

**Mark scheme for Support Worksheet – Topic 6,  
Worksheet 1**

- 1 The electrostatic force. [1]
- 2 a Most of the alpha particles directed at a thin foil of gold were only slightly deflected. [1]  
Very rarely a few were deflected by very large angles. [1]  
To do this a huge force was necessary and it could only come about if the alpha particles approached very close to the positive charge of the atom, i.e. the positive charge had to be concentrated in a very small volume. [1]
- b Cannot account for why the electrons should not radiate. [1]
- 3 a Emission spectra are obtained when a gas at low pressure is excited (by an electric field OR high temperatures, for example) [1]  
And photons whose energy is equal to energy level differences are emitted by the gas. [1]
- b Atomic spectra show emission and absorption lines at **specific wavelengths** [1]  
which can be explained if we assume discrete energy levels and therefore specific energy differences between energy levels. [1]
- 4 Absorption spectra are obtained when light passes through a gas at low pressure; [1]  
and wavelengths corresponding to energies equal to energy level differences are absorbed by the gas. [1]
- 5  $16 - 7 = 9$  [1]
- 6 Nuclei with the same number of protons; [1]  
but different number of neutrons. [1]
- 7 Protons. [1]
- 8 Protons and neutrons. [1]
- 9 The random and spontaneous emission of energy by a nucleus; [1]  
in the form of alpha, beta or gamma particles. [1]
- 10 They can transfer energy to electrons in atoms and cause them to leave the atom. [1]
- 11  ${}_{84}^{218}\text{Po} \rightarrow {}_2^4\alpha + {}_{82}^{214}\text{Pb}$  [2]
- 12  ${}_{27}^{60}\text{Co} \rightarrow {}_{-1}^0\text{e} + {}_{28}^{60}\text{Ni} + {}_0^0\bar{\nu}$  [2]
- 13  ${}_{12}^{24}\text{Mg} \rightarrow \gamma + {}_{12}^{24}\text{Mg}$  [1]



- 14** Random: it cannot be predicted which nucleus will decay and when it will decay. [1]  
Spontaneous: the decay process cannot be influenced in any way. [1]
- 15** A time 15 minutes is three half-lives [1]  
and so the amount left is  $120 \rightarrow 60 \rightarrow 30 \rightarrow 15$  mg [1]