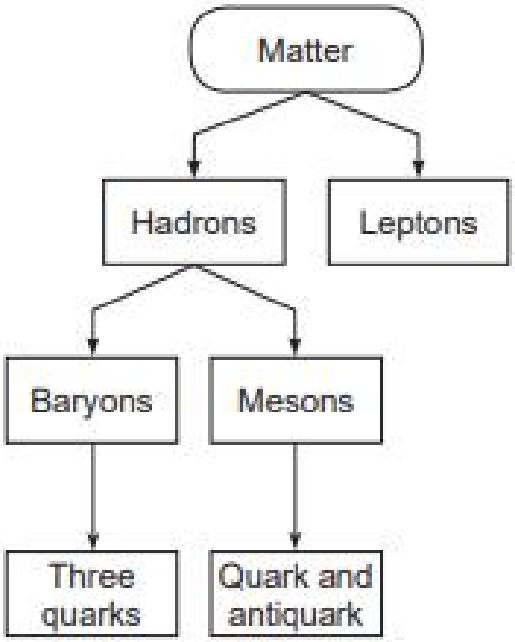
Question 15 **(12 marks)**

The table below shows the classification of matter.



A kaon is a subatomic particle first detected in cosmic rays in 1947. There are four types:

K^- a negatively-charged particle consisting of a strange quark and an up antiquark

K^+ a positively-charged antiparticle of the K^- kaon

K^0 a neutrally-charged particle consisting of a strange antiquark and a down quark

K^{0-} the antiparticle of the K^0.

(a) Are kaons classified as baryons or mesons? _____ (1 mark)

(b) Justify your answer to part (a). (2 marks)

_____

_____

_____

_____

(c) Name the quarks that make up the K^{0-} particle. (2 marks)

_____

_____

(d) K^- particles have a mean lifetime of 1.238×10^{-8} s in their own frame of reference. Kaons produced in a particle accelerator were found to be moving at $0.850c$. Calculate their mean lifetime in the frame of reference of a stationary observer. (3 marks)

_____ s

Kaons were produced in the Tevatron, a particle accelerator in the United States. Protons were accelerated in a linear accelerator (LINAC) containing a strong electric field. Then they were injected into the circular main injector ring to be accelerated to energies of up to 1 TeV.

(e) With the use of appropriate equations, explain how the protons were:

(i) accelerated to high speeds in the linear accelerator. (2 marks)

(ii) held in circular paths in the main ring. (2 marks)