Chemistry Review
Unit 2 – Periodic Table

Development of the Periodic table, Properties of Elements, Chemistry of a Group, Chemistry of a Period, Naming Elements

The Periodic Table

1. The placement of an element on the Periodic Table gives an indication of the chemical and physical properties of that element.

2. Elements are arranged in order of increasing atomic number.

3. The number of protons in an atom (atomic number) identifies the element.
- ✓ The number of protons in an atom only changes through nuclear reactions.

4. The atomic mass is the sum of protons and neutrons in the nucleus.
- ✓ The mass number given on the periodic table is a weighted average of the different isotopes of that element.
- ✓ Electrons do not significantly add to the atomic mass.

5. Isotopes of an element are identified by the sum of protons and neutrons.
- ✓ Isotopes of the same element have the same number of protons and a different number of neutrons.
- ✓ Examples of isotopic notation are: $^{14}_{6}C$, ^{14}C, carbon-14, C-14

6. Elements can be classified by their properties and their location on the Periodic Table as metals, non-metals, metalloids, and noble gasses.

7. Elements may be differentiated by their physical properties.
- ✓ Ex: Density, conductivity, malleability, hardness, ductility, solubility

8. Elements may be differentiated by their chemical properties.
- ✓ Chemical properties describe how an element behaves in a chemical reaction.

9. Elements are arranged into periods and groups.

10. Elements of the same period have the same number of occupied energy levels.

11. Elements of the same group have the same valence configuration and similar chemical properties.
- ✓ Group 1 elements other than H are *alkali metals*.
- ✓ Group 2 elements are *alkali earth metals*.
- ✓ Group 17 elements are *halogens.*
- ✓ Alkali metals, alkali earth metals, and halogens all are highly reactive and do not exist as free elements in nature (they are all found in compounds).
- ✓ Group 18 elements are *noble or inert gasses*. These elements have filled valence levels and are do not normally react with other substances.

12. The succession of elements within a group demonstrates characteristic trends in properties. As you progress *down* a group:
- ✓ atomic radius increases.
- ✓ electronegativity decreases.
- ✓ first ionization energy decreases.
- ✓ metallic character increases.

13. The succession of elements within a period demonstrates characteristic trends in properties. As you progress *across* a group from *left to right*:

- ✓ atomic radius decreases.
- ✓ electronegativity increases.
- ✓ first ionization energy increases.
- ✓ metallic character decreases.

14. Some elements may exist in two or more forms in the same phase. These forms differ in their molecular or crystal structure, hence their different properties.

- ✓ Ex: Carbon exists as both graphite and diamond (a network solid).

January 2008

10 Which term indicates how strongly an atom attracts the electrons in a chemical bond?

(1) alkalinity
(2) atomic mass
(3) electronegativity
(4) activation energy

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

(1) ionic, because the valence electrons are shared between atoms
(2) ionic, because the valence electrons are mobile
(3) metallic, because the valence electrons are stationary
(4) metallic, because the valence electrons are mobile

33 Which general trend is found in Period 2 on the Periodic Table as the elements are considered in order of increasing atomic number?

(1) decreasing atomic mass
(2) decreasing electronegativity
(3) increasing atomic radius
(4) increasing first ionization energy

31 Which list of elements consists of metalloids, only?

(1) B, Al, Ga
(2) C, N, P
(3) O, S, Se
(4) Si, Ge, As

51 Describe *one* chemical property of Group 1 metals that results from the atoms of each metal having only one valence electron. [1]

August 2007

4 Which element is a solid at STP and a good conductor of electricity?

(1) iodine
(2) mercury
(3) nickel
(4) sulfur

5 Which element has both metallic and nonmetallic properties?

(1) Rb
(2) Rn
(3) Si
(4) Sr

6 The carbon atoms in graphite and the carbon atoms in diamond have different

(1) atomic numbers
(2) atomic masses
(3) electronegativities
(4) structural arrangements

7 Atoms of which element have the greatest tendency to gain electrons?

(1) bromine
(2) chlorine
(3) fluorine
(4) iodine

8 Which statement describes a chemical property of the element magnesium?

(1) Magnesium is malleable.
(2) Magnesium conducts electricity.
(3) Magnesium reacts with an acid.
(4) Magnesium has a high boiling point.

14 An ion of which element has a larger radius than an atom of the same element?

(1) aluminum
(2) chlorine
(3) magnesium
(4) sodium

33 Which statement explains why sulfur is classified as a Group 16 element?

(1) A sulfur atom has 6 valence electrons.
(2) A sulfur atom has 16 neutrons.
(3) Sulfur is a yellow solid at STP.
(4) Sulfur reacts with most metals.

34 How do the atomic radius and metallic properties of sodium compare to the atomic radius and metallic properties of phosphorus?

(1) Sodium has a larger atomic radius and is more metallic.
(2) Sodium has a larger atomic radius and is less metallic.
(3) Sodium has a smaller atomic radius and is more metallic.
(4) Sodium has a smaller atomic radius and is less metallic.

June 2007

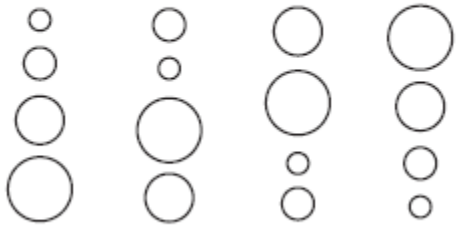
5 Which two characteristics are associated with metals?

(1) low first ionization energy and low electronegativity
(2) low first ionization energy and high electronegativity
(3) high first ionization energy and low electronegativity
(4) high first ionization energy and high electronegativity

6 Which element is most chemically similar to chlorine?

(1) Ar
(2) F
(3) Fr
(4) S

32 Which grouping of circles, when considered in order from the top to the bottom, best represents the relative size of the atoms of Li, Na, K, and Rb, respectively?



(1) (2) (3) (4)

34 At STP, which element is brittle and *not* a conductor of electricity?

(1) S
(2) K
(3) Na
(4) Ar

43 At which Celsius temperature does lead change from a solid to a liquid?

(1) 874°C
(2) 601°C
(3) 328°C
(4) 0°C

Base your answers to questions 73 through 76 on the information below.

The table below lists physical and chemical properties of six elements at standard pressure that correspond to known elements on the Periodic Table. The elements are identified by the code letters, *D*, *E*, *G*, *J*, *L*, and *Q*.

Properties of Six Elements at Standard Pressure

Element D Density 0.00018 g/cm^3 Melting point –272°C Boiling point –269°C Oxide formula (none)	Element E Density 1.82 g/cm^3 Melting point 44°C Boiling point 280°C Oxide formula E_2O_5	Element G Density 0.53 g/cm^3 Melting point 181°C Boiling point 1347°C Oxide formula G_2O
Element J Density 0.0013 g/cm^3 Melting point –210°C Boiling point –196°C Oxide formula J_2O_5	Element L Density 0.86 g/cm^3 Melting point 64°C Boiling point 774°C Oxide formula L_2O	Element Q Density 0.97 g/cm^3 Melting point 98°C Boiling point 883°C Oxide formula Q_2O

73 What is the total number of elements in the "Properties of Six Elements at Standard Pressure" table that are solids at STP? [1]

74 An atom of element *G* is in the ground state. What is the total number of valence electrons in this atom? [1]

75 Letter Z corresponds to an element on the Periodic Table other than the six listed elements. Elements *G*, *Q*, *L*, and Z are in the same group on the Periodic Table, as shown in the diagram below.

G
Q
L
Z

Based on the trend in the melting points for elements *G*, *Q*, and *L* listed in the "Properties of Six Elements at Standard Pressure" table, estimate the melting point of element Z, in degrees Celsius. [1]

76 Identify, by code letter, the element that is a noble gas in the "Properties of Six Elements at Standard Pressure" table. [1]

73 _____

74 _____

75 _____ °C

76 _____

January 2007

6 An atom of argon rarely bonds to an atom of another element because an argon atom has

(1) 8 valence electrons
(2) 2 electrons in the first shell
(3) 3 electron shells
(4) 22 neutrons

7 The elements on the Periodic Table are arranged in order of increasing

(1) boiling point
(2) electronegativity
(3) atomic number
(4) atomic mass

8 Which element is classified as a nonmetal?

(1) Be
(2) Al
(3) Si
(4) Cl

9 Solid samples of the element phosphorus can be white, black, or red in color. The variations in color are due to different

(1) atomic masses
(2) molecular structures
(3) ionization energies
(4) nuclear charges

11 Lithium and potassium have similar chemical properties because the atoms of both elements have the same

(1) mass number
(2) atomic number
(3) number of electron shells
(4) number of valence electrons

31 When the elements in Group 1 are considered in order from top to bottom, each successive element at standard pressure has

(1) a higher melting point and a higher boiling point
(2) a higher melting point and a lower boiling point
(3) a lower melting point and a higher boiling point
(4) a lower melting point and a lower boiling point

33 At STP, which list of elements contains a solid, a liquid, and a gas?

(1) Hf, Hg, He
(2) Cr, Cl_2, C
(3) Ba, Br_2, B
(4) Se, Sn, Sr

38 A 10.0-gram sample of which element has the *smallest* volume at STP?

(1) aluminum
(2) magnesium
(3) titanium
(4) zinc

August 2006

2 Which Period 4 element has the most metallic properties?

(1) As (3) Ge
(2) Br (4) Sc

34 Based on electronegativity values, which type of elements tends to have the greatest attraction for electrons in a bond?

(1) metals (3) nonmetals
(2) metalloids (4) noble gases

35 Which list of elements from Group 2 on the Periodic Table is arranged in order of increasing atomic radius?

(1) Be, Mg, Ca (3) Ba, Ra, Sr
(2) Ca, Mg, Be (4) Sr, Ra, Ba

52 Explain, in terms of electron configuration, why selenium and sulfur have similar chemical properties. [1]

52 _____

Base your answers to questions 68 through 71 on the information below.

A metal, *M*, was obtained from a compound in a rock sample. Experiments have determined that the element is a member of Group 2 on the Periodic Table of the Elements.

68 What is the phase of element *M* at STP? [1]

69 Explain, in terms of electrons, why element *M* is a good conductor of electricity. [1]

70 Explain why the radius of a positive ion of element *M* is *smaller* than the radius of an atom of element *M*. [1]

71 Using the symbol *M* for the element, write the chemical formula for the compound that forms when element *M* reacts with iodine. [1]

68 _____

69 _____

70 _____

71 _____

June 2006

2 Which element has chemical properties that are most similar to those of calcium?

(1) Co (3) N
(2) K (4) Sr

3 Which element is malleable and can conduct electricity in the solid phase?

(1) iodine (3) sulfur
(2) phosphorus (4) tin

13 Which element has atoms with the greatest attraction for electrons in a chemical bond?

(1) beryllium (3) lithium
(2) fluorine (4) oxygen

31 Which trends are observed as each of the elements within Group 15 on the Periodic Table is considered in order from top to bottom?

(1) Their metallic properties decrease and their atomic radii decrease.
(2) Their metallic properties decrease and their atomic radii increase.
(3) Their metallic properties increase and their atomic radii decrease.
(4) Their metallic properties increase and their atomic radii increase.

36 A metal, M, forms an oxide compound with the general formula M_2O. In which group on the Periodic Table could metal M be found?

(1) Group 1 (3) Group 16
(2) Group 2 (4) Group 17

38 At standard pressure, which element has a melting point higher than standard temperature?

(1) F_2 (3) Fe
(2) Br_2 (4) Hg

January 2006

6 The element in Group 14, Period 3 on the Periodic Table is classified as a

(1) metal (3) metalloid
(2) noble gas (4) nonmetal

7 Which trends are observed when the elements in Period 3 on the Periodic Table are considered in order of increasing atomic number?

(1) The atomic radius decreases, and the first ionization energy generally increases.
(2) The atomic radius decreases, and the first ionization energy generally decreases.
(3) The atomic radius increases, and the first ionization energy generally increases.
(4) The atomic radius increases, and the first ionization energy generally decreases.

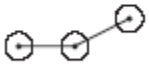
35 Elements Q, X, and Z are in the same group on the Periodic Table and are listed in order of increasing atomic number. The melting point of element Q is –219°C and the melting point of element Z is –7°C. Which temperature is closest to the melting point of element X?

(1) –7°C (3) –219°C
(2) –101°C (4) –226°C

Base your answers to questions 78 through 80 on the data in Reference Table *S*.

78 On the data table *in your answer booklet*, record the boiling points for He, Ne, Ar, Kr, and Xe. [1]

79 On the grid *in your answer booklet*, plot the boiling point versus the atomic number for He, Ne, Ar, Kr, and Xe. Circle and connect the points. [1]

Example: 

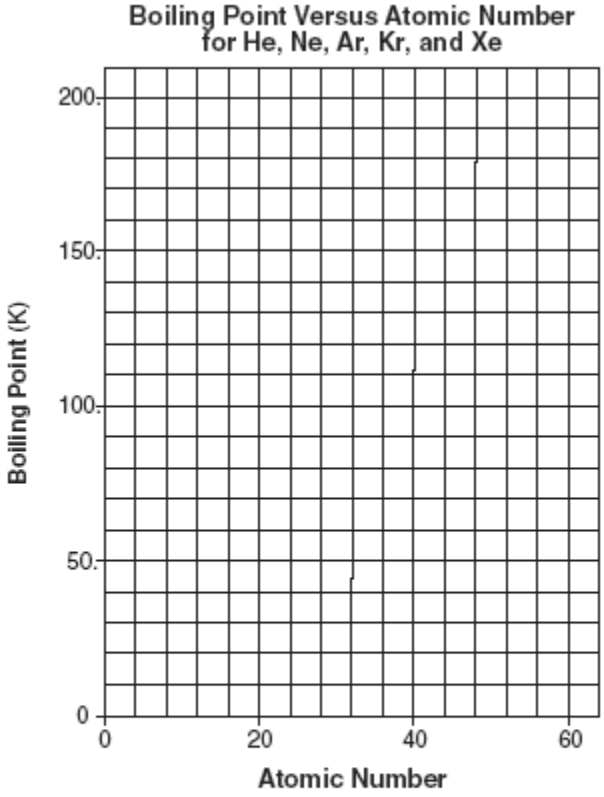
80 Based on your graph, describe the trend in the boiling points of these elements as the atomic number increases. [1]

78

Data Table

Symbol	Atomic Number	Boiling Point (K)
He	2	
Ne	10	
Ar	18	
Kr	36	
Xe	54	

79



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August 2005

6 The elements located in the lower left corner of the Periodic Table are classified as

(1) metals
(2) nonmetals
(3) metalloids
(4) noble gases

8 Which list consists of elements that have the most similar chemical properties?

(1) Mg, Al, and Si
(2) Mg, Ca, and Ba
(3) K, Al, and Ni
(4) K, Ca, and Ga

34 At STP, an element that is a brittle solid and a poor conductor of heat and electricity could have an atomic number of

(1) 12
(2) 13
(3) 16
(4) 17

35 Based on Reference Table S, atoms of which of these elements have the strongest attraction for the electrons in a chemical bond?

(1) Al
(2) Si
(3) P
(4) S

Base your answers to questions 64 through 67 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

64 On the grid *in your answer booklet*, mark an appropriate scale on the axis labeled "First Ionization Energy (kJ/mol)." An appropriate scale is one that allows a trend to be seen. [1]

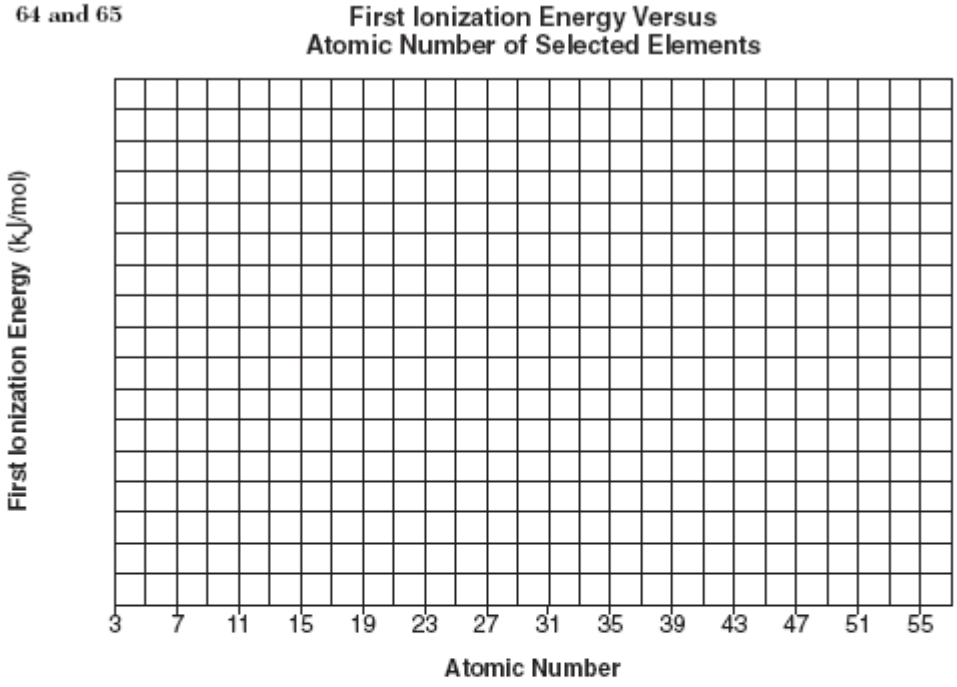
65 On the same grid, plot the data from the table. Circle and connect the points. [1]

Example: 

66 State the trend in first ionization energy for the elements in the table as the atomic number increases. [1]

67 Explain, in terms of atomic structure, why cesium has a *lower* first ionization energy than rubidium. [1]

64 and 65



66 _____

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67 _____

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June 2005

4 The elements in Period 5 on the Periodic Table are arranged from left to right in order of

(1) decreasing atomic mass
(2) decreasing atomic number
(3) increasing atomic mass
(4) increasing atomic number

5 Which list of elements contains a metal, a metalloid, and a nonmetal?

(1) Zn, Ga, Ge
(2) Si, Ge, Sn
(3) Cd, Sb, I
(4) F, Cl, Br

12 Based on Reference Table *S*, the atoms of which of these elements have the strongest attraction for electrons in a chemical bond?

(1) N
(2) Na
(3) P
(4) Pt

35 The data table below shows elements *Xx*, *Yy*, and *Zz* from the same group on the Periodic Table.

Element	Atomic Mass (atomic mass unit)	Atomic Radius (pm)
Xx	69.7	141
Yy	114.8	?
Zz	204.4	171

What is the most likely atomic radius of element *Yy*?

(1) 103 pm
(2) 127 pm
(3) 166 pm
(4) 185 pm

53 Explain, in terms of atomic structure, why germanium is chemically similar to silicon. [1]

53 _____

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January 2005

5 Which element has chemical properties that are most similar to the chemical properties of sodium?

(1) Mg (3) Se
(2) K (4) Cl

6 Germanium is classified as a

(1) metal (3) nonmetal
(2) metalloid (4) noble gas

7 Which statement correctly describes diamond and graphite, which are different forms of solid carbon?

(1) They differ in their molecular structure, only.
(2) They differ in their properties, only.
(3) They differ in their molecular structure and properties.
(4) They do not differ in their molecular structure or properties.

32 An unknown element X can form a compound with the formula XBr_3. In which group on the Periodic Table would element X be found?

(1) 1 (3) 13
(2) 2 (4) 14

33 As the elements in Group 17 on the Periodic Table are considered from top to bottom, what happens to the atomic radius and the metallic character of each successive element?

(1) The atomic radius and the metallic character both increase.
(2) The atomic radius increases and the metallic character decreases.
(3) The atomic radius decreases and the metallic character increases.
(4) The atomic radius and the metallic character both decrease.

41 Given the particle diagram:

At 101.3 kPa and 298 K, which element could this diagram represent?

(1) Rn (3) Ag
(2) Xe (4) Kr

August 2004

4 What determines the order of placement of the elements on the modern Periodic Table?

(1) atomic number
(2) atomic mass
(3) the number of neutrons, only
(4) the number of neutrons and protons

12 Which statement concerning elements is true?

(1) Different elements must have different numbers of isotopes.
(2) Different elements must have different numbers of neutrons.
(3) All atoms of a given element must have the same mass number.
(4) All atoms of a given element must have the same atomic number.

32 Which set of symbols represents atoms with valence electrons in the same electron shell?

(1) Ba, Br, Bi
(2) Sr, Sn, I
(3) O, S, Te
(4) Mn, Hg, Cu

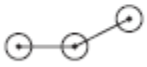
51 In the 19th century, Dmitri Mendeleev predicted the existence of a then unknown element *X* with a mass of 68. He also predicted that an oxide of *X* would have the formula X_2O_3. On the modern Periodic Table, what is the group number and period number of element *X*? [1]

51 Group _____ **and Period** _____

Base your answers to questions 58 through 60 on the electronegativity values and atomic numbers of fluorine, chlorine, bromine, and iodine that are listed on Reference Table S.

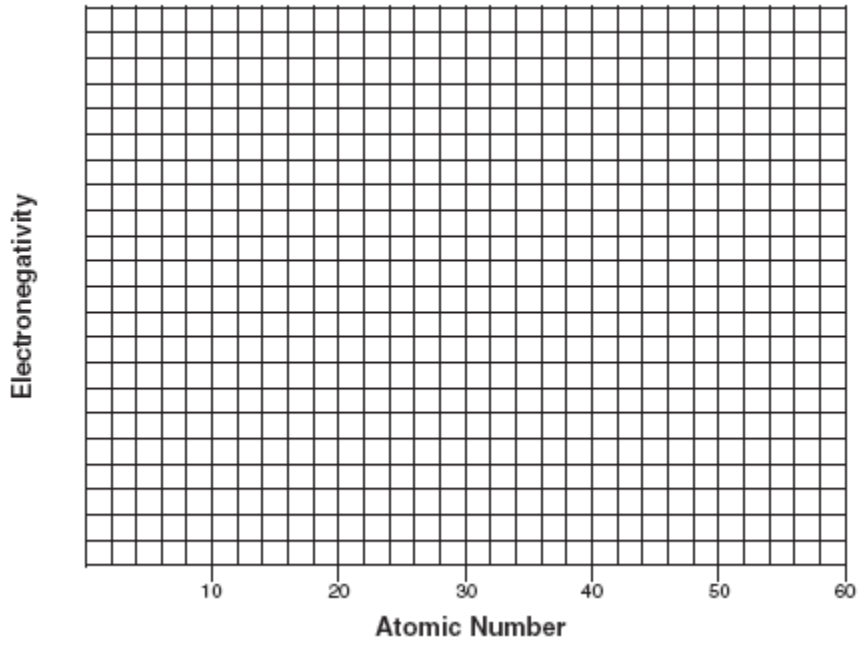
58 On the grid provided *in your answer booklet*, mark an appropriate scale on the axis labeled "Electronegativity." An appropriate scale is one that allows a trend to be seen. [1]

59 On the same grid, plot the electronegativity and atomic number data from Reference Table S. Circle and connect the points. [1]

Example: 

60 Explain, in terms of *electronegativity*, why the H–F bond is expected to be more polar than the H–I bond. [1]

58 and 59



60 _____

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June 2004

5 Which pair of symbols represents a metalloid and a noble gas?

(1) Si and Bi
(2) As and Ar
(3) Ge and Te
(4) Ne and Xe

6 Which statement describes a chemical property of iron?

(1) Iron can be flattened into sheets.
(2) Iron conducts electricity and heat.
(3) Iron combines with oxygen to form rust.
(4) Iron can be drawn into a wire.

13 Which of these elements has the *least* attraction for electrons in a chemical bond?

(1) oxygen
(2) fluorine
(3) nitrogen
(4) chlorine

37 Element *X* is a solid that is brittle, lacks luster, and has six valence electrons. In which group on the Periodic Table would element *X* be found?

(1) 1
(2) 2
(3) 15
(4) 16

50 As the elements of Group 1 on the Periodic Table are considered in order of increasing atomic radius, the ionization energy of each successive element generally

(1) decreases
(2) increases
(3) remains the same

62 Based on the Periodic Table, explain why Na and K have similar chemical properties. [1]

62 _____

_____

_____

January 2004

3 Which element is a noble gas?

(1) krypton
(2) chlorine
(3) antimony
(4) manganese

4 On the present Periodic Table of the Elements, the elements are arranged according to increasing

(1) number of oxidation states
(2) number of neutrons
(3) atomic mass
(4) atomic number

5 What is a property of most metals?

(1) They tend to gain electrons easily when bonding.
(2) They tend to lose electrons easily when bonding.
(3) They are poor conductors of heat.
(4) They are poor conductors of electricity.

8 The amount of energy required to remove the outermost electron from a gaseous atom in the ground state is known as

(1) first ionization energy
(2) activation energy
(3) conductivity
(4) electronegativity

22 Which of these elements is the best conductor of electricity?

(1) S
(2) N
(3) Br
(4) Ni

31 When an atom of phosphorus becomes a phosphide ion (P^{3-}), the radius

(1) decreases
(2) increases
(3) remains the same

34 As the atoms of the Group 17 elements in the ground state are considered from top to bottom, each successive element has

(1) the same number of valence electrons and similar chemical properties
(2) the same number of valence electrons and identical chemical properties
(3) an increasing number of valence electrons and similar chemical properties
(4) an increasing number of valence electrons and identical chemical properties

49 As each successive element in Group 15 of the Periodic Table is considered in order of increasing atomic number, the atomic radius

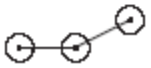
(1) decreases
(2) increases
(3) remains the same

Base your answers to questions 53 through 55 on the data table provided *in your answer booklet*.

53 *In your answer booklet*, record the electronegativity for the elements with atomic numbers 11 through 17. [1]

54 On the grid provided *in your answer booklet*, mark an appropriate scale on the axis labeled "Electronegativity." [1]

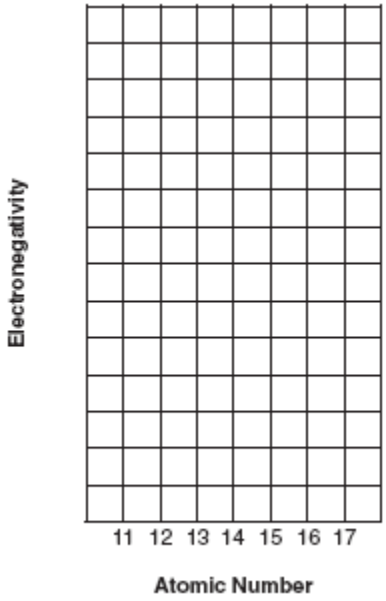
55 On the same grid, plot the data from the data table. Circle and connect the points. [1]

Example: 

53

Atomic Number	Electronegativity
11	
12	
13	
14	
15	
16	
17	

54 and 55



August 2003

5 The elements in the Periodic Table are arranged in order of increasing

(1) atomic number
(2) atomic radius
(3) mass number
(4) neutron number

7 Which element is a solid at STP?

(1) H_2
(2) I_2
(3) N_2
(4) O_2

19 In which group of the Periodic Table do most of the elements exhibit both positive and negative oxidation states?

(1) 17
(2) 2
(3) 12
(4) 7

37 The element in Period 4 and Group 1 of the Periodic Table would be classified as a

(1) metal
(2) metalloid
(3) nonmetal
(4) noble gas

38 As the elements in Period 2 of the Periodic Table are considered in succession from left to right, there is a decrease in atomic radius with increasing atomic number. This may best be explained by the fact that the

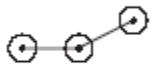
(1) number of protons increases, and the number of shells of electrons remains the same
(2) number of protons increases, and the number of shells of electrons increases
(3) number of protons decreases, and the number of shells of electrons remains the same
(4) number of protons decreases, and the number of shells of electrons increases

Base your answers to questions 56 through 58 on the *Reference Tables for Physical Setting/Chemistry.*

56 Complete the data table provided *in your answer booklet* for the following Group 18 elements: He, Ne, Ar, Kr, Xe [1]

57 Using information from your data table in question 56, construct a line graph on the grid provided *in your answer booklet,* following the directions below.

- Mark an appropriate scale on the axis labeled "First Ionization Energy (kJ/mol)." [1]
- Plot the data from your data table. Circle each point and connect the points. [1]

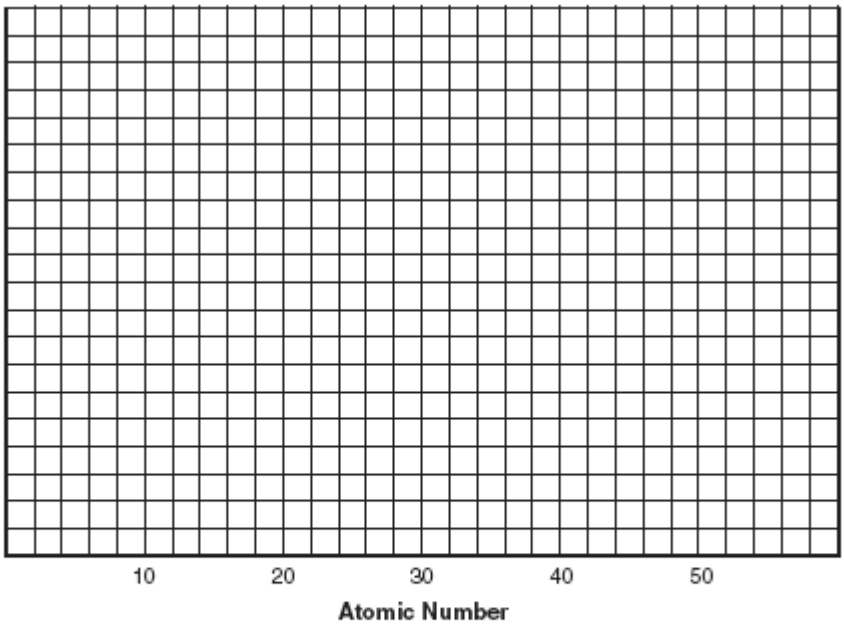
Example: 

58 Based on your graph in question 57, describe the trend in first ionization energy of Group 18 elements as the atomic number increases. [1]

56

Atomic Number	Element	First Ionization Energy (kJ/mol)
2	He	
10	Ne	
18	Ar	
36	Kr	
54	Xe	

57



58 _____

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June 2003

38 Which list of elements is arranged in order of increasing atomic radii?

(1) Li, Be, B, C
(2) Sr, Ca, Mg, Be
(3) Sc, Ti, V, Cr
(4) F, Cl, Br, I

47 Which ion has the same electron configuration as an atom of He?

(1) H^-
(2) O^{2-}
(3) Na^+
(4) Ca^{2+}

Base your answers to questions 53 and 54 on the information below.

Given: Samples of Na, Ar, As, Rb

53 Which *two* of the given elements have the most similar chemical properties? [1]

54 Explain your answer in terms of the Periodic Table of the Elements. [1]

53 _____ and _____

54 _____

_____

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3 In which list are the elements arranged in order of increasing atomic mass?

(1) Cl, K, Ar
(2) Fe, Co, Ni
(3) Te, I, Xe
(4) Ne, F, Na

6 Which Group of the Periodic Table contains atoms with a stable outer electron configuration?

(1) 1
(2) 8
(3) 16
(4) 18

15 The high electrical conductivity of metals is primarily due to

(1) high ionization energies
(2) filled energy levels
(3) mobile electrons
(4) high electronegativities

37 Which list of elements contains *two* metalloids?

(1) Si, Ge, Po, Pb
(2) As, Bi, Br, Kr
(3) Si, P, S, Cl
(4) Po, Sb, I, Xe