St. Margaret's School (Secondary)



Department of Science Physics

- 1 Which type of radiation consists of electrons?
 - A alpha-particles
 - B beta particles
 - **C** gamma-rays
 - D X-rays
- 2 A sample of a radioactive isotope produces a count rate of 10 000 counts per minute. The half-life of the isotope is one day.

What was the count rate of the sample two days ago?

- A 2500 counts per minute
- B 5000 counts per minute
- C 20 000 counts per minute
- D 40 000 counts per minute
- **3** Which nucleus is produced when americium-241 $\binom{241}{95}Am$ emits an alpha-particle?
 - **A** $^{237}_{93}Np$ **B** $^{237}_{97}Bk$ **C** $^{245}_{93}Np$ **D** $^{245}_{97}Bk$
- 4 Which states the three types of radiation emitted by radioactive isotopes in order of their ionizing effect from highest to lowest?
 - A alpha-particles, beta-particles, gamma-rays
 - B alpha-particles, gamma-rays, beta-particles
 - C beta-particles, gamma-rays, alpha-particles
 - D gamma-rays, beta-particles, alpha-particles

- 5 Which statement about the half-life of a radioactive isotope is correct?
 - A Half-life changes as the isotope decays.
 - **B** Half-life is the time it takes for the nucleon number of the isotope to halve.
 - **C** Half-life is half the time it takes for the number of nuclei of the isotope to decrease to zero.
 - **D** Half-life is the time it takes for the number of nuclei of the isotope to decrease by half.
- 6 A factory continuously produces plastic sheets. A radioactive isotope and a detector are used to check the thickness of the sheets.

What is the most suitable source to use?

- A an alpha source with a half-life of a few minutes
- **B** an alpha source with a half-life of several years
- C a beta source with a half-life of a few minutes
- **D** a beta source with a half-life of several years
- 7 A source contains a radioactive material.

Without the radioactive source present, a detector records a background count rate of 20 counts per minute.

This source is placed in a fixed position near the detector. Initially a count rate of 520 per minute is recorded.

Which count rate is recorded after a time of two half-lifes of the radioactive source?

- A 125 counts per minute
- B 130 counts per minute
- C 135 counts per minute
- D 145 counts per minute

8 A nucleus of ${}^{215}_{84}Po$ decays by emitting an alpha-particle and the resulting nucleus then decays by emitting a beta-particle.

	Nucleon number	Proton number
Α	211	81
в	211	83
С	212	81
D	212	83

What is the nucleon number and proton number of the final nucleus?

9 The half-life of a radioactive isotope is 24 hours. A sample of this isotope produces an initial count rate of 720 counts per second.

How long does it take for the count rate to fall to 90 counts per second?

Α	3 hours	В	72 hours	С	96 hours	D	192 hours

- 10 Which type of electromagnetic radiation is produced during radioactive decay?
 - A alpha-particles B beta-particles C gamma-rays D X-rays
- **11** In the Geiger-Marsden experiment, a beam of apha-particles is fired at a very thin sheet of gold foil, in a vacuum.

What is deduced from this experiment?

- **A** Alpha-particles are repelled by electrons.
- **B** Atoms contain air.
- **C** Electrons are found in atomic nuclei.
- **D** Nuclei are much smaller than atoms.

12 A radioactive isotope ${}^{14}C$ emits beta-particles.

A sample of this isotope is left for a period of time that is equal to its half-life. Which two quantities decrease to half of their initial value during this time?

- **A** the decay rate and the number of protons
- **B** the mass of the sample and the number of ${}^{14}_{\Box}C$ nuclei
- **C** the number of ${}^{14}_{\Box}C$ nuclei and the decay rate
- **D** the number of protons and the mass of the sample
- 13 Which row gives the range and electrical charge of an alpha-particle?

	range in air	electrical charge				
A	a few centimetres	negative				
в	a few centimetres	positive				
С	a few metres	negative				
D	a few metres	positive				

14 Which row states the nature and range of beta-particles in air?

	nature	range in air
Α	electromagnetic radiation	1 – 10 cm
в	electromagnetic radiation	10 – 100 cm
С	electron	1 – 10 cm
D	electron	10 – 100 cm

15 Three types of radiation emitted by unstable nuclei are electrons, helium nuclei and electromagnetic radiation.

	electrons	helium nuclei	electromagnetic radiation					
Α	alpha	beta	gamma					
в	alpha	gamma	beta					
С	beta	alpha	gamma					

gamma

What are these types of radiation?

16 A sample of wood contains 9.0×10^{16} nuclei of carbon-14. The nuclei undergo radioactive decay with a half-life of 5600 years.

alpha

How many carbon-14 nuclei remain in this sample after 16 800 years?

Α	$1.1 imes 10^{2}$	B 1.1 × 10 ¹⁶	C 3.0×10^{16}	D 4.5×10^{16}
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17 People working with radioactive materials use a photographic film badge covered in paper. The badge is used to monitor the level of their exposure to radiation.

Which radiation is detected?

beta

A alpha-particles only

D

- **B** beta-particles only
- C gamma-rays and beta-particles
- **D** gamma-rays only
- **18** When a radioactive atom decays by alpha-particle emission, its nucleus loses
 - **A** 1 proton only.
 - **B** 1 proton and 1 electron.
 - **C** 2 protons and 2 electrons.
 - **D** 2 protons and 2 neutrons.

A school keeps radioactive sources for use in radioactivity experiments in a laboratory.The background radiation is measured at the start of an experiment.

Which statement is correct?

- **A** The background radiation is caused by the school's radioactive sources in the laboratory.
- **B** The background radiation is present when there are no radioactive sources in the laboratory.
- **C** The background radiation is radiation that is not detected in radioactivity experiments.
- **D** The background radiation is the same in laboratories in different countries.
- **20** The count rate from a radioactive source falls from 4000 counts per minute to 500 counts per minute in 72 minutes.

What is the half-life of the source?

- A 8 minutes B 9 minutes C 18 minutes D 24 minutes
- **21** What are the characteristics of an alpha-particle?

	charge	ionizing effect
Α	negative	strong
в	negative	weak
С	positive	strong
D	positive	weak

22 Alpha-particles pass through an electric field or a magnetic field.



How is the path of the particles affected by these fields?

	electric field	magnetic field		
Α	deflected	deflected		
в	deflected	undeflected		
С	undeflected	deflected		
D	undeflected	undeflected		

23 Which row is correct for nuclear fission and for nuclear fusion?

	fission	fusion				
Α	produces larger nuclei	is the energy source of a star				
в	produces larger nuclei	releases energy in a power station				
С	produces smaller nuclei	is the energy source of a star				
D	produces smaller nuclei	releases energy in a power station				

24 Which graph shows how the count rate of a radioactive isotope varies with time?



- 25 For which purpose is the radioactive isotope carbon-14 used?
 - A dating of ancient bones
 - **B** fuel for a nuclear power station
 - **C** killing cancerous cells
 - **D** operating mobile telephones
- **26** When dealing with radioactive materials there are possible dangers. Which statement is correct?
 - A Beta-particles can pass through skin and damage body cells.
 - **B** Materials that emit only alpha-particles must be kept in thick lead containers.
 - **C** Radioactive materials are safe to handle after two half-lives.
 - **D** Sources of gamma radiation are dangerous because they have long half-lives.
- **27** An isotope X is radioactive and has a half-life of 4 years. A sample initially contains 8000 atoms of X.

After how many years will the sample contain 1000 atoms of X?

A 4 **B** 8 **C** 12 **D** 16

- 28 What is the safest way to dispose of a large quantity of highly radioactive waste?
 - **A** burning it on a fire
 - B burying it in dry rock deep underground
 - **C** pouring it down the drain
 - **D** pumping it into a river
- **29** The count rate from a radioactive material falls from 400 counts per second to 50 counts per second in 12 minutes.

What is its half-life?

- A 3 minutes B 4 minutes C 6 minutes D 8 minutes
- **30** In nuclear 1 , hydrogen nuclei 2 to form helium nuclei, releasing energy. Which words correctly complete gaps 1 and 2?

	1	2
Α	fission	join together
В	fission	split apart
С	fusion	join together
D	fusion	split apart

31 The diagram shows the radioactive emissions that pass through a piece of plastic and a piece of metal of the same thickness.



Which types of radioactive emission can distinguish between the plastic and the metal?

- A alpha, beta and gamma
- B alpha only
- **C** beta only
- D gamma only
- **32** The background count rate in a laboratory is 10 counts/min.

The measured count rate from a radioactive source is 410 counts/min, which includes the background.

The half-life of the source is 5 days.

What is the measured count rate after 15 days?

A	10 counts/min	В	50 counts/min	С	60 counts/min	D	110 counts/min
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33 Tritium is a radioactive isotope of hydrogen with a half-life of 12 years.

If a sample starts with 40 million atoms of tritium, how many atoms of tritium will be left after 12 years?

A 5 million **B** 10 million **C** 20 million **D** 40 million

34 The isotope barium-140 has a half-life of 13 days. A sample of this isotope is kept for 13 days.

Which quantity halves during this time?

- A the number of atoms of barium-140 in the sample
- **B** the number of electrons in an atom of barium-140
- **C** the number of nucleons in an atom of barium-140
- **D** the number of protons in a nucleus of barium-140
- **35** In a laboratory experiment, particles from a radioactive source are deviated by a magnetic field and reach a detector.



Which particles are deviated and reach the detector?

- A alpha-particles and gamma-rays
- B alpha-particles only
- C beta-particles and gamma-rays
- D beta-particles only
- **36** When a sample of a radioactive nuclide decays, the count rate falls from 1200 to 150 in three minutes.

What is the half-life of the radioactive nuclide?

Α	0.75 minutes	В	1.0 minute	С	3.0 minutes	D	9.0 minutes
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37 The table shows details of two samples of radioactive nuclides X and Y.

Nuclide	Number of radioactive atoms at time = 0	Half-life
Х	16 000	1 day
Y	2 000	2 days

After how many days will the number of atoms of nuclide X be equal to the number of atoms of nuclide Y?

Α	2 days	B 4 days	С	6 days	D	8 days
	2	2		5		

38 A student investigates a radioactive source that emits only alpha-particles. Without any source nearby, the detector shows a low reading.

The source and thick cardboard are placed near the detector, as shown.



What is the reading on the detector now, and why?

	detector reading	reason
Α	low	background radiation is detected
в	low	some alpha-particles pass through cardboard
С	zero	alpha-particles are all absorbed by the cardboard
D	zero	background radiation is all absorbed by the cardboard

39 A radioactive source emits alpha-particles, beta-particles and gamma-rays. A Geiger-Müller tube and counter detect the emissions, which pass through a thin sheet of paper and a strong magnetic field.



What is detected by the Geiger-Müller tube?

- A alpha-particles and beta-particles
- **B** alpha-particles only
- **C** beta-particles and gamma-rays
- **D** beta-particles only
- **40** The count-rate from a radioactive source falls from 400 to 50 in 3.0 minutes. What is the half-life?
 - A 0.75 minutes B 1.0 minutes C 2.7 minutes D 8.0 minutes

41 The activity of a radioactive source is measured over a period of time. The graph shows the decay curve.



- Why is the curve not smooth?
- **A** Background radiation has not been subtracted.
- В Radioactive decay is a random process.
- The half-life is not constant. С
- **D** The temperature is changing.
- 42 A radioactive isotope has a half-life of 6000 years.

How much time passes before the rate of emission from a sample of this isotope falls to half of its original value?

- **A** 6 000 years **B** 18 000 years **C** 24 000 years **D** 96 000 years
- 43 Which travels in a straight line across a magnetic field?
 - **A** alpha-particle **B** electron C gamma-ray **D** proton

44 In the treatment of brain cancer, a patient's head is enclosed in a helmet containing a number of radioactive sources. The radiation from each source is directed towards the cancer.

	nuclide	radiation	half-life
Α	caesium-137	gamma	30 years
в	sodium-24	beta	15 hours
С	strontium-90	beta	29 years
D	californium-246	alpha	36 hours

Which nuclide is the most suitable for these sources?

- 45 What occurs in the decay of a radioactive nucleus?
 - **A** The nucleus absorbs another nucleus.
 - **B** The nucleus absorbs at least one form of radiation.
 - **C** The nucleus always splits into two equal fragments.
 - **D** The nucleus emits at least one form of radiation.
- **46** The radioactive nucleus ${}^{87}_{37}Rb$ decays with the emission of a beta-particle. How many protons and neutrons are left in the nucleus?

	protons	neutrons
Α	37	49
в	37	50
С	38	49
D	38	87

- **47** Which statement is true for all three types of radioactive emission (alpha-particles, beta-particles and gamma-rays)?
 - **A** They are completely absorbed by a thin aluminium sheet.
 - **B** They are deflected by electric fields.
 - **C** They emit light.
 - **D** They ionize gases.
- **48** The diagram shows one type of radiation passing between the poles of a strong magnet and being detected.



Which type of radiation is being detected?

- A alpha-particles only
- B beta-particles only
- C gamma-rays only
- D alpha-particles and beta-particles

49 An experimenter sets up the following apparatus, in air, to discover whether a radioactive source is emitting alpha-particles.



The experimenter moves the paper between the source and the detector. There is no difference in the count-rate.

Why is this?

- A Paper does not absorb alpha-particles.
- **B** The count-rate due to the background radiation is too high.
- **C** The radioactive source is too far from the detector.
- **D** The source emits beta-particles and alpha-particles.
- 50 The half-life of a radioisotope is 2400 years. The activity of a sample is 720 counts / s. How long will it take for the activity to fall to 90 counts / s?
 - A 300 years B 2400 years C 7200 years D 19 200 years

51 A radioactive source is placed 3 cm from the Geiger-Muller tube in air. The average count rate is 742 counts / minute.



Then, in three experiments, measurements are taken with sheets of different materials placed between the source and the tube. The results are recorded in the table.

Material of sheet between source and tube	Thin card	Aluminium foil	Thick lead
Average count rate / counts per minute	273	275	68

Which types of radiation does the source emit?

- **A** alpha and beta only
- **B** alpha and gamma only
- **C** beta and gamma only
- D alpha, beta and gamma
- 52 Which equation shows a nuclear fission reaction?
 - $\mathbf{A} \quad {}_{1}^{2}H + {}_{1}^{1}H \rightarrow {}_{2}^{4}He$
 - **B** $^{14}_{7}N + neutron \rightarrow ^{15}_{7}N$
 - **C** ${}^{46}_{21}Sc \rightarrow {}^{46}_{21}Sc + gamma ray$
 - **D** ${}^{46}_{21}Sc \rightarrow {}^{46}_{21}Sc + {}^{56}_{21}Sc + gamma ray$
- 53 The half-life of a radioactive material is 24 years.The activity of a sample falls to a fraction of its initial value after 72 years.What is the fraction?
 - A 1/3 B 1/4 C 1/6 D 1/8

54 Which is the correct comparison of the penetrating power and ionizing power of alphaparticles and gamma radiation?

	greater penetrating power	greater ionizing power
Α	alpha	alpha
В	alpha	gamma
С	gamma	alpha
D	gamma	gamma

55 The diagram shows the apparatus used in an experiment in which barriers of various materials are placed in turn between different radioactive sources and a detector.



The table shows the count rates recorded by the detector for four sources.

Which source emits alpha-particles only?

	count rate / counts per minute				
	no barrier	paper	thin aluminium	thick lead	
Α	200	200	200	30	
в	200	30	30	30	
С	1200	600	200	30	
D	1200	1200	30	30	

56 Two types of emission from a radioactive source are separated by passing them through a magnetic field.

The deflections are shown in the diagram.



What are the emissions P and Q?

	emission P	emission Q
Α	alpha-particles	gamma-rays
в	beta-particles	gamma-rays
С	gamma-rays	alpha-particles
D	gamma-rays	beta-particles

57 Ra decays with a half-life of 1600 s.

Rn decays with a half-life of 52 s.

Po decays with a half-life of 9.1 s.

Pb decays with a half-life of 10.6 h.

The changing count rate for one of these radioactive nuclides is shown in the graph.



From the half-life shown by the graph, which was the decaying radioactive nuclide?

A Ra B Rn C Po	D Pb
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- **58** When dealing with radioactive substances there are possible dangers. Which statement is correct?
 - A Beta-particles can pass through skin and damage body cells.
 - **B** Gamma-particles is more dangerous than alpha or beta particles because it has a longer half-life.
 - **C** Materials that emit only alpha-particles must be kept in thick lead containers.
 - **D** Radioactive materials are safe to handle after two half-lives.
- 59 In a fission reactor, which particle causes a Uranium-235 nucleus to split?
 - A Alpha-particle B Gamma ray C Neutron D Proton
- 60 A radioactive isotope has a half-life of 2 minutes.What can be deduced from this statement?
 - **A** After $\frac{1}{2}$ minute, $\frac{1}{4}$ of the isotope remains.
 - **B** After $\frac{1}{2}$ minute, none of the isotope remains.
 - **C** After 4 minutes, ¹/₄ of the isotope remains.
 - **D** After 4 minutes, none of the isotope remains.

61 The diagram shows how the thickness of paper is measured during manufacturing. If the sheet is too thick, fewer beta-particles can reach the detector.



A source of alpha-particles is not used for this purpose because alpha-particles

- **A** are all stopped by the paper.
- **B** are too dangerous to those working nearby.
- **C** have a short half-life.
- **D** make the paper radioactive.
- **62** X, Y and Z are three types of radiation.

X is almost completely absorbed by 5 cm of lead but not by 5 mm of aluminium.

Y is almost completely absorbed by 5 mm but not by thin card.

Z is absorbed by thin card.

What are X, Y and Z?

	х	Y	Z
Α	alpha	beta	gamma
в	beta	alpha	gamma
С	gamma	alpha	beta
D	gamma	beta	alpha

- **63** Which statement about a nucleus of ${}^{15}_{7}N$ is correct?
 - **A** The nucleus contains 7 neutrons and 8 protons.
 - **B** The nucleus contains 7 neutrons and 15 protons.
 - **C** The nucleus contains 7 protons and 8 neutrons.
 - **D** The nucleus contains 7 protons and 15 neutrons.

64 The diagrams represent the nuclei of three atoms.



What is particle X?

65

- A an electron B a helium nucleus C a neutron D a proton
- **66** A nucleus contains 94 protons and 240 nucleons. It emits an alpha-particle. How many protons and how many neutrons are in the nucleus produced?

	Number of protons	Number of neutrons
Α	90	144
в	90	236
С	92	144
D	92	236

67 In the Geiger-Marsden experiment, a beam of alpha-particles is fired at a very thin sheet of gold foil, in a vacuum.

What is deduced from this experiment?

- **A** Alpha-particles are repelled by electrons.
- **B** Atoms contain air.
- **C** Electrons are found in atomic nuclei.
- **D** Nuclei are much smaller than atoms.
- **68** ${}^{14}_{6}C$ represents a nuclide of the element carbon and ${}^{14}_{7}N$ a nuclide of nitrogen. How does a neutral atom of ${}^{14}_{7}N$ differ from a neutral atom of ${}^{14}_{6}C$?
 - **A** The nitrogen atom has one electron less than the carbon atom.
 - **B** The nitrogen atom has one neutron more than the carbon atom.
 - **C** The nitrogen atom has one proton less than the carbon atom.
 - **D** The nitrogen atom has one proton more than the carbon atom.

69 Which particle has the smallest mass?

- A Alpha-particle B Electron C Neutron D Proton
- 70 The energy emitted by the sun is released when the nuclei of an element fuse together. Which nuclei, when fusing together, release most of the energy in the sun?
 - A Carbon B Helium C Hydrogen D Uranium
- **71** How many nucleons are in one neutral atom of the krypton isotope $\frac{84}{36}Kr$?

A 36 B 48 C 84 D 12	Α	36	B 48	C 84	D	120
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A neutral atom of chlorine-37 is compared with a neutral atom of argon-37.How do the number of electrons and the number of neutrons in each of the atoms compare?

	Number of electrons	Number of neutrons
Α	Different	Different
в	Different	Same
С	Same	Same
D	Same	Different

- 73 Which nuclides have the same number of neutrons in a nucleus?
 - **A** ${}^{12}_{5}B$ and ${}^{12}_{6}C$ **B** ${}^{1}_{1}H$ and ${}^{2}_{1}H$ **C** ${}^{12}_{6}C$ and ${}^{13}_{7}N$ **D** ${}^{12}_{6}C$ and ${}^{14}_{7}N$
- **74** In the Geiger-Marsden experiment, a beam of alpha-particles is fired at a thin sheet of gold in a vacuum. The majority of the alpha-particles pass straight through the sheet without being deflected.

What does this show?

- **A** The alpha-particle is uncharged.
- **B** The alpha-particles is very large.
- **C** The nucleus is positively charged.
- **D** The nucleus is very small.
- 75 The compositions of four nuclei are shown in the table.

Nucleus	Number of protons	Number of neutrons	Number of nucleons
Р	88	141	229
Q	88	136	224
R	89	139	228
S	92	136	228

Which two nuclei are isotopes of the same element?

Α	P and Q	В	P and S	С	Q and S	D	R and S

76 A nucleus of phosphorus ${}^{32}_{15}P$ emits a beta-particle to form a new nucleus. What is the nucleon number and what is the proton number of the new nucleus?

	Nucleon number	Proton number
	(mass number)	(atomic number)
Α	28	13
в	31	14
С	31	15
D	32	16

77 The radioactive isotope radium-226 may be shown as ${}^{226}_{88}Ra$. How many protons does an atom of radium contain?

Α	44	B 88	C 138	D	226
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78 The nucleus of a helium atom is represented as ${}_{2}^{4}He$. What does a neutral atom of helium contain?

	Electrons	Protons	Neutrons
Α	2	2	2
в	2	4	4
С	4	2	4
D	4	4	2



What are X and Y?

	Х	Y
Α	Electron	Nucleus
в	Neutrons	Electron
С	Nucleus	Proton
D	Proton	Neutron

80 Which nucleus is produced when thorium-223 $\binom{223}{90}Th$ emits an alpha-particle?

00 92 00 92	²¹⁹ ₈₈ Ra	A ²	В	$^{219}_{92}U$	С	²²⁷ 88 ² 88	D	22 9
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81 How many protons are in the nucleus of an atom of radium, ${}^{226}_{88}Ra$?

A 88 B 138	C 226	D 314
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- **82** A radioactive nuclide ${}^{238}_{92}U$ decays into thorium by emitting an alpha-particle. The thorium then decays into protactinium by emitting a beta-particle. What is the symbol for protactinium?
 - **A** $^{230}_{90}Pa$ **B** $^{234}_{89}Pa$ **C** $^{234}_{90}Pa$ **D** $^{234}_{91}Pa$

83 Chlorine exists as two isotopes. One has a nucleon number of 35 and the other has a nucleon number of 37.

Which table shows the correct numbers of protons and neutrons in the isotopes?

Α		Number of protons	Number of neutrons
	Isotope 1	17	18
	Isotope 2	17	20
в		Number of protons	Number of neutrons
	Isotope 1	18	17
	Isotope 2	20	17
С		Number of protons	Number of neutrons
С	Isotope 1	Number of protons 35	Number of neutrons 17
С	Isotope 1 Isotope 2	Number of protons 35 37	Number of neutrons 17 17
C	Isotope 1 Isotope 2	Number of protons 35 37 Number of protons	Number of neutrons 17 17 Number of neutrons
C D	Isotope 1 Isotope 2 Isotope 1	Number of protons 35 37 Number of protons 17	Number of neutrons 17 17 Number of neutrons 35

84 One isotope of carbon is ${}^{14}_{6}C$.

How many neutrons and protons does each atom of this isotope contain?

	Number of neutrons	Number of protons
Α	6	6
в	6	8
С	8	6
D	14	6

85 In one radioactive decay, radium (Ra) gives rise to radon (Rn) as shown.

$^{226}_{88}Ra \rightarrow ^{222}_{86}Rn$

What particle is also produced?

- A An alpha-particle
- B A beta-particle
- **C** Both an alpha-particle and a beta-particle
- D No particle but only gamma-rays
- **86** Proton number is another name for atomic number. Nucleon number is another name for mass number.

What are isotopes?

- A Nuclei with different proton numbers and different nucleon numbers
- B Nuclei with different protons numbers and the same nucleon number
- **C** Nuclei with the same proton number and different nucleon numbers
- **D** Nuclei with the same proton number and the same nucleon number
- 87 ${}^{15}_{7}N$ is a nuclide of nitrogen.

How many electrons are there in a neutral atom of ${}^{15}_{7}N$?

- **A** 7 **B** 8 **C** 15 **D** 22
- 88 What are the numbers of neutrons, protons and electrons in a neutral atom of $^{235}_{92}U?$

	Number of neutrons	Number of protons	Number of electrons
Α	92	143	143
в	92	235	235
С	143	92	92
D	235	92	92

89 A nuclide of strontium is represented by the symbol ${}^{88}_{38}Sr$.

What does the nucleus contain?

- A 38 electrons and 50 neutrons
- **B** 38 neutrons and 38 protons
- C 38 neutrons and 50 protons
- D 38 protons and 50 neutrons
- **90** A nucleus of the element cobalt may be represented by the symbol $\frac{59}{27}Co$. What is the structure of this nucleus?

	Number of protons	Number of neutrons
Α	27	32
в	27	59
С	59	27
D	59	32

91 A narrow beam of alpha-particles is fired at a thin piece of gold foil. Which is the final direction of the largest number of alpha-particles?



92 A nuclide has the notation ${}^{48}_{23}X$.

	Proton number (atomic number)	Nucleon number (mass number)
Α	23	50
в	24	48
С	48	24
D	50	23

Which line in the table describes a different isotope of this nuclide?

- 93 The neutral atoms of all isotopes of the same element contain the same number of
 - A electrons and protons.
 - **B** electrons and neutrons.
 - **C** neutrons only
 - **D** neutrons and protons.
- **94** Which conclusion can be drawn from the Geiger-Marsden alpha-particle scattering experiment?
 - **A** A positive charge is spread throughout the atom.
 - **B** Electrons are arranged in orbits.
 - **C** Electrons are negatively charged.
 - **D** There is a dense nucleus in the atom.
- 95 A nucleus of sodium, Na, has 11 protons and 12 neutrons.Which symbol represents this nucleus?
 - **A** $^{11}_{12}Na$ **B** $^{12}_{11}Na$ **C** $^{23}_{11}Na$ **D** $^{23}_{12}Na$

The uranium nucleus ${}^{238}_{92}U$ emits an alpha-particle to become thorium, which then emits a 96 beta-particle to become protactinium.



Between 1909 and 1911, Geiger and Marsden carried out experiments in which alpha 97 particles were fired at metal foil. Most of the alpha particles passed through the foil with small deflections, but some were deflected through a large angle.

These results suggest that

A 95

- **A** atoms contain clouds of electrons through which some alpha particles cannot pass.
- **B** atoms contain neutrons that alpha particles bounce off.
- **C** atoms have positive and negative charges spread throughout their volume.
- **D** atoms have positive charges concentrated in a small volume.
- A nucleus is represented by $^{230}_{91}Z$. It emits one alpha-particle and then one beta-particle. 98 What is the resulting nucleus X?
 - **A** $^{226}_{88}X$ **B** $^{226}_{89}X$ **C** $^{226}_{90}X$ $^{230}_{89}X$
- A nuclide of the element plutonium is ${}^{242}_{94}Pu$. 99 What is the number of neutrons in its nucleus?
 - **A** 94 **B** 148 **C** 242 **D** 336

- 100 Which statement defines isotopes?
 - A two (or more) nuclides which have the same number of protons but different numbers of electrons.
 - **B** two (or more) nuclides which have the same number of neutrons but different numbers of electrons.
 - **C** two (or more) nuclides which have the same number of neutrons but different numbers of protons.
 - **D** two (or more) nuclides which have the same number of protons but different numbers of neutrons.
- **101** A nucleus consists of 90 protons and 144 neutrons.

After emitting two beta-particles followed by an alpha-particle, this nucleus has

- A 86 protons and 140 neutrons,
- **B** 86 protons and 142 neutrons.
- **C** 90 protons and 140 neutrons.
- **D** 90 protons and 142 neutrons.

102 Deuterium ${}_{1}^{2}H$ and tritium ${}_{1}^{3}H$ are two isotopes of hydrogen.

Compared to a deuterium atom, how many protons and neutrons does a tritium atom have?

	Protons	Neutrons
Α	More	More
в	More	Same
С	Same	More
D	Same	Same

103 The results of the Geiger-Marsden scattering experiment provided evidence for the presence of the nucleus within the atom.

What were scattered in this experiment?

- A Alpha-particles B Beta-particles C Gamma-rays D Gold nuclei
- **104** The nucleus of a nitrogen atom can be represented as ${}^{14}_{7}N$. The nucleus of this atom consists of
 - **A** 7 protons and 7 electrons.
 - **B** 7 protons and 7 neutrons.
 - **C** 14 protons and 7 electrons.
 - **D** 14 protons and 7 neutrons.
- **105** Three nuclei P, Q and R have proton numbers and nucleon numbers as shown.

	Proton number	Nucleon number
Р	43	93
Q	43	94
R	44	94

Which nuclei are isotopes of the same element?

	A I	P and Q only	В	O and R only	С	Q and R only	D	P, Q and
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