Problem 1:

Radiation energy spectra can be categorized into two main groups: those that consist of one or more discrete energies (line spectra) and those that consist of a broad distribution of energies (continuous spectra). For each of the radiation sources listed below, indicate whether « line » or « continuous » is a better description:

a) Alpha particles  
   LINE

b) Beta particles  
   CONTINUOUS

c) Gamma rays  
   LINE

d) Characteristic X-rays  
   LINE

e) Conversion electrons  
   LINE

f) Auger electrons  
   LINE

g) Fission fragments  
   CONTINUOUS

h) Bremsstrahlung  
   CONTINUOUS

i) Annihilation radiation  
   LINE
Problem 2:

Which has the higher energy: a conversion electron from the L shell or from the M shell, if both arise from the same nuclear excitation energy?

\[ E_{e^-} = E_{ex} - E_{binding} \]

\[ E_{binding}(L) > E_{binding}(M) \]

\[ E_{e^-}(L) < E_{e^-}(M) \]

Thus, a conversion electron from the M shell will have higher energy than the electron from the L shell, if both arise from the same nuclear excitation energy.

Problem 3:

Determine \( A_z X \) in the following nuclear reactions:

a) \( _1^2 H + _z^A X \rightarrow _2^4 He + _2^4 He \) \( \rightarrow ^6 Li \)

b) \( _7^{14} N + _z^A X \rightarrow _8^{17} O + _1^1 H \) \( \rightarrow ^4 He \)

c) \( _z^A X \rightarrow _{27}^{60} Co + \gamma \) \( \rightarrow ^{60}_{27} Co^* \)

d) \( _z^A X + _2^4 He \rightarrow _6^{12} C^* + _{0}^1 n \) \( \rightarrow ^9_{4} Be \)