

Titanium (Ti) - Student Datasheet

Atomic number 22 - Transition metal - Group 4 - Period 4 - d-block

Titanium is element 22, a strong, corrosion-resistant transition metal with unusually high strength for its density. Its room-temperature α phase is HCP, while heating pure titanium to about 1155 K produces the β BCC phase before melting.

Quick reference

Atomic number	22
Relative atomic mass	47.867
Electron configuration	[Ar] 3d ² 4s ²
Common oxidation state(s)	+4 common; +3 also important
Density	4.506 g/cm ³
Melting point	1943 K
Boiling point	3560 K
Structure near room temperature	α -Ti · HCP

Structure & orbitals

Reference isotope: ⁴⁸Ti - 22 protons + 26 neutrons. Ground-state/reference electron configuration: [Ar] 3d² 4s².

The occupied 4s model and two named 3d angular forms are shown separately. A 3d subshell contains five spatial orbitals; 3d z² and 3d xy are representative members rather than 'the' shape of all 3d electrons. These are isolated-atom probability models, not bands in solid titanium.

Material / molecular structure: Pure titanium is hexagonal close-packed near room temperature (P6₃/mmc) and transforms to β -Ti BCC near 1155 K at ambient pressure

Phase / temperature context

At approximately ambient pressure, pure titanium is α -HCP below about 1155 K, β -BCC from about 1155 K to the 1943 K melting point, liquid to about 3560 K, and gaseous above. High-pressure titanium phases are outside this temperature-only teaching track.

Five things to remember

1. Atomic number 22 means every titanium nucleus contains 22 protons.
2. The neutral ground-state reference is [Ar] 3d² 4s².
3. Pure titanium is HCP (α -Ti) near room temperature and becomes BCC (β -Ti) near 1155 K at ambient pressure.
4. ⁴⁸Ti is the most abundant natural titanium isotope.
5. Most titanium consumption is in TiO₂ products, while titanium metal is valuable where low density, strength and corrosion resistance matter.

Real-world context

Aerospace

Titanium alloys combine high strength-to-weight ratio, fatigue performance and temperature capability in aircraft and spacecraft structures and engines.

Implants

Titanium's corrosion resistance and biocompatibility support orthopedic and dental implant applications.

Marine systems

A stable oxide film gives titanium excellent resistance in seawater, supporting heat exchangers and other marine equipment.

Titanium dioxide

TiO₂ is a major white pigment and functional material; it is a titanium compound, not titanium metal.

Mineral feedstocks

Ilmenite and rutile are important titanium-bearing minerals; resource and production geography are commodity datasets that require year labels.

Where on Earth? / geography modes

Titanium minerals - Ilmenite + rutile

Titanium is widespread in rocks but industrial feedstocks are concentrated in mineral-sand and hard-rock systems

Examples/context: Ilmenite; Rutile; Mineral sands; Hard rock

Titanium supply chain - 2026 commodity context

Titanium-mineral concentrates, TiO₂ pigment and titanium sponge are distinct commodity datasets and must not be merged

Examples/context: Mineral concentrates; Pigment; Sponge metal; Fabrication

Discovery geography - Cornwall • 1791

William Gregor identified an unknown-metal oxide in black sand from Cornwall before Klaproth named titanium

Examples/context: Manaccan, Cornwall; Berlin; Rutile

Isotopes

Isotope	Status / timescale	Why it matters
⁴⁸ Ti	Stable · ≈73.7% natural abundance	The dominant natural titanium isotope; 22 protons and 26 neutrons.
⁴⁶ Ti / ⁴⁷ Ti	Stable · minor natural isotopes	Together they contribute a significant minority of natural titanium.
⁴⁹ Ti / ⁵⁰ Ti	Stable · minor natural isotopes	Five stable isotopes make up natural titanium.

Evidence note

Atomic/isotope and ordinary physical values are measured/evaluated. The HCP viewer is a conventional-cell teaching schematic based on the reviewed room-temperature structure; the 1155 K α→β boundary is an ambient-pressure equilibrium reference. Commodity layers keep mineral concentrates, pigment and sponge-metal datasets distinct.

Review questions

What is titanium's atomic number?

Answer: 22. Titanium is element 22.

What is pure titanium's room-temperature crystal structure?

Answer: HCP · α -titanium. α -Ti is hexagonal close-packed at ambient conditions.

What happens near 1155 K at ambient pressure?

Answer: α -Ti transforms to β -Ti BCC. Pure titanium changes from HCP to BCC before it melts.

Which isotope dominates natural titanium?

Answer: ^{48}Ti . ^{48}Ti is the most abundant natural isotope.

Which statement is correct?

Answer: TiO_2 is a titanium compound, not titanium metal. The metal and its oxide have very different structures and uses.

Frequently asked questions

What is titanium?

Titanium is chemical element 22, a Group 4 transition metal.

What is titanium used for?

Important uses include aerospace alloys, medical implants, marine/chemical equipment and, through TiO_2 , pigments and functional coatings.

What color is titanium?

Clean titanium metal is silvery-grey with metallic luster; surface oxide films can also produce interference colors.

Does titanium conduct electricity?

Yes, titanium metal conducts electricity, although less strongly than highly conductive metals such as copper.

Where is titanium found?

It is widespread in rocks and occurs in minerals including ilmenite and rutile; industrial supply comes from mineral concentrates rather than native titanium metal.

What happens to titanium near 1155 K?

At ambient pressure pure titanium transforms from the low-temperature α -HCP structure to the high-temperature β -BCC structure.

Sources used for this guide

- Royal Society of Chemistry - Titanium

<https://periodic-table.rsc.org/element/22/titanium>

- NIST - Atomic Data for Titanium

<https://physics.nist.gov/PhysRefData/Handbook/Tables/titaniumtable1.htm>

- USGS - Mineral Commodity Summaries 2026

<https://pubs.usgs.gov/publication/mcs2026>

- WebElements - Titanium crystal structure

https://webelements.com/titanium/crystal_structure.html

This datasheet is a learning aid. Interactive 3D models are teaching models; uncertainty and predicted values must remain labelled. Search-demand data may guide explanation, but scientific values come from cited scientific sources.