

Name _____

Mr. GARDNER

Unit #4: Periodic Table

The Periodic Table of the Elements

3	Li	Atomic Number
	Li	Element Symbol
Lithium	6.94	Element Name
		Average Atomic Mass

1 H Hydrogen 1.01																	2 He Helium 4.00														
3 Li Lithium 6.94	4 Be Beryllium 9.01																	5 B Boron 10.81	6 C Carbon 12.01	7 N Nitrogen 14.01	8 O Oxygen 16.00	9 F Fluorine 19.00	10 Ne Neon 20.18								
11 Na Sodium 22.99	12 Mg Magnesium 24.31																	13 Al Aluminum 26.98	14 Si Silicon 28.09	15 P Phosphorus 30.97	16 S Sulfur 32.07	17 Cl Chlorine 35.45	18 Ar Argon 39.95								
19 K Potassium 39.10	20 Ca Calcium 40.08	21 Sc Scandium 44.96	22 Ti Titanium 47.87	23 V Vanadium 50.94	24 Cr Chromium 52.00	25 Mn Manganese 54.94	26 Fe Iron 55.85	27 Co Cobalt 58.93	28 Ni Nickel 58.69	29 Cu Copper 63.55	30 Zn Zinc 65.39	31 Ga Gallium 69.72	32 Ge Germanium 72.61	33 As Arsenic 74.92	34 Se Selenium 78.96	35 Br Bromine 79.90	36 Kr Krypton 83.80														
37 Rb Rubidium 85.47	38 Sr Strontium 87.62	39 Y Yttrium 88.91	40 Zr Zirconium 91.22	41 Nb Niobium 92.91	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 101.07	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.60	53 I Iodine 126.90	54 Xe Xenon 131.29														
55 Cs Cesium 132.91	56 Ba Barium 137.33	57 La Lanthanum 138.91	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	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 (264)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 Ds Darmstadtium (268)	111 Rg Roentgenium (269)	112 Cn Copernicium (285)																				
																		58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.05	71 Lu Lutetium 174.97
																		90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	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 168.93	102 No Nobelium (259)	103 Lr Lawrencium (260)

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Periodic Table: Vocabulary terms and Key Objectives

VOCABULARY

atomic radius half the distance between two adjacent atoms in a crystal or half the distance between nuclei of identical atoms bonded together

electronegativity a measure of the attraction of a nucleus for a bonded electron

family a vertical column on the periodic table

group a vertical column on the periodic table

ionic radius the distance from the nucleus to the outer energy level of the ion

ionization energy the amount of energy needed to remove the most loosely bound electron from a neutral gaseous atom

metal element whose atoms lose electrons in chemical reactions to become positive ions

metalloid an element that has both metallic and nonmetallic properties

noble gas a nonreactive element that is in group 18 on the periodic table

nonmetal element whose atoms will gain or share electrons in chemical reactions

period a horizontal row of the periodic table

periodic law the properties of elements are periodic functions of their atomic numbers

KEY OBJECTIVES

- State Moseley's Periodic Law
- Describe the arrangement of elements in the modern periodic table in regards to electron configuration
- Describe how metallic and non-metallic properties differ
- Define, describe and locate metalloids
- Define atomic/ionic radius and indicate how the two differ in regards to relative size
- Indicate how the following vary within the periodic table: Ionization energy, metallic character, electronegativity, atomic and ionic radius
- Compare properties of elements in certain groups of the table
- Compare properties of the transition elements
- Describe changes in properties across a period

1

1 **The Periodic Table**2 **Mid 19th century:**

- Mendeleev was the 1st person to arrange a table of elements based on atomic mass.
 - Noticed that similar chemical properties appeared at regular intervals
- Moseley later arranged the table by atomic number (X-rays were used to determine the atomic # of atoms based on the positive charges in the nucleus)
- Periodic Law: properties of elements are periodic functions of their atomic number.
 - Periodic trends are seen throughout table

3 **Modern Periodic Table arranged by:**

-
- Periods= number indicates the principal energy level where the valence electrons are located
 - Horizontal rows on table
- Groups= elements with the same # of valence electrons and thus similar or related properties
 - Vertical columns on table
 - Also known as 'Families'

4 **Arrangement continued:**

- Also broken down into metals, non-metals and metalloids or semimetals (B, Si, Ge, As, Sb, Te) based on:
 - Physical properties: odor, color, hardness, shape, density, malleability, solubility, melting and boiling points
 - Chemical properties or reactivity:
 - vigorous (active)
 - sluggish (inactive)
 - inert (normally do not react) → Noble Gases

5 **Metals: Left side of table**

- Alloys: mixtures of metals that result in improved characteristics and properties (stainless steel, brass, bronze)
- Metallic properties increase as you go down a group (lower Ionization energy and electronegativity)
- Solids at room temp. (except Hg, mercury)
- Density greater than water (except group 1)
- Lose electrons to form (+) ions with a smaller atomic radius

6 **Non-Metals: Top right side of table**

- Gases, molecular or network solids at room temp. (Br, bromine is an exception as it is in liquid form)
- High Ionization Energies (I.E.) and electronegativity

②

- Gain electrons to form (-) ions with a larger atomic radius

7 Allotropes:

- Two or more forms of the same element, differing in molecular or crystalline structure.
- Results in different properties
- Ex. Carbon: diamond, graphite, Fullerenes (buckyballs)
-
-
- Ex. Oxygen: O₂ and O₃ (ozone)

8 Hydrogen:

- Both metallic and non-metallic properties
- Does not belong to group 1
- Does not have similar properties to group 1 elements
- Can lose or gain an electron to form (+/-) oxidation numbers
 - Ex. when bonding to a metal= metal hydride
 - $\text{Na} + \text{H}^- \rightarrow \text{NaH}$

9 Group 1: Alkali metals

Group 2: Alkaline Earth metals

- Occur in nature only in compounds due to high reactivity
- Easily lose electrons due to low I.E.
- Typically form stable ionic compounds (with non-metals)
 - Ex. Sodium Chloride: NaCl
- Elements can be reduced to their free state by electrolysis

10 Group 3-12: Transition elements

- Elements here have an incomplete 'd' sublevel
- May exhibit multiple oxidation states
- Are generally less active than groups 1+2
- Form ions with color (ex. CuSO₄•5H₂O is blue)

11 Group 17: Halogens

- Occur only as compounds due to high reactivity
- Fluorine also derived by electrolysis
- Salts formed called halides
- Held together by Van der waals forces
- Only group to contain all 3 states of matter at room temperature
 - F, Cl → gas
 - Br → liquid
 - I → solid

12 Group 18: Noble Gases

3

- Monatomic elements with filled valence shells
 - Can be found as individual atoms
- May actually form bonds (though not common)

13  *

**

- *Lanthanides: elements 58-71 (extension of period 6)
 - all have similar properties to group 3
 - Would be stacked like a deck of cards on #57
- **Actinides: elements 89-103 (extension of period 7)

14  **Naming elements over 100= latin root system**

- 0= nil
- 1= un
- 2= bi
- 3= tri
- 4= quad
- 5= pent
- 6= hex
- 7= sept
- 8= oct
- 9= enn

15  **Atomic Radius**

- 1/2 the distance between adjacent nuclei of the same element
- helpful to determine density, solubility, melting point and acid strength

16  **Atomic Radius**

- Across period (left to right) a ↓ occurs
 - as atomic number ↑, nuclear charge also ↑ due to ↑ in protons
 - Electons are held more tightly around the nucleus, thus radius will ↓
- Down a group (top to bottom) an ↑ occurs
 - additional energy levels will shield the (+) nucleus, thus the attractive force is reduced and the radius will ↑

17  **Ionic Radius: relative to a neutral atom**

- (+) ion = smaller = known as a cation
- (-) ion = larger = known as an anion

18  **Ionization Energy**

- A) The ease at which an atom will lose an electron
- B) The smaller the IE, the easier the electron will be removed or lost

4

- 1) Metals have low IE (especially Groups 1+2)
- 2) Non-metals have higher IE
- C) Inverse relationship exists between the size of an atom and its first Ionization Energy
 - 1) The larger the atom the easier it will lose an electron, as it is farther from positive nucleus
 - 2) The smaller the atom, the more difficult to remove/lose an electron as it is held closer to positive nucleus

19 **Ionization Energy continued**

- D) As you move down a group, IE decreases
- E) As you move across a period, IE increases
- F) When an atom loses an e-, it becomes a (+)ion
- When an atom gains an e-, it becomes a (-)ion
- G) When atoms combine, one usually has a high IE, while the other will have a low IE
-

20 **Ionization Energy continued**

- IE Summary
- Across a period = general increase
- Down a group = general decrease
- 2nd + 3rd I.E. are successively larger due to more (+) nucleus holding the outer electrons closer
 - Ex. 1st IE $X + \text{energy} \rightarrow X^+ + e^-$
 - Ex. 2nd IE $X^+ + \text{More energy} \rightarrow X^{2+} + e^-$
-

21 **Ionization Energy Periodic Trends**22 **Electronegativity:**

- A measure of the ability of an atom or molecule to attract electrons in a chemical bond.
 - Across a period = general increase
 - Down a group = general decrease
- Basis for determining bond types (non-polar, polar and ionic)
 - If difference is zero = non-polar
 - Difference of 0.1→1.7 = polar
 - Though lower values are sometimes considered to be non-polar (ex. 0.1→0.3 etc)
 - Difference of 1.7 and above = ionic

23 **Electronegativity:**

5

The Elements
by Tom Lehrer

There's antimony, arsenic, aluminum, selenium,
And hydrogen and oxygen and nitrogen and rhenium
And nickel, neodymium, neptunium, germanium,
And iron, americium, ruthenium, uranium,
Europium, zirconium, lutetium, vanadium
And lanthanum and osmium and astatine and radium
And gold, protactinium and indium and gallium (*inhale*)
And iodine and thorium and thulium and thallium.

There's yttrium, ytterbium, actinium, rubidium
And boron, gadolinium, niobium, iridium
And strontium and silicon and silver and samarium,
And bismuth, bromine, lithium, beryllium and barium.

Isn't that interesting? (Laughter.)

I knew you would.

*I hope you're all taking notes, because there's gonna be a short quiz next
period.*

There's holmium and helium and hafnium and erbium
And phosphorous and francium and fluorine and terbium
And manganese and mercury, molybdenum, magnesium,
Dysprosium and scandium and cerium and cesium
And lead, praseodymium, and platinum, plutonium,
Paladium, promethium, potassium, polonium, and
Tantalum, technetium, titanium, tellurium, (*inhale*)
And cadmium and calcium and chromium and curium.

There's sulfur, californium and fermium, berkelium
And also mendelevium, einsteinium, nobelium
And argon, krypton, neon, radon, xenon, zinc and rhodium
And chlorine, carbon, cobalt, copper, tungsten, tin and sodium

These are the only ones of which the news has come to Ha'vard,
And there may be many others but they haven't been discavared.



Name: _____

Date: _____

Class: _____

See if you can figure out the following element riddles with the hints below!

- 1) What I do when I am chased. _____
- 2) A goofy inmate. _____
- 3) What I do when I'm hungry. _____
- 4) Fermented water. _____
- 5) Man of the Ganese tribe. _____
- 6) What they call their rich aunt. _____
- 7) Why she wears perfume. _____
- 8) What he did to the horse. _____
- 9) Half a dime. _____
- 10) The lone ranger's horse. _____
- 11) Having little fat. _____
- 12) A person who gives traffic tickets. _____
- 13) What a torpedoed ship will do. _____
- 14) On ox's outer covering. _____
- 15) Eve's husband. _____
- 16) A storage place for cars. _____
- 17) What you do with wounded men. _____
- 18) What you do with sick people. _____
- 19) What you do with dead people. _____

.....

Iodine	Nickel	Oxide	Atom	Silver	Tin
Copper	Carbon	Barium	Iron	Silicon	Zinc
Manganese	Gold	Hydrogen	Rhodium	Tellurium	Antimony
Oxygen	Curium	Chlorine	Neon	Lead	Helium

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Name: _____

An Elemental Challenge

Clue	Element Symbol	Element Name
Masculine pronoun		
Sound a horse makes		
35th President's middle initial		
Fish ' _ Chips		
Oprah's magazine		
Enthalpy		
Response to a very cold day		
Average grade		
A nurse		
Pressure		
Me, myself, and _		
Entropy		
__ <i>The World Turns</i>		
Hamlet: To __ or not to __		
Deli sandwich: __-Boy		
Spanish for "yes"		
43rd President's middle initial		
Jack's giant yelled this		
Good __, see you later...		
Cow's favorite response		
When you don't win or lose		
Volume		
A toddler's common question		
Hershey, __		
Not me, it must be __		
One of Santa's favorite words		
Before noon		
AIM speak for <i>No Problem</i>		
A serious lung disease		
A father's response to a stinky diaper		
Opposite of out		
Cajun Country		
Afternoon		
Let sleeping dogs __		
Cheering on the home team		
Sound a sheep makes		
Strike out in baseball		
France		
A toddler's common response		
e.g., Everest		

8

14 PERIODIC TABLE

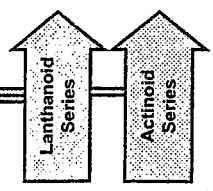
(Based on Carbon 12 = 12.000)

Nonmetals

Metals

1* IA*		Metals										Nonmetals					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
H Hydrogen 1.007 94	He Helium 4.002 602	Li Lithium 6.941	Be Beryllium 9.012 182	B Boron 10.811	C Carbon 12.011	N Nitrogen 14.006 74	O Oxygen 15.999 4	F Fluorine 18.998 403 2	Ne Neon 20.179 7	Na Sodium 22.989 768	Mg Magnesium 24.305 0	Al Aluminum 26.981 539	Si Silicon 28.085 5	P Phosphorus 30.973 762	S Sulfur 32.066	Cl Chlorine 35.452 7	Ar Argon 39.948
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K Potassium 39.098 3	Ca Calcium 40.078	Sc Scandium 44.955 910	Ti Titanium 47.88	V Vanadium 50.941 5	Cr Chromium 51.996 1	Mn Manganese 54.938 05	Fe Iron 55.847	Co Cobalt 58.933 20	Ni Nickel 58.693 4	Cu Copper 63.546	Zn Zinc 65.39	Ga Gallium 69.723	Ge Germanium 72.61	As Arsenic 74.921 59	Se Selenium 78.96	Br Bromine 79.904	Kr Krypton 83.80
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb Rubidium 85.467 8	Sr Strontium 87.62	Y Yttrium 88.905 85	Zr Zirconium 91.224	Nb Niobium 92.906 38	Mo Molybdenum 95.94	Tc Technetium 97.907 2	Ru Ruthenium 101.07	Rh Rhodium 102.905 50	Pd Palladium 106.42	Ag Silver 107.868 2	Cd Cadmium 112.411	In Indium 114.82	Sn Tin 118.710	Sb Antimony 121.757	Te Tellurium 127.60	I Iodine 126.904 47	Xe Xenon 131.290
55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
Cs Cesium 132.905 43	Ba Barium 137.327	La Lanthanum 138.905 5	Ce Cerium 140.115	Pr Praseodymium 140.907 65	Nd Neodymium 144.24	Pm Promethium 144.912 8	Sm Samarium 150.36	Eu Europium 151.965	Gd Gadolinium 157.25	Tb Terbium 158.925 34	Dy Dysprosium 162.50	Ho Holmium 164.930 32	Er Erbium 167.26	Tm Thulium 168.934 21	Yb Ytterbium 173.04	Lu Lutetium 174.967	Hf Hafnium 178.49
87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
Fr Francium 223.019 7	Ra Radium 226.025 4	Ac Actinium 227.027 8	Th Thorium 232.038 1	Pa Protactinium 231.036 88	U Uranium 238.028 9	Np Neptunium 237.048 2	Pu Plutonium 244.064 2	Am Americium 243.061 4	Cm Curium 247.070 3	Bk Berkelium 247.070 3	Cf Californium 251.079 6	Es Einsteinium 252.082 8	Fm Fermium 257.095 1	Md Mendelevium 258.098 6	No Nobelium 259.100 9	Rn Radon 222.017 6	At Astatine 209.987 1

*Metalloids lie along this heavy staircase line.



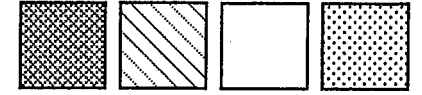
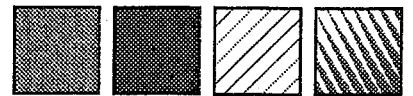
*Currently there are two systems of labeling groups on the periodic table. A traditional system uses Roman numerals I through VIII with letters A and B. A more current system uses Arabic numerals I through 18, with no A and B designations. Throughout this text the current system will be used with traditional heading following in parenthesis, for example, Group 1 (IA).

9

16 GROUPS OF ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
H	He																
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Lr	Unq	Unp	Unh	Uns	Uno	Une									

La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No



Chalcogens

Halogens

Noble gases

Transition metals

Alkali metals

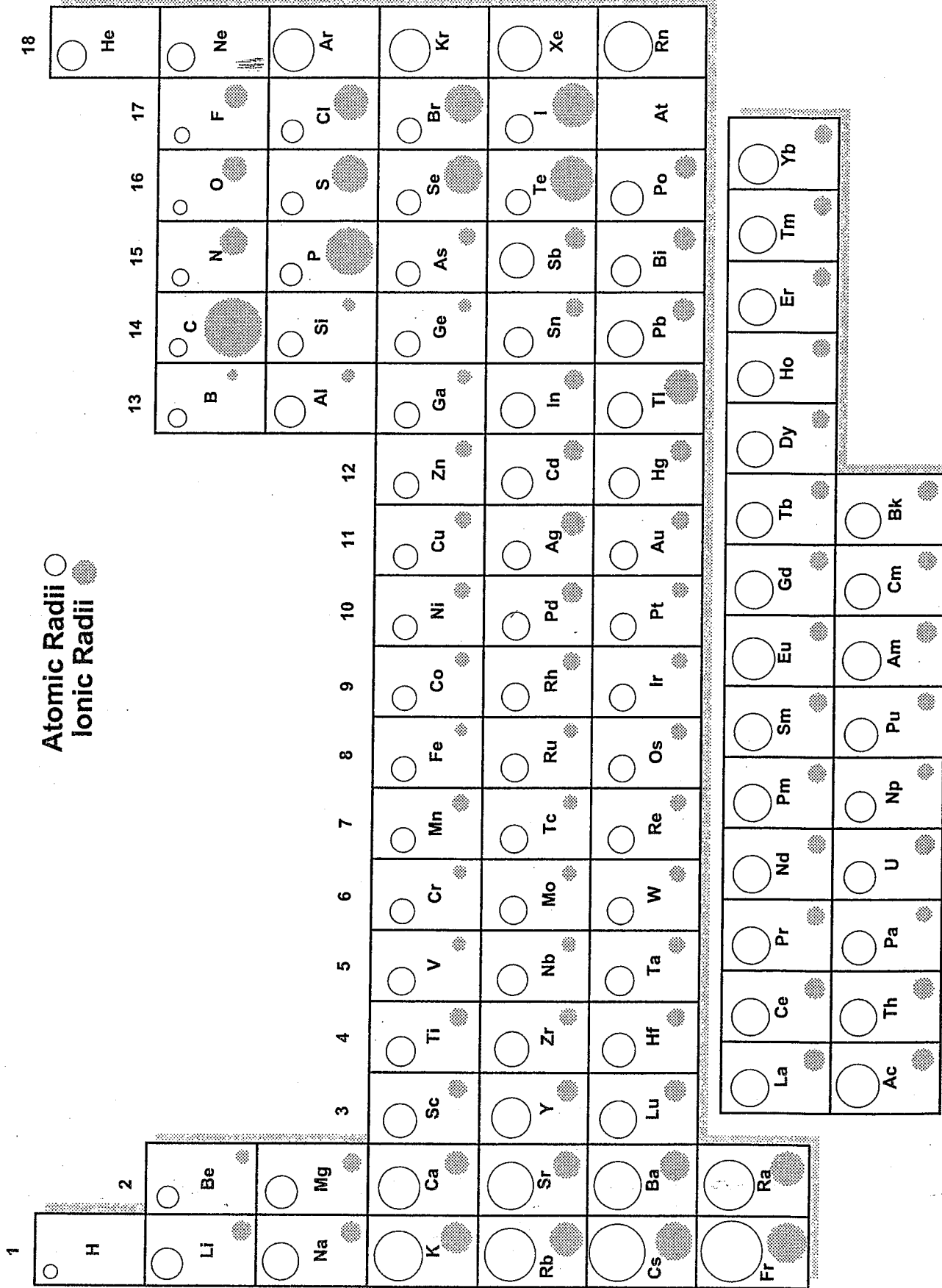
Alkaline earth metals

Lanthanoids

Actinoids

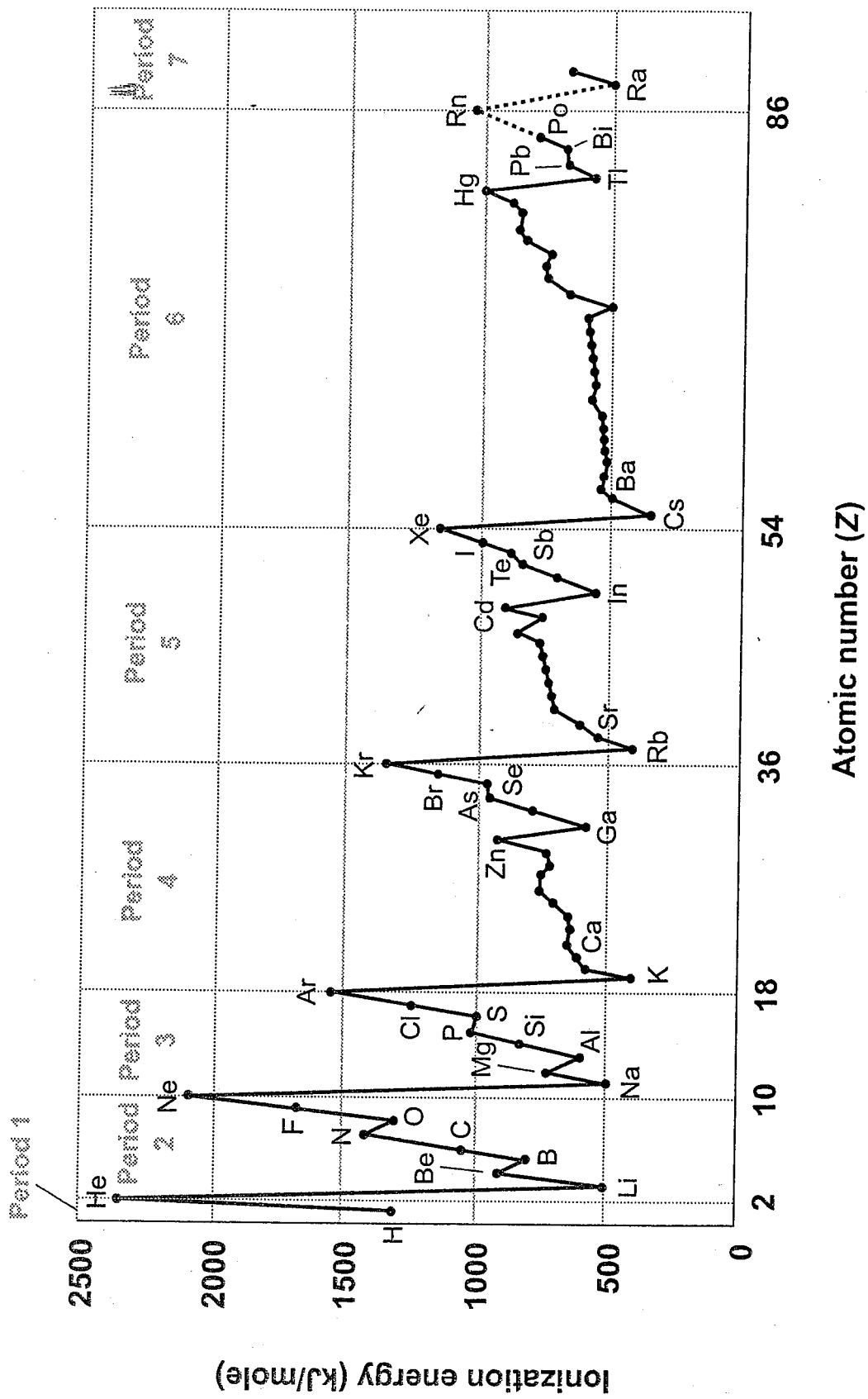
10

21 ATOMIC AND IONIC RADII



==

24 IONIZATION ENERGY VERSUS ATOMIC NUMBER



12

Name _____

Getting To Know the Periodic Table

Objective: To be able to use the periodic table to identify and classify elements and to use the periodic table to predict the behavior of elements

Procedure:

1. Number the groups.
2. Number the periods
3. Draw a heavy black line between the metals and nonmetals.
4. Write the name of each of the following groups above the number:

Group 1	alkali metals
Group 2	alkaline earth metal
Group 3-12	(collectively) transition metals
Group 16	chalcogens
Group 17	halogens
Group 18	Noble gases
5. Write the names of the two rows at the bottom of the chart: lanthanides and actinides
6. Write the symbol of each element that exists as a gas at ordinary conditions in RED.
7. Write the symbol of each element that is a solid at ordinary conditions in BLACK.
8. Write the symbol of each element that is a liquid at ordinary condition in BLUE.
9. Write the symbol of each element that is a man-made element as **Bold**. Example: **Pm**
10. Place the atomic number for each element above the symbol.
11. Use the following chart to lightly shade the periodic table.

Halogen	blue
Noble gases	yellow
Alkali metals	purple
Alkaline earth metals	red
Transition elements	green
Chalcogens	brown
Lanthanides	orange
Actinides	light blue
12. Outline the symbol's box in dark green if it is RADIOACTIVE in its most common form.

13

KEY:

RED {GAS}

H, He, N, O, F, Ne, Cl, Ar, Kr, Xe, Rn, Sm, Eu, Gd

BLUE {LIQUID}

Ga, Br, Cs, Hg, Fr

GREEN {RADIOACTIVE}

Tc, Po, At, Rn, Fr, Ra, Rf, Ha, La, Ce, Pr, Nd, Pm, Ac, Th, Pa, U, Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, Lr



BOLD {SYNTHETIC}

Tc, Pm, Np, Pu, Am, Cm, Bk, Cr, Es, Fm, Md, No, Lr

BLACK {SOLID}

Li, Be, B, C, Na, Mg, Al, Si, P, S, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ge, As, Se, Rb, Sr, Y, Zr, Nb, Mo, Ru, Rh, Pd, Ag, Cd, In, Sn, Sb, Te, I, Ba, Hf, Ta, W, Re, Os, Ir, Pt, Au, Tl, Pb, Bi, Po, At, Ra, Rf, Ha, Sg, Bh, Hs, Mt, Tb, Dy, Ho, Er, Tm, Yb, Lu, Uun, Uuu, Uub

Name _____

Periodic Table Review

MEMORY JOGGER

In Chapter 2 you learned how to use charges to write correct formulas. Remember that all compounds must be electrically neutral. When the charges in a compound formed from two ions are the same but of opposite sign, the ions combine in a 1:1 ratio. If the charges are different, write the charge of one as the subscript of the other to obtain the correct formula.

Group 2 elements have two valence electrons and form compounds with Group 17 elements having the general formula MX_2 . Examples include $BeCl_2$, $MgBr_2$, and CaF_2 .



Review Questions

30. Which value represents the first ionization energy of a nonmetal? (1) 497.9 kJ (2) 577.4 kJ (3) 811.7 kJ (4) 1000. kJ
31. As the elements of Group 1 are considered in order from top to bottom, the first ionization energy of each successive element will (1) decrease (2) increase (3) remain the same (4) follow an unpredictable pattern
32. Compared to an atom of potassium, an atom of calcium has a (1) larger radius and lower reactivity (2) larger radius and higher reactivity (3) smaller radius and lower reactivity (2) smaller radius and higher reactivity
33. Which statement describes the elements in Period 3? (1) Each successive element has a greater atomic radius. (2) Each successive element has a lower electronegativity. (3) All elements have similar chemical properties. (4) All elements have valence electrons in the same principal energy level.
34. As atoms of elements in Group 16 are considered in order from top to bottom, the electronegativity of each successive element (1) decreases (2) increases (3) remains the same (4) cannot be predicted by a trend
35. A nonmetal could have an electronegativity of (1) 1.0 (2) 2.0 (3) 1.6 (4) 2.6
36. Which properties are most common in nonmetals? (1) low ionization energy and low electronegativity (2) low ionization energy and high electronegativity (3) high ionization energy and low electronegativity (4) high ionization energy and high electronegativity
37. A diatomic element with a high first ionization energy would most likely be a (1) nonmetal with a high electronegativity (2) nonmetal with a low electronegativity (3) metal with a high electronegativity (4) metal with a low electronegativity
38. Which element at room temperature is a poor conductor of electricity and has a relatively high electronegativity? (1) Cu (2) S (3) Mg (4) Fe
39. Within Period 2 of the periodic table, as the atomic number increases, the atomic radius generally (1) decreases (2) increases (3) remains the same (4) follows no pattern
40. Atoms of which element have the smallest radius? (1) Si (2) P (3) S (4) Cl
41. Which statement best compares the atomic radius of a potassium atom and the atomic radius of a calcium atom? (1) The radius of the potassium atom is smaller because of its smaller nuclear charge. (2) The radius of the potassium atom is smaller because of its larger nuclear charge. (3) The radius of the potassium atom is larger because of its smaller nuclear charge. (4) The radius of the potassium atom is larger because of its larger nuclear charge.
42. According to the reference table, which of the following elements has the smallest radius? (1) nickel (2) cobalt (3) calcium (4) potassium
43. In which area of the periodic table are the elements with the strongest nonmetallic properties located? (1) lower left (2) upper left (3) lower right (4) upper right
44. At which location in the periodic table would the most active metallic element be found? (1) in Group 1 at the top (2) in Group 1 at the bottom (3) in Group 17 at the top (4) in Group 17 at the bottom
45. In which section of the periodic table are the most active nonmetals located? (1) upper right corner (2) lower right corner (3) upper left corner (4) lower left corner
46. What is the total number of elements in Group 17 that are gases at room temperature and standard pressure? (1) 1 (2) 2 (3) 3 (4) 4

16

47. Which of the following groups in the periodic table contain elements so reactive that they are never found in the free state? (1) 1 and 2 (2) 1 and 11 (3) 2 and 15 (4) 11 and 15
48. Which halogen can only be prepared from its fused compounds? (1) I_2 (2) Cl_2 (3) Br_2 (4) F_2
49. As the elements in Group 15 are considered in order of increasing atomic number, which sequence in properties occurs? (1) nonmetal \rightarrow metalloid \rightarrow metal (2) metalloid \rightarrow metal \rightarrow nonmetal (3) metal \rightarrow metalloid \rightarrow nonmetal (4) metal \rightarrow nonmetal \rightarrow metalloid
50. Which elements have the most similar chemical properties? (1) K and Na (2) K and Cl (3) K and Ca (4) K and S
51. Because of its high reactivity, which element is normally obtained by the electrolysis of its fused salts? (1) sulfur (2) lithium (3) argon (4) gold
52. Which element in Group 17 is the most active non-metal? (1) Br (2) I (3) Cl (4) F
53. Which of the following Group 15 elements has the most metallic properties? (1) Bi (2) P (3) Sb (4) N
54. The elements calcium and strontium have similar chemical properties because they both have the same (1) atomic number (2) mass number (3) number of valence electrons (4) number of completely filled subshells
55. Which Group 15 element exists as a diatomic molecule at room temperature and pressure? (1) phosphorus (2) nitrogen (3) bismuth (4) arsenic
56. Which two elements have chemical properties that are most similar? (1) Cl and Ar (2) Li and Na (3) K and Ca (4) C and N
57. In which set do the elements exhibit the most similar chemical properties? (1) N, O, and F (2) Hg, Br, and Rn (3) Li, Na, and K (4) Al, Si, and P
58. Which of these metals loses electrons most readily? (1) calcium (2) magnesium (3) potassium (4) sodium
59. If M represents an element in Group 2, the formula of its chloride would be (1) MCl (2) MCl_2 (3) M_2Cl (4) M_2Cl_2
60. Which group below contains elements with the greatest variation in chemical properties? (1) Li, Be, B (2) Li, Na, K (3) B, Al, Ga (4) Be, Mg, Ca
61. Which element in Group 15 would most likely have luster and good electrical conductivity? (1) N (2) P (3) Bi (4) As
62. Which statement best describes the Group 2 metals? (1) They have one valence electron, and they form ions with a 1+ charge. (2) They have one valence electron, and they form ions with a 1- charge. (3) They have two valence electrons, and they form ions with a 2+ charge. (4) They have two valence electrons, and they form ions with a 2- charge.
63. Which element in Group 15 has the strongest metallic character? (1) Bi (2) As (3) P (4) N
64. Which halogens are gases at room temperature and pressure? (1) chlorine and fluorine (2) chlorine and bromine (3) iodine and fluorine (4) iodine and bromine
65. In which group of elements do the atoms gain electrons most readily? (1) 1 (2) 2 (3) 16 (4) 18
66. Which element is more reactive than strontium? (1) potassium (2) calcium (3) iron (4) copper
67. The oxide of metal X has the formula XO . Which group in the periodic table contains metal X? (1) Group 1 (2) Group 2 (3) Group 13 (4) Group 17
68. As elements in a group of the periodic table are considered in order from top to bottom, the metallic character of each successive element generally (1) decreases (2) increases (3) remains the same (4) follows no pattern
69. As the elements in Period 3 are considered from left to right, they tend to (1) lose electrons more readily and increase in metallic character (2) lose electrons more readily and increase in nonmetallic character (3) gain electrons more readily and increase in metallic character (4) gain electrons more readily and increase in nonmetallic character
70. An atom of which element in the ground state has a complete outermost energy level? (1) He (2) Be (3) Hg (4) H
71. Which of the following Group 15 elements has the most metallic properties? (1) Bi (2) P (3) Sb (4) N
72. As the atoms of the elements in Group 1 of the periodic table are considered from top to bottom, the number of valence electrons in the atoms of each successive element (1) decreases (2) increases (3) remains the same (4) follows no pattern

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73. Which element attains the structure of a noble gas when it becomes a 1+ ion? (1) K (2) Ca (3) F (4) Ne

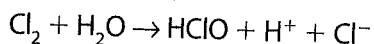
74. According to the reference table, which sequence correctly places the elements in order of increasing ionization energy? (1) H→Li→Na→K
(2) I→Br→Cl→F (3) O→S→Se→Te
(4) H→Be→Al→Ga

Answer the following questions, using complete sentences when appropriate.

75. The ionization energy of Na is 118 kcal, while the ionization energy of Mg to form Mg^+ is 175. While this is the expected result for an adjacent element, the ionization of Na^+ to Na^{2+} is 1091 kcal, while only 345 kcal is needed to ionize Mg^+ to Mg^{2+} . Explain.

76. The Na^+ ion has a smaller radius than the Ne atom. Explain why this is so.

77. Chlorine reacts with water according to the equation:



Write an equation to show how iodine reacts with water.

78. Why is the periodic table organized by increasing atomic number rather than by increasing atomic mass, as had been suggested by Mendeleev?

79. Explain why the members of Group 1 react by losing an electron, but the members of Group 17 react by gaining an electron.

80. Let the letter M stand for a member of Group 13. What is the formula of the combination of this element with bromine? With oxygen? Explain.

81. Why is hydrogen not considered to be a member of Group 1 (the alkali metals)?

82. Consider atoms of the elements boron, carbon and aluminum. Which is the largest? The smallest? Which has the highest ionization energy? The lowest?

83. Why do elements in a given group of the periodic table show similar chemical properties?

84. Why do the elements of a given period always follow the progression of metal to metalloid to nonmetal to noble gas?

85. What change in charge takes place as a metal loses one or more electrons?

86. Using the law of octets, explain why it is unlikely for sodium to form a Na^{2+} ion.

87. What would be the general formula of a Group 2 element (represented by M) combined with chlorine of Group 17?

88. What would be the general formula of a Group 17 element (represented by X) combined with magnesium of Group 2?

89. What would be the general formula of a Group 1 element combined with an element of Group 16?

90. Mendeleev arranged the elements on the table in order of increasing atomic mass, but it was later learned that the correct order is by increasing atomic number. Study the periodic table and locate examples where the atomic number of two successive elements increases, but the atomic mass decreases.



Questions for Regents Practice

Part A

1. The elements in the modern periodic table are arranged according to their

- (1) atomic number
- (2) oxidation number
- (3) atomic mass
- (4) nuclear mass

2. Which characteristic describes most nonmetals in the solid phase?

- (1) good conductors of electricity
- (2) good conductors of heat
- (3) malleable
- (4) brittle

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3. When combining with nonmetallic atoms, metallic atoms generally will
- (1) lose electrons and form negative ions
 - (2) lose electrons and form positive ions
 - (3) gain electrons and form negative ions
 - (4) gain electrons and form positive ions
4. When metal atoms bond with nonmetal atoms, the nonmetal atoms will
- (1) lose electrons and the resulting ions are smaller
 - (2) lose electrons and the resulting ions are larger
 - (3) gain electrons and the resulting ions are smaller
 - (4) gain electrons and the resulting ions are larger
5. Which characteristic describes most metals in the solid phase?
- (1) good conductors of electricity
 - (2) poor conductors of heat
 - (3) dull
 - (4) brittle
6. Which element is a nonmetallic liquid at room temperature?
- (1) hydrogen
 - (2) oxygen
 - (3) mercury
 - (4) bromine
7. Which physical characteristic of a solution may indicate the presence of a transition element?
- (1) its density
 - (2) its color
 - (3) its effect on litmus
 - (4) its effect on phenolphthalein
8. Compared to atoms of metals, atoms of nonmetals generally
- (1) have higher electronegativity values
 - (2) have lower first ionization energies
 - (3) conduct electricity more readily
 - (4) lose electrons more readily
9. Properties of metals include
- (1) low ionization energy and high electronegativity
 - (2) low ionization energy and low electronegativity
 - (3) high ionization energy and high electronegativity
 - (4) high ionization energy and low electronegativity
10. Which part of the periodic table contains elements with the strongest metallic properties?
- (1) upper right
 - (2) upper left
 - (3) lower right
 - (4) lower left
11. Which Group 17 element is a solid at room temperature and pressure?
- (1) Br₂
 - (2) F₂
 - (3) Cl₂
 - (4) I₂
12. Which gas is monatomic at room temperature and pressure?
- (1) nitrogen
 - (2) neon
 - (3) fluorine
 - (4) chlorine
13. Atoms of elements in a group of the periodic table have similar chemical properties. This similarity is most closely related to the atoms'
- (1) number of principal energy levels
 - (2) number of valence electrons
 - (3) atomic numbers
 - (4) atomic masses
14. In which group are all the elements found naturally only in compounds?
- (1) 18
 - (2) 2
 - (3) 11
 - (4) 14

Part B

15. An element is a solid at room temperature. It can be a
- (1) metal only
 - (2) metalloid only
 - (3) metal or a nonmetal only
 - (4) metal, a metalloid, or a nonmetal

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16. How does the size of a barium ion compare to the size of a barium atom?
- (1) The ion is smaller because it has fewer electrons.
 - (2) The ion is smaller because it has more electrons.
 - (3) The ion is larger because it has fewer electrons.
 - (2) The ion is larger because it has more electrons.
17. Which element is malleable and ductile?
- (1) S
 - (2) Si
 - (3) Ge
 - (4) Au
18. Which of the following Period 4 elements has the most metallic characteristics?
- (1) Ca
 - (2) Ge
 - (3) As
 - (4) Br
19. Which three groups of the periodic table contain the most elements classified as metalloids?
- (1) 1, 2, and 13
 - (2) 2, 13, and 14
 - (3) 14, 15, and 16
 - (4) 16, 17, and 18
20. An aqueous solution of XCl_2 contains colored ions. Element X could be
- (1) Ba
 - (2) Ca
 - (3) Ni
 - (4) Bi
21. Which element has the highest first ionization energy?
- (1) sodium
 - (2) aluminum
 - (3) calcium
 - (4) phosphorus
22. An element has a first ionization energy of 1314 kJ/mol and an electronegativity of 3.5. It is classified as a
- (1) metal
 - (2) nonmetal
 - (3) metalloid
 - (4) halogen
23. Which sequence of elements is arranged in order of decreasing atomic radii?
- (1) Al, Si, P
 - (2) Li, Na, K
 - (3) Cl, Br, I
 - (4) N, C, B
24. Which ion has the largest radius?
- (1) Na^+
 - (2) Mg^{2+}
 - (3) K^+
 - (4) Ca^{2+}
25. In the ground state, atoms of the elements in Group 15 of the periodic table all have the same number of
- (1) filled principal energy levels
 - (2) occupied principal energy levels
 - (3) neutrons in the nucleus
 - (4) electrons in the valence energy level.
26. Which of the following Group 18 elements would be most likely to form a compound with fluorine?
- (1) He
 - (2) Ne
 - (3) Ar
 - (4) Kr
27. The properties of carbon are expected to be most similar to those of
- (1) boron
 - (2) aluminum
 - (3) silicon
 - (4) phosphorus
28. If M represents an alkali metal of Group 1, what is the formula for the compound formed by M and oxygen?
- (1) MO_2
 - (2) M_2O
 - (3) M_2O_3
 - (4) M_3O_2
29. An atom of an element has 28 innermost electrons and 7 valence electrons. In which period of the periodic table is this element located?
- (1) 2
 - (2) 3
 - (3) 4
 - (4) 5

Part C

30. Mendeleev arranged the periodic table in order of increasing atomic masses. Locate iodine and tellurium on the table and note that they are not arranged by increasing mass, and yet Mendeleev placed iodine in Group 17 and tellurium in Group 16. What is the likely reason that he did not arrange them by increasing mass?
31. Ions are isoelectronic when they contain the same number of electrons. Which of the following ions are isoelectronic? Mg^{2+} , Cl^- , Al^{3+} , K^+ , S^{2-} , Ba^{2+} . For each of the preceding ions, name the noble gas that it is isoelectronic with.
32. If K_2O , SrO , and Al_2O_3 are correct formulas, predict the formulas of the oxides of Rb, Mg, and Ga.
33. A sample of a substance decomposes, leaving a solid that will not undergo further decomposition. It is a solid that conducts electricity and has a melting point of 2160 K and a density of 6.1 g/cm^3 . Using your knowledge of chemistry and the reference tables, identify the element.
34. An element has an atomic radius of 160 pm, and an electronegativity of 1.3. Using your reference table identify the elements that it could be. Using other properties on the table how would you test to see which of these elements it was?
35. Why does chemical reactivity increase from top to bottom of Group 1, while it decreases from top to bottom of Group 17?
36. Which of the following has the greater ionization energy, Na or Na^+ ? Explain your answer.

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Periodic Table Quiz

Match each item with the correct statement below.

- | | |
|----------------------|-----------------|
| a. electronegativity | f. periodic law |
| b. ionization energy | g. cation |
| c. atomic radius | h. period |
| d. metal | i. group |
| e. transition metal | j. electrons |

- _____ 1. type of element that is a good conductor of heat and electric current
- _____ 2. one-half the distance between the nuclei of two atoms when the atoms are joined
- _____ 3. type of ion formed by Group 2A elements
- _____ 4. subatomic particles that are transferred to form positive and negative ions
- _____ 5. energy required to remove an electron from an atom

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

- _____ 6. Which of the following elements is in the same period as phosphorus?
a. carbon b. magnesium c. nitrogen d. oxygen
- _____ 7. Each period in the periodic table corresponds to _____.
a. a principal energy level b. an energy sublevel c. an orbital d. a suborbital
- _____ 8. Which of the following categories includes the majority of the elements?
a. metalloids b. liquids c. metals d. nonmetals
- _____ 9. Which of the following elements is a transition metal?
a. cesium b. copper c. tellurium d. tin
- _____ 10. How does atomic radius change from top to bottom in a group in the periodic table?
a. It tends to decrease. b. It tends to increase. c. It first increases, then decreases. d. It first decreases, then increases.
- _____ 11. Atomic size generally _____.
a. increases as you move from left to right across a period b. decreases as you move from top to bottom within a group c. remains constant within a period d. decreases as you move from left to right across a period
- _____ 12. What element in the second period has the largest atomic radius?
a. carbon b. lithium c. potassium d. neon

Short Answer

13. Which group of elements in the periodic table is known as the alkali metals?

Numeric Response

14. How many electrons does the ion Ca^{2+} contain?

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Name _____

Periodic Table Pop Quiz

- 1) Explain the following in regards to fireworks:
 - a. Why is light given off during this display?

 - b. What is the reason for the different colors observed?

- 2) What is the difference between monatomic and diatomic elements. Give examples of each, perhaps even something you learned in class to help you remember them.

- 3) How would you know you were looking at a transition element in the ion/compound form?

- 4) What is special about the halogens in terms of physical state at room temperature?

- 5) What happens to the size and charge of a neutral atom as it loses an electron?

- 6) Regarding the table:
 - a. The horizontal rows in the table are called _____

 - b. The vertical columns are called _____

- 7) Does two or more structures for the same element refers to an allotrope or an alloy? (Circle the best choice)

- 8) Why do the noble gasses typically not react?

- 9) Convert 254 mm into Km:

- 10) Explain two reasons why you should always wear safety goggles while doing experiment dealing with chemicals

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The Periodic Table

Multiple Choice

Identify the choice that best completes the statement or answers the question.

- _____ 1. Which of the following elements is in the same period as phosphorus?
a. carbon b. magnesium c. nitrogen d. oxygen
- _____ 2. Each period in the periodic table corresponds to _____.
a. a principal energy level b. an energy sublevel c. an orbital d. a suborbital
- _____ 3. The modern periodic table is arranged in order of increasing atomic _____.
a. mass b. charge c. number d. radius
- _____ 4. Who arranged the elements according to atomic mass and used the arrangement to predict the properties of missing elements?
a. Henry Moseley b. Antoine Lavoisier c. John Dalton d. Dmitri Mendeleev
- _____ 5. Which of the following categories includes the majority of the elements?
a. metalloids b. liquids c. metals d. nonmetals
- _____ 6. Of the elements Pt, V, Li, and Kr, which is a nonmetal?
a. Pt b. V c. Li d. Kr
- _____ 7. To what category of elements does an element belong if it is a poor conductor of electricity?
a. transition elements b. metalloids c. nonmetals d. metals
- _____ 8. In which of the following sets is the symbol of the element, the number of protons, and the number of electrons given correctly?
a. In, 49 protons, 49 electrons b. Zn, 30 protons, 60 electrons c. Cs, 55 protons, 132.9 electrons d. F, 19 protons, 19 electrons
- _____ 9. The atomic number of an element is the total number of which particles in the nucleus?
a. neutrons b. protons c. electrons d. protons and electrons
- _____ 10. Which of the following electron configurations is most likely to result in an element that is relatively inactive?
a. a half-filled energy sublevel b. a filled energy sublevel c. one empty and one filled energy sublevel d. a filled highest occupied principal energy level
- _____ 11. Which subatomic particle plays the greatest part in determining the properties of an element?
a. proton b. electron c. neutron d. none of the above
- _____ 12. Which of the following elements is a transition metal?
a. cesium b. copper c. tellurium d. tin
- _____ 13. How does atomic radius change from top to bottom in a group in the periodic table?
a. It tends to decrease. b. It tends to increase. c. It first increases, then decreases. d. It first decreases, then increases.
- _____ 14. How does atomic radius change from left to right across a period in the periodic table?
a. It tends to decrease. b. It tends to increase. c. It first increases, then decreases. d. It first decreases, then increases.

Name: _____

ID: A

- _____ 15. What element in the second period has the largest atomic radius?
a. carbon b. lithium c. potassium d. neon
- _____ 16. Which of the following factors contributes to the increase in atomic size within a group in the periodic table as the atomic number increases?
a. more shielding of the electrons by the highest occupied energy level b. an increase in size of the nucleus
c. an increase in number of protons d. fewer electrons in the highest occupied energy level
- _____ 17. Which of the following elements has the smallest atomic radius?
a. sulfur b. chlorine c. selenium d. bromine
- _____ 18. What is the charge of a cation?
a. a positive charge b. no charge c. a negative charge d. The charge depends on the size of the nucleus.
- _____ 19. Which of the following statements is true about ions?
a. Cations form when an atom gains electrons. b. Cations form when an atom loses electrons. c. Anions form when an atom gains protons. d. Anions form when an atom loses protons.
- _____ 20. What is the element with the highest electronegativity value?
a. cesium b. helium c. calcium d. fluorine
- _____ 21. What is the energy required to remove an electron from an atom in the gaseous state called?
a. nuclear energy b. ionization energy c. shielding energy d. electronegative energy
- _____ 22. For Group 2A metals, which electron is the most difficult to remove?
a. the first b. the second c. the third d. All the electrons are equally difficult to remove.
- _____ 23. Compared with the electronegativities of the elements on the left side of a period, the electronegativities of the elements on the right side of the same period tend to be _____.
a. lower b. higher c. the same d. unpredictable

Review Chapters 1 + 2

Atomic Structure/Periodic Table

Multiple Choice

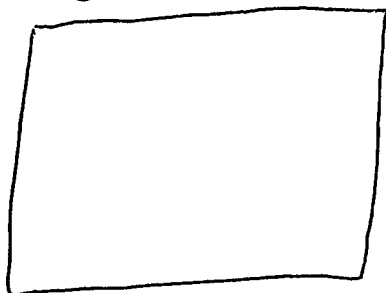
Identify the letter of the choice that best completes the statement or answers the question.

- _____ 1. Each period in the periodic table corresponds to _____.
a. a principal energy level b. an energy sublevel c. an orbital d. a suborbital
- _____ 2. To what category of elements does an element belong if it is a poor conductor of electricity?
a. transition elements b. metalloids c. nonmetals d. metals
- _____ 3. The atomic number of an element is the total number of which particles in the nucleus?
a. neutrons b. protons c. electrons d. protons and electrons
- _____ 4. Which subatomic particle plays the greatest part in determining the properties of an element?
a. proton b. electron c. neutron d. none of the above
- _____ 5. Which of the following elements is a transition metal?
a. cesium b. copper c. tellurium d. tin
- _____ 6. How does atomic radius change from left to right across a period in the periodic table?
a. It tends to decrease. b. It tends to increase. c. It first increases, then decreases. d. It first decreases, then increases.
- _____ 7. What causes the shielding effect to remain constant across a period?
a. Electrons are added to the same principal energy level. b. Electrons are added to different principal energy levels. c. The charge on the nucleus is constant. d. The atomic radius increases.
- _____ 8. What is the charge of a cation?
a. a positive charge b. no charge c. a negative charge d. The charge depends on the size of the nucleus.
- _____ 9. Why is the second ionization energy greater than the first ionization energy?
a. It is more difficult to remove a second electron from an atom. b. The size of atoms increases down a group. c. The size of anions decreases across a period. d. The nuclear attraction from protons in the nucleus decreases.
- _____ 10. Compared with the electronegativities of the elements on the left side of a period, the electronegativities of the elements on the right side of the same period tend to be _____.
a. lower b. higher c. the same d. unpredictable
- _____ 11. Dalton hypothesized that atoms are indivisible and that all atoms of an element are identical. It is now known that _____.
a. all of Dalton's hypotheses are correct b. atoms of an element can have different numbers of protons
c. atoms are divisible d. all atoms of an element are not identical but they must all have the same mass
- _____ 12. Which of the following is true about subatomic particles?
a. Electrons are negatively charged and are the heaviest subatomic particle. b. Protons are positively charged and the lightest subatomic particle. c. Neutrons have no charge and are the lightest subatomic particle. d. The mass of a neutron nearly equals the mass of a proton.

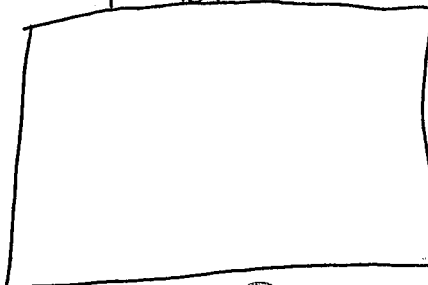
- _____ 13. All atoms are _____.
a. positively charged, with the number of protons exceeding the number of electrons b. negatively charged, with the number of electrons exceeding the number of protons c. neutral, with the number of protons equaling the number of electrons d. neutral, with the number of protons equaling the number of electrons, which is equal to the number of neutrons
- _____ 14. As a consequence of the discovery of the nucleus by Rutherford, which model of the atom is thought to be true?
a. Protons, electrons, and neutrons are evenly distributed throughout the volume of the atom. b. The nucleus is made of protons, electrons, and neutrons. c. Electrons are distributed around the nucleus and occupy almost all the volume of the atom. d. The nucleus is made of electrons and protons.
- _____ 15. What does the number 84 in the name krypton-84 represent?
a. the atomic number b. the mass number c. the sum of the protons and electrons d. twice the number of protons
- _____ 16. Isotopes of the same element have different _____.
a. numbers of neutrons b. numbers of protons c. numbers of electrons d. atomic numbers
- _____ 17. If E is the symbol for an element, which two of the following symbols represent isotopes of the same element?
1. ${}_{10}^{20}\text{E}$ 2. ${}_{11}^{20}\text{E}$ 3. ${}_{9}^{21}\text{E}$ 4. ${}_{10}^{21}\text{E}$
a. 1 and 2 b. 3 and 4 c. 1 and 4 d. 2 and 3
- _____ 18. The atomic mass of an element depends upon the _____.
a. mass of each electron in that element b. mass of each isotope of that element c. relative abundance of protons in that element d. mass and relative abundance of each isotope of that element
- _____ 19. In Bohr's model of the atom, where are the electrons and protons located?
a. The electrons move around the protons, which are at the center of the atom. b. The electrons and protons move throughout the atom. c. The electrons occupy fixed positions around the protons, which are at the center of the atom. d. The electrons and protons are located throughout the atom, but they are not free to move.
- _____ 20. How does the energy of an electron change when the electron moves closer to the nucleus?
a. It decreases. b. It increases. c. It stays the same. d. It doubles.

Bonus - Draw the atomic structures as devised by the following

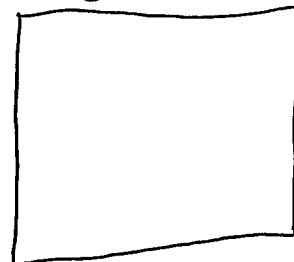
Dalton



Thomson



Bohr



Name: _____

- 1) Which gas is monatomic at STP?
 A) chlorine C) fluorine
 B) neon D) nitrogen
- 2) Which halogen can only be prepared by the electrolysis of its fused compounds?
 A) Cl₂ C) F₂
 B) Br₂ D) I₂
- 3) Which physical characteristic of a solution may indicate the presence of a transition element?
 A) its effect on phenolphthalein
 B) its density
 C) its effect on litmus
 D) its color
- 4) Which of the following groups in the Periodic Table contain elements so highly reactive they are *never* found in the free state?
 A) 1 and 11 C) 2 and 15
 B) 11 and 15 D) 1 and 2
- 5) The elements known as the alkaline earth metals are found in Group
 A) 16 C) 1
 B) 17 D) 2
- 6) An element whose ions have a charge of 2- would be found in Group
 A) 13 C) 2
 B) 17 D) 16
- 7) The nonmetal that is a liquid at STP is
 A) calcium C) bromine
 B) mercury D) chlorine
- 8) In which area of the Periodic Table are the elements with the *strongest* nonmetallic properties located?
 A) upper right C) lower right
 B) upper left D) lower left
- 9) An element with an electronegativity of 3.2 is *most* likely classified as a
 A) nonmetal
 B) noble gas
 C) semimetal (metalloid)
 D) metal
- 10) The properties of silicon are characteristic of
 A) a nonmetal, only
 B) neither a metal nor a nonmetal
 C) both a metal and a nonmetal
 D) a metal, only
- 11) Which element is malleable and ductile?
 A) Si C) Au
 B) Ge D) S
- 12) Which reactant is most likely to have *d* electrons involved in a chemical reaction?
 A) an alkali metal
 B) a noble gas
 C) a halogen
 D) a transition element
- 13) On the present *Periodic Table of the Elements*, the elements are arranged according to increasing
 A) atomic mass
 B) number of oxidation states
 C) atomic number
 D) number of neutrons
- 14) In which shell are the valence electrons of the elements in Period 2 found?
 A) 1 C) 3
 B) 2 D) 4
- 15) In Period 3, from left to right in order, each successive element will
 A) increase in metallic character
 B) decrease in electronegativity
 C) decrease in atomic mass
 D) increase in number of protons
- 16) In which group of the Periodic Table do most of the elements exhibit *both* positive and negative oxidation states?
 A) 17 C) 2
 B) 7 D) 12
- 17) As each successive element in Group 15 of the Periodic Table is considered in order of increasing atomic number, the atomic radius
 A) remains the same
 B) increases
 C) decreases
- 18) 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
 A) number of protons decreases, and the number of shells of electrons remains the same
 B) number of protons decreases, and the number of shells of electrons increases
 C) number of protons increases, and the number of shells of electrons increases
 D) number of protons increases, and the number of shells of electrons remains the same

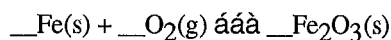
28

- 19) Compared to the radius of a chlorine atom, the radius of a chloride ion is
- larger because chlorine gains an electron
 - larger because chlorine loses an electron
 - smaller because chlorine gains an electron
 - smaller because chlorine loses an electron
- 20) Which of the following ions has the *smallest* radius?
- Rb⁺
 - Cl⁻
 - K⁺
 - F⁻
- 21) The high electrical conductivity of metals is primarily due to
- high electronegativities
 - mobile electrons
 - filled energy levels
 - high ionization energies
- 22) Which of these elements is the *best* conductor of electricity?
- N
 - Br
 - S
 - Ni
- 23) What is a property of most metals?
- They are poor conductors of electricity.
 - They tend to lose electrons easily when bonding.
 - They are poor conductors of heat.
 - They tend to gain electrons easily when bonding.
- 24) What are two properties of *most* nonmetals?
- low ionization energy and poor electrical conductivity
 - low ionization energy and good electrical conductivity
 - high ionization energy and poor electrical conductivity
 - high ionization energy and good electrical conductivity
- 25) 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
 - 2
 - 15
 - 16
- 26) Antimony is classified as a
- noble gas
 - metalloid
 - metal
 - nonmetal
- 27) The amount of energy required to remove the outermost electron from a gaseous atom in the ground state is known as
- activation energy
 - electronegativity
 - first ionization energy
 - conductivity
- 28) The strength of an atom's attraction for the electrons in a chemical bond is the atom's
- heat of reaction
 - heat of formation
 - electronegativity
 - ionization energy
- 29) If *M* represents an element in Group 2, the formula of its chloride would be
- MCl₂
 - M₂Cl₂
 - M₂Cl
 - MCl
- 30) As the atoms of the Group 17 elements in the ground state are considered from top to bottom, each successive element has
- an increasing number of valence electrons and identical chemical properties
 - the same number of valence electrons and similar chemical properties
 - an increasing number of valence electrons and similar chemical properties
 - the same number of valence electrons and identical chemical properties
- 31) Which element is classified as a noble gas at STP?
- nitrogen
 - hydrogen
 - neon
 - oxygen
- 32) Which group of the Periodic Table contains atoms with a stable outer electron configuration?
- 18
 - 1
 - 8
 - 16
- 33) At STP, the element oxygen can exist as either O₂ or O₃ gas molecules. These two forms of the element have
- the same chemical properties and different physical properties
 - different chemical properties and the same physical properties
 - different chemical and physical properties
 - the same chemical and physical properties
- 34) Which of these elements has physical and chemical properties most similar to silicon (Si)?
- chlorine (Cl)
 - lead (Pb)
 - germanium (Ge)
 - phosphorus (P)
- 35) Which element is a brittle, nonconducting solid at 25°C?
- Br
 - Bi
 - S
 - Al

29

- 36) Skiers, snowmobilers, and others involved in outdoor winter recreation use disposable heat packs. These heat packs are porous paper pouches containing sawdust, powdered carbon, sodium chloride, powdered iron, and ZeoliteTM. During production, this mixture is moistened slightly with water and then sealed in an airtight plastic pack. The reaction starts when the pack is opened and the mixture is exposed to air.

Given the unbalanced equation:



- (a) Balance the equation, using *smallest* whole number coefficients.
- (b) If the word "energy" was added to the equation to correctly indicate the energy change in this heat pack reaction, would the word "energy" be placed on the "reactant side" or on the "product side" of the equation?

- 37) Given the unbalanced equation:



Balance the given equation, using the *lowest* whole-number coefficients.

- 38) Given: Samples of Na, Ar, As, Rb

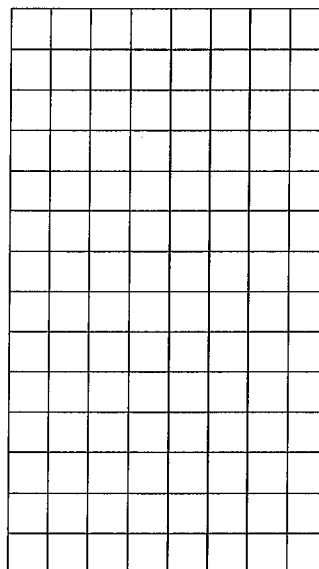
- (a) Which *two* of the given elements have the most similar chemical properties?
- (b) Explain your answer to *part (a)* in terms of the *Periodic Table of the Elements*.

- 39) After a neutral sulfur atom gains two electrons, what is the resulting charge of the ion?

40)

Atomic Number	Electronegativity
11	
12	
13	
14	
15	
16	
17	

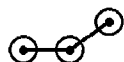
Electronegativity



11 12 13 14 15 16 17
Atomic Number

- (a) Record the electronegativity for the elements with atomic numbers 11 through 17.
- (b) On the grid above, mark an appropriate scale on the axis labeled "Electronegativity."
- (c) On the grid above, plot the data from the data table. Circle and connect the points.

EXAMPLE:



30

80

MERCURY



Mercury is a deadly liquid element that causes damage to the nervous system.

Hg
200.59

101

MENDELEVIVM



Mendelevium was named for Dmitri Mendeleev, inventor of the periodic table.

Md
258

NOTE: Be sure you actually do study this year...Each night, put some time in and you will see the exponential growth of your knowledge that will help you on upcoming exams in this class.

Periodic Table

Mr. Gardner