Physics 12 Holiday Homework Term 2-3 2017

Total Marks: _____/62 **Student Name:_____**

Bohr's Model on a Whole New Level:

Although objects like black bodies at high temperature emit a continuous spectrum of electromagnetic radiation, a different kind of spectrum is observed when pure samples of pure elements are heated. For example, when a high-voltage electrical discharge is passed through a sample of hydrogen gas at low pressure, light of only very precise frequencies is produced. When the emitted light is passed through a prism, only a few narrow lines, called a **line spectrum**. The light emitted by hydrogen atoms is red because, of its four characteristic lines, the most intense line in its spectrum is in the red portion of the visible spectrum, at 656 nm.

Figure 1: *When the light emitted by a sample of excited hydrogen atoms is split into its component wavelengths by a prism, four characteristic violet, blue, green, and red emission lines can be observed, the most intense of which is at 656 nm.*

Question 1: Explain the difference between a continuous spectrum and a line spectrum. Is sunlight an example of continuous or line spectra. (2 marks)

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Question 2: Explain the graph to the right and why the orbit energy in kJ/mol decreases with increasing n. Use some of your knowledge from Chemistry to fully answer this question. (3 marks)

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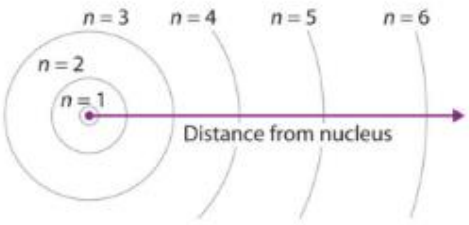
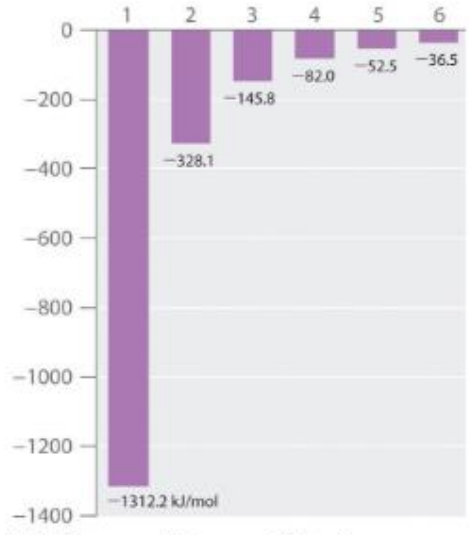
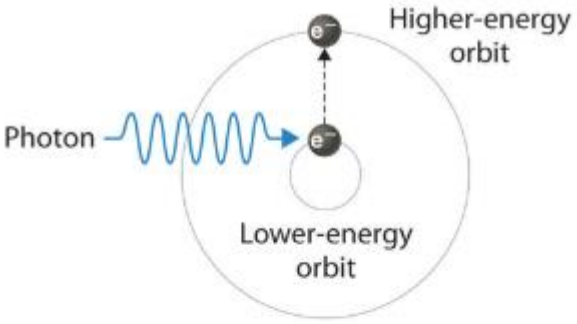


(a) Hydrogen orbits (Bohr model). Orbits are not drawn to scale.

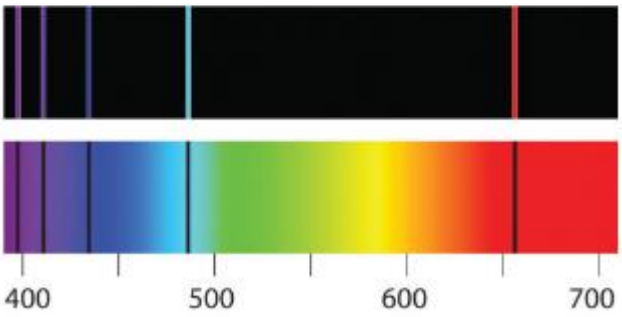


(b) Hydrogen orbit energy (kJ/mol) vs. *n*

Question 3: The diagram to the right shows the absorption and emission line spectra for Hydrogen gas. Explain what an absorption spectra is and how the absorption spectra for hydrogen could be created. Remember research this…do not guess. (3 marks)

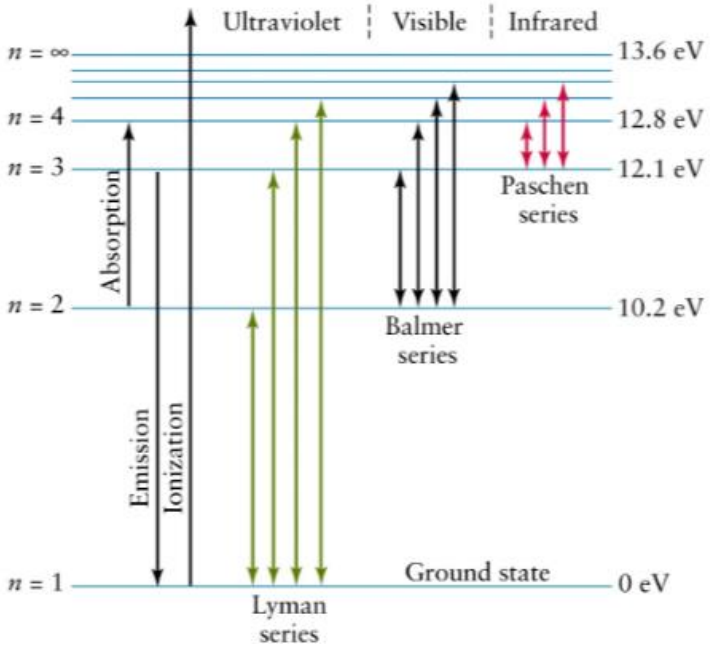


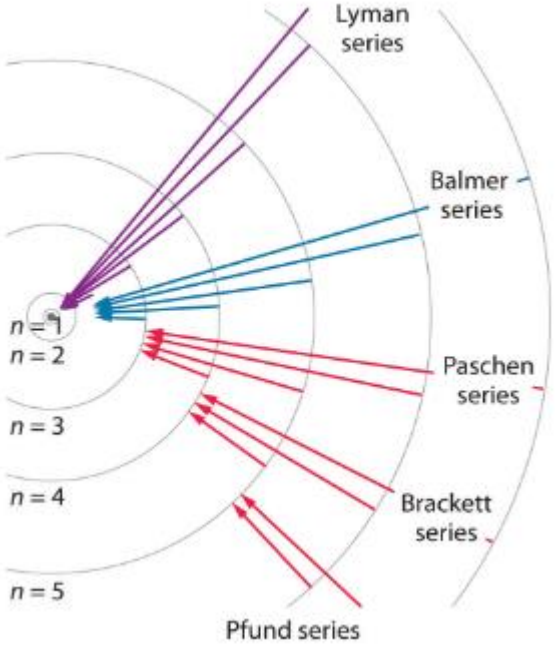
(a) Electronic absorption transition



(b) H_2 emission spectrum (top), H_2 absorption spectrum (bottom)

Question 4: Refer to the two diagrams below then answer the questions below.





a) Explain what ground state for an electron means. (1 mark)

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b) If the scientists who collected the original data had a way to measure wavelength how could they determine the energy level of a particular n energy level above ground state? (2 marks)

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c) One of the major emission lines for Hydrogen gas is 656 nm. Calculate the frequency and energy associated with this wavelength. (2 marks)

d) How could Lyman and Blamer proven that the energy absorbed is equal to the energy released when an electron falls back down to the energy state (n level) it came from. (4 marks)

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e) Show how to convert eV to Joules. If the ionisation energy is 13.6 eV, how many Joules of energy is needed to ionise an electron in the Hydrogen atom from ground state? (2 marks)

f) Would an electron in a hydrogen atom that is falling from an n=5 level to an n=2 level, release a photon that has a higher or lower frequency than a photon released as an electron falling from n=2 to n=1. Justify your answer using calculations. (4 marks)

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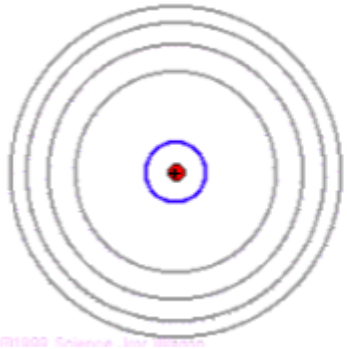
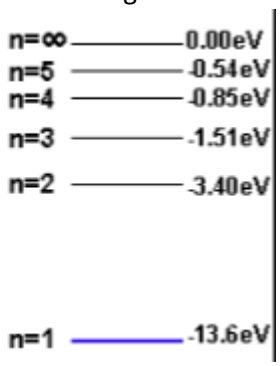
Space for calculations:

g) Use the diagram below to show the fall of an electron from n=5 to n =2. Note the inner dot on the diagram is the nucleus. Please only show electrons falling from one orbital to another. (1 mark)





Question 5: Describe in detail two failings of the Bohr model. (4 marks)

Question 6: Describe in detail two strengths of the Bohr model and then explain how this model set the stage for further advancements in quantum theory. (6 marks)

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Question 7: Watch the following two videos then answer the questions below:

Heisenberg's Uncertainty Principle: https://www.youtube.com/watch?v=a8FTr2qMutA

https://www.youtube.com/watch?v=fplwN99LujE

a) What is the Heisenberg's Uncertainty Principle: [2]

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b) How does Heisenberg's Uncertainty Principle allow a particle appear out of nowhere momentarily? [2]

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c) The more massive a particle is or the larger the energy contained in the particle the _____its life span will be.[1]

Question 8: Watch the following video then answer the questions below:

https://www.youtube.com/watch?v=p5QXZ0__8VU

a) What is a virtual particle? Note a virtual photon is emitted by electrons. Explain how the virtual photon causes electron repulsion? [3]

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b) What are the four fundamental forces and what effect do each of these forces cause. [4]

i. _____

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ii. _____

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iii. _____

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iv. _____

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c) One of the virtual particles mentions is the Gauge Bosons but the textbook refers to them as just Bosons. Explain what a boson is and how it is related to the four fundamental forces. [3]

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d) Lighter mass-less bosons can live longer and have a longer range effect. Which bosons have the longest range effects? [2]

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e) Name the boson for each of these forces: [2]

i. Gravity_____

ii. Electromagnetism_____

f) Quarks have three imaginary colours. What are these colours? [1]

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g) The force carrier between quarks that holds them together in protons and neutrons is called

a_____. [1]

h) The colours of quarks always mix to get what colour?_____[1]

i) Of the six types of quarks which are the only two that are commonly found in matter? [3]

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Question 9: Watch the following video then answer the questions below:

https://www.youtube.com/watch?v=27-nXdQql44

a) Explain in more detail how virtual photons interact between electrons and draw a Freyman diagram showing how two electrons interact in the box below. [3]

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