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Chapter 7 (397929)

About this Assignment

Description
Atomic Structure

Instructions
Atomic Structure

1. KT6 7.P.005. [489845] Show Details

Green light has a wavelength of 5.1 × 10^2 nm.
What is the energy, in joules, of one photon of green light?
4.0 ☑ _____ J/photon
What is the energy, in joules, of 1.0 mol of photons of green light?
4.0 ☑ _____ J/mol

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2. KT6 7.P.006. [467162] Show Details

Violet light has a wavelength of about 409 nm. What is its frequency?
4.0 ☑ _____ s^{-1}
Calculate the energy of one photon of violet light.
4.0 ☑ _____ J
What is the energy of 1.1 mol of violet photons?
4.0 ☑ _____ kJ
Compare the energy of photons of violet light with those of red light. Which is more energetic?
- ○ violet light
- ○ red light

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3. KT6 7.P.012. [467500] Show Details

You are an engineer a switch that works by the photoelectric effect. The metal you wish to use in your device requires 6.7× 10^{-19} J/atom to remove an electron. Will the switch work if the light falling on the metal has a wavelength of 540 nm or greater?
- ○ yes
- ○ no

Why or why not?
- ○ The device will work because wavelengths less than 540 nm cannot be used for device operation.
- ○ The device will not work because the atmosphere will filter out wavelengths less than 540 nm.
- ○ The device will work because wavelengths greater than 540 nm can operate the device.

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4. KT6 7.P.013. [467352] Show Details

The most prominent line in the spectrum of mercury is at 253.652 nm. Other lines are located at 365.015 nm, 404.656 nm, 435.833 nm, and 1013.975 nm.

(a) Which of these lines represents the most energetic light?
- ○ 253.652 nm
- ○ 365.015 nm
- ○ 404.656 nm

- ○ 435.833 nm
- ○ 1013.975 nm

(b) What is the frequency of the most prominent line?

[ ] s^{-1}

What is the energy of one photon with this wavelength?

[ ] J/photon

(c) Are any of these lines found in the spectrum of mercury shown in Figure 7.9?

- ○ yes
- ○ no

Which ones?

- ☐ 253.652 nm
- ☐ 365.015 nm
- ☐ 404.656 nm
- ☐ 435.833 nm
- ☐ 1013.975 nm
- ☐ None of these.

What color or colors are these lines?

- ☐ violet
- ☐ blue
- ☐ red
- ☐ orange
- ☐ yellow
- ☐ green
- ☐ None of these.

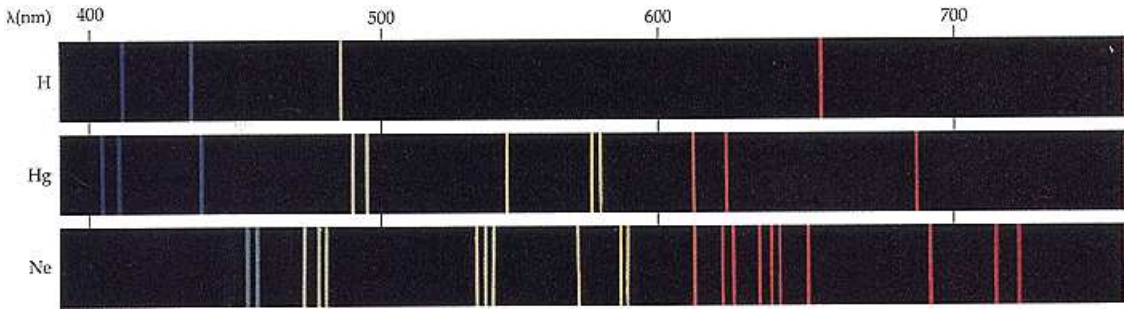

Figure 7.9

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5. KT6 7.P.017. [467332] Show Details

Consider only transitions involving the following energy levels for the hydrogen atom (where the energy level spacing below are not to scale).

_____ $n = 5$

_____ $n = 4$

_____ $n = 3$

_____ $n = 2$

_____ $n = 1$

(a) How many emission lines are possible, considering only these five quantum levels?

[ ] lines

(b) Photons of the highest frequency are emitted in a transition from the level with $n =$ [ ] to a

level with the n = [ ].

(c) The emission line having the longest wavelength corresponds to a transition from the level with n = [ ] to a level with the n = [ ].

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6. KT6 7.P.019. [467435] Show Details

The energy emitted when an electron moves from a higher energy state to a lower energy state in any atom can be observed as electromagnetic radiation.

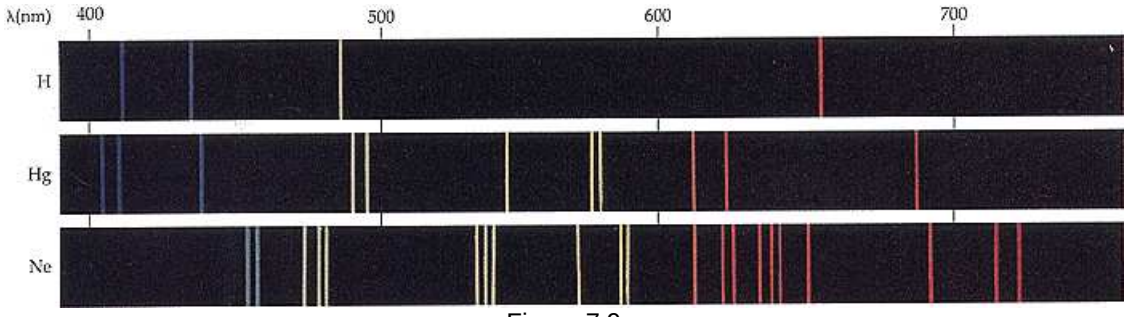

Figure 7.9

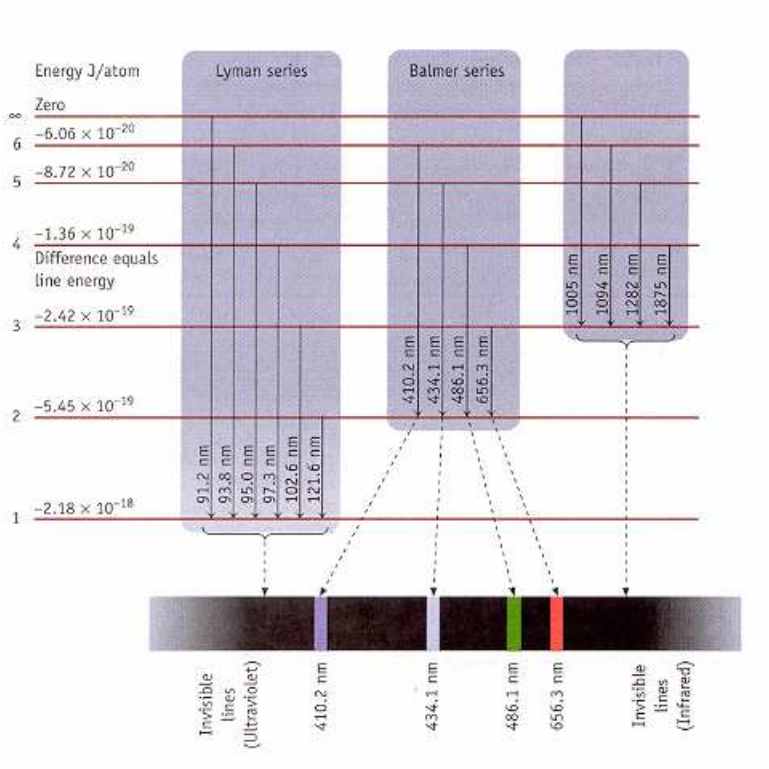

Figure 7.12

(a) Which involves the emission of less energy in the H atom, an electron moving from n = 4 to n = 2 or an electron moving from n = 3 to n = 2?

- Both emit the same energy.
- n = 3 to n = 2
- n = 4 to n = 2
- Energy is never emitted.

(b) Which involves the emission of more energy in the H atom, an electron moving from n = 4 to n = 1 or an electron changing from n = 5 to n = 2? Explain.

- n = 5 to n = 2, because the energy level are progressively widening at higher levels.
- Both these jumps are not associated with energy emission.

- Both have the same energy level as the jump is three orbits.
- n = 4 to n = 1, because the energy levels are progressively closer at higher levels.

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7. KT6 7.P.025. [467434] Show Details

Calculate the wavelength, in nanometers, associated with a 1.3×10^{2} g golf ball moving at 30. m/s (about 67 mph).

4.0 ☑ _____ nm

How fast must the ball travel to have a wavelength of 4.5×10^{-3} nm?

4.0 ☑ _____ m/s

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8. KT6 7.P.028. [489799] Show Details

Answer the following questions.

(a) When n = 4, ℓ = 2, and m_ℓ = -1, to what orbital type does this refer? (Type the orbital label using the format 1s for 1*s*.)

_____

(b) How many orbitals occur in the n = 3 electron shell?

_____

How many subshells?

_____

What are the letter labels of the subshells?

- *s*
- *s*, *p*
- *s*, *p*, *d*
- *s*, *p*, *d*, *f*
- *s*, *p*, *d*, *f*, *g*

(c) If a subshell is labeled *f*, how many orbitals occur in the subshell?

_____

What are the values of m_ℓ?

- 0
- 0, ±1
- 0, ±1, ±2
- 0, ±1, ±2, ±3

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9. KT6 7.P.035. [489872] Show Details

What is the maximum number of orbitals that can be identified by each of the following sets of quantum numbers? (0 is a possible answer.)

(a) n = 7, ℓ = 5

_____

(b) n = 2, ℓ = 1, m_ℓ = +3

_____

(c) n = 4, ℓ = 2

_____

(d) n = 6, ℓ = 3, m_ℓ = 0

_____

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10. KT6 7.P.054. [489811] Show Details

Radiation in the ultraviolet region of the electromagnetic spectrum is quite energetic. It is this radiation that causes dyes to fade and your skin to burn. If you are bombarded with 1.00 mol of photons with a wavelength of 284 nm, what amount of energy, in kilojoules per mole of photons, are you being subjected to?

4.0 kJ/mol

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