Inside the Atom

Compare what atomic models explain and where they fall short

CHE.1.a "Assess the merits and limitations of historic and modern atomic models pertaining to the presence, position, mass, and charge of subatomic particles."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each model's strength and circle its limitation. Use your marks to compare how the models describe subatomic particles.

How Do We Know What Is Inside?

1. Imagine trying to map a room by tossing marbles into it and listening for impacts. Early atomic models faced a similar problem: atoms were too small to see directly. Dalton pictured each element as made of solid, indivisible atoms. His model helped explain why elements combine in fixed ratios, but it had no place for subatomic particles. Later, Thomson used evidence from cathode rays to identify negatively charged electrons. He placed them within a spread of positive charge, making atoms neutral, but proposed no nucleus.

2. Rutherford fired positively charged alpha particles at thin gold foil. Most passed through, but a few bounced back sharply. His model put a tiny, dense, positively charged nucleus at the center and electrons outside it. This explained the rare sharp deflections better than Thomson's spread-out positive charge. Protons in the nucleus carry positive charge and have much more mass than electrons, which carry negative charge. Rutherford's model, however, did not explain why electrons remain around the nucleus.

3. Bohr proposed that electrons occupy specific energy levels around the nucleus. This model explained the distinct colors of light from hydrogen, but it could not accurately describe more complex atoms. Today's quantum model describes electrons by regions where they are likely to be found, not fixed paths. It places positively charged protons and neutral neutrons in the nucleus; each has far more mass than an electron. The model explains many observations, but it predicts probabilities rather than an electron's exact position at any instant.

2 ANSWER WITH EVIDENCE

Use the passage

1. What did Thomson's model explain about charge, and what important position did it leave out?

2. Why did Rutherford's model explain the gold-foil results better than Thomson's model?

3. What could Bohr's model explain about electrons, and where did it fall short?

4. How does the modern model improve on Dalton's model when describing particles and mass?

3 YOUR TURN

Your own words

A museum label claims, "Electrons travel in exact circles, and nearly all an atom's mass is spread through its outer region." Write 3 or 4 sentences correcting both claims with two models and one observation from the passage. Include the positions of positive and neutral particles.

ANSWER KEY

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PART 1 · READ AND MARK

Underline each model's strength and circle its limitation. Use your marks to compare how the models describe subatomic particles. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	What did Thomson's model explain about charge, and what important position did it leave out?	**It explained how negative electrons within spread-out positive charge could make an atom neutral, but it had no nucleus.**
2	Why did Rutherford's model explain the gold-foil results better than Thomson's model?	**A tiny, dense, positively charged nucleus could cause the rare sharp deflections; spread-out positive charge could not explain them as well.**
3	What could Bohr's model explain about electrons, and where did it fall short?	**Its specific electron energy levels explained hydrogen's distinct light colors, but the model could not accurately describe more complex atoms.**
4	How does the modern model improve on Dalton's model when describing particles and mass?	**Dalton's atoms had no subatomic particles. The modern model includes electrons outside a nucleus containing protons and neutrons, each far more massive than an electron.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The quantum model describes electrons in regions where they are likely to be found, not on exact circles. In Rutherford's gold-foil experiment, a few particles bounced back sharply, supporting a tiny, dense nucleus instead of mass spread through the outer region. In the modern model, positively charged protons and neutral neutrons occupy that nucleus, and each has far more mass than an electron.

Accept responses that distinguish likely electron locations from exact paths and place the much heavier protons and neutrons in the nucleus. The rare sharp deflections provide evidence for a small, dense nucleus.