

CLASS 9 SCIENCE — CHAPTER 9

NCERT SOLUTIONS

Atomic Foundations of Matter

New NCERT *Exploration* Textbook | 2026–27

The chapter-end “Revise, Reflect, Refine” section contains **15 questions**.

Q1. Elements A and B — Ions and Ionic Compound

Element **A** has **one electron** in its third shell.

Element **B** has **six electrons** in its second shell.

(i) How many electrons does A tend to give or take?

A has electronic configuration:

2, 8, 1

It has **1 valence electron**.

It tends to **lose 1 electron** to achieve a stable configuration.

 **Answer: A gives 1 electron.**

(ii) What kind of ion does A form?

When A loses one electron, it becomes positively charged.



✓ **A forms a cation (A^+).**

(iii) How many electrons does B tend to give or take?

B has six electrons in its second shell.

Its configuration is:

2, 6

It needs **2 more electrons** to complete its octet.

✓ **B takes 2 electrons.**

(iv) What kind of ion does B form?

B gains two electrons and becomes negatively charged.



✓ **B forms an anion (B^{2-}).**

(v) What type of bond will form?

A loses electrons and B gains electrons.

Therefore, electrons are **transferred** from A to B.

✓ **Ionic bond**

(vi) Formula of the compound

A has charge:

A^+

B has charge:



Two A^+ ions are needed to balance one B^{2-} ion.

✓ **Formula:**



Q2. Element X and Diatomic Molecule

Element X has **six electrons in its outer shell** and forms a diatomic molecule.

(i) Why does X form a diatomic molecule?

X has 6 valence electrons.

It needs 2 more electrons to complete its octet.

Two X atoms can **share electrons** with each other.

Therefore, they form a molecule containing two atoms:



(ii) What type of bond?

The two X atoms share electrons.

✓ **Covalent bond**

(iii) Structure of X_2

Each X atom contributes two electrons for sharing.

The molecule can be represented as:

X = X

There are **two shared pairs of electrons**, forming a **double covalent bond**.

(iv) Element Y has two electrons in its second shell

Y has configuration:

2, 2

It has 2 valence electrons and tends to form two covalent bonds.

Since X needs two electrons and Y can share two electrons:

Structure:

X — Y — X



Formula:

YX₂

This follows the textbook's discussion of electron sharing and covalent bonding.



Q3. Ionic Compound with Total Charges 6+ and 6-

We need the combination where:

Total positive charge = +6

Total negative charge = -6

Options:

(i) 2 Al³⁺ and 3 Cl⁻

Positive:

$$2 \times (+3) = +6$$

Negative:

$$3 \times (-1) = -3$$

 Not correct.

(ii) 3 Mg²⁺ and 1 PO₄³⁻

Positive:

$$3 \times (+2) = +6$$

Negative:

$$1 \times (-3) = -3$$

 Not correct.

(iii) 2 Fe³⁺ and 3 O²⁻

Positive:

$$2 \times (+3) = +6$$

Negative:

$$3 \times (-2) = -6$$

 **Correct.**

(iv) 3 Ca²⁺ and 2 SO₄²⁻

Positive:

$$3 \times (+2) = +6$$

Negative:

$$2 \times (-2) = -4$$

✗ Not correct.

✓ Answer:

(iii) 2Fe^{3+} and 3O^{2-}

Q4. Correct the Statements

(i) Elements are made up of molecules and compounds are made up of atoms.

✗ False

Elements can exist as atoms or molecules, while compounds contain atoms of **different elements chemically combined**.

Correct statement:

Elements may exist as atoms or molecules, while compounds are made up of atoms of two or more different elements chemically combined.

(ii) The molecule of a compound is always made up of two or more atoms of the same kind.

✗ False

A compound contains atoms of **different elements**.

Correct statement:

A molecule of a compound contains atoms of two or more different elements chemically bonded together.

(iii) One molecule of nitrogen gas contains three nitrogen atoms.

 **False**

Nitrogen gas is:



Therefore, one nitrogen molecule contains **two nitrogen atoms**.

(iv) Water is made of two hydrogen atoms covalently bonded with one oxygen atom.

 **True**

Water is:



It contains:

- 2 hydrogen atoms
- 1 oxygen atom

The hydrogen and oxygen atoms are joined by covalent bonds.



Q5. Write Chemical Formulae

(i) Aluminium nitrate

Aluminium ion:



Nitrate ion:



Three nitrate ions are required to balance Al^{3+} .



(ii) Calcium oxide

Calcium:



Oxygen:



Charges balance in a 1:1 ratio.



(iii) Ferric oxide

Ferric ion:

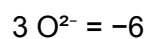
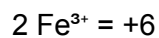


Oxide ion:



LCM of 3 and 2 = 6.

We need:





Q6. Formulae from Given Ions

(i) Ca^{2+} and Br^-

One Ca^{2+} needs two Br^- .

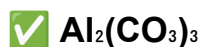


(ii) Al^{3+} and CO_3^{2-}

LCM of 3 and 2 = 6.

$$2 \text{Al}^{3+} = +6$$

$$3 \text{CO}_3^{2-} = -6$$



(iii) K^+ and SO_4^{2-}

Two K^+ ions balance one SO_4^{2-} ion.



(iv) NH_4^+ and Cl^-

Charges are +1 and -1.



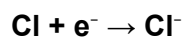
Q7. Correct Representation of Cl^- Ion

Atomic number of chlorine = 17.

A neutral chlorine atom has:

17 electrons

Chlorine gains one electron to form chloride ion:



Therefore:

$$17 + 1 = \mathbf{18 \text{ electrons}}$$

Electronic configuration:

2, 8, 8

So the correct diagram is the one showing:

18 electrons arranged as 2, 8, 8

✓ **Answer: (ii)**



Q8. Formula Unit Mass

(i) Ammonium nitrate — NH_4NO_3

Atomic masses:

$$\text{N} = 14 \text{ u}$$

$$\text{H} = 1 \text{ u}$$

$$\text{O} = 16 \text{ u}$$

NH_4NO_3 contains:

$$2 \text{ N} + 4 \text{ H} + 3 \text{ O}$$

Formula unit mass:

$$= (2 \times 14) + (4 \times 1) + (3 \times 16)$$

$$= 28 + 4 + 48$$

✓ 80 u

(ii) Phosphoric acid — H_3PO_4

H = 1 u

P = 31 u

O = 16 u

Formula unit mass:

$$= (3 \times 1) + 31 + (4 \times 16)$$

$$= 3 + 31 + 64$$

✓ 98 u

(iii) Sodium hydrogencarbonate — NaHCO_3

Na = 23 u

H = 1 u

C = 12 u

O = 16 u

Formula unit mass:

$$= 23 + 1 + 12 + (3 \times 16)$$

$$= 23 + 1 + 12 + 48$$

✓ 84 u



Q9. Formulae of Compounds

(i) Magnesium + Nitrogen

Magnesium:



Nitrogen:



Cross the valencies:



(ii) Lithium + Nitrogen

Lithium:



Nitrogen:



Three Li^+ ions are needed.



(iii) Sodium + Sulfur

Sodium:



Sulfur:



Two Na^+ ions are needed.



(iv) Aluminium + Oxygen

Aluminium:



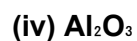
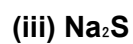
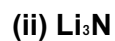
Oxygen:



Therefore:



Answers:



Q10. Complete Table 9.3

The cations are:

- Li^+
- Al^{3+}
- Cu^{2+}

The anions are:

- NO_3^-
- SO_4^{2-}
- PO_4^{3-}
- NH_4^+

! Important: NH_4^+ is itself a cation, so the textbook table is interpreted using the ion headings exactly as given in the supplied answer key. The completed combinations are:

Cation	NO_3^-	SO_4^{2-}	PO_4^{3-}
NH_4^+	NH_4NO_3	$(\text{NH}_4)_2\text{SO}_4$	$(\text{NH}_4)_3\text{PO}_4$
Li^+	LiNO_3	Li_2SO_4	Li_3PO_4
Al^{3+}	$\text{Al}(\text{NO}_3)_3$	$\text{Al}_2(\text{SO}_4)_3$	AlPO_4
Cu^{2+}	$\text{Cu}(\text{NO}_3)_2$	CuSO_4	$\text{Cu}_3(\text{PO}_4)_2$

The supplied answer key confirms these formulae.



Q11. Law of Conservation of Mass

Given:

Sodium carbonate = **5.3 g**

Acetic acid = **6.0 g**

Products:

CO_2 = **2.2 g**

Water = **0.9 g**

Sodium acetate = **8.2 g**

Step 1: Total mass before reaction

$5.3 + 6.0$

= **11.3 g**

Step 2: Total mass after reaction

$$2.2 + 0.9 + 8.2$$

$$= 11.3 \text{ g}$$

Therefore:

Mass of reactants = Mass of products

$$11.3 \text{ g} = 11.3 \text{ g}$$

✓ **Answer:**

The **Law of Conservation of Mass** is valid.

No mass is lost or gained during the chemical reaction.



Q12. Species with 11 Protons, 12 Neutrons and 10 Electrons

Given:

Protons = 11

Neutrons = 12

Electrons = 10

(i) Atomic number and mass number

Atomic number:

Z = Number of protons

$$Z = 11$$

Mass number:

A = Protons + Neutrons

$$A = 11 + 12$$

$$\mathbf{A = 23}$$

(ii) Neutral, cation or anion?

Protons = 11

Electrons = 10

There is one more positive charge than negative charge.

Net charge:

$$11 - 10 = \mathbf{+1}$$

Therefore, it is a:

 **Cation (Na⁺)**

(iii) Electronic configuration

10 electrons are arranged as:

2, 8

(iv) Name the species

Atomic number 11 = **Sodium**

Since it has lost one electron:

Sodium ion (Na⁺)

 **Answer:**

Z = 11

A = 23

Cation = Na⁺

Electronic configuration = 2, 8

Species = Sodium cation



Q13. Elements A and B

Given:

A = 2, 8, 5

B = 2, 8, 7

(i) Which element is more reactive?

A has:

5 valence electrons

B has:

7 valence electrons

B needs only **one electron** to complete its octet.

Therefore, B has a stronger tendency to gain an electron.



Element B is more reactive.

(ii) Ionic or covalent bond?

A has 5 valence electrons.

B has 7 valence electrons.

Neither is likely to completely transfer electrons to the other.

Instead, they can **share electrons**.

✓ **Covalent bond**

(iii) Formula of the compound

A needs 3 electrons to complete its octet.

B needs 1 electron.

Therefore, one A atom shares electrons with three B atoms.

✓ **Formula:**

AB₃

Q14. Assertion and Reason — Copper Sulfate

Assertion:

Copper sulfate conducts electricity in the molten state but not in the solid state.

Reason:

Copper and sulfate ions are fixed in the lattice in molten state, while in solid state they can move freely.

Assertion:

✓ **True**

Molten copper sulfate has mobile ions, so it conducts electricity.

Reason:

 **False**

The statement has the states reversed.

In the **solid state**, ions are fixed in their positions and cannot move freely.

In the **molten state**, ions become free to move.

 **Answer:**

(iii) A is true, but R is false.



Q15. Electrons and Neutrons

Find the number of electrons and neutrons in:

1. ^{27}Al
 2. $^{80}\text{Br}^-$
 3. $^{201}\text{Hg}^{2+}$
-

(i) ^{27}Al

Aluminium atomic number = **13**

Therefore:

Protons = 13

Neutral Al:

Electrons = **13**

Neutrons:

$$27 - 13 = 14$$

 **Electrons = 13**

✓ **Neutrons = 14**

(ii) $^{80}\text{Br}^-$

Bromine atomic number = **35**

Neutral Br has 35 electrons.

Br^- has gained one electron:

$$35 + 1 = 36$$

Neutrons:

$$80 - 35$$

$$= 45$$

✓ **Electrons = 36**

✓ **Neutrons = 45**

(iii) $^{201}\text{Hg}^{2+}$

Mercury atomic number = **80**

Neutral Hg has 80 electrons.

Hg^{2+} has lost two electrons:

$$80 - 2$$

$$= 78$$

Neutrons:

$$201 - 80$$

$$= 121$$

✓ **Electrons = 78**

✓ Neutrons = 121

CHAPTER 9 — COMPLETE ANSWER KEY

Q	Answer
1	A gives $1e^- \rightarrow A^+$; B takes $2e^- \rightarrow B^{2-}$; ionic; A₂B
2	X has 6 valence e^- ; covalent bonding; diatomic molecule
3	(iii)
4	(iv) is correct; corrections given above
5	Al(NO ₃) ₃ , CaO, Fe ₂ O ₃
6	CaBr ₂ , Al ₂ (CO ₃) ₃ , K ₂ SO ₄ , NH ₄ Cl
7	(ii)
8	80 u, 98 u, 84 u
9	Mg ₃ N ₂ , Li ₃ N, Na ₂ S, Al ₂ O ₃
10	Completed table above
11	Reactants = 11.3 g , products = 11.3 g
12	Z = 11, A = 23, Na ⁺ , configuration 2,8
13	B; covalent; AB₃
14	(iii)
15	Al: 13e ⁻ , 14n; Br ⁻ : 36e ⁻ , 45n; Hg ²⁺ : 78e ⁻ , 121n

The supplied NCERT answer key confirms the key Chapter 9 answers, including Q1, Q3–Q10 and Q12–Q15.

CHAPTER 9 — IMPORTANT FORMULAS & RULES

Mass number

Mass number = Number of protons + Number of neutrons

Neutrons

Number of neutrons = Mass number – Atomic number

Ionic charge

Charge = Number of protons – Number of electrons

Formula unit mass

Formula unit mass = Sum of atomic masses of all atoms present in the formula

Ionic compound

Total positive charge = Total negative charge

Covalent bond

Covalent bond = Sharing of electrons

Ionic bond

Ionic bond = Transfer of electrons followed by electrostatic attraction between oppositely charged ions

Remember:

Metal → tends to lose electrons → Cation

Non-metal → tends to gain electrons → Anion

Atoms sharing electrons → Covalent bond

Atoms transferring electrons → Ionic bond