SUBATOMIC STRUCTURE

MAJOR SUBATOMIC PARTICLES

MAJOR SUBATOMIC PARTICLES

PROTONS

MAJOR SUBATOMIC PARTICLES

MAJOR SUBATOMIC PARTICLES

PROTONS

NEUTRONS

MAJOR SUBATOMIC PARTICLES

MAJOR SUBATOMIC PARTICLES

PROTONS
NEUTRONS
ELECTRONS

MAJOR SUBATOMIC PARTICLES

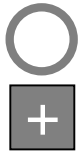
¿

PROTONS

MAJOR SUBATOMIC PARTICLE PROTONS

POSITIVE CHARGE (+)

MAJOR SUBATOMIC PARTICLE PROTONS



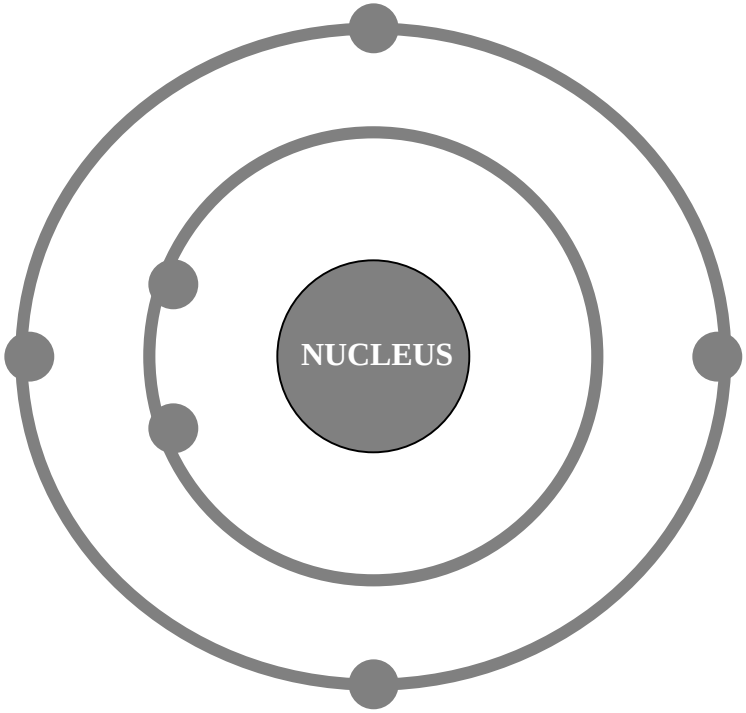
MAJOR
SUBATOMIC PARTICLE
PROTONS

POSITIVE CHARGE (+)

WITHIN NUCLEUS

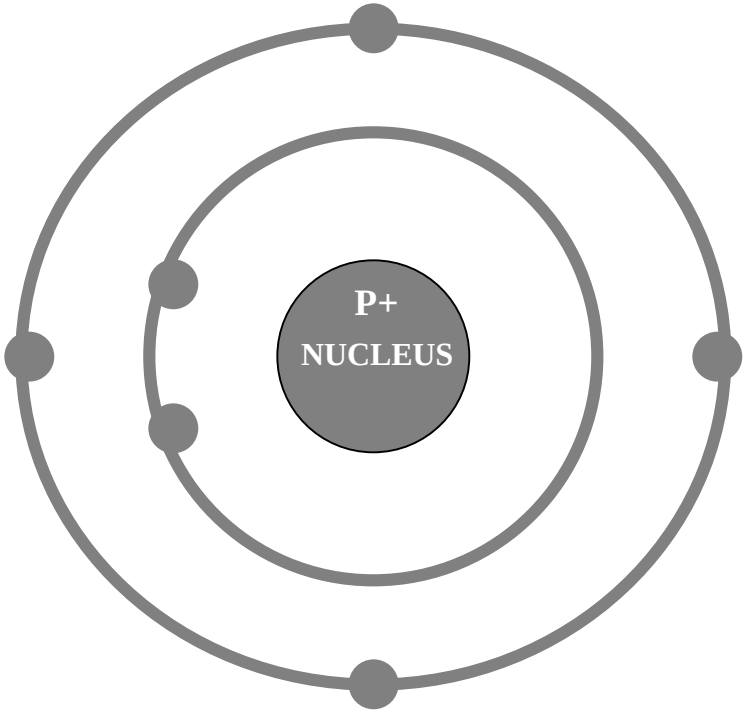
MAJOR
SUBATOMIC PARTICLE
PROTONS

SUBATOMIC PARTICLES



TYPICAL ATOM

SUBATOMIC PARTICLES



TYPICAL ATOM

PROTONS WITHIN NUCLEUS

¿

NEUTRONS

MAJOR SUBATOMIC PARTICLE NEUTRONS

NEUTRAL CHARGE (~)

MAJOR SUBATOMIC PARTICLE NEUTRONS

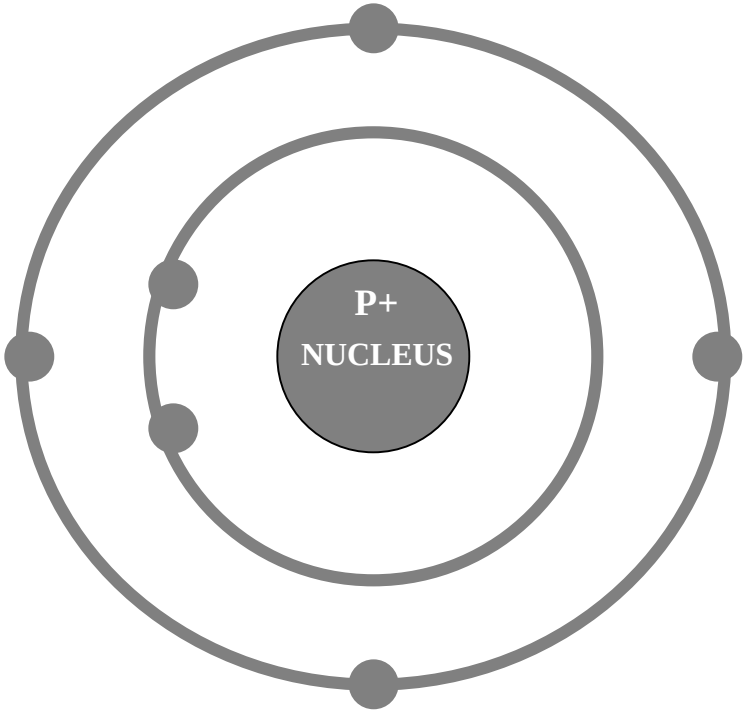
MAJOR
SUBATOMIC PARTICLE
NEUTRONS

NEUTRAL CHARGE (~)

WITHIN NUCLEUS

MAJOR
SUBATOMIC PARTICLE
NEUTRONS

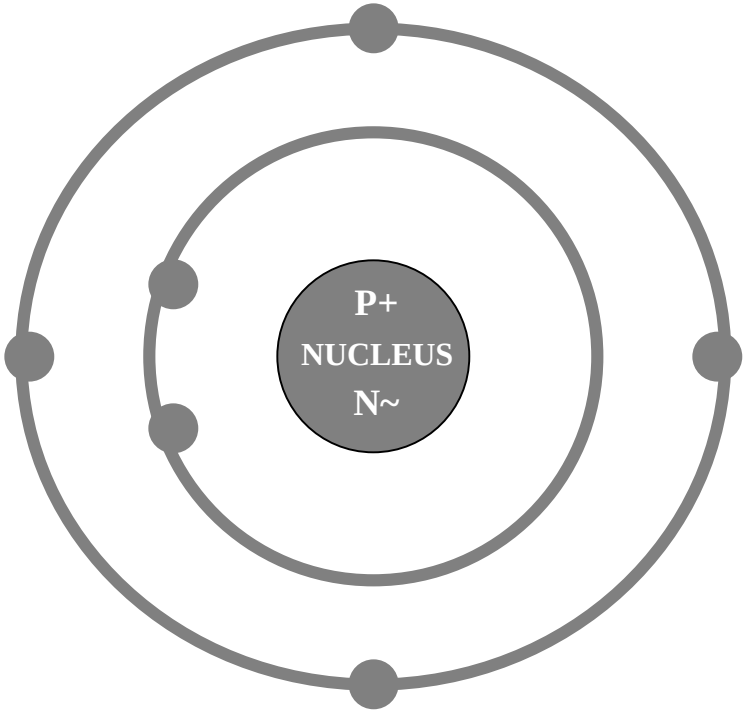
SUBATOMIC PARTICLES



TYPICAL ATOM

^
E

SUBATOMIC PARTICLES



TYPICAL ATOM

NEUTRONS WITHIN NUCLEUS

¿

ELECTRONS

MAJOR SUBATOMIC PARTICLE ELECTRONS

NEGATIVE CHARGE (-)

MAJOR SUBATOMIC PARTICLE ELECTRONS

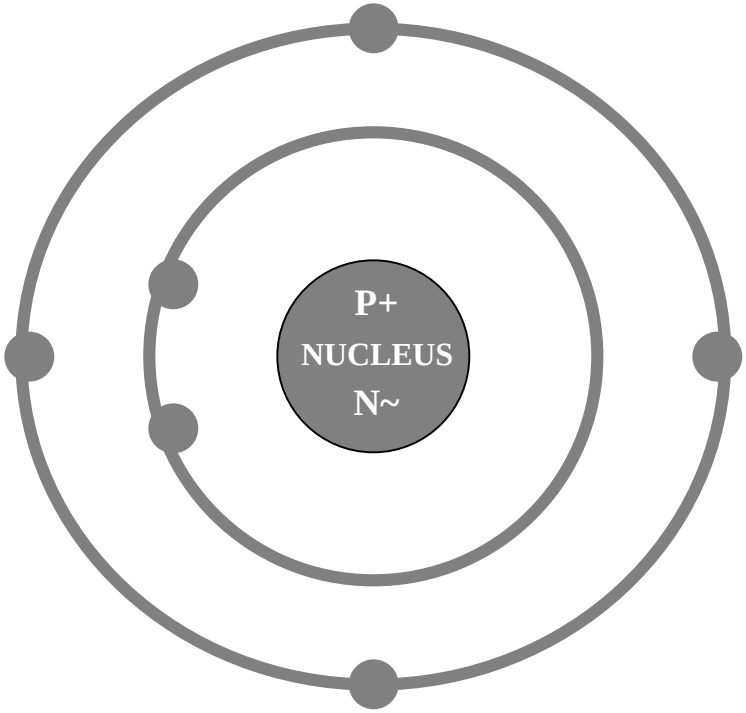
MAJOR SUBATOMIC PARTICLE ELECTRONS

NEGATIVE CHARGE (-)

ORBITING NUCLEUS

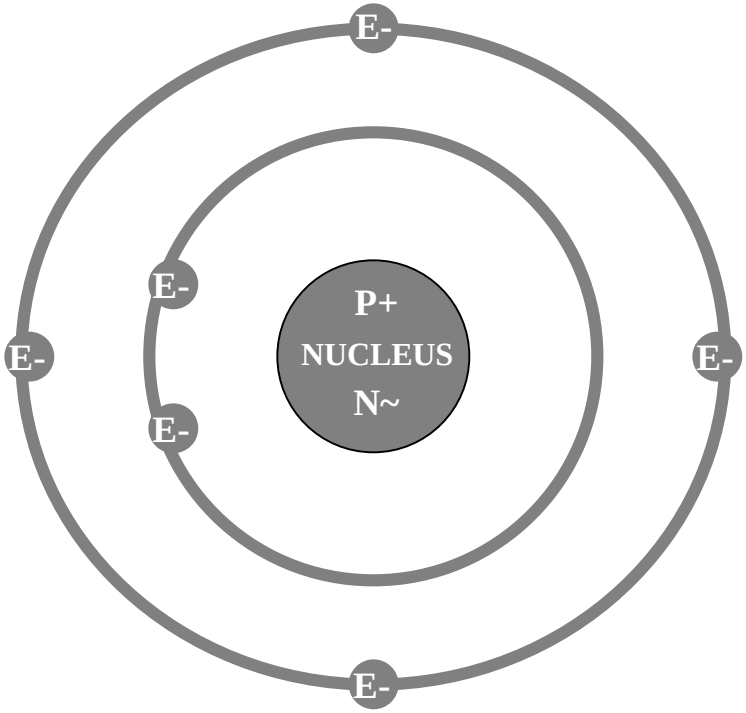
MAJOR SUBATOMIC PARTICLE ELECTRONS

SUBATOMIC PARTICLES



TYPICAL ATOM

SUBATOMIC PARTICLES

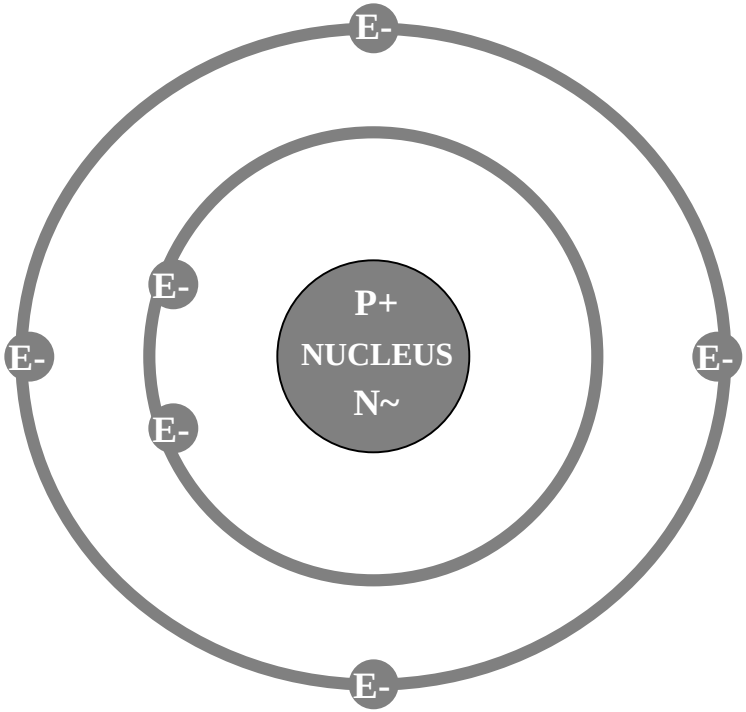


TYPICAL ATOM

ELECTRONS ORBIT NUCLEUS

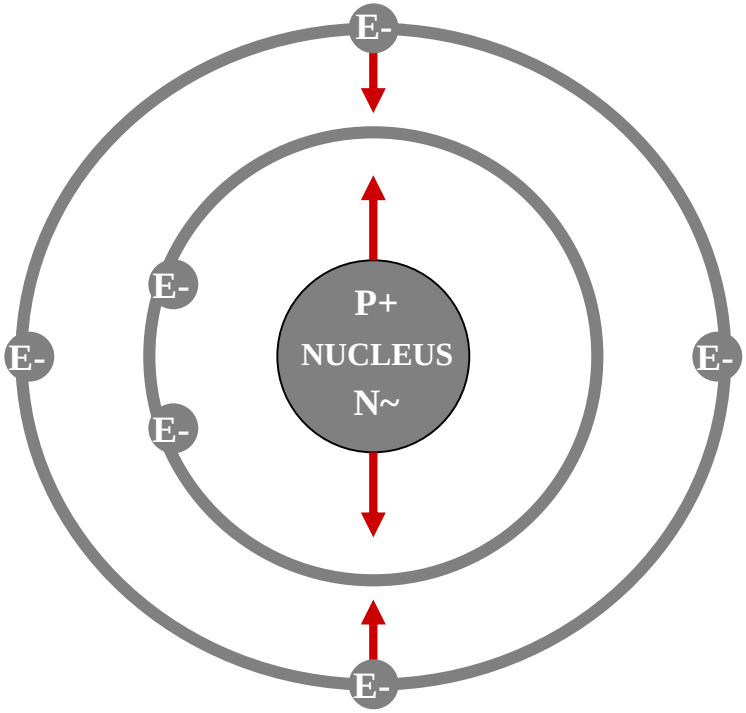
MAJOR SUBATOMIC PARTICLES APPILED

TYPICAL ATOM
SUBATOMIC PARTICLES



TYPICAL ATOM
SUBATOMIC PARTICLES

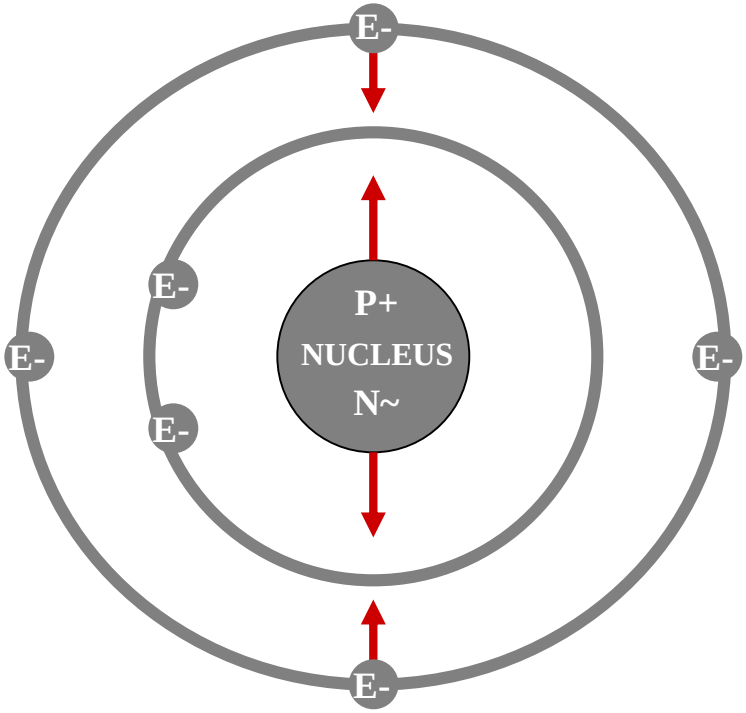
TYPICAL ATOM
SUBATOMIC PARTICLES



P+ → ← E-

ATTRACT

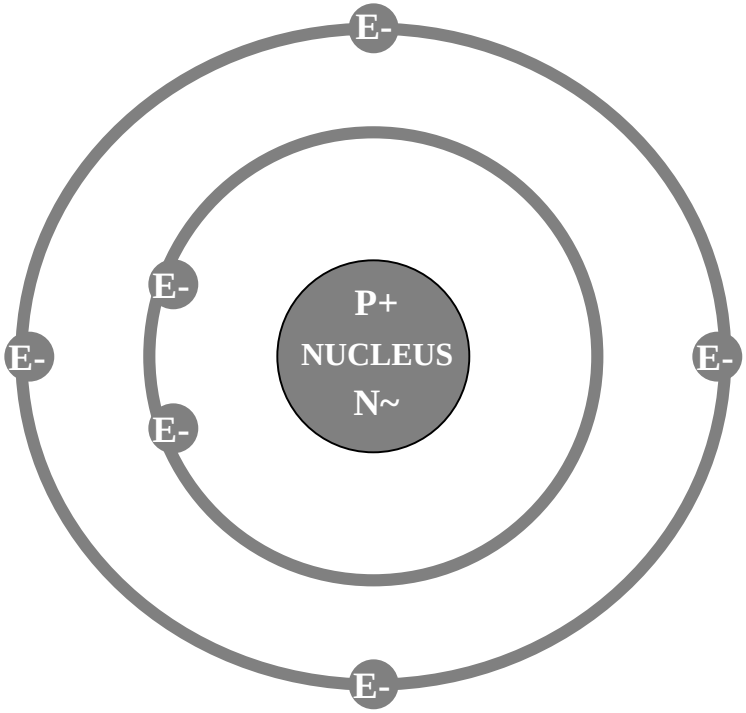
TYPICAL ATOM
SUBATOMIC PARTICLES



P+ → ← E-

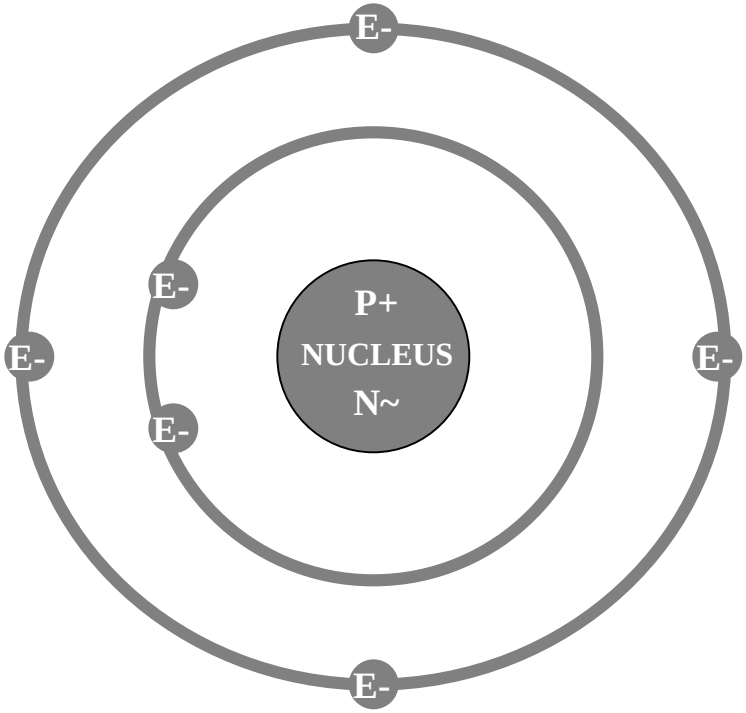
HOLDS ATOM INTACT

TYPICAL ATOM
SUBATOMIC PARTICLES



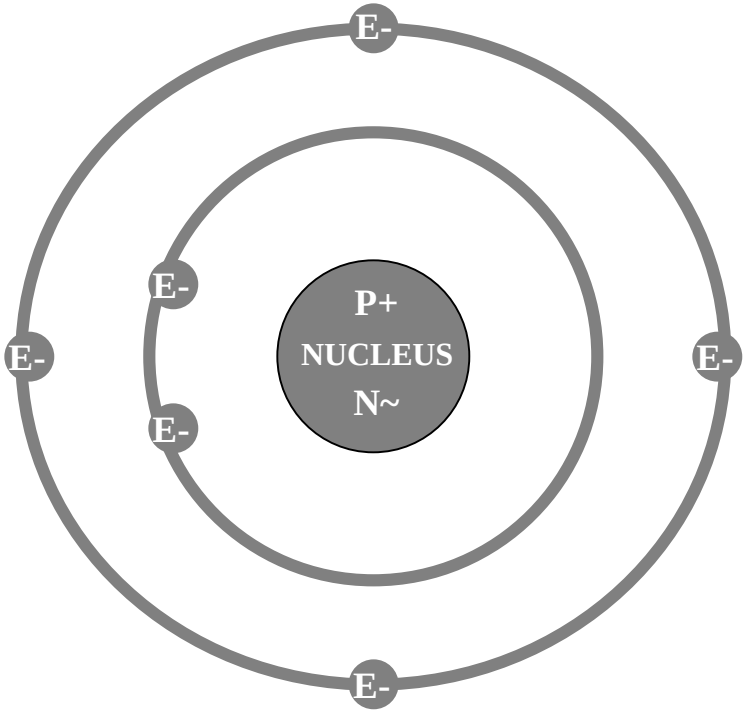
TYPICAL ATOM ~ CHARGE

TYPICAL ATOM
SUBATOMIC PARTICLES



TYPICAL ATOM ~ CHARGE
NO. P+ NO. E-

TYPICAL ATOM
SUBATOMIC PARTICLES



TYPICAL ATOM ~ CHARGE
NO. P+ = NO. E-

ATOMIC NO.
VS
ATOMIC WT.

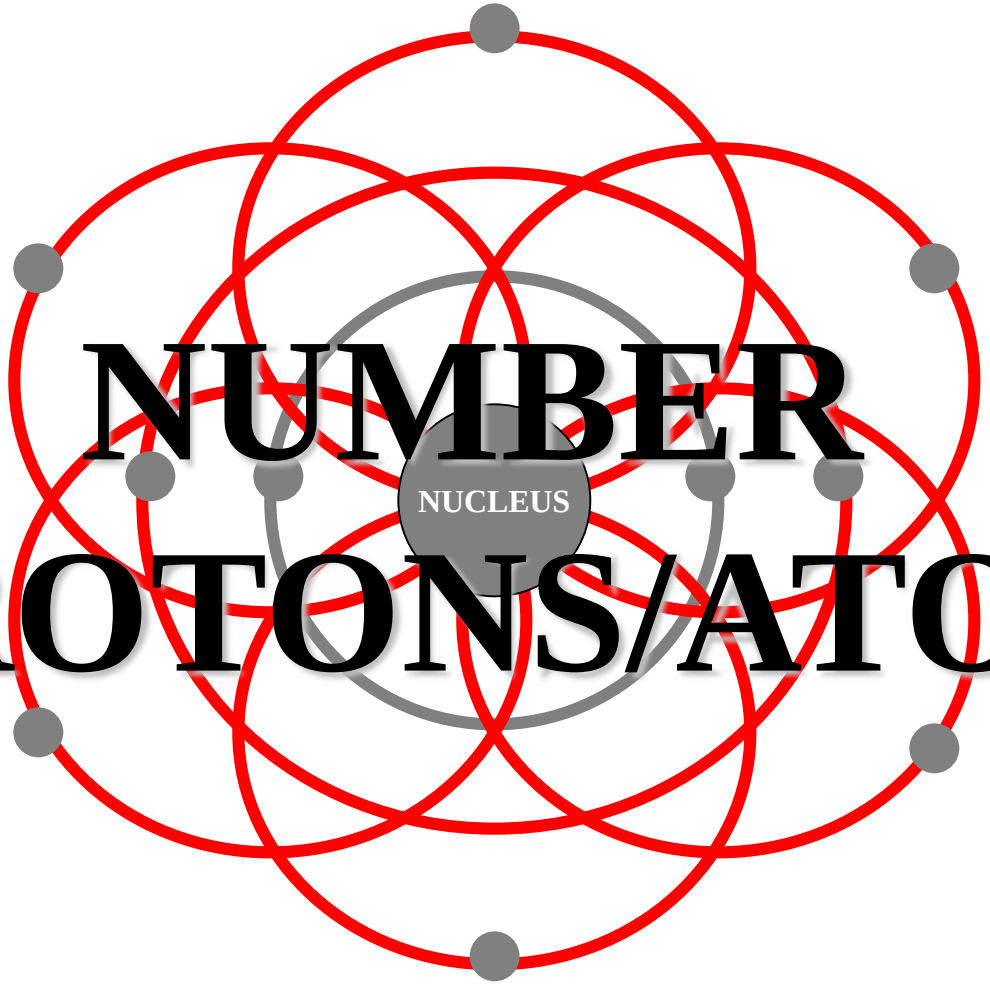
A

ATOMIC NO.

ATOMIC NO.

EG

ATOMIC NUMBER

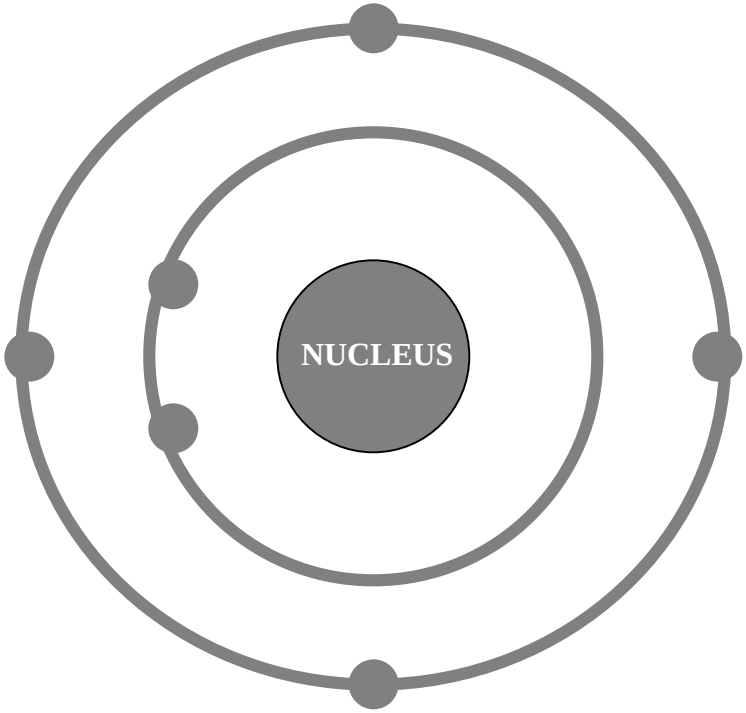


NUMBER
PROTONS/ATOM

ATOMIC NUMBER

ATOMIC NO. EXAMPLE

ATOMIC NUMBER



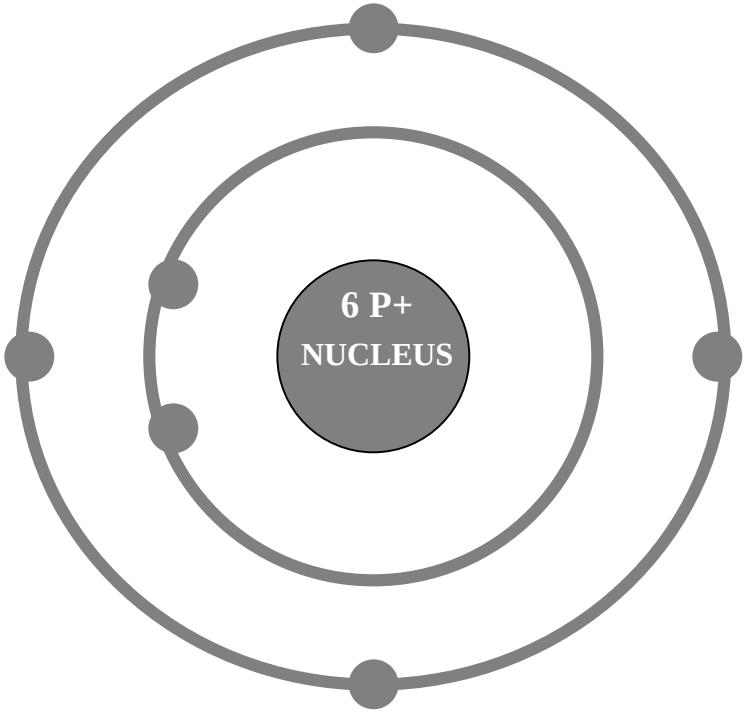
CARBON ATOM

= E-

ATOMIC NUMBER

¿

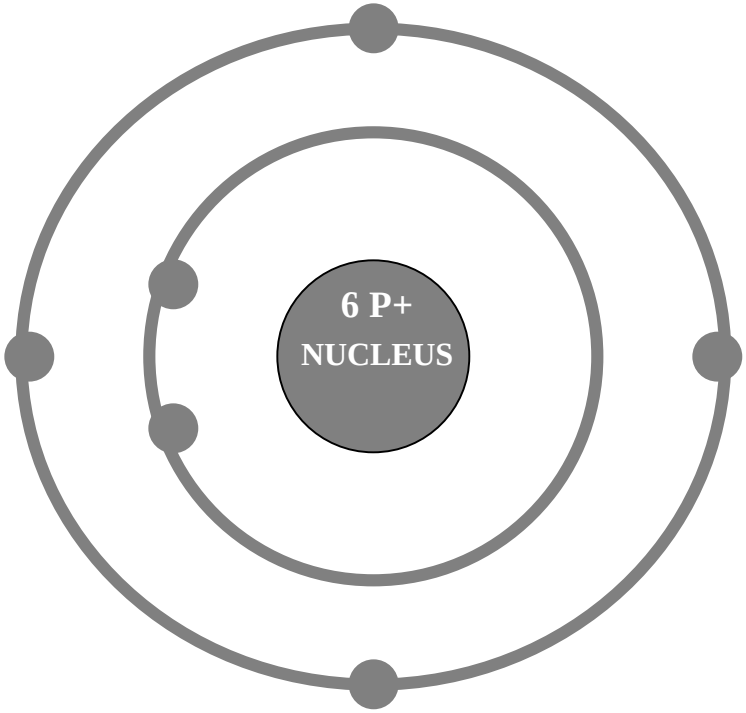
6



CARBON ATOM

= E-

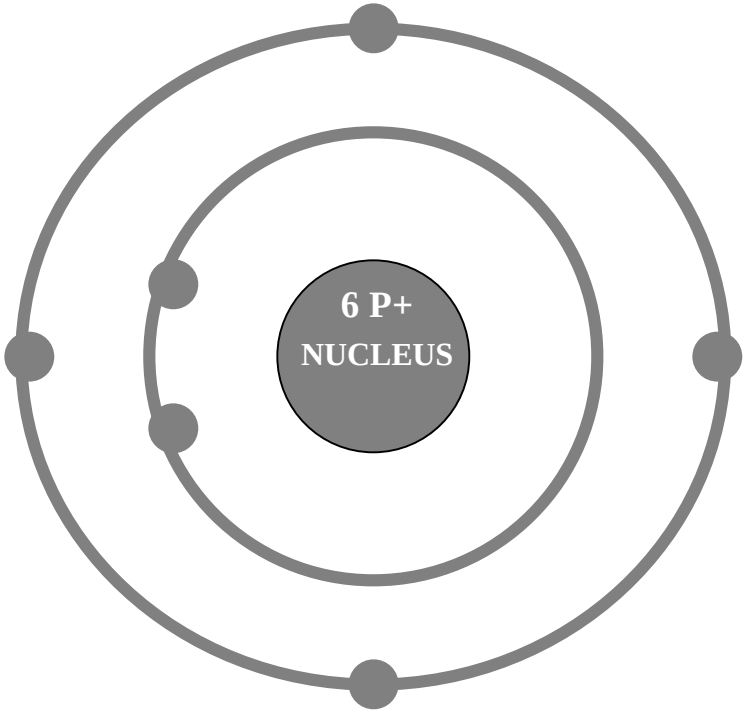
ATOMIC NUMBER



CARBON ATOMIC NO. = 6

= E-

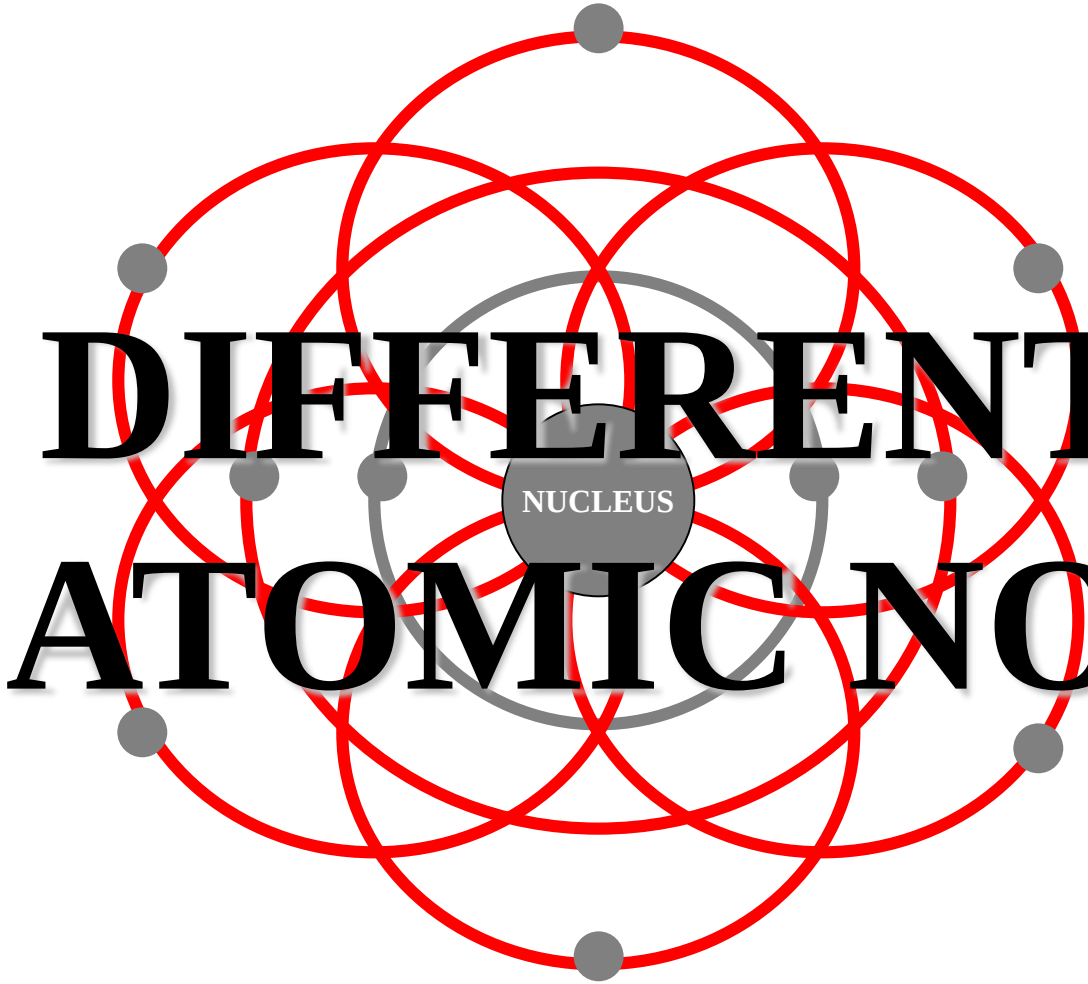
ATOMIC NUMBER



STABLE W/IN ELEMENT

= E-

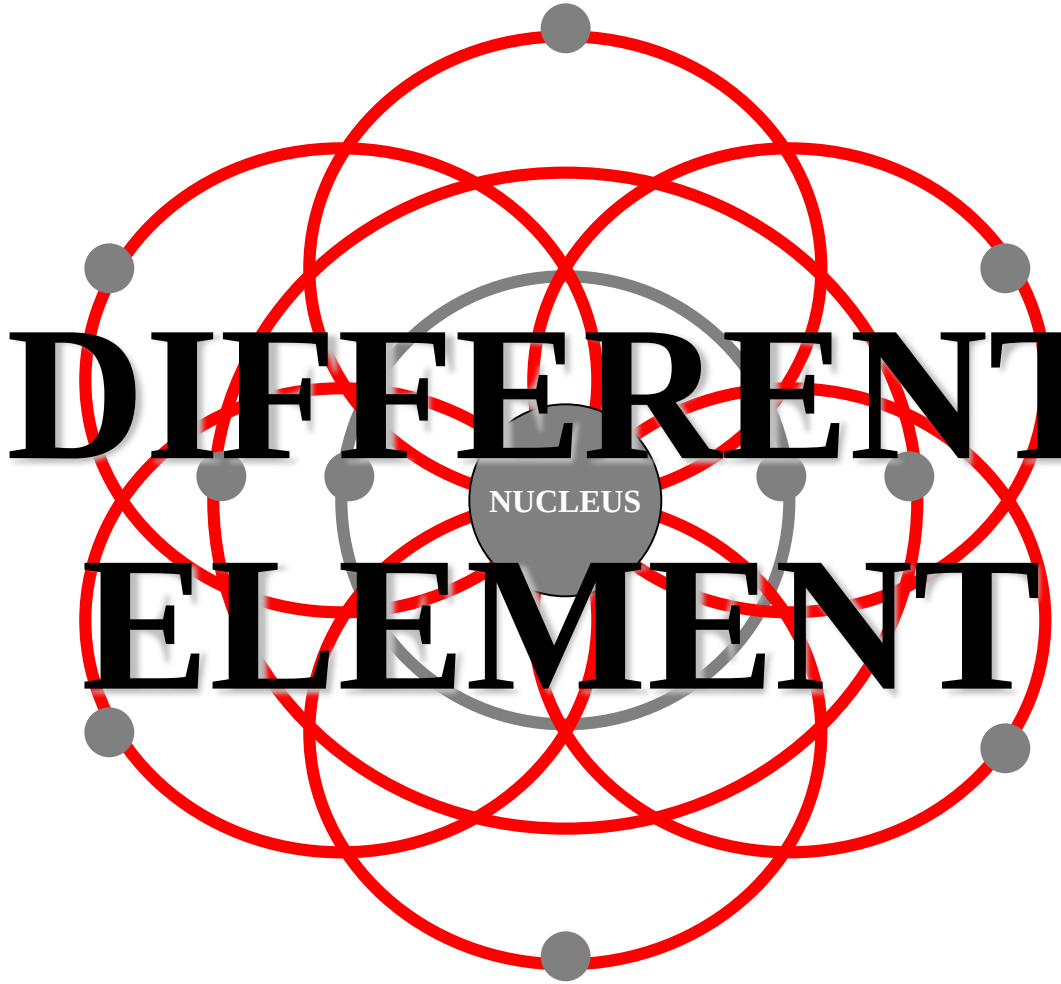
ATOMIC NUMBER



DIFFERENT ATOMIC NO.

ATOMIC NUMBER

ATOMIC NUMBER



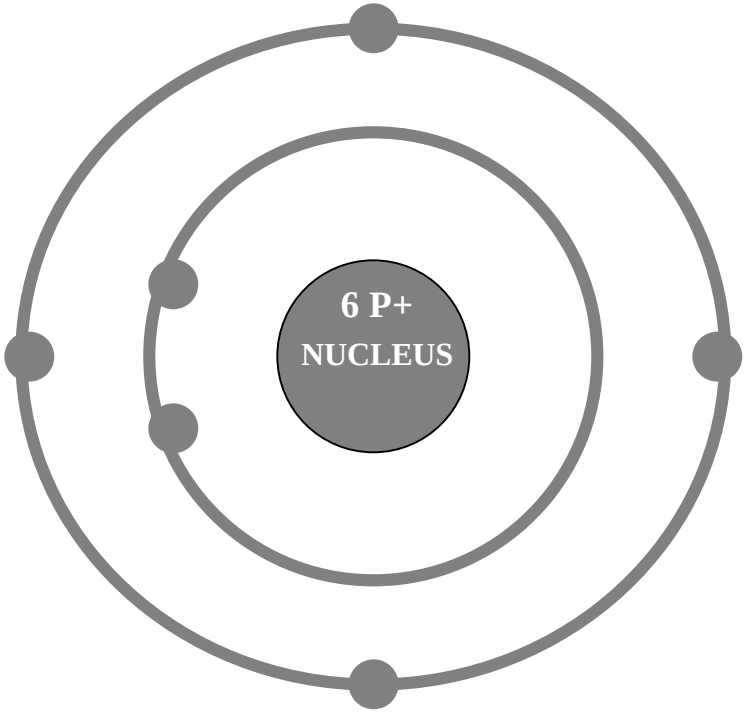
DIFFERENT ELEMENT

ATOMIC NUMBER

ATOMIC NO. APPLIED

C

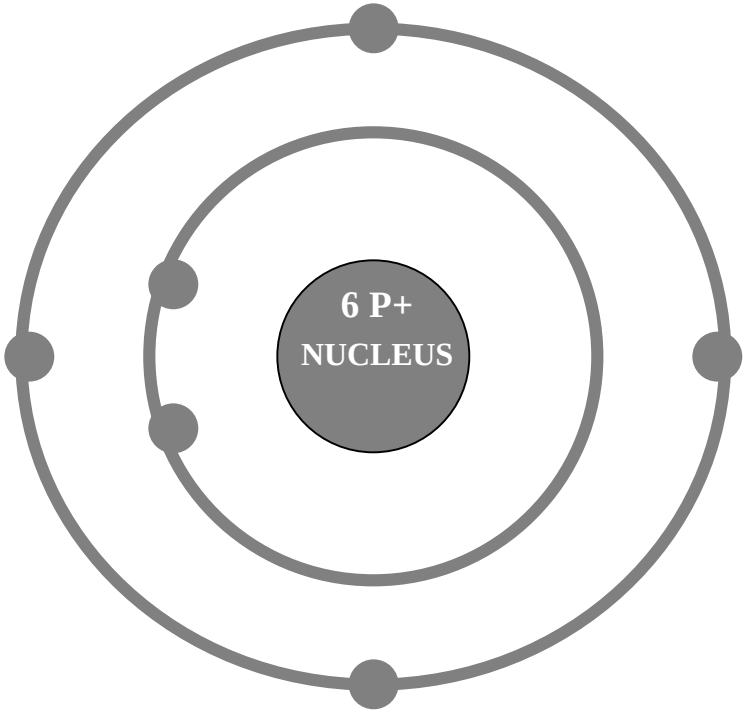
ATOMIC NUMBER



ATOMIC NO. = 6

= E-

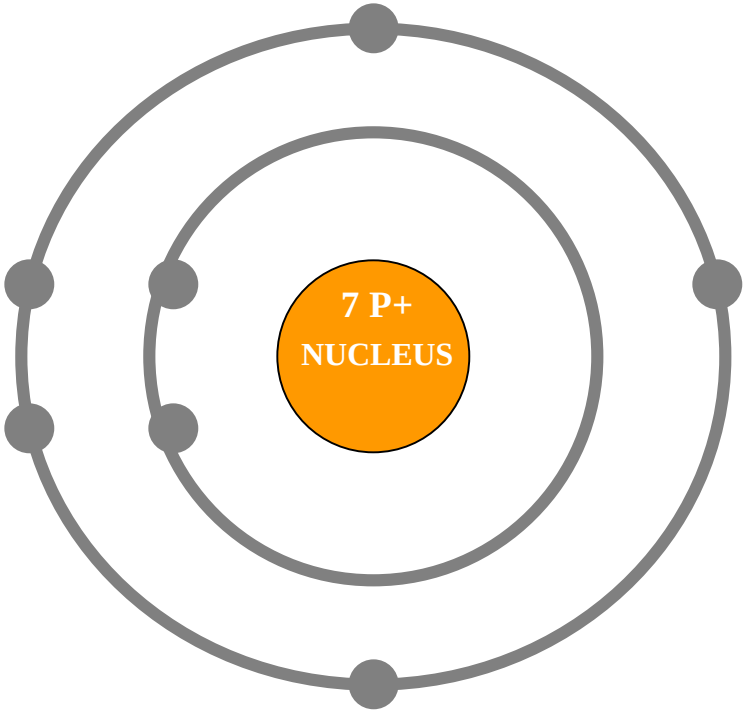
ATOMIC NUMBER



CARBON ATOM

= E-

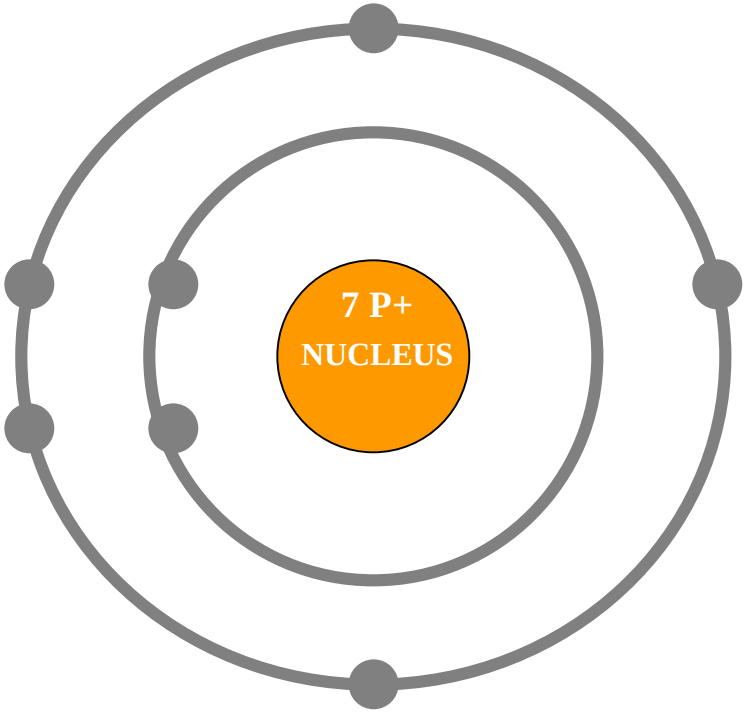
ATOMIC NUMBER



ATOMIC NO. = 7

= E-

ATOMIC NUMBER

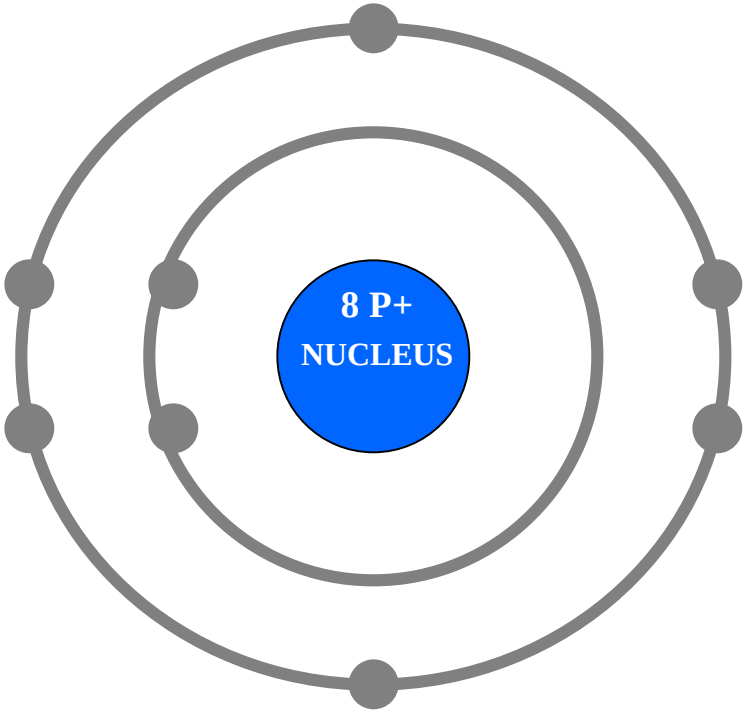


NITROGEN ATOM

= E-

ATOMIC NUMBER

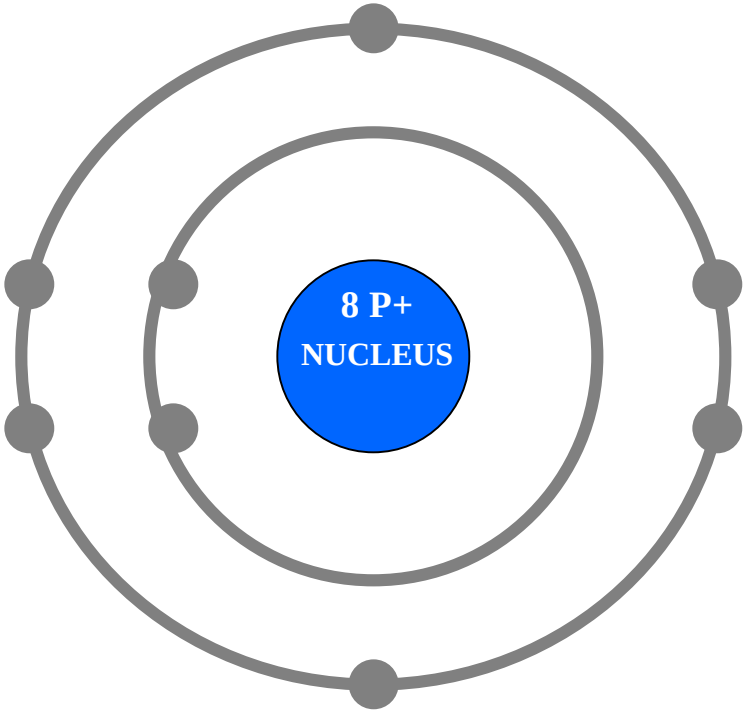
O



ATOMIC NO. = 8

= E-

ATOMIC NUMBER

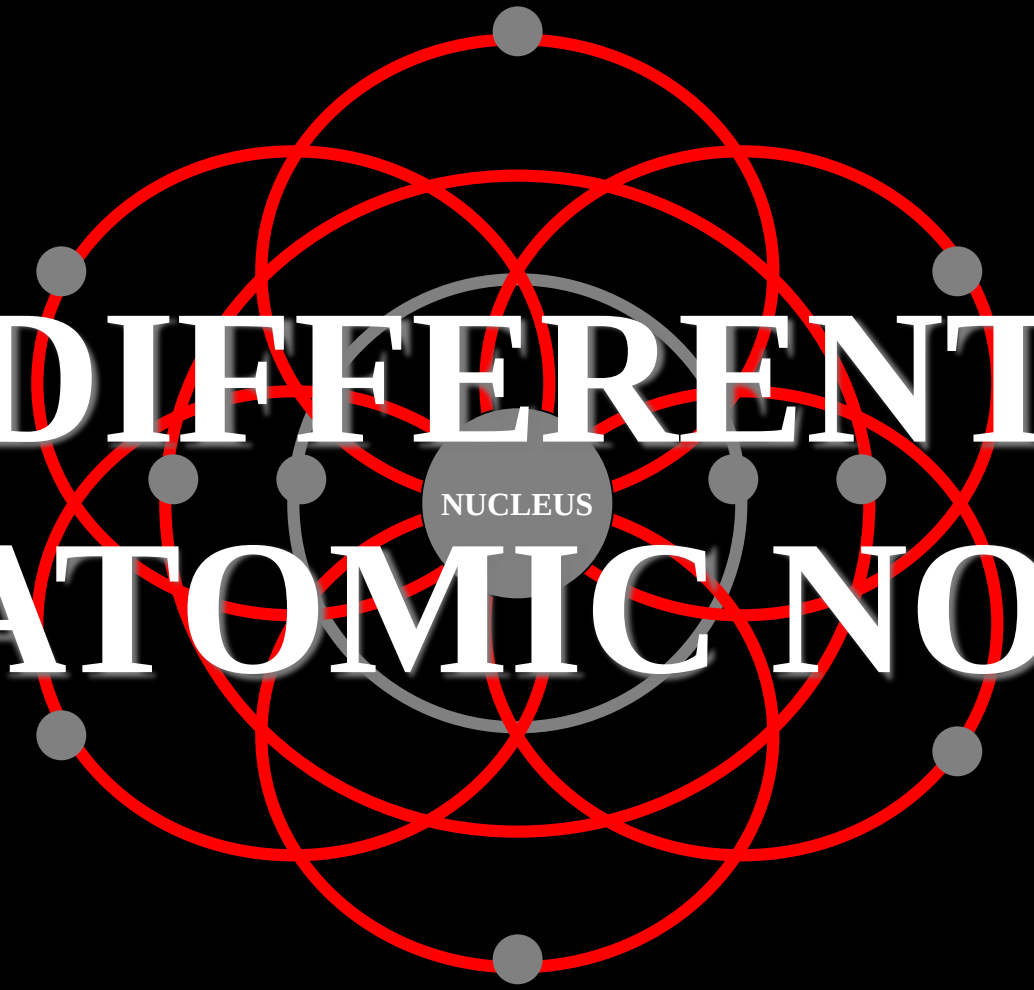


OXYGEN ATOM

= E-

ATOMIC NUMBER

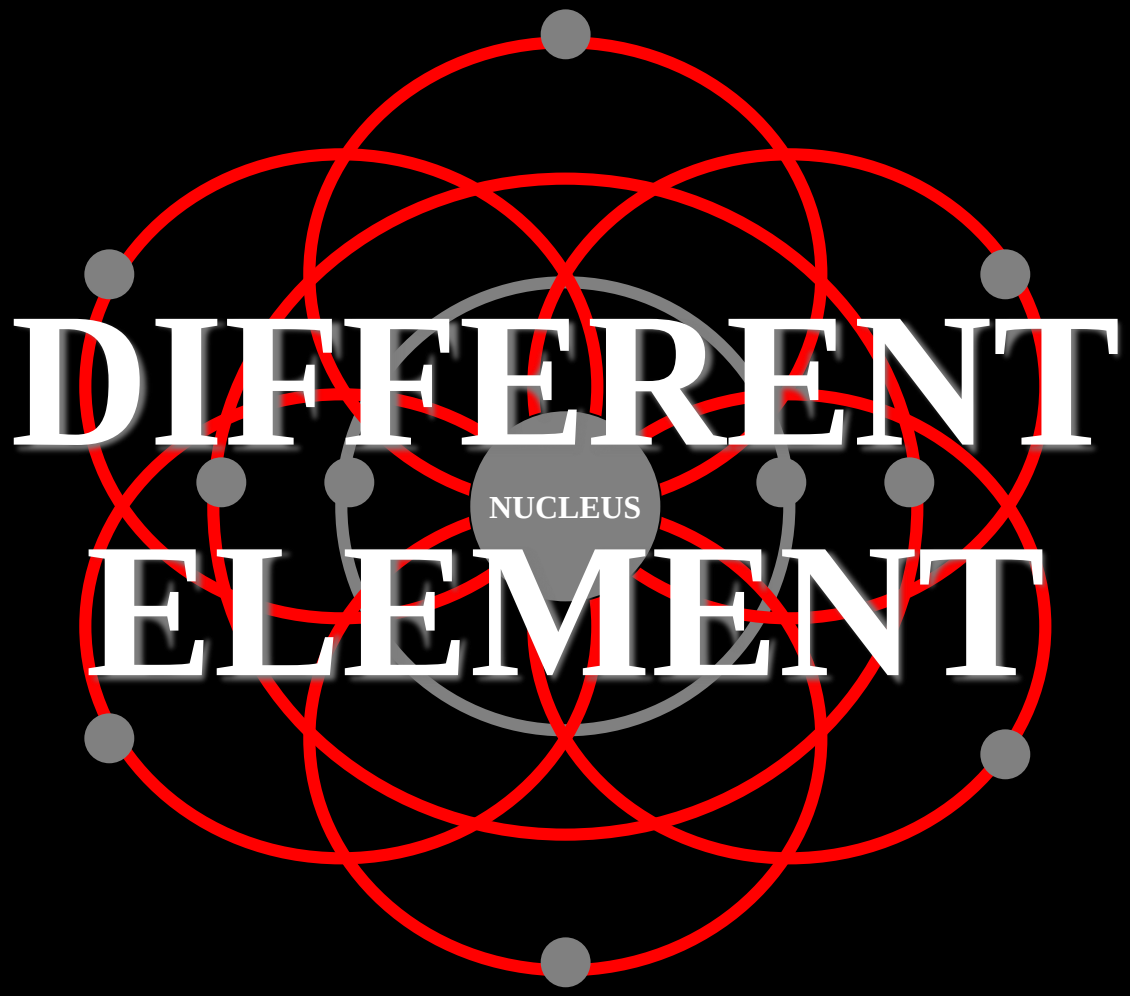
D



DIFFERENT ATOMIC NO.

ATOMIC NUMBER

ATOMIC NUMBER



DIFFERENT ELEMENT

ATOMIC NUMBER

PERIODIC TABLE

1																	2
H																	**He**
Hydrogen																	Helium
1.00794																	4.003
3	4											5	6	7	8	9	10
Li	**Be**											**B**	**C**	**N**	**O**	**F**	**Ne**
Lithium	Beryllium											Boron	Carbon	Nitrogen	Oxygen	Fluorine	Neon
6.941	9.012182											10.811	12.0107	14.00674	15.9994	18.9984032	20.1797
11	12											13	14	15	16	17	18
Na	**Mg**											**Al**	**Si**	**P**	**S**	**Cl**	**Ar**
Sodium	Magnesium											Aluminum	Silicon	Phosphorus	Sulfur	Chlorine	Argon
22.989770	24.3050											26.981538	28.0855	30.973761	32.066	35.4527	39.948
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K	**Ca**	**Sc**	**Ti**	**V**	**Cr**	**Mn**	**Fe**	**Co**	**Ni**	**Cu**	**Zn**	**Ga**	**Ge**	**As**	**Se**	**Br**	**Kr**
Potassium	Calcium	Scandium	Titanium	Vanadium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc	Gallium	Germanium	Arsenic	Selenium	Bromine	Krypton
39.0983	40.078	44.955910	47.867	50.9415	51.9961	54.938049	55.845	58.933200	58.6934	63.546	65.39	69.723	72.61	74.92160	78.96	79.904	83.80
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb	**Sr**	**Y**	**Zr**	**Nb**	**Mo**	**Tc**	**Ru**	**Rh**	**Pd**	**Ag**	**Cd**	**In**	**Sn**	**Sb**	**Te**	**I**	**Xe**
Rubidium	Strontium	Yttrium	Zirconium	Niobium	Molybdenum	Technetium	Ruthenium	Rhodium	Palladium	Silver	Cadmium	Indium	Tin	Antimony	Tellurium	Iodine	Xenon
85.4678	87.62	88.90585	91.224	92.90638	95.94	(98)	101.07	102.90550	106.42	107.8682	112.411	114.818	118.710	121.760	127.60	126.90447	131.29
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs	**Ba**	**La**	**Hf**	**Ta**	**W**	**Re**	**Os**	**Ir**	**Pt**	**Au**	**Hg**	**Tl**	**Pb**	**Bi**	**Po**	**At**	**Rn**
Cesium	Barium	Lanthanum	Hafnium	Tantalum	Tungsten	Rhenium	Osmium	Iridium	Platinum	Gold	Mercury	Thallium	Lead	Bismuth	Polonium	Astatine	Radon
132.90545	137.327	138.9055	178.49	180.9479	183.84	186.207	190.23	192.217	195.078	196.96655	200.59	204.3833	207.2	208.98038	(209)	(210)	(222)
87	88	89	104	105	106	107	108	109	110	111	112	113	114				
Fr	**Ra**	**Ac**	**Rf**	**Db**	**Sg**	**Bh**	**Hs**	**Mt**									
Francium	Radium	Actinium	Rutherfordium	Dubnium	Seaborgium	Bohrium	Hassium	Meitnerium									
(223)	(226)	(227)	(261)	(262)	(263)	(262)	(265)	(266)	(269)	(272)	(277)						

58	59	60	61	62	63	64	65	66	67	68	69	70	71
Ce	**Pr**	**Nd**	**Pm**	**Sm**	**Eu**	**Gd**	**Tb**	**Dy**	**Ho**	**Er**	**Tm**	**Yb**	**Lu**
Cerium	Praseodymium	Neodymium	Promethium	Samarium	Europium	Gadolinium	Terbium	Dysprosium	Holmium	Erbium	Thulium	Ytterbium	Lutetium
140.116	140.90765	144.24	(145)	150.36	151.964	157.25	158.92534	162.50	164.93032	167.26	168.93421	173.04	174.967
90	91	92	93	94	95	96	97	98	99	100	101	102	103
Th	**Pa**	**U**	**Np**	**Pu**	**Am**	**Cm**	**Bk**	**Cf**	**Es**	**Fm**	**Md**	**No**	**Lr**
Thorium	Protactinium	Uranium	Neptunium	Plutonium	Americium	Curium	Berkelium	Californium	Einsteinium	Fermium	Mendelevium	Nobelium	Lawrencium
232.0381	231.03588	238.0289	(237)	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(262)

PERIODIC TABLE

ARRANGED BY ATOMIC NO.

1 H Hydrogen 1.00794																	2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012182											5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.00674	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797
11 Na Sodium 22.989770	12 Mg Magnesium 24.3050											13 Al Aluminum 26.981538	14 Si Silicon 28.0855	15 P Phosphorus 30.973761	16 S Sulfur 32.066	17 Cl Chlorine 35.4527	18 Ar Argon 39.948
19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scand 44.95	22 Ti Titan 47.8	23 V 5 415	24 Cr 1.99	25 Mn Mangan 54.938	26 Fe Ir 55.84	27 Co 58.93 200	28 Ni 6934	29 Cu 63.	30 Zn Zinc 65.39	31 Ga 69	32 Ge Ger 72.	33 As Arsen 2160	34 Se Selen 78.9	35 Br Bromine 79.904	36 Kr Krypton 83.80
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.90447	54 Xe Xenon 131.29
55 Cs Cesium 132.90545	56 Ba Barium 137.327	57 La Lanthanum 138.9055	72 Hf Hafni 178	73 Ta Tantalum 0.9479	74 W Tungsten 183.84	75 Re Rhenium 186.20	76 Os 190.2	77 Ir 192 7	78 Pt inum .07	79 Au Gold 196.96655	80 Hg Mercu 200.5	81 Tl Thall 33	82 Pb Lead 207.2	83 Bi Bismuth 8.98038	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (263)	107 Bh Bohrium (262)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 (269)	111 (272)	112 (277)	113	114				

58 Ce Cerium 140.116	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92534	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93032	68 Er Erbium 167.26	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
90 Th Thorium 232.0381	91 Pa Protactinium 231.03588	92 U Uranium 238.0289	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)

ATOMIC NUMBER

ATOMIC NO. DOES NOT VARY /ATOM/ELEMENT

ATOMIC NUMBER

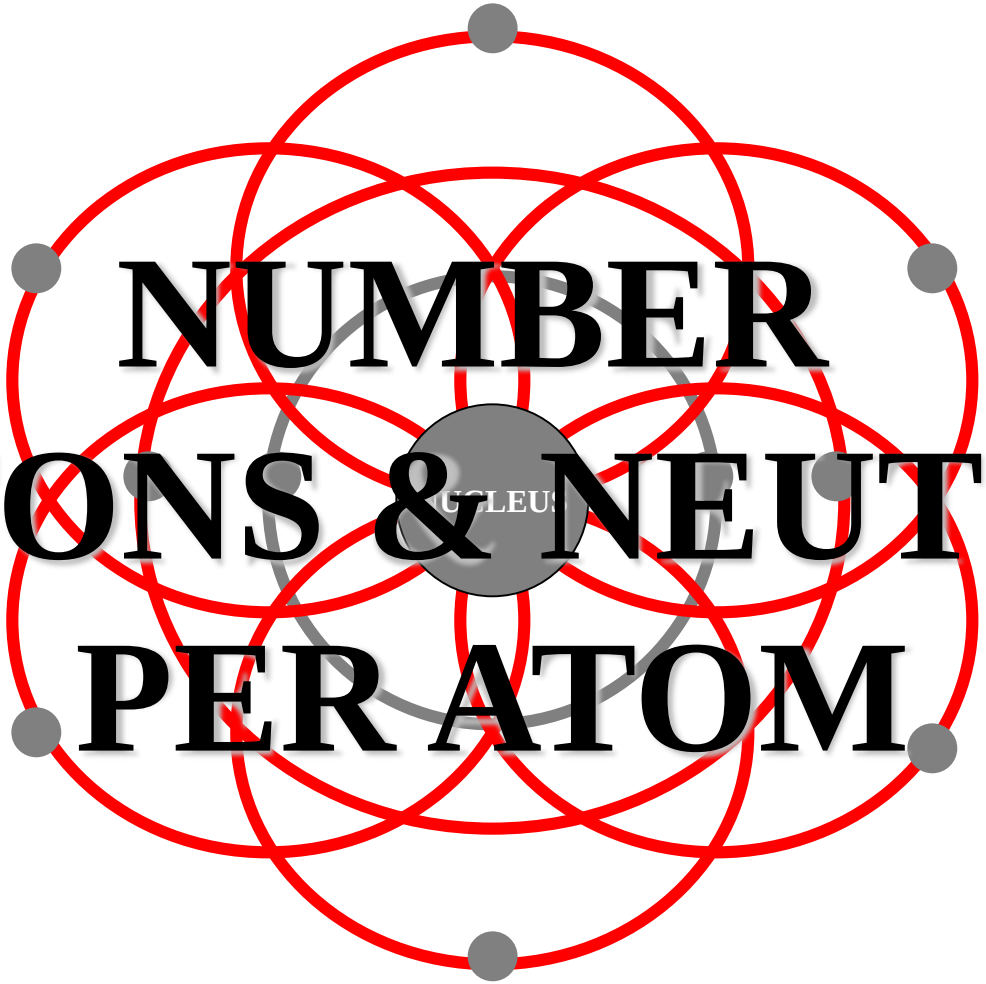
A

ATOMIC WT.

ATOMIC WT.

D

ATOMIC WEIGHT

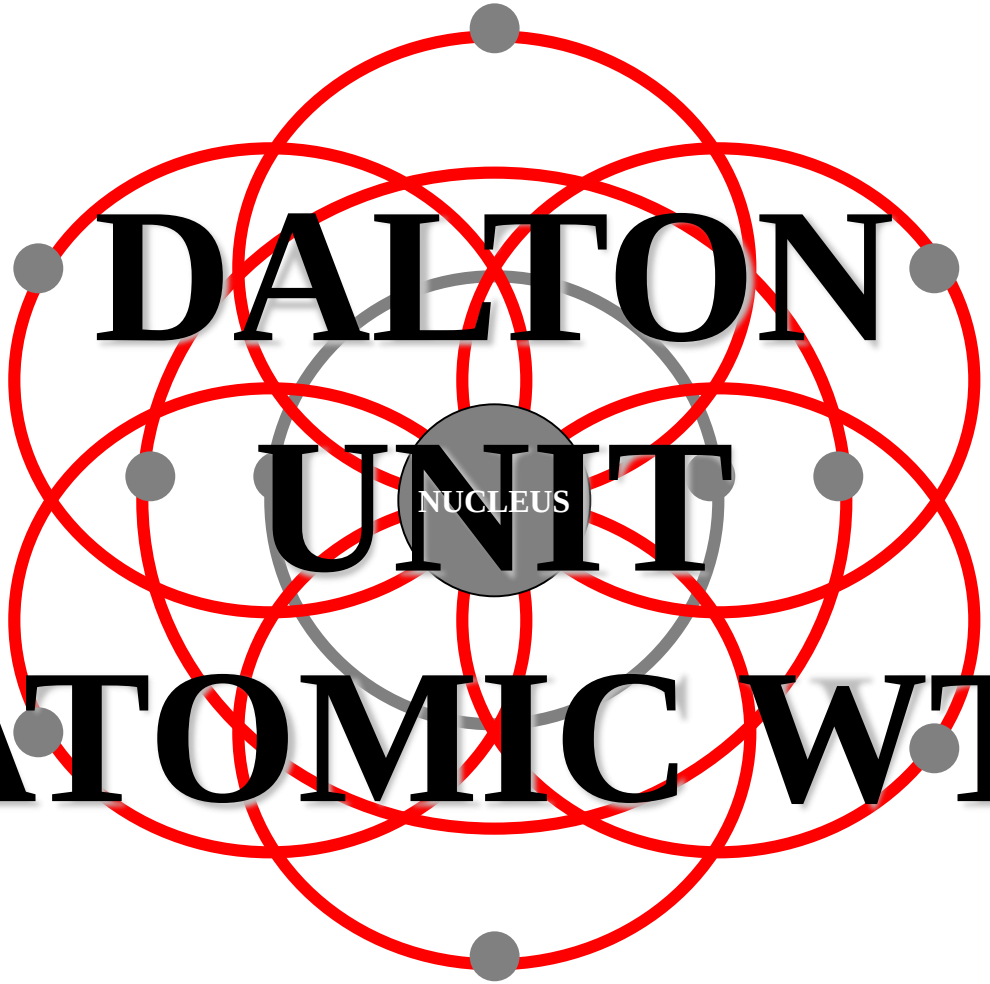


NUMBER PROTONS & NEUTRONS PER ATOM

ATOMIC WEIGHT

DALTON

ATOMIC WEIGHT



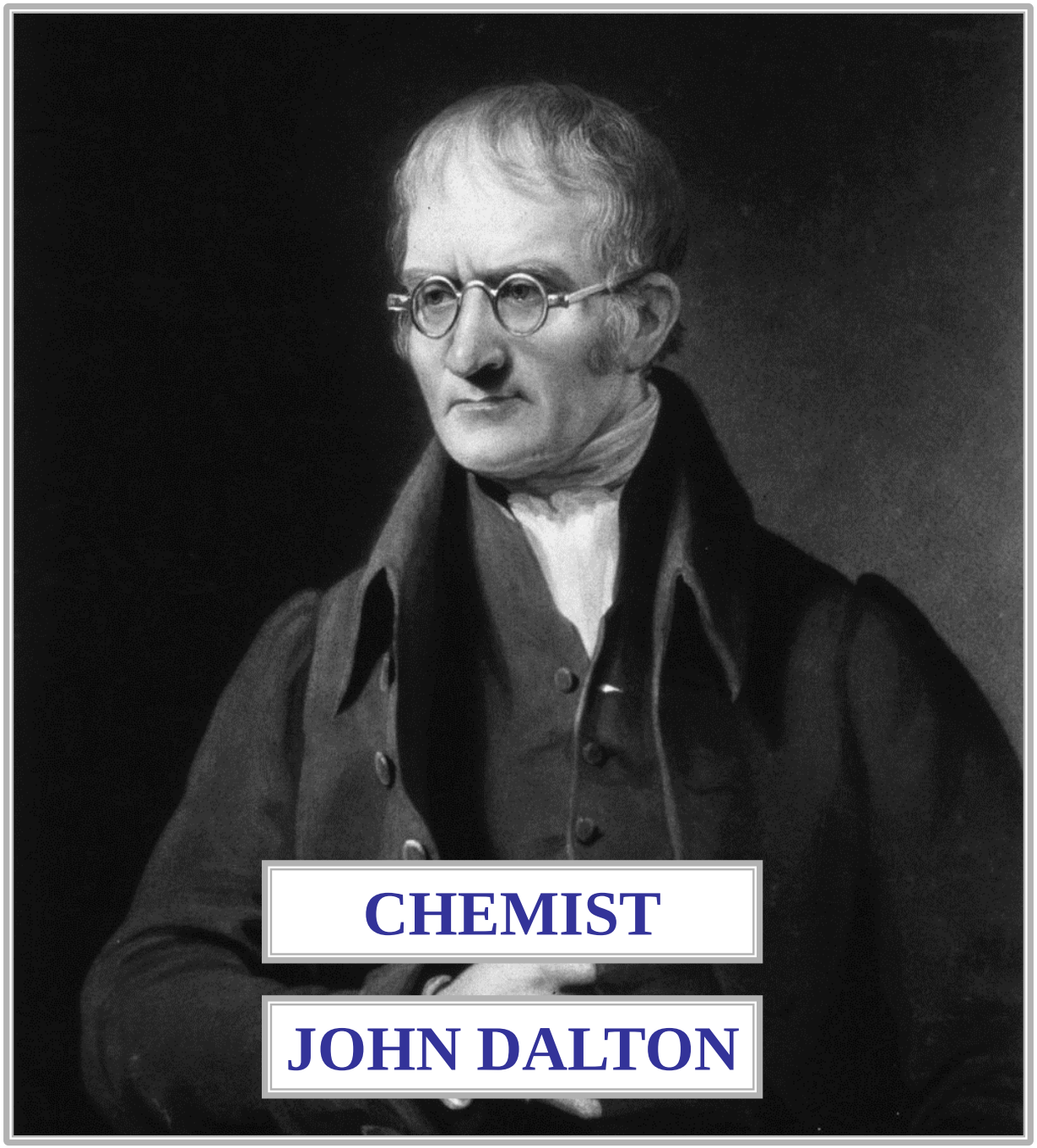
DALTON

UNIT

ATOMIC WT.

ATOMIC WEIGHT

P



CHEMIST

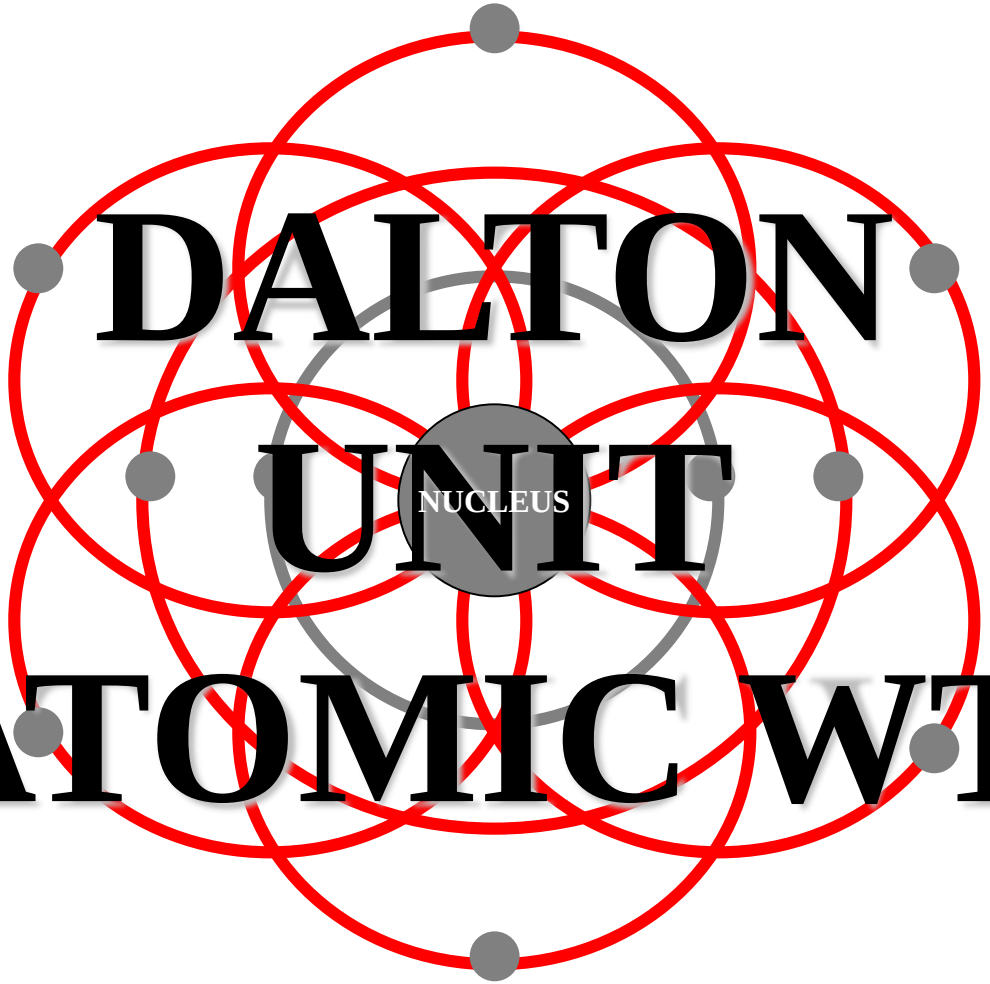
JOHN DALTON

DALTON
ATOMIC WEIGHT

PROTON

DALTON
ATOMIC WEIGHT

PROTON = 1 DALTON



DALTON

UNIT

ATOMIC WT.

PROTON = 1 DALTON

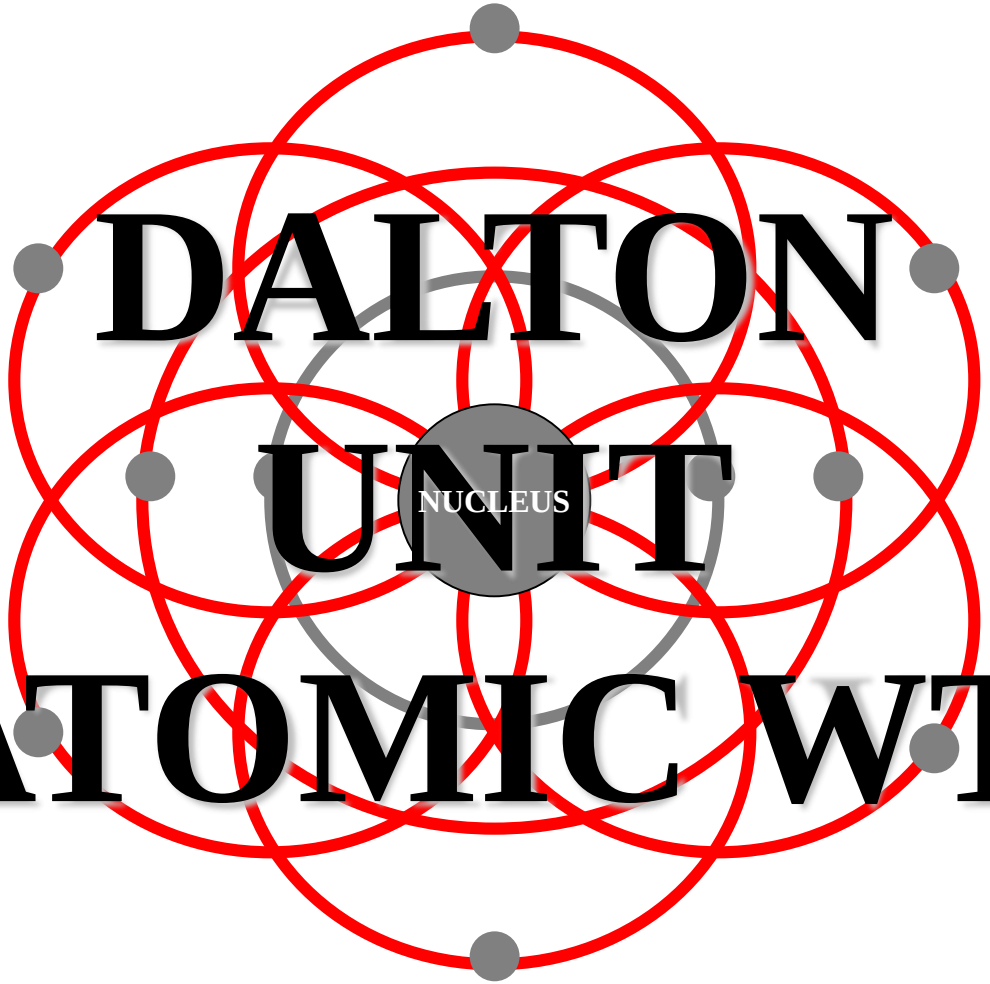
DALTON
ATOMIC WEIGHT

NEUTRON

DALTON
ATOMIC WEIGHT

E

NEUTRON = 1 DALTON



DALTON

UNIT

ATOMIC WT.

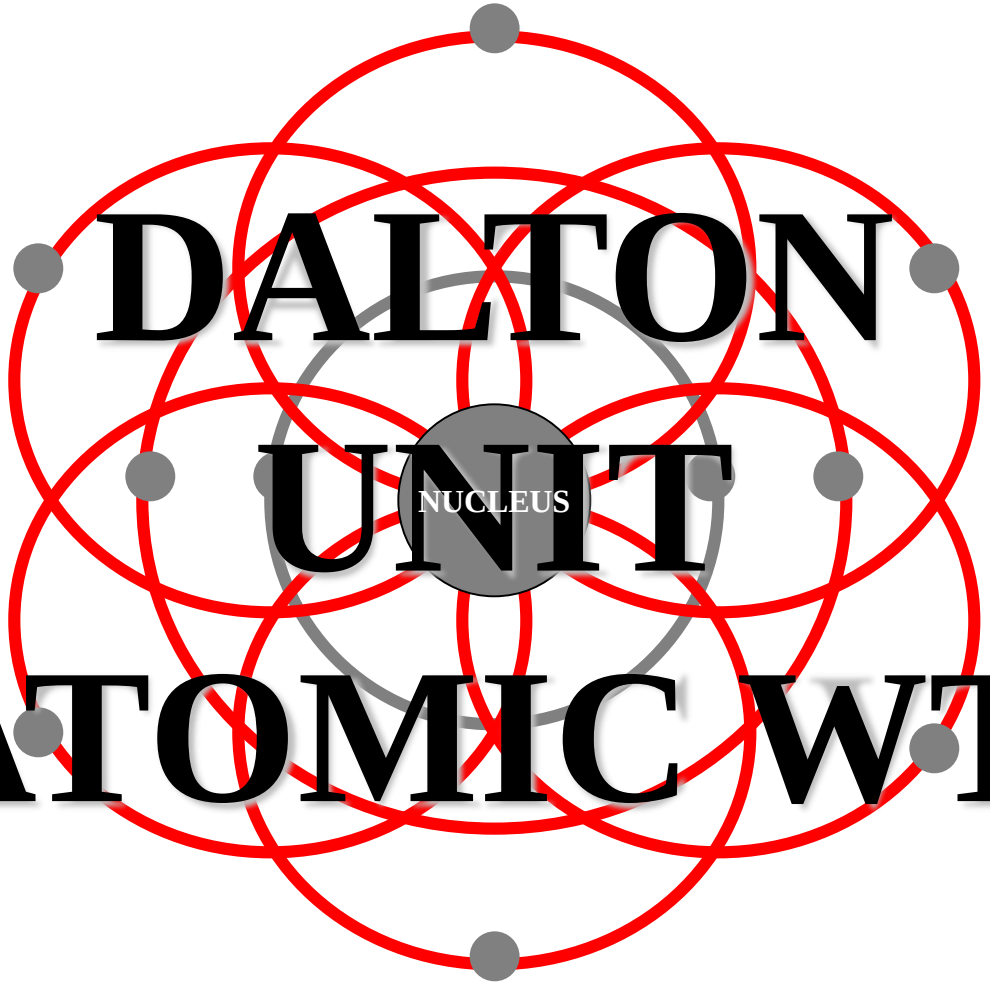
NEUTRON = 1 DALTON

DALTON
ATOMIC WEIGHT

ELECTRON

DALTON
ATOMIC WEIGHT

ELECTRON = 0 DALTON

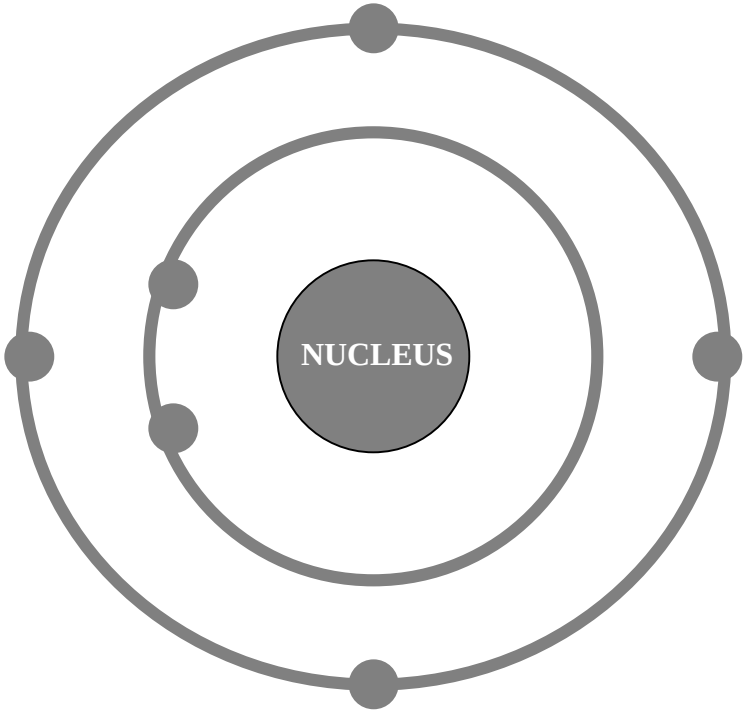


DALTON UNIT ATOMIC WT.

ELECTRON = 0 DALTON

ATOMIC WT. EXAMPLE

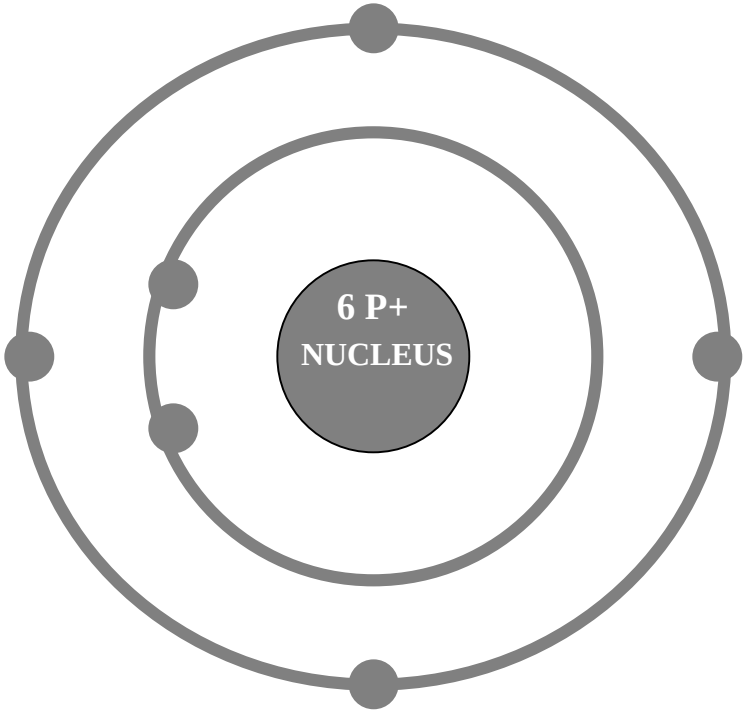
ATOMIC WEIGHT



TYPICAL CARBON ATOM

= E-

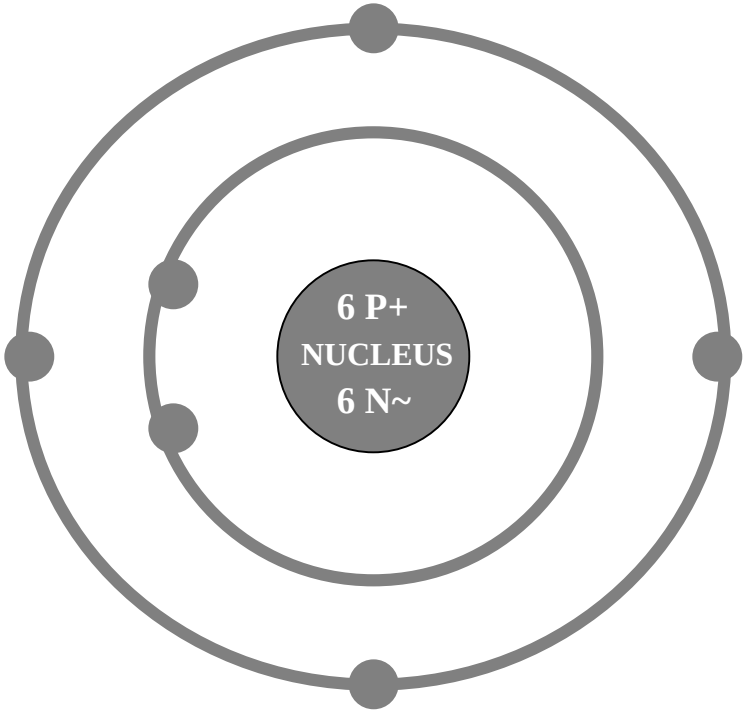
ATOMIC WEIGHT



TYPICAL CARBON ATOM

= E-

ATOMIC WEIGHT

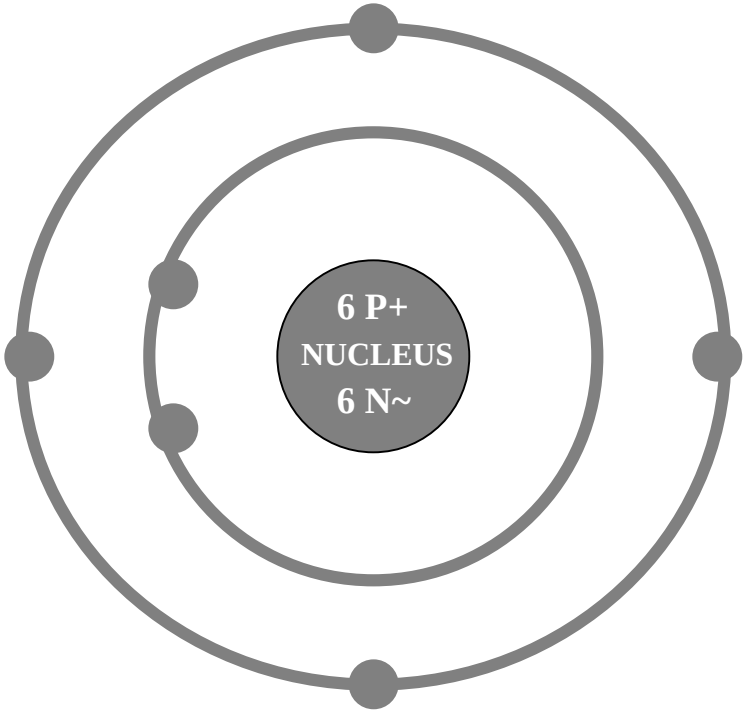


TYPICAL CARBON ATOM

● = E-

ATOMIC WEIGHT

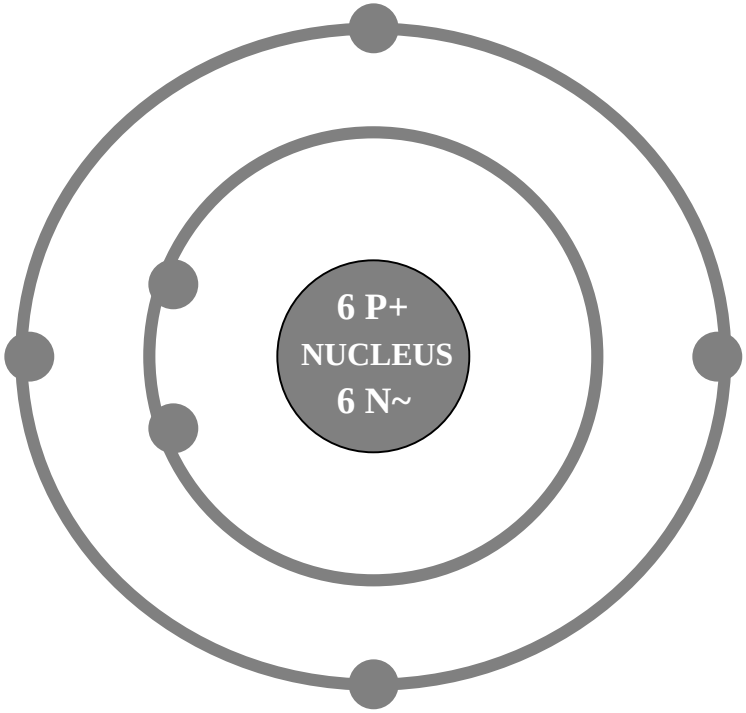
P
+



CARBON AT. WT. = 12 DALTONS

= E-

ATOMIC WEIGHT

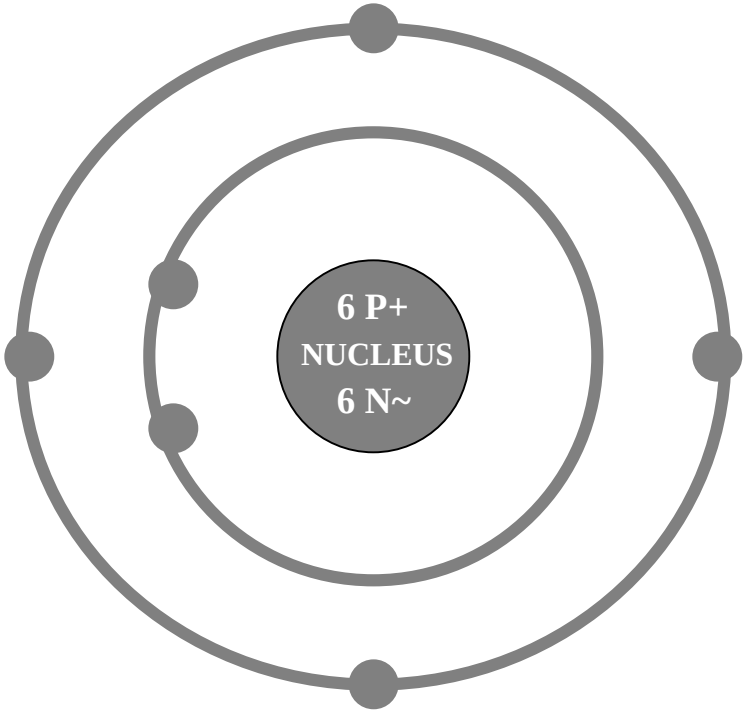


PROTON NO./ATOM/ELEMENT

= E-

N

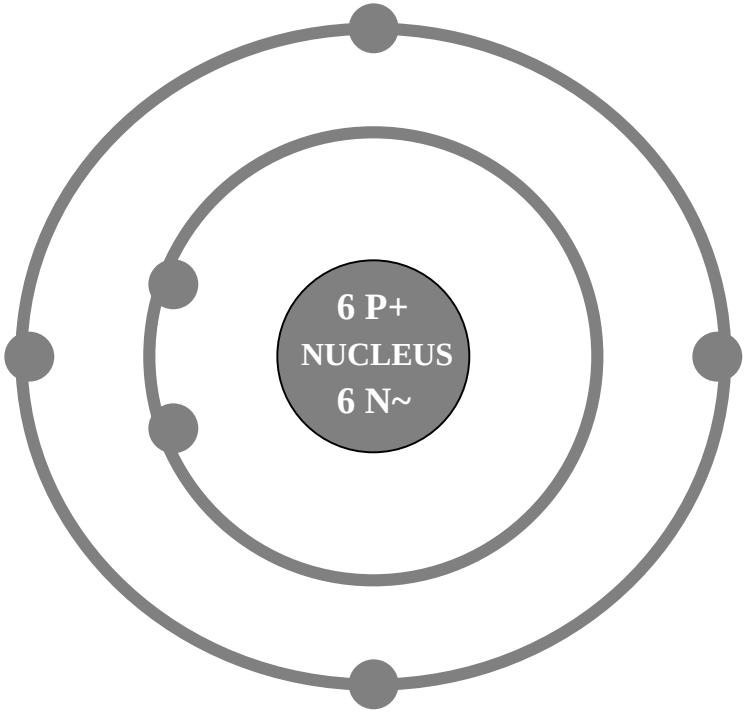
ATOMIC WEIGHT



PROTON NO. STABLE

= E-

ATOMIC WEIGHT

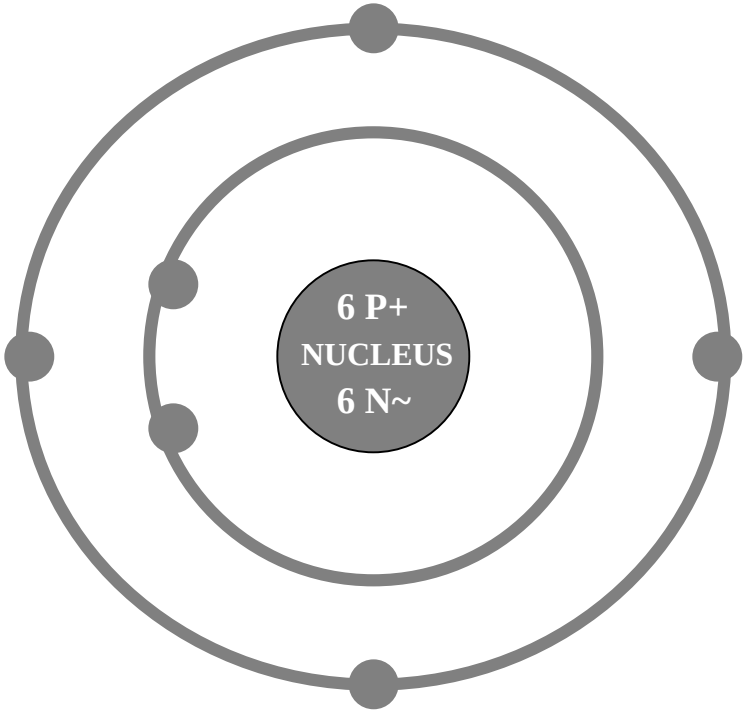


NEUTRON NO./ATOM/ELEMENT

= E-

EG

ATOMIC WEIGHT

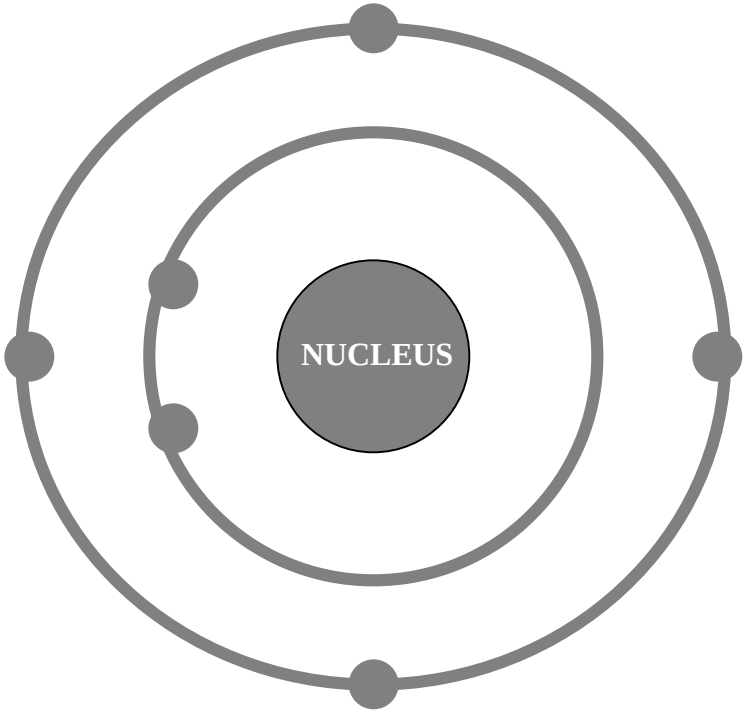


NEUTRON NO. MAY VARY

= E-

NEUTRON NO. MAY VARY EXAMPLE

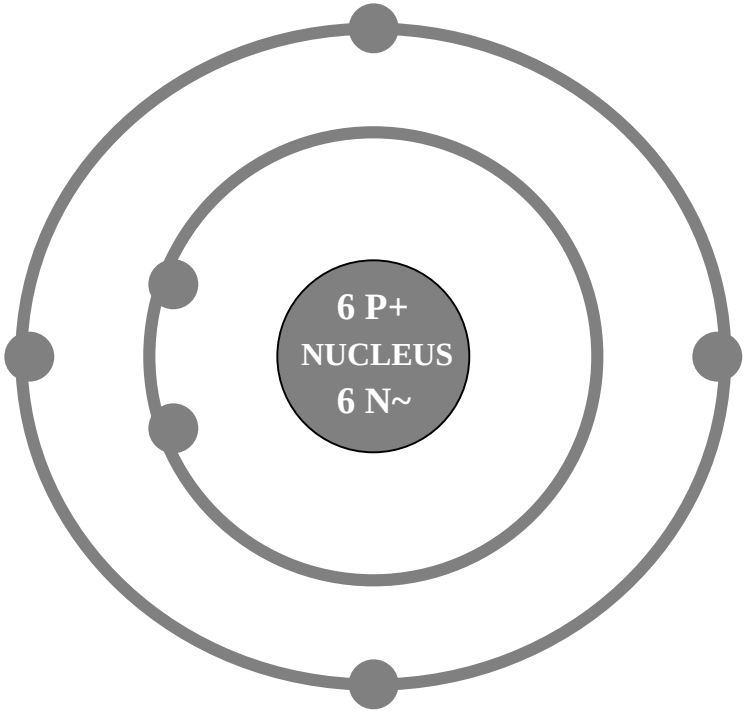
ATOMIC WEIGHT



TYPICAL CARBON ATOM

= E-

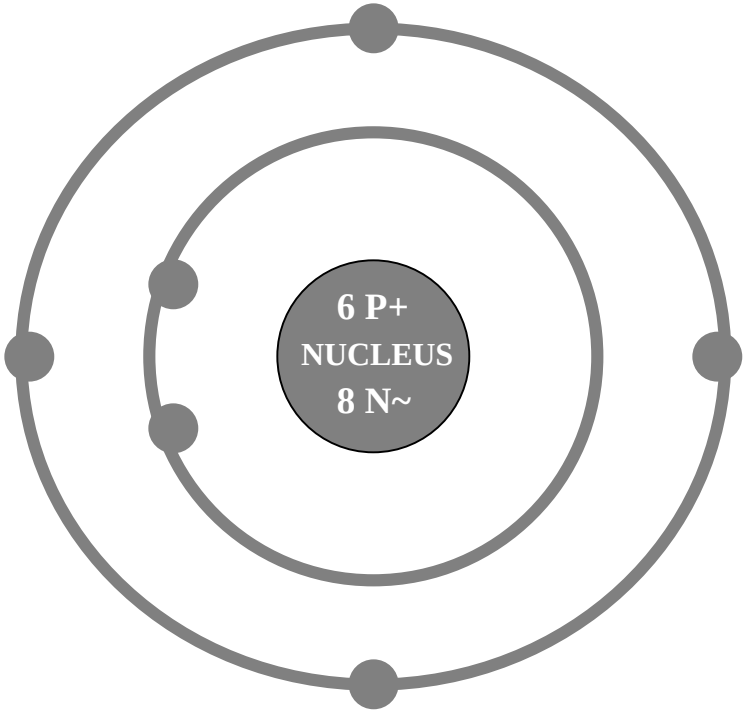
ATOMIC WEIGHT



TYPICAL CARBON ATOM

= E-

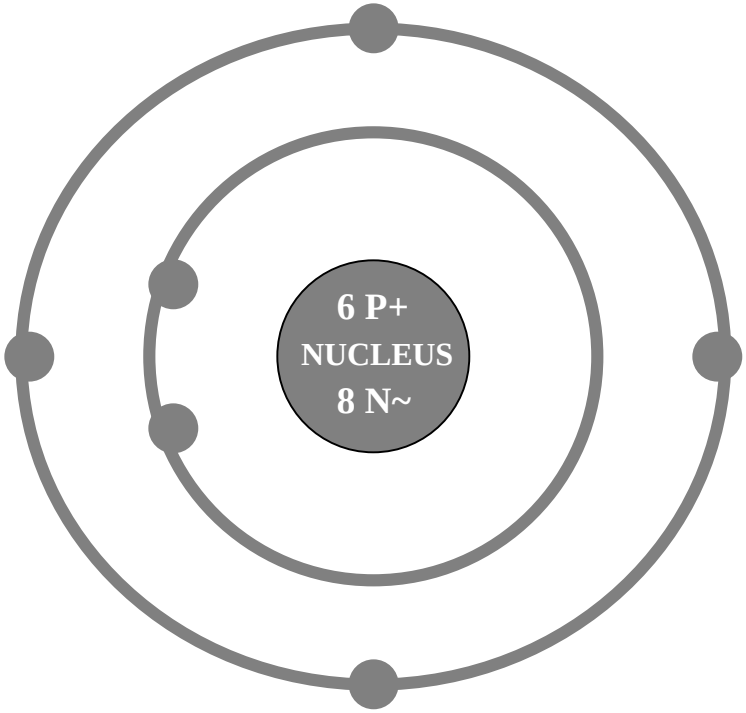
ATOMIC WEIGHT



ATYPICAL CARBON ATOM

= E-

ATOMIC WEIGHT



CARBON AT. WT. = 14 DALTONS

= E-

ATOMIC WEIGHT

ATOMIC WT. MAY VARY /ATOM/ELEMENT

ATOMIC WEIGHT

A

QUESTION

WHAT DO SCIENTISTS CALL AN ATOM WITH AN ATYPICAL NEUTRON NUMBER?

QUESTION

ANSWER

ISOTOPE

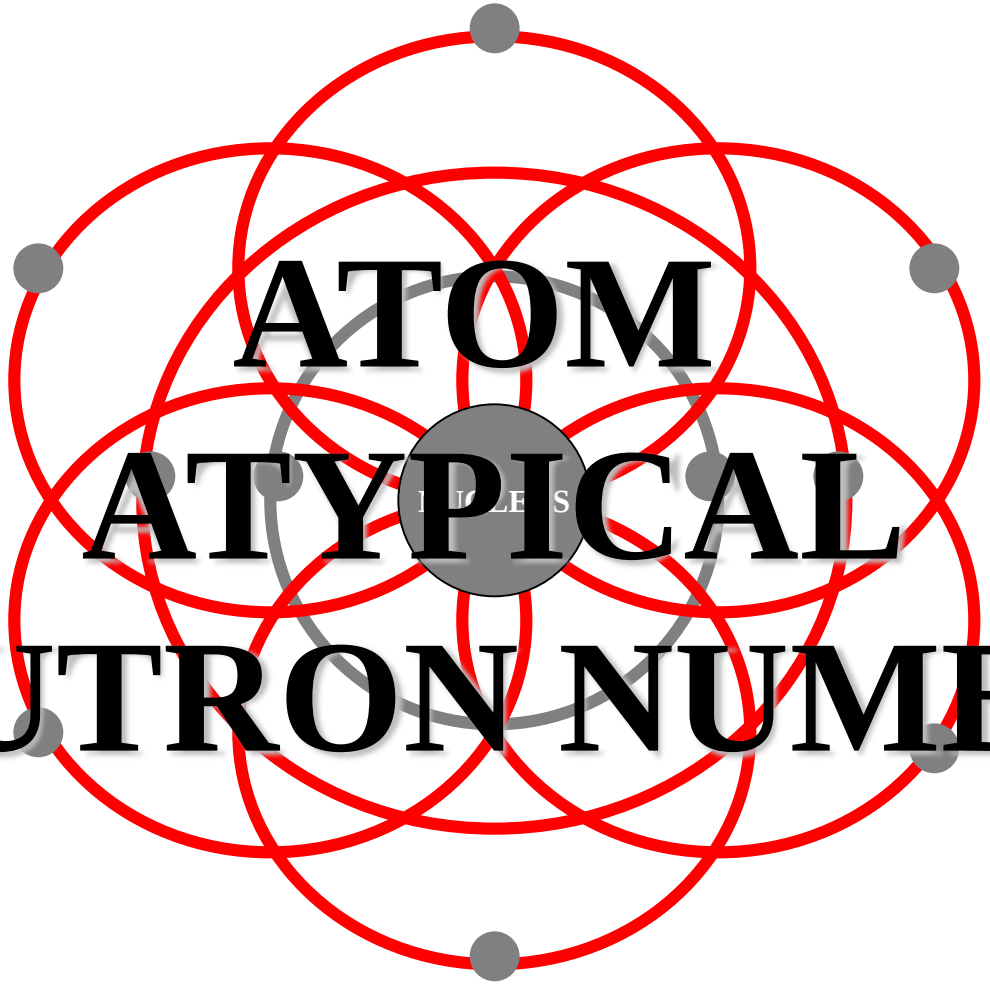
ANSWER

ISOTOPE

ISOTOPE

C12

ISOTOPE



ATOM

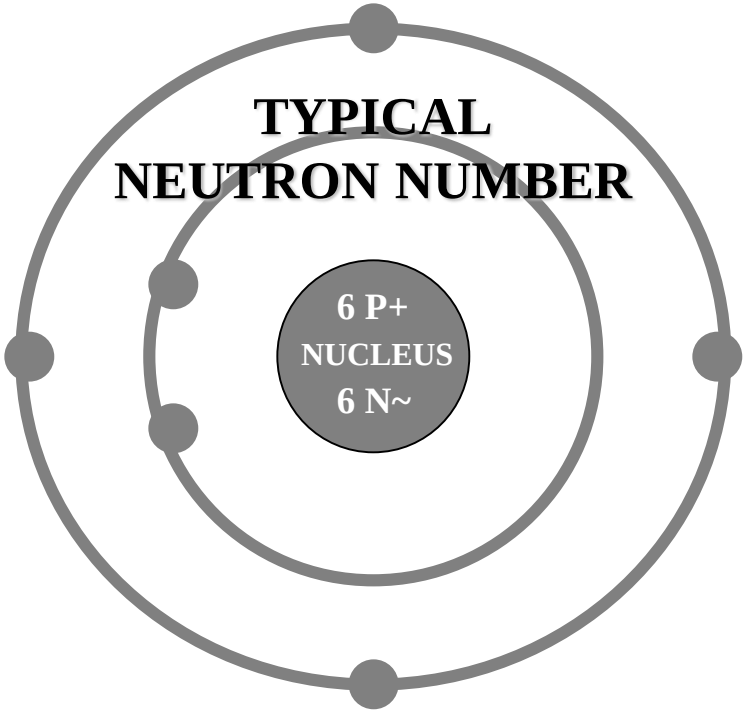
ATYPICAL

NEUTRON NUMBER

ISOTOPE

C14

TYPICAL CARBON ATOM

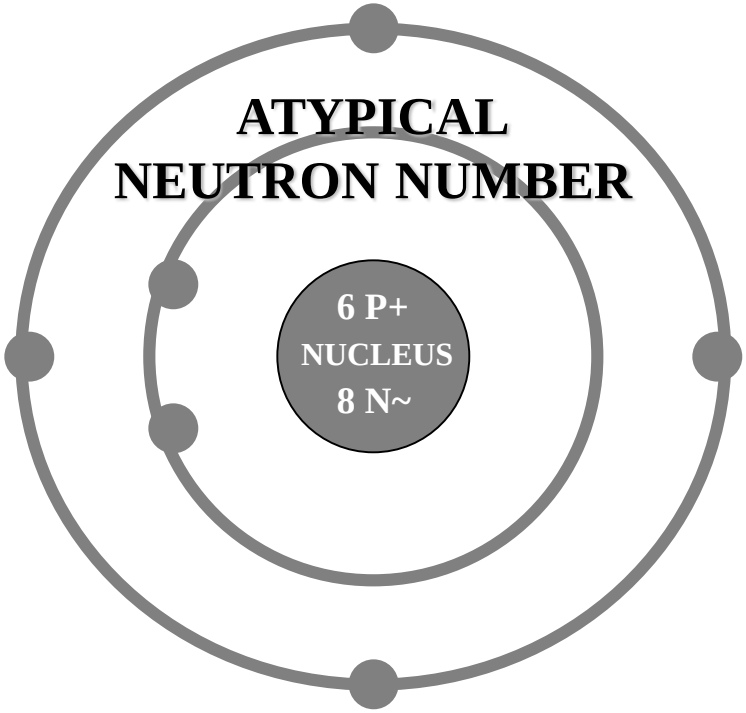


ATOMIC WT. = 12 DALTONS

C12

= E-

ISOTOPE
CARBON ATOM



ATOMIC WT. = 14 DALTONS
C14

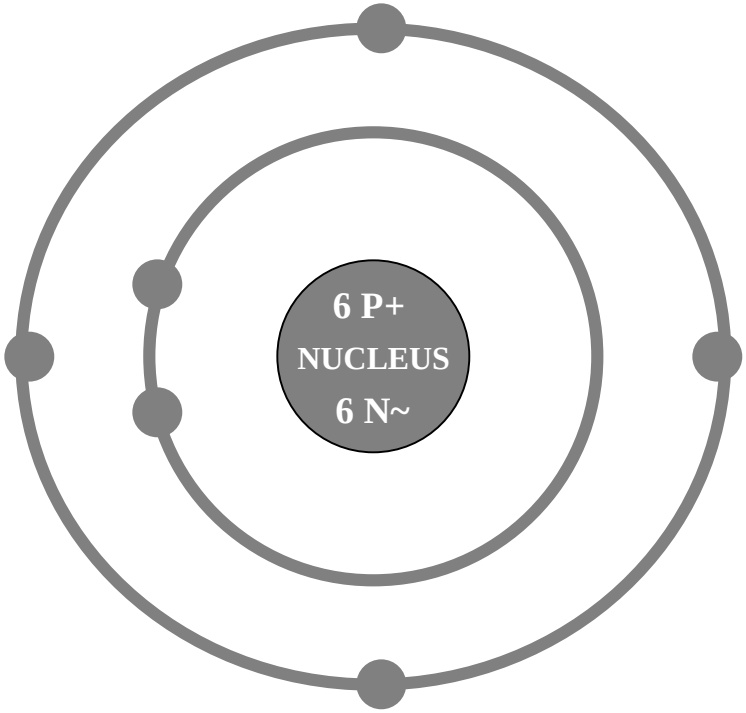
= E-

QUESTION

DO ISOTOPES OF THE SAME ELEMENT HAVE DIFFERENT CHEMICAL PROPERTIES?

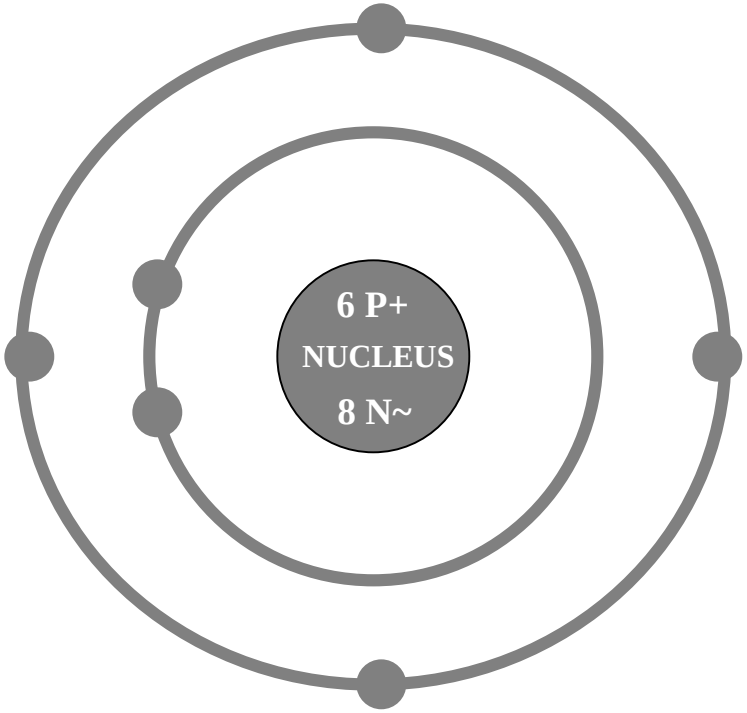
QUESTION

CARBON ATOMS



C12

TYPICAL



C14

ISOTOPE

● = E-

QUESTION

DO ISOTOPES OF THE SAME ELEMENT HAVE DIFFERENT CHEMICAL PROPERTIES?

QUESTION

ANSWER

NO

ANSWER

CARBON ATOMS

ISOTOPE

CHEMICAL

PROPERTIES

DO NOT CHANGE

C12

TYPICAL

C12 & C14
CHEMICALLY
ACT AS
CARBON ATOMS

C14

ISOTOPE

= E-

R

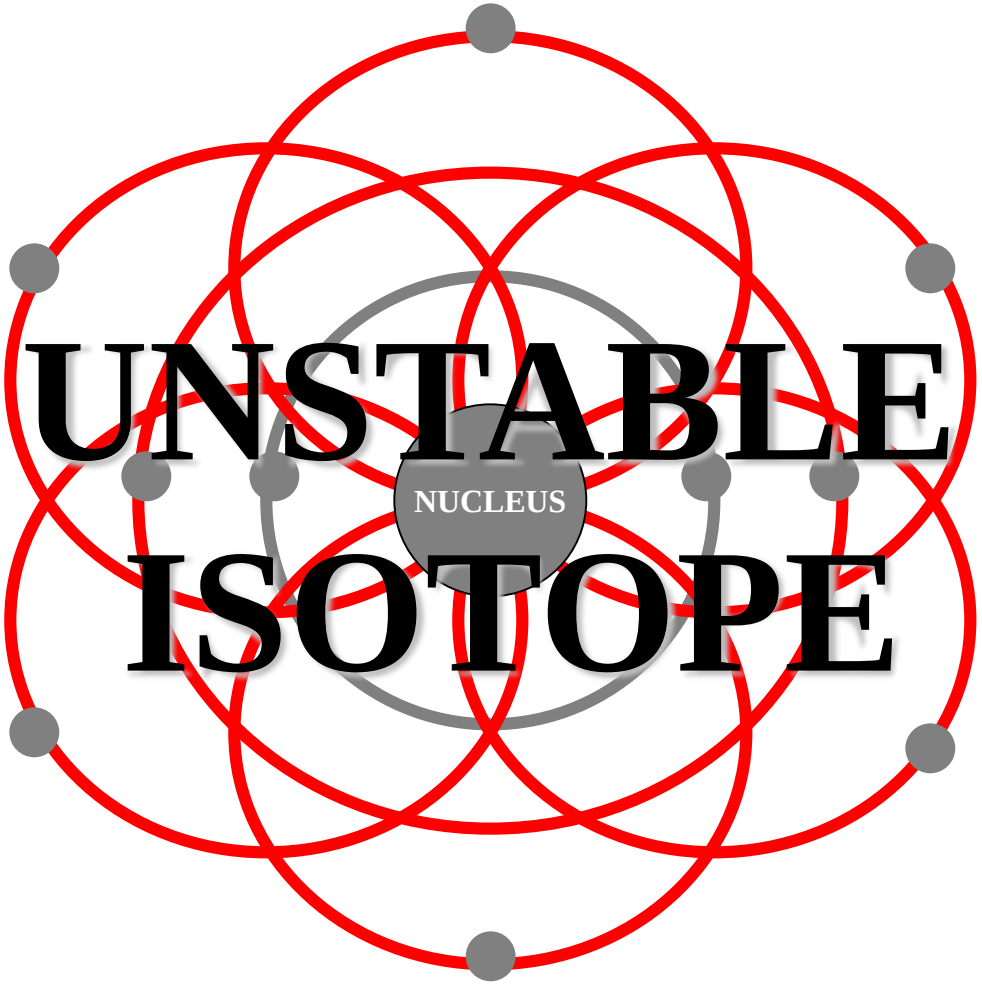
RADIOACTIVE ISOTOPE

RADIOACTIVE ISOTOPE

A

B

RADIOACTIVE ISOTOPE

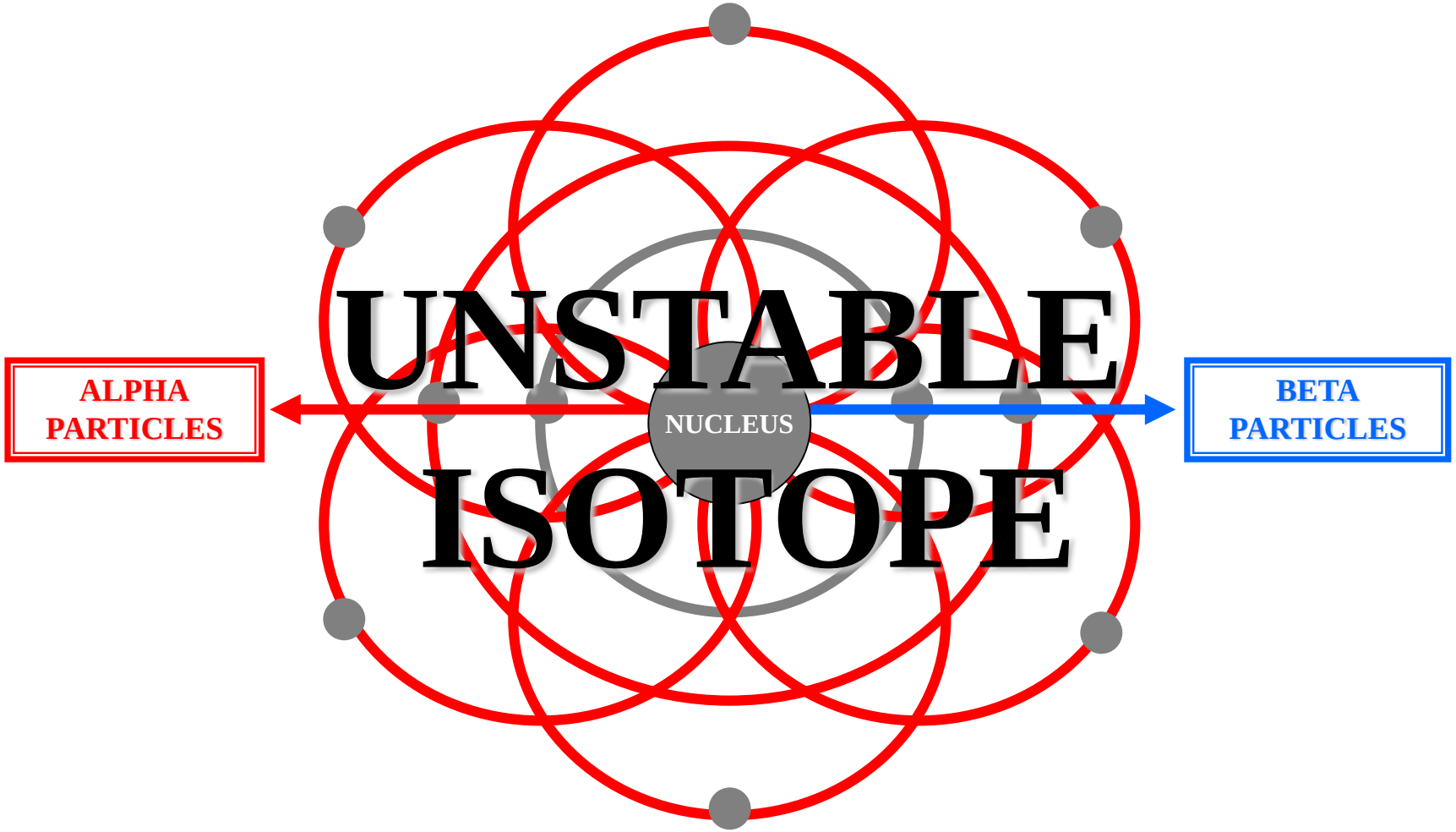


UNSTABLE ISOTOPE

RADIOACTIVE ISOTOPE

EG

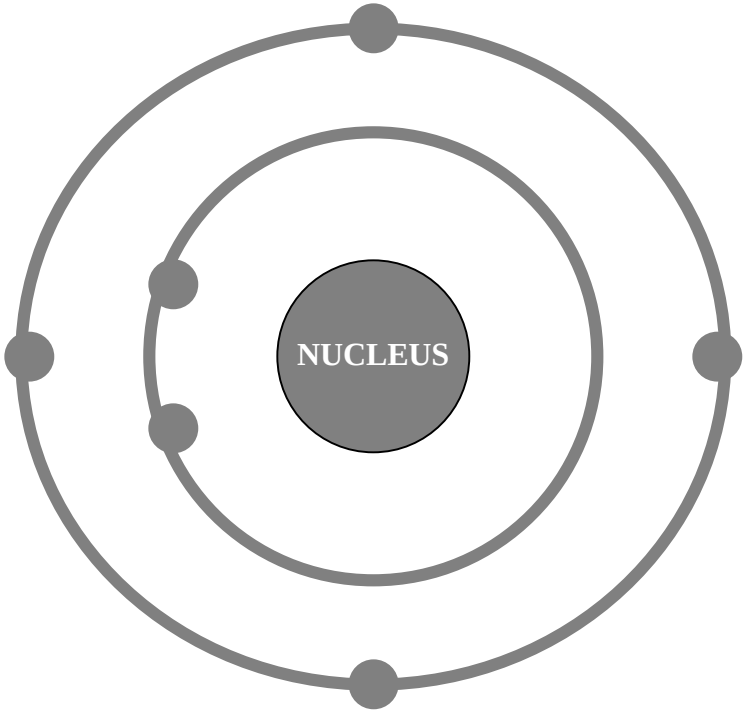
RADIOACTIVE ISOTOPE



EMITS ALPHA OR BETA PARTICLES

B

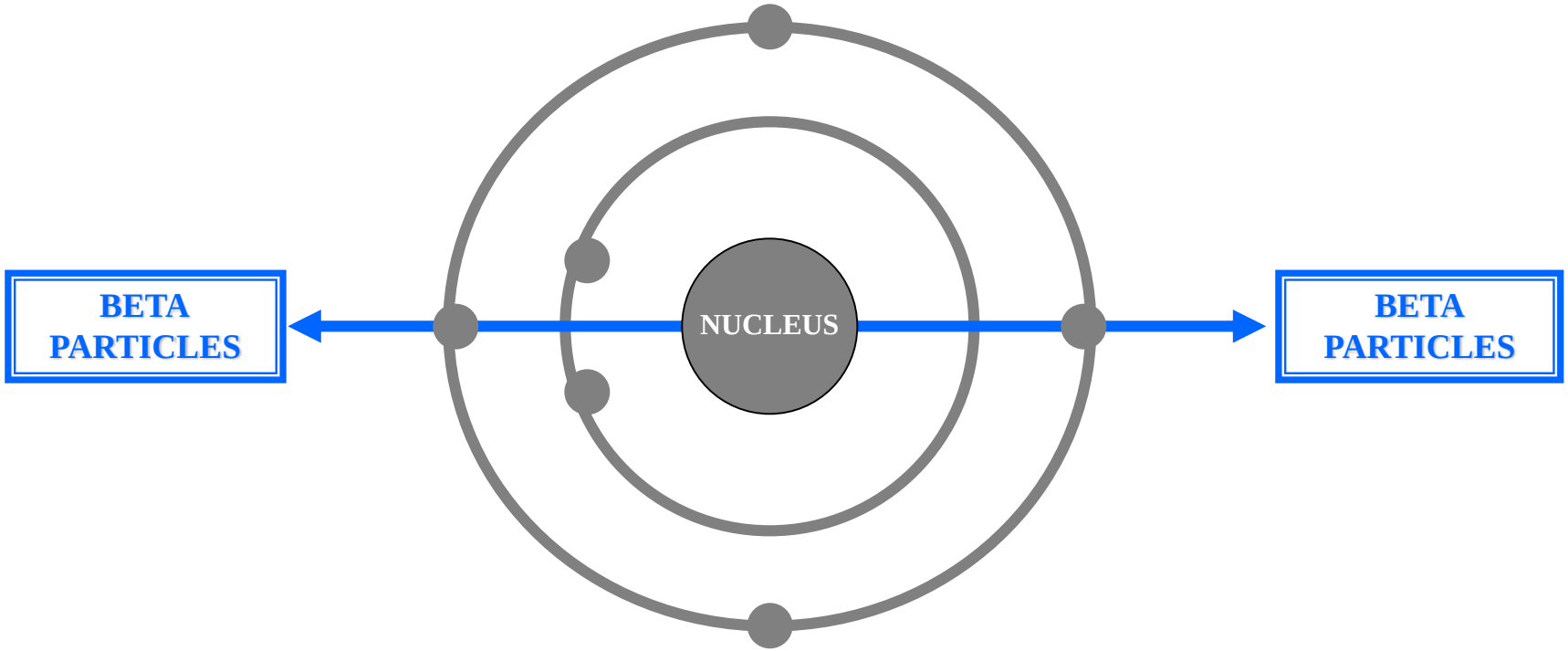
RADIOACTIVE ISOTOPE
UNSTABLE ISOTOPE



C14

= E-

RADIOACTIVE ISOTOPE
UNSTABLE ISOTOPE



EMITS BETA PARTICLES

C14

= E-

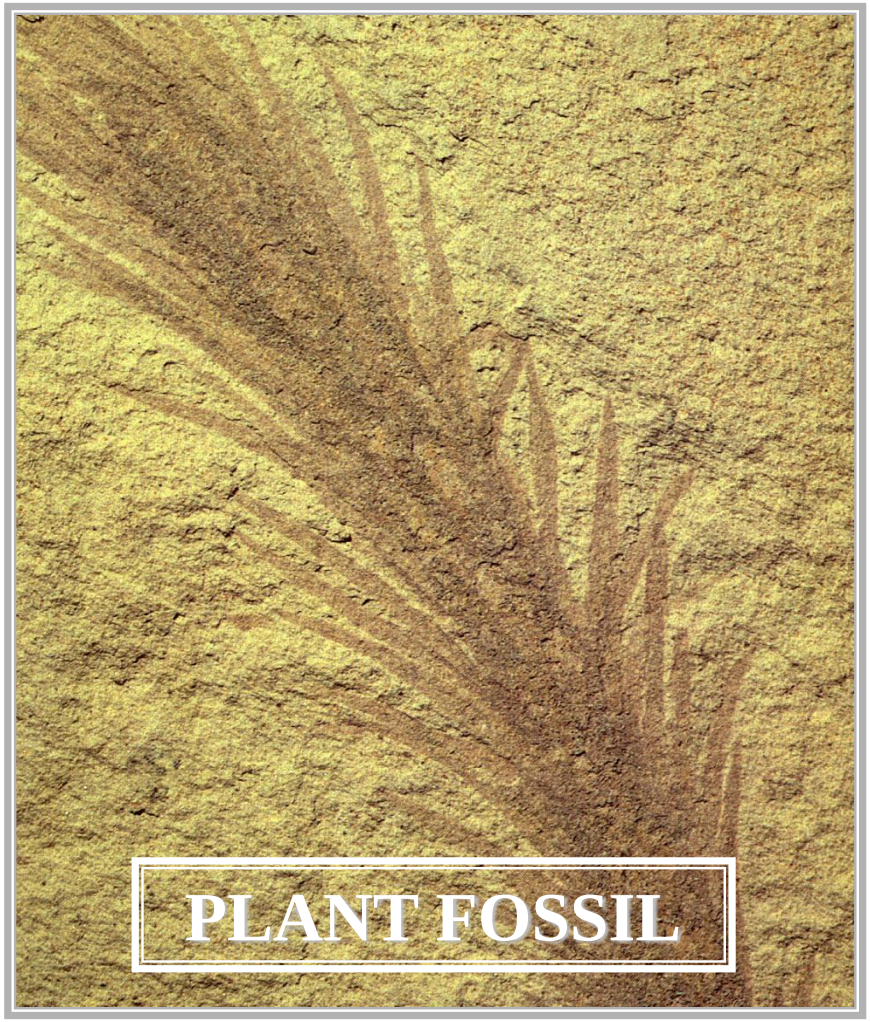
C14 USEFUL BIOLOGICAL TOOL

C14
FOSSIL DATING

BT

C14: FOSSIL DATING

Radio-Carbon Dating



C14 BIOCHEMICAL TRACER

C14 BIOCHEMICAL TRACER

USED TO ELICITATE BIOCHEMICAL PATHWAYS