

GENERAL AWARENESS · SCIENCE (CHEMISTRY) · CHAPTER 8

Matter, Atomic Structure & Periodic Table

States of matter and changes of state, elements, compounds and mixtures, solutions and colloids, separation methods, atomic models, electrons, protons and neutrons, isotopes and isobars, valency, and the periodic table from Döbereiner to Moseley with its groups and trends.

SSC CGL Tier 1

SSC CHSL Tier 1

RRB NTPC · Group D

QUESTIONS PER
PAPER

SSC 0–1 · RRB 1–2

PYQ FREQUENCY

Mendeleev,
Newlands, groups,
isobars, valency,
sublimation

PREREQUISITE

None (first
Chemistry chapter)

STUDY TIME

90 min theory + 30
min practice

Why this chapter matters: The periodic table is the most asked chemistry topic in CGL: 2022–2024 papers asked Mendeleev's year, eka-aluminium, mendelevium, the Davy Medal, Newlands' octaves, groups, metalloids and atomic size. Group D asks isobars, valency and configurations in almost every shift, and NTPC asks the electron, states of matter and sublimation.

IN THIS CHAPTER

02 Concepts

03 Rule box

04 Shortcuts

05 Traps

06 27 PYQs

07 Practice MCQs

07 Answer key

08 Quick revision

PART 2

2 Concepts & theory

2.1 States of matter and changes of state

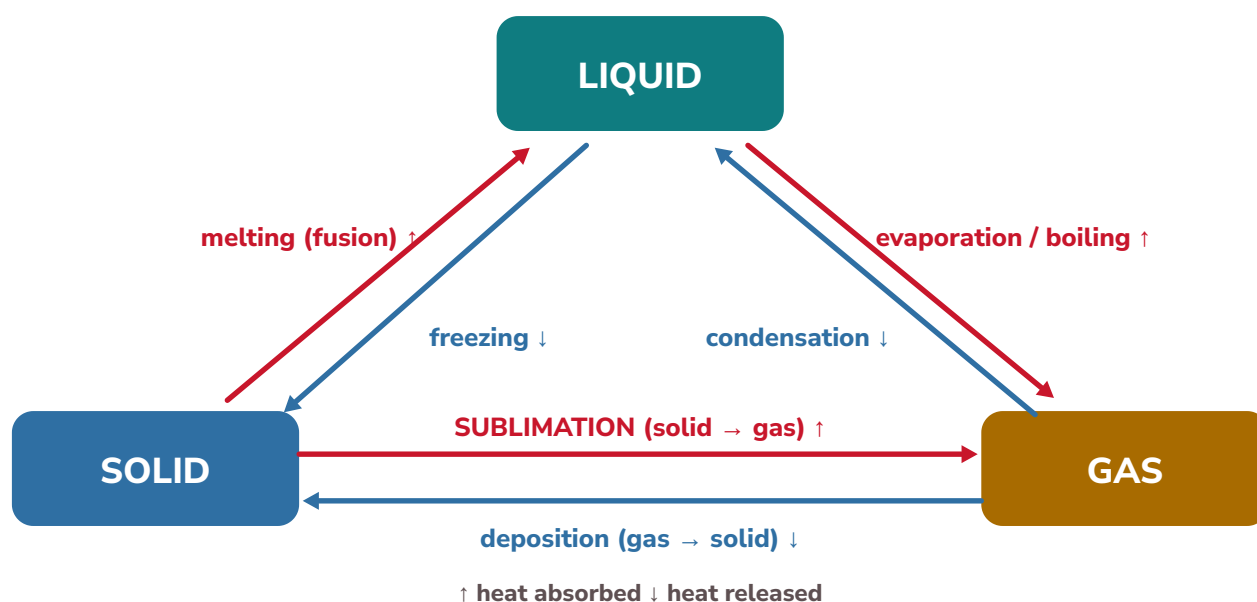
- Matter** has mass and occupies space. Three common states: **solid, liquid, gas**; also **plasma** (fourth: ionised gas in the Sun, lightning, neon signs) and **Bose–Einstein condensate** (fifth: near absolute zero). Scientists now speak of five states.
- Heat changes the state: **melting point** of ice 0 °C, **boiling point** of water 100 °C at normal pressure. **Latent heat** is absorbed without a rise in temperature; steam at 100 °C burns more than water at 100 °C.
- Sublimation**: solid → gas directly (camphor, naphthalene, iodine, ammonium chloride, dry ice). **Evaporation** is a surface process at any temperature and causes **cooling**; it increases with temperature, surface area and wind, and decreases with humidity.
- Diffusion**: particles spreading out by themselves, fastest in gases (smell of incense, perfume). Pressure on gases: **LPG** and **CNG** are gases compressed in cylinders.

The three common states of matter

Point	Solid	Liquid	Gas
Shape	Fixed	Takes the shape of the container	No shape; fills the container
Volume	Fixed	Fixed	Not fixed
Particles	Closely packed, vibrate in place	Close but slide past each other	Far apart, move fast and randomly
Forces between particles	Strongest	Medium	Weakest
Compressibility	Almost nil	Very little	High (LPG, CNG cylinders)
Diffusion	Slowest	Faster	Fastest

Fourth state: PLASMA, ionised gas (the Sun and stars, lightning, neon signs). Fifth state: BOSE–EINSTEIN CONDENSATE, atoms cooled to near absolute zero; predicted by S. N. Bose and Einstein (1924–25), made in 1995.

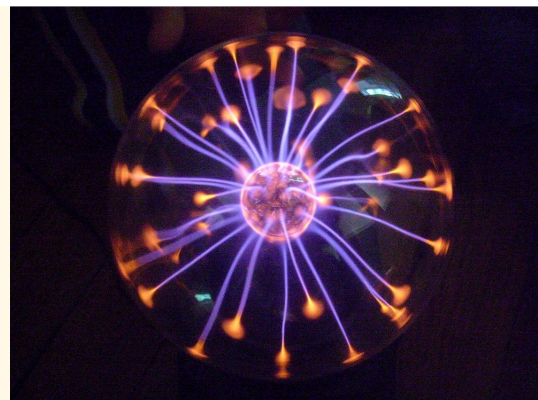
Changes of state



Sublimes on heating: camphor, naphthalene (mothballs), ammonium chloride, iodine and dry ice (solid CO_2). Evaporation happens at any temperature, from the surface only, and causes cooling (sweating, earthen pots); boiling happens at a fixed temperature throughout the liquid.



Dry ice (solid CO_2) sublimates at -78°C .



A **plasma lamp**: the fourth state of matter.

2.2 Elements, compounds and mixtures

- 1 Element:** one kind of atom (iron, oxygen). **Compound:** elements joined chemically in a fixed ratio, with new properties (water H_2O , salt NaCl). **Mixture:** components in any ratio, keeping their own properties (air, alloys, sea water).
- 2 Homogeneous** mixtures are uniform (sugar solution, air, brass); **heterogeneous** ones are not (sand in water, oil and water). Alloys are mixtures, not compounds.
- 3 Solution** (particles under 1 nm, clear, no Tyndall effect) · **colloid** (1–1000 nm: milk, fog, smoke, blood, butter, jelly; shows the **Tyndall effect**; can be separated by centrifugation, not filtration) · **suspension** (large particles that settle: muddy water).

Separating mixtures

Filtration

Insoluble solid from a liquid: sand from water; tea leaves

Evaporation - crystallisation

Dissolved solid from a solution: salt from sea water; pure copper sulphate crystals

Distillation

Liquids with very different boiling points; pure water from salt water

Fractional distillation

Liquids with close boiling points: petroleum refining, gases of air

Sublimation

Sublimable solid from a mixture: ammonium chloride from salt

Chromatography

Colours in ink or dyes, pigments in leaves; drugs in blood

Centrifugation

Spins out fine particles: cream from milk, blood tests; separates colloids that pass filters

Separating funnel

Immiscible liquids: oil and water; kerosene and water

Magnetic separation

Iron filings from sand or sulphur

Solution: particles under 1 nm, clear, no Tyndall effect (salt or sugar in water). Colloid: 1–1000 nm, shows the Tyndall effect, does not settle (milk, fog, smoke, blood, gel, butter). Suspension: bigger particles, settles (muddy water, chalk in water).



Paper chromatography separates the dyes in ink.

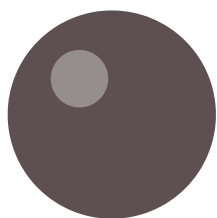


Bromine: the only non-metal liquid at room temperature.

2.3 Atomic structure

- 1 Ideas of indivisible particles: **Maharishi Kanad** ('parmanu') and Democritus. **John Dalton** (1808): atoms are indivisible and combine in simple whole-number ratios.
- 2 **Electron**: J. J. Thomson (1897), cathode rays. **Proton**: Goldstein's canal rays (1886). **Nucleus**: Rutherford's gold-foil experiment (1911). **Neutron**: Chadwick (1932). **Bohr** (1913): electrons move in fixed shells K, L, M, N holding $2n^2$ electrons.
- 3 **Atomic number Z** = protons; **mass number A** = protons + neutrons. **Isotopes**: same Z, different A; **isobars**: same A, different Z; **isotones**: same number of neutrons.
- 4 **Valency**: electrons lost, gained or shared to complete the octet. Na (2, 8, 1) valency 1; Mg (2, 8, 2) valency 2; Cl (2, 8, 7) valency 1; noble gases valency 0.

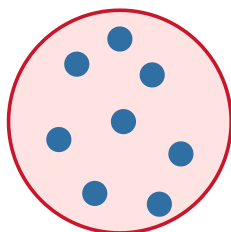
Dalton (1808)



Indivisible solid sphere

Atomic theory

Thomson (1904)

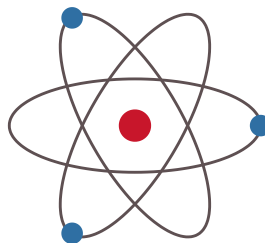


+ sphere, e^- embedded

'Plum pudding'

Electron 1897

Rutherford (1911)

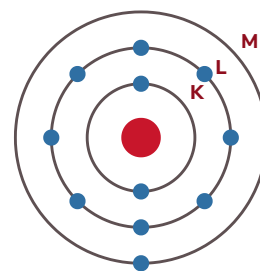


tiny + nucleus

Gold-foil experiment

Nucleus

Bohr (1913)



sodium: 2, 8, 1

Fixed orbits (shells)

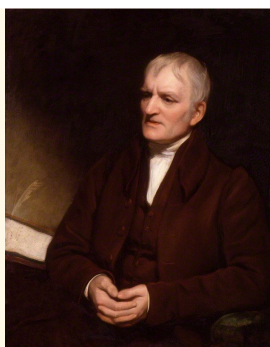
$2n^2$ rule

Shells hold at most $2n^2$ electrons: K 2, L 8, M 18 (but the outermost shell holds at most 8). Sodium (11) is 2, 8, 1; chlorine (17) is 2, 8, 7. The modern quantum model describes orbitals (s, p, d, f).

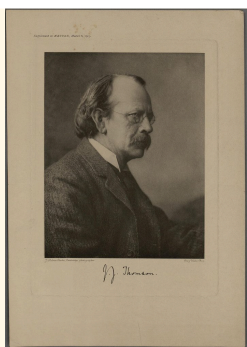
Particles of the atom and key terms

Electron	Charge -1 ; mass about $1/1836$ of a proton; J. J. Thomson, 1897 (cathode rays)
Proton	Charge $+1$; E. Goldstein's canal rays (1886); named by Rutherford
Neutron	No charge; mass $\approx$ proton; James Chadwick, 1932
Atomic number (Z)	Number of protons (= electrons in a neutral atom); fixes the element
Mass number (A)	Protons + neutrons (nucleons)
Isotopes	Same Z, different A: protium, deuterium, tritium; C-12 and C-14
Isobars	Same A, different Z: argon-40 and calcium-40
Isotones	Same number of neutrons: C-14 and N-15
Valency	Combining capacity = electrons lost, gained or shared to complete the octet

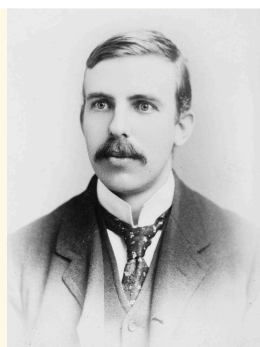
Number of neutrons = $A - Z$. Hydrogen-1 (protium) is the only atom with no neutron. Tritium is radioactive. Heavy water is D_2O .



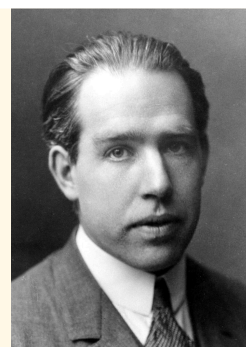
John Dalton: atomic theory (1808).



J. J. Thomson: electron (1897).



Ernest Rutherford: nucleus (1911).

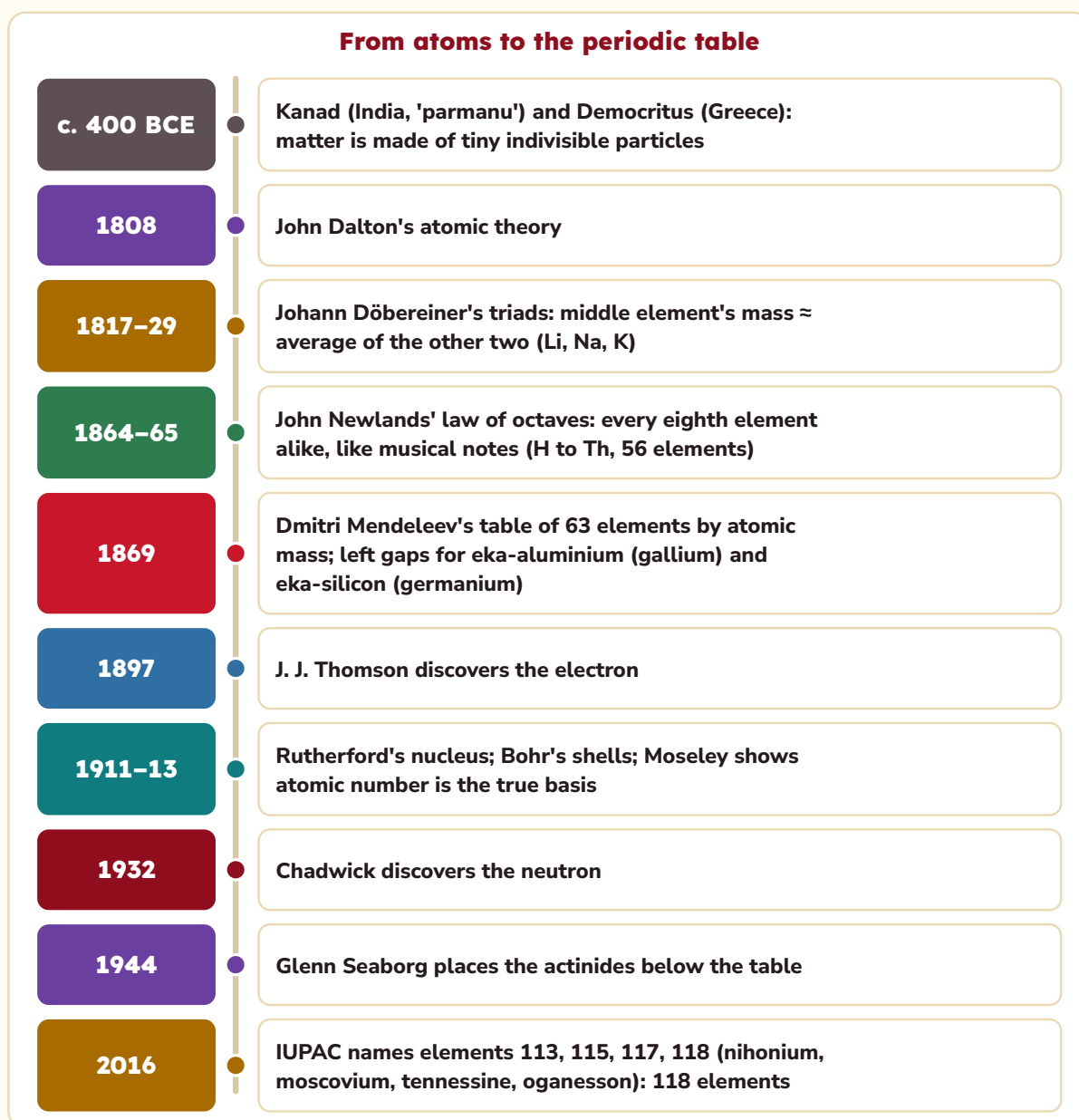


Niels Bohr: shells (1913).

2.4 Classification of elements

- Döbereiner's triads** (1817–29): in groups of three similar elements, the middle one's atomic mass is about the average of the other two. He found only three triads (Li–Na–K; Ca–Sr–Ba; Cl–Br–I).

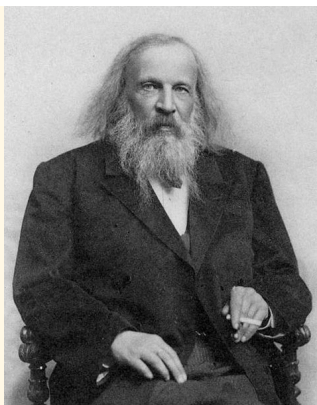
- 2 **Newlands' law of octaves** (1864–65): every eighth element is like the first, like the notes of music (sa re ga ma). It worked only up to calcium; he put cobalt and nickel with the halogens under 'Do'. He received the Davy Medal in 1887.
- 3 **Mendeleev** (1869): 63 elements in order of increasing **atomic mass**; he left gaps and predicted eka-boron (scandium), eka-aluminium (gallium) and eka-silicon (germanium). Problems: position of hydrogen and isotopes. Element 101 is mendelevium.
- 4 **Modern periodic law (Henry Moseley, 1913)**: properties are a periodic function of **atomic number**. The modern (long-form) table has **7 periods and 18 groups** and 118 elements.



Modern periodic law (Moseley, 1913): properties of elements are a periodic function of their ATOMIC NUMBERS. Mendelevium (element 101) is named after Mendeleev; Newlands received the Davy Medal in 1887.



J. W. Döbereiner: triads.



Dmitri Mendeleev (1834–1907).



Henry Moseley (1887–1915):
atomic number.

2.5 The modern periodic table and its trends

- 1** Group 1 **alkali metals** (Li, Na, K, Rb, Cs, Fr; hydrogen sits here but is a non-metal); group 2 **alkaline earth metals**; groups 3–12 **transition metals**; group 17 **halogens**; group 18 **noble gases**, which separate the halogens from the alkali metals. Lanthanides and actinides sit below the table.
- 2** Period number = number of shells; group (for groups 1, 2) = valence electrons, for groups 13–18 = 10 + valence electrons. Example: 2, 8, 6 → period 3, group 16 (sulphur).
- 3** **Across a period:** atomic size ↓, electronegativity ↑, metallic character ↓. **Down a group:** atomic size ↑, metallic character ↑. Fluorine is the most electronegative element; chlorine has the highest electron affinity; noble gases have the highest ionisation energies.
- 4** Facts: mercury is the only liquid metal and bromine the only liquid non-metal at room temperature; metalloids are B, Si, Ge, As, Sb, Te; hydrogen is the lightest and most abundant element in the universe; oxygen is the most abundant in the Earth's crust.

The modern periodic table: 7 periods, 18 groups

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
H 1																	He 2
Li 3	Be 4											B 5	C 6	N 7	O 8	F 9	Ne 10
Na 11	Mg 12											Al 13	Si 14	P 15	S 16	Cl 17	Ar 18
K 19	Ca 20	Sc 21	Ti 22	V 23	Cr 24	Mn 25	Fe 26	Co 27	Ni 28	Cu 29	Zn 30	Ga 31	Ge 32	As 33	Se 34	Br 35	Kr 36
Rb 37	Sr 38	Y 39	Zr 40	Nb 41	Mo 42	Tc 43	Ru 44	Rh 45	Pd 46	Ag 47	Cd 48	In 49	Sn 50	Sb 51	Te 52	I 53	Xe 54
Cs 55	Ba 56		Hf 72	Ta 73	W 74	Re 75	Os 76	Ir 77	Pt 78	Au 79	Hg 80	Tl 81	Pb 82	Bi 83	Po 84	At 85	Rn 86
Fr 87	Ra 88		Rf 104	Db 105	Sg 106	Bh 107	Hs 108	Mt 109	Ds 110	Rg 111	Cn 112	Nh 113	Fl 114	Mc 115	Lv 116	Ts 117	Og 118
Lanthanides		La 57	Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	Ho 67	Er 68	Tm 69	Yb 70	Lu 71	
Actinides		Ac 89	Th 90	Pa 91	U 92	Np 93	Pu 94	Am 95	Cm 96	Bk 97	Cf 98	Es 99	Fm 100	Md 101	No 102	Lr 103	

■ Alkali metals (1)

■ p-block (13–16)

■ Alkaline earth (2)

■ Halogens (17)

■ Transition (3–12)

■ Noble gases (18)

Across a period (left → right): atomic size decreases, electronegativity and non-metallic character increase.
 Down a group: atomic size and metallic character increase. Fluorine is the most electronegative element; caesium among the most electropositive. Metalloids: boron, silicon, germanium, arsenic, antimony, tellurium.

As of October 2026:

- Nobel Prize in Chemistry 2026** (announced 7 October 2026): **Henri Kagan** and **Kenso Soai** "for the discovery of non-linear effects and autocatalysis in asymmetric organic synthesis".
- The periodic table has **118** named elements; the last four (nihonium 113, moscovium 115, tennessine 117, oganesson 118) were named by IUPAC in 2016.

Rule box

Memorise these 10

MUST KNOW

1	Mendeleev's table: 1869, by atomic mass	CGL 2023
2	Groups: alkali 1, alkaline earth 2, halogens 17, noble 18	CGL 2023
3	Newlands: H to Th (56 elements); Co, Ni under 'Do'	CGL 2024
4	Eka-aluminium (mass about 68) = gallium	CGL 2022
5	Mendelevium is element 101	CGL 2022
6	Atomic size increases down a group	CGL 2023
7	Metalloids: B, Si, Ge, As, Sb, Te	CGL 2023
8	Isobars: same mass number, different atomic number	CHSL 2017
9	Modern periodic law: Moseley (atomic number)	Group D 2022
10	Fifth state: Bose–Einstein condensate	MTS 2021

Shortcuts & exam tricks

Who did what: D-N-M-M

Döbereiner triads → Newlands octaves → Mendeleev mass (1869) → Moseley number (1913).

isoTOPes, isoBARs, isoTONes

isoToPes = same Protons; isoBARs = same mass (a 'bar' of weight); isotoNes = same Neutrons.

Group and period from configuration

Count shells = period; last-shell electrons = group (add 10 if 3 or more). 2, 8, 7 → period 3, group 17.

Valency quickly

Valence electrons 1–4: valency = that number; 5–8: valency = 8 minus it.

Sublimers: CAN-ID

Camphor, Ammonium chloride, Naphthalene, Iodine, Dry ice.

Eka list

Eka-boron = scandium, eka-aluminium = gallium, eka-silicon = germanium (all found later, 1875–86).

5

PART 5

Common mistakes & traps

WATCH OUT

- | | |
|---|--|
| ✗ Mendeleev gave the modern periodic law. | ✓ Moseley did (atomic number); Mendeleev used atomic mass. |
| ✗ Isobars have the same atomic number. | ✓ Isobars share the mass number; isotopes share the atomic number. |
| ✗ Plasma is the fifth state of matter. | ✓ Plasma is the fourth; Bose–Einstein condensate is the fifth. |
| ✗ Atomic size increases across a period. | ✓ It decreases across a period and increases down a group. |
| ✗ Alloys and air are compounds. | ✓ They are mixtures: no fixed ratio, components keep their properties. |

Previous year questions

27 SSC and RRB questions with their official tags and wording. The correct option is highlighted and the solution follows. Cover the solution and attempt each question first.

SSC CGL**Mendeleev, Newlands, groups, trends, metalloids · 2020–2024****SSC CGL 2024 Tier 1****10 Sep 2024 · Shift 1**

In which musical note did Newland put the metals Co and Ni with halogens?

(a) Fa

(b) Do

(c) Re

(d) Mi

Solution: In Newlands' octaves, cobalt and nickel were forced into the same slot as fluorine, chlorine and bromine, under 'Do'. Such misfits are why the law worked only up to calcium.

SSC CGL 2023 Tier 1**27 Jul 2023 · Shift 2**

When did Dmitri Mendeleev invent the periodic table, ordering the symbols of the chemical elements according to their atomic weights?

(a) 1794

(b) 1869

(c) 1890

(d) 1779

Solution: Mendeleev published his table of 63 elements in 1869, arranged by increasing atomic mass and similar properties.

SSC CGL 2023 Tier 1**25 Jul 2023 · Shift 1**

Match the columns.

Column-A (Common name)	Column-B (Group number in the Modern Periodic Table)
i. Alkali metals	a. 18
ii. Alkaline earth metals	b. 17
iii. Halogens	c. 2
iv. Noble gases	d. 1

(a) i - a, ii - b, iii - c,
iv - d(b) i - a, ii - c, iii - b,
iv - d(c) i - b, ii - a, iii - c,
iv - d**(d) i - d, ii - c, iii - b,
iv - a**

Solution: Alkali metals group 1, alkaline earth metals group 2, halogens group 17, noble gases group 18.

SSC CGL 2023 Tier 1

21 Jul 2023 · Shift 2

Identify the correct statement about Newlands' law of octaves.

(a) He started with the element having the highest atomic mass (hydrogen) and ended at thorium which was the 56th element.

(b) He started with the element having the lowest atomic mass (hydrogen) and ended at sodium.

(c) He started with the element having the lowest atomic mass (hydrogen) and ended at aluminium.

(d) He started with the element having the lowest atomic mass (hydrogen) and ended at thorium which was the 56th element.

Solution: Newlands (1864–65) arranged the 56 known elements from hydrogen (lightest) to thorium; every eighth element resembled the first, like notes of music.

SSC CGL 2023 Tier 1

18 Jul 2023 · Shift 2

Which of the following are metalloids?

(a) Boron, oxygen, aluminium

(b) Boron, mercury, iron

(c) Boron, silicon, antimony

(d) Aluminium, mercury, copper

Solution: Metalloids show properties of both metals and non-metals: boron, silicon, germanium, arsenic, antimony and tellurium.

SSC CGL 2023 Tier 1

17 Jul 2023 · Shift 4

What happens to the atomic size as you go down the group?

(a) Triples

(b) Decreases

(c) Increases

(d) No change

Solution: Each step down a group adds a new shell, so atoms get bigger. Across a period size decreases because the nuclear charge rises.

SSC CGL 2023 Tier 1

14 Jul 2023 · Shift 2

What will be the atomic number of an element X which is placed in period 2 and group 17?

(a) 8

(b) 7

(c) 10

(d) 9

Solution: Period 2 means two shells; group 17 means 7 outer electrons: $2, 7 = 9$ electrons, i.e. fluorine ($Z = 9$).

SSC CGL 2022 Tier 1

9 Dec 2022 · Shift 3

In 1887, the Royal Society, London gave the Davy Medal for the 'discovery of the periodic law of chemical elements' to _____.

(a) AEB de
Chancourtois

(b) Dmitri
Mendeleev

(c) Lothar Meyer

(d) John Alexander
Newland

Solution: John Newlands received the Davy Medal in 1887 for his law of octaves. Mendeleev and Lothar Meyer had received it earlier, in 1882.

SSC CGL 2022 Tier 1

2 Dec 2022 · Shift 3

According to Mendeleev's periodic table, what was the atomic mass of Eka-aluminium which was later replaced by Gallium?

(a) 95

(b) 83

(c) 68

(d) 50

Solution: Mendeleev predicted eka-aluminium with atomic mass about 68; gallium (discovered 1875) has 69.7. Eka-silicon became germanium.

SSC CGL 2022 Tier 1

2 Dec 2022 · Shift 3

In 1955, which synthetic element is provisionally named Mendelevium in honour of Dmitri Mendeleev, who created one of the first periodic tables?

(a) Element 90

(b) Element 101

(c) Element 103

(d) Element 106

Solution: Mendelevium (Md) is element 101, made by Seaborg's team at Berkeley in 1955. Element 90 is thorium, 103 lawrencium, 106 seaborgium.

SSC CGL 2020 Tier 1

16 Aug 2021 · Shift 3

In the periodic table, the highly electronegative halogens and the highly electropositive alkali metals are separated by:

(a) Rare earth
elements

(b) Alkaline earth
metals

(c) Noble gases

(d) Noble metals

Solution: Group 17 (halogens) is followed by group 18 (noble gases), and the next period starts with group 1 (alkali metals).

SSC CHSL 2019 Tier 1

13 Oct 2020 · Shift 3

Which scientist arranged the Periodic Table of Elements in the order of increasing atomic masses?

(a) Dmitri
Mendeleev

(b) Henry Moseley

(c) Robert Boyle

(d) William Ramsay

Solution: Mendeleev used atomic mass (1869); Moseley later showed atomic number is the right basis (1913).

SSC CHSL 2017 Tier 1

26 Mar 2018 · Shift 2

Isobars are atoms of different chemical elements that have _____.

(a) Same atomic
number but different
mass number

(b) Same mass
number but
different atomic
number

(c) Same mass
number and same
atomic number

(d) None of the
above

Solution: Isobars: same mass number, e.g. argon-40 and calcium-40. Isotopes have the same atomic number.

SSC CHSL 2017 Tier 1

10 Mar 2018 · Shift 1

Which among the following has lowest electron affinity?

(a) Fluorine

(b) Chlorine

(c) Bromine

(d) Argon

Solution: Noble gases like argon already have a full octet and do not attract an extra electron, so their electron affinity is about zero. Chlorine has the highest electron affinity.

RRB NTPC CBT 1

18 Mar 2026 · Shift 1

Who is credited with the discovery of the electron?

(a) Marie Curie

(b) Ernest
Rutherford

(c) Albert Einstein

(d) J.J. Thomson

Solution: J. J. Thomson found the electron in cathode rays (1897) and proposed the 'plum pudding' model.

RRB NTPC CBT 1

16 Mar 2026 · Shift 3

The state of matter where particles are far apart and move randomly and quickly is the:

(a) Plasma state

(b) Solid state

(c) Liquid state

(d) Gaseous state

Solution: In gases the attraction between particles is weakest, so they spread out and move fast in all directions.

RRB NTPC CBT 1

5 Jun 2025 · Shift 2

In which order did Mendeleev arrange the elements in his periodic table?

(a) Increasing atomic mass

(b) Increasing atomic number

(c) Decreasing atomic radius

(d) Increasing number of neutrons

Solution: Atomic mass; the modern table uses atomic number.

RRB NTPC CBT 2

9 May 2022 · Shift 1

What is sublimation?

(a) direct change of a substance from a gas to a liquid state

(b) direct change of a substance from a gas to a solid state

(c) direct change of a substance from a liquid to a gas state

(d) direct change of a substance from a solid to a gas state

Solution: Camphor, naphthalene, iodine, ammonium chloride and dry ice sublime. Gas to solid directly is deposition.

RRB Group D

3 Feb 2026 · Shift 1

Isobars are the atoms with:

(a) same mass number but different atomic number

(b) same atomic number but different mass number

(c) same melting point but different refractive index

(d) same refractive index but different melting point

Solution: Option 2 describes isotopes.

RRB Group D

6 Sep 2022 · Shift 2

The modern periodic classification was given by:

(a) J W Dobereiner

(b) D I Mendeleev

(c) John Newlands

(d) Henry Moseley

Solution: Henry Moseley (1913) showed that atomic number is the fundamental property; the modern periodic law is based on it.

RRB Group D

27 Sep 2022 · Shift 3

How many triads were identified by Dobereiner in his system of classification of elements?

(a) Six

(b) Five

(c) Four

(d) Three

Solution: Dobereiner identified three triads: lithium, sodium, potassium; calcium, strontium, barium; chlorine, bromine, iodine.

RRB Group D

17 Aug 2022 · Shift 1

In Newland's law of octaves, the first element is _____ and the last known element is _____.

(a) hydrogen, lanthanum

(b) hydrogen, thorium

(c) hydrogen, zirconium

(d) helium, zirconium

Solution: Hydrogen to thorium, 56 elements.

RRB Group D

4 Oct 2018 · Shift 2

The electronic configuration of an element is 2, 8, 7, so its valency is:

(a) 2

(b) 8

(c) 7

(d) 1

Solution: It needs one electron to complete its octet ($8 - 7 = 1$). This is chlorine.

RRB Group D

3 Oct 2018 · Shift 2

An element has electronic configuration 2,8,6. It belongs to _____.

(a) 6 group and 2 period

(b) 16 group and 3 period

(c) 1 group and 1 period

(d) 2 group and 2 period

Solution: Three shells $\rightarrow$ period 3; six valence electrons $\rightarrow$ group 16 ($10 + 6$). This is sulphur.

SSC MTS 2021

22 Jul 2022 · Shift 2

Which of the following is the fifth state of matter?

(a) Gas

(b) Liquid

(c) Plasma

(d) Bose-Einstein condensates

Solution: Solid, liquid, gas, plasma (fourth) and Bose–Einstein condensate (fifth), named after S. N. Bose and Einstein.

SSC GD 2025

18 Feb 2025 · Shift 3

Which of the following can be separated from a mixture by the process of centrifugation, but NOT by the process of filtration?

(a) Both Colloid and suspension

(b) Suspension only

(c) Colloid only

(d) Solution

Solution: Colloid particles pass through filter paper but can be spun out by a centrifuge. Suspensions can be filtered; solutions cannot be separated by either.

SSC CPO 2022 Paper 1

10 Nov 2022 · Shift 3

Which of the following types of elements is included in the leftmost group of the periodic table?

(a) Noble gases

(b) Halogen

(c) Non metal

(d) Alkali metals

Solution: Group 1 (leftmost): lithium, sodium, potassium, rubidium, caesium, francium. Noble gases are the rightmost group.

Trend: CGL 2022–2024 asked the history of the periodic table in detail (Mendeleev 1869, eka-aluminium, mendelevium, Newlands and the Davy Medal, the Co–Ni anomaly) plus groups, metalloids and atomic-size trends. CHSL and Group D repeat isobars, valency from configurations and Döbereiner's three triads; NTPC 2025–26 asks the electron, Mendeleev's basis and states of matter. Learn the timeline and the group numbers by heart.

PART 7

7

Practice MCQs

Level 1 · Basic

Level 2 · Standard

Level 3 · Exam traps

Q1–Q7 · 15 sec each

Q8–Q14 · 25 sec each

Q15–Q20 · 35 sec each

Level 1

Q1 The modern periodic table is based on:

- (a) atomic number
- (b) atomic mass
- (c) number of neutrons
- (d) density

Q2 Halogens are placed in group:

- (a) 1
- (b) 17
- (c) 2
- (d) 18

Q3 Which of these sublimates on heating?

- (a) Common salt
- (b) Sugar
- (c) Camphor
- (d) Sand

Q4 The neutron was discovered by:

- (a) J. J. Thomson
- (b) Ernest Rutherford
- (c) E. Goldstein
- (d) James Chadwick

Q5 Milk is an example of a:

- (a) colloid
- (b) true solution
- (c) suspension
- (d) compound

Q6 Atoms with the same atomic number but different mass numbers are:

- (a) isobars
- (b) isotopes
- (c) isotones
- (d) isomers

Q7 The modern periodic table has:

- (a) 8 periods and 18 groups
- (b) 7 periods and 8 groups
- (c) 7 periods and 18 groups
- (d) 18 periods and 7 groups

Level 2

Q8 An element has atomic number 12. Its group and period are:

- (a) group 12, period 2
- (b) group 3, period 2
- (c) group 2, period 2
- (d) group 2, period 3

Q9 Petroleum is separated into petrol, diesel and kerosene by:

- (a) fractional distillation
- (b) filtration
- (c) sublimation
- (d) centrifugation

Q10 Across a period from left to right, atomic size generally:

- (a) increases
- (b) decreases
- (c) stays the same
- (d) first doubles then halves

Q11 The scattering of a beam of light by a colloid is called the:

- (a) Raman effect
- (b) Doppler effect
- (c) Tyndall effect
- (d) photoelectric effect

Q12 Rutherford's gold-foil experiment showed that an atom has:

- (a) electrons embedded in a positive sphere
- (b) no empty space
- (c) neutrons in orbits
- (d) a tiny, dense, positive nucleus

Q13 The most electronegative element is:

- (a) fluorine
- (b) chlorine
- (c) oxygen
- (d) caesium

Q14 Mendeleev's eka-silicon was later discovered as:

- (a) gallium
- (b) germanium
- (c) scandium
- (d) silicon

Level 3

Q15 Consider: 1. Evaporation causes cooling. 2. Evaporation occurs only at the boiling point. 3. Evaporation increases with surface area. Which are correct?

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

Q16 Match List I with List II:

List I	List II
P. Döbereiner	1. Atomic number
Q. Newlands	2. Triads
R. Mendeleev	3. Law of octaves
S. Moseley	4. Atomic mass and gaps for new elements

- (a) P-3, Q-2, R-4, S-1
- (b) P-2, Q-3, R-1, S-4
- (c) P-2, Q-4, R-3, S-1
- (d) P-2, Q-3, R-4, S-1

Q17 Which pair is INCORRECTLY matched?
 (a) Argon-40 and calcium-40 – isotopes
 (b) Protium and deuterium – isotopes
 (c) C-14 and N-15 – isotones
 (d) Na (2, 8, 1) – valency 1

Q18 Arrange in increasing order of atomic number: 1. Neon 2. Sodium 3. Oxygen 4. Magnesium
 (a) 1, 3, 2, 4
 (b) 3, 1, 2, 4
 (c) 3, 2, 1, 4
 (d) 3, 1, 4, 2

Q19 The 2026 Nobel Prize in Chemistry (Henri Kagan and Kenso Soai) was for work on:
 (a) lithium-ion batteries
 (b) metal–organic frameworks
 (c) non-linear effects and autocatalysis in asymmetric organic synthesis
 (d) quantum dots

Q20 How many electrons can the M shell hold at most?
 (a) 2
 (b) 8
 (c) 32
 (d) 18

Score yourself: ____ / 20 • Time taken: ____ min

7.1 Answer key

1 A	2 B	3 C	4 D	5 A	6 B	7 C	8 D	9 A	10 B
11 C	12 D	13 A	14 B	15 C	16 D	17 A	18 B	19 C	20 D

Q1 Moseley, 1913.

Q2 F, Cl, Br, I, At.

Q3 Also naphthalene, iodine, ammonium chloride.

Q4 1932.

Q5 An emulsion of fat in water.

Q6 Example: C-12 and C-14.

Q7 Mendeleev's table had 8 groups.

Q8 2, 8, 2: three shells, two valence electrons (magnesium).

Q9 The fractions have close boiling points.

Q10 Nuclear charge rises and pulls the shells inwards.

Q11 True solutions do not show it.

Q12 Most alpha particles passed straight through.

Q13 Caesium is among the most electropositive.

Q14 Eka-aluminium became gallium; eka-boron scandium.

Q15 Evaporation happens at all temperatures.

Q17 They are isobars (same mass number).

Q19 Announced on 7 October 2026.

Q16 In order: 1817–29, 1864–65, 1869, 1913.

Q18 O 8, Ne 10, Na 11, Mg 12.

Q20 $2n^2$ with $n = 3$.

One-page quick revision

Night-before sheet · Matter, Atoms & Periodic Table

SC-08

TOP 10 POINTS

1. 5 states: solid, liquid, gas, plasma, BEC.
2. Sublime: camphor, naphthalene, iodine, NH_4Cl , dry ice.
3. Colloid: Tyndall effect; centrifuge, not filter.
4. Thomson e^- 1897 · Rutherford nucleus 1911 · Chadwick n 1932.
5. Shells hold $2n^2$: K 2, L 8, M 18.
6. Isotopes same Z ; isobars same A ; isotones same n .
7. Triads 3 · octaves H-Th · Mendeleev 1869 (mass).
8. Moseley 1913: atomic number; 7 periods, 18 groups.
9. 1 alkali, 2 alkaline earth, 17 halogens, 18 noble.
10. Size ↓ across, ↑ down; F most electronegative.

Eka-Al = Ga · Eka-Si = Ge

TOP 3 TRAPS

- Modern law: Moseley, not Mendeleev.
- Plasma 4th, BEC 5th.
- Alloys are mixtures.

SELF-CHECK

- ☐ Group and period of 2, 8, 5
- ☐ Name Döbereiner's three triads
- ☐ Neutrons in ^{23}Na ($Z = 11$)

Term	Meaning	Term	Meaning
Latent heat	Heat used to change state at constant temperature	Diffusion	Particles spreading on their own
Valency	Combining capacity of an atom	Metalloid	Element with metal and non-metal properties
Electronegativity	Pull of an atom on shared electrons	Octet	Eight electrons in the outer shell

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