Chapter 5

Atomic physics

5.1 The nuclear atom

01. 0625_m22_qp_22 Q: 39

Nuclear fusion is a reaction that takes place in stars.

Which row describes this reaction?

	action of atomic nuclei	energy
A	an atomic nucleus splits into two or more smaller nuclei	absorbed
B	an atomic nucleus splits into two or more smaller nuclei	released
C	atomic nuclei join together to form a larger nucleus	absorbed
D	atomic nuclei join together to form a larger nucleus	released

---

02. 0625_m21_qp_22 Q: 38

Three students are describing the structure of an atom.

student 1 All the positively charged particles are in the nucleus.

student 2 Positive electrons are in the nucleus.

student 3 Negative electrons orbit around the nucleus.

Which students are making a correct statement?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

03. 0625_s21_qp_21 Q: 37

The charge on a proton is *e*.

What is the charge on an electron and what is the charge on a neutron?

	electron	neutron
A	*e*	*e*
B	*e*	0
C	−*e*	−*e*
D	−*e*	0

---

04. 0625_s21_qp_21 Q: 38

Four students are asked to comment on the processes of nuclear fission and nuclear fusion.

Their comments are recorded in the table.

Which row is correct?

	fission	fusion
A	energy is absorbed	a large unstable nucleus splits
B	a large unstable nucleus splits	energy is absorbed
C	two light nuclei join	energy is absorbed
D	energy is released	two light nuclei join

---

05. 0625_s21_qp_22 Q: 37

Which row correctly states how nuclei behave during nuclear fission and during nuclear fusion?

	fission	fusion
A	nuclei join together	nuclei join together
B	nuclei join together	nuclei split apart
C	nuclei split apart	nuclei join together
D	nuclei split apart	nuclei split apart

---

06. 0625_m20_qp_22 Q: 38

When Rutherford bombarded thin gold foil with α-particles, he found that some α-particles were deflected through large angles.

Which statement explains this deflection?

A Most of the atom consists of empty space.

B All of the positive charge and most of the mass of the gold atom are concentrated in a small volume.

C Positive charge in the gold atom is spread evenly throughout the atom.

D All of the negative charge is concentrated at its centre.

---

07. 0625_s20_qp_21 Q: 37

Uranium-235 is a radioactive isotope. It undergoes a chain of decays and eventually forms the stable isotope lead-207. These two isotopes are represented as shown.

$^{235}_{92}U$ $^{207}_{82}Pb$

During this chain of decay, how many protons and how many neutrons are lost from a single nucleus of uranium-235 to form a single nucleus of lead-207?

	protons	neutrons
A	10	18
B	10	28
C	18	10
D	28	10

---

08. 0625_s20_qp_22 Q: 37

Uranium-235 can undergo nuclear fission in many ways.

Which equation correctly shows a possible fission reaction for uranium-235?

A $^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3{}^{1}_{0}n$

B $^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{91}_{38}Sr + {}^{144}_{54}Xe + 2{}^{1}_{0}n$

C $^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{95}_{37}Rb + {}^{136}_{55}Cs + 3{}^{1}_{0}n$

D $^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{87}_{35}Br + {}^{146}_{57}La + 4{}^{1}_{0}n$

---

09. 0625_s20_qp_23 Q: 37

What occurs during nuclear fusion?

A Two light atomic nuclei join together and emit energy.

B Two light atomic nuclei join together and absorb energy.

C A heavy atomic nucleus splits and emits energy.

D A heavy atomic nucleus splits and absorbs energy.

---

10. 0625_w20_qp_21 Q: 38

Which statement is correct for the nucleus of **any** atom?

A The nucleus contains electrons, neutrons and protons.

B The nucleus contains the same number of protons as neutrons.

C The nucleus has a total charge of zero.

D The nucleus is very small compared with the size of the atom.

---

11. 0625_w20_qp_22 Q: 37

Which statement is correct for the nucleus of **any** atom?

A The nucleus contains electrons, neutrons and protons.

B The nucleus contains the same number of protons as neutrons.

C The nucleus has a total charge of zero.

D The nucleus is very small compared with the size of the atom.

---

12. 0625_w20_qp_22 Q: 38

The symbol represents a nucleus of zinc.

$$^{68}_{30}Zn$$

Which row gives the numbers of protons and neutrons in this nucleus?

	number of protons	number of neutrons
A	30	38
B	30	68
C	38	30
D	38	68

---

13. 0625_w20_qp_23 Q: 37

Which statement is correct for the nucleus of **any** atom?

A The nucleus contains electrons, neutrons and protons.

B The nucleus contains the same number of protons as neutrons.

C The nucleus has a total charge of zero.

D The nucleus is very small compared with the size of the atom.

---

14. 0625_w20_qp_23 Q: 38

How many protons and how many neutrons are in a nucleus of $^{234}_{90}Th$?

	protons	neutrons
A	90	144
B	90	234
C	144	90
D	234	90

---

15. 0625_m19_qp_22 Q: 38

What are isotopes of an element?

A atoms of a different element with a different number of neutrons

B atoms of a different element with a different number of protons

C atoms of the same element with a different number of neutrons

D atoms of the same element with a different number of protons

---

16. 0625_s19_qp_22 Q: 38

Which observation provides evidence for the nuclear atom?

A attraction of opposite charges

B emission of γ-rays during the decay of a radioactive nuclide

C scattering of α-particles by thin metal foils

D scattering of γ-rays by a thin metal foil

17. 0625_s19_qp_23 Q: 36

α-particles are directed at a metal foil.

Most of the particles pass through the foil with little change in direction.

A small proportion of the particles are scattered back through large angles.

What does this evidence suggest about the structure of an atom?

A It consists of a charged centre much smaller than the size of the atom and with little of the mass of the atom.

B It consists of a negative charge the size of the atom containing small positive charges scattered through it.

C It consists of a charged centre much smaller than the size of the atom but with most of the mass of the atom.

D It consists of a positive charge the size of the atom containing small negative charges scattered through it.

---

18. 0625_s19_qp_23 Q: 38

What is nuclear fission?

A the merging of two nuclei to create a heavier nucleus

B the process by which electrons are removed from an atom

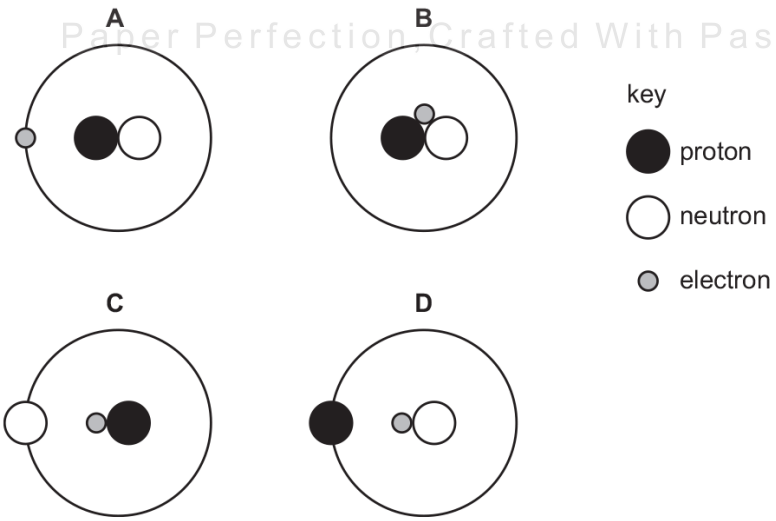
C the process by which stars generate energy

D the splitting of a nucleus to create two smaller nuclei

---

19. 0625_w19_qp_21 Q: 37

Which diagram shows a possible structure of a neutral atom?



---

20. 0625_w19_qp_21 Q: 38

The scattering of particles by a thin gold foil provided scientists with evidence for the nuclear atom.

Which particles were scattered by the gold nuclei in the thin foil?

A α-particles

B β-particles

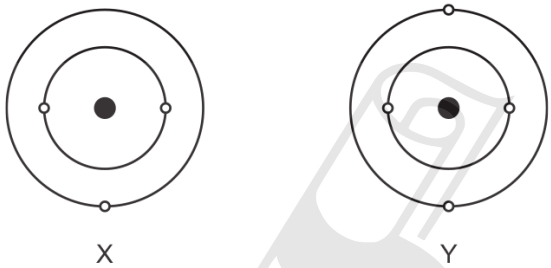
C neutrons

D protons

---

21. 0625_w19_qp_22 Q: 37

The diagrams show the simple atomic structure for two neutral atoms X and Y of different elements.



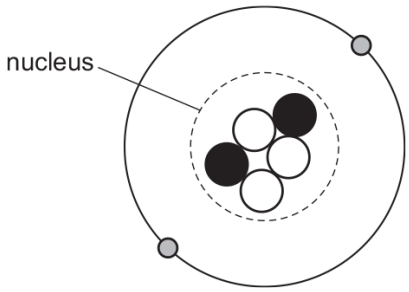
Which row is correct?

	atom with more electrons	atom with a more positively charged nucleus
A	X	X
B	X	Y
C	Y	X
D	Y	Y

---

22. 0625_w19_qp_23 Q: 38

The diagram represents a neutral atom.



Which row identifies each type of particle in the diagram?

	●	○	●
A	electron	neutron	proton
B	electron	proton	neutron
C	neutron	electron	proton
D	proton	electron	neutron

---

23. 0625_w19_qp_23 Q: 39

A thin metal foil is placed in a vacuum. α-particles are fired at the foil and most go straight through. A very small proportion of the α-particles are deflected through large angles.

What does this provide evidence for?

A α-particles are very small.

B There are negative electrons in each atom.

C There is a tiny nucleus in each atom.

D There are neutrons in each atom.

---

24. 0625_m18_qp_22 Q: 37

The notation for an isotope of sodium is $^{23}_{11}Na$.

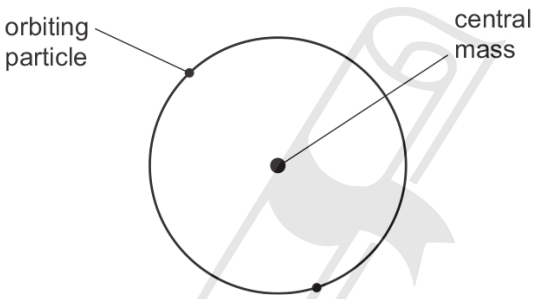
Which row gives the composition of a neutral atom of this isotope of sodium?

	number of protons	number of neutrons	number of electrons
A	11	12	11
B	11	12	12
C	11	23	11
D	12	11	12

---

25. 0625_s18_qp_21 Q: 37

In the atomic model, an atom consists of a central mass, orbited by much smaller particles.



What is the name of the central mass and of the orbiting particles?

	central mass	orbiting particles
A	neutron	α-particles
B	neutron	electrons
C	nucleus	α-particles
D	nucleus	electrons

---

26. 0625_s18_qp_21 Q: 38

Nuclear fusion is a reaction that takes place in stars.

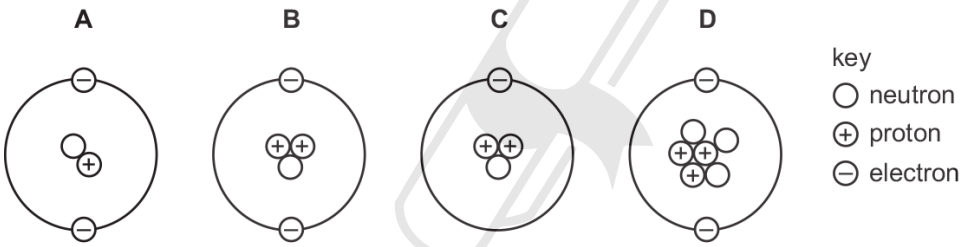
Which row describes this reaction?

	action of atomic nuclei	energy
A	an atomic nucleus splits into two or more smaller nuclei	absorbed
B	an atomic nucleus splits into two or more smaller nuclei	released
C	atomic nuclei join together to form a larger nucleus	absorbed
D	atomic nuclei join together to form a larger nucleus	released

---

27. 0625_w18_qp_21 Q: 37

Which diagram represents the structure of a neutral atom?



---

28. 0625_m17_qp_22 Q: 38

The nuclide notation for an isotope of silver is $^{109}_{47}\mathrm{Ag}$.

How many nucleons are in a nucleus of this isotope?

A 47 **B** 62 **C** 109 **D** 156

---

29. 0625_s17_qp_21 Q: 37

Which row gives the relative charge of an electron, a neutron and a proton?

	electron	neutron	proton
A	–1	0	–1
B	–1	0	+1
C	+1	–1	0
D	+1	0	+1

---

30. 0625_s17_qp_22 Q: 37

Which particle has a negative charge?

A an alpha particle

B an electron

C a neutron

D a proton

---

31. 0625_s17_qp_22 Q: 38

A type of nuclear reaction takes place in stars.

Which row describes this type of reaction?

	nuclear reaction	nuclei formed	energy transfer
A	fission	larger than original nuclei	released
B	fission	smaller than original nuclei	absorbed
C	fusion	larger than original nuclei	released
D	fusion	smaller than original nuclei	absorbed

---

32. 0625_s17_qp_23 Q: 37

When a source of α-particles is directed towards a thin metal foil they become scattered.

Which observation of this experiment provides evidence for a small charged nucleus?

A A small proportion of the α-particles come straight back from the foil towards the source.

B A small proportion of the α-particles pass straight through the foil.

C Some of the α-particles are deflected by an angle of less than 90°.

D Some of the α-particles follow a curved path after leaving the foil.

---

33. 0625_s17_qp_23 Q: 38

Which description of a neutral atom of copper is correct?

A a nucleus surrounded by electrons

B a nucleus surrounded by molecules

C electrons surrounded by a nucleus

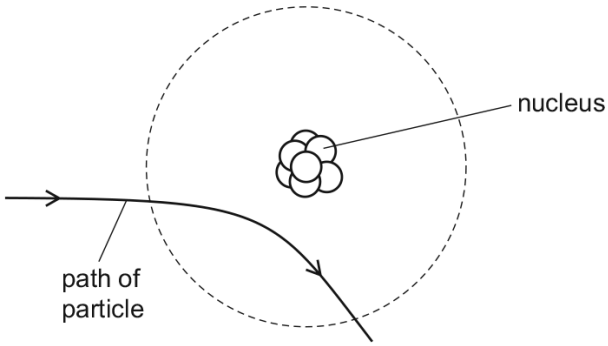
D electrons surrounded by molecules

---

34. 0625_w17_qp_22 Q: 38

In the diagram, the circle represents an atom (not to scale) with the nucleus at its centre.

A particle is emitted by a radioactive source and approaches the nucleus of the atom. The curved arrow shows the path of the particle.



What is the nature and charge of the particle?

	nature of particle	charge of particle
A	α-particle	negative
B	α-particle	positive
C	β-particle	negative
D	β-particle	positive

---

35. 0625_m16_qp_22 Q: 37

The scattering of α-particles by a thin metal foil supports the nuclear model of an atom.

Why are α-particles used rather than neutrons?

A because they always travel more slowly

B because they are heavier

C because they are larger in diameter

D because they have a positive charge

---

36. 0625_s16_qp_21 Q: 39

A certain element has several isotopes.

Which statement about these isotopes is correct?

A They must have different numbers of electrons orbiting their nuclei.

B They must have the same number of neutrons in their nuclei.

C They must have the same number of nucleons in their nuclei.

D They must have the same number of protons in their nuclei.

---

37. 0625_s16_qp_22 Q: 37

A very important experiment increased scientists' understanding of the structure of matter.

In the experiment, particles scattered as they passed through a thin metal foil.

Which particles were used, and to which conclusion did the experiment lead?

	particles	conclusion
A	alpha particles	matter is made up of atoms
B	alpha particles	atoms have a very small nucleus
C	beta particles	matter is made up of atoms
D	beta particles	atoms have a very small nucleus

---

38. 0625_s16_qp_22 Q: 38

Below are the symbols for five different nuclides.

$^{35}_{17}X$	$^{37}_{17}X$	$^{38}_{18}X$	$^{81}_{35}X$	$^{81}_{37}X$
nuclide 1	nuclide 2	nuclide 3	nuclide 4	nuclide 5

Which two nuclides are isotopes of the same element?

A nuclide 1 and nuclide 2

B nuclide 2 and nuclide 3

C nuclide 2 and nuclide 5

D nuclide 4 and nuclide 5

---

39. 0625_s16_qp_23 Q: 37

Below are four statements about isotopes of a certain element.

Which statement about the isotopes **must** be correct?

A They are radioactive.

B They are unstable.

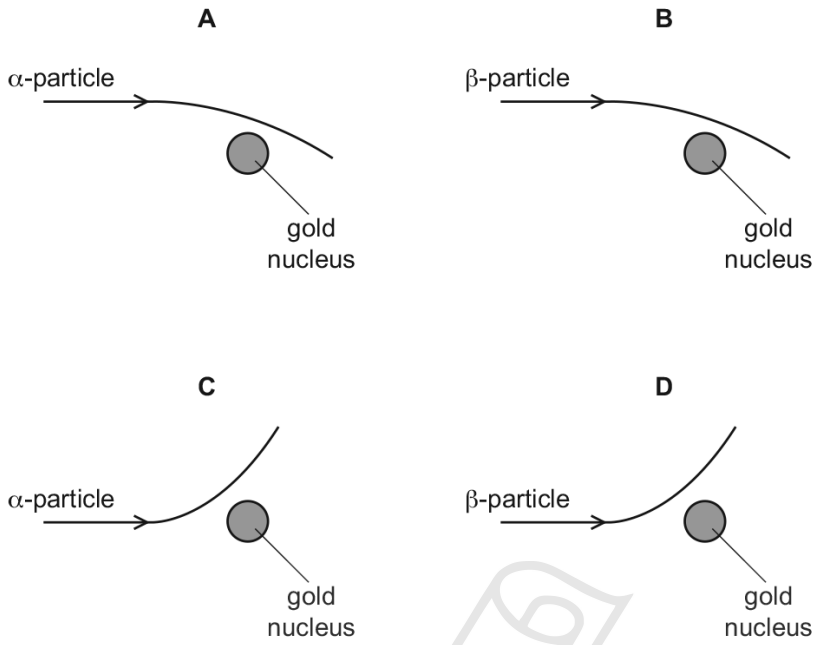
C They have the same number of neutrons.

D They have the same number of protons.

---

40. 0625_s16_qp_23 Q: 38

Which diagram represents an experiment that provided evidence for the nuclear atom?



---

41. 0625_w16_qp_21 Q: 37

A very important experiment improved scientists' understanding of the structure of matter.

The experiment involved α-particles being fired at a thin gold foil.

What happened?

A All the α-particles were absorbed by the nuclei of the gold atoms.

B All the α-particles were unaffected by the gold atoms.

C Some of the α-particles were attracted by the neutrons in the nuclei of the gold atoms.

D Some of the α-particles were repelled by the protons in the nuclei of the gold atoms.

---

42. 0625_w16_qp_21 Q: 38

What is meant by nuclear fusion?

A the emission of an electron from a nucleus

B the emission of two protons from a nucleus

C the joining together of two nuclei

D the splitting of a nucleus into two smaller nuclei

---

43. 0625_w16_qp_22 Q: 37

What happens in the process of nuclear fission?

A electrons are added to a nucleus

B electrons are removed from a nucleus

C the nucleus of an atom splits

D two atomic nuclei join together

---

44. 0625_w16_qp_23 Q: 37

Which particle is absorbed by a nucleus to cause nuclear fission?

A a neutron

B a proton

C an α-particle

D a β-particle

---

45. 0625_m15_qp_12 Q: 40

A nuclide has the symbol $^{14}_{6}C$.

How many protons are there in one nucleus of this nuclide?

A 6 **B** 8 **C** 14 **D** 20

---

46. 0625_s15_qp_11 Q: 40

$^{14}_{6}C$ is a nuclide of carbon.

What is the composition of one nucleus of this nuclide?

	neutrons	protons
A	6	8
B	6	14
C	8	6
D	14	6

---

47. 0625_s15_qp_12 Q: 40

A nuclide has the symbol $^{22}_{10}\mathrm{Ne}$.

What is the proton number of a nucleus of this nuclide?

A 10 **B** 12 **C** 22 **D** 32

---

48. 0625_s15_qp_13 Q: 40

Which statement is correct for the nucleus of **any** atom?

A The nucleus contains electrons, neutrons and protons.

B The nucleus contains the same number of protons as neutrons.

C The nucleus has a total charge of zero.

D The nucleus is very small compared with the size of the atom.

---

49. 0625_w15_qp_11 Q: 40

The nuclide notation for radium-226 is $^{226}_{88}\mathrm{Ra}$.

How many electrons orbit the nucleus of a neutral atom of radium-226?

A 0 **B** 88 **C** 138 **D** 226

---

50. 0625_s14_qp_11 Q: 40

A lithium nucleus contains 3 protons and 4 neutrons.

What is its nuclide notation?

A $^{3}_{4}\mathrm{Li}$ **B** $^{4}_{3}\mathrm{Li}$ **C** $^{7}_{3}\mathrm{Li}$ **D** $^{7}_{4}\mathrm{Li}$

---

51. 0625_s14_qp_12 Q: 40

A particular nuclide of chlorine can be represented by the symbol shown.

$$^{37}_{17}\mathrm{C}l$$

How many electrons are there in a neutral atom of this nuclide?

A 17 **B** 20 **C** 37 **D** 54

---

52. 0625_w14_qp_11 Q: 40

A nuclide is represented by the symbol ${}^{P}_{Q}X$.

How many neutrons are in one nucleus of the nuclide?

A P **B** Q **C** P + Q **D** P – Q

---

53. 0625_w14_qp_13 Q: 40

Which statement about the nuclei of all atoms is correct?

A They are very small compared with the size of the atoms.

B They always contain the same number of protons as neutrons.

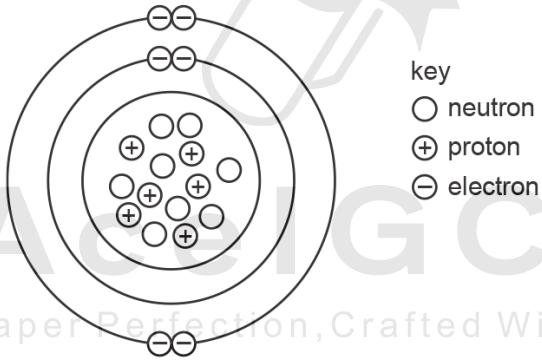
C They contain electrons, neutrons and protons.

D They have a total charge of zero.

---

54. 0625_s13_qp_11 Q: 40

The diagram represents a carbon atom.



What is the nucleon number (mass number) for this atom?

A 6 **B** 8 **C** 14 **D** 20

---

55. 0625_s13_qp_12 Q: 40

A nuclide is represented by the notation shown.

$$ {}^{P}_{Q}X $$

How many nucleons are there in one atom of this nuclide?

A P **B** Q **C** P + Q **D** P – Q

---

56. 0625_w13_qp_11 Q: 40

A nucleus X has 17 protons and 18 neutrons.

Which notation is correct for this nucleus?

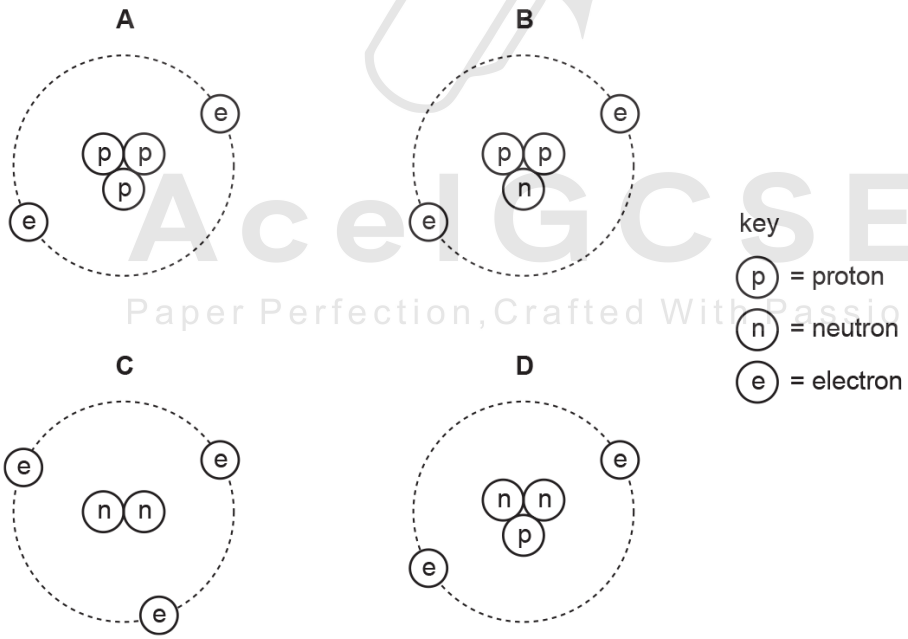
A ${}^{17}_{18}X$ **B** ${}^{17}_{35}X$ **C** ${}^{18}_{17}X$ **D** ${}^{35}_{17}X$

---

57. 0625_w13_qp_13 Q: 40

A nucleus of helium has the symbol ${}^{3}_{2}He$.

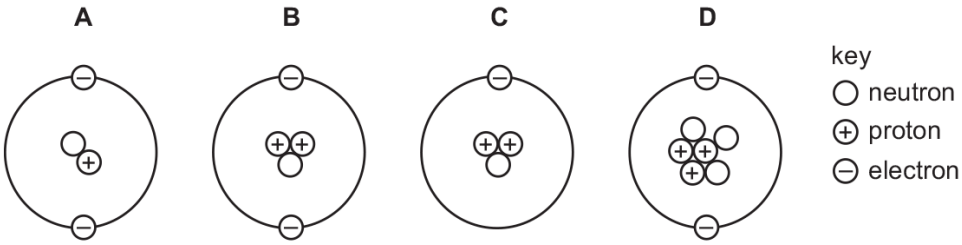
Which diagram represents an atom of ${}^{3}_{2}He$?



---

58. 0625_s12_qp_11 Q: 40

Which diagram could represent the structure of a neutral atom?



---

59. 0625_s12_qp_12 Q: 40

Which statement about a neutral atom of $^{226}_{88}Ra$ is correct?

A It has an equal number of neutrons and protons.

B It has more electrons than neutrons.

C It has more electrons than protons.

D It has more neutrons than protons.

---

60. 0625_w12_qp_11 Q: 40

Which statement about a carbon nucleus represented by $^{14}_{6}C$ is correct?

A It contains 6 neutrons.

B It contains 6 electrons.

C It contains 8 protons.

D It contains 14 nucleons.

---

61. 0625_w12_qp_13 Q: 40

Which of the following is **not** a charged particle?

A α-particle

B β-particle

C neutron

D proton

SN	Paper	Q. No.	Answer
01	0625_m22_qp_22	39	D
02	0625_m21_qp_22	38	C
03	0625_s21_qp_21	37	D
04	0625_s21_qp_21	38	D
05	0625_s21_qp_22	37	C
06	0625_m20_qp_22	38	B
07	0625_s20_qp_21	37	A
08	0625_s20_qp_22	37	A
09	0625_s20_qp_23	37	A
10	0625_w20_qp_21	38	D
11	0625_w20_qp_22	37	D
12	0625_w20_qp_22	38	A
13	0625_w20_qp_23	37	D
14	0625_w20_qp_23	38	A
15	0625_m19_qp_22	38	C
16	0625_s19_qp_22	38	C
17	0625_s19_qp_23	36	C
18	0625_s19_qp_23	38	D
19	0625_w19_qp_21	37	A
20	0625_w19_qp_21	38	A
21	0625_w19_qp_22	37	D
22	0625_w19_qp_23	38	A
23	0625_w19_qp_23	39	C
24	0625_m18_qp_22	37	A
25	0625_s18_qp_21	37	D
26	0625_s18_qp_21	38	D
27	0625_w18_qp_21	37	B
28	0625_m17_qp_22	38	C
29	0625_s17_qp_21	37	B
30	0625_s17_qp_22	37	B
31	0625_s17_qp_22	38	C
32	0625_s17_qp_23	37	A
33	0625_s17_qp_23	38	A
34	0625_w17_qp_22	38	B
35	0625_m16_qp_22	37	D
36	0625_s16_qp_21	39	D
37	0625_s16_qp_22	37	B
38	0625_s16_qp_22	38	A
39	0625_s16_qp_23	37	D
40	0625_s16_qp_23	38	C
41	0625_w16_qp_21	37	D
42	0625_w16_qp_21	38	C
43	0625_w16_qp_22	37	C
44	0625_w16_qp_23	37	A
45	0625_m15_qp_12	40	A
46	0625_s15_qp_11	40	C
47	0625_s15_qp_12	40	A
48	0625_s15_qp_13	40	D
49	0625_w15_qp_11	40	B

SN	Paper	Q. No.	Answer
50	0625_s14_qp_11	40	C
51	0625_s14_qp_12	40	A
52	0625_w14_qp_11	40	D
53	0625_w14_qp_13	40	A
54	0625_s13_qp_11	40	C
55	0625_s13_qp_12	40	A
56	0625_w13_qp_11	40	D
57	0625_w13_qp_13	40	B
58	0625_s12_qp_11	40	B
59	0625_s12_qp_12	40	D
60	0625_w12_qp_11	40	D
61	0625_w12_qp_13	40	C