

Particle Physics - 1

Practice questions

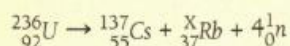
- 1 Which line represents the correct number of protons, neutrons and electrons in an atom of one of the isotopes of lead $^{208}_{82}\text{Pb}$?

	protons	neutrons	electrons
A	82	126	126
B	126	82	126
C	208	82	208
D	82	126	82

- 2 What is the specific charge of a gold $^{197}_{79}\text{Au}$ nucleus? The mass of the gold nucleus is $3.29 \times 10^{-25} \text{ kg}$; the charge on the electron is $1.6 \times 10^{-19} \text{ C}$.

- A $3.63 \times 10^7 \text{ C kg}^{-1}$ C $3.92 \times 10^7 \text{ C kg}^{-1}$
 B $3.84 \times 10^7 \text{ C kg}^{-1}$ D $9.56 \times 10^7 \text{ C kg}^{-1}$

- 3 Uranium-236 may split into a caesium nucleus, a rubidium nucleus and four neutrons as shown below in the following nuclear equation. What is the value of X for the rubidium nucleus?



- A 92 B 95 C 98 D 99

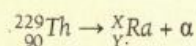
- 4 What is the charge, in C, of an atom of $^{15}_7\text{N}$ from which a single electron has been removed?

- A $-9.6 \times 10^{-19} \text{ C}$ C $+1.6 \times 10^{-19} \text{ C}$
 B $-1.6 \times 10^{-19} \text{ C}$ D $+9.6 \times 10^{-19} \text{ C}$

- 5 In a radioactive decay a gamma photon of wavelength $8.3 \times 10^{-13} \text{ m}$ is emitted. What is the energy of the photon? The speed of light is $3 \times 10^8 \text{ ms}^{-1}$.

- A $5.4 \times 10^{-46} \text{ J}$ C 57 J
 B $2.4 \times 10^{-13} \text{ J}$ D $2.0 \times 10^{43} \text{ J}$

- 6 Thorium decays by the emission of an alpha particle as shown in the equation:



What are the correct values for X and Y?

	X	Y
A	225	88
B	88	225
C	229	91
D	227	86

- 7 $^{14}_6\text{C}$ is a radioactive isotope of carbon. It can form an ion when two electrons are removed from the atom. What is the charge on this ion in coulombs?

- A $-9.6 \times 10^{-19} \text{ C}$ C $3.2 \times 10^{-19} \text{ C}$
 B $-3.2 \times 10^{-19} \text{ C}$ D $9.6 \times 10^{-19} \text{ C}$

- 8 The line spectrum from helium includes a yellow line with a wavelength of 587.6 nm. What is the energy of a photon with this wavelength?
- A $3.89 \times 10^{-40} \text{ J}$ C $1.13 \times 10^{-27} \text{ J}$
 B $1.17 \times 10^{-31} \text{ J}$ D $3.38 \times 10^{-19} \text{ J}$
- 9 An alpha particle has a kinetic energy of $9.6 \times 10^{-13} \text{ J}$. The mass of the alpha particle is $6.6 \times 10^{-27} \text{ kg}$. What is the speed of the particle?
- A $1.2 \times 10^7 \text{ ms}^{-1}$ C $1.5 \times 10^{14} \text{ ms}^{-1}$
 B $1.7 \times 10^7 \text{ ms}^{-1}$ D $2.9 \times 10^{14} \text{ ms}^{-1}$
- 10 $^{238}_{92}\text{U}$ decays by emitting α and β^- particles in a number of stages to form $^{206}_{82}\text{Pb}$. How many β^- decays are involved in this decay chain?
- A 2 B 4 C 6 D 8
- 11 a) Name the constituent of an atom which
- has zero charge (1)
 - has the largest specific charge (1)
 - when removed leaves a different isotope of the element. (1)
- b) The equation
- $$^{99}_{43}\text{Tc} \rightarrow ^A_Z\text{Ru} + ^0_{-1}\beta + X$$
- represents the decay of technetium-99 by the emission of a β^- particle.
- Identify the particle X. (1)
 - Determine the values of A and Z. (2)
- 12 Alpha decay is a process by which an unstable isotope of an element may decay.
- State what is meant by an **isotope**. (2)
 - Copy and complete this equation for alpha decay: (2)
- $$^A_Z\text{X} \rightarrow \dots\text{Y} + ^4_2\text{He}$$
- Explain why the alpha particle, once outside the nucleus, is unaffected by the strong nuclear force of the parent nucleus. (2)
- 13 An atom of calcium, $^{48}_{20}\text{Ca}$, is ionised by removing two electrons.
- State the number of protons, neutrons and electrons in the ion formed. (1)
 - Calculate the charge of the ion. (1)
 - Calculate the specific charge of the ion. (2)
- 14 a) Describe how the strong nuclear force between two nucleons varies with the separation of the nucleons, quoting suitable values for the separation. (3)

b) An unstable nucleus can decay by the emission of an alpha particle. State the nature of an alpha particle. (1)

c) Copy and complete the equation below to represent the emission of an α particle by a ${}^{238}_{92}\text{U}$ nucleus.



15 a) Explain what is meant by the specific charge of a nucleus. (1)

The incomplete table shows information for two isotopes of uranium.

	Number of protons	Number of neutrons	Specific charge of nucleus...
First isotope	92	143	
Second isotope			3.7×10^7

b) Copy the table and add the unit for specific charge in the heading of the last column of the table. (1)

c) Add the number of protons in the second isotope to the second row of the table. (1)

d) Calculate the specific charge of the first isotope and write this in the table. (3)

e) Calculate the number of neutrons in the second isotope and put this number in the table. (4)