

1

(a) Describe the interaction that is responsible for keeping protons and neutrons together in a stable nucleus.

You should include details of the properties of the interaction in your answer.

(3)

(b) Nuclei can decay by alpha decay and by beta decay.

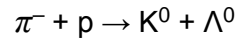
In alpha decay only one particle is emitted but in beta decay there are two emitted particles.

Explain how baryon number is conserved in alpha and beta decay.

(3)

- (c) Kaons are mesons that can be produced by the strong interaction between pions and protons.

The equation shows a reaction in which a kaon and a lambda particle are produced.



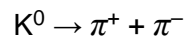
Deduce the quark structure of the Λ^0

quark structure = _____

(2)

- (d) The kaon decays by the weak interaction.

The equation shows an example of kaon decay.



State **one** feature of this decay that shows it is an example of the weak interaction.

(1)

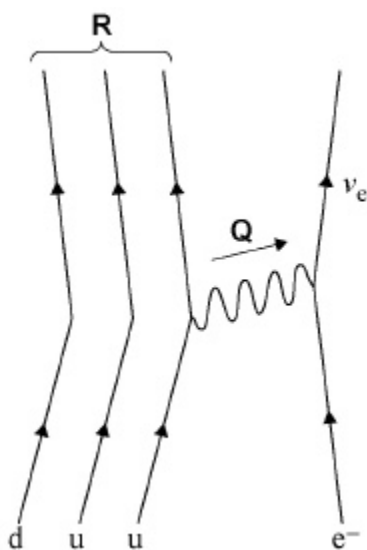
- (e) There have been considerable advances in our understanding of particle physics over the past 100 years.

Explain why it is necessary for many teams of scientists and engineers to collaborate in order for these advances to be made.

(2)

(Total 11 marks)

5 The partially completed diagram represents electron capture.



Which row identifies the exchange particle **Q** and the quark structure of particle **R**?

	Particle Q	Quark structure of particle R	
A	W^-	uuu	<input type="checkbox"/>
B	W^+	dud	<input type="checkbox"/>
C	W^+	uuu	<input type="checkbox"/>
D	W^-	dud	<input type="checkbox"/>

(Total 1 mark)

6 The decay of a neutral kaon K^0 is given by the equation

$$K^0 \rightarrow X + Y + \bar{\nu}_e$$

What are X and Y?

	X and Y	
A	e^+ and e^-	<input type="checkbox"/>
B	μ^+ and e^-	<input type="checkbox"/>
C	π^+ and e^-	<input type="checkbox"/>
D	π^- and e^+	<input type="checkbox"/>

(Total 1 mark)

11

When a nucleus of the radioactive isotope ${}^{65}_{28}\text{Ni}$ decays, a β^- particle and an electron antineutrino are emitted.

How many protons and neutrons are there in the resulting daughter nucleus?

	Number of protons	Number of neutrons	
A	28	65	<input type="checkbox"/>
B	29	65	<input type="checkbox"/>
C	29	36	<input type="checkbox"/>
D	30	35	<input type="checkbox"/>

(Total 1 mark)

12

What interactions are involved in the production of a strange particle and its decay into non-strange particles?

	Production	Decay	
A	strong	weak	<input type="checkbox"/>
B	strong	strong	<input type="checkbox"/>
C	weak	strong	<input type="checkbox"/>
D	weak	weak	<input type="checkbox"/>

(Total 1 mark)

16

An atom of $^{16}_7\text{N}$ gains 3 electrons.

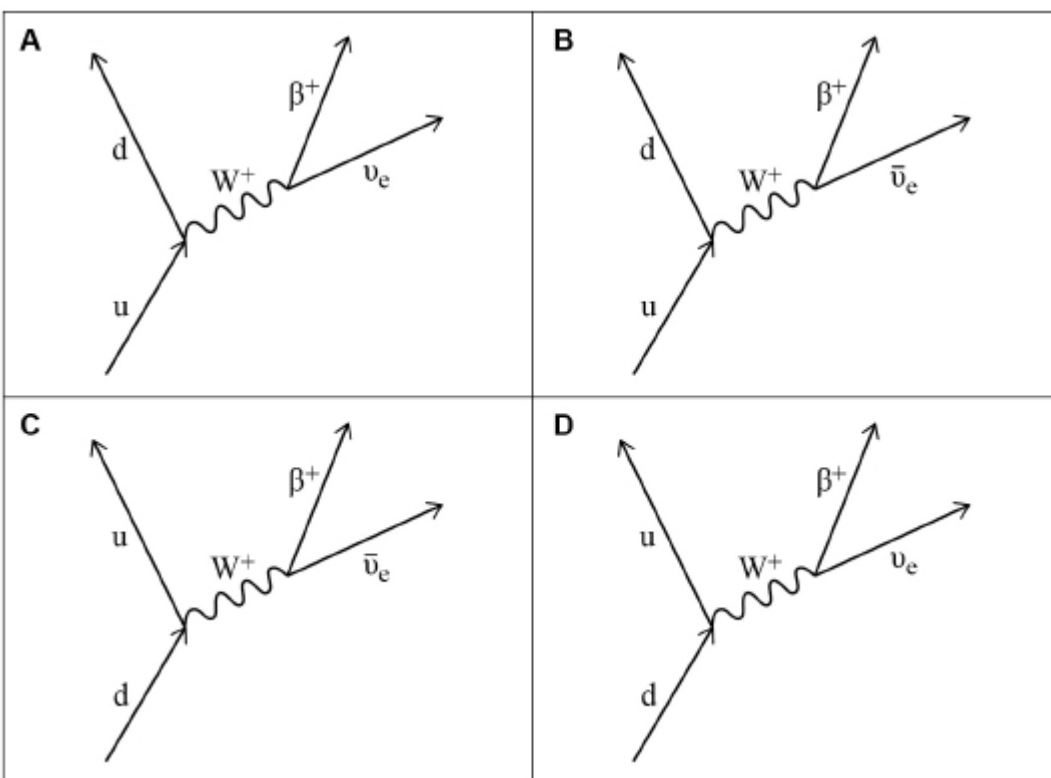
What is the specific charge of the ion?

- A $1.80 \times 10^7 \text{ C kg}^{-1}$
- B $-1.80 \times 10^7 \text{ C kg}^{-1}$
- C $4.19 \times 10^7 \text{ C kg}^{-1}$
- D $-4.19 \times 10^7 \text{ C kg}^{-1}$

(Total 1 mark)

17

Which diagram represents the process of beta-plus decay?



- A
- B
- C
- D

(Total 1 mark)