13.1 Atoms, Nuclei & Radiation

Question Paper

Course	CIE A Level Physics (9702) 2019-2021
Section	13. Particle & Nuclear Physics
Topic	13.1 Atoms, Nuclei & Radiation
Difficulty	Easy

Time allowed: **20**

Score: **/15**

Percentage: **/100**

Question 1

Alpha, beta and gamma radiations have various depths of penetration in matter and different charges.

Which row in the table best shows the penetration and charge of each radiation?

	alpha	beta	gamma
A	absorbed by a sheet of card negative charge	absorbed by several mm of aluminium no charge	not fully absorbed by several mm of lead no charge
B	absorbed by several mm of aluminium positive charge	not fully absorbed by several mm of lead negative charge	absorbed by a sheet of card no charge
C	absorbed by a sheet of card negative charge	absorbed by several mm of aluminium positive charge	not fully absorbed by several mm of lead no charge
D	absorbed by a sheet of card positive charge	absorbed by several mm of aluminium negative charge	not fully absorbed by several mm of lead no charge

[1 mark]

Question 2

Which statement about alpha, beta and gamma radiation is correct?

A gamma radiation has the greatest ionising power

B beta radiation has the greatest ionising power

C alpha radiation has the greatest ionising power

D alpha, beta and gamma radiation have nearly equal ionising powers

[1 mark]

Question 3

One of the rows in the table shows a pair of nuclei that are isotopes of one another.

Which row is it?

	nucleon number	number of neutrons
A	186 180	112 118
B	184 187	110 110
C	186 182	112 108
D	186 186	110 112

[1 mark]

Question 4

Plutonium-239 ($^{239}_{94}Pu$) decays by emitting α-radiation.

Which nuclide is formed from one of these decay reactions? (The product nuclides are represented by X.)

A $^{239}_{95}X$ **B** $^{237}_{92}X$ **C** $^{239}_{93}X$ **D** $^{235}_{92}X$

[1 mark]

Question 5

Most α-particles pass straight through when fired at a thin sheet of metal foil, but a few are deflected by a large angle.

Which change would increase the **proportion** of α-particles deflected by a large angle?

A using a double thickness foil

B using a foil made of a metal with fewer protons in its nuclei

C using α-particles with greater kinetic energy

D using an alpha source with a higher activity

[1 mark]

Question 6

Four nuclei are represented below

$$^{24}_{13}Q \quad ^{28}_{14}E \quad ^{25}_{15}G \quad ^{25}_{12}M$$

Which of the following statements about these nuclei is correct?

A an uncharged atom of element Q has 24 orbital electrons

B when E absorbs a neutron and then emits an alpha particle, nucleus E transforms into M

C nuclei G and M are isotopes of the same element

D nucleus M could transform into Q by emitting a beta particle

[1 mark]

Question 7

A nucleus Q decays into a nucleus R by emitting an alpha particle followed by two beta particles.

Which statement about this nuclear decay is correct?

A nucleus R is an isotope of nucleus Q

B nucleus R has the same nucleon number as nucleus Q

C beta particle decay occurs when a proton changes into a neutron

D the total mass of the products is equal to the mass of the initial nucleus Q

[1 mark]

Question 8

When an α-particle is produced by $^{258}_{92}U$ it produces a new atom X.

What are the values of the proton number and nucleon number for atom X?

	protons	nucleons
A	92	256
B	90	254
C	92	250
D	88	254

[1 mark]

Question 9

Which of the following statements about the nucleus of the atom is correct?

A nucleon numbers are unchanged by the emission of β-particles

B in some nuclear processes, mass-energy is not conserved

C for some nuclei, the nucleon number can be less than the proton number

D different isotopic nuclei have different proton numbers

[1 mark]

Question 10

The following statements are about α-particles.

Which is correct?

A α-particles emitted from a single radioactive isotope have a continuous distribution of energies

B α-particles have less ionising power than β-particles

C the speeds of α-particles can be as high as 1.5×10^{7} m s^{-1}

D the charge of an α-particle is $+1.60 \times 10^{-19}$ C

[1 mark]

Question 11

The atom $^{133}_{55}Cs$ is a neutral atom

How many protons, neutrons and electrons are in this atom?

	protons	neutrons	electrons
A	133	55	133
B	55	78	55
C	78	55	78
D	55	133	55

[1 mark]

Question 12

When aluminium $^{27}_{13}Al$ was bombarded with α-particles the first radioactive substance was made. The product of this reaction was an unstable isotope of phosphorus, $^{30}_{15}P$.

Which of the following is a by-product of this reaction?

A a neutron

B a γ-ray

C a β-particle

D an α-particle

[1 mark]

Question 13

New insights were discovered when α-particles were fired at a sheet of gold foil.

Which conclusion can be drawn from the results of the experiment?

A the atomic nucleus contains protons and neutrons

B electrons orbit the atomic nucleus

C some atoms of the same element contain different numbers of neutrons

D atomic nuclei occupy a very small fraction of the volume of an atom

[1 mark]

Question 14

When β^- particles are emitted from identical nuclei in a substance, which of the following remain constant?

A proton number of the nuclei

B nucleon number of the nuclei

C neutron number of the nuclei

D energy of the β-particles

[1 mark]

Question 15

A Geiger-muller tube held at a distance of about 12 cm from a radioactive source. The radiation emitted from the nuclear isotope was entirely stopped by a 2 mm thick sheet of lead.

Which of the statements can be deduced from the above information about the emission from the isotope?

A it could be alpha, beta and gamma radiation

B it could be beta and gamma radiation, but not alpha radiation

C it could be alpha and gamma radiation, but not beta radiation

D it could be alpha and beta radiation, but not gamma radiation

[1 mark]