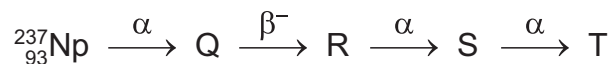


- 38** The diagram shows a sequence of radioactive decays involving three α -particles and a β^- particle.



What is nuclide T?

- A** ${}_{88}^{225}\text{Ra}$ **B** ${}_{88}^{231}\text{Ra}$ **C** ${}_{90}^{225}\text{Th}$ **D** ${}_{90}^{229}\text{Th}$

- 39** The number of electrons in a neutral atom of an isotope of plutonium, ${}_{94}^{239}\text{Pu}$, is changed to produce a charged atom (ion) W.

W has an overall charge of $+1.6 \times 10^{-19} \text{ C}$.

How many protons, neutrons and electrons are in W?

	protons	neutrons	electrons
A	94	145	93
B	94	145	95
C	238	94	239
D	239	94	238

- 40** Which particle is a lepton?

- A** meson
B positron
C proton
D quark

6 The nuclide ${}^3_1\text{H}$ is an isotope of hydrogen that is called tritium.

(a) (i) Determine the numbers of protons, neutrons and electrons in a neutral atom of tritium.

number of protons =

number of neutrons =

number of electrons =

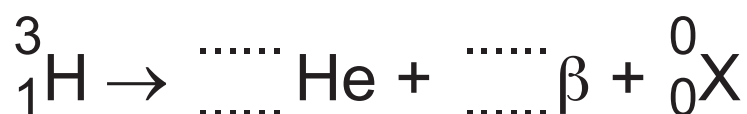
[2]

(ii) Draw a labelled diagram to represent a simple model of the arrangement of the protons, neutrons and electrons in a tritium atom.

[2]

(b) Tritium is radioactive and undergoes β^- decay to form an isotope of helium (He). Gamma radiation is not emitted during this decay.

(i) Complete the equation to represent the radioactive decay of tritium.



[2]

(ii) State the name of particle X.

..... [1]

(c) Determine the quark composition of a tritium nucleus.

.....
 [2]

[Total: 9]

40 The nucleus of a radioactive isotope of an element emits an α -particle. The daughter nucleus then emits a β^- particle and then the daughter nucleus of that reaction emits another β^- particle.

Which statement describes the final nuclide that is formed?

- A** It is a different isotope of the original element.
- B** It is a nuclide of a different element of higher proton number.
- C** It is a nuclide of the same element but with different proton number.
- D** It is identical to the original nuclide.

40 How many flavours (types) of antiquark are there?

- A** 3
- B** 4
- C** 5
- D** 6

8 (a) An antiparticle equivalent of the neutron is called the antineutron. The quarks in the antineutron are the antiparticles of the quarks in a neutron.

The elementary charge is e .

In Table 8.1, state the flavour and charge of the three antiquarks that comprise the antineutron.

Table 8.1

flavour	charge / e

[3]

(b) In β^- decay, a neutron decays to form a proton.

Theory predicts that an antineutron should decay to form an antiproton. A particle and an antiparticle should also be observed.

Suggest the names of the particle and the antiparticle.

particle:

antiparticle:

[2]

[Total: 5]

8 (a) State what is meant by the de Broglie wavelength.

.....
 [1]

(b) Calculate the de Broglie wavelength of an electron moving at a speed of $4.9 \times 10^7 \text{ ms}^{-1}$.

wavelength = m [2]

(c) State **one** similarity and **one** difference between an electron and a positron.

similarity:

 difference:
 [2]

(d) An electron moving at a speed of $4.9 \times 10^7 \text{ ms}^{-1}$ collides with a positron that is travelling at the same speed in the opposite direction. As a result of the collision, two gamma-ray photons are produced.

(i) State the name of this type of reaction.

..... [1]

(ii) State what happens to the electron and to the positron.

.....

 [2]

(iii) Explain why two gamma-ray photons are produced, rather than just one.

.....

..... [1]

(iv) Show that the kinetic energy of the electron before the collision is $1.1 \times 10^{-15} \text{ J}$.

[1]

(v) Use the information in (d)(iv) to determine, to three significant figures, the wavelength associated with the gamma radiation emitted in the collision.

wavelength = m [3]

[Total: 13]