

Particle Physics Exam Qs

Q1.(a) State the combination of quarks that makes up a neutron.

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(1)

(b) When a neutron decays, a down quark changes into an up quark as shown by the following reaction.

$$d \rightarrow u + e^- + \bar{\nu}_e$$

(i) Show, in terms of the conservation of charge, baryon number and lepton number, that this transformation is permitted.

(3)

(ii) State the products arising from the decay of an anti-down quark, \bar{d} .

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.....

(1)

(Total 5 marks)

Q2. In a nuclear reaction $^{14}_7\text{N}$ is bombarded by neutrons. This results in the capture of one neutron and the emission of one proton by one nucleus of $^{14}_7\text{N}$. The resulting nucleus is

A $^{13}_7\text{N}$

B $^{14}_6\text{C}$

C $^{12}_6\text{C}$

D $^{14}_8\text{O}$

(Total 1 mark)

Q3.Leptons, mesons and baryons are three classes of sub-atomic particles.

- (a) Some classes of particles are fundamental; others are not. Circle the correct category for each of these three classes.

leptons	fundamental/not fundamental
mesons	fundamental/not fundamental
baryons	fundamental/not fundamental

(1)

- (b) Name the class of particles of which the proton is a member.

.....

(1)

- (c) By referring to the charges on up and down quarks explain how the proton has a charge of $+1e$.

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.....
.....

(2)

(Total 4 marks)

Q4.A negative pion (π^-) is a meson with a charge of $-1e$.

State and explain the structure of the π^- in terms of up and down quarks.

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.....
.....

(Total 3 marks)

Q5. A physicist, who is attempting to analyse a nuclear event, suggests that a π^- particle and a proton collided and were annihilated with the creation of a neutron, a π^+ particle, and a K^- particle.

π and K particles are mesons. The baryon and lepton numbers of both these mesons are zero.

(a) Write down the equation that represents this interaction.

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(1)

(b) Show, in terms of the conservation of charge, baryon number and lepton number, that this transformation is permitted.

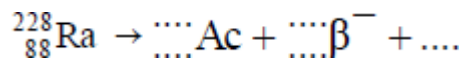
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(4)

(Total 5 marks)

Q6. A radium-288 nuclide (${}^{228}_{88}\text{Ra}$) is radioactive and decays by the emission of a β^- particle to form an isotope of actinium (Ac).

(a) Complete the equation for this decay.



(3)

(b) β^- decay is the result of a neutron within a nucleus decaying into a proton. Describe the change in the quark sub-structure that occurs during the decay.

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(1)

(Total 4 marks)