

Physics 100 - Spring 2009 - Recitation 5

①

In the Bohr Model of the atom, what happens to the electron when the atom absorbs a photon? What happens to the electron when the atom emits a photon?

Below is a schematic diagram of an atom with four different states (or orbits) in which the electron could exist. Next to it is a graphical representation of the electron energy in each possible STATE ... $E_1 < E_2 < E_3 < E_4$.

In terms of E_1, E_2, E_3, E_4 , what is the energy of the most energetic photon emitted by this atom?

In terms of E_1, E_2, E_3, E_4 , what is the energy of the least energetic photon?

Suppose for a moment that

$$h = 6.6 \times 10^{-34} \text{ J}\cdot\text{s}$$

or

$$4.1 \times 10^{-21} \text{ MeV}\cdot\text{s}$$

$$E_1 = -13.6 \text{ eV}$$

$$E_2 = -3.4 \text{ eV}$$

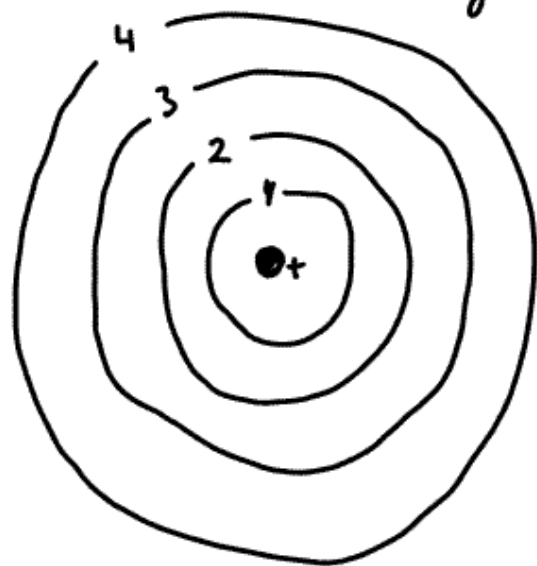
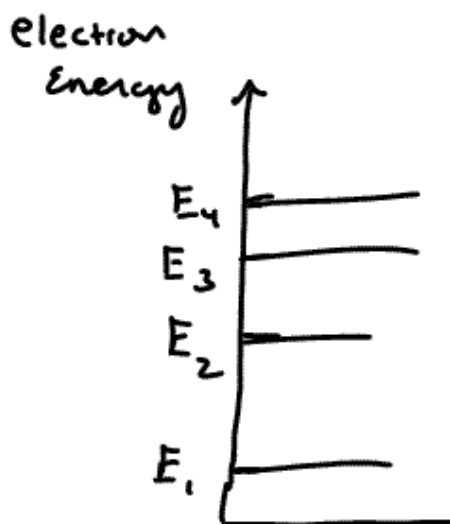
$$E_3 = -1.5 \text{ eV}$$

$$E_4 = -0.85 \text{ eV}$$

I know the "-" sign seems strange ... it means the electron is bound in the atom. Just think of scale as offset from zero.

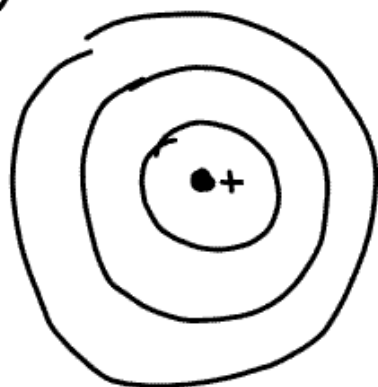
What is the highest frequency light emitted by this atom?

What is the lowest frequency light emitted by this atom?



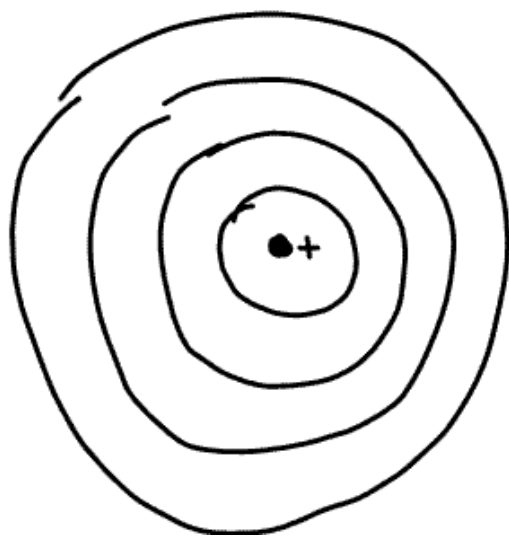
Look on p 196 of Hobson to determine the region of the electromagnetic spectrum where light of this frequency would be found.

②



An atom has 3 possible energy states in which the electron could exist. How many spectral lines could be emitted by this atom?

③



An atom has 4 possible energy states in which the electron could exist. How many spectral lines could be emitted by this atom?

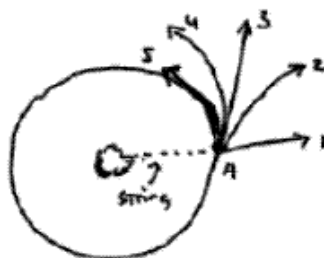
Old exam problems for practice/preparation for Exam 1

- 4) A common opinion concerning the creationism versus evolution controversy is the idea the Earth was created fairly recently but that it was created with fossils and other evidence of great age already present, so that Earth has the appearance of being old even though it is really quite young. This opinion is best classified as

- a) nonscientific because it contradicts common sense.
- b) nonscientific because it is not testable and open to be disproved.
- c) a scientific opinion that is probably incorrect.
- d) a scientific opinion that is certainly correct.
- e) a scientific hypothesis for which there is currently little evidence.

5)

The sketch shows the path of a ball tied to a string and swung in a horizontal circle clockwise. The string breaks when the ball is at the position shown as point A. Circle the path that best represents the initial direction of the ball in the moment after the string is cut.



6)

You are isolated and floating out in space far away from outside influences. Obviously between bouts of feeling sorry for yourself, you get bored. It turns out you have a block of wood and a block of lead, one in each hand. The blocks look and feel identical. How could you tell which one is the lead block?

- a) Give each block a light tap with your finger; the one that accelerates the least is the lead block.
- b) Give each one a light tap with your finger; the one that accelerates the most is the lead block.
- c) Let go of the blocks; the one that falls the fastest is the lead block.
- d) None of the above methods will tell you which block is which.

7)

Two electrically charged balls sit on a table. Ball A has a charge of $+10q$. Ball B has a charge of $-1q$.

- a) Ball A repels ball B with a force that is 10 times that with which ball B repels ball A.
- b) Ball A attracts ball B with a force that is 10 times that with which ball B attracts ball A.
- c) There is no force between the balls.
- d) Ball A repels ball B with the same force that ball B repels ball A.
- e) Ball A attracts ball B with the same force that ball B attracts ball A.

8)

A radio station broadcasts a signal at a frequency of 90×10^6 Hz (or s^{-1}).

What is the wavelength of this radio wave?

Photons in this signal have what energy?

9

Which of the following has the longest wavelength?

- a) An alpha particle.
- b) An electron.
- c) A baseball.
- d) A water molecule.
- e) None of these objects have a wavelength.

10

Astronauts in orbit around the earth feel "weightless" because

- a) there is no gravity in the vacuum of space.
- b) they are moving at constant velocity.
- c) no forces are acting on them.
- d) NASA has them on a strict low carb diet.
- e) they are in free fall around the earth.

11

An average person in the US lives approximately 72 years. Does this mean that it is impossible for such an average person to travel more than 72 light years from earth (in principle)? Briefly explain your reasoning. Note: assume crazy things like cryogenic sleep do not play a role here.

12

An object falling near the surface of the earth has a constant acceleration of 9.8 m/s^2 . This means that the

- a) object falls 9.8 m during the first second of its motion.
- b) object falls 9.8 m during each second of its motion.
- c) speed of the object increases by 9.8 m/s during each second of its motion.
- d) acceleration of the object increases by 9.8 m/s^2 during each second of its motion.
- e) force of gravity on the object is 9.8 Newtons.

13

Sam and Fred stand on the roof of Sue B, each enjoying a twelve-ounce can of a fine beverage. When they notice someone else on the roof coming near them, Sam and Fred decide to ditch their fine beverages. Sam reaches over the edge of the roof and drops his can. Fred leans out over the edge of the roof and throws his can straight down.

If the cans leave the boys' hands simultaneously and at the same height, which can hits the ground first?

While in the air after leaving the hands, which can has the greater acceleration, or are they the same?

14

Earthbound doctors monitor the heartbeat of astronauts in a ship flying past earth with a speed of $0.9c$. If one of the astronauts measures her heartbeat to be 70 beat/minute, what do the doctors on earth perceive her heart rate to be (in beats/minute)?

15

Consider a wave moving at 6 m/s on a rope. I have frozen time momentarily and sketched the wave below from a side view. What you see is the displacement of the rope from the nominal vertical position with no wave passing along the y axis versus the position along the rope along the x axis. If I unfroze time, the shape you see would move to the right at 6 m/s .

- What is the amplitude of the wave sketched below?
- What is the wavelength of the wave sketched below?
- What is the frequency of the wave sketched below?
- What is the period of the wave sketched below?

