

15 At the beginning of the 20th century, Rutherford carried out large-angle alpha particle scattering experiments using gold ($^{197}_{79}\text{Au}$) foil.

The vast majority of the alpha particles went straight through the foil whilst a few were deflected straight back.

(a) Describe how the model of the atom changed, as a consequence of these experiments.

(4)

(b) In one experiment the alpha particles had an initial energy of 7.7 MeV.

Calculate the distance of closest approach of the alpha particles to the nucleus of a gold atom. Assume that the gold nucleus remains at rest.

(4)

Distance of closest approach =

(c) Rutherford also carried out the experiment with aluminium ($^{27}_{13}\text{Al}$) foil.

The aluminium foil had the same thickness as the gold foil and the alpha particles had the same initial kinetic energy.

The following observations were made.

Observation 1:

The fraction of alpha particles scattered at any particular angle for aluminium foil was always much less than for gold foil.

Observation 2:

The alpha particles scattered from aluminium foil had less kinetic energy than the alpha particles scattered from gold foil.

Explain how these observations can be used to deduce how an aluminium nucleus compares to a gold nucleus.

(4)

(Total for Question 15 = 12 marks)