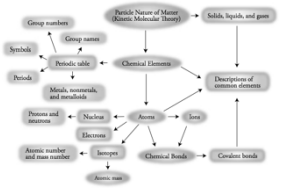
CHEM 108

Organization of Matter



Discussion Questions, Active Lessons & Lab Related Activities

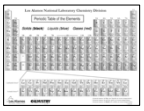
CHEM 108

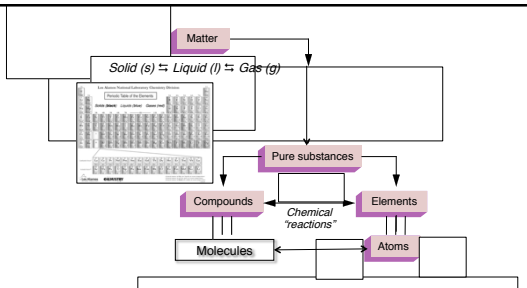
Organization of Matter I

Discussion Questions 1.5

Physical & Chemical Properties

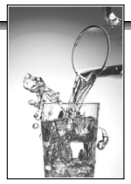
Atoms and The Periodic Table





Atoms / Elements & Compounds/ Molecules

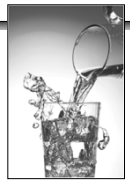
QUESTION



Which of the following would NOT be considered matter?

A. Water
B. Sugar
C. Light
D. Gasoline
E. Sand

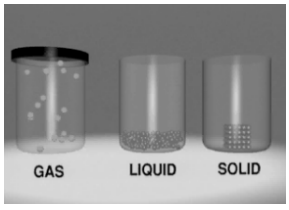
Answer



Which of the following would NOT be considered matter?

A. Water
B. Sugar
C. Light (Energy)
D. Gasoline
E. Sand

Physical States of Matter

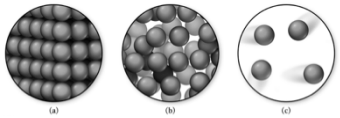


http://chemconnections.org/general/movies/States-of-Matter.mov

Physical States of Matter

http://chemconnections.org/general/movies/States-of-Matter.mov

QUESTION

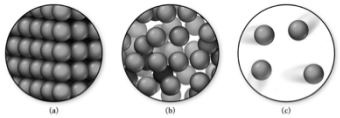


The kinetic energy of physical states increases in the following order: Solid (s) < Liquid (l) < Gas (g).

- *Correctly match the illustrations, which represent either atoms or molecules and their physical states.*

A) a = solid, b = gas, c = liquid
B) a = liquid, b = solid, c = gas
C) a = solid, b = liquid, c = gas
D) a = liquid, b = gas, c = solid
E) a = gas, b = liquid, c = solid

Answer

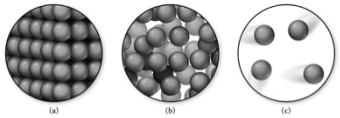


The kinetic energy of physical states increases in the following order: Solid (s) < Liquid (l) < Gas (g).

- *Correctly match the illustrations, which represent either atoms or molecules and their physical states.*

A) a = solid, b = gas, c = liquid
B) a = liquid, b = solid, c = gas
C) a = solid, b = liquid, c = gas
D) a = liquid, b = gas, c = solid
E) a = gas, b = liquid, c = solid

QUESTION



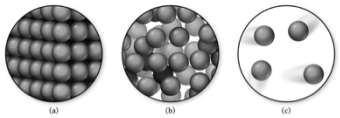
The kinetic energy of physical states increases in the following order: Solid (s) < Liquid (l) < Gas (g).

- *Rank the physical states in order of increasing intermolecular attractions (forces) between the molecules.*

A) solid < gas < liquid
B) liquid < solid < gas
C) solid < liquid < gas
D) liquid < gas < solid
E) gas < liquid < solid

("intermolecular" refers to separate different molecules)

Answer

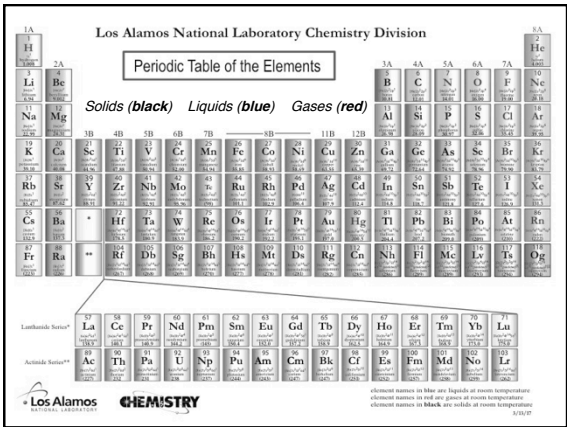


The kinetic energy of physical states increases in the following order: Solid (s) < Liquid (l) < Gas (g).

- *Rank the physical states in order of increasing intermolecular attractions (forces) between the molecules.*

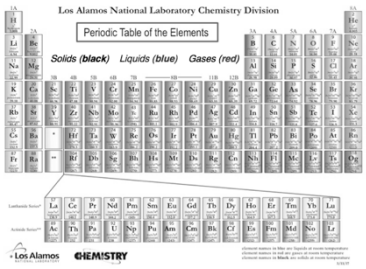
A) solid < gas < liquid
B) liquid < solid < gas
C) solid < liquid < gas
D) liquid < gas < solid
E) gas < liquid < solid

("intermolecular" refers to separate different molecules)



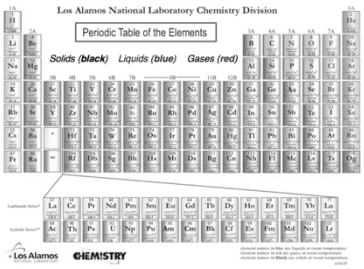
QUESTION

- *Which elements are gases in their natural/native state?*



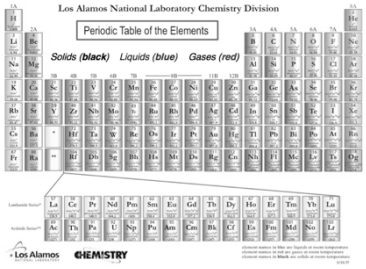
QUESTION

- *Which elements are liquids in their natural/native state?*

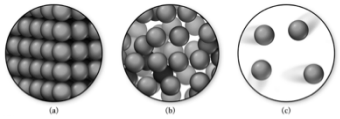


QUESTION

- *How many elements are solids in their natural/native state?*



How do attractive forces relate to the 3 states of matter and a Gecko?

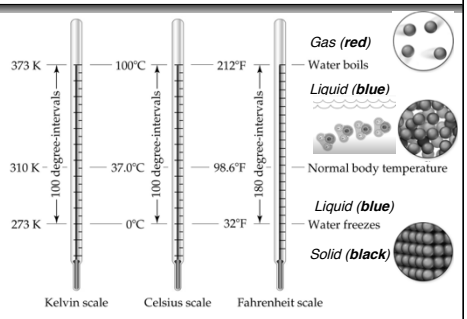


https://www.youtube.com/watch?v=YeSuQm7KfaE

Bonds *intermolecular forces*
intramolecular forces

Physical States of Water

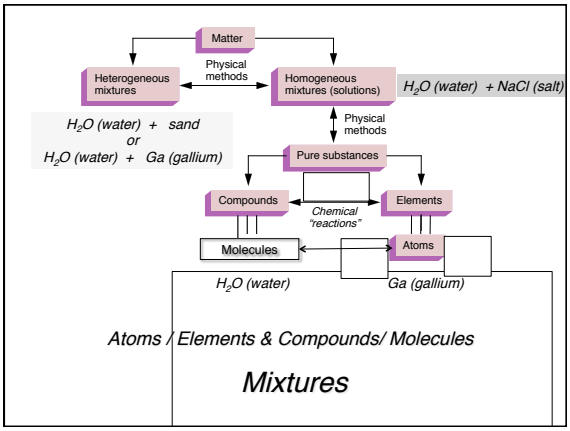
H_2O molecules



Disappearing Spoon

https://www.youtube.com/watch?v=Nzoi9m3t4uM

The spoon is made of gallium, describe what is happening.

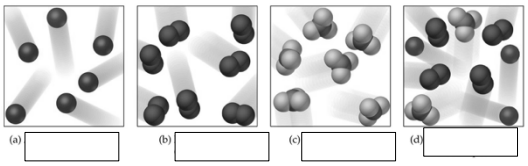


Atoms / Elements & Compounds/ Molecules

Mixtures

Chemical Visualization: Atoms & Molecules

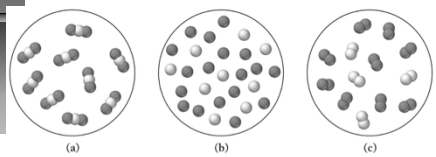
Atomic Force Microscopy / Molecular Modeling
Experimental / Mathematical



Which phase is depicted in all of the illustrations?

Solid (s) ⇆ Liquid (l) ⇆ Gas (g)

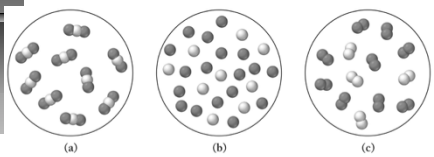
QUESTION



- *Which drawing(s) illustrate(s) a pure substance and not a mixture.*

A) a, b, and c
B) a and b
C) a only
D) b only
E) c only

Answer



- *Which drawing(s) illustrate(s) a pure substance and not a mixture.*

A) a, b, and c
B) a and b
C) a only
D) b only
E) c only

QUESTION

Which of the following is a pure substance?

A. Sodium (Element # 11)
B. Milk
C. Blood
D. Saline solution
E. Stainless steel

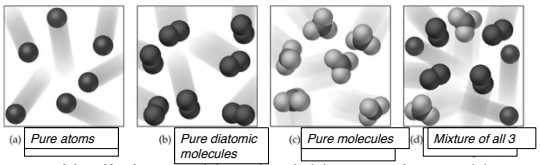
Answer

Which of the following is a pure substance?

A. Sodium (Na, Element # 1
B. Milk
C. Blood
D. Saline solution
E. Stainless steel

Chemical Visualization: Atoms & Molecules

Atomic Force Microscopy / Molecular Modeling
Experimental / Mathematical



Identify the atom(s), molecule(s), pure substance(s), mixture(s)?

Atoms / Elements & Compounds/ Molecules

Chemistry & Matter
Types of Properties

- *Physical vs. Chemical*
- *Solid (s) ⇆ Liquid (l) ⇆ Gas (g) (Physical)*
- *Extensive vs. Intensive Properties*

Varies with amount (extensive) or does not vary with amount (intensive)

Heat of reaction is an extensive Chemical Property related to a Chemical Reaction; Density = mass/volume; it is an intensive Physical Property related to two separate extensive Physical Properties: mass and volume.

QUESTION

Extensive properties of a pure substance depend on sample size whereas intensive properties are characteristic of that substance. Which of these properties are intensive?

I) Color
II) Mass
III) Density

A) III only B) I and III C) II and III D) I, II and III

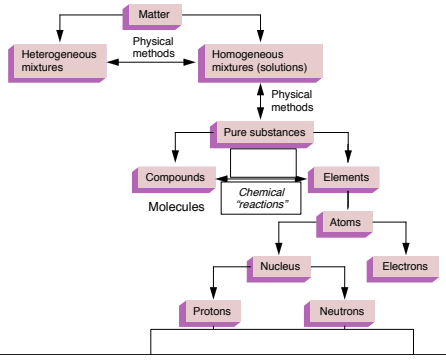
Answer

Extensive properties of a pure substance depend on sample size whereas intensive properties are characteristic of that substance. Which of these properties are intensive?

I) Color
II) Mass
III) Density

A) III only B) I and III C) II and III D) I, II and III

Atoms & Molecules



Chemistry & Matter

- *Organization of atoms & molecules: atoms/elements → molecules/compounds*
- *Chemical Reactions: atoms combine to form molecules. Molecules can react further.*
- *Physical vs. Chemical Properties*

QUESTION

Which of the following is an element?

A. *Sugar*
B. *Salt (Sodium chloride, NaCl)*
C. *Brass*
D. *Chlorine (Cl_2)*
E. *Air*

Answer

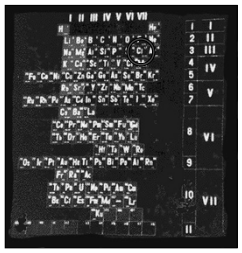
Which of the following is an element?

A. *Sugar*
B. *Salt (Sodium chloride, NaCl)*
C. *Brass*
D. *Chlorine (Cl_2)*
E. *Air*

CHEMISTRY of Atoms
The Periodic Table

Mendeleev's Table 1868-1871

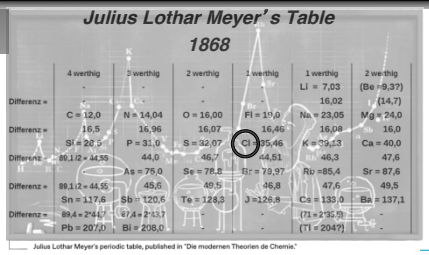
Mural at St. Petersburg University, Russia



https://www.youtube.com/watch?v=SDKqp3x_jW8

CHEMISTRY of Atoms
The Periodic Table

Julius Lothar Meyer's Table
1868



Julius Lothar Meyer's periodic table, published in "Die modernen Theorien de Chemie."

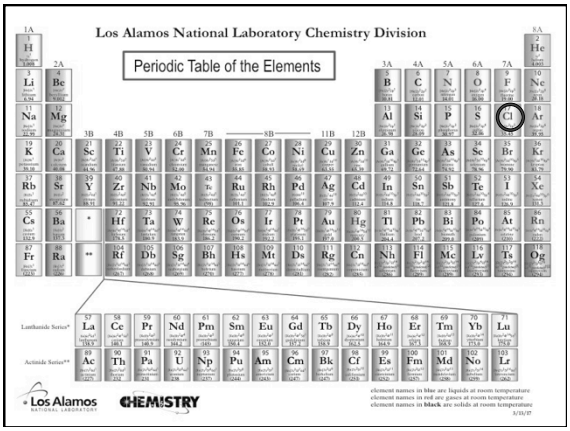
https://www.inverse.com/science/julius-lothar-meyer-google-doodle-august-19

https://www.google.com/doodles/julius-lothar-meyers-190th-birthday

CHEMISTRY of Atoms
The Periodic Table

2019: Museum Mural courtesy of Lawrence Berkeley Lab
https://www.youtube.com/watch?v=zGM-wSKFBpo

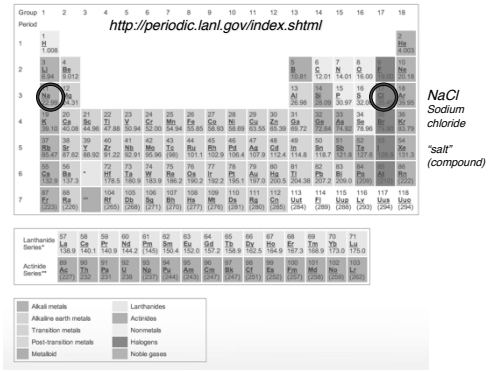
https://www.youtube.com/watch?v=aficgNfEr5Q



Periodic Table

Los Alamos National Lab

http://periodic.lanl.gov/index.shtml



NaCl
Sodium chloride

"salt" (compound)

Chemistry & Matter

- *How many different chemicals (elements + compounds) do you think have been reported in the scientific literature?*

A) 100,000
B) 1,000,000
C) 10,000,000
D) 100,000,000
E) 1,000,000,000

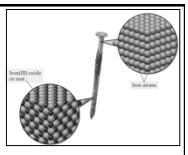
CAS Registry : ~12,000 in 1907

[~ 500 new molecules are currently added / hr]
154 million in 2019, 152 million contain carbon atoms

Observations of Physical & Chemical Properties

http://chemconnections.org/general/movies/phys-chem-prop.mov

QUESTION



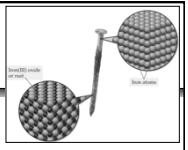
Which of these are chemical properties of matter?

I) Rust/Corrosion
II) Density = Mass / Volume
III) Flammability
IV) Boiling point (Temperature: Liquid ⇆ Gas)

A) I and II ***B) I and III***

C) II and IV ***D) III and IV***

Answer



Which of these are chemical properties of matter?

I) Rust/Corrosion
II) Density = Mass / Volume
III) Flammability
IV) Boiling point (Temperature: Liquid ⇆ Gas)

A) I and II ***B) I and III***

C) II and IV ***D) III and IV***

QUESTION

If you hold in your hand a solid piece of pure gallium, symbol Ga / element number 31 in the Periodic Table, this silvery metal, which has been used in certain types of thermometers, will melt into a liquid by absorbing your body's heat.

Which term best describes this observation?

A) boiling point
B) physical change
C) chemical change
D) metaphysical property
E) heat of reaction

Answer

If you hold in your hand a solid piece of pure gallium, symbol Ga / element number 31 in the Periodic Table, this silvery metal, which has been used in certain types of thermometers, will melt into a liquid by absorbing your body's heat.

Which term best describes this observation?

A) boiling point
B) physical change
C) chemical change
D) metaphysical property
E) heat of reaction

CHEM 108

Organization of Matter I

Discussion Questions 1.5

Atoms/Elements

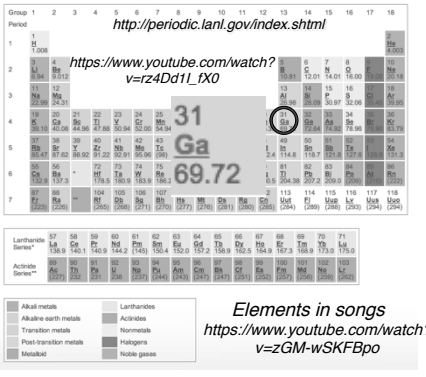
and

The Periodic Table

Periodic Table (August 2017)

Los Alamos National Lab

http://periodic.lanl.gov/index.shtml



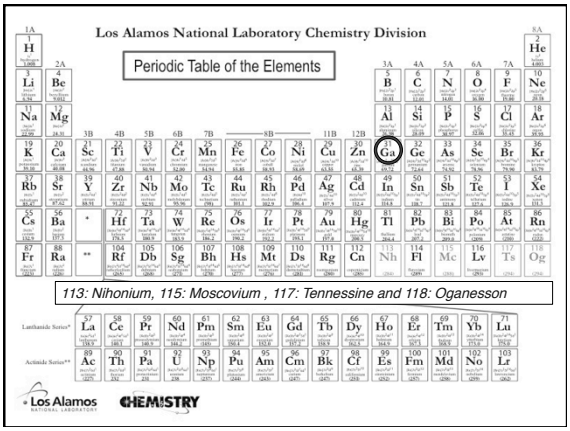
https://www.youtube.com/watch?v=rz4Dd1I_fX0

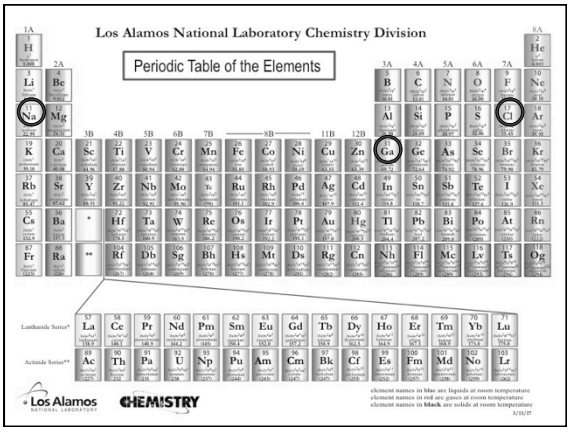
Elements in songs

https://www.youtube.com/watch?v=zGM-wSKFBpo

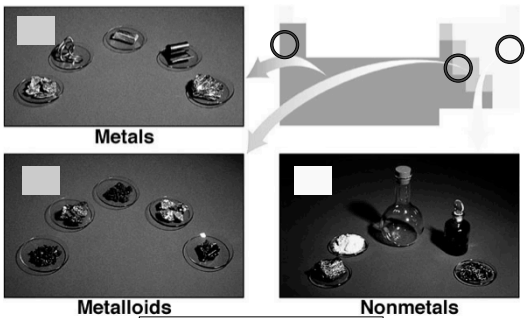
Scientists Name 4 New Elements
113, 115, 117 and 118
Completing the Periodic Table
(November, 2016)

Have We Found All The Elements?
https://www.youtube.com/watch?v=rwC9BBHkaAI

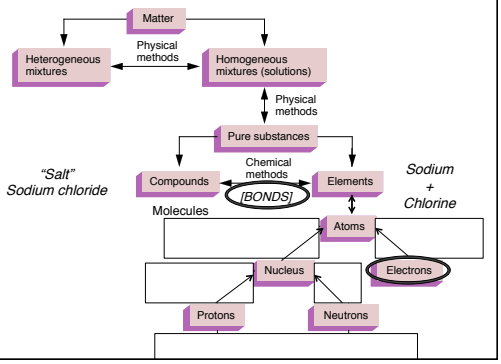




Metals, Metalloids, and Nonmetals



Atoms & Molecules

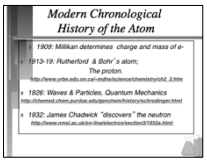


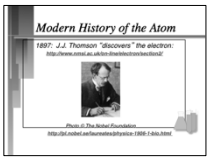
CHEMISTRY of the Atom

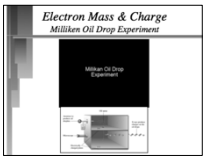
FUNDAMENTAL PARTICLES:

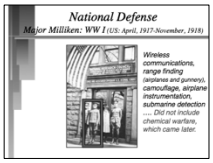
	Mass	*Charge*	*Symbol*
Nucleus:			
ð *PROTON*	*1 amu*	*+1*	*H^+, H, p*
• *1.67 x 10 $^{-27}$ kg*			
ð *NEUTRON*	*1 amu*	*0*	*n*
• *1.67 x 10 $^{-27}$ kg*			
ð *ELECTRON*	*very small*	*-1*	*e^-*
• *≈ 2000 x smaller than a proton or neutron*			

*This particle is said to "hold" or "**bond**" atoms together in molecules.*







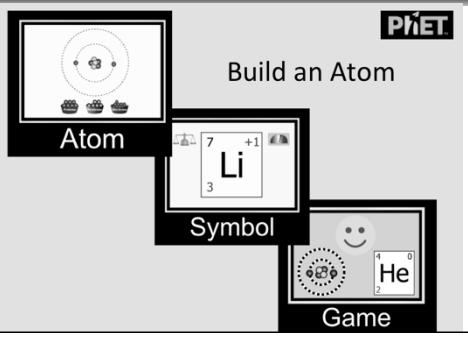


Modern History of the Atom

Ernest Rutherford (1871-1937)

https://forms.gle/P2aUryDgdSGanXcB8

CHEMISTRY of the Atom

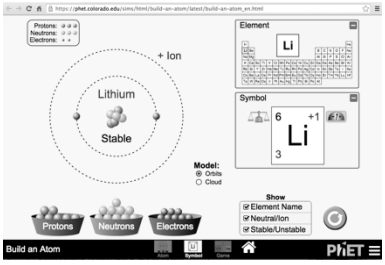


https://forms.gle/P2aUryDgdSGanXcB8

CHEMISTRY of the Atom

Build an Atom

https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html



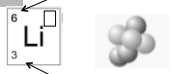
https://forms.gle/P2aUryDgdSGanXcB8

CHEMISTRY of the Atom

Build an Atom

- Periodic Table Atoms

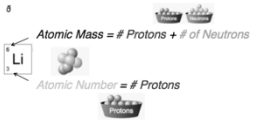
Atomic Mass = # Protons + # of Neutrons



Atomic Number = # Protons

Writing Atomic Symbols

(Not Written the Same as in the Periodic Table)

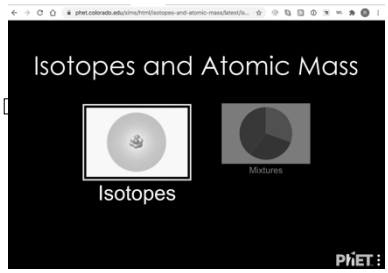


https://www.youtube.com/watch?v=su_UC9ZCD-0

https://forms.gle/P2aUryDgdSGanXcB8

Build an Atom

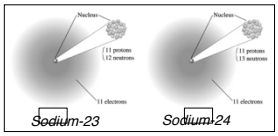
https://phet.colorado.edu/sims/html/isotopes-and-atomic-mass/latest/isotopes-and-atomic-mass_en.html



https://phet.colorado.edu/sims/html/isotopes-and-atomic-mass/latest/isotopes-and-atomic-mass_en.html

CHEMISTRY of the Atom

- *Atoms* *(neutral electrostatic charge: # protons = # electrons)*
  - *# Protons = Atomic Number*
  - *Atomic Mass = # Protons + # of Neutrons*
  - *Isotope: same atomic number but different atomic mass (different # of neutrons)*



QUESTION

Which among the following represent a set of isotopes? Atomic nuclei containing:

a. 20 protons and 20 neutrons.
b. 21 protons and 19 neutrons.
c. 22 neutrons and 18 protons.
d. 20 protons and 22 neutrons.
e. 21 protons and 20 neutrons.

A. a, b, c
B. c, d
C. a, e
D. a, d and b, e
E. No isotopes are indicated.

Answer

Which among the following represent a set of isotopes? Atomic nuclei containing:

a. 20 protons and 20 neutrons.
b. 21 protons and 19 neutrons.
c. 22 neutrons and 18 protons.
d. 20 protons and 22 neutrons.
e. 21 protons and 20 neutrons.

A. a, b, c
B. c, d
C. a, e
D. a, d and b, e
E. No isotopes are indicated.

https://forms.gle/P2aUryDgdSGanXcB8

CHEM 108

Organization of Matter I

Discussion Questions 1.5

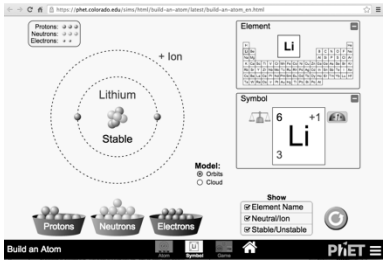
Atoms/ Ions and The Periodic Table

https://forms.gle/P2aUryDgdSGanXcB8

CHEMISTRY of the Atom

Build an Atom

https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html



CHEMISTRY of Atoms / Ions

- *Atomic Number = 12 (atom's identity)*
- *Atomic Mass = 24*
- *12 protons; # neutrons = 24 - 12*
- *neutral atom has 12 electrons*
- *Ion contains 10 electrons*

$^{24}_{12}Mg^{+2}$

- *12 p^+ + 10e^- = +2: symbol?*

CHEMISTRY of Atoms / Ions

- *Atomic Number = 17 (atom's identity)*
- *Atomic Mass = ?*
- *# protons = ? ; # neutrons = ?*
- *neutral atom has ? electrons*
- *Ion contains 18 electrons*

$$^{35}_{17}Cl^{-1}$$

- *17 p^+ + 18e^- = -1: symbol?*

Ions

- *Cation: A positive ion*
  - *Mg^{2+}*
- *Anion: A negative ion*
  - *Cl^-*
- *Ionic Bonding: Force of attraction between oppositely charged ions.*

QUESTION

Calcium plays several critical roles in the functioning of human cells. However, this form of calcium is the ion made with 20 protons and 18 electrons. Therefore the ion would be…

A. positive and called an anion.
B. positive and called a cation.
C. negative and called an anion.
D. negative and called a cation.

Answer

Calcium plays several critical roles in the functioning of human cells. However, this form of calcium is the ion made with 20 protons and 18 electrons. Therefore the ion would be…

A. positive and called an anion.
B. positive and called a cation.
C. negative and called an anion.
D. negative and called a cation.

An atom of calcium (20 protons = 20+) which has lost two electrons (now with 18–). The ion would have a +2 charge. Positive ions are called cations.

QUESTION

Of the following, which would NOT qualify as an isotope of ^{35}Cl?

A. ^{36}Cl
B. $^{35}Cl^-$
C. $^{37}Cl^-$
D. ^{37}Cl

Answer

Of the following, which would NOT qualify as an isotope of ^{35}Cl?

A. ^{36}Cl
B. $^{35}Cl^-$
C. $^{37}Cl^-$
D. ^{37}Cl

B. *has the same number of neutrons as the atom in the question, therefore it does not fit the criteria for isotopes (i.e. different number of neutrons with the same proton number). Isotopes can be ions as well as neutral atoms. $^{37}Cl^-$ and ^{37}Cl are also not a pair of isotopes.*

QUESTION

Which of these species has the highest number of electrons?

A) $_{20}Ca$ B) $_{19}K^{+}$ C) $_{16}S^{2-}$ D) $_{15}P^{3-}$

Answer

Which of these species has the highest number of electrons?

A) $_{20}Ca$ B) $_{19}K^{+}$ C) $_{16}S^{2-}$ D) $_{15}P^{3-}$

QUESTION

The ion $^{45}Sc^{3+}$ has

A) 24 electrons, 21 protons and 24 neutrons
B) 18 electrons, 21 protons and 24 neutrons
C) 24 electrons, 24 protons and 21 neutrons
D) 18 electrons, 24 protons and 21 neutrons

Answer

The ion $^{45}Sc^{3+}$ has

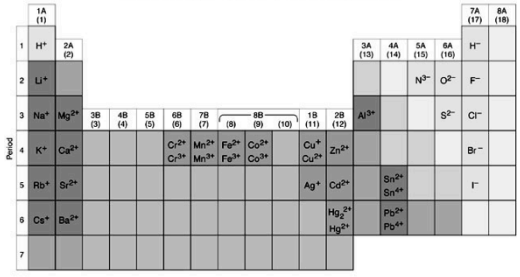
A) 24 electrons, 21 protons and 24 neutrons
B) 18 electrons, 21 protons and 24 neutrons
C) 24 electrons, 24 protons and 21 neutrons
D) 18 electrons, 24 protons and 21 neutrons

Answer

The ion $^{45}Sc^{3+}$ has

A) 24 electrons, 21 protons and 24 neutrons
B) 18 electrons, 21 protons and 24 neutrons
C) 24 electrons, 24 protons and 21 neutrons
D) 18 electrons, 24 protons and 21 neutrons

Some Common Monatomic Ions of the Elements



QUESTION

Which of the following pairs of ions have the same number of electrons?

A. Al^{3+} and Ga^{3+}
B. Fe^{2+} and Fe^{3+}
C. S^{2-} and P^{3-}
D. Li^{+} and Cl^{-}
E. Cl^{-} and Br^{-}

Answer

Which of the following pairs of ions have the same number of electrons?

A. Al^{3+} and Ga^{3+}
B. Fe^{2+} and Fe^{3+}
C. S^{2-} and P^{3-}
D. Li^{+} and Cl^{-}
E. Cl^{-} and Br^{-}