

Xenon (Xe) - Student Datasheet

Atomic number 54 - Noble gas - Group 18 - Period 5 - p-block

Xenon is element 54, a heavy noble gas that overturned the old idea that noble gases are completely inert. Its closed 5p shell coexists with a real chemistry of xenon fluorides and oxides under suitable conditions.

Quick reference

Atomic number	54
Relative atomic mass	131.293
Electron configuration	[Kr] 4d10 5s2 5p6
State at 20 C	Colorless monatomic gas at 20 deg C
Density	0.005366 g/cm3 - gas reference
Melting point	161.4 K
Boiling point	165.051 K
Common oxidation state	0 ordinary - +2, +4, +6 and +8 occur in compounds
Electronegativity	2.6 - commonly quoted Pauling value

Structure & orbitals

At ordinary conditions xenon is a monatomic noble gas. Cryogenic solid xenon forms a close-packed/FCC structure, but the ordinary-state viewer emphasizes separated Xe atoms.

The 5s model is spherical and the 5p model has the directional p angular form. These are isolated-atom probability models, not molecular orbitals of XeF₂ or XeF₄.

Temperature / phase context

At approximately standard pressure, xenon is solid below about 161.4 K, liquid through a narrow interval to about 165.051 K, and gaseous above the boiling point.

Five things to remember

- Atomic number 54 means every xenon nucleus contains 54 protons.
- Neutral xenon has the closed-shell configuration [Kr] 4d10 5s2 5p6.
- Xenon is a monatomic gas at ordinary conditions.
- Xenon forms real compounds, including fluorides, despite being a noble gas.
- Xenon's normal liquid interval is narrow: melting near 161.4 K and boiling near 165.05 K.

Xenon: Real World & Signature Science

Xenon is a noble gas, not a 'nonreactive under every condition' gas. XeF₂, XeF₄ and other compounds are a powerful lesson that periodic trends are tendencies rather than absolute slogans.

Why this element matters

High-intensity lighting Xenon discharge lamps can produce intense broad-spectrum light used in specialized optical and projection applications.	Ion propulsion Spacecraft ion thrusters often use xenon because it is heavy, inert to store and readily ionized in the thruster.
Medical anesthesia Xenon has anesthetic properties and is used in limited specialized medical contexts because it is expensive and requires recovery systems.	Nuclear / detector science Xenon isotopes and liquid xenon are important in particle detectors and nuclear-science measurements.
Noble-gas chemistry Compounds such as XeF ₂ and XeF ₄ demonstrate that 'noble' means low reactivity under ordinary conditions, not chemically impossible.	

From air to xenon products: a high-level path

1. Xenon is present only at trace levels in air, so it is recovered as a minor product of large-scale air separation.
2. Cryogenic separation concentrates rare gases before further purification; detailed plant operations are outside this guide.
3. Purified xenon is filled into controlled gas systems or further processed for specialized chemical/scientific uses.
4. Because xenon is scarce and expensive, some high-value applications recover and recycle the gas.

Where on Earth?

Atmospheric occurrence - Global trace gas

Xenon is a trace component of Earth's atmosphere; a global conceptual layer is more truthful than isolated occurrence pins

Discovery - London - 1898

William Ramsay and Morris Travers discovered xenon while studying residues from liquefied air

Engineered uses - Conceptual

Purified xenon is used in lamps, medicine, detectors and ion propulsion rather than mined from xenon deposits

History

1898 - William Ramsay and Morris Travers discovered xenon while fractionating liquefied air.

1962 - Neil Bartlett prepared the first xenon compound, overturning the belief that noble gases could not form compounds.

Late 20th century - Xenon became important in lamps, detectors, medicine and electric spacecraft propulsion.

Today - Xenon chemistry and xenon-based detectors remain active examples of heavy-atom and noble-gas science.

Uses

Ion propulsion Xenon is a common propellant for electric ion thrusters in satellites and deep-space missions.	Discharge lamps Excited xenon emits intense light in specialized flash and arc lamps.
Medical anesthesia Xenon can act as an anesthetic in specialized systems, though cost and supply constrain use.	Particle detectors Liquid xenon provides a dense, clean detection medium in advanced physics experiments.

Xenon: Isotopes, Questions & Evidence

Isotopes

¹³²Xe - Stable - one of the most abundant natural isotopes
Teaching nucleus contains 54 protons and 78 neutrons.

¹²⁹Xe - Stable - major natural isotope
Important in spectroscopy and isotope studies.

¹³¹Xe - Stable - major natural isotope
Another abundant natural isotope with nuclear-spin applications.

Xenon isotope family - Nine naturally occurring isotopes
Natural xenon has a rich isotope mixture, including stable and extremely long-lived species.

Common questions

What is xenon's atomic number?

54.

Is xenon a noble gas?

Yes. Xenon is a Group 18 noble gas with a closed 5p⁶ outer shell.

What is xenon used for?

Uses include ion propulsion, discharge lamps, specialized anesthesia and particle detectors.

Can xenon form compounds?

Yes. Xenon fluorides and oxides are established compounds, so noble gases are not absolutely chemically inert.

Who discovered xenon?

William Ramsay and Morris Travers discovered xenon in London in 1898.

What is xenon's electron configuration?

[Kr] 4d¹⁰ 5s² 5p⁶.

Quick self-check

1. What is xenon's atomic number? Answer: 54
2. What is xenon's ordinary elemental form? Answer: Monatomic gas
3. Can xenon form compounds? Answer: Yes
4. What is xenon's electron configuration? Answer: [Kr] 4d¹⁰ 5s² 5p⁶
5. Which use is associated with xenon? Answer: Ion propulsion

Evidence & provenance

Atomic and phase values are measured/evaluated. The ordinary-state viewer uses separated atoms; low-temperature solid xenon is not shown as the room-temperature state. Noble-gas chemistry statements refer to known compounds, not to ordinary spontaneous reactivity.

Core sources

Royal Society of Chemistry - Xenon	https://periodic-table.rsc.org/element/54/xenon
NIST - Atomic Data for Xenon	https://physics.nist.gov/PhysRefData/Handbook/Tables/xenontable1.htm
NASA - Ion propulsion educational resources	https://www.nasa.gov/