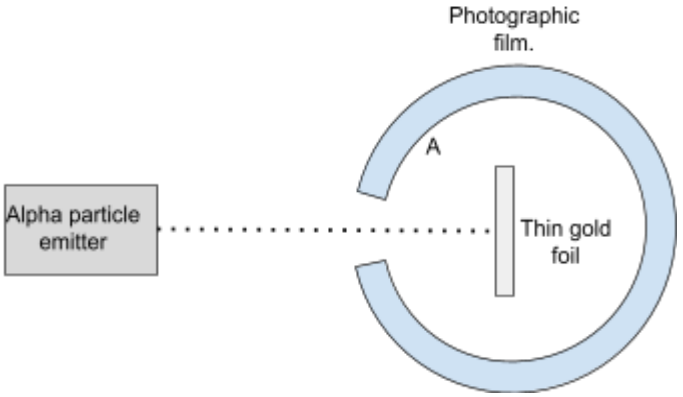
Particles and Waves

Spectra and Model of the Atom

1) In 1913 two researchers called Geiger and Marsden carried out research for Ernest Rutherford.

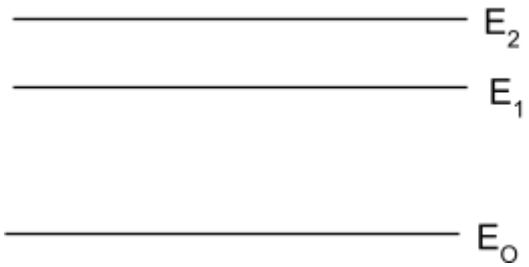
   Alpha particles were directed towards a thin piece of foil.

   State which of the following statements about the experiment is true:



   a) Most of the alpha particles passed straight through the gold foil.
   b) Not many alpha particles passed through the gold foil.
   c) A tiny number were deflected to position A.
   d) Most alpha particles were deflected to position A
   e) The experiment proved the plum pudding model of the atom.
   f) The experiment proved that most of the atom is empty space.
   g) The experiment proved that there is a massively positively charged region at the centre of the atom.
   h) Rutherford stated that the experiment revealed an atom with a small densely negative charged region at the centre of the atom.

2) Rutherford's model of the atom was improved by Niels Bohr taking into account the study of emission spectra.
   The diagram below shows the energy levels of a simple atom.



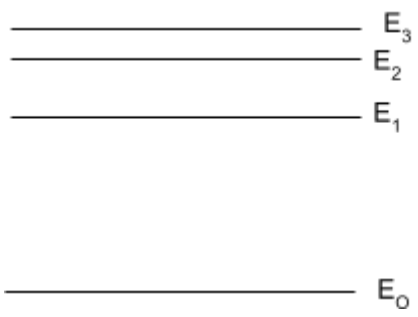
   a) Copy the diagram and show all the possible electron transitions that will give rise to emission lines.
   b) Which transition gives rise to the emission of a photon with the highest frequency?
   c) State the name given to the lowest energy level E_O

3) The diagram below shows the possible energy level diagram of an atom.

a) Determine the number of emission lines that would be produced.

b) State the transition that would emit a photon of the longest wavelength.

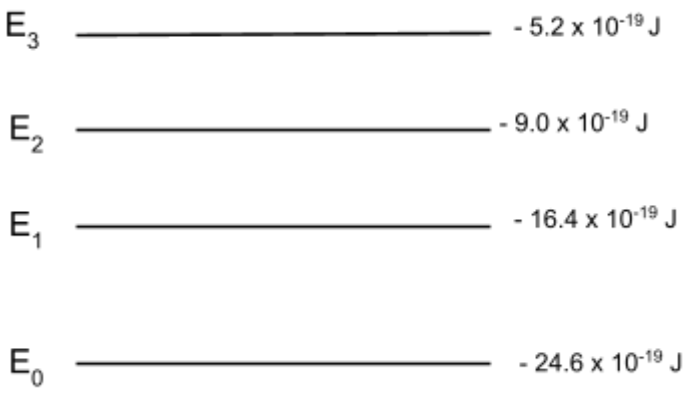
c) State the transition that would emit a photon of the highest frequency.



4) The diagram below represents the energy levels in the Bohr model of an atom.

a) An electron makes a downward transition from energy level E_3 to E_0
Determine the energy of the photon emitted.

b) An electron makes a downward transition from energy level E_1 to E_0
Determine the frequency of the photon

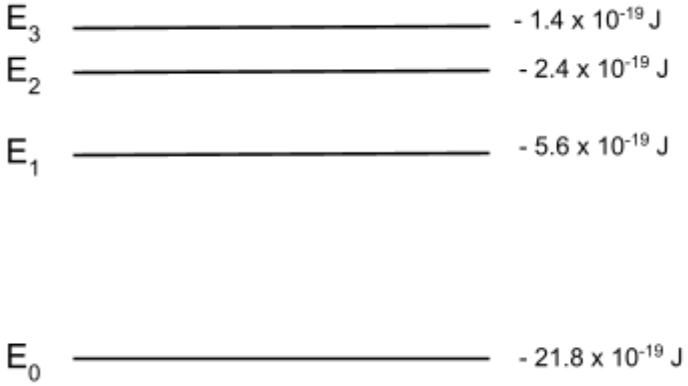


5) The diagram shows the discrete energy levels of an atom.

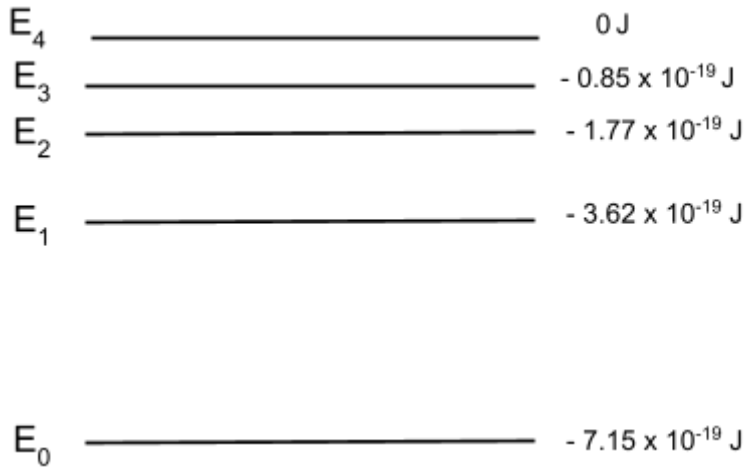
a) State which transition produces a photon with the longest wavelength.
Explain your answer.

b) Calculate the wavelength of the photon emitted from a transition E_1 to E_0

c) A photon is emitted during a transition. It has a frequency of 4.83×10^{14} Hz.
Determine the energy levels of the transition.



6) The diagram shows the discrete energy levels of an atom.



a) An electron is in the ground state. State the energy of a photon that the electron would have to absorb to reach the ionisation level.

b) A photon of light having wavelength 370 nm is absorbed by an electron in the ground state. Determine the energy level the electron would rise to.

c) The spectral line of the transition E_2 to E_1 is much brighter than any of the other lines in the emission spectra of this atom.
Explain why this line is the brightest.

d) Determine the number of emission lines that this atom could produce.