THE LANTHANOIDS

Group-3 **Ce (Cerium)** Period-6

Latin Name: Cerium **Year Of Discovery:** 1803 **Discoverer:** Jons Jacob Berzelius, Martin Klaproth

Physical Properties

Atomic Number	58	**Molar Mass (g mol^{-1})**	140.116
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^1 5d^1$ or $[Xe]4f^1 5d^1 6s^2$		
Density (g cm^{-3})	-	**Oxidation States**	+3, +4
Atomic Radius (pm)	Empirical: 183	**Element Category**	Lanthanoids
Covalent Radius (pm)	204 ± 9	**Van der Waals Radius (pm)**	-
Ionic Radius (trivalent) (pm)	103 (Ce^{3+})	**Ionisation Energy (kJ/mol)**	534.4 (1^{st}), 1050 (2^{nd}), 1949 (3^{rd})
Molar Volume (cm^3 mol^{-1})	-	**Electronegativity**	1.12 (Pauling Scale)
Melting Point (°C)	795	**Boiling Point (°C)**	3443
Phase at STP	Solid	**CAS Number**	7440-45-1
Electrical Resistivity (nΩm) (293.15 K)	828 (β)	**Magnetic Susceptibility (cm^3 mol^{-1}) (293 K)**	(β) $+2450\times10^{-6}$
Magnetic Ordering	Paramagnetic	**Thermal Conductivity ($Wm^{-1}K^{-1}$)**	11.3
Heat Of Fusion (kJ mol^{-1})	5.46	**Heat Of Vapourization (kJ mol^{-1})**	398
Molar Heat Capacity (J $mol^{-1}K^{-1}$)	26.94	**Vapour Pressure**	100 kPa (at 3705 K)
Crystal Structure	β: dhcp, γ: fcc	**Young's Modulus (GPa)**	γ 33.6

Chemical Properties

Reactivity is similar to Calcium. Ce forms oxide Ce_2O_3 when burnt in O_2 and hydroxide $Ce(OH)_3$ with H_2O. It forms carbide CeC_2 when heated with C at 2773 K. On heating with nitrogen nitride forms.

Nuclear Properties	Not Radioactive
Isotopes	^{134}Ce (Synthetic), ^{136}Ce (≈0.186%), ^{138}Ce (≈0.251%), ^{139}Ce (Synthetic), ^{140}Ce (≈88.449%), ^{141}Ce (Synthetic), ^{142}Ce (≈11.114%), ^{143}Ce (Synthetic), ^{144}Ce (Synthetic).
Ores	Found in combination with rare earth elements monazite.
Uses	Oxides are used as catalysts in petroleum cracking.
Compounds	Ce_2O_3, $Ce(OH)_3$, CeC_2,

Group-3 Pr (Praseodymium) Period-6

Latin Name: Praseodymium **Year Of Discovery:** 1885 **Discoverer:** -Carl Auer von Welsbach

Physical Properties

Atomic Number	59	Molar Mass (g mol^{-1})	140.90765
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^3$ or $[Xe]4f^3 6s^2$		
Density (g cm^{-3})	6.77	Oxidation States	+3, +4
Atomic Radius (pm)	Empirical: 182	Element Category	Lanthanoids
Covalent Radius (pm)	203 ± 7	Van der Waals Radius (pm)	-
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	527 (1^{st}),1020(2^{nd}),2086 (3^{rd})
Molar Volume (cm^3 mol^{-1})	-	Electronegativity	1.13 (Pauling Scale)
Melting Point (°C)	935	Boiling Point (°C)	3130
Phase at STP	Solid	CAS Number	7440-10-0
Electrical Resistivity (nΩm)	0.7 (α)	Magnetic Susceptibility (cm^3 mol^{-1}) (293 K)	(α) $+5010\times10^{-6}$
Magnetic Ordering	Paramagnetic	Thermal Conductivity ($Wm^{-1}K^{-1}$)	12.5
Heat Of Fusion (kJ mol^{-1})	6.89	Heat Of Vapourization (kJ mol^{-1})	331
Molar Heat Capacity (J $mol^{-1}K^{-1}$)	27.20	Vapour Pressure	100 kPa (at 3779 K)
Crystal Structure	dhcp	Young's Modulus (GPa)	α 37.3

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Nd (Neodymium) Period-6

Latin Name: Neodymium **Year Of Discovery:** 1885 **Discoverer:** Carl Auer von Welsbach

Physical Properties

Atomic Number	60	Molar Mass (g mol^{-1})	144.242
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^4$ or $[Xe]4f^4 6s^2$		
Density (g cm^{-3})	7.01	Oxidation States	+2, +3, +4
Atomic Radius (pm)	Empirical: 181	Element Category	Lanthanoids
Covalent Radius (pm)	201 ± 6	Van der Waals Radius (pm)	-
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	533.1 (1^{st}), 1040 (2^{nd}), 2130 (3^{rd})
Molar Volume (cm^3 mol^{-1})	-	Electronegativity	1.14 (Pauling Scale)
Melting Point (°C)	1024	Boiling Point (°C)	3074
Phase at STP	Solid	CAS Number	7440-00-8
Electrical Resistivity (nΩm) (293.15 K)	643 (α, $poly$)	Magnetic Susceptibility (cm^3 mol^{-1}) (293 K)	(β) +5628×10^{-6}
Magnetic Ordering	Paramagnetic	Thermal Conductivity ($Wm^{-1}K^{-1}$)	16.5
Heat Of Fusion (kJ mol^{-1})	7.14	Heat Of Vapourization (kJ mol^{-1})	289
Molar Heat Capacity (J $mol^{-1}K^{-1}$)	27.45	Vapour Pressure	100 kPa (at 3336 K)
Crystal Structure	dhcp	Young's Modulus (GPa)	α 41.4

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Pm (Promethium) Period-6

Latin Name: Promethium **Year Of Discovery:** 1945 **Discoverer:** -

Physical Properties

Atomic Number	61	Molar Mass (g mol^{-1})	145
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^5$ or $[Xe]4f^5 6s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+3
Atomic Radius (pm)		Element Category	Lanthanoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Sm (Samarium) Period-6

Latin Name: Samarium **Year Of Discovery:** 1879 **Discoverer:** -

Physical Properties

Atomic Number	62	Molar Mass (g mol^{-1})	150.36
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^6$ or $[Xe]4f^6 6s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+2, +3
Atomic Radius (pm)		Element Category	Lanthanoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Eu (Europium) Period-6

Latin Name: Europium **Year Of Discovery:** 1901 **Discoverer:** Eugene-Anatole

Physical Properties

Atomic Number	63	Molar Mass (g mol^{-1})	151.964
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^7$ or $[Xe]4f^7 6s^2$		
Density (g cm^{-3})	5.264	Oxidation States	+2, +3
Atomic Radius (pm)	Empirical: 180	Element Category	Lanthanoids
Covalent Radius (pm)	198±6	Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	547.1 (1^{st}), 1085 (2^{nd}), 2404 (3^{rd})
Molar Volume (cm^3 mol^{-1})		Electronegativity	1.2 (Pauling Scale)
Melting Point (°C)	826	Boiling Point (°C)	1529
Phase at STP	Solid	CAS Number	7440-53-1
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})	9.21	Heat Of Vapourization (kJ mol^{-1})	176
Molar Heat Capacity (J $mol^{-1}K^{-1}$)	27.66	Vapour Pressure	100kPa at 1796 K
Crystal Structure	bcc	Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Gd (Gadolinium) Period-6

Latin Name: Gadolinium **Year Of Discovery:** 1880 **Discoverer:** -

Physical Properties

Atomic Number	64	Molar Mass (g mol^{-1})	157.25
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 5d^1 4f^7$ or $[Xe]4f^7 5d^1 6s^2$		
Density (g cm^{-3})	7.90	Oxidation States	+3
Atomic Radius (pm)	Empirical: 180	Element Category	Lanthanoids
Covalent Radius (pm)	196±6	Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	593.4 (1^{st}), 1170 (2^{nd}), 1990 (3^{rd})
Molar Volume (cm^3 mol^{-1})		Electronegativity	1.14 (Pauling Scale)
Melting Point (°C)	1312	Boiling Point (°C)	3000
Phase at STP	Solid	CAS Number	7440-54-2
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	10.6
Heat Of Fusion (kJ mol^{-1})	10.05	Heat Of Vapourization (kJ mol^{-1})	301.3
Molar Heat Capacity (J $mol^{-1}K^{-1}$)	37.03	Vapour Pressure	100kPa at
Crystal Structure	hcp	Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3

Tb (Terbium)

Period-6

Latin Name: Terbium **Year Of Discovery:** 1843 **Discoverer:** -

Physical Properties

Atomic Number	65	Molar Mass (g mol^{-1})	158.92535
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^9$ or $[Xe]4f^9 6s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+3, +4
Atomic Radius (pm)		Element Category	Lanthanoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Dy (Dysprosium) Period-6

Latin Name: Dysprosium **Year Of Discovery:** 1886 **Discoverer:** -

Physical Properties

Atomic Number	66	Molar Mass (g mol^{-1})	162.5
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{10}$ or $[Xe]4f^{10}6s^2$		
Density (g cm^{-3})	8.54	Oxidation States	+3, +4
Atomic Radius (pm)	Empirical: 178	Element Category	Lanthanoids
Covalent Radius (pm)	192±7	Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	573 (1^{st}), 1130 (2^{nd}), 2200 (3^{rd})
Molar Volume (cm^3 mol^{-1})		Electronegativity	1.22 (Pauling Scale)
Melting Point (°C)	1407	Boiling Point (°C)	2562
Phase at STP	Solid	CAS Number	7429-91-6
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	10.7
Heat Of Fusion (kJ mol^{-1})	11.06	Heat Of Vapourization (kJ mol^{-1})	280
Molar Heat Capacity (J $mol^{-1}K^{-1}$)	27.7	Vapour Pressure	100kPa at 2831 K
Crystal Structure	hcp	Young's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Ho (Holmium) Period-6

Latin Name: Holmium **Year Of Discovery:** 1878 **Discoverer:** -

Physical Properties

Atomic Number	67	Molar Mass (g mol^{-1})	164.93032
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{11}$ or $[Xe]4f^{11}6s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+3
Atomic Radius (pm)		Element Category	Lanthanoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Er (Erbium) Period-6

Latin Name: Erbium **Year Of Discovery:** 1843 **Discoverer:** Carl Gustaf Mosander

Physical Properties

Atomic Number	68	Molar Mass (g mol^{-1})	167.259
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{12}$ or $[Xe]4f^{12}6s^2$		
Density (g cm^{-3})	9.066	Oxidation States	+3
Atomic Radius (pm)	Empirical: 176	Element Category	Lanthanoids
Covalent Radius (pm)	189±6	Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	589.3 (1^{st}), 1150(2^{nd}), 2194 (3^{rd})
Molar Volume (cm^3 mol^{-1})		Electronegativity	1.24 (Pauling Scale)
Melting Point (°C)	1529	Boiling Point (°C)	2868
Phase at STP	Solid	CAS Number	7440-52-0
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	14.5
Heat Of Fusion (kJ mol^{-1})	19.9	Heat Of Vapourization (kJ mol^{-1})	280
Molar Heat Capacity (J $mol^{-1}K^{-1}$)	28.12	Vapour Pressure	100kPa at 3132 K
Crystal Structure	hcp	Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3

Tm (Thulium)

Period-6

Latin Name: Thulium **Year Of Discovery:** 1879 **Discoverer:** -

Physical Properties

Atomic Number	69	Molar Mass (g mol^{-1})	168.93421
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{13}$ or $[Xe]4f^{13}6s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+2, +3
Atomic Radius (pm)		Element Category	Lanthanoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Yb (Ytterbium) Period-6

Latin Name: Ytterbium **Year Of Discovery:** 1878 **Discoverer:** -

Physical Properties

Atomic Number	70	Molar Mass (g mol^{-1})	173.045
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14}$ or $[Xe]4f^{14}6s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+2, +3
Atomic Radius (pm)		Element Category	Lanthanoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Lu (Lutetium) Period-6

Latin Name: Lutetium **Year Of Discovery:** 1907 **Discoverer:** -

Physical Properties

Atomic Number	71	Molar Mass (g mol^{-1})	174.9668
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 5d^1 4f^{14}$ or $[Xe]4f^{14}5d^1 6s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+3
Atomic Radius (pm)		Element Category	Lanthanoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

THE ACTINOIDS

Group-3 **Th (Thorium)** Period-7

Latin Name: Thorium	**Year Of Discovery:** 1829	**Discoverer:** -

Physical Properties

Atomic Number	90	Molar Mass (g mol^{-1})	232.03806
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 6d^2$ or $[Rn]6d^2 7s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	$+3_{\text{less stable}}$, $+4, +5_{\text{less stable}}$
Atomic Radius (pm)		Element Category	Actinoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Pa (Protactinium) Period-7

Latin Name: Protactinium **Year Of Discovery:** 1913 **Discoverer:** -

Physical Properties

Atomic Number	91	Molar Mass (g mol^{-1})	231.03588
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 6d^1 5f^2$ or $[Rn]5f^2 6d^1 7s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	$+3_{\text{less stable}}$, +4,+5, +6
Atomic Radius (pm)		Element Category	Actinoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 U (Uranium) Period-7

Latin Name: Uranium **Year Of Discovery:** 1789 **Discoverer:** Martin Heinrich Klaproth

Physical Properties

Atomic Number	92	Molar Mass (g mol^{-1})	238.02891
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 6d^1 5f^3$ or $[Rn]5f^3 6d^1 7s^2$		
Density (g cm^{-3})	19.1	Oxidation States	+3, +4, +5, +6
Atomic Radius (pm)	Empirical: 156	Element Category	Actinoids
Covalent Radius (pm)	196±7	Van der Waals Radius (pm)	186
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	597.6 (1^{st}), 1420 (2^{nd}),
Molar Volume (cm^3 mol^{-1})		Electronegativity	1.38 (Pauling Scale)
Melting Point (°C)	1132.2	Boiling Point (°C)	4131
Phase at STP	Solid	CAS Number	7440-61-1
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})	9.14	Heat Of Vapourization (kJ mol^{-1})	417.1
Molar Heat Capacity (J $mol^{-1}K^{-1}$)	27.665	Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Np (Neptunium) Period-7

Latin Name: Neptunium **Year Of Discovery:** 1940 **Discoverer:** -

Physical Properties

Atomic Number	93	Molar Mass (g mol^{-1})	237
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 6d^1 5f^4$ or $[Rn]5f^4 6d^1 7s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+3, +4, +5, +6
Atomic Radius (pm)		Element Category	Actinoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Pu (Plutonium) Period-7

Latin Name: Plutonium **Year Of Discovery:** 1940 **Discoverer:** -

Physical Properties

Atomic Number	94	Molar Mass (g mol^{-1})	244
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^6$ or $[Rn]5f^6 7s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+3, +4, +5, +6
Atomic Radius (pm)		Element Category	Actinoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Am (Americium) Period-7

Latin Name: Americium **Year Of Discovery:** 1944 **Discoverer:** -

Physical Properties

Atomic Number	95	Molar Mass (g mol^{-1})	243
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^7$ or $[Rn]5f^7 7s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+3, $+4_{\text{less stable}}$,
Atomic Radius (pm)		Element Category	Actinoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3

Cm (Curium)

Period-7

Latin Name: Curium **Year Of Discovery:** 1944 **Discoverer:** -

Physical Properties

Atomic Number	97	Molar Mass (g mol^{-1})	247
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 6d^1 5f^7$ or $[Rn]5f^7 6d^1 7s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+3, $+4_{\text{less stable}}$,
Atomic Radius (pm)		Element Category	Actinoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Bk (Berkelium) Period-7

Latin Name: Berkelium **Year Of Discovery:** 1949 **Discoverer:** -

Physical Properties

Atomic Number	97	Molar Mass (g mol^{-1})	247
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^9$ or $[Rn]5f^9 7s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+3, +4
Atomic Radius (pm)		Element Category	Actinoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Cf (Californium) Period-7

Latin Name: Californium **Year Of Discovery:** 1950 **Discoverer:** -

Physical Properties

Atomic Number	98	Molar Mass (g mol^{-1})	251
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^{10}$ or $[Rn]5f^{10}7s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+3
Atomic Radius (pm)		Element Category	Actinoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Es (Einsteinium) Period-7

Latin Name: Einsteinium **Year Of Discovery:** 1952 **Discoverer:** -

Physical Properties

Atomic Number	99	Molar Mass (g mol^{-1})	252
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^{11}$ or $[Rn]5f^{11}7s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+3
Atomic Radius (pm)		Element Category	Actinoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Fm (Fermium) Period-7

Latin Name: Fermium **Year Of Discovery:** 1952 **Discoverer:** -

Physical Properties

Atomic Number	100	Molar Mass (g mol^{-1})	257
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^{12}$ or $[Rn]5f^{12}7s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+3
Atomic Radius (pm)		Element Category	Actinoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Md (Mendelevium) Period-7

Latin Name: Mendelevium **Year Of Discovery:** 1955 **Discoverer:** -

Physical Properties

Atomic Number	101	Molar Mass (g mol^{-1})	258
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^{13}$ or $[Rn]5f^{13}7s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+3
Atomic Radius (pm)		Element Category	Actinoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 No (Nobelium) Period-7

Latin Name: Nobelium **Year Of Discovery:** 1958 **Discoverer:** -

Physical Properties

Atomic Number	102	Molar Mass (g mol^{-1})	259
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^{14}$ or $[Rn]5f^{14}7s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+2, +3
Atomic Radius (pm)		Element Category	Actinoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	

Group-3 Lr (Lawrencium) Period-7

Latin Name: Lawrencium **Year Of Discovery:** 1961 **Discoverer:** -

Physical Properties

Atomic Number	103	Molar Mass (g mol^{-1})	262
Electronic Configuration	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 6d^1 5f^{14}$ or $[Rn]5f^{14}6d^17s^2$		
Density (g cm^{-3}) at 20°C		Oxidation States	+3
Atomic Radius (pm)		Element Category	Actinoids
Covalent Radius (pm)		Van der Waals Radius (pm)	
Ionic Radius (divalent ion) (pm)		Ionisation Energy (kJ/mol)	
Molar Volume (cm^3 mol^{-1})		Electronegativity	
Melting Point (°C)		Boiling Point (°C)	
Phase at STP		CAS Number	
Electrical Resistivity (nΩm) (293.15 K)		Magnetic Susceptibility (cm^3 mol^{-1}) (292 K)	
Magnetic Ordering		Thermal Conductivity ($Wm^{-1}K^{-1}$)	
Heat Of Fusion (kJ mol^{-1})		Heat Of Vapourization (kJ mol^{-1})	
Molar Heat Capacity (J $mol^{-1}K^{-1}$)		Vapour Pressure	
Crystal Structure		Youngs's Modulus (GPa)	

Chemical Properties

Nuclear Properties	
Isotopes	
Ores	
Uses	
Compounds	