

Chem 10 Chapter 4

Atoms and Elements

Practice and End of Chapter Questions

Worked solutions at the end

Use your course periodic table and a calculator as needed. Show the setup, include units, and round at the end. Question numbers match the numbers in the solutions. Use heading navigation to move between sections.

Practice Questions

Question 1

Which statement below accurately describes the contributions of Democritus?

- A) proposed the modern Atomic Theory
- B) created the modern periodic table
- C) discovered the existence of electrons
- D) ancient Greek philosopher who proposed that matter was not continuous
- E) none of the above

Question 2

Which statement below accurately describes the contributions of Thomson?

- A) created the modern periodic table
- B) discovered the existence of electrons
- C) proposed the modern Atomic Theory
- D) ancient Greek philosopher who proposed that matter was continuous
- E) none of the above

Question 3

Which statement reflects the results of Rutherford's gold foil experiments?

- A) Almost all of the alpha particles passed directly through the foil.
- B) Almost all of the alpha particles were deflected back in the direction from which they came.
- C) Almost all of the alpha particles sputtered gold atoms off of the surface of the foil.
- D) Almost all of the alpha particles were deflected while passing through the foil.
- E) none of the above

Question 4

The atomic mass unit is defined as:

- A) 1/12 the mass of a carbon atom containing six protons and six neutrons.
- B) 1/14 the mass of a nitrogen atom containing 7 protons and 7 neutrons.
- C) the mass of the hydrogen atom containing only one proton.
- D) the mass of electrons found in a carbon atom containing six protons and neutrons.
- E) none of the above

Question 5

Which of the following subatomic particles has a mass of 1.67×10^{-27} kg?

- A) neutrons only
- B) protons only
- C) electrons only
- D) protons and neutrons
- E) none of the above

Question 6

Which of the following elements has only 12 protons?

- A) Zn
- B) C
- C) Mg
- D) O
- E) none of the above

Question 7

Which of the following is NOT a correct name, symbol combination?

- A) iron, I
- B) beryllium, Be
- C) silicon, Si
- D) magnesium, Mg
- E) manganese, Mn

Question 8

Which of the following is NOT a correct name, symbol combination?

- A) manganese, Mg
- B) iron, Fe
- C) silicon, Si
- D) phosphorus, P
- E) beryllium, Be

Question 9

Which one of the following is a main-group element?

- A) Cu
- B) Ce
- C) Cs
- D) Co
- E) none of the above

Question 10

Group 7A elements are also called:

- A) noble gases.
- B) halogens.
- C) alkaline earth metals.
- D) alkali metals.
- E) none of the above

Question 11

All of the following statements about different elements are true EXCEPT:

- A) Barium is an alkaline earth metal.
- B) Iodine is a halogen.
- C) Manganese is a transition metal.
- D) Krypton is one of the noble gases.
- E) Sulfur is considered a metalloid.

Question 12

Ions are formed when atoms:

- A) gain or lose electrons.
- B) gain or lose protons.
- C) gain or lose neutrons.
- D) Each of these results in ion formation.
- E) None of these results in ion formation.

Question 13

Which of the following statements about ions is INCORRECT?

- A) Cations are positive ions and anions are negative ions.
- B) Cations are formed when an atom loses electrons.
- C) Cations always have the same number of protons as electrons.
- D) Anions are formed when an atom gains electrons.
- E) All statements are correct.

Question 14

What is the correct formula for a potassium ion with 18 electrons?

- A) K^+
- B) P^-
- C) P^+
- D) K^-
- E) none of the above

Question 15

How many protons and electrons are present in O^{2-} ?

- A) 16 protons and 8 electrons
- B) 8 protons and 10 electrons
- C) 10 protons and 8 electrons
- D) 8 protons and 8 electrons
- E) none of the above

Question 16

Isotopes are:

- A) atoms of the same element that have different number of protons.
- B) atoms of the same element that have different number of neutrons.
- C) atoms of the same element that have the same number of neutrons.
- D) atoms of the same element that have different number of electrons.
- E) none of the above

Question 17

How many neutrons are present in Ne-22?

- A) 10
- B) 22
- C) 32
- D) 12
- E) none of the above

Question 18

What is the mass number of the hydrogen isotope that contains 2 neutrons?

- A) 1
- B) 2
- C) 3
- D) 4
- E) none of the above

Question 19

An atom that has the same number of neutrons as barium-138 (atomic number 56) is:

- A) lanthanum-137 (atomic number 57)
- B) xenon-136 (atomic number 54)
- C) cesium-138 (atomic number 55)
- D) barium-136 (atomic number 56)
- E) none of the above

Question 20

A fictional element has two isotopes, each making up 50% of the population. Isotope 1 has a mass of 80.0 amu, Isotope 2 has a mass of 85.0 amu. Calculate the atomic mass of the fictional element.

- A) 42.5 amu
- B) 82.5 amu
- C) 40 amu
- D) 165 amu
- E) none of the above

End of Chapter Questions

Question 21

What are the properties of metals? Where are metals found on the periodic table?

Question 22

Where on the periodic table are metalloids found?

Question 23

What is a family or group of elements?

Question 24

Locate each group of elements on the periodic table and list its group number.

- (a) alkali metals
- (b) alkaline earth metals
- (c) halogens
- (d) noble gases

Question 25

What is an ion?

Question 26

What is an anion? What is a cation?

Question 27

Locate each group on the periodic table and list the charge of the ions it tends to form.

- (a) Group 1A
- (b) Group 2A
- (c) Group 3A
- (d) Group 6A
- (e) Group 7A

Question 28

What are isotopes?

Question 29

What is the percent natural abundance of isotopes?

Question 30

What is the mass number of an isotope?

Question 31

What notations are commonly used to specify isotopes? What do each of the numbers in these symbols mean?

Question 32

What is the atomic mass of an element?

Question 33

Which statements are inconsistent with Dalton's atomic theory as it was originally stated? Explain.

- (a) All carbon atoms are identical.
- (b) Helium atoms can be split into two hydrogen atoms.
- (c) An oxygen atom combines with 1.5 hydrogen atoms to form water molecules.
- (d) Two oxygen atoms combine with a carbon atom to form carbon dioxide molecules.

Question 34

If atoms are mostly empty space and atoms compose all ordinary matter, why does solid matter seem to have no space within it?

Question 35

Which statements about electrons are true?

- (a) Electrons repel each other.
- (b) Electrons are attracted to protons.
- (c) Some electrons have a charge of $1-$ and some have no charge.
- (d) Electrons are much lighter than neutrons.

Question 36

Which statements about electrons are false?

- (a) Most atoms have more electrons than protons.
- (b) Electrons have a charge of $1-$.
- (c) If an atom has an equal number of protons and electrons, it will be charge-neutral.
- (d) Electrons experience an attraction to protons.

Question 37

Which statements about protons are true?

- (a) Protons have twice the mass of neutrons.
- (b) Protons have the same magnitude of charge as electrons but are opposite in sign.
- (c) Most atoms have more protons than electrons.
- (d) Protons have a charge of $1+$.

Question 38

Which statements about protons are false?

- (a) Protons have about the same mass as neutrons.
- (b) Protons have about the same mass as electrons.
- (c) Some atoms do not have any protons.
- (d) Protons have the same magnitude of charge as neutrons but are opposite in sign.

Question 39

Find the atomic number Z for each element.

- (a) Fr
- (b) Kr
- (c) Pa
- (d) Ge
- (e) Al

Question 40

How many protons are in the nucleus of an atom of each element?

- (a) Ar
- (b) Sn
- (c) Xe
- (d) O
- (e) Tl

Question 41

List the symbol and atomic number of each element.

- (a) carbon
- (b) nitrogen
- (c) sodium
- (d) potassium
- (e) copper

Question 42

List the name and atomic number of each element.

- (a) Mn
- (b) Ag
- (c) Au
- (d) Pb
- (e) S

Question 43

Classify each element as a metal, nonmetal, or metalloid.

- (a) Sr
- (b) Mg
- (c) F
- (d) N
- (e) As

Question 44

Which elements would you expect to lose electrons in chemical changes?

- (a) potassium
- (b) sulfur
- (c) fluorine
- (d) barium
- (e) copper

Question 45

Which elements are main-group elements?

- (a) Te
- (b) K
- (c) V
- (d) Re
- (e) Ag

Question 46

Which elements are alkaline earth metals?

- (a) sodium
- (b) aluminum
- (c) calcium
- (d) barium
- (e) lithium

Question 47

Which elements are alkali metals?

- (a) barium
- (b) sodium
- (c) gold
- (d) tin
- (e) rubidium

Question 48

Classify each element as a halogen, a noble gas, or neither.

- (a) Cl
- (b) Kr
- (c) F
- (d) Ga
- (e) He

Question 49

To what group number does each element belong?

- (a) oxygen
- (b) aluminum
- (c) silicon
- (d) tin
- (e) phosphorus

Question 50

Which element do you expect to be most like magnesium? Why?

- (a) potassium
- (b) silver
- (c) bromine
- (d) calcium
- (e) lead

Question 51

Which pair of elements do you expect to be most similar? Why?

- (a) Si and P
- (b) Cl and F
- (c) Na and Mg
- (d) Mo and Sn
- (e) N and Ni

Question 52

Which pair of elements do you expect to be most similar? Why?

- (a) Ti and Ga
- (b) N and O
- (c) Li and Na
- (d) Ar and Br
- (e) Ge and Ga

Question 53

Which element is a main-group nonmetal?

- (a) K
- (b) Fe
- (c) Sn
- (d) S

Question 54

Which element is a row 5 transition element?

- (a) Sr
- (b) Pd
- (c) P
- (d) V

Question 55

Fill in the blanks to complete the table.

Chemical symbol	Group number	Group name	Metal or nonmetal
K	_____	_____	metal
Br	_____	halogens	_____
Sr	_____	_____	_____
He	8A	_____	_____
Ar	_____	_____	_____

Question 56

Complete each ionization equation.

- (a) $\text{Na} \rightarrow \text{Na}^+ + \text{_____}$
- (b) $\text{O} + 2 \text{e}^- \rightarrow \text{_____}$
- (c) $\text{Ca} \rightarrow \text{Ca}^{2+} + \text{_____}$
- (d) $\text{Cl} + \text{e}^- \rightarrow \text{_____}$

Question 57

Determine the charge of each ion.

- (a) oxygen ion with 10 electrons
- (b) aluminum ion with 10 electrons
- (c) titanium ion with 18 electrons
- (d) iodine ion with 54 electrons

Question 58

Determine the number of protons and electrons in each ion.

- (a) Na^+
- (b) Ba^{2+}
- (c) O^{2-}
- (d) Co^{3+}

Question 59

Determine whether each statement is true or false. If false, correct it.

- (a) The Ti^{2+} ion contains 22 protons and 24 electrons.
- (b) The I^- ion contains 53 protons and 54 electrons.
- (c) The Mg^{2+} ion contains 14 protons and 12 electrons.
- (d) The O^{2-} ion contains 8 protons and 10 electrons.

Question 60

Predict the ion formed by each element.

- (a) Rb
- (b) K
- (c) Al
- (d) O

Question 61

Predict how many electrons each element will most likely gain or lose.

- (a) Ga
- (b) Li
- (c) Br
- (d) S

Question 62

Determine the atomic number and mass number for each isotope.

- (a) the hydrogen isotope with 2 neutrons
- (b) the chromium isotope with 28 neutrons
- (c) the calcium isotope with 22 neutrons
- (d) the tantalum isotope with 109 neutrons

Question 63

Write an isotopic symbol for each isotope, with mass number at the upper left and atomic number at the lower left.

- (a) oxygen with 8 neutrons
- (b) fluorine with 10 neutrons
- (c) sodium with 12 neutrons
- (d) aluminum with 14 neutrons

Question 64

Write the isotopic symbol for each isotope, with mass number at the upper left and atomic number at the lower left.

- (a) cobalt-60
- (b) neon-22
- (c) iodine-131
- (d) plutonium-244

Question 65

Determine the number of protons and neutrons in each isotope.

- (a) sodium-23, atomic number 11
- (b) radium-226, atomic number 88
- (c) lead-208, atomic number 82
- (d) nitrogen-14, atomic number 7

Question 66

Rubidium has two naturally occurring isotopes: Rb-85 with mass 84.9118 u and natural abundance 72.17%, and Rb-87 with mass 86.9092 u and natural abundance 27.83%. Calculate the atomic mass of rubidium.

Question 67

Bromine has two naturally occurring isotopes, Br-79 and Br-81, and an atomic mass of 79.904 u.

- (a) If the natural abundance of Br-79 is 50.69%, what is the natural abundance of Br-81?
- (b) If the mass of Br-81 is 80.9163 u, what is the mass of Br-79?

Question 68

An element has two naturally occurring isotopes. Isotope 1 has a mass of 120.9038 u and a relative abundance of 57.4%, and isotope 2 has a mass of 122.9042 u and a relative abundance of 42.6%. Find the atomic mass and identify the element using the periodic table.

Question 69

Electrical charge is sometimes reported in coulombs (C). On this scale, one electron has a charge of -1.6×10^{-19} C. Suppose your body acquires -125 mC of charge on a dry day. How many excess electrons has it acquired? Use the charge of an electron as a conversion factor.

Question 70

The hydrogen atom contains 1 proton and 1 electron. The radius of the proton is approximately 1.0 fm (femtometer), and the radius of the hydrogen atom is approximately 53 pm (picometers). Calculate the volume of the nucleus and of the atom. What percentage of the hydrogen atom's volume does the nucleus occupy?

Solutions

Find the solution with the same question number.

Question 1 Solution

D. Democritus proposed that matter consists of discrete particles rather than being continuous. His proposal was philosophical, rather than the experimentally supported atomic theory developed later.

Question 2 Solution

B. Thomson's cathode-ray experiments established the existence of negatively charged particles, electrons.

Question 3 Solution

A. Most alpha particles passed through the foil. The rare large deflections showed that positive charge and most atomic mass are concentrated in a very small nucleus.

Question 4 Solution

A. One unified atomic mass unit is one-twelfth the mass of a carbon-12 atom, which contains six protons and six neutrons.

Question 5 Solution

D. Protons and neutrons each have a mass close to 1.67×10^{-27} kg. An electron is much lighter.

Question 6 Solution

C. The number of protons is the atomic number. Atomic number 12 identifies magnesium, Mg.

Question 7 Solution

A. Iron is Fe. The symbol I stands for iodine.

Question 8 Solution

A. Manganese is Mn. Mg stands for magnesium.

Question 9 Solution

C. Cs is in Group 1A, a main-group column. Cu and Co are transition metals; Ce is a lanthanide.

Question 10 Solution

B. Group 7A, or Group 17, contains the halogens.

Question 11 Solution

E. Sulfur is a nonmetal, not a metalloid. The other classifications are correct.

Question 12 Solution

A. Gaining or losing electrons changes charge without changing the element. Changing the number of protons changes the element; changing neutrons changes the isotope.

Question 13 Solution

C. A cation has fewer electrons than protons. Equal numbers of protons and electrons would give a neutral atom.

Question 14 Solution

A. Potassium has 19 protons. With 18 electrons its charge is $19 - 18 = +1$, so the ion is K^+ .

Question 15 Solution

B. Oxygen has 8 protons. A $2-$ charge means two extra electrons: $8 + 2 = 10$ electrons.

Question 16 Solution

B. Isotopes have the same number of protons, which fixes the element, but different numbers of neutrons.

Question 17 Solution

D. Neon has atomic number 10. Neutrons = mass number – atomic number = $22 - 10 = 12$.

Question 18 Solution

C. A hydrogen nucleus has one proton. Mass number = 1 proton + 2 neutrons = 3.

Question 19 Solution

B. Barium-138 has $138 - 56 = 82$ neutrons. For the options, the neutron counts are: La-137, 80; Xe-136, 82; Cs-138, 83; Ba-136, 80. Xenon-136 is the match.

Question 20 Solution

B. Use a weighted average. Equal abundances mean equal weights.

$$\text{Atomic mass} = (0.500)(80.0 \text{ u}) + (0.500)(85.0 \text{ u}) = 82.5 \text{ u}$$

Question 21 Solution

Metals usually conduct heat and electricity well, are lustrous, are malleable, and are ductile. They tend to lose electrons in chemical reactions. They occupy the left and central regions of the periodic table, including the two separated rows at the bottom.

Question 22 Solution

Metalloids lie along the zigzag boundary between metals and nonmetals. Examples include boron, silicon, germanium, arsenic, antimony, and tellurium.

Question 23 Solution

A family or group is a vertical column in the periodic table. Elements in a group have similar chemical properties.

Question 24 Solution

- (a) Alkali metals: Group 1A, or 1, at the far left; hydrogen is not an alkali metal.
- (b) Alkaline earth metals: Group 2A, or 2, the next column.
- (c) Halogens: Group 7A, or 17, the next-to-last column.
- (d) Noble gases: Group 8A, or 18, the far-right column.

Question 25 Solution

An ion is an atom or a bonded group of atoms with a net electrical charge. An atomic ion forms when an atom gains or loses electrons.

Question 26 Solution

An anion has a negative charge; an atomic anion has gained electrons. A cation has a positive charge; an atomic cation has lost electrons.

Question 27 Solution

- (a) Group 1A metals lose 1 electron: +1.
- (b) Group 2A metals lose 2 electrons: +2.
- (c) Group 3A metals, especially Al, commonly lose 3 electrons: +3.
- (d) Group 6A nonmetals gain 2 electrons: -2.
- (e) Group 7A nonmetals gain 1 electron: -1.

These are the usual introductory predictions for simple ions in compounds, not claims that the free elements already exist as ions.

Question 28 Solution

Isotopes are atoms of the same element with different numbers of neutrons. They have equal atomic numbers but different mass numbers.

Question 29 Solution

It is the percentage of atoms of an element in a naturally occurring sample that belong to a particular isotope. The abundances of all isotopes in the sample add to 100%.

Question 30 Solution

The mass number A is the total number of protons and neutrons in the nucleus: $A = \text{protons} + \text{neutrons}$. It is a whole-number count, not the measured mass in atomic mass units.

Question 31 Solution

One notation is element name followed by mass number, such as carbon-14. Another places the mass number A at the upper left and atomic number Z at the lower left of the element symbol.



Here $14 = \text{protons} + \text{neutrons}$, $6 = \text{protons}$, and $\text{neutrons} = 14 - 6 = 8$.

Question 32 Solution

In this context, atomic mass is the weighted average of the masses of the element's naturally occurring isotopes, using their fractional abundances as weights. It is expressed in atomic mass units, u .

Question 33 Solution

- (a) Consistent with Dalton's original theory, although isotopes show that it is not literally true today.
- (b) Inconsistent: Dalton treated atoms as indivisible and not convertible into atoms of another element.
- (c) Inconsistent: compounds contain whole atoms, not 1.5 atoms in a molecule.
- (d) Consistent: atoms of different elements combine in whole-number ratios.

Question 34 Solution

The electron distributions extend across most of an atom's size. When atoms are pushed too close together, strong resistance arises from their electronic interactions. A solid therefore resists penetration and compression even though its nuclei occupy only a tiny fraction of its volume. The small nuclear volume does not mean there are macroscopic empty passages through the solid.

Question 35 Solution

True: (a), (b), and (d). Like charges repel, opposite charges attract, and an electron has about $1/1839$ the mass of a neutron. Statement (c) is false: every electron has charge -1 in elementary-charge units.

Question 36 Solution

Only (a) is false in the usual distinction between neutral atoms and ions. A neutral atom has equal numbers of electrons and protons. Statements (b), (c), and (d) are true.

Question 37 Solution

True: (b) and (d). A proton has charge $+1$, equal in magnitude and opposite in sign to an electron's charge. Protons and neutrons have nearly equal masses. Neutral atoms have equal numbers of protons and electrons.

Question 38 Solution

False: (b), (c), and (d). A proton is about 1836 times as massive as an electron. Every atom has at least one proton. Neutrons have zero charge, whereas protons have charge +1. Statement (a) is true.

Question 39 Solution

Read the atomic number, not the average atomic mass, from the periodic table.

- (a) Fr: 87.
- (b) Kr: 36.
- (c) Pa: 91.
- (d) Ge: 32.
- (e) Al: 13.

Question 40 Solution

The number of protons equals the atomic number.

- (a) Ar: 18.
- (b) Sn: 50.
- (c) Xe: 54.
- (d) O: 8.
- (e) Tl: 81.

Question 41 Solution

- (a) Carbon: C, 6.
- (b) Nitrogen: N, 7.
- (c) Sodium: Na, 11.
- (d) Potassium: K, 19.
- (e) Copper: Cu, 29.

Question 42 Solution

- (a) Mn: manganese, 25.
- (b) Ag: silver, 47.
- (c) Au: gold, 79.
- (d) Pb: lead, 82.
- (e) S: sulfur, 16.

Question 43 Solution

- (a) Sr: metal.

- (b) Mg: metal.
- (c) F: nonmetal.
- (d) N: nonmetal.
- (e) As: metalloid, along the zigzag boundary.

Question 44 Solution

Potassium (a), barium (d), and copper (e) are metals and tend to lose electrons. Sulfur and fluorine are nonmetals and commonly gain electrons when forming simple ions.

Question 45 Solution

Te (a) and K (b). Main-group elements occupy Groups 1, 2, and 13–18. V, Re, and Ag lie in the transition-metal region.

Question 46 Solution

Calcium (c) and barium (d), both in Group 2A. Sodium and lithium are alkali metals, in Group 1A.

Question 47 Solution

Sodium (b) and rubidium (e), both in Group 1A.

Question 48 Solution

- (a) Cl: halogen.
- (b) Kr: noble gas.
- (c) F: halogen.
- (d) Ga: neither; it is a Group 3A metal.
- (e) He: noble gas.

Question 49 Solution

Both common group-number conventions are shown.

- (a) O: 6A, or 16.
- (b) Al: 3A, or 13.
- (c) Si: 4A, or 14.
- (d) Sn: 4A, or 14.
- (e) P: 5A, or 15.

Question 50 Solution

Calcium (d). Calcium and magnesium are in the same group, 2A, and share characteristic alkaline-earth chemistry.

Question 51 Solution

Cl and F (b). They are in the same group, the halogens. Sharing a group generally predicts similar chemical properties better than simply being nearby in a row.

Question 52 Solution

Li and Na (c). Both are Group 1A alkali metals and commonly form +1 ions.

Question 53 Solution

S (d). Sulfur is a main-group nonmetal in Group 6A. The other three are metals.

Question 54 Solution

Pd (b). Palladium lies in period 5 and the transition-metal region. Sr is in period 5 but is a main-group metal.

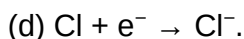
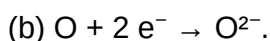
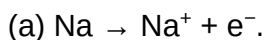
Question 55 Solution

Use the group position to supply the group number and family. "Noble gases" includes both helium and argon.

Symbol	Group number	Group name	Classification
K	1A or 1	alkali metals	metal
Br	7A or 17	halogens	nonmetal
Sr	2A or 2	alkaline earth metals	metal
He	8A or 18	noble gases	nonmetal
Ar	8A or 18	noble gases	nonmetal

Question 56 Solution

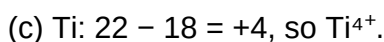
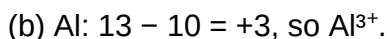
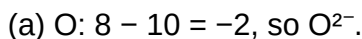
Conserve charge as well as the element.



Electrons on the product side represent loss; electrons on the reactant side represent gain.

Question 57 Solution

Charge = number of protons – number of electrons.



(d) I: $53 - 54 = -1$, so I^- .

Question 58 Solution

The proton count does not change when an ion forms. Subtract the positive charge from Z for a cation; add the magnitude of a negative charge for an anion.

(a) Na^+ : 11 protons, 10 electrons.

(b) Ba^{2+} : 56 protons, 54 electrons.

(c) O^{2-} : 8 protons, 10 electrons.

(d) Co^{3+} : 27 protons, 24 electrons.

Question 59 Solution

(a) False: Ti^{2+} has 22 protons and 20 electrons.

(b) True.

(c) False: Mg^{2+} has 12 protons and 10 electrons.

(d) True.

Ion formation changes electrons, not protons.

Question 60 Solution

(a) Rb^+ : Group 1A, loses one electron.

(b) K^+ : Group 1A, loses one electron.

(c) Al^{3+} : Group 3A metal, loses three electrons.

(d) O^{2-} : Group 6A nonmetal, gains two electrons.

Question 61 Solution

For the usual simple ions: (a) Ga loses 3; (b) Li loses 1; (c) Br gains 1; (d) S gains 2.

Question 62 Solution

Use Z from the periodic table, then $A = Z + \text{neutrons}$.

(a) H: $Z = 1$, $A = 1 + 2 = 3$.

(b) Cr: $Z = 24$, $A = 24 + 28 = 52$.

(c) Ca: $Z = 20$, $A = 20 + 22 = 42$.

(d) Ta: $Z = 73$, $A = 73 + 109 = 182$.

Question 63 Solution

First calculate $A = Z + \text{neutrons}$.

(a) $A = 8 + 8 = 16$.



(b) $A = 9 + 10 = 19.$



(c) $A = 11 + 12 = 23.$



(d) $A = 13 + 14 = 27.$



Question 64 Solution

The number after the element name is A. Obtain Z from the periodic table.

(a)



(b)



(c)



(d)



Question 65 Solution

Protons = Z; neutrons = A – Z.

(a) 11 protons; $23 - 11 = 12$ neutrons.

(b) 88 protons; $226 - 88 = 138$ neutrons.

(c) 82 protons; $208 - 82 = 126$ neutrons.

(d) 7 protons; $14 - 7 = 7$ neutrons.

Question 66 Solution

Use fractional abundances, not percentages, as the weights.

$$\text{Atomic mass} = (0.7217)(84.9118 \text{ u}) + (0.2783)(86.9092 \text{ u})$$

$$\text{Atomic mass} = 85.46767642 \text{ u} \approx 85.47 \text{ u}$$

The average lies between the isotope masses and is closer to the more abundant Rb-85.

Question 67 Solution

(a) The two abundances add to 100%.

$$\% \text{ Br-81} = 100.00 - 50.69 = 49.31\%$$

(b) Let x be the mass of Br-79.

$$79.904 = 0.5069x + (0.4931)(80.9163)$$

$$x = \frac{79.904 - (0.4931)(80.9163)}{0.5069} \approx 78.92 \text{ u}$$

Question 68 Solution

Calculate the weighted average.

$$\text{Atomic mass} = (0.574)(120.9038 \text{ u}) + (0.426)(122.9042 \text{ u})$$

$$\text{Atomic mass} = 121.7559704 \text{ u} \approx 121.76 \text{ u}$$

This matches antimony, Sb. The isotope abundances are rounded, so do not interpret the calculator's final digits as additional precision.

Question 69 Solution

First convert millicoulombs to coulombs. A negative net charge means extra electrons.

$$-125 \text{ mC} \times \frac{1 \text{ C}}{1000 \text{ mC}} \times \frac{1 \text{ electron}}{-1.6 \times 10^{-19} \text{ C}} = 7.8 \times 10^{17} \text{ electrons}$$

The charge is negative, but the number of excess electrons is positive.

Question 70 Solution

Treat both as spheres. Convert the radii to the same unit before comparing volumes.

$$r(\text{nucleus}) = 1.0 \times 10^{-15} \text{ m}$$

$$r(\text{atom}) = 53 \times 10^{-12} \text{ m}$$

$$V(\text{nucleus}) = \frac{4\pi}{3} (1.0 \times 10^{-15} \text{ m})^3 = 4.2 \times 10^{-45} \text{ m}^3$$

$$V(\text{atom}) = \frac{4\pi}{3} (53 \times 10^{-12} \text{ m})^3 = 6.2 \times 10^{-31} \text{ m}^3$$

$$\text{Percent} = \left(\frac{1.0 \times 10^{-15}}{53 \times 10^{-12}} \right)^3 \times 100 = 6.7 \times 10^{-13} \%$$

The ratio of radii must be cubed; using the radius ratio itself would greatly overestimate the nuclear volume fraction.