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IGCSE PHYSICS 0625 · TOPICAL PAST PAPERS

The Nuclear Model of the Atom

Paper 2 — Theory / Structured Questions (topical compilation)

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Question # 1: May June/2003/P2/Q8

Hydrogen nuclei fuse together in the Sun. The nucleus of one isotope of hydrogen contains one proton and has the nuclide notation ${}^1_1\text{H}$. Other isotopes of hydrogen have the nuclide notations ${}^2_1\text{H}$ and ${}^3_1\text{H}$.

- (a) State the number of protons and the number of neutrons in a nucleus of each of the two other isotopes of hydrogen.

${}^2_1\text{H}$

.....

${}^3_1\text{H}$

.....[2]

Question # 2: May June/2004/P2/Q8

- (d) The nucleon number (mass number) of ${}^{220}_{86}\text{Rn}$ is 220.
Define *nucleon number*.

.....

.....[1]

- (e) Radon (${}^{220}_{86}\text{Rn}$) decays by the emission of an alpha-particle.
State the proton number (atomic number) and the nucleon number (mass number) of the nucleus left after an alpha-particle is emitted from this nucleus.

proton number

nucleon number

[2]

Question # 3: May June/2007/P2/Q8

- (a) Explain how it is possible for an element to have different isotopes.

.....

.....

.....

..... [1]

Question # 4: May June/2009/P2/Q8

The symbol ${}_{92}^{238}\text{U}$ represents a nucleus of uranium with nucleon number (mass number) 238 and proton number (atomic number) 92.

- (a) State the meaning of *nucleon number*.

.....

.....

..... [2]

Question # 5: May June/2014/P21/Q8

A hospital laboratory uses a small sample of a radioactive isotope of iodine, ${}_{53}^{131}\text{I}$.

- (a) (i) Describe the structure of the nucleus of an atom of this isotope.

.....

..... [2]

Question # 6: May June/2014/P22/Q8

- (a) An atom consists of electrons surrounding a nucleus made up of protons and neutrons.

State which of these particles

- (i) have an equal and opposite charge,

..... [1]

- (ii) have almost equal mass.

..... [1]

Question # 7: May June/2015/P22/Q8

Two isotopes of hydrogen are written as ${}^1_1\text{H}$ and ${}^2_1\text{H}$.

- (a) Complete Fig. 8.1 to show the number of protons and neutrons in one nucleus of each of these isotopes of hydrogen.

	number of protons	number of neutrons
${}^1_1\text{H}$		
${}^2_1\text{H}$		

Fig. 8.1

[2]

- (b) Explain, using ideas about electrons, neutrons and protons, why atoms of ${}^1_1\text{H}$ and ${}^2_1\text{H}$ are uncharged.

.....

.....

.....

.....

.....

..... [3]

Question # 8: Oct Nov/2009/P2/Q8

(a) State the number of

(i) electrons in a neutral atom of the isotope ${}^7_3\text{Li}$,

number of electrons = [1]

(ii) nucleons in an atom of the isotope ${}^{208}_{82}\text{Pb}$,

number of nucleons = [1]

(iii) protons in an atom of the isotope ${}^{23}_{11}\text{Na}$.

number of protons = [1]

(b) An atom of the isotope chlorine-35 contains 17 protons.

For an atom of the isotope chlorine-37, state the number of

(i) protons,

number of protons = [1]

(ii) neutrons.

number of neutrons = [1]

Question # 9: Oct Nov/2012/P22/Q8

The nuclei of four neutral atoms are represented using nuclide notation as:



- (a) Neutral atoms also contain electrons. State which of the four nuclei is surrounded by the greatest number of electrons.

..... [1]

- (b) From these four nuclei, state the **two** nuclei that have the same number of

- (i) protons,

..... [1]

- (ii) nucleons,

..... [1]

- (iii) neutrons.

..... [1]

Question # 10: Oct Nov/2014/P21/Q8

The nuclide notation for the radioactive isotope boron-12 is ${}^{12}_5\text{B}$.

- (a) In the space below, draw a labelled diagram to illustrate the structure of a neutral atom of this isotope. Show all the particles in the atom.

[4]

Question # 11: Oct Nov/2016/P22/Q7

Plutonium-238 is a radioactive isotope that decays by alpha-particle emission. It also emits gamma-rays.

- (a) The nuclide notation for plutonium-238 is ${}^{238}_{94}\text{Pu}$.

Describe the structure and composition of a neutral atom of plutonium-238.

.....

.....

.....

.....[3]

Question # 12: May June/2019/P22/Q11

- (b) When a large star explodes, nuclei of heavy elements are formed.

One such nucleus is uranium-235 (${}^{235}_{92}\text{U}$).

- (i) State the name and the number of each type of particle found in one nucleus of ${}^{235}_{92}\text{U}$.

name of particle number found in nucleus

name of particle number found in nucleus [2]

- (ii) State one feature that is the same for the nuclei of all isotopes of uranium.

.....

..... [1]

- (c) Geiger and Marsden carried out an experiment to investigate the scattering of alpha-particles. Fig. 11.1 shows a diagram of the apparatus that they used.

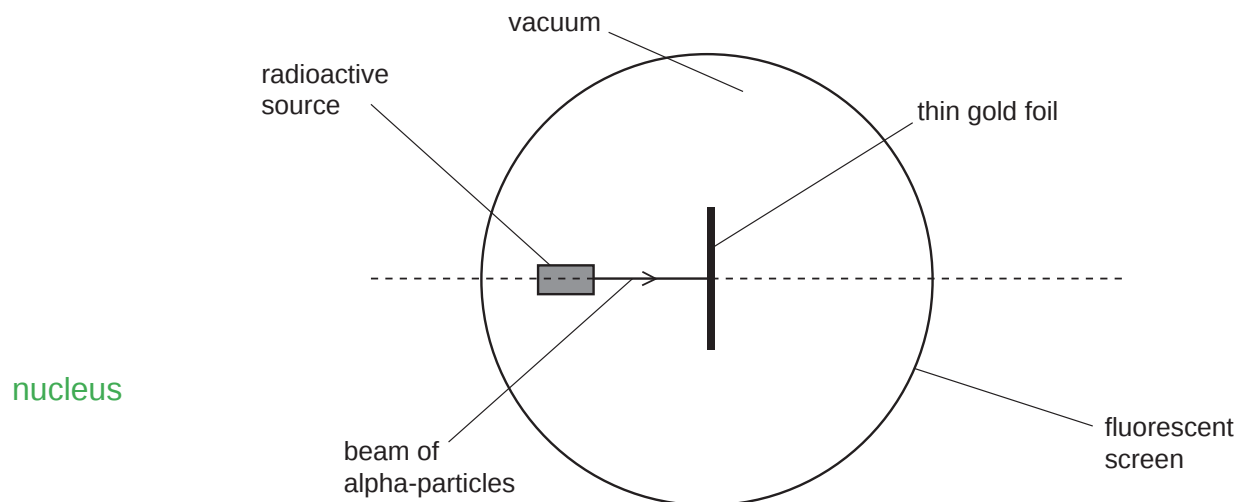


Fig. 11.1

When an alpha-particle strikes the fluorescent screen a flash of light is emitted.

- (i) On Fig. 11.1, mark with a letter P where most flashes occur on the screen. [1]

- (ii) Describe what is seen on the other parts of the screen.

.....
..... [1]

- (iii) State two conclusions about atoms of gold that resulted from this experiment.

.....
.....
.....
..... [2]

Question # 13: May June/2020/P21/Q7

Two isotopes of carbon are carbon-12 and carbon-14.

One of these isotopes, carbon-14, undergoes radioactive decay.

- (b)** Carbon-12 has a proton number (atomic number) of 6 and a nucleon number (mass number) of 12.

Complete Table 7.1 for a neutral atom of each of these two isotopes.

Table 7.1

	carbon-12	carbon-14
number of protons	6	
number of neutrons		
number of electrons		

nucleus

[2]

Question # 14: May June/2020/P22/Q7

Radon-222 is an isotope of radon which undergoes a series of radioactive decays.

Fig. 7.1 is a diagram showing the proton number (atomic number) and nucleon number (mass number) of nuclei involved in the series of decays.

The point P represents a nucleus of radon-222.

Starting at P, a nucleus of radon-222 decays to Q; then from Q to R; then from R to S; then from S to T; and finally from T to U.

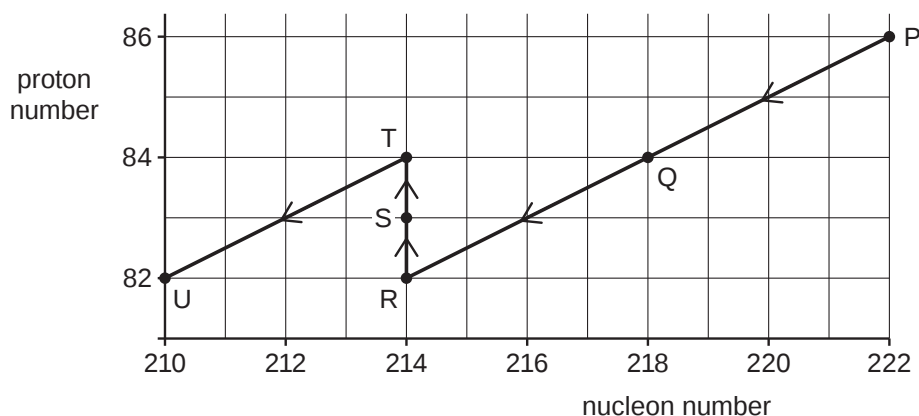


Fig. 7.1

- (a) (i) State two points on Fig. 7.1 which represent isotopes of the same element.

..... [1]

- (ii) Different isotopes of the same element have different atomic compositions.

State how the composition of their atoms is different.

.....
 [1]

nucleus

Question # 15: Oct Nov/2019/P21/Q7

Table 7.1 shows the composition of four neutral atoms and one atom that has been ionised.

These five particles are labelled P, Q, R, S and T.

Table 7.1

	P	Q	R	S	T
number of electrons	17	18	18	19	20
number of neutrons	20	20	24	23	21
number of protons	17	19	18	19	20

(a) The charge on an electron is $-1.6 \times 10^{-19} \text{ C}$.

(i) State which of P, Q, R, S and T is the ionised atom.

..... [1]

(ii) State the size and the sign of the charge on the ionised atom.

charge = [1]

(b) State which pair from P, Q, R, S and T are isotopes of the same element.

..... [1]

Question # 16: Oct Nov/2020/P22/Q6

Phosphorus-32 ($^{32}_{15}\text{P}$) is an isotope of phosphorus that undergoes radioactive decay.

(a) The most common isotope of phosphorus is phosphorus-31.

(i) Describe the structure and composition of a neutral atom of phosphorus-31.

.....

 [2]

(ii) State how an atom of phosphorus-32 differs from an atom of phosphorus-31.

.....
 [1]

nucleus

atomic model

nucleus