INSIDE ATOMS

Energy levels

Extract from "Advanced chemistry for you", Lawrie RYAN, Nelson Thornes

1. Introduction grâce à une animation

Listen to this animation:

In this experiment, what are the atoms of gas excited with?
→ *They are excited with an electric discharge.*
Which atoms are there?
→ *There are Hydrogen atoms.*
What does the light go through?
→ *The light goes through a slit.*
What is the light decomposed by?
→ *The light is decomposed by a prism.*
What is the phenomenon called?
→ *The phenomenon is called dispersion.*
Which sort of spectrum do we observe?
→ *We observe a line spectrum.*
What does a line in the spectrum correspond to?
→ *A line corresponds to the energy emitted by a transition between two energy levels.*
What do the figures next to the lines stand for?
→ *The figures next to the lines stand for the wavelength.*
Are all photons (particles of light) visible?
→ *No they are not.*
Which transitions correspond to visible lines?
→ *All transitions from a higher level to the level 2 correspond to visible lines.*

2. Retour au texte pour compléments d'information

Read the first part of the text until the energy level diagram and answer the questions:

What does a horizontal line in the energy level diagram stand for?
→ *A horizontal line stands for a level of energy.*
What do the arrows downwards represent? Are they emissions or absorptions?
→ *The arrows downwards represent transitions. They are emissions.*
Draw an absorption in black.
What is the Lyman series?
→ *The Lyman series is the group of transitions which return to the fundamental level (number 1).*
The visible transitions shown in the animation are called the Balmer series. Draw in green the arrows corresponding to it.

3. Complément d'informations

Actually, the energy emitted by a transition is inversely proportional to the wavelength. That is, the higher the jump is, the smaller the wavelength.

Recall me the limits of the visible wavelengths.
→ *400 nm (violet)* $< \lambda_{visible} <$ *750 nm (red)*

Thus, the returns to the level 1 (Lyman series) correspond to higher jumps, that is smaller wavelengths, such as Ultra Violet radiation. The returns to the level 2 (Balmer series) correspond to smaller jumps, that is larger wavelengths, such as visible radiation. And so on, returns to level 3 correspond to much larger wavelengths, such as Infra Red radiation…

Read the second part of the text.

What can you notice when you use more sensitive apparatus?
→ *When we use more sensitive apparatus, we can notice several lines instead of a single one.*
What is it the evidence for?
→ *This is the evidence for sub-shells.*
What is particular to the sub-shells of the third and the fourth shells?
→ *They overlap.*

Each sub-shell has a maximum of electrons: s = 2; p = 6; d = 10
Work out the maximum of electrons for the shells n = 1, n = 2, n = 3?

→ *For n = 1,* $1s^2$*, that is 2 electrons maximum.*
→ *For n = 2,* $2s^2 2p^6$*, that is 8 electrons maximum.*
→ *For n = 3,* $3s^2 3p^6 3d^{10}$*, that is 18 electrons maximum.*

Explain the order of filling the shells thanks to the sub-shells?

→*Thanks to the diagram, we can see that* $4s^2$ *is filled before* $3d^{10}$ *because the sub-shell 4s overlaps the sub-shell 3d.*

(Les élèves étant très intrigués par cette singularité, on peut être amené à leur parler de la règle de Klechkowski…)