

Cambridge International AS & A Level

PHYSICS (9702) P1

TOPIC WISE QUESTIONS & ANSWERS | COMPLETE SYLLABUS



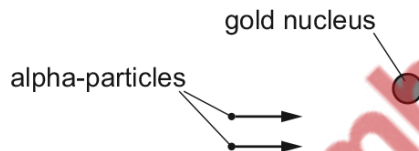
Chapter 13

Particle and nuclear physics

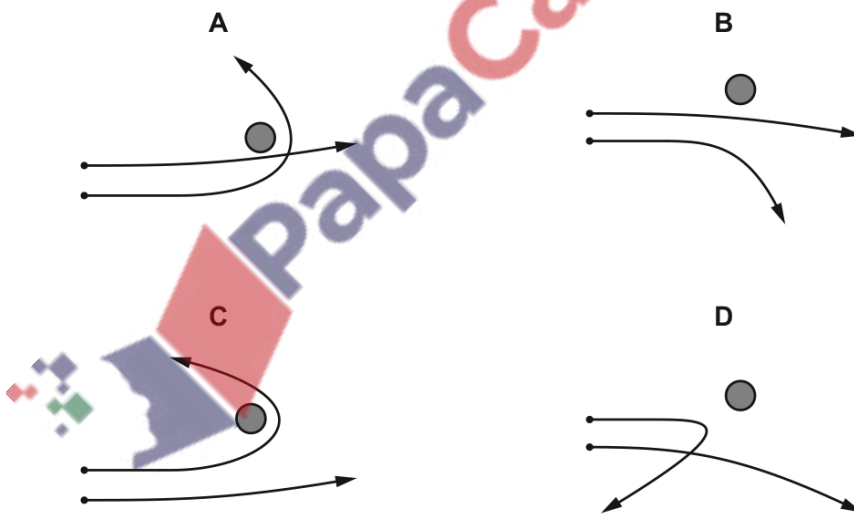
13.1 Atoms, nuclei and radiation

1309. 9702_m20_qp_12 Q: 38

Two alpha-particles with the same kinetic energy are moving towards, and are then deflected by, a gold nucleus.



Which diagram could show the paths of the two alpha-particles?



1310. 9702_s20_qp_11 Q: 39

An element has two isotopic forms.

What are the nuclear arrangements of these two isotopes?

- A They have different nucleon numbers and different proton numbers.
- B They have different nucleon numbers but the same proton number.
- C They have the same nucleon number and the same proton number.
- D They have the same nucleon number but different proton numbers.

1311. 9702_s20_qp_12 Q: 39

An unstable nucleus goes through successive decays to become a final, stable nucleus.

The initial nucleus and the final nucleus are isotopes of each other.

How many α and β^- particles could have been emitted during the decay sequence?

	particle	
	α	β^-
A	1	0
B	1	2
C	2	0
D	2	1

1312. 9702_s20_qp_13 Q: 39

Radiation from a radioactive source has a range of a few millimetres in air and can be deflected by an electric field.

Which type of radiation is being emitted?

- A α -radiation
- B β^- radiation
- C β^+ radiation
- D γ -rays

1313. 9702_m19_qp_12 Q: 39

A neutron ${}_0^1\text{n}$ is fired at a ${}_{92}^{235}\text{U}$ nucleus. The neutron is absorbed by the nucleus which then splits to form nuclei of ${}_{56}^{141}\text{Ba}$ and ${}_{36}^{92}\text{Kr}$.

What is the number of neutrons emitted when the ${}_{92}^{235}\text{U}$ nucleus splits?

- A** 0 **B** 1 **C** 2 **D** 3
-

1314. 9702_m19_qp_12 Q: 40

Which word equation represents β^+ decay?

- A** proton \rightarrow neutron + electron + electron antineutrino
B proton \rightarrow neutron + electron + electron neutrino
C proton \rightarrow neutron + positron + electron antineutrino
D proton \rightarrow neutron + positron + electron neutrino
-

1315. 9702_s19_qp_11 Q: 39

Which statement about the alpha-particle scattering experiment provides evidence for the existence of the nucleus?

- A** A tiny proportion of the alpha-particles are deflected through large angles.
B Slower alpha-particles are deflected through larger angles.
C The kinetic energies of the deflected alpha-particles are unchanged.
D The number of alpha-particles deflected depends on the thickness of the foil.
-

1316. 9702_s19_qp_12 Q: 38

A nucleus of francium-221 (${}_{87}^{221}\text{Fr}$) decays into a nucleus of bismuth-209 (${}_{83}^{209}\text{Bi}$) in several steps.

Which particles could be emitted?

- A** 2 α -particles and 4 β^- particles
B 2 α -particles and 4 β^+ particles
C 3 α -particles and 2 β^- particles
D 3 α -particles and 2 β^+ particles
-

1317. 9702_s19_qp_13 Q: 39

What is a correct estimate of the order of magnitude of the diameter of a typical atomic nucleus?

- A 10^{-14} m B 10^{-18} m C 10^{-22} m D 10^{-26} m

1318. 9702_w19_qp_11 Q: 39

An unstable nucleus of an element decays by emitting an α -particle or a β^- particle to become a nucleus of a different element. This nucleus is also unstable and also emits an α -particle or a β^- particle. The process continues until an isotope of the original element is produced.

What is the minimum possible number of these particles emitted?

- A 2 B 3 C 4 D 5

1319. 9702_w19_qp_12 Q: 38

The table gives some data relating to four neutral (uncharged) atoms W, X, Y and Z.

	W	X	Y	Z
nucleon (mass) number	16	17	17	18
total number of particles (protons, neutrons and electrons) in the atom	24	26	25	28

Two of the atoms are isotopes of the same element.

What is the proton number of this element?

- A 7 B 8 C 9 D 10

1320. 9702_w19_qp_12 Q: 39

What is **not** a fundamental particle?

- A electron
 B neutrino
 C neutron
 D positron

1321. 9702_w19_qp_13 Q: 39

A radioactive nucleus emits an α -particle or a β^- particle, creating a product nucleus.

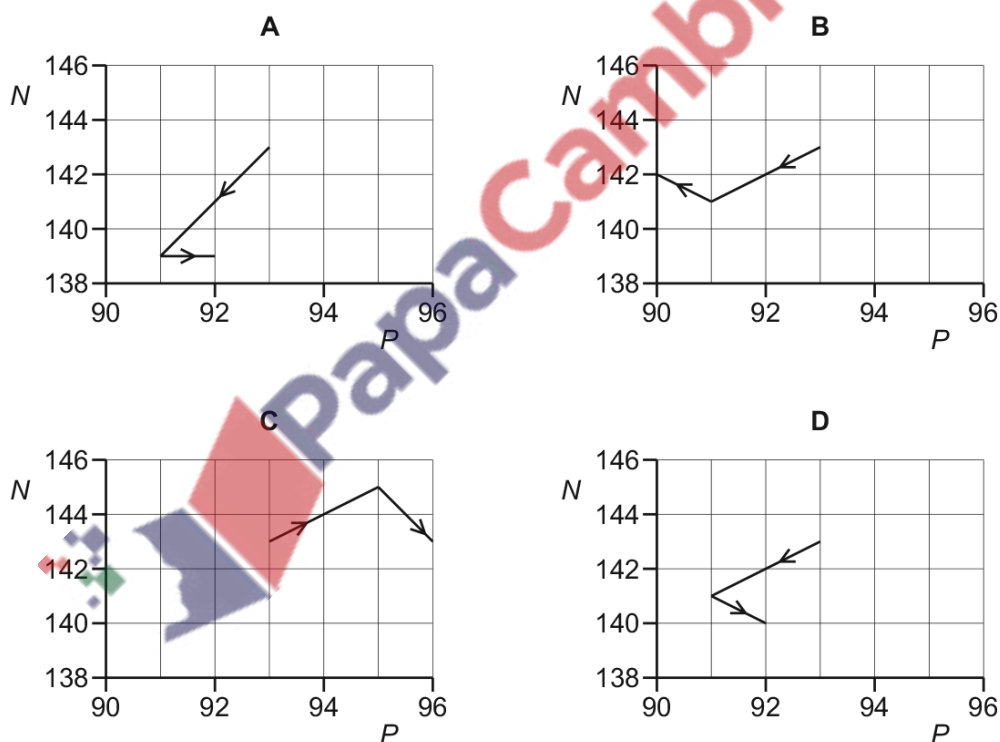
Which decay could create the product nucleus stated?

	radioactive nucleus	decay	product nucleus
A	${}_{88}^{226}\text{Ra}$	α	${}_{86}^{224}\text{Rn}$
B	${}_{92}^{238}\text{U}$	α	${}_{94}^{242}\text{Pu}$
C	${}_{88}^{228}\text{Ra}$	β^-	${}_{87}^{228}\text{Fr}$
D	${}_{90}^{231}\text{Th}$	β^-	${}_{91}^{231}\text{Pa}$

1322. 9702_m18_qp_12 Q: 39

A nucleus of neptunium-236 contains 93 protons and 143 neutrons. This nucleus decays with the emission of an α -particle. The nucleus formed then emits a β^- particle.

Which diagram shows the changes in the number P of protons and the number N of neutrons in these nuclei?



1323. 9702_s18_qp_11 Q: 40

 What is the correct equation for β^+ decay?

- A neutron \rightarrow proton + electron + electron antineutrino
- B neutron \rightarrow proton + electron + electron neutrino
- C proton \rightarrow neutron + positron + electron antineutrino
- D proton \rightarrow neutron + positron + electron neutrino

1324. 9702_s18_qp_12 Q: 38

In the α -particle scattering experiment, a beam of α -particles is aimed at a thin gold foil. Most of the α -particles go straight through or are deflected by a small angle. A very small proportion are deflected through more than 90° , effectively rebounding towards the source of the α -particles.

 Which conclusion about the structure of atoms **cannot** be drawn from this experiment alone?

- A Most of the atom is empty space.
- B Most of the mass of an atom is concentrated in the nucleus.
- C The nucleus contains both protons and neutrons.
- D The nucleus is charged.

1325. 9702_s18_qp_12 Q: 39

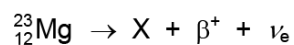
Radon-211, ${}_{86}^{211}\text{Rn}$, francium-210, ${}_{87}^{210}\text{Fr}$, and radium-212, ${}_{88}^{212}\text{Ra}$, are three nuclides.

How many neutrons does each nuclide have in its nucleus?

	radon-211	francium-210	radium-212
A	86	87	88
B	125	123	124
C	211	210	212
D	297	297	300

1326. 9702_s18_qp_13 Q: 39

A nucleus of magnesium-23 undergoes β^+ decay, as represented by the nuclear equation shown.



What is nucleus X?

- A** ${}_{11}^{22}\text{Na}$ **B** ${}_{13}^{22}\text{Al}$ **C** ${}_{11}^{23}\text{Na}$ **D** ${}_{13}^{23}\text{Al}$

1327. 9702_w18_qp_11 Q: 39

A nucleus emits a β^- particle.

What is the change to the proton number and to the nucleon number of the nucleus?

	proton number	nucleon number
A	-1	+1
B	0	-1
C	+1	-1
D	+1	0

1328. 9702_w18_qp_12 Q: 39

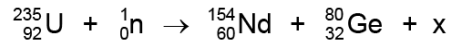
A proton in a nucleus undergoes β^+ decay. One of the products is a neutron.

What are the other products?

- A** an electron and a neutrino
B an electron and an antineutrino
C a positron and a neutrino
D a positron and an antineutrino

1329. 9702_w18_qp_13 Q: 38

A neutron collides with a nucleus of uranium-235. One possible nuclear reaction that results is represented by the equation



where x represents one or more particles.

What does x represent?

- A one neutron
- B two electrons
- C two neutrons
- D two protons

1330. 9702_w18_qp_13 Q: 39

A nucleus Q has the notation ${}^y_x\text{Q}$.

Which of the following is an isotope of Q?

- A ${}^{y-1}_x\text{Q}$
- B ${}^y_{x-1}\text{Q}$
- C ${}^y_{x+1}\text{Q}$
- D ${}^{y-1}_{x+1}\text{Q}$

1331. 9702_m17_qp_12 Q: 38

Which row describes the relative ionizing power and the relative penetration power per unit length in air of α -particles and γ -rays?

	α -particles	γ -rays
A	least ionizing	least penetrating
B	least penetrating	most ionizing
C	most ionizing	most penetrating
D	most penetrating	least ionizing

1332. 9702_s17_qp_11 Q: 38

The table lists the nucleon number and the proton number of various nuclei. The nuclei are represented by the letters L to T.

nucleus	nucleon number	proton number
L	227	89
M	226	89
N	225	89
O	227	90
P	226	90
Q	225	90
R	227	91
S	226	91
T	225	91

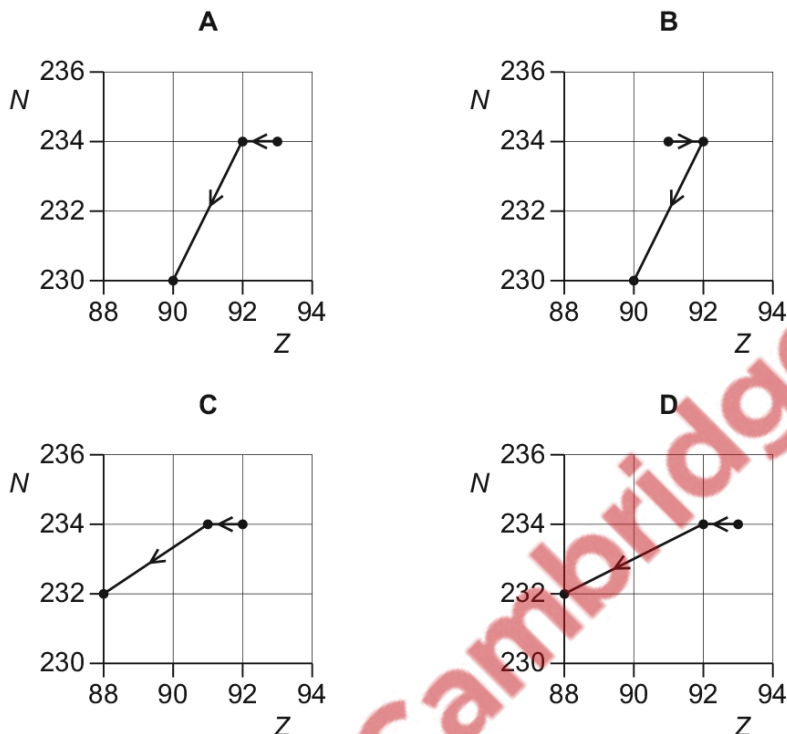
Which row in the following table correctly shows three nuclei of the same element, and three nuclei that have the same number of neutrons?

	same element	same number of neutrons
A	LMN	RPN
B	MPS	RST
C	OPQ	MPS
D	RPN	OPQ

1333. 9702_s17_qp_11 Q: 39

A radioactive nucleus is formed by β^- decay. This nucleus then decays by α -emission.

Which graph of nucleon number N plotted against proton number Z shows the β^- decay followed by the α -emission?



1334. 9702_s17_qp_12 Q: 38

In a television programme to illustrate scientific models, a presenter fires a gun many times at a bale of hay. Two small cannon balls are embedded within the hay some distance apart from each other.

The hay bale measures approximately $2\text{ m} \times 2\text{ m} \times 2\text{ m}$ and the cannon balls are made of iron, approximately spherical, and about 5 cm in diameter.

What might the presenter be illustrating?

- A α -particle scattering
- B β^- decay
- C conservation of momentum
- D double-slit interference

1335. 9702_s17_qp_12 Q: 39

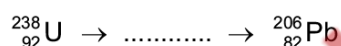
A certain nuclide, uranium-235, has nucleon number 235, proton number 92 and neutron number 143. Data on four other nuclides are given below.

Which nuclide is an isotope of uranium-235?

	nucleon number	proton number	neutron number
A	235	91	144
B	236	92	144
C	237	94	143
D	238	95	143

1336. 9702_s17_qp_13 Q: 37

A nucleus of uranium-238, ${}_{92}^{238}\text{U}$, decays in a series of steps to form a nucleus of lead-206, ${}_{82}^{206}\text{Pb}$, as shown.



An α -particle or a β^- particle is emitted during each step.

What is the total number of β^- particles that are emitted?

- A** 6 **B** 8 **C** 10 **D** 16

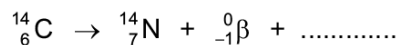
1337. 9702_s17_qp_13 Q: 38

Which statement about α -particles 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 charge of an α -particle is $+1.60 \times 10^{-19}\text{C}$.
- D** The speeds of α -particles can be as high as $1.5 \times 10^7\text{m s}^{-1}$.

1338. 9702_s17_qp_13 Q: 39

The nuclear equation shown has a term missing.



What is represented by the missing term?

- A an antineutrino
- B an electron
- C a neutrino
- D a positron

1339. 9702_w17_qp_11 Q: 39

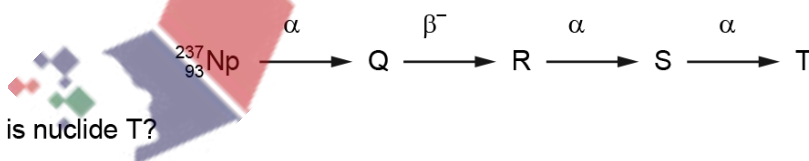
An astatine nucleus has a nucleon number of 218 and a proton number of 85. It decays to form a polonium nucleus, emitting a β^- particle and an α -particle in the process.

What are the nucleon number and the proton number of this polonium nucleus?

	nucleon number	proton number
A	214	83
B	214	84
C	215	83
D	216	82

1340. 9702_w17_qp_12 Q: 39

The diagram shows a sequence of radioactive decays involving three α -particles and a β^- particle.



What is nuclide T?

- A ${}^{225}_{88}\text{Ra}$
- B ${}^{231}_{88}\text{Ra}$
- C ${}^{225}_{90}\text{Th}$
- D ${}^{229}_{90}\text{Th}$

1341. 9702_w17_qp_13 Q: 39

Each option shows the number of neutrons, protons and electrons in two atoms, some of which are ionised.

Which pair of atoms in the table are isotopes of the same element?

	neutron	proton	electron
A	20 20	17 19	20 20
B	28 28	23 24	23 24
C	34 36	29 29	29 28
D	40 42	32 31	32 32

1342. 9702_m16_qp_12 Q: 38

A sample of an isotope emits β^- particles.

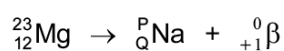
The emitted β^- particles have a range of energies.

What must also be emitted?

- A** antineutrinos
- B** neutrinos
- C** antineutrons
- D** neutrons

1343. 9702_m16_qp_12 Q: 39

A nucleus of magnesium decays into a nucleus of sodium by emitting a β^+ particle. The decay is represented by the equation shown.



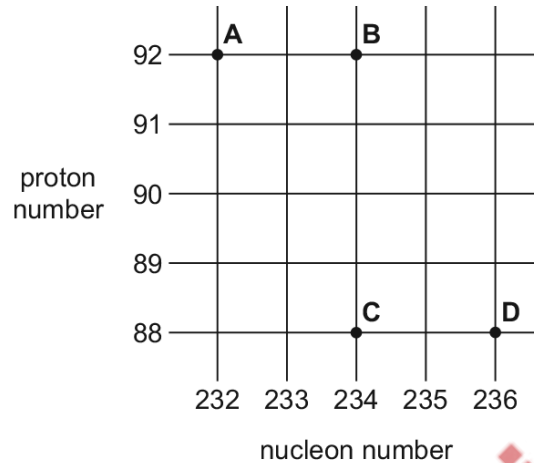
What are the values of P and Q?

	P	Q
A	22	11
B	22	13
C	23	11
D	23	13

1344. 9702_m16_qp_12 Q: 40

Thorium-234 (${}_{90}^{234}\text{Th}$) decays by β^- emission into a daughter product which in turn decays by a further β^- emission into a granddaughter product.

Which letter in the diagram represents the granddaughter product?



1345. 9702_s16_qp_11 Q: 39

Which word equation represents β^+ decay?

- A proton \rightarrow neutron + electron + electron antineutrino
- B proton \rightarrow neutron + electron + electron neutrino
- C proton \rightarrow neutron + positron + electron antineutrino
- D proton \rightarrow neutron + positron + electron neutrino

1346. 9702_s16_qp_11 Q: 40

Which statement about the alpha-particle scattering experiment provides evidence for the existence of the nucleus?

- A A tiny proportion of the alpha-particles are deflected through large angles.
- B Slower alpha-particles are deflected through larger angles.
- C The kinetic energies of the deflected alpha-particles are unchanged.
- D The number of alpha-particles deflected depends on the thickness of the foil.

1347. 9702_s16_qp_12 Q: 38

The gold nucleus ${}_{79}^{185}\text{Au}$ undergoes alpha decay.

What are the nucleon number and proton number of the nucleus formed by this decay?

	nucleon number	proton number
A	183	79
B	183	77
C	181	77
D	181	75

1348. 9702_s16_qp_13 Q: 38

A nitrogen-13 nucleus ${}_{7}^{13}\text{N}$ undergoes beta decay.

In the equations below, ν and $\bar{\nu}$ represent a neutrino and antineutrino respectively and γ represents a photon of gamma radiation.

Which equation represents this decay?

- A** ${}_{7}^{13}\text{N} \rightarrow {}_{6}^{13}\text{C} + \beta^{-} + \bar{\nu} + \gamma$
- B** ${}_{7}^{13}\text{N} \rightarrow {}_{6}^{13}\text{C} + \beta^{-} + \nu + \gamma$
- C** ${}_{7}^{13}\text{N} \rightarrow {}_{6}^{13}\text{C} + \beta^{+} + \bar{\nu} + \gamma$
- D** ${}_{7}^{13}\text{N} \rightarrow {}_{6}^{13}\text{C} + \beta^{+} + \nu + \gamma$

1349. 9702_s16_qp_13 Q: 39

Radon ${}_{86}^{222}\text{Rn}$ is the start of a decay chain that forms bismuth ${}_{83}^{214}\text{Bi}$ by α and β^{-} emission.

For the decay of each nucleus of radon, how many α particles and β^{-} particles are emitted?

	α particles	β^{-} particles
A	1	1
B	2	1
C	1	2
D	2	2

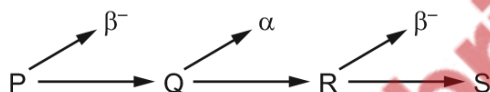
1350. 9702_w16_qp_11 Q: 39

 What are the correct descriptions of a γ -ray and a β^- particle?

	γ -ray	β^- particle
A	high-speed electron	electromagnetic radiation
B	electromagnetic radiation	helium-4 nucleus
C	electromagnetic radiation	high-speed electron
D	high-speed electron	helium-4 nucleus

1351. 9702_w16_qp_11 Q: 40

In a radioactive decay series, three successive decays each result in a particle being emitted.

 The first decay results in the emission of a β^- particle. The second decay results in the emission of an α particle. The third decay results in the emission of another β^- particle.


Nuclides P and S are compared.

Which statement is correct?

- A** P and S are identical in all respects.
- B** P and S are isotopes of the same element.
- C** S is a different element of lower atomic number.
- D** S is a different element of reduced mass.

1352. 9702_w16_qp_12 Q: 39

 The calcium nuclide ${}_{20}^{42}\text{Ca}$ is formed by β^- decay.

 What are the nucleon (mass) number and proton (atomic) number of the unstable nuclide that underwent β^- decay to form the calcium nuclide?

	nucleon number	proton number
A	41	19
B	41	21
C	42	19
D	42	21

1353. 9702_w16_qp_13 Q: 39

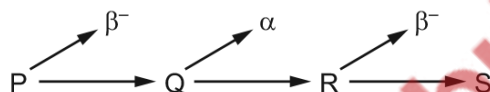
What are the correct descriptions of a γ -ray and a β^- particle?

	γ -ray	β^- particle
A	high-speed electron	electromagnetic radiation
B	electromagnetic radiation	helium-4 nucleus
C	electromagnetic radiation	high-speed electron
D	high-speed electron	helium-4 nucleus

1354. 9702_w16_qp_13 Q: 40

In a radioactive decay series, three successive decays each result in a particle being emitted.

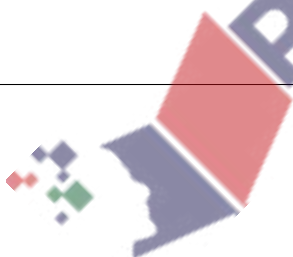
The first decay results in the emission of a β^- particle. The second decay results in the emission of an α particle. The third decay results in the emission of another β^- particle.



Nuclides P and S are compared.

Which statement is correct?

- A** P and S are identical in all respects.
- B** P and S are isotopes of the same element.
- C** S is a different element of lower atomic number.
- D** S is a different element of reduced mass.



1355. 9702_s15_qp_11 Q: 39

When α -particles are directed at gold leaf

- 1 almost all α -particles pass through without deflection,
- 2 a few α -particles are deviated through large angles.

What are the reasons for these effects?

	1	2
A	most α -particles have enough energy to pass right through the gold leaf	gold is very dense so a few low energy α -particles bounce back from the gold surface
B	most α -particles miss all gold atoms	a few α -particles bounce off gold atoms
C	the gold nucleus is very small so most α -particles miss all nuclei	occasionally the path of an α -particle is close to a nucleus
D	the positive charge in an atom is not concentrated enough to deflect an α -particle	occasionally an α -particle experiences many small deflections in the same direction

1356. 9702_s15_qp_11 Q: 40

The nuclide ${}^{222}_{86}\text{Rn}$ decays in a sequence of stages to form the nuclide ${}^{206}_{82}\text{Pb}$.

Four of the nuclides formed in the sequence are α -particle emitters. The others are β -particle emitters.

How many nuclides formed in the decay sequence are β -particle emitters?

- A** 2 **B** 4 **C** 8 **D** 12

1357. 9702_s15_qp_12 Q: 38

An experiment in which α -particles were deflected by a gold foil produced new insights into the structure of the atom.

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

- A** Atomic nuclei occupy a very small fraction of the volume of an atom.
- B** Electrons orbit the atomic nucleus.
- C** Some atoms of the same element contain different numbers of neutrons.
- D** The atomic nucleus contains protons and neutrons.

1358. 9702_s15_qp_12 Q: 39

A radioactive substance contains a number of identical nuclei that emit β -particles.

Which property of these nuclei remains unaltered by the emission?

- A charge
- B neutron number
- C nucleon number
- D proton number

1359. 9702_s15_qp_12 Q: 40

A uranium-238 nucleus, ${}_{92}^{238}\text{U}$, undergoes nuclear decays to form uranium-234, ${}_{92}^{234}\text{U}$.

Which series of decays could give this result?

- A emission of four β -particles
- B emission of four γ -rays
- C emission of one α -particle and two β -particles
- D emission of two α -particles and eight β -particles

1360. 9702_s15_qp_13 Q: 38

Nucleus P decays in two stages to produce nucleus Q.

Which decay sequence will result in the highest number of neutrons in nucleus Q?

- A an α -particle followed by a β -particle
 - B an α -particle followed by a γ -ray
 - C a β -particle followed by another β -particle
 - D a β -particle followed by a γ -ray
-

1361. 9702_s15_qp_13 Q: 39

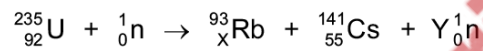
A neutral atom has a nucleus given by the symbol ${}^{133}_{55}\text{Cs}$.

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

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

1362. 9702_s15_qp_13 Q: 40

The nuclear equation for a fission reaction is shown below.



What are the values of X and Y?

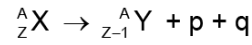
	X	Y
A	37	0
B	37	1
C	37	2
D	38	2



13.2 Fundamental particles

1363. 9702_m20_qp_12 Q: 39

The equation represents the decay of a nucleus X to a nucleus Y.



What are particles p and q?

	p	q
A	β^- particle	neutron
B	β^- particle	proton
C	β^+ particle	antineutrino
D	β^+ particle	neutrino

1364. 9702_m20_qp_12 Q: 40

Which row gives the correct type and quark composition for the named particle?

	particle	type	quark composition
A	neutron	hadron	u u d
B	neutron	lepton	u d d
C	proton	hadron	u u d
D	proton	lepton	u d d

key

u = up quark

d = down quark

1365. 9702_s20_qp_11 Q: 40

A hadron has a charge $+e$, where e is the elementary charge.

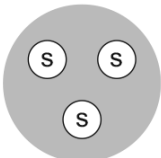
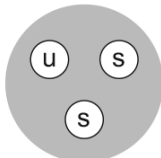
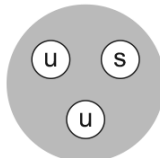
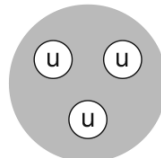
Which combination of up (u) and down (d) quarks could form this hadron?

- A** ddd **B** udd **C** uud **D** uuu

1366. 9702_s20_qp_12 Q: 40

A hadron has a charge of $-e$ and is composed of three quarks.

What could be the quark composition of the hadron?

A  **B**  **C**  **D** 

key
u = up quark
s = strange quark

1367. 9702_s20_qp_13 Q: 40

Which equation describes the process of β^+ decay?

key:

u = up quark

d = down quark

ν = (electron) neutrino

$\bar{\nu}$ = (electron) antineutrino

A $ddu \rightarrow uud + \beta^+ + \nu$

B $ddu \rightarrow uud + \beta^+ + \bar{\nu}$

C $uud \rightarrow ddu + \beta^+ + \nu$

D $uud \rightarrow ddu + \beta^+ + \bar{\nu}$

1368. 9702_s19_qp_11 Q: 40

Some particles are a combination of three quarks.

Which combination of quarks would **not** result in a particle with a charge of either $+1.6 \times 10^{-19} \text{ C}$ or zero?

A up, down, down

B up, strange, strange

C up, up, down

D up, up, up

1369. 9702_s19_qp_12 Q: 39

Which equation describes the changes to the quark composition of a nucleus and the lepton emission during the process of β^+ decay?

- A down \rightarrow up + positron + electron neutrino
- B down \rightarrow up + positron + electron antineutrino
- C up \rightarrow down + positron + electron neutrino
- D up \rightarrow down + positron + electron antineutrino

1370. 9702_s19_qp_12 Q: 40

There are protons, neutrons and electrons in the simple model of an atom.

To which class (group), hadron or lepton, do these particles belong?

	hadron	lepton
A	electron	proton and neutron
B	neutron	proton and electron
C	proton and electron	neutron
D	proton and neutron	electron

1371. 9702_s19_qp_13 Q: 40

Which statement describes β^- decay in terms of a simple quark model?

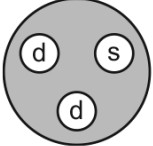
- A A down quark changes to an up quark, and an electron and an electron antineutrino are emitted.
- B A down quark changes to an up quark, and a positron and an electron neutrino are emitted.
- C An up quark changes to a down quark, and an electron and an electron antineutrino are emitted.
- D An up quark changes to a down quark, and a positron and an electron neutrino are emitted.

1372. 9702_w19_qp_11 Q: 40

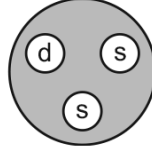
The diagrams show the quark composition of four different hadrons. One of the hadrons is a Σ^+ particle. It has a charge of $+e$, where e is the elementary charge.

Which hadron could be the Σ^+ particle?

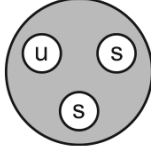
A



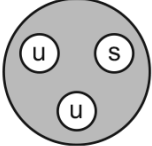
B



C



D



key
u = up quark
d = down quark
s = strange quark

1373. 9702_w19_qp_12 Q: 40

An unstable nucleus decays and emits a β^- particle.

Which changes, if any, occur to the quark composition of the nucleus?

	quark changes	
	up quarks	down quarks
A	+1	0
B	+1	-1
C	-1	+1
D	0	+1

1374. 9702_w19_qp_13 Q: 40

Which statement is correct?

- A** Electrons and neutrinos are fundamental particles.
- B** Electrons and neutrinos are hadrons.
- C** Protons and neutrons are leptons.
- D** Protons and neutrons are quarks.

1375. 9702_m18_qp_12 Q: 40

An isolated neutron decays to produce a proton, a β^- particle and an antineutrino.

Which row gives the quark composition of the neutron and the proton and the type of force that gives rise to this reaction?

	quark composition		type of force
	neutron	proton	
A	down, down, up	down, up, up	strong interaction
B	down, down, up	down, up, up	weak interaction
C	down, up, up	down, down, up	strong interaction
D	down, up, up	down, down, up	weak interaction

1376. 9702_s18_qp_11 Q: 38

Which elementary particle is a lepton?

- A** proton
- B** neutron
- C** electron
- D** quark

1377. 9702_s18_qp_11 Q: 39

How many down quarks are in a nucleus of hydrogen-3, ${}^3_1\text{H}$?

- A** 2
- B** 3
- C** 4
- D** 5

1378. 9702_s18_qp_12 Q: 40

A neutron is composed of one up (u) quark and two down (d) quarks. When the neutron decays to a proton, there is β -emission.

What is the change in the quark structure of the neutron due to the β -emission?

(The symbol for a neutrino is ν_e and for an antineutrino is $\bar{\nu}_e$.)

- A** $d \rightarrow u + \beta^- + \nu_e$
- B** $d \rightarrow u + \beta^- + \bar{\nu}_e$
- C** $u \rightarrow d + \beta^+ + \nu_e$
- D** $u \rightarrow d + \beta^+ + \bar{\nu}_e$

1379. 9702_s18_qp_13 Q: 40

Which list contains only leptons?

- A electron, neutrino, positron
- B electron, neutrino, proton
- C electron, proton, neutron
- D neutrino, neutron, positron

1380. 9702_w18_qp_11 Q: 40

How many up quarks and how many down quarks are in a nucleus of the nuclide ${}_{17}^{37}\text{Cl}$?

	up quarks	down quarks
A	51	60
B	54	57
C	57	54
D	60	51

1381. 9702_w18_qp_12 Q: 40

A certain type of hadron has zero charge. It is composed of a down quark, a strange quark and one other quark.

What could be the other quark?

- A up
- B down
- C strange
- D anti-strange

1382. 9702_w18_qp_13 Q: 40

In β^- decay, a neutron inside a nucleus changes to a proton.

Which statement describes the quark composition of the nucleus during the decay?

- A The number of down quarks decreases by one.
- B The number of down quarks increases by one.
- C The number of down quarks stays the same.
- D The number of up quarks stays the same.

1383. 9702_m17_qp_12 Q: 39

A nucleus of sodium-21, ${}_{11}^{21}\text{Na}$, decays to form a new nucleus containing 10 protons and 11 neutrons.

Which leptons are emitted from the sodium-21 nucleus during the decay?

- A a positron and an antineutrino
- B a positron and a neutrino
- C an electron and an antineutrino
- D an electron and a neutrino

1384. 9702_m17_qp_12 Q: 40

A neutron decays to form a proton.

Which particle is **not** involved in the decay process?

- A antineutrino
- B down quark
- C positron
- D up quark

1385. 9702_s17_qp_11 Q: 40

What are the structures of the proton and of the neutron in terms of quarks?

	proton		neutron	
	up quark	down quark	up quark	down quark
A	1	1	2	2
B	1	2	2	1
C	2	1	1	2
D	2	2	1	1

1386. 9702_s17_qp_12 Q: 40

During β^- decay, which change takes place to the quark composition of the nucleus that emits the β^- particle, and which other particle is emitted?

	quark change	other particle emitted
A	down to up	antineutrino
B	down to up	neutrino
C	up to down	antineutrino
D	up to down	neutrino

1387. 9702_s17_qp_13 Q: 40

Which particle is a fundamental particle?

- A** electron
- B** hadron
- C** neutron
- D** proton

1388. 9702_w17_qp_11 Q: 40

What is the quark composition of a hydrogen-3 nucleus, ${}^3_1\text{H}$?

	number of quarks	
	up	down
A	4	5
B	5	4
C	5	7
D	7	5

1389. 9702_w17_qp_12 Q: 40

Which combination of up (u) and down (d) quarks forms a neutron?

- A** u u u
- B** u u d
- C** u d d
- D** d d d

1390. 9702_w17_qp_13 Q: 40

Which combination of up (u) and down (d) quarks forms a proton?

- A** u u u **B** u u d **C** u d d **D** d d d

1391. 9702_s16_qp_11 Q: 38

 Which statement describes β^- decay in terms of a simple quark model?

- A** A down quark changes to an up quark and emits an electron and an electron antineutrino.
B A down quark changes to an up quark and emits a positron and an electron neutrino.
C An up quark changes to a down quark and emits an electron and an electron antineutrino.
D An up quark changes to a down quark and emits a positron and an electron neutrino.

1392. 9702_s16_qp_12 Q: 39

Which row gives the correct classification of protons, electrons and neutrinos?

	protons	electrons	neutrinos
A	hadrons	leptons	hadrons
B	hadrons	leptons	leptons
C	leptons	hadrons	hadrons
D	leptons	hadrons	leptons

1393. 9702_s16_qp_12 Q: 40

 Which equation represents β^+ decay?

- A** neutron \rightarrow proton + positron + antineutrino
B neutron \rightarrow proton + positron + neutrino
C proton \rightarrow neutron + positron + antineutrino
D proton \rightarrow neutron + positron + neutrino

1394. 9702_s16_qp_13 Q: 40

The magnitude of the charge on the proton may be regarded as +1 unit. On this basis, the charges on the up (u) quark, down (d) quark and their antiquarks (\bar{u} and \bar{d}) are not whole units.

Which row in the table shows the correct values for the charges on the u, d, \bar{u} and \bar{d} quarks?

	u	d	\bar{u}	\bar{d}
A	$+\frac{2}{3}$	$-\frac{1}{3}$	$+\frac{2}{3}$	$-\frac{1}{3}$
B	$-\frac{2}{3}$	$+\frac{1}{3}$	$+\frac{2}{3}$	$-\frac{1}{3}$
C	$+\frac{2}{3}$	$-\frac{1}{3}$	$-\frac{2}{3}$	$+\frac{1}{3}$
D	$-\frac{2}{3}$	$+\frac{1}{3}$	$-\frac{2}{3}$	$+\frac{1}{3}$

1395. 9702_w16_qp_11 Q: 38

What is a proton?

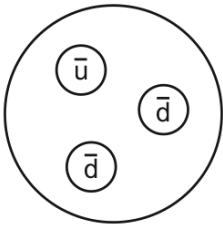
- A** a hadron
- B** a particle consisting of two down quarks and one up quark
- C** a positive fundamental particle
- D** a positive lepton



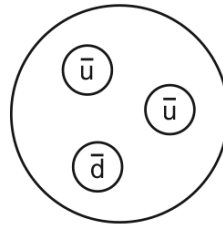
1396. 9702_w16_qp_12 Q: 40

Which diagram represents the structure of an antineutron?

A



B



key

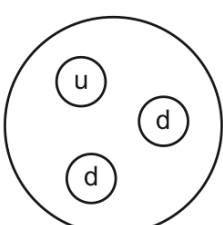
u up quark

d down quark

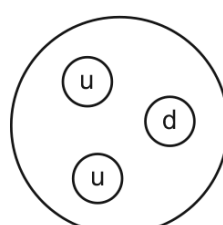
\bar{u} up antiquark

\bar{d} down antiquark

C



D

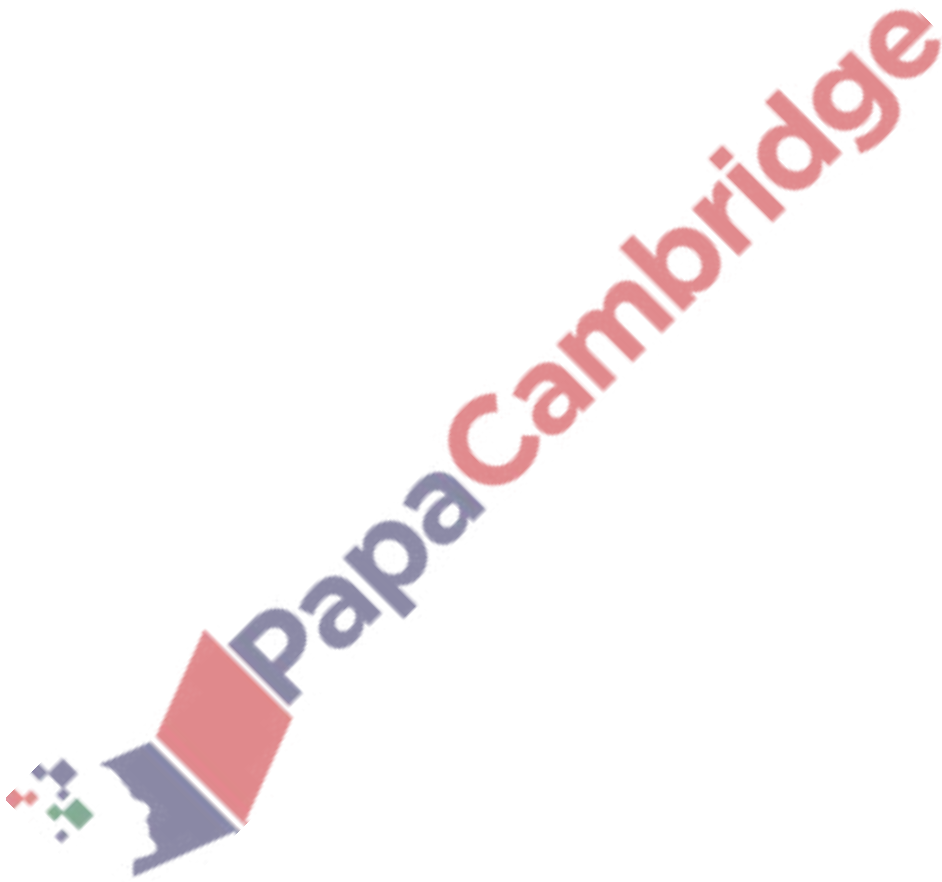


1397. 9702_w16_qp_13 Q: 38

What is a proton?

- A** a hadron
- B** a particle consisting of two down quarks and one up quark
- C** a positive fundamental particle
- D** a positive lepton



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