4.2 The development of the model of the atom

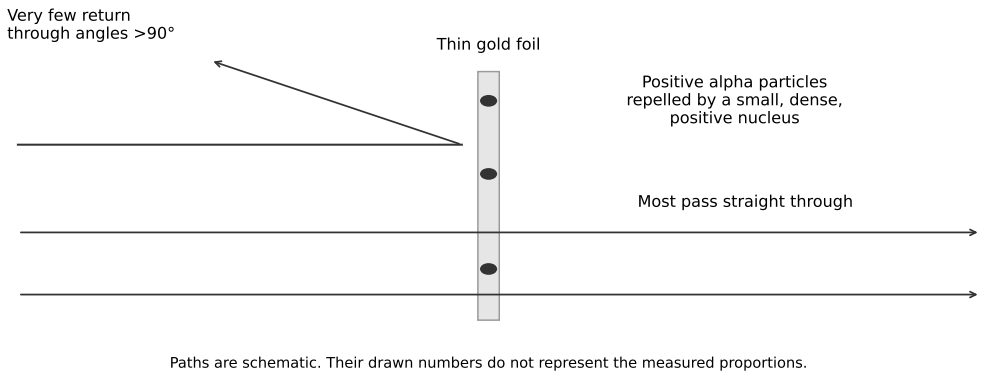
Name: _____ Class: _____ Date: _____ **Total: 15 marks**

KEY WORDS nucleus

Objective

Tell the story of the atomic model in order, and explain why the alpha scattering evidence forced the change from the plum pudding model. Original questions for spec statement 4.4.1.3.

1 Key knowledge and worked examples



The observations only make sense with a nuclear model.

Stage	Model	Evidence that caused it
before 1897	tiny spheres, indivisible	none better available
after electron found	**plum pudding**: ball of positive charge, electrons embedded	electrons exist but atom is neutral
after scattering	**nuclear model**: mass and positive charge at the centre	alpha scattering results
Bohr	electrons orbit at **specific distances**	his calculations matched observations
later	nucleus = whole-number positive units → **protons**	further experiments
Chadwick (~20 years on)	**neutrons** in the nucleus	his experimental evidence

Why the scattering changed the model (three marks):

1. If the pudding model were right, alpha particles would pass through with only small deflections – the charge is spread out.
2. Most did pass straight through (atoms are mostly empty space), but **a few bounced back through large angles**.
3. A large deflection needs a concentrated repulsion: the mass and positive charge must sit in a **tiny, dense, positively charged nucleus**.

You do not need the experimental details behind Bohr or Chadwick – only what each contributed.

2 Practice

2.1 Put in order: plum pudding model, nuclear model, tiny indivisible spheres, Bohr orbits, neutrons. [1]

2.2 State two features of the plum pudding model. [2]

2.3 State what Bohr added to the nuclear model. [1]

3 Exam-style questions

3.1 Describe the difference between the plum pudding model and the nuclear model of the atom. [2]

3.2 In the alpha scattering experiment, most alpha particles passed straight through the gold foil.

(a) What does this observation show about the structure of the atoms? [1]

(b) A few alpha particles were deflected through angles greater than 90°. Explain what this observation shows. [3]

(c) Explain why these observations led to the plum pudding model being replaced. [2]

3.3 "The change from the plum pudding model to the nuclear model shows how science works." Explain this statement using the idea of evidence and models. [3]