

Name of the Student: _____

Max. Marks : 18 Marks

Time : 18 Minutes

Q1.

Mesons that contain a strange (or antistrange) quark are known as K-mesons or kaons. Mesons are a sub-group of a larger group of particles.

- (a) (i) State the name of this larger group of particles.

(1)

- (ii) Determine the charge on a kaon with a quark structure of $u\bar{s}$.

(1)

- (b) A proposed decay for this kaon is

$$u\bar{s} \longrightarrow \mu^+ + \nu_\mu$$

- (i) Apply the law of conservation of strangeness to the proposed decay.

(1)

- (ii) Comment on whether or not this decay is possible.

(1)

(Total 4 marks)

Q2.

- (a) State what is produced when an electron and a positron annihilate each other.

(1)

- (b) (i) Explain why mass is not necessarily conserved when particles interact or decay.

(1)

- (ii) Momentum is conserved in all particle interactions. Name the **three** other conservation laws that are obeyed in **all** nuclear interactions.

(3)

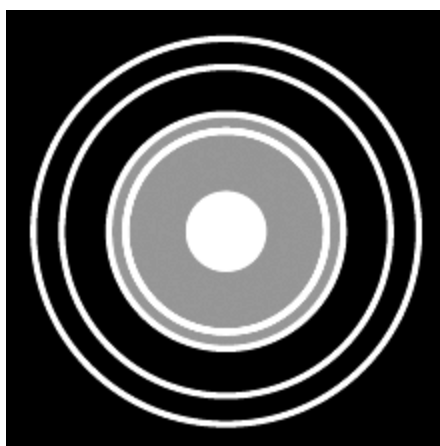
(Total 5 marks)

Q3.

- (a) J.J. Thompson investigated the nature of cathode rays in discharge tubes. Suggest how he could have demonstrated that the cathode rays were negatively charged particles.

(2)

- (b) In an experiment, electrons are incident on a thin piece of graphite. The electrons emerging from the graphite strike a fluorescent screen and produce the pattern shown in the figure below.



State and explain the evidence this provides about the nature of moving electrons.

(2)

(c) High energy electrons may be used to investigate the nature of protons of diameter 2.4×10^{-15} m.

- (i) Calculate the lowest value of the momentum of the high energy electrons that would be suitable for this investigation.
State an appropriate unit for your answer.

momentum _____ unit _____

(3)

- (ii) Calculate the kinetic energy of the electrons.

kinetic energy _____ J

(2)

(Total 9 marks)