

STRUCTURE OF THE ATOM

Read the following questions before viewing the program.

Program 1

1. Which Greek philosopher is credited with proposing that matter consists of tiny particles called atoms?
2. What is the origin of the word atom?
3. List the main concepts in Democritus's theory of matter.
4. Explain why the early Christian church opposed the theory of atomism.
5. After Democritus's theory was rejected by more prominent philosophers such as Plato and Aristotle, no progress was made towards the theory of the atom for a long period of time. About how long was this period?
6. Alchemists did not make a positive contribution to the theory of matter but they did bring about an important change in attitude. What was this change?

Program 2

1. Describe briefly the problem that Dalton was trying to solve when the concept of the atom occurred to him.
2. List the key points in Dalton's atomic theory.
3. Faraday did not believe that Dalton's atomic theory was correct, but his work did suggest that matter was held together by specific forces. What according to Faraday, were these forces?
4. Faraday and many other scientists worked with cathode rays. Draw a diagram to show how cathode rays are produced.

5. Work with cathode rays eventually showed that atoms were not the hard, impenetrable spheres visualized by Dalton. William Crookes determined several important characteristics of cathode rays. What were these characteristics? Upon what experimental evidence did Crookes draw his conclusions?
6. How did J.J. Thomson show that cathode rays consist of a stream of negatively charged particles?
7. How was J.J. Thomson able to determine the ratio of mass to charge for the cathode ray particles?
8. What is the significance of the fact that J.J. Thomson found the ratio of mass to charge for the cathode ray particles was the same, no matter what metal he used for the cathode or what gas he placed in the tube?
9. What is the significance of Millikan's experiment, in which oil droplets were placed between oppositely charged plates and observed?
10. Using a diagram, show the main features of Thomson's model of the atom.
11. What are the key differences between J.J. Thomson's model and Dalton's model of the atom?

Program 3

1. Who is the scientist credited with the discovery of radioactivity?
2. With the aid of a diagram, explain how a magnetic field can be used to prove that a radioactive substance may be giving off two kinds of particles.
3. Name the two kinds of particles given off by radioactive substances.
4. What characteristics of the alpha particle seemed to make it suitable for probing the atom?

5. Draw a diagram showing how Rutherford arranged his apparatus so that alpha particles could be fired at atoms and their paths could be detected.
6. List the observations made by Rutherford and his associates when alpha particles were directed at a sheet of gold foil. Include a sketch showing the trajectories of a number of alpha particles as they pass through the foil.
7. Which observation did Rutherford find particularly surprising?
8. Explain why Rutherford concluded that most of the atom was empty space.
9. How did Rutherford come to the realization that the collisions between the alpha particles and the atoms differed from collisions between hard spheres, such as billiard balls?
10. What name did Rutherford give to the concentration of mass in the atom?
11. How did Rutherford come to realize that the radius of the nucleus must be no more than 3×10^{-14} m?
12. Draw a picture of the model of the atom as Rutherford visualized it.
13. How did Rutherford explain the fact that the electrons in the space about the nucleus did not leave the nucleus, but stayed near it?
14. Why, according to classical physics, should the electron spiral into the nucleus if Rutherford's concept of the atom was actually correct?

Program 4

1. State the difference between the way classical physicists visualized the radiation of energy and the way Max Plank visualized it.
2. What name did Plank give to this "bundle" of energy?
3. Which electrons about the nucleus of an atom possess the most energy?
4. How did Bohr's concept of the arrangement of electrons about the atom differ from Rutherford's concept?
5. How many electron orbits are there possible for the hydrogen atom?
6. What happens to the speed of the electron as it goes to a higher energy level?
7. How can an electron in the first energy level of the hydrogen atom obtain enough energy to get to a higher energy level?
8. What happens when a free electron with *less* than 10.2 eV of energy interacts with an electron in the first energy level of the hydrogen atom?
9. What would your answer for question 11 be if the free electron has *more* than 10.2 eV of energy?
10. How much energy is required to enable an electron in the first energy level to escape completely from the atom?
11. When an electron moves from a lower to a higher energy level it absorbed energy. How does it lose the energy it absorbed when it moves back to the lower energy level?