

1

An atom of calcium, ${}_{20}^{48}\text{Ca}$, is ionised by removing two electrons.

(i) State the number of protons, neutrons and electrons in the ion formed.

protons.....

neutrons.....

electrons.....

(3)

(ii) Calculate the charge of the ion.

charge C

(1)

(iii) Calculate the specific charge of the ion.

specific charge C kg⁻¹

(2)

(Total 6 marks)

2

(a) The most abundant isotope of cobalt is represented by ${}_{27}^{59}\text{Co}$.

How many protons, neutrons and orbital electrons are there in a neutral atom of this element?

..... protons

..... neutrons

..... electrons

(2)

(b) How is the nuclide that has one less proton than the nickel nuclide, ${}_{28}^{61}\text{Ni}$, represented?

.....

(2)

(c) (i) The heaviest isotope of hydrogen, whose nucleon number is 3, is called tritium. How is tritium represented?

.....

(ii) Calculate the charge per unit mass, in $C\ kg^{-1}$, for a tritium nucleus.

.....

.....

.....

(3)
(Total 7 marks)

3

The table below contains five statements that refer to isotopes and some radium isotopes.

	$^{223}_{88}\text{Ra}$	$^{224}_{88}\text{Ra}$	$^{225}_{88}\text{Ra}$	$^{226}_{88}\text{Ra}$
Isotope with the smallest mass number	✓			
Isotope with most neutrons in nucleus				
Isotope with nucleus which has the largest specific charge				
Isotope decays by β^- decay to form $^{225}_{89}\text{Ac}$				
Isotope decays by alpha decay to form $^{220}_{86}\text{Rn}$				

(a) Complete the table by ticking **one** box in each row to identify the appropriate isotope. The first row has been completed for you.

(4)

- (b) (i) An atom of one of the radium isotopes in the table is ionised so that it has a charge of $+3.2 \times 10^{-19} \text{ C}$.

State what happens in the process of ionising this radium atom.

.....

(1)

- (ii) The specific charge of the ion formed is $8.57 \times 10^5 \text{ C kg}^{-1}$.

Deduce which isotope in the table has been ionised. Assume that both the mass of a proton and the mass of a neutron in the nucleus is $1.66 \times 10^{-27} \text{ kg}$.

isotope =

(3)

(Total 8 marks)

4

- (a) How many protons, neutrons and electrons are there in an atom of $^{14}_6\text{C}$?

..... protons

..... neutrons

..... electrons

(2)

- (b) The $^{14}_6\text{C}$ atom loses two electrons.

For the ion formed;

- (i) calculate its charge in C,

.....

- (ii) state the number of nucleons it contains,

.....

(iii) calculate the ratio $\frac{\text{charge}}{\text{mass}}$ in C kg⁻¹.

.....

(4)
 (Total 6 marks)

5

(a) The nucleus of a particular atom has a *nucleon number* of 14 and a *proton number* of 6.

(i) State what is meant by nucleon number and proton number.

nucleon number

.....

proton number

.....

(1)

(ii) Calculate the number of neutrons in the nucleus of this atom.

answer =

(1)

(iii) Calculate the specific charge of the nucleus.

answer = Ckg⁻¹

(3)

(b) The specific charge of the nucleus of another isotope of the element is $4.8 \times 10^7 \text{ Ckg}^{-1}$.

(i) State what is meant by an isotope.

.....

(2)

(ii) Calculate the number of neutrons in this isotope.

answer =

(3)

(Total 10 marks)

6

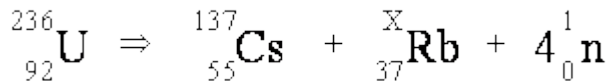
(a) A stable atom contains 28 nucleons.

Write down a possible number of protons, neutrons and electrons contained in the atom.

..... protons
 neutrons
 electrons

(2)

(b) An unstable *isotope* of uranium may split into a caesium nucleus, a rubidium nucleus and four neutrons in the following process.



(i) Explain what is meant by isotopes.

.....

(ii) How many neutrons are there in the ${}_{55}^{137}\text{Cs}$ nucleus?

.....

(iii) Calculate the ratio $\frac{\text{charge}}{\text{mass}}$, in C kg^{-1} , for the ${}_{92}^{238}\text{U}$ nucleus.

.....

(iv) Determine the value of X for the rubidium nucleus.

.....
 X =

(6)
 (Total 8 marks)

7

(a) State what is meant by the specific charge of a nucleus and give an appropriate unit for this quantity.

.....

unit:

(2)

(b) Nucleus X has the same nucleon number as nucleus Y. The specific charge of X is 1.25 times greater than that of Y.

(i) Explain, in terms of protons and neutrons, why the specific charge of X is greater than that of Y.

.....

(2)

- (ii) Nucleus X is ${}^1_5\text{B}$. Deduce the number of protons and the number of neutrons in nucleus Y.

number of protons

number of neutrons

(4)
(Total 8 marks)

8

An atom of argon ${}^{37}_{18}\text{Ar}$ is ionised by the removal of two orbiting electrons.

- (a) How many protons and neutrons are there in this ion?

..... protons

..... neutrons

(2)

- (b) What is the charge, in C, of this ion?

.....

.....

(2)

- (c) Which constituent particle of this ion has

- (i) a zero charge per unit mass ratio,

.....

.....

- (ii) the largest charge per unit mass ratio?

.....

(2)

- (d) Calculate the percentage of the total mass of this ion that is accounted for by the mass of its electrons.

.....

.....

.....

.....

(3)
(Total 9 marks)