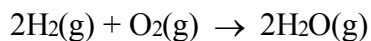


Super Long Quarterly Practice

1. Consider the following reaction:





What kind of change do the reactants undergo in the reaction?

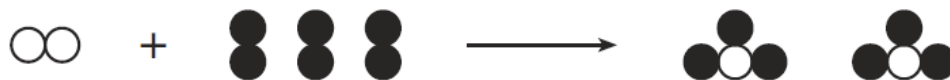
- A) atomic change B) phase change
C) chemical change D) nuclear change

2. Which balanced equation represents a chemical change?

- A) $\text{H}_2\text{O}(\ell) + \text{energy} \rightarrow \text{H}_2\text{O}(\text{g})$
B) $2\text{H}_2\text{O}(\ell) + \text{energy} \rightarrow 2\text{H}_2(\text{g}) + \text{O}_2(\text{g})$
C) $\text{H}_2\text{O}(\ell) \rightarrow \text{H}_2\text{O}(\text{s}) + \text{energy}$
D) $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\ell) + \text{energy}$

3. Given the balanced particle-diagram equation:

Key	
	= an atom of an element
	= an atom of a different element

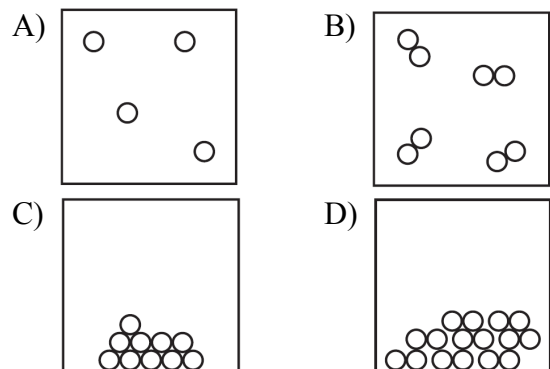


Which statement describes the type of change and the chemical properties of the product and reactants?

- A) The equation represents a physical change, with the product and reactants having different chemical properties.
B) The equation represents a physical change, with the product and reactants having identical chemical properties.
C) The equation represents a chemical change, with the product and reactants having different chemical properties.
D) The equation represents a chemical change, with the product and reactants having identical chemical properties.
-
-

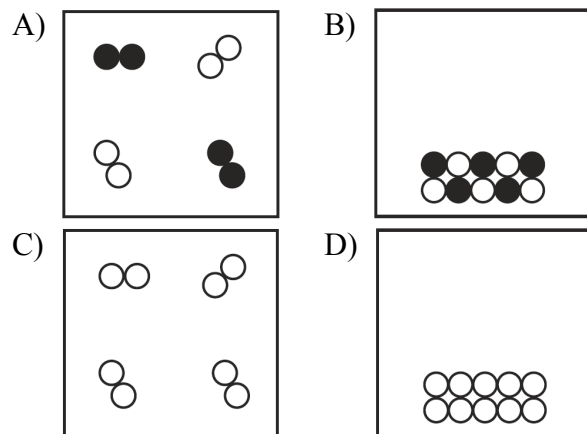
4. Which particle model diagram represents xenon at STP?

Key
○ = an atom of xenon



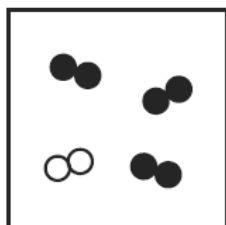
5. Which particle diagram represents one substance in the gas phase?

Key
○ = atom of one element
● = atom of another element

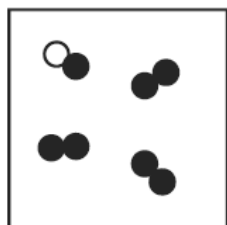


6. Which two particle diagrams represent mixtures of diatomic elements?

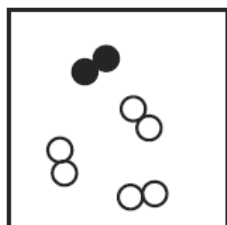
Key	
○	= atom of one element
●	= atom of another element



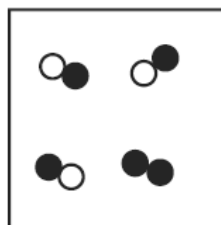
A



B



C



D

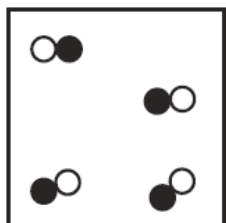
A) A and B

B) A and C

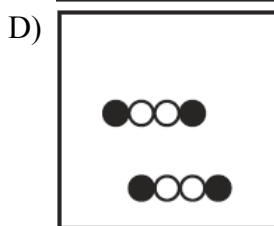
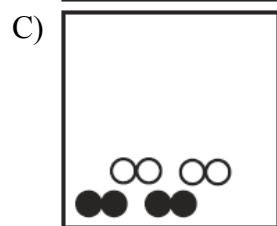
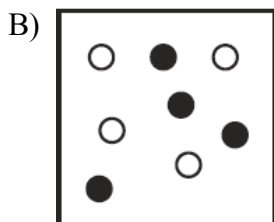
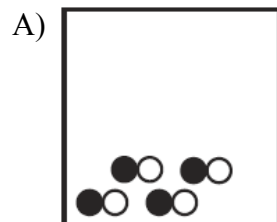
C) B and C

D) B and D

7. Given the particle diagram representing four molecules of a substance:

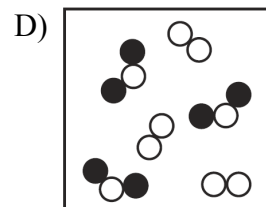
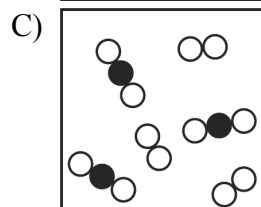
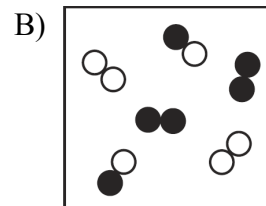
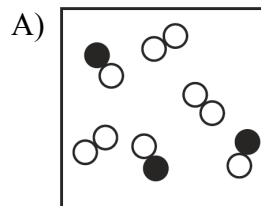


Which particle diagram best represents this same substance after a physical change has taken place?



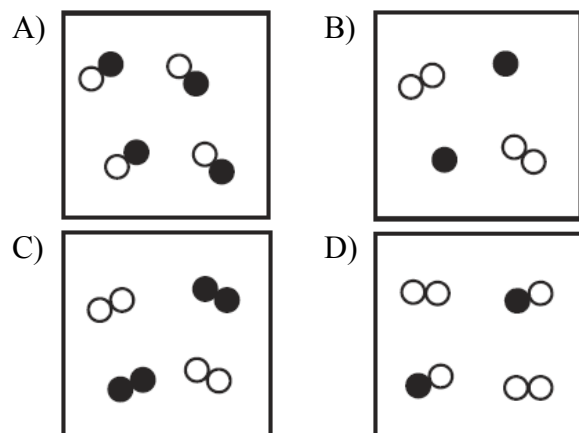
8. Which particle diagram represents a mixture of three substances?

Key	
○	= an atom of one element
●	= an atom of a different element

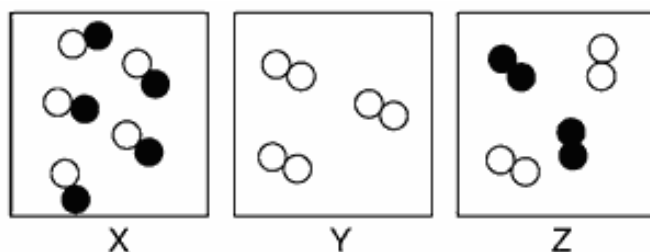


9. Which particle diagram represents a mixture of an element and a compound?

Key
○ = an atom of an element
● = an atom of a different element



10. Given the diagrams X , Y , and Z below:



Key
Atom of element A = ○
Atom of element B = ●

Which diagram or diagrams represent a mixture of elements A and B ?

- A) X , only B) Z , only
C) X and Y D) X and Z

11. An orbital is a region in an atom where there is a high probability of finding

- A) an alpha particle B) an electron
C) a neutron D) a positron

12. Which particles are found in the nucleus of an argon atom?

- A) protons and electrons
B) positrons and neutrons
C) protons and neutrons
D) positrons and electrons

13. Which statement describes the charge and location of an electron in an atom?

- A) An electron has a positive charge and is located outside the nucleus.
- B) An electron has a positive charge and is located in the nucleus.
- C) An electron has a negative charge and is located outside the nucleus.
- D) An electron has a negative charge and is located in the nucleus.

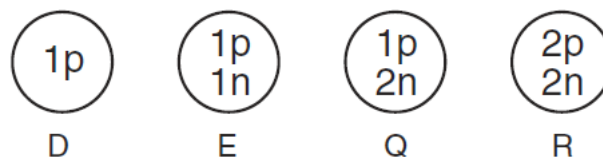
14. Which statement describes the location of protons and neutrons in an atom of helium?

- A) Protons and neutrons are in the nucleus.
- B) Protons and neutrons are outside the nucleus.
- C) Protons are outside the nucleus, and neutrons are in the nucleus.
- D) Protons are in the nucleus, and neutrons are outside the nucleus.

15. Which statement describes the structure of an atom?

- A) The nucleus contains positively charged electrons.
- B) The nucleus contains negatively charged protons.
- C) The nucleus has a positive charge and is surrounded by negatively charged electrons.
- D) The nucleus has a negative charge and is surrounded by positively charged electrons.

16. Each diagram below represents the nucleus of a different atom.



Which diagrams represent nuclei of the same element?

- A) D and E , only B) D , E , and Q
C) Q and R , only D) Q , R , and E

17. The most common isotope of chromium has a mass number of 52. Which notation represents a different isotope of chromium?

- A) $^{52}_{24}\text{Cr}$ B) $^{54}_{24}\text{Cr}$
C) $^{24}_{52}\text{Cr}$ D) $^{24}_{54}\text{Cr}$

18. Chlorine-37 can be represented as

- A) $^{17}_{35}\text{Cl}$ B) $^{20}_{37}\text{Cl}$
C) $^{35}_{20}\text{Cl}$ D) $^{37}_{17}\text{Cl}$

19. Which isotopic notation represents an atom of carbon-14?

- A) ^6_8C B) ^8_6C C) $^{6}_{14}\text{C}$ D) $^{14}_6\text{C}$

20. An atom of potassium-37 and an atom of potassium-42 differ in their total number of

- A) electrons B) neutrons
C) protons D) positrons

21. Which symbols represent atoms that are isotopes of each other?

- A) ^{14}C and ^{14}N B) ^{16}O and ^{18}O
C) ^{131}I and ^{131}I D) ^{222}Rn and ^{222}Ra

22. An atom of carbon-14 contains

- A) 8 protons, 6 neutrons, and 6 electrons
B) 6 protons, 6 neutrons, and 8 electrons
C) 6 protons, 8 neutrons, and 8 electrons
D) 6 protons, 8 neutrons, and 6 electrons

23. Which correctly represents an atom of neon containing 11 neutrons?

- A) $^{11}_{10}\text{Ne}$ B) $^{20}_{11}\text{Ne}$
C) $^{21}_{10}\text{Ne}$ D) $^{21}_{11}\text{Ne}$

24. A sample of element X contains 90. percent ^{35}X atoms, 8.0 percent ^{37}X atoms, and 2.0 percent ^{38}X atoms. The average isotopic mass is closest to

- A) 32 B) 35 C) 37 D) 38

25. If 75.0% of the isotopes of an element have a mass of 35.0 amu and 25.0% of the isotopes have a mass of 37.0 amu, what is the atomic mass of the element?

- A) 35.0 amu B) 36.0 amu
C) 35.5 amu D) 37.0 amu

26. Naturally occurring gallium is a mixture of isotopes that contains 60.11% of Ga-69 (atomic mass = 68.93 u) and 39.89% of Ga-71 (atomic mass = 70.92 u). Which numerical setup can be used to determine the atomic mass of naturally occurring gallium?

- A) $\frac{(68.93 \text{ u} + 70.92 \text{ u})}{2}$
B) $\frac{(68.93 \text{ u})(0.6011)}{(70.92 \text{ u})(0.3989)}$
C) $(68.93 \text{ u})(0.6011) + (70.92 \text{ u})(0.3989)$
D) $(68.93 \text{ u})(39.89) + (70.92 \text{ u})(60.11)$

27. Some information about the two naturally occurring isotopes of gallium is given in the table below.

**Natural Abundance of
Two Gallium Isotopes**

Isotope	Natural Abundance (%)	Atomic Mass (u)
Ga-69	60.11	68.926
Ga-71	39.89	70.925

Which numerical setup can be used to calculate the atomic mass of gallium?

- A) $(0.6011)(68.926 \text{ u}) + (0.3989)(70.925 \text{ u})$
B) $(60.11)(68.926 \text{ u}) + (39.89)(70.925 \text{ u})$
C) $(0.6011)(70.925 \text{ u}) + (0.3989)(68.926 \text{ u})$
D) $(60.11)(70.925 \text{ u}) + (39.89)(68.926 \text{ u})$

28. The table below gives the atomic mass and the abundance of the two naturally occurring isotopes of chlorine.

Naturally Occurring Isotopes of Chlorine

Isotopes	Atomic Mass of the Isotope (u)	Natural Abundance (%)
^{35}Cl	34.97	75.76
^{37}Cl	36.97	24.24

Which numerical setup can be used to calculate the atomic mass of the element chlorine?

- A) $(34.97 \text{ u})(75.76) + (36.97 \text{ u})(24.24)$ B) $(34.97 \text{ u})(0.2424) + (36.97 \text{ u})(0.7576)$
C) $(34.97 \text{ u})(0.7576) + (36.97 \text{ u})(0.2424)$ D) $(34.97 \text{ u})(24.24) + (36.97 \text{ u})(75.76)$

29. The atomic masses and the natural abundances of the two naturally occurring isotopes of lithium are shown in the table below.

Lithium Isotopes

Isotope	Atomic Mass (u)	Natural Abundance (%)
Li-6	6.02	7.5
Li-7	7.02	92.5

Which numerical setup can be used to determine the atomic mass of lithium?

- A) $(0.075)(6.02 \text{ u}) + (0.925)(7.02 \text{ u})$
B) $(0.925)(6.02 \text{ u}) + (0.075)(7.02 \text{ u})$
C) $(7.5)(6.02 \text{ u}) + (92.5)(7.02 \text{ u})$
D) $(92.5)(6.02 \text{ u}) + (7.5)(7.02 \text{ u})$

30. The results of the gold foil experiment led to the conclusion that an atom is

- A) mostly empty space and has a small, negatively charged nucleus
B) mostly empty space and has a small, positively charged nucleus
C) a hard sphere and has a large, negatively charged nucleus
D) a hard sphere and has a large, positively charged nucleus

31. As a result of the gold foil experiment, it was concluded that an atom

- A) contains protons, neutrons, and electrons
B) contains a small, dense nucleus
C) has positrons and orbitals
D) is a hard, indivisible sphere

32. Which conclusion is based on the “gold foil experiment” and the resulting model of the atom?

- A) An atom is mainly empty space, and the nucleus has a positive charge.
B) An atom is mainly empty space, and the nucleus has a negative charge.
C) An atom has hardly any empty space, and the nucleus has a positive charge.
D) An atom has hardly any empty space, and the nucleus has a negative charge.

33. In Rutherford's gold foil experiments, some alpha particles were deflected from their original paths but most passed through the foil with no deflection. Which statement about gold atoms is supported by these experimental observations?

- A) Gold atoms consist mostly of empty space.
B) Gold atoms are similar to alpha particles.
C) Alpha particles and gold nuclei have opposite charges.
D) Alpha particles are more dense than gold atoms.

34. A mixture of crystals of salt and sugar is added to water and stirred until all solids have dissolved. Which statement best describes the resulting mixture?
- A) The mixture is homogeneous and can be separated by filtration.
B) The mixture is homogeneous and cannot be separated by filtration.
C) The mixture is heterogeneous and can be separated by filtration.
D) The mixture is heterogeneous and cannot be separated by filtration.
35. Which statement describes a mixture of sand and water at room temperature?
- A) It is heterogeneous, and its components are in the same phase.
B) It is heterogeneous, and its components are in different phases.
C) It is homogeneous, and its components are in the same phase.
D) It is homogeneous, and its components are in different phases.
36. A sample is prepared by completely dissolving 10.0 grams of NaCl in 1.0 liter of H₂O. Which classification best describes this sample?
- A) homogeneous compound
B) homogeneous mixture
C) heterogeneous compound
D) heterogeneous mixture
37. The elements on the Periodic Table of the Elements are arranged in order of increasing
- A) atomic mass B) formula mass
C) atomic number D) oxidation number
38. Which list of elements consists of a metal, a metalloid, and a nonmetal?
- A) Li, Na, Rb B) Cr, Mo, W
C) Sn, Si, C D) O, S, Te
39. Which list of elements contains a metal, a metalloid, a nonmetal, and a noble gas?
- A) Be, Si, Cl, Kr B) C, N, Ne, Ar
C) K, Fe, B, F D) Na, Zn, As, Sb
40. Which list of elements contains a metal, a metalloid, and a nonmetal?
- A) Zn, Ga, Ge B) Si, Ge, Sn
C) Cd, Sb, I D) F, Cl, Br
41. Which element has properties most like those of magnesium?
- A) calcium B) cesium
C) potassium D) sodium
42. The chemical properties of calcium are most similar to the chemical properties of
- A) Ar B) K C) Mg D) Sc
43. Which two elements have the most similar chemical properties?
- A) Be and Mg B) Ca and Br
C) Cl and Ar D) Na and P
44. Which list consists of elements that have the most similar chemical properties?
- A) Mg, Al, and Si B) Mg, Ca, and Ba
C) K, Al, and Ni D) K, Ca, and Ga
45. Which list includes elements with the most similar chemical properties?
- A) Br, Ga, Hg B) Cr, Pb, Xe
C) O, S, Se D) N, O, F
46. Which element has chemical properties that are most similar to the chemical properties of sodium?
- A) beryllium B) calcium
C) lithium D) magnesium
47. Which general trends in atomic radius and electronegativity are observed as the elements in Period 3 are considered in order of increasing atomic number?
- A) Atomic radius decreases and electronegativity increases.
B) Atomic radius increases and electronegativity decreases.
C) Both atomic radius and electronegativity increase.
D) Both atomic radius and electronegativity decrease.

48. Which trends are observed as each of the elements within Group 15 on the Periodic Table is considered in order from top to bottom?
- A) Their metallic properties decrease and their atomic radii decrease.
 - B) Their metallic properties decrease and their atomic radii increase.
 - C) Their metallic properties increase and their atomic radii decrease.
 - D) Their metallic properties increase and their atomic radii increase.
49. As the atoms in Period 3 of the Periodic Table are considered from left to right, the atoms generally show
- A) an increase in radius and an increase in ionization energy
 - B) an increase in radius and a decrease ionization energy
 - C) a decrease in radius and an increase in ionization energy
 - D) a decrease in radius and a decrease in ionization energy
50. Which characteristics both generally *decrease* when the elements in Period 3 on the Periodic Table are considered in order from left to right?
- A) nonmetallic properties and atomic radius
 - B) nonmetallic properties and ionization energy
 - C) metallic properties and atomic radius
 - D) metallic properties and ionization energy
51. Which trends are observed when the elements in Period 3 on the Periodic Table are considered in order of increasing atomic number?
- A) The atomic radius decreases, and the first ionization energy generally increases.
 - B) The atomic radius decreases, and the first ionization energy generally decreases.
 - C) The atomic radius increases, and the first ionization energy generally increases.
 - D) The atomic radius increases, and the first ionization energy generally decreases.
52. An element that has a low first ionization energy and good conductivity of heat and electricity is classified as a
- A) metal
 - B) metalloid
 - C) nonmetal
 - D) noble gas
53. At STP, which element is brittle and *not* a conductor of electricity?
- A) S
 - B) K
 - C) Na
 - D) Ar
54. Which elements are malleable and good conductors of electricity?
- A) iodine and silver
 - B) iodine and xenon
 - C) tin and silver
 - D) tin and xenon
55. Which electron configuration represents an excited state for an atom of calcium?
- A) 2-8-7-1
 - B) 2-8-7-2
 - C) 2-8-7-3
 - D) 2-8-8-2
56. Which electron configuration represents a potassium atom in an excited state?
- A) 2-7-6
 - B) 2-8-5
 - C) 2-8-8-1
 - D) 2-8-7-2
57. Which electron configuration represents the electrons of an atom in an excited state?
- A) 2-1
 - B) 2-7-4
 - C) 2-8-7
 - D) 2-4
58. Which electron configuration represents the electrons of an atom of neon in an excited state?
- A) 2-7
 - B) 2-8
 - C) 2-7-1
 - D) 2-8-1
59. Which electron configuration represents an atom of magnesium in an excited state?
- A) 2-7-3
 - B) 2-7-6
 - C) 2-8-2
 - D) 2-8-5
60. A specific amount of energy is emitted when excited electrons in an atom in a sample of an element return to the ground state. This emitted energy can be used to determine the
- A) mass of the sample
 - B) volume of the sample
 - C) identity of the element
 - D) number of moles of the element

61. During a flame test, a lithium salt produces a characteristic red flame. This red color is produced when electrons in excited lithium atoms
- are lost by the atoms
 - are gained by the atoms
 - return to lower energy states within the atoms
 - move to higher energy states within the atoms
62. The bright-line spectrum of an element in the gaseous phase is produced as
- protons move from lower energy states to higher energy states
 - protons move from higher energy states to lower energy states
 - electrons move from lower energy states to higher energy states
 - electrons move from higher energy states to lower energy states
63. The bright-line spectrum of sodium is produced when energy is
- absorbed as electrons move from higher to lower electron shells
 - absorbed as electrons move from lower to higher electron shells
 - released as electrons move from higher to lower electron shells
 - released as electrons move from lower to higher electron shells
64. Compared to the energy of an electron in the second shell of an atom of sulfur, the energy of an electron in the
- first shell is lower
 - first shell is the same
 - third shell is lower
 - third shell is the same
65. Which atom in the ground state has an outermost electron with the most energy?
- Cs
 - K
 - Li
 - Na
66. Which statement describes the relative energy of the electrons in the shells of a calcium atom?
- An electron in the first shell has more energy than an electron in the second shell.
 - An electron in the first shell has the same amount of energy as an electron in the second shell.
 - An electron in the third shell has more energy than an electron in the second shell.
 - An electron in the third shell has less energy than an electron in the second shell.
67. Which Lewis electron-dot diagram represents an atom in the ground state for a Group 13 element?
- -
 -
 -
68. Which Lewis electron-dot diagram is correct for a S²⁻ ion?
- -
 -
 -
69. Which Lewis electron-dot structure is drawn correctly for the atom it represents?
- -
 -
 -
70. Which electron-dot symbol correctly represents an atom of its given element?
- -
 -
 -
71. Which is the electron-dot symbol for an atom with an electron configuration of 2-5?
- -
 -
 -
72. Atom X has an electron configuration of 2-8-2. Which electron-dot symbol correctly represents this atom?
- -
 -
 -

73. If the electron configuration of an atom of element X is 2-6, the electron dot symbol for the element is

- A) $X:$ B) $\cdot\dot{X}\cdot$ C) $:\ddot{X}:$ D) $\cdot\ddot{X}:$

74. Which electron-dot symbol represents an atom of chlorine in the ground state?

- A) $Cl:$ B) $\cdot\ddot{Cl}\cdot$ C) $:\ddot{Cl}:$ D) $:\ddot{Cl}:$

75. Which is the correct electron dot representation of an atom of sulfur in the ground state?

- A) $S:$ B) $\cdot\dot{S}$ C) $\cdot\ddot{S}$ D) $:\ddot{S}:$

76. Which Lewis electron-dot diagram represents the bonding in potassium iodide?

- A) $K^+ \left[:\ddot{I}: \right]^-$ B) $\left[:\ddot{K}: \right]^- I^+$
 C) $K:\ddot{I}:$ D) $:\ddot{K}:\ddot{I}$

77. Which Lewis electron-dot diagram represents calcium oxide?

- A) $Ca^x:\ddot{O}:$
 B) $^x_xCa:\ddot{O}:$
 C) $\left[:\ddot{Ca}^x \right]^{2+} O^{2-}$
 D) $Ca^{2+} \left[:\ddot{O}^x \right]^{2-}$

78. What is the correct Lewis electron-dot structure for the compound magnesium fluoride?

- A) $Mg:\ddot{F}:$ B) $Mg^+ \left[:\ddot{F}: \right]^-$
 C) $\left[:\ddot{F}: \right]^- Mg^{2+} \left[:\ddot{F}: \right]^-$ D) $:\ddot{F}:\ddot{Mg}:\ddot{F}:$

79. A solid substance is an excellent conductor of electricity. The chemical bonds in this substance are most likely

- A) ionic, because the valence electrons are shared between atoms
 B) ionic, because the valence electrons are mobile
 C) metallic, because the valence electrons are stationary
 D) metallic, because the valence electrons are mobile

80. Which factor distinguishes a metallic bond from an ionic bond or a covalent bond?

- A) the mobility of electrons
 B) the mobility of protons
 C) the equal sharing of electrons
 D) the unequal sharing of electrons

81. The correct formula for lead (IV) oxide is

- A) PbO B) Pb₂O
C) PbO₂ D) Pb₂O₂

82. The correct name of the compound with the formula PbO₂ is

- A) lead (I) oxide B) lead (II) oxide
C) lead (III) oxide D) lead (IV) oxide

83. The correct formula for nickel (II) oxide is

- A) NiO B) Ni₂O
C) NiO₂ D) Ni₃O₂

84. The chemical formula for nickel (II) bromide is

- A) Ni₂Br B) NiBr₂
C) N₂Br D) NBr₂

85. A solid sample of a compound and a liquid sample of the same compound are each tested for electrical conductivity. Which test conclusion indicates that the compound is ionic?

- A) Both the solid and the liquid are good conductors.
B) Both the solid and the liquid are poor conductors.
C) The solid is a good conductor, and the liquid is a poor conductor.
D) The solid is a poor conductor, and the liquid is a good conductor.

86. A sample of a substance has these characteristics:

- melting point of 984 K
- hard, brittle solid at room temperature
- poor conductor of heat and electricity as a solid
- good conductor of electricity as a liquid on in an aqueous solution

This sample is classified as

- A) a metallic element
B) a radioactive element
C) a molecular compound
D) an ionic compound

87. Which type of substance can conduct electricity in the liquid phase but *not* in the solid phase?

- A) ionic compound
B) molecular compound
C) metallic element
D) nonmetallic element

88. A hard substance that has a high melting point and is a poor conductor of electricity in the solid phase could be

- A) CO₂ B) Mg C) NaCl D) CCl₄

89. A substance that has a melting point of 1074 K conducts electricity when dissolved in water, but does *not* conduct electricity in the solid phase. The substance is most likely

- A) an ionic solid B) a network solid
C) a metallic solid D) a molecular solid

90. Which of the following substances is the best conductor of electricity?

- A) H₂O(g) B) H₂O(s)
C) NaCl(s) D) NaCl(l)

91. A crystalline solid has a high melting point and is a good conductor of electricity in the liquid state. This solid could be

- A) CO₂ B) Hg
C) C₆H₁₂O₆ D) KCl

-
92. Base your answer to the following question on the information below and on your knowledge of chemistry.

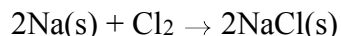
The table below contains selected information about chlorine and two compounds containing chlorine. One piece of information is missing for each of the substances in the table.

Chlorine and Two Compounds Containing Chlorine

Name	Formula	Molar Mass (g/mol)	Phase at STP
chlorine	Cl ₂	71	?
calcium chloride	CaCl ₂	?	solid
1,2-dichloroethene	?	97	liquid

Explain, in terms of electrons, why the compound containing calcium and chlorine is classified as an ionic compound.

93. Base your answer to the following question on the balanced equation below.



Explain, in terms of electrons, why the bonding in NaCl is ionic.

94. Base your answer to the following question on the information below and on your knowledge of chemistry.

Some compounds of silver are listed with their chemical formulas in the table below.

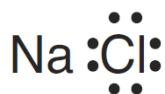
Silver Compounds

Name	Chemical Formula
silver carbonate	Ag ₂ CO ₃
silver chlorate	AgClO ₃
silver chloride	AgCl
silver sulfate	Ag ₂ SO ₄

Explain, in terms of element classification, why silver chloride is an ionic compound.

-
95. Draw the electron-dot (Lewis) structure of calcium chloride.

96. A student drew the Lewis electron-dot diagram below to represent sodium chloride .



Explain why this diagram is *not* an accurate representation for the bonding in NaCl

-
97. Base your answer to the following question on the information below and on your knowledge of chemistry.

Periodic trends are observed in the properties of the elements in Period 3 on the Periodic Table. These elements vary in physical properties, such as phase, and in chemical properties, such as their ability to lose or gain electrons during a chemical reaction.

State the general trend in atomic radius as the elements in Period 3 are considered in order of increasing atomic number.

Base your answers to questions **98** through **100** on the information below and on your knowledge of chemistry.

The elements in Group 2 on the Periodic Table can be compared in terms of first ionization energy, electronegativity, and other general properties.

98. Explain, in terms of atomic structure, why barium has a lower first ionization energy than magnesium.
99. Explain, in terms of electron configuration, why the elements in Group 2 have similar chemical properties.
100. Describe the general trend in electronegativity as the metals in Group 2 on the Periodic Table are considered in order of increasing atomic number.

-
101. State the general trend in first ionization energy as the elements in Period 3 are considered from left to right.
102. Base your answer to the following question on the information below and on your knowledge of chemistry.

The elements in group 17 are halogens. The word "halogen" is derived from Greek and means "salt former."

State the trend in electronegativity for the halogens as these elements are considered in order of increasing atomic number.

103. Base your answer to the following question on the elements in Group 2 on the Periodic Table.
- State the general trend in first ionization energy for the elements in Group 2 as these elements are considered in order from top to bottom in the group.
-

104. Base your answer to the following question on the table below.

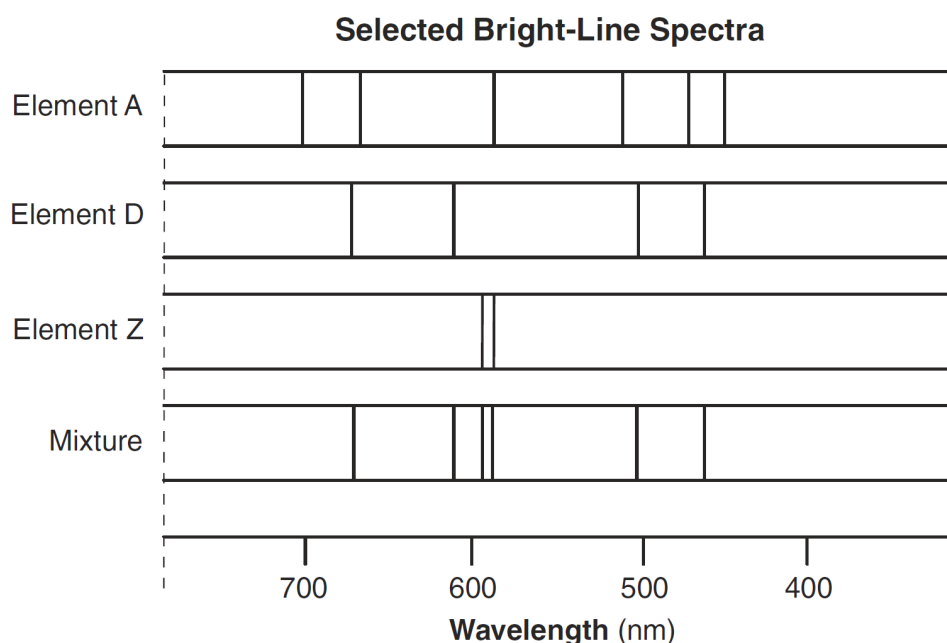
First Ionization Energy of Selected Elements

Element	Atomic Number	First Ionization Energy (kJ/mol)
lithium	3	520
sodium	11	496
potassium	19	419
rubidium	37	403
cesium	55	376

State the trend in first ionization energy for the elements in the table as the atomic number increases.

105. Base your answer to the following question on the information below and on your knowledge of chemistry.

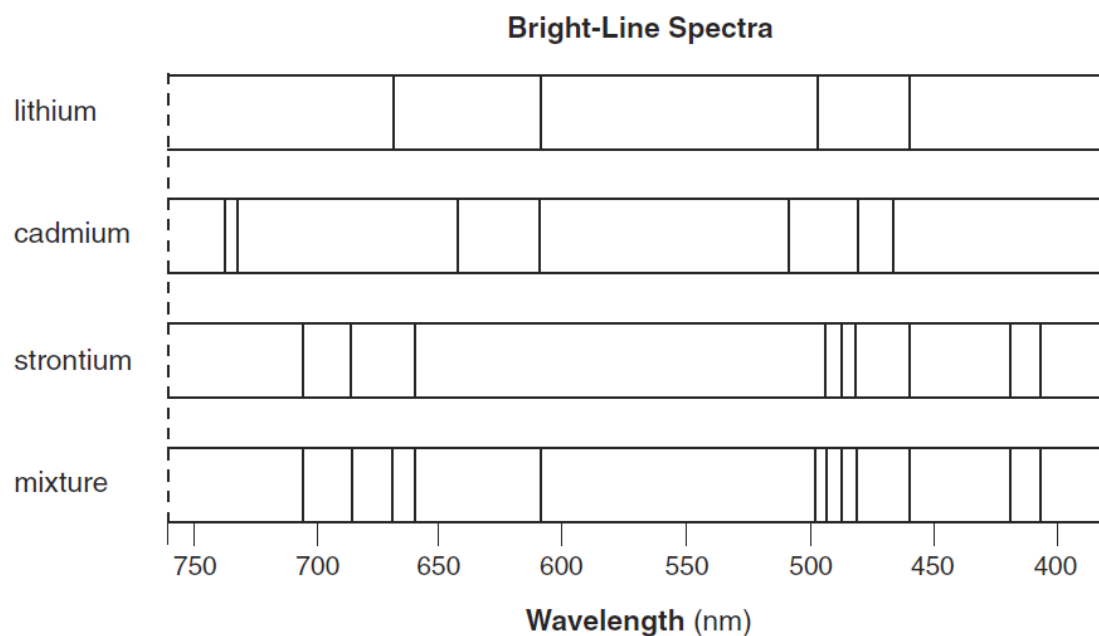
The bright-line spectra observed in a spectroscope for three elements and a mixture of two of these elements are represented in the diagram below.



Describe, in terms of *both* electrons and energy state, how the light represented by the spectral lines is produced.

106. Base your answer to the following question on the information below.

The bright-line spectra for three elements and a mixture of elements are shown below.



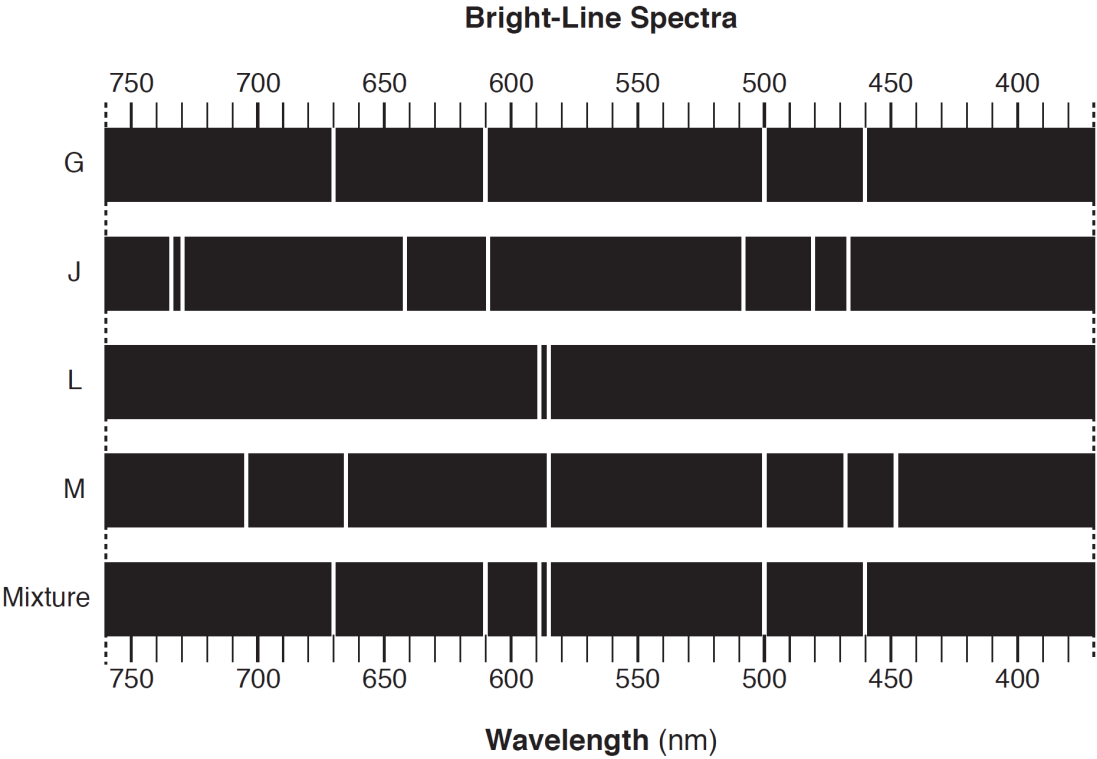
Explain, in terms of both electrons and energy, how the bright-line spectrum of an element is produced.

107. Base your answer to the following question on the diagram below, which shows bright-line spectra of selected elements.



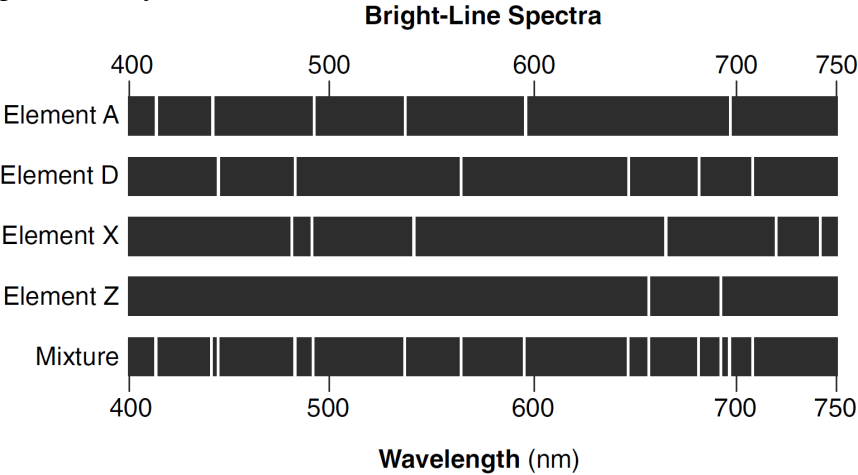
Explain how a bright-line spectrum is produced, in terms of *excited state*, *energy transitions*, and *ground state*.

108. The bright-line spectra of four elements, G , J , L , and M , and a mixture of *at least two* of these elements is given below.



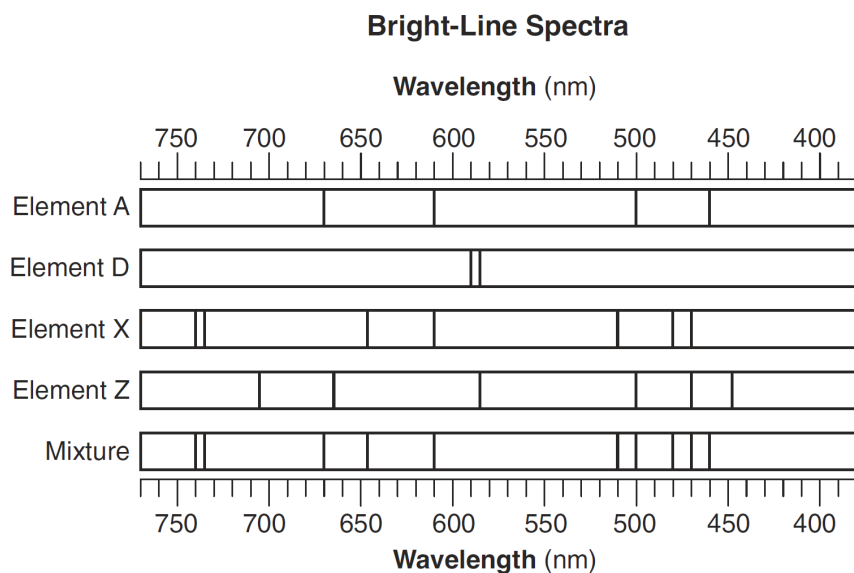
Which elements are present in the mixture?

109. The diagram below represents the bright-line spectra of four elements and a bright-line spectrum produced by a mixture of three of these elements.



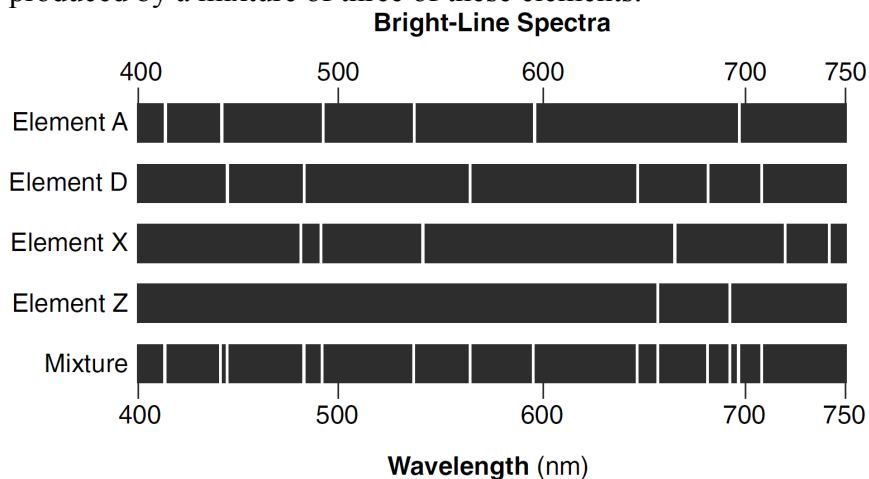
Which element is *not* present in the mixture?

110. Base your answer to the following question on your knowledge of chemistry and the bright-line spectra produced by four elements and the spectrum of a mixture of elements represented in the diagram below.



Which elements are present in this mixture?

111. The diagram below represents the bright-line spectra of four elements and a bright-line spectrum produced by a mixture of three of these elements.



Which element is *not* present in the mixture?