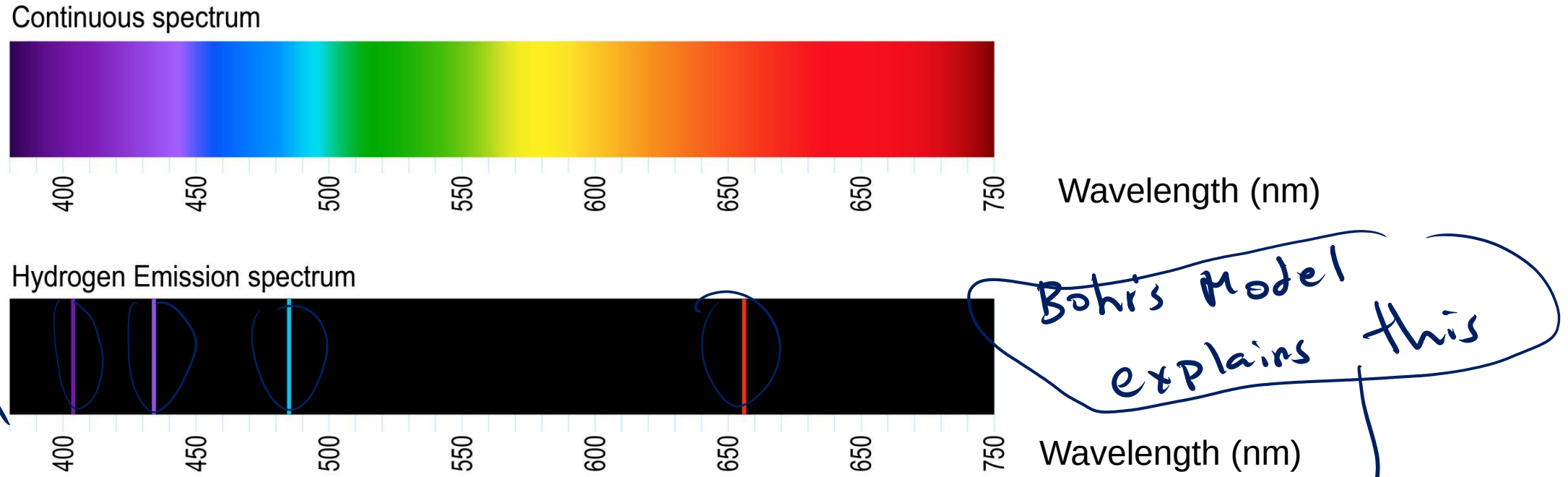


Image: B



Remember

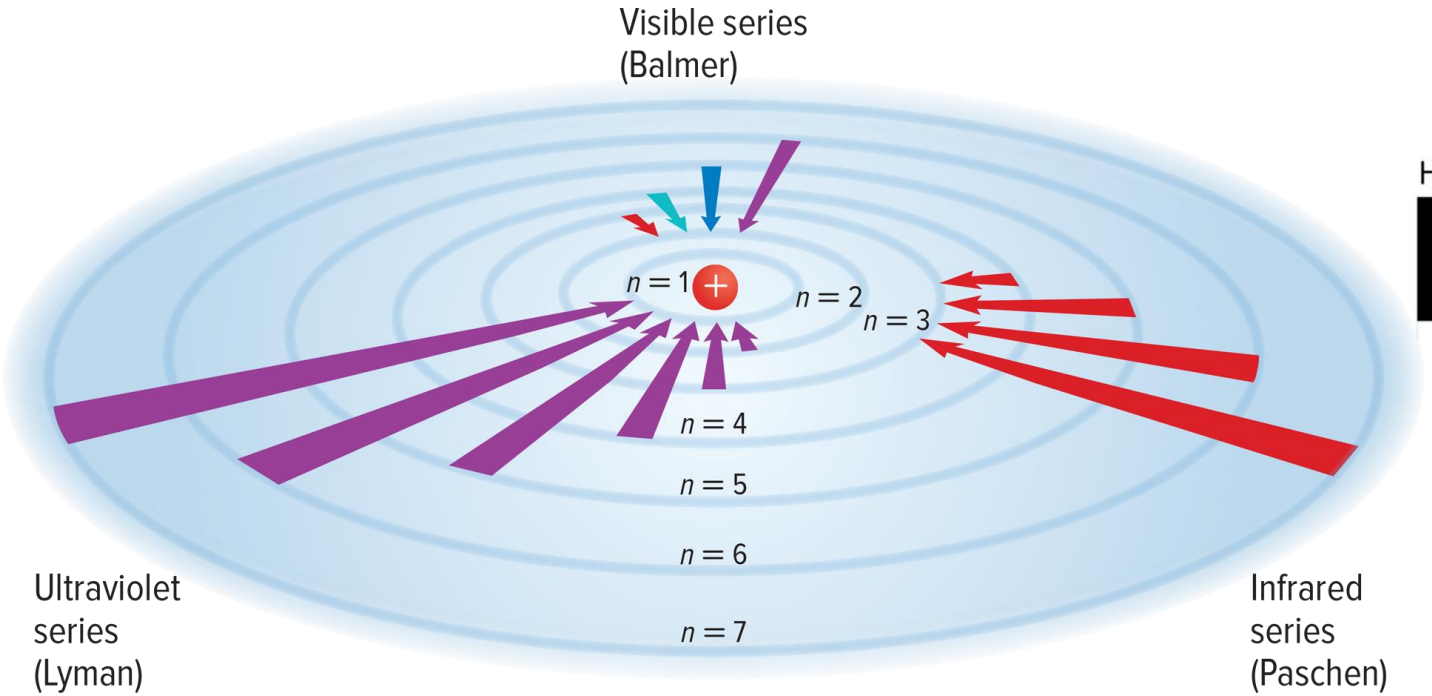
Write one science question on the image below.

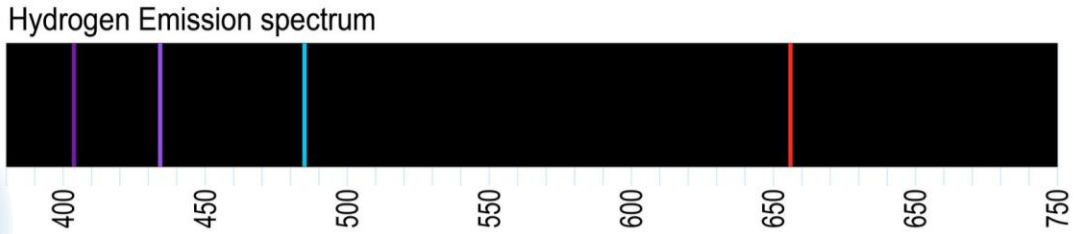


Why is the emission spectrum of hydrogen not continuous (only some lines) ?

Bohr's Model of the Atom

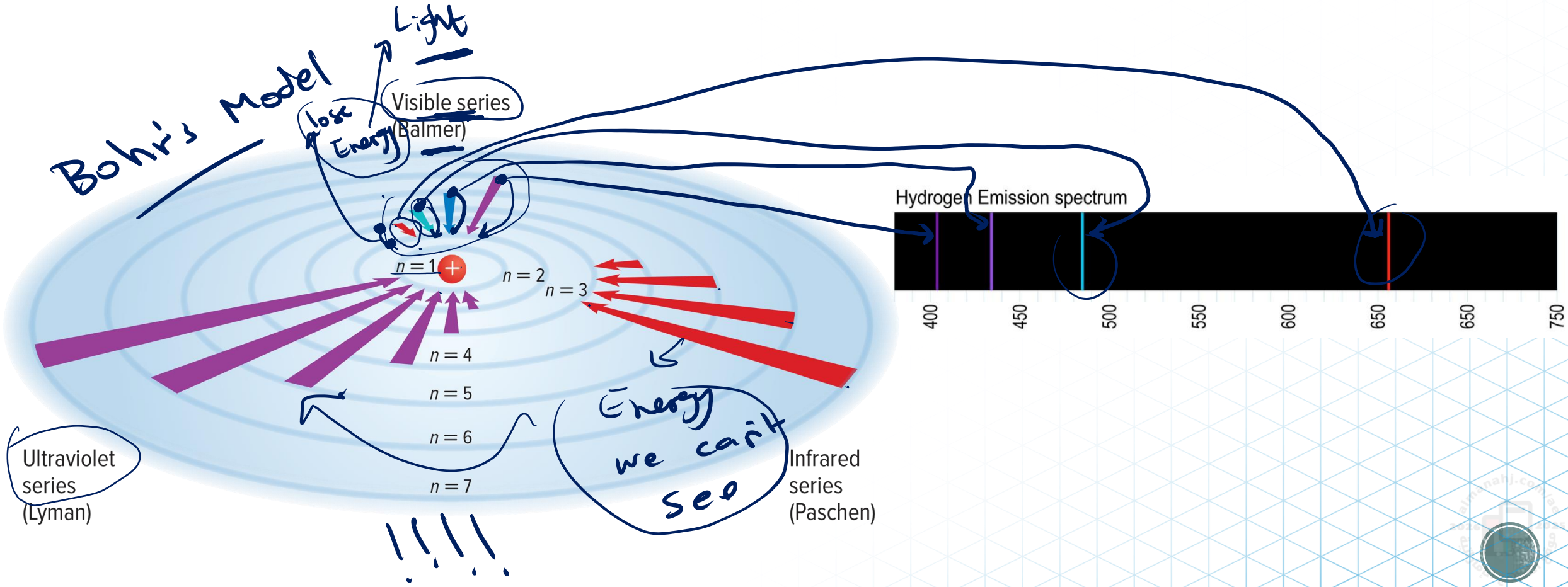
A hydrogen atom is in the ground state when its single electron is in the $n = 1$ orbit.
When energy is added, the electron moves to a higher-energy orbit, $n = 2$.





Bohr's Model of the Atom

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When energy is added, the electron moves to a higher-energy orbit, $n = 2$.



Hydrogen Atomic Spectrum & Energy Levels

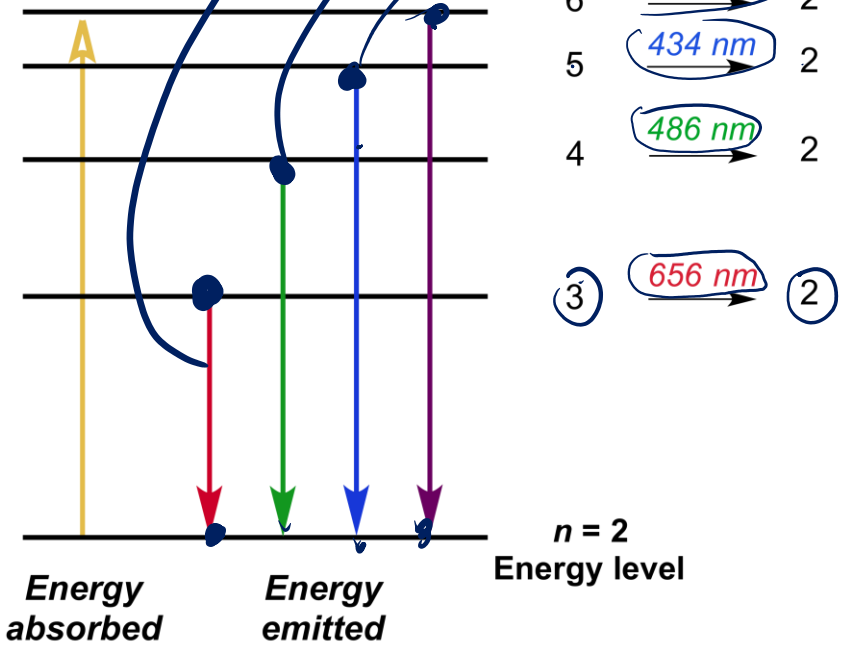


Image 1

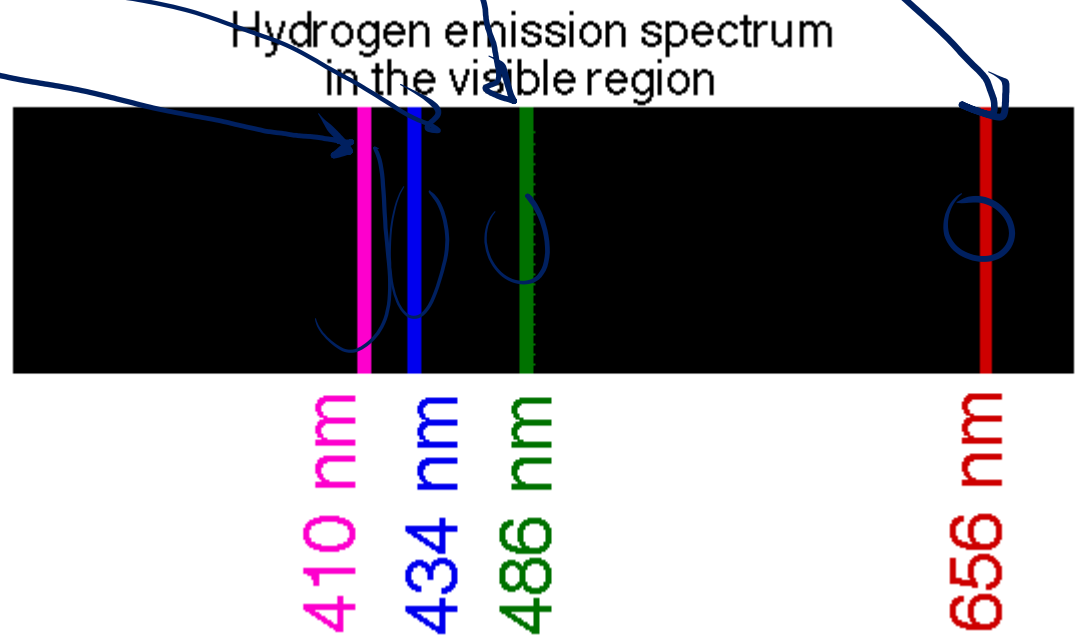


Image 2

Hydrogen Atomic Spectrum & Energy Levels

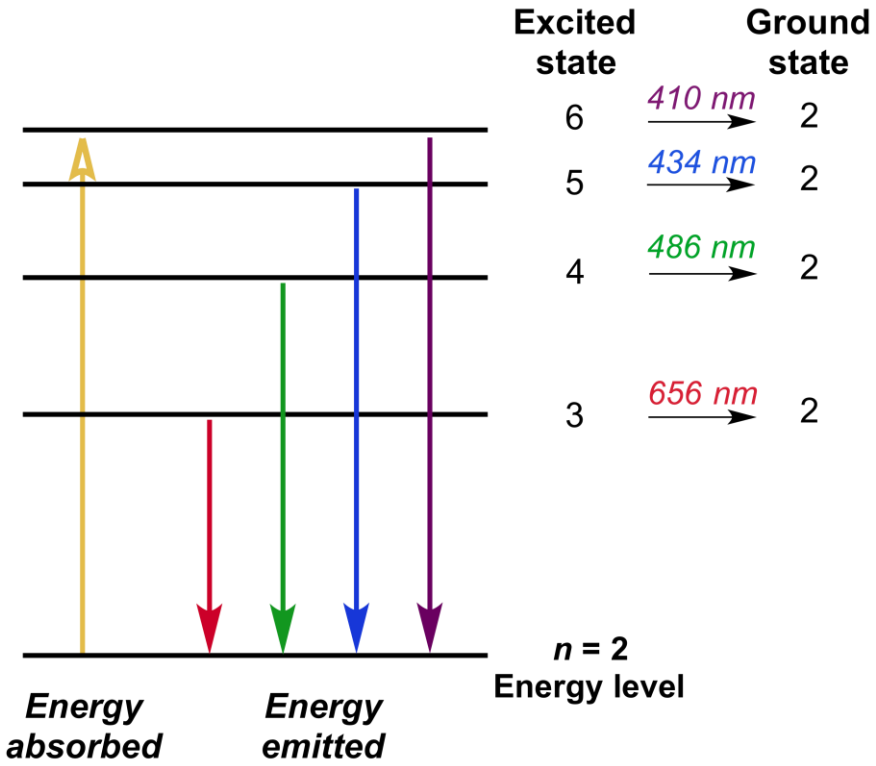


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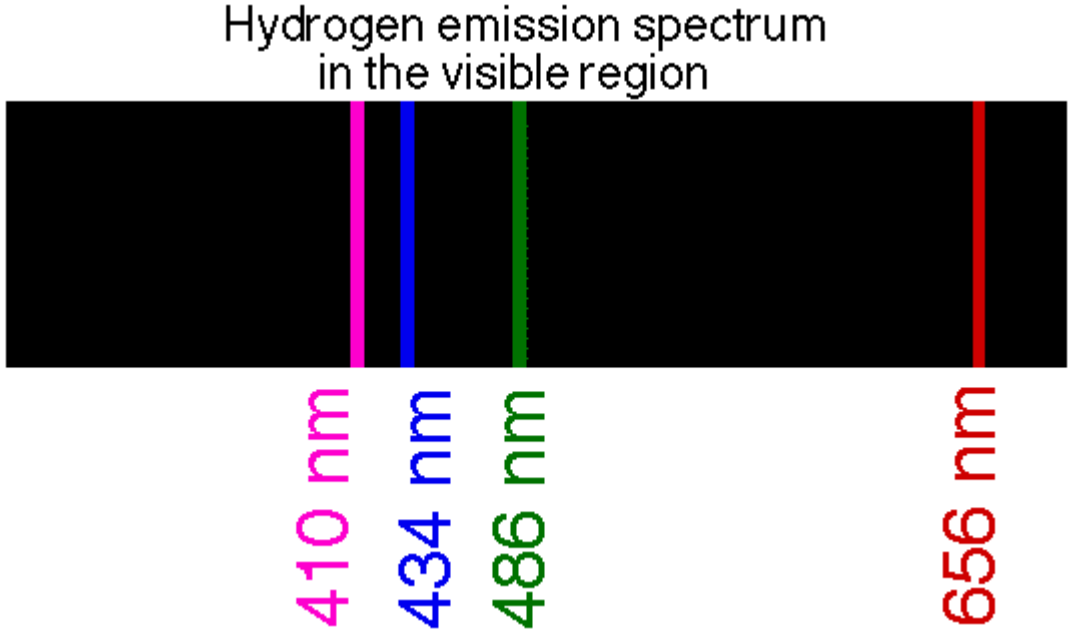
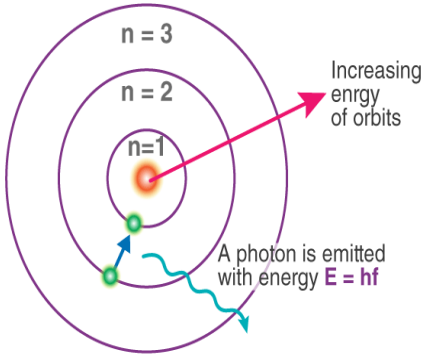


Image 2

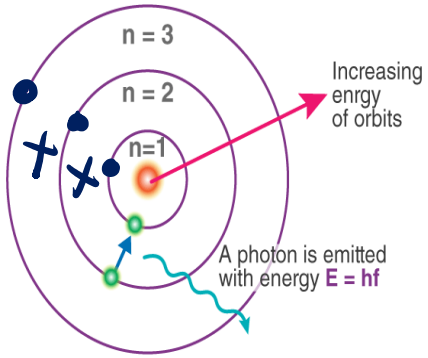
Reading activity: The limitations(تحديات) of Bohr's Model.



The limits of Bohr's model Bohr's model explained hydrogen's observed spectral lines. However, the model failed to explain the spectrum of any other element. Moreover, Bohr's model did not fully account for the chemical behavior of atoms. In fact, although Bohr's idea of quantized energy levels laid the groundwork for atomic models to come, later experiments demonstrated that the Bohr model was fundamentally incorrect. The movements of electrons in atoms are not completely understood even now; however, substantial evidence indicates that electrons do not move around the nucleus in circular orbits.

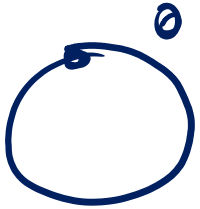
From the paragraph above, right down 3 main limitations of Bohr's Model.

Reading activity: The limitations(تحديات) of Bohr's Model.



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The limits of Bohr's model Bohr's model explained hydrogen's observed spectral lines. However, the model failed to explain the spectrum of any other element. Moreover, Bohr's model did not fully account for the chemical behavior of atoms. In fact, although Bohr's idea of quantized energy levels laid the groundwork for atomic models to come, later experiments demonstrated that the Bohr model was fundamentally incorrect. The movements of electrons in atoms are not completely understood even now; however, substantial evidence indicates that electrons do not move around the nucleus in circular orbits.



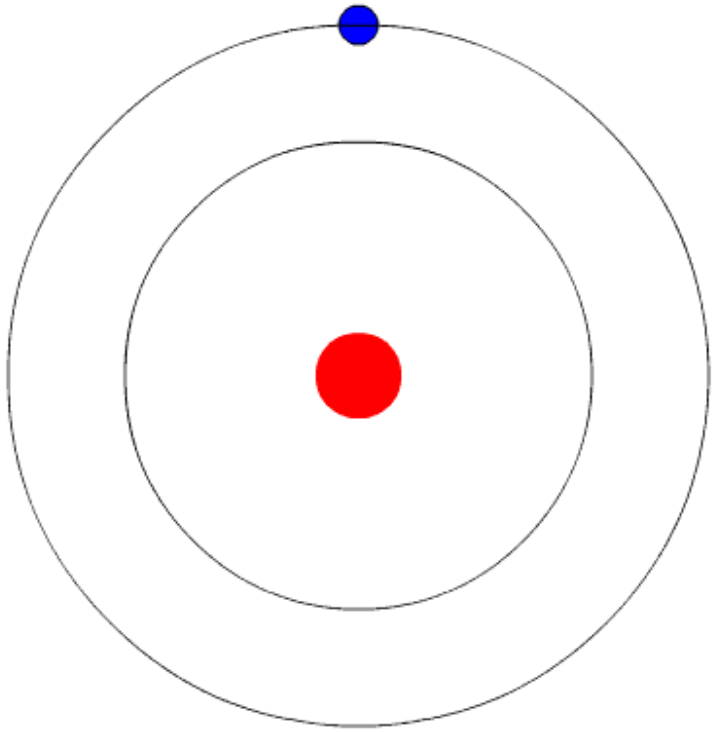
From the paragraph above, right down 3 main limitations of Bohr's Model.

Think!?

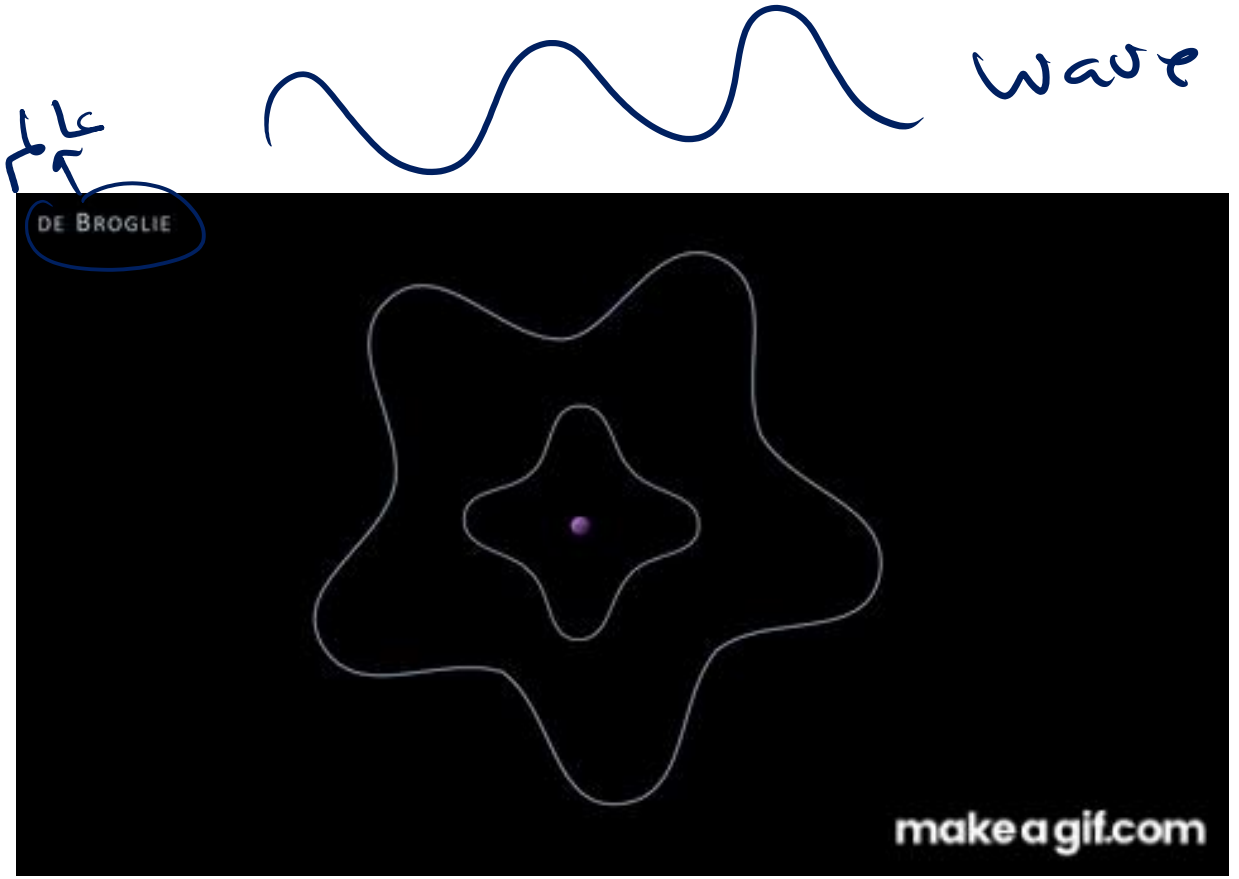


If Bohr’s model has some mistakes, then, **where are the electrons really**??

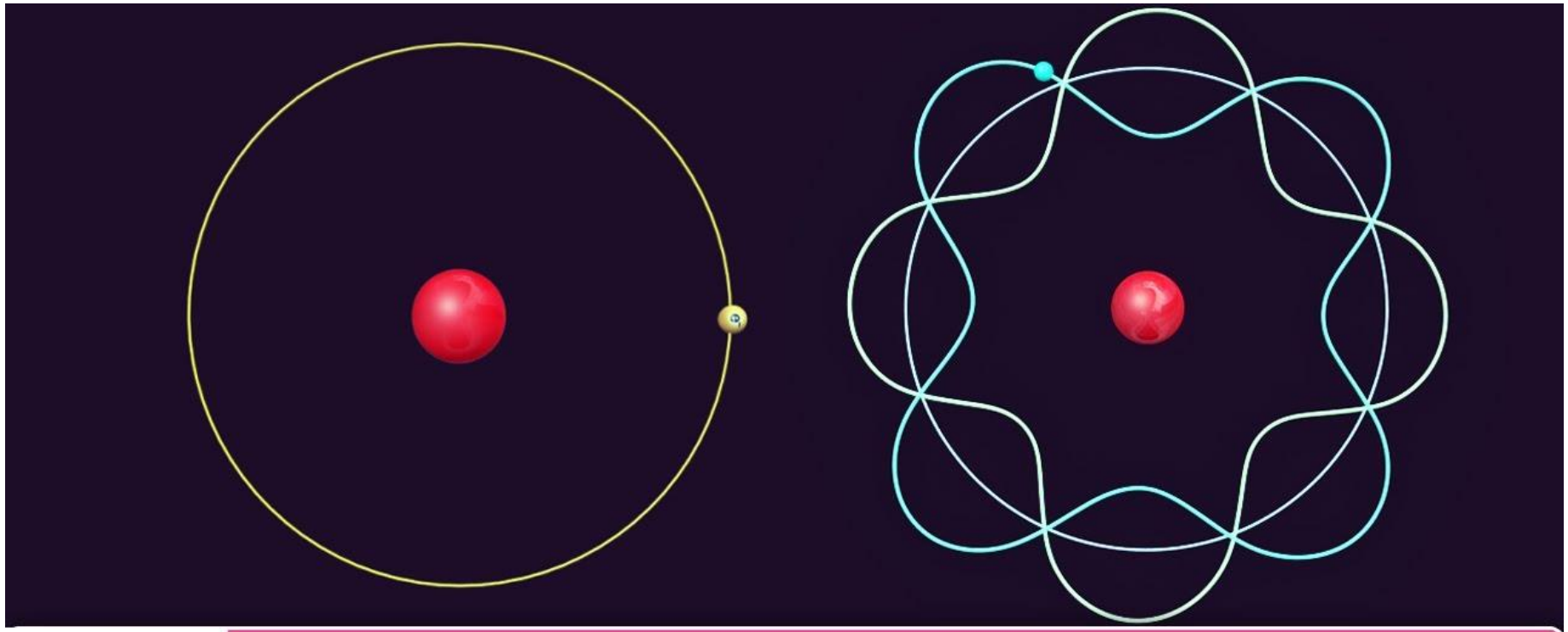
The Quantum Mechanical Model



Bohr’s Model



DE Broglie's New Model:
Electrons behave like a wave and a particle



DE BROGLIE'S EXPLANATION OF BOHR'S SECOND POSTULATE OF QUANTIZATION

ACTIVE
The Joy Of Happy Learning

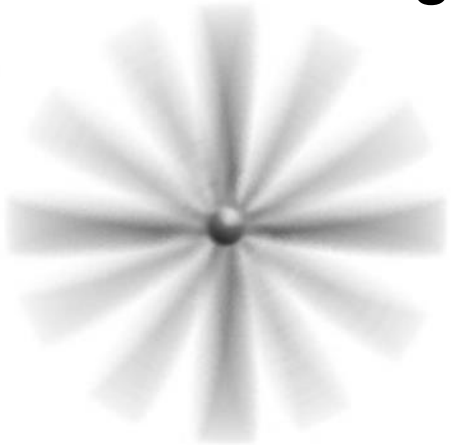
Have a look at these two images of a fan(مروحة).

Image 1

Blade **A**



Image 2



-Which image gives you the location of blade **A**? **Image 1**

-Which image tells you the speed of blade **A**? **Image 2**

-Which image can tell you both the **speed** and **location** of **blade A** at the same time? Is it possible? **None. We can't.**

Have a look at these two images of a fan(مروحة).

Electrons

moving

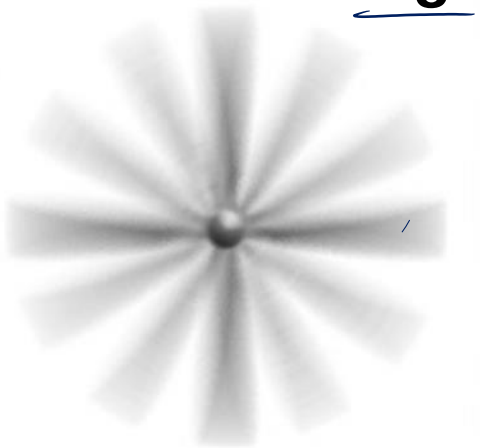
Image 1

Not moving

Image 2

Blade **A**





-Which image gives you the location of blade **A**? **Image 1**

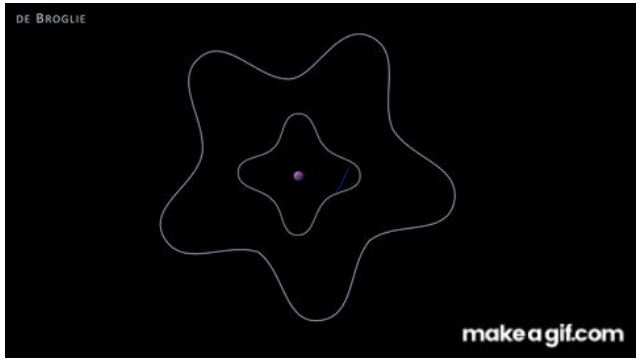
-Which image tells you the speed of blade **A**? **Image 2**

-Which image can tell you both the **speed** and **location** of **blade A** at the same time? Is it possible? **None. We can't.**

"Heinsberg" Uncertainty Principle



Based on De Broglie's Model of the standing wave, the scientist Heisenberg formulated the following postulate or concept:



It is impossible to define or determine both the speed and the location of an electron at the same time.

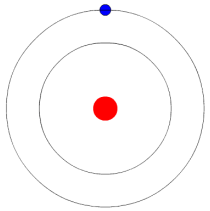
The electrons are around the nucleus.

However, ***where are the electrons located exactly????***

Schrödinger

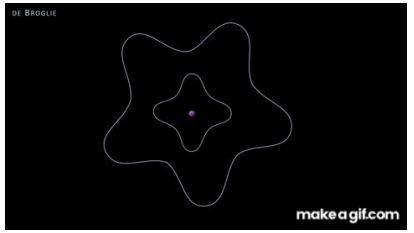


Bohr's Energy levels. **Electrons have quantized energies.**



De Broglie's electron-wave nature

Heisenberg uncertainty principle

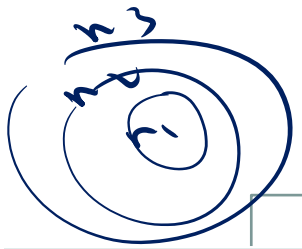


The Quantum Mechanical Model to describe the electron's **location and energy.**

Electrons are in a space called "Orbitals"

Schrödinger

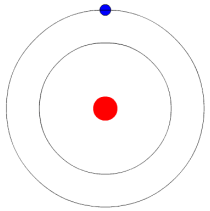


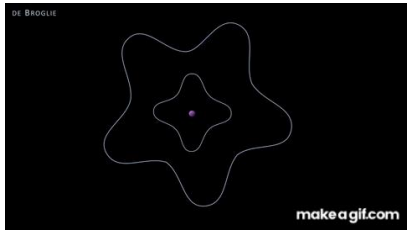


Bohr's Energy levels. **Electrons have quantized energies.**

De Broglie's electron-wave nature

Heisenberg uncertainty principle





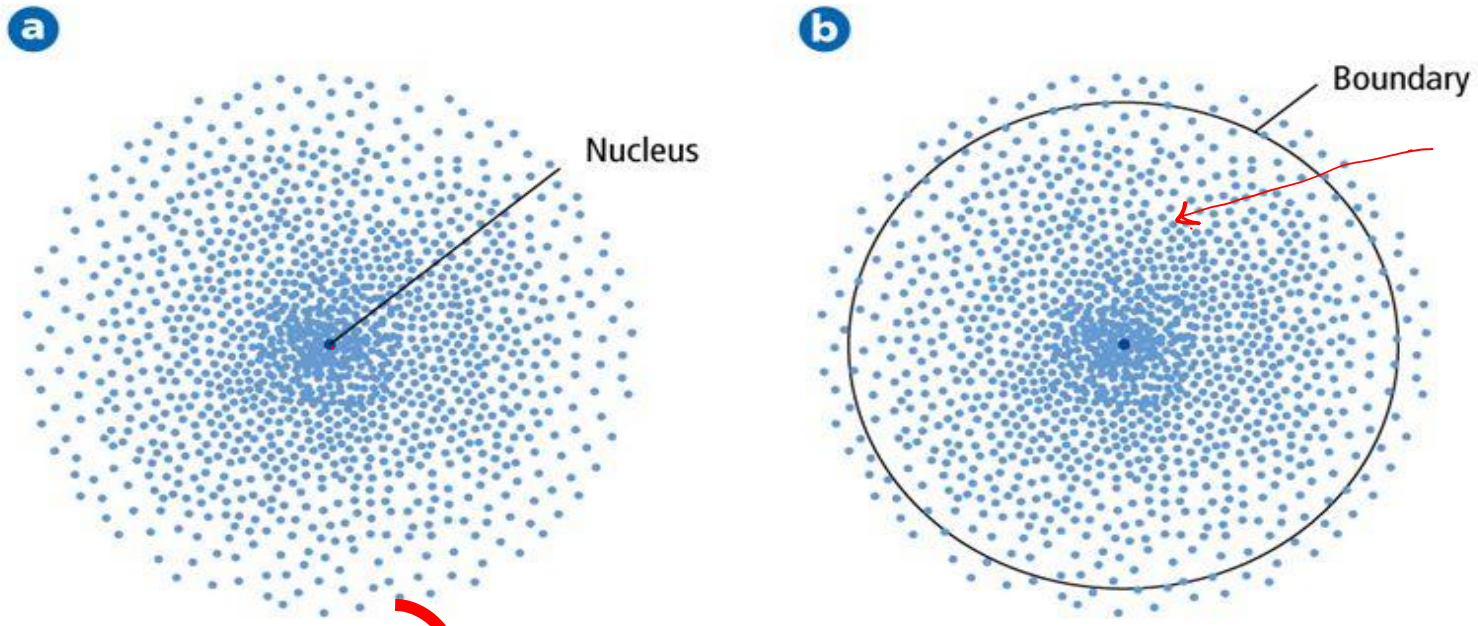
Newest Model

The Quantum Mechanical Model to describe the electron's **location and energy.**

Electrons are in a space called "Orbitals" أفلاك → the home of electrons

Atomic Orbitals *(Location of the electrons)*

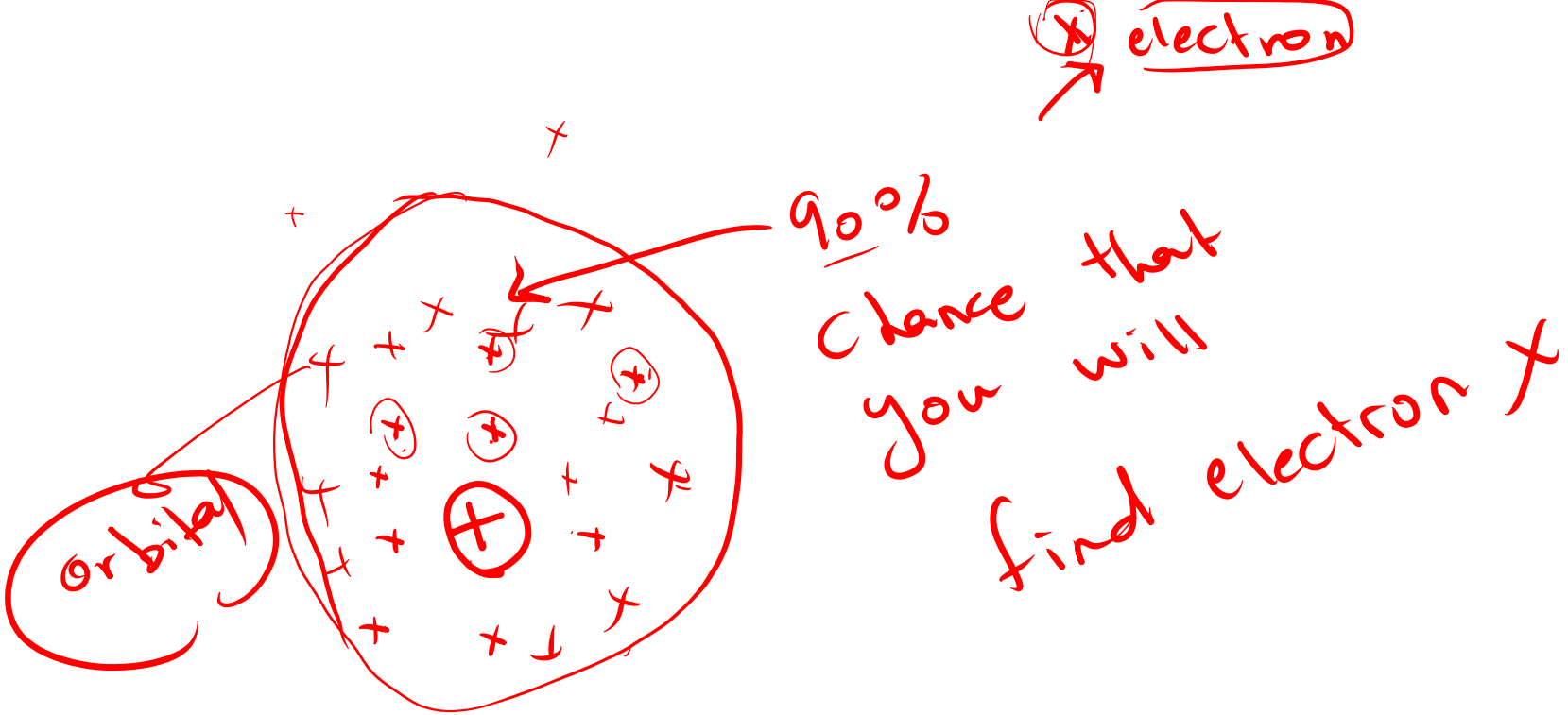
- (fuzzy cloud) = An **atomic orbital** is often thought of as a region of space in which there is a high probability of finding an electron.



High probability = 90% probability

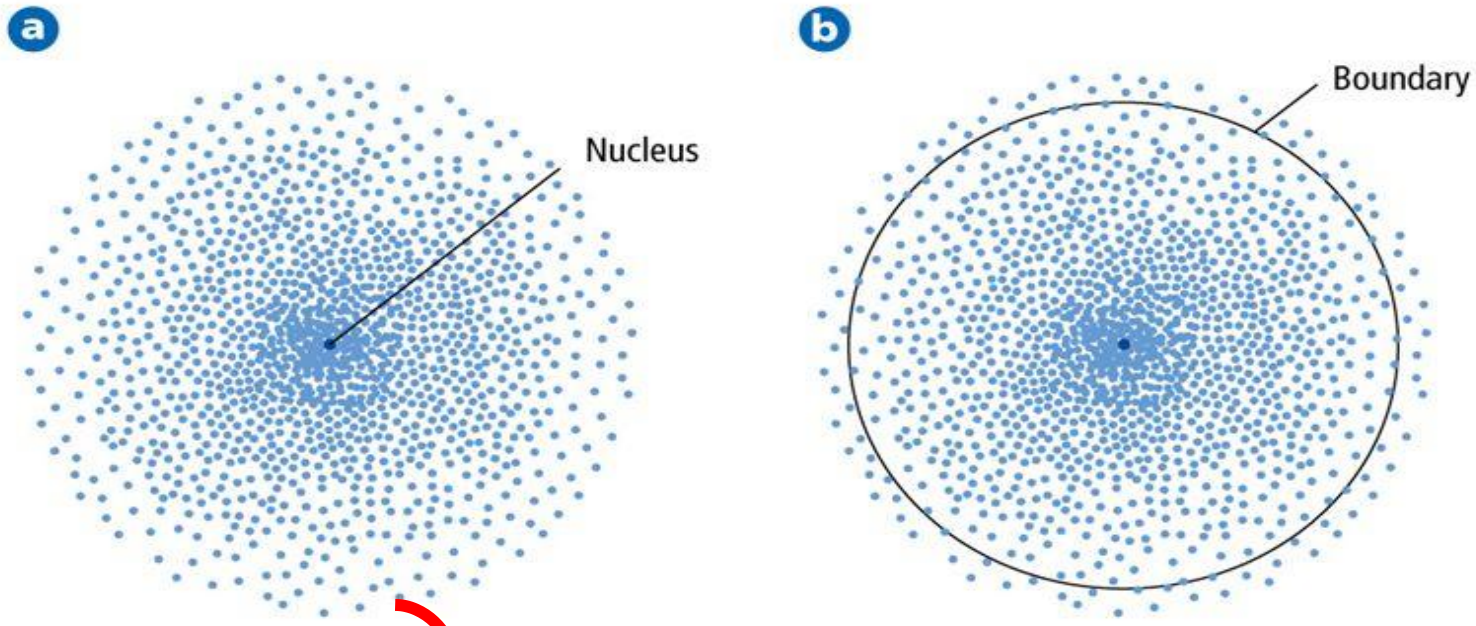
Density Maps

"•" this is not an electron. It is a **possible location of an electron**


electron
90%
chance that
you will
find electron x
orbital

Atomic Orbitals *(Location of the electrons)*

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High probability = 90% probability

Density Maps

"•" this is not an electron. It is a **possible location of an electron**

Compare and Contrast the Quantum and Bohr's Model

The atomic model in which electrons are treated as waves is called the wave mechanical model of the atom or, the **quantum mechanical model of the atom.** Like Bohr's model, the quantum mechanical model limits an electron's energy to certain values. However, unlike Bohr's model, the quantum mechanical model makes no attempt to describe the electron's path around the nucleus.

READING CHECK **Compare and contrast** Bohr's model and the quantum mechanical model.

READING CHECK **Compare and contrast** Bohr's model and the quantum mechanical model.

Which statements are correct? There is more than one correct answer.

1- Bohr's Model & the quantum model limit an electron's energy to certain values (Energy levels of electrons, quantum energy).

2- The quantum mechanical model doesn't describe the path or the movement of electrons.

3- An atomic orbital is a 3D space around the nucleus where protons can be found.

4- The quantum mechanical model describes the path of electrons in the orbitals.

5- Bohr's model is more accurate(أكثر دقة) than the quantum mechanical model.

(True or False)

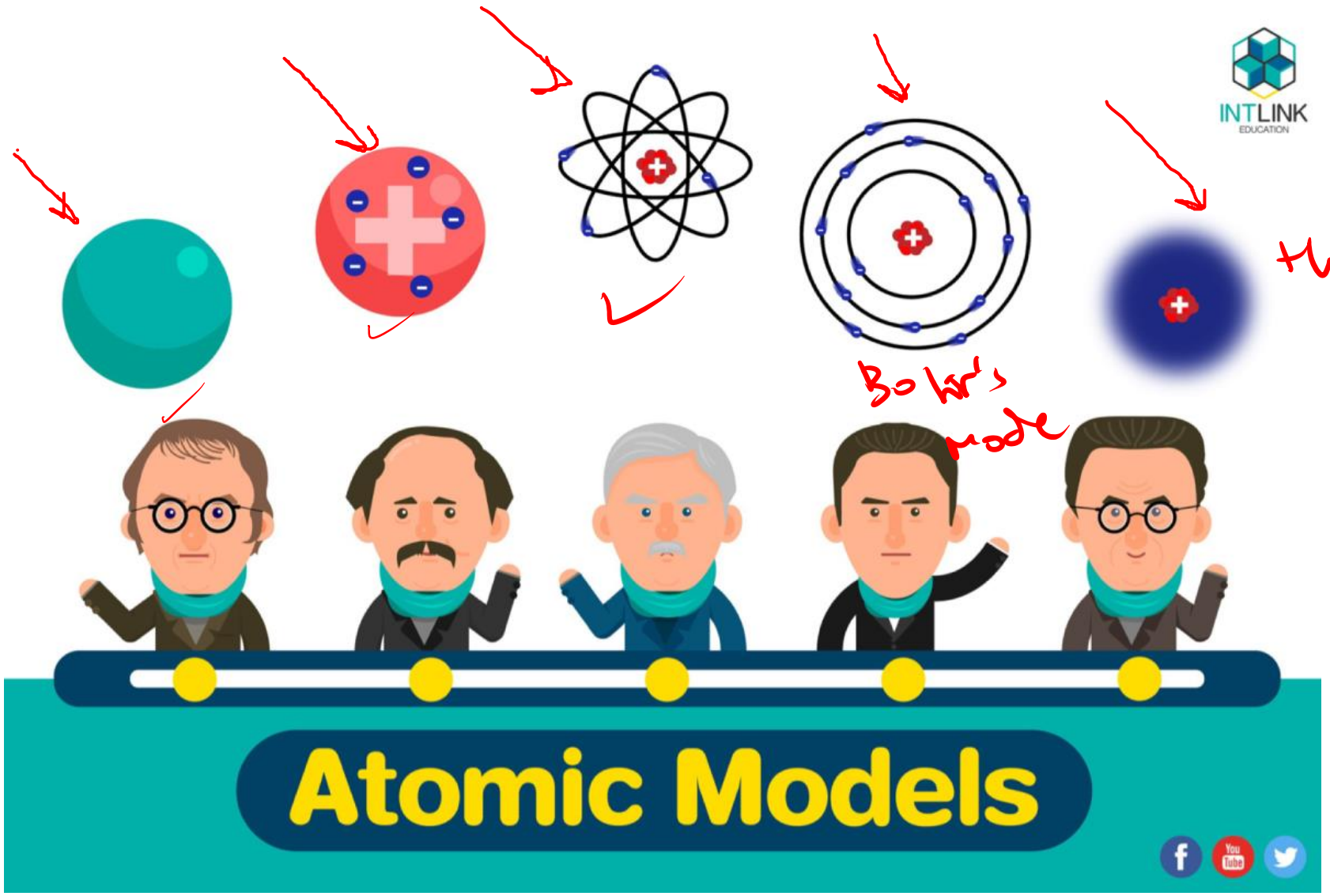
1- In the quantum mechanical model, electrons have specific/quantized Energy. **T**

2- Like Bohr's Model, the quantum mechanical model does attempt to describe the path of electrons around the nucleus. **F**

المسار طريقة الحركة

location

Atomic Models



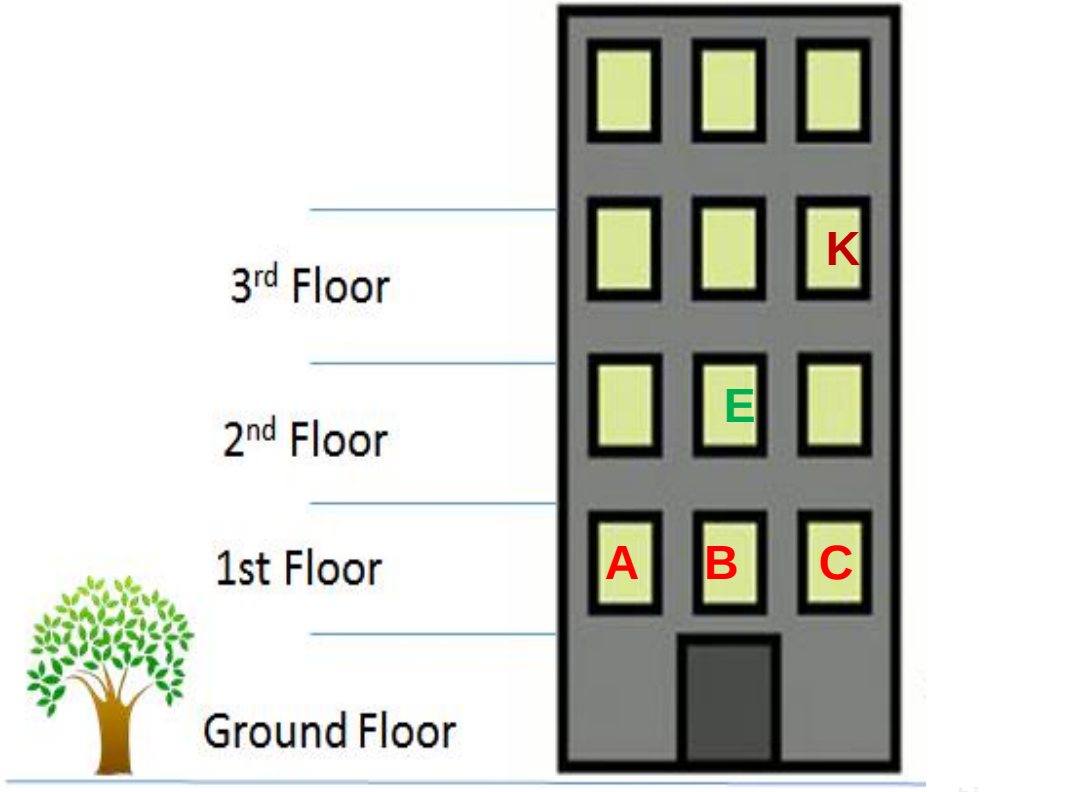
Activity: How can we **describe the location of an electron?**

You are ordering from talabat and the driver asked you for your location. You live in apartment **K**. How will you describe your location in the building?

You need:
Building name
Block
Floor number
Apartment number.

Example:
Asiad building,
Block 5,
3rd floor
apartment K

We need 4 types of information to describe an electron



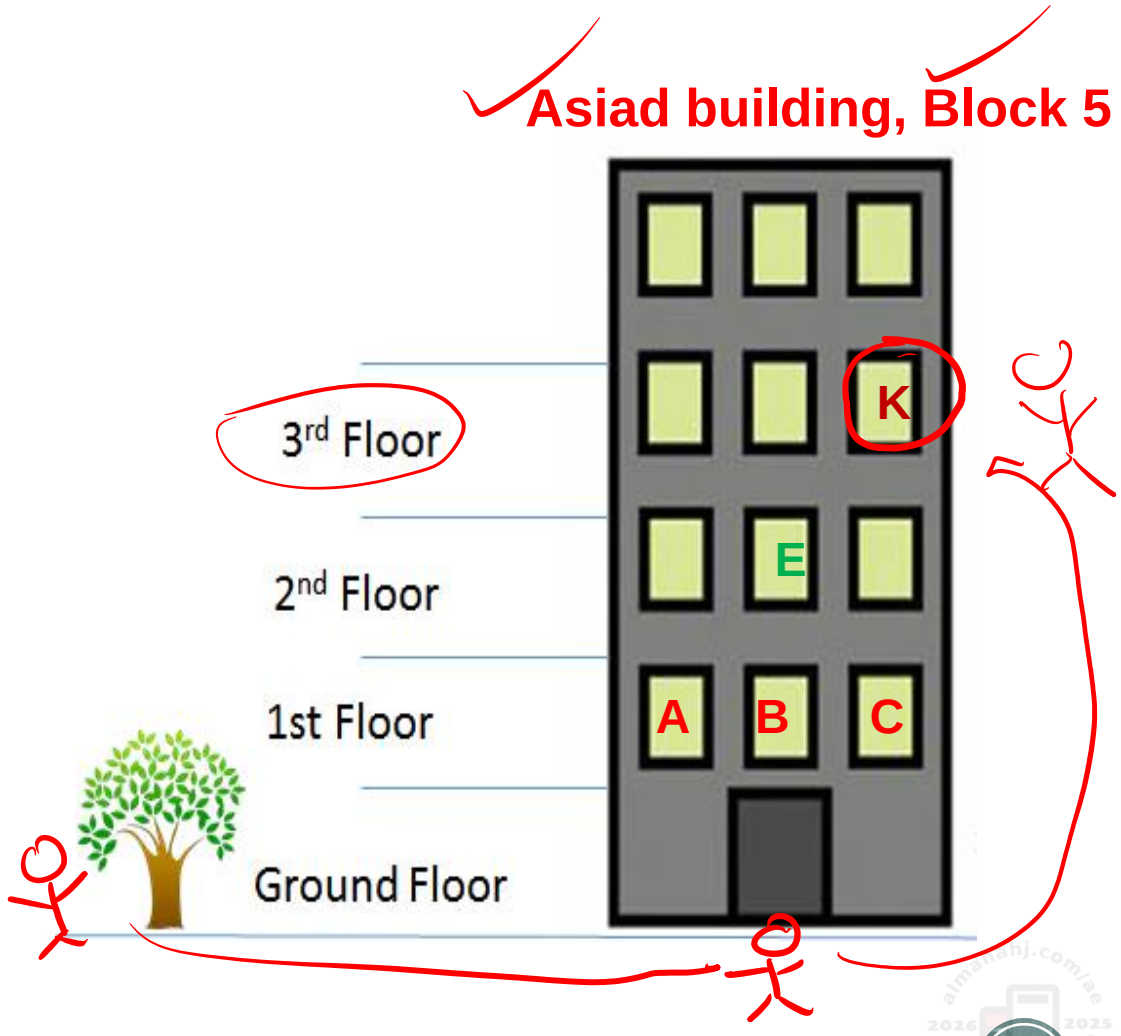
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We need 4 types of information to describe an electron



Keywords

Quantum numbers	**4 numbers that describe an electron around the atom.**
Energy Shell	*Energy* ***Level***
Energy Subshell	*Energy* **Sublevel**
Orbital	A probable location of the electron.
Orbit	A circular path (مسار دائري)

energy level 1
sublevel 1.1

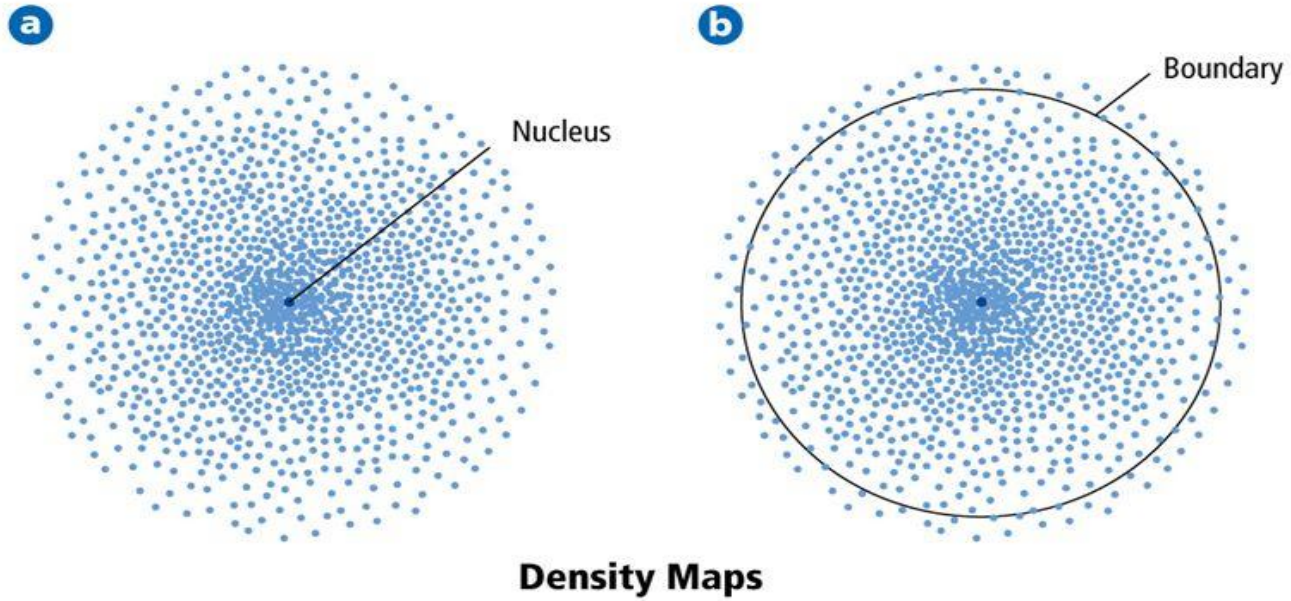
90%

Atomic Orbitals

(Location of the electrons)

- (fuzzy cloud) = An **atomic orbital** is often thought of as a region of space in which there is a high probability of finding an electron.

High probability = 90% probability



Density Maps

"•" this is not an electron. It is a **possible location of an electron**

To describe an electron's orbital or location, we focus on the 4 quantum numbers:

- Relative size and Energy of the orbital.
- Shape of the orbital.
- Orbital orientation
- Electron spin

The 4 Quantum Numbers

These 4 quantum numbers describe the location and energy level of an electron in the atom:



Name	Symbol	Allowed Values	Property
Principal	n	positive integers 1,2,3…	Orbital size and energy level
Secondary (Angular momentum)	*l*	Integers from 0 to (n-1)	Orbital shape (sublevels/subshells)
Magnetic	m_l	Integers –*l* to +*l*	Orbital orientation

The 4 Quantum Numbers

To completely describe an electron, we use: The four Quantum numbers



Name	Symbol	Allowed Values	Property
Principal	n	positive integers 1,2,3…	Orbital size and energy level
Secondary (Angular momentum)	l	Integers from 0 to (n-1)	Orbital shape (sublevels/subshells)
Magnetic	m_l	Integers $-l$ to $+l$	Orbital orientation
Spin	m_s	$+\frac{1}{2}$ or $-\frac{1}{2}$	Electron spin Direction

Hydrogen's Atomic Orbitals

Principal Quantum Number (n)

- The quantum mechanical model assigns four quantum numbers to atomic orbitals.
- The **principal quantum number** (*n*) indicates the relative size and energy of atomic orbitals.
- As *n* increases, the orbital becomes larger, the electron spends more time farther from the nucleus, and the atom's energy increases.
- ***n*** specifies the atom's major energy levels, called the **principal energy levels**.
- An atom's lowest principal energy level is assigned a principal quantum number of 1.

Hydrogen's Atomic Orbitals

Principal Quantum Number (n)

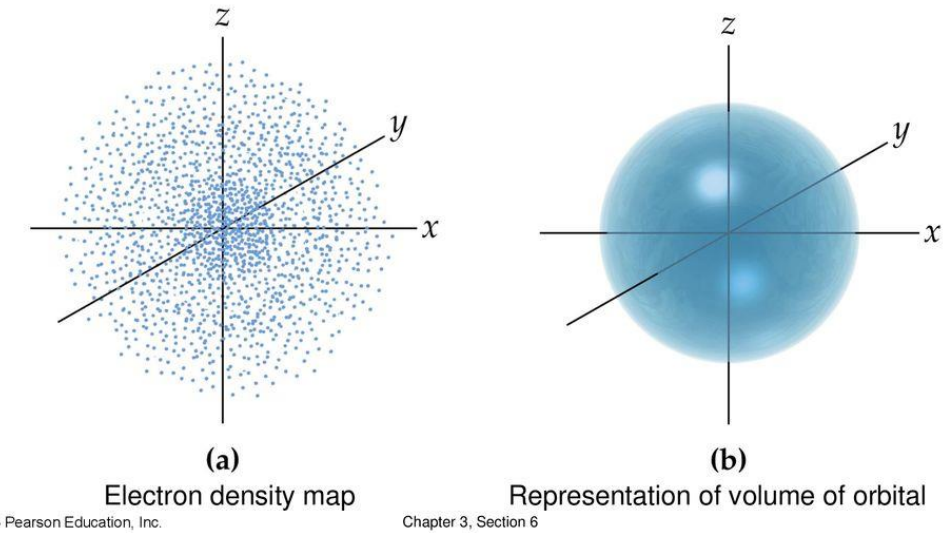
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Shape of the orbitals: **Secondary/Angular Quantum number (ℓ)**

Subshells or Sublevels (s, p, d & f)

s orbitals

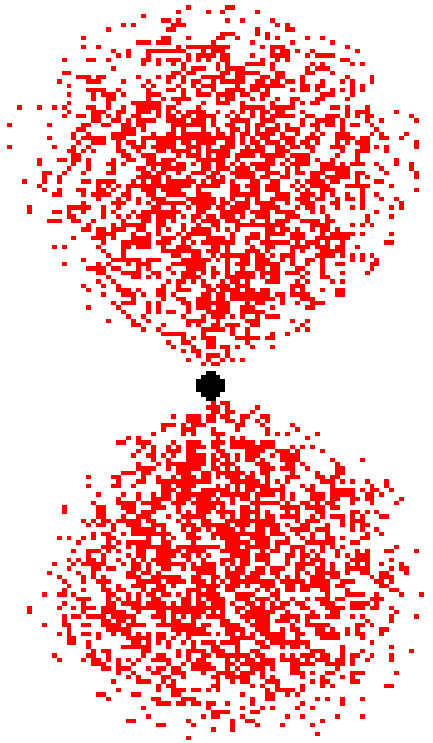
- spherical in shape



(a) Electron density map (b) Representation of volume of orbital

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P orbitals



Try Yourself

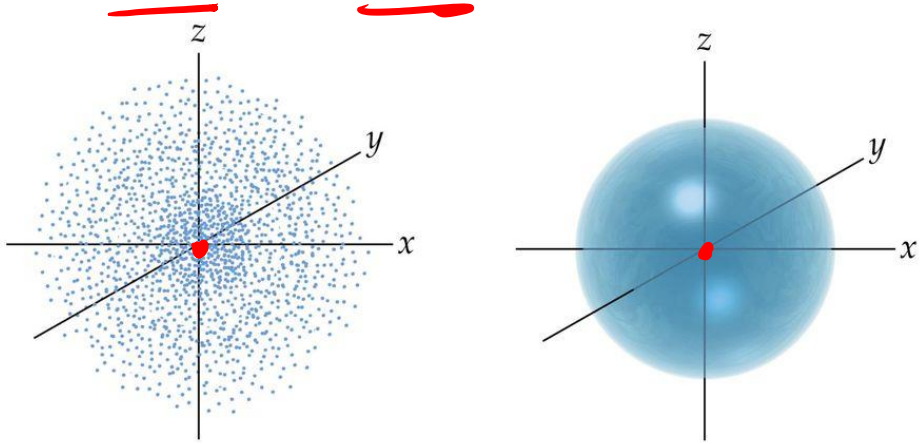
https://www.chemtube3d.com/orbitals-s/

Shape of the orbitals: **Secondary/Angular Quantum number (l)**

Subshells or Sublevels (s, p, d & f)

s orbitals

- spherical in shape

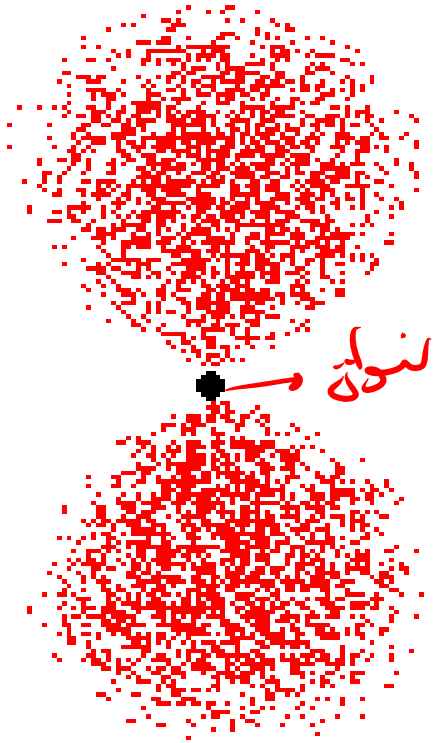


(a) Electron density map

(b) Representation of volume of orbital

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P orbitals



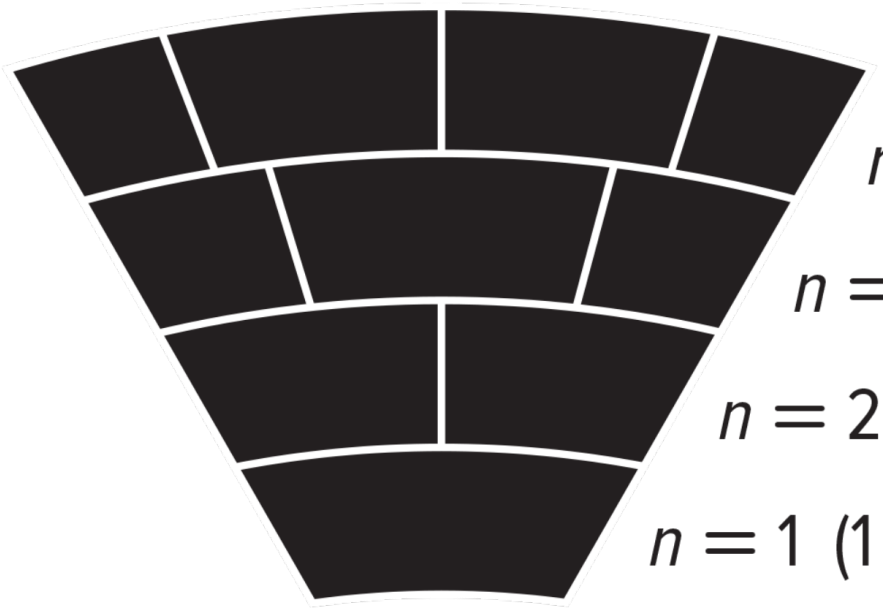
Try Yourself

https://www.chemtube3d.com/orbitals-s/

Hydrogen's Atomic Orbitals

Energy Sublevels

- Principal energy levels contain **energy sublevels (n).**
- Principle energy level 1 consists of a single sublevel (s), principle energy level 2 consists of two sublevels (s and p), and so on.



$n = 4$ (4 sublevels) **"s", "p" , "d" and "f" sublevels**

$n = 3$ (3 sublevels) **"s", "p" and "d" sublevels**

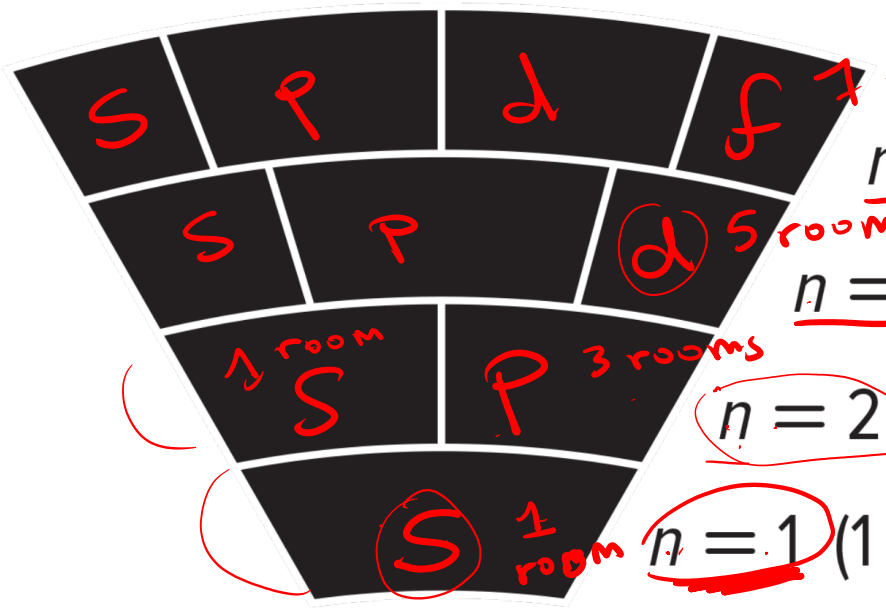
$n = 2$ (2 sublevels) **"S" and "P" sublevels.**

$n = 1$ (1 sublevel) **"S"** sublevel.

Hydrogen's Atomic Orbitals

Energy Sublevels

- Principal energy levels contain **energy sublevels (n).**
- Principle energy level 1 consists of a single sublevel (s), principle energy level 2 consists of two sublevels (s and p), and so on.



$n = 4$ (4 sublevels) **"s", "p" , "d" and "f" sublevels**

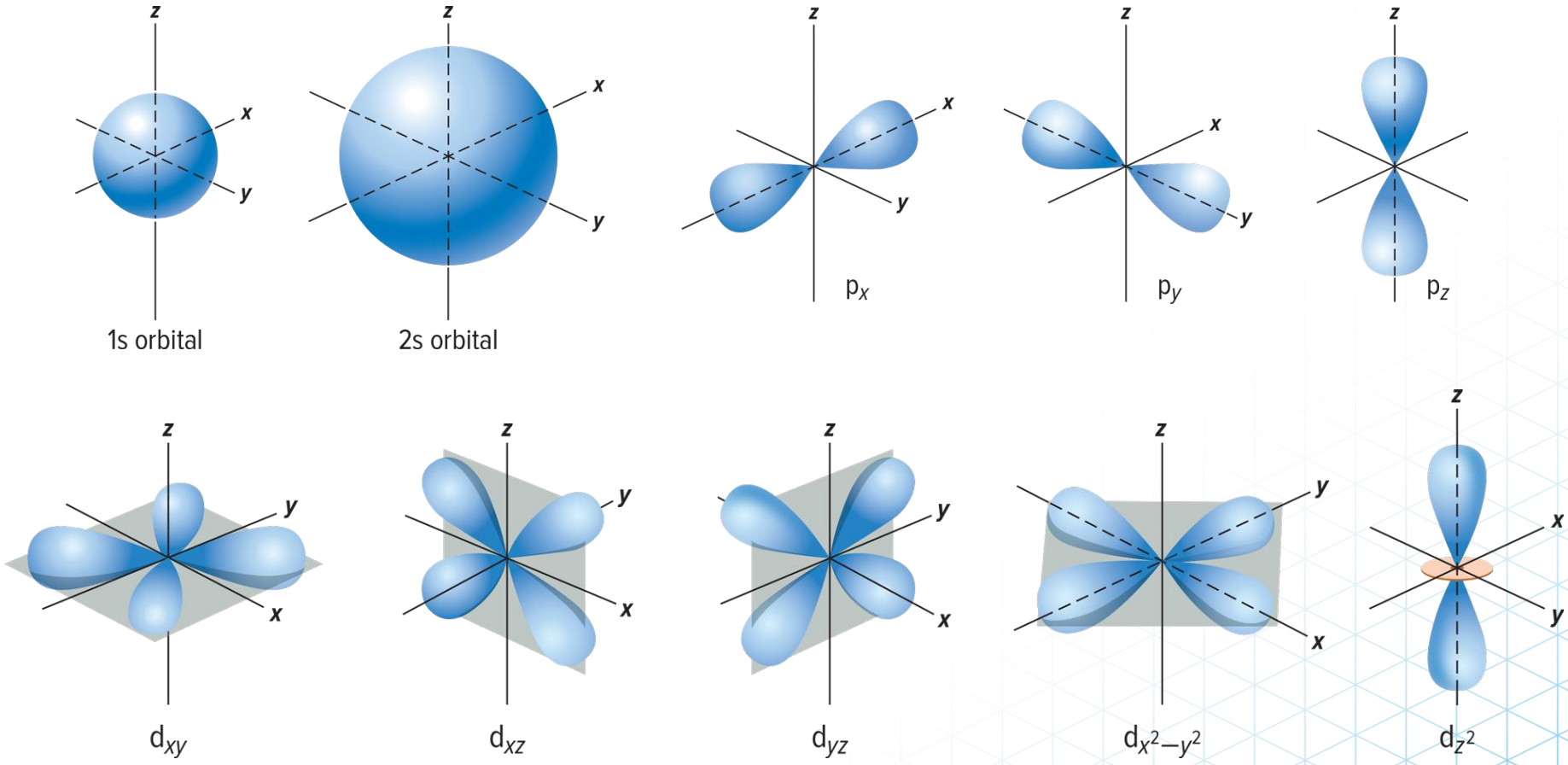
$n = 3$ (3 sublevels) **"s", "p" and "d" sublevels**

$n = 2$ (2 sublevels) **"S" and "P" sublevels.**

$n = 1$ (1 sublevel) **"S"** sublevel.

Hydrogen's Atomic Orbitals

- Sublevels are labeled *s*, *p*, *d*, or *f* according to the shapes of the atom's orbitals.



Hydrogen's Atomic Orbitals

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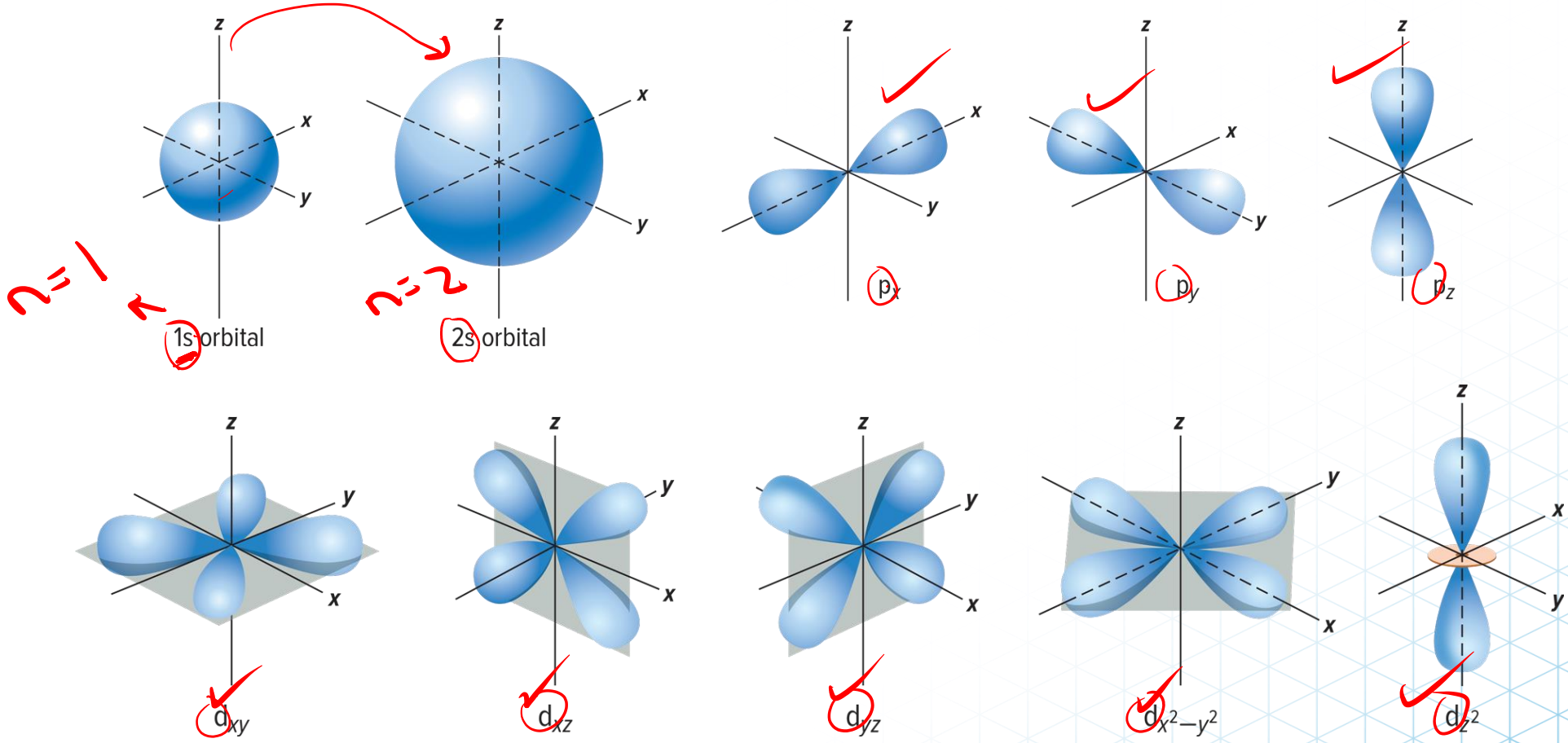
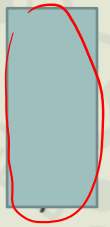


Table 2 Hydrogen's First Four Principal Energy Levels

Principal Quantum Number (n)	Sublevels (Types of Orbitals) Present	Number of Orbitals Related to Sublevel	Total Number of Orbitals Related to Principal Energy Level (n^2)
1			$1^2 =$ 
2			$2^2 =$ 
3			$3^2 =$ 
4			$4^2 =$ 

Rule

room

One Orbital can hold a maximum of 2 electrons

Energy levels (n) = floors

Energy sublevels (s, p, d, f) = Apartments

orbitals = rooms in the apartments

electrons = people

Table 2 Hydrogen's First Four Principal Energy Levels

Principal Quantum Number (n)	Sublevels (Types of Orbitals) Present	Number of Orbitals Related to Sublevel	Total Number of Orbitals Related to Principal Energy Level (n^2)
1	s	1	1
2	s p	1 3	4
3	s p d	1 3 5	9
4	s p d f	1 3 5 7	16

One Orbital can hold a maximum of 2 electrons

“Critical thinking”

- **The number of orbitals in any energy level (n) is equal to n^2.**
  - **Example: energy level (n=2) will have a 2^2= 4 orbitals**

- **One Orbital can hold a maximum of 2 electrons.**

What is the maximum number of electrons in any energy level (n)?

- ❖ n^2
- ❖ $2n^2$
- ❖ $2n$

“Critical thinking”

- **The number of orbitals in any energy level n is equal to n^2.**
  - **Example: energy level (n=2) will have a 2^2= 4 orbitals**

- **One Orbital can hold a maximum of 2 electrons.**

What is the maximum number of electrons in any energy level (n)?

- ❖ n^2
- ❖ **$2n^2$**
- ❖ 2n

“Critical thinking”

- **The number of orbitals in any energy level n is equal to n^2.**
  - **Example: energy level (n=2) will have a 2^2= 4 orbitals**

- **One Orbital can hold a maximum of 2 electrons.**

What is the maximum number of electrons in any energy level (n)?

- ❖ n^2
- ❖ **$2n^2$**
- ❖ 2n

n^2 = # of orbitals in "n"

$2 \times n^2$ = # of electrons in "n"

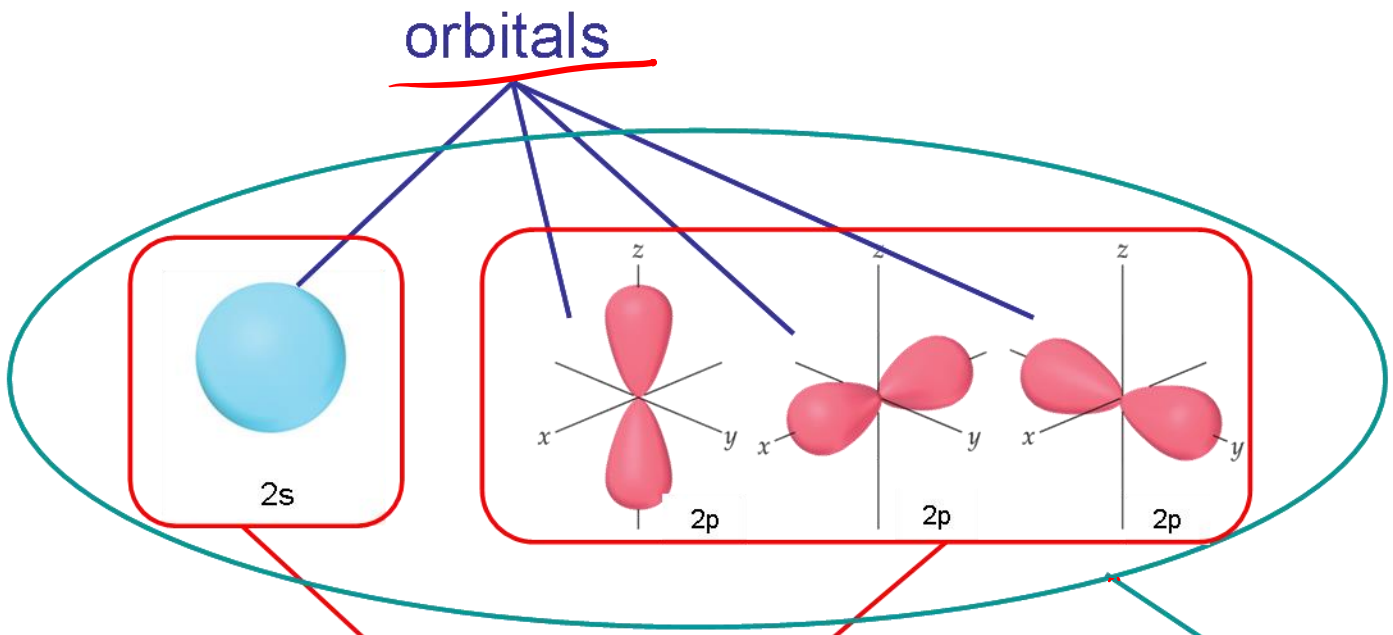
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3	s p d	1 3 5	9
4	s p d f	1 3 5 7	16

One Orbital can hold a maximum of 2 electrons

Maximum number of electrons in a level= $2n^2$ or $2n+2$ or n^2+4 ?

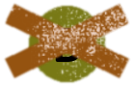
Summary
Shells, Subshells and orbitals



Quiz

1. What is the lowest allowable energy state of an atom called?


excited state


quantum state


ground state

CORRECT


atomic orbital

Quiz

3. How many sublevels does principal energy level 3 consist of?



- 1
- 2
- C 3 **CORRECT**
- 4

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Module 4 Lesson 2