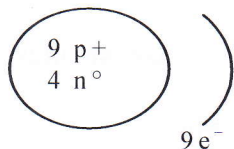# Test Review- Trends, Isotopes, Radiation…..

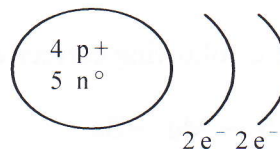## Simplified Atomic Model

1. Which of the following diagrams correctly represents the simplified atomic model of the beryllium (Be) atom?
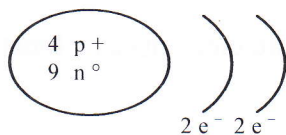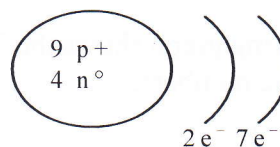
A)

9 p+
4 n°
9 e⁻

C)

4 p+
5 n°
2 e⁻ 2 e⁻

B)

4 p+
9 n°
2 e⁻ 2 e⁻

D)

9 p+
4 n°
2 e⁻ 7 e⁻

2. Choose the correct answer to complete the following sentence. In all neutral atoms there are always...

A) as many protons as electrons.   C) as many electrons as neutrons.
B) as many protons as neutrons.   D) more neutrons than protons.

Trends

1. Give the definition and show the trend arrows for the following:

	Definition	Trend
Atomic radius	The distance between the nucleus + the outermost electrons of an atom	← ↓
Reactivity	The tendency of a substance to undergo chemical changes.	↓ ↑ metals nonmetals
Ionization	The energy needed to remove an electron from an atom.	↑→
Electronegativity	The ability of an atom to hold on to or attract electrons.	↑→

2. Which of the following statements is true for metal reactivity?
A) As you go down a group or family the reactivity rate decreases. ✗
B) As you go across a period from group 1 to group 3, the reactivity rate increases.
C) As you go across a period from group 1 to group 3, there is no change to the reactivity rate.
D) As you go down a family or group the reactivity rate increases.

3. Which statements about periodic trends are correct?
   1- Sulfur is smaller than chlorine, but bigger than oxygen.
   2- Sodium has a higher electronegativity than potassium, but weaker than lithium.
   3- Bromine has a greater electronegativity than krypton, but a weaker one than iodine.
   4- Magnesium has a greater reactivity than beryllium than, but weaker than calcium.
   5- Neon has the greatest ionization energy because it has the fewest orbits and highest number of valence electrons.

   A) 1 and 3   B) 2 and 3   C) 2 and 4   D) 2, 4 and 5

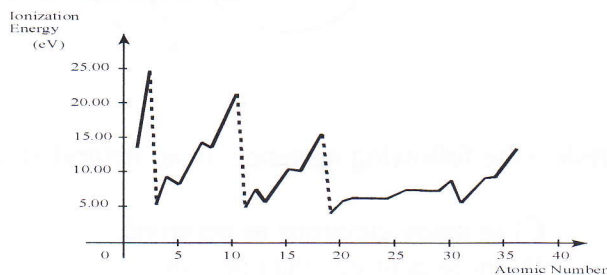4. Which of the following correctly lists the five atoms in increasing size (smallest to largest)?
   A) O → F → S → Mg →Ba   C) F → O → S → Ba → Mg
   B) F → O → S → Mg → Ba   D) F→ S → Ba→ Mg → O

5. The following graph shows the ionization energies of certain elements as a function of their atomic numbers.

According to this graph, which of the following statements is TRUE?
   A) Ionization rates increase as you go across a period because the number of valence electrons increases.
   B) Ionization rates increase as you go across a period because the number of valence electrons decreases.
   C) Ionization rates increase as you go across a period because the number of orbits increases.
   D) Ionization rates increase as you go across a period because the number of orbits decreases.

6. Which of the following statements are true for the atomic radius within the same period?
   I) Moving from left to right across a given period, there is an increase in the number of electrons, protons and neutrons, and thus the atomic radius increases.
   II) The atomic radius decreases with the increasing atomic number across a given period.
   III) The atomic radius is independent from the type of atom within a given period.
   IV) Moving from left to right across a given period, there is an increase in the number of protons and electrons. Therefore the electric forces between nucleus and shell increases, thus reducing the atomic size.
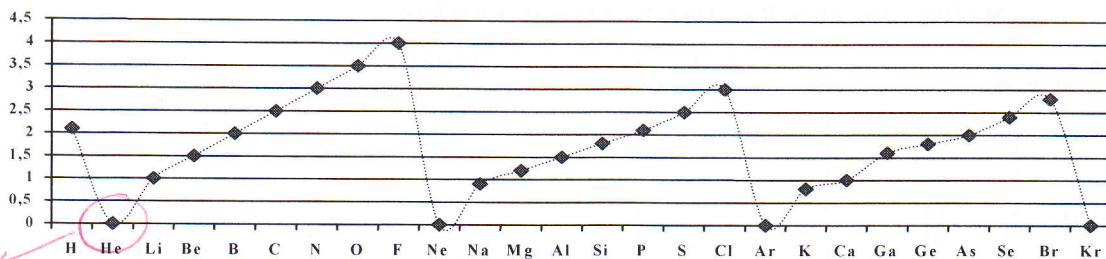
   A) I and III   B) I, II and IV   C) II and III   D) II and IV

7. The graph below shows the electronegativity index of some elements of the periodic table.

noble gas
"O" = electroneg.

Which of the following statement is true?
A) The electronegativity index steadily increases within the same family.
B) The electronegativity index steadily increases, then drops to 0 within the same period. ✓
C) The electronegativity index remains constant within the same family period as one goes from left to right on the periodic table. ✗
D) The electronegativity index steadily decreases within the same period. ✗

8. The properties of the elements in the periodic table vary from one element to another as you go down a group. Four of these variations are :
   ✓ 1. Atomic radius ⇅   3. Electronegativity ↑
   ✓ 2. Chemical activity ↓   4. Ionization ↑
   Which of these variations will increase as you go down group 1?
   A) 1 and 2   B) 1 and 3   C) 2 and 4   D) 3 and 4

→ energy needed to remove an e⁻

9. Why does ionization energy decrease as you move down a group on the periodic table?
A. The electrons are farther from the nucleus making them more difficult to remove.
B. The electrons are farther from the nucleus making them easier to remove. ✓
C. The electrons are closer to the nucleus making them more difficult to remove.
D. The electrons are closer to the nucleus making them easier to remove.

10. Chlorine is much more apt to exist as a negative ion than is sodium. This is because
A) chlorine is bigger than sodium.
B) chlorine has a greater ionization energy than sodium.
C) chlorine has a greater electronegativity than sodium. ✓
D) chlorine is a gas and sodium is a solid.

11. Electronegativity ____↑____ from left to right within a period and ____↓____ from top to bottom within a group.
A) decreases, increases   C) increases, decreases
B) increases, increases   D) stays the same, increases

12. Ionization energies of the elements ____↑____ as you go from left to right across a period of the periodic table, and ____↑____ as you go from the bottom to the top of a group in the table.
A) increase, increase   C) decrease, increase
B) increase, decrease   D) decrease, decrease

13. The histogram below shows the distribution of the melting points of elements within the first four periods of the periodic table.

Melting Point in Relation to Atomic Number
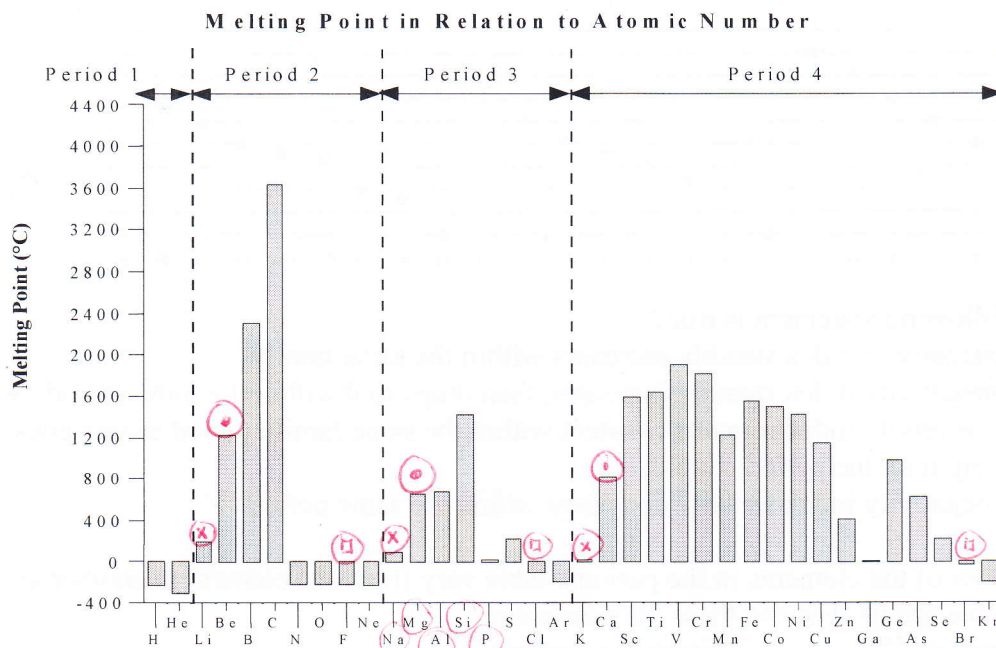
What pattern can be observed for the melting points?
A) The melting points increase among the alkali metals. ⊗   *decrease* ✗
B) The melting points increase among the alkaline earth metals. ⦿   ✗
C) The melting points increase among the halogens. ⊡   ✓
D) The melting points increase among the metals across period 4. ✗

14. The graph below represents the melting points of elements 1 to 54.

Melting Point versus Atomic Number
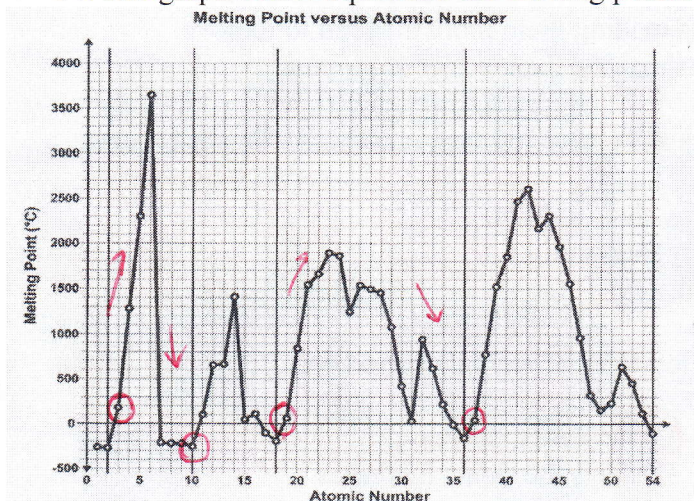
Which statement best describes the periodicity of melting point for the first 54 elements of the periodic table?
A) The melting point decreases within a period.
B) The melting point increases within a period.
C) The melting point decreases then increases within a period.
D) The melting point increases, then decreases within a period.

15. Which trends are true moving down group 1 of the periodic table?
A) Electronegativity and atomic radius increases. ✗
B) Ionization and electronegativity increases. ✗
C) Atomic radius and reactivity increases. ✓
D) Reactivity and ionization increases. ✗

16. In general, as you go across a period in the periodic table from left to right: (1) the atomic radius ____↓____ ; (2) the electronegativity ____↑____ ; and (3) the first ionization energy ____↑____ .
A) decreases, decreases, increases
B) increases, increases, decreases
C) increases, increases, increases
D) decreases, increases, increases

Isotopes and Radiation

1. An oxygen atom has 8 protons, 8 neutrons and 8 electrons. Which of the following describes an isotope of an oxygen atom?
A) It has 8 protons, 8 neutrons and 10 electrons. ✗
B) It has 10 protons, 8 neutrons and 8 electrons. ✗
C) It has 8 protons, 10 neutrons and 8 electrons.
D) It has 10 protons, 10 neutrons and 8 electrons

at. # = 8
isotopes → same # P, diff # n
⑧ ≠ 8

2. The element hydrogen has three isotopes : ^1_1H, ^2_1H and ^3_1H.

Which of the following statements is false ?
A) The three atoms have the same number of protons. yes
B) The three atoms have the same number of electrons. yes
C) The three atoms have the same number of neutrons. no
D) The three atoms have the same chemical properties. yes

3. In the Periodic Table, what is the relationship between the atomic mass of an element and its atomic number, Z ?
→ P+n
A) In general, the atomic mass of an element decreases as the atomic number, Z, increases.
B) In general, the atomic mass of an element increases as the atomic number, Z, increases.
C) In general, there is no relationship between the atomic mass of an element and the atomic number, Z.
D) In general, the atomic mass of an element increases by the same amount as the atomic number, Z.

#P

4. Shown below are isotopes of unknown elements.

1.	2.	3.	4.
$^{14}_{6}X$	$^{14}_{7}X$	$^{16}_{6}X$	$^{32}_{16}X$
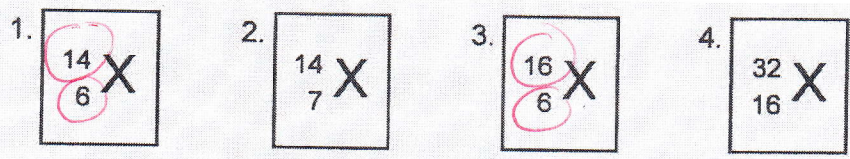
same #P (atomic #)
diff # n (mass #)

Which diagrams, illustrated above, represent isotopes of the same element?
A) 1 and 2   B) 1 and 3   C) 2 and 4   D) 3 and 4

atomic # = 15

30 = 15 + ? ⟹ (15)

30 = 15 + ? ⟹ (16)

5. How many neutrons will phosphorus 30, 31 and 32 possess?

32 = 15 + ? ⟹ (17)

6. A neutral atom of Cl-37 has
   A) 37 protons, 37 neutrons, and 37 electrons
   B) 17 protons, 37 neutrons, and 17 electrons
   C) 17 protons, 20 neutrons, and 17 electrons
   D) 17 protons, 17 neutrons, and 17 protons

atomic # 17 = #p
mass # 37 ⟹ 37 = P + n
37 = 17 + ?

7. Using this graph, determine the **mass number** for each of the three different isotopes of oxygen, O.

protons + neutrons

atomic # 8 → 8 protons

Number of neutrons

8 + 7 = (15)
8 + 8 = (16)
8 + 9 = (17)

Number of protons
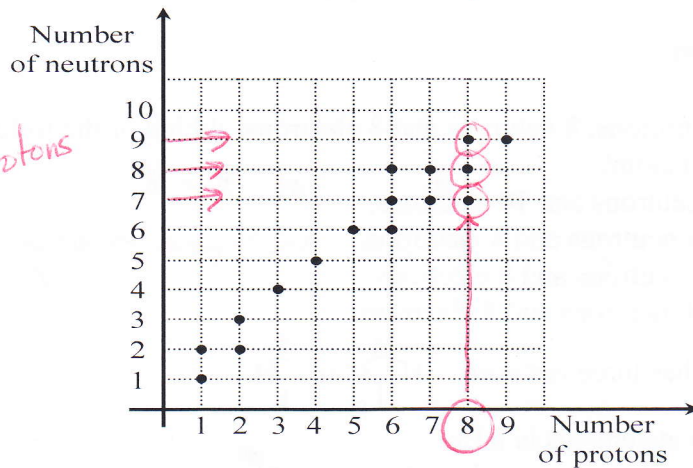
8. The following statements describe characteristics of alpha, beta, or gamma rays.
   1. They are attracted by the negative plate of an electric field. *α*
   2. They are attracted by the positive plate of an electric field. *β*
   3. They are associated with electrons. *β*
   4. They are associated with protons. *α*
   5. They are the weakest ray. *α*
   6. They are not affected by a negative or positive plate of an electric field. *γ*

   Which of the characteristics above are associated with beta rays?

   # 2 + 3

9. Nitrogen isotopes are used to study the intake of nitrogen in plants and the metabolism of proteins in the human body. Which two of the simplified atomic models below represent isotopes of nitrogen?

Simplified Atomic Models

1. $7 p^+$ ✔
    $7 n^0$ ✔
    $2 e^-$ $5 e^-$ ✔

2. $8 p^+$ ✗
    $7 n^0$
    $2 e^-$ $6 e^-$

3. $7 p^+$ ✔
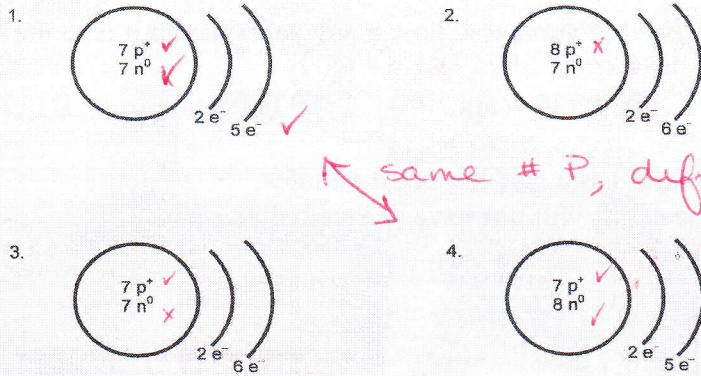 $7 n^0$ ✗
    $2 e^-$ $6 e^-$

4. $7 p^+$ ✔
    $8 n^0$ ✔
    $2 e^-$ $5 e^-$ ✔

same # P, diff # neutrons

A) Models 1 and 2   **B) Models 1 and 4**   C) Models 2 and 3   D) Models 3 and 4

Half Life

1. Calculate the time it would take to have less than 4.0 g of tellurium if its half-life is 7 days and you begin with 25.0 g.

time	quantity
0	25.0 g
7 d	12.5
14 d	6.25
21 d	3.125

→ between 14 + 21 days

2. Carbon-14 's half-life takes 5 770 years. A piece of wood that contains only 20% of carbon-14. What is the approximate age of the piece of wood?

time	quantity
0	100%
5770	50%
11 540	25%
17 310	12.5%

→ between 11 540 + 17 310 years

(* closer to 11 540 y)

3. A radioactive isotope has a half-life of 2 minutes. What can be deduced from this statement?
   A) After 4 minutes, none of the isotope remains.
   B) After 4 minutes, ¼ of the isotope remains.
   C) After 1 minute, ½ of the isotope remains.
   D) After ½ a minute, ½ of the isotope remains

time	quantity
0	100%
2	50%
4	25%

time	quantity
0	4 g
① ↘ 5770	2 g
② ↘ 11540	1 g
③ ↘ 17310	0.5 g
↘ 0.25 g)

4. $^{14}_{6}C$ has a half-life of 5770 years, how many grams of a 4.0 g sample would be left after 3 half-lives?

A) 1.0 g   B) 0.50 g   C) 0.38 g   D) 0.35 g

5. Using the half-life listed in number 4, how many years would it take the 4.0 g sample to decay to 0.25 g? (1 more half-life)

A) 4 years   B) 5 730 years   C) 23 080 years   D) 17 200 years

6. A radioactive substance has a half-life of 30 minutes.
What fraction of the atoms will **not** have decayed after 1 hour?

time	quantity
0	100%
30 m	50%
60 m	25%

25%

Bonding and Polyatomic ions

1. Make a Lewis diagram and give the molecular formula for each compund.

	Lewis diagram	Molecular formula
Aluminum fluoride Al^{+3} F^{-1} 3×1		AlF_3
Chlorine gas Cl_2		Cl_2
Phosphorus tribromide		PBr_3
Calcium chloride $Ca^{+2} Cl^{-1}$ 2×1		$CaCl_2$

Remember: ionic → draw ions + arrows

covalent → do not draw ions + arrows
draw loops.

2. Give the molecular formula for the following.

Beryllium sulfide Be^{+2} S^{-2} 2×2	Be S	Hydrogen fluoride H F $\mid$ $\mid$	HF
Sodium oxide Na^{+1} O^{-2} 1×2	Na$_2$O	Dihydrogen sulfide	H$_2$S
Diphosphorus trisulfide	P$_2$S$_3$	Iodine	I$_2$
Carbon tetrachloride	CCl$_4$	Aluminum sulfide Al^{+3} S^{-2} 3×2	Al$_2$S$_3$

3. Name the following molecules.

ionic	Na$_3$P	sodium phosphide	SCl$_2$	sulfur dichloride	cov.
ionic	NaCl	sodium chloride	PF$_3$	phosphorus trifluoride	cov.
cov.	NH$_3$	nitrogen trihydride	C$_2$S$_4$	dicarbon tetrasulfide	cov.
cov.	O$_2$	oxygen gas	BeCl$_2$	beryllium chloride	ionic

4. Write all the possible molecular formulas and names of the molecules formed when the following metals and radicals bond.

K^{+1} Mg^{+2} Al^{+3} SO_4^{2-} PO_4^{3-}

Formula		Name
K^{+1} SO_4^{-2} 1×2	K$_2$SO$_4$	potassium sulfate
K^{+1} PO_4^{-3} 1×3	K$_3$PO$_4$	potassium phosphate
Mg^{+2} SO_4^{-2} 2×2	Mg SO$_4$	magnesium sulfate
Mg^{+2} PO_4^{-3} 2×3	Mg$_3$(PO$_4$)$_2$	magnesium phosphate
Al^{+3} SO_4^{-2} 3×2	Al$_2$(SO$_4$)$_3$	aluminum sulfate
Al^{+3} PO_4^{-3} 3×3	AlPO$_4$	aluminum phosphate

$Al^{+3} \underset{3 \longleftrightarrow 3}{\times} PO_4^{-3})$
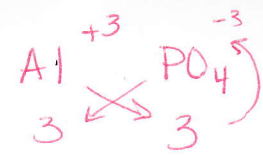
5. The formula aluminum phosphate is AlPO₄. In this formula, what is the charge of the radical PO₄?

    A) 1-   B) 2-   (C) 3-   D) 6-

$Mg^{+2} \underset{2 3}{\times} AsO_4$

6. Given that the radical AsO₄ has charge of 3⁻, determine with the help of the periodic table, the formula of the compound resulting from its combination with magnesium.

    A) MgAsO₄   (B) Mg₃(AsO₄)₂   C) Mg₃AsO₄   D) Mg(AsO₄)₃

$Mg_3(AsO_4)_2$

7. Some of the following molecules do not have the proper number of ions showing. Determine which are wrong and correct them.

Molecule		Correction
Li(OH)₂	X $Li^{+1} \underset{1 1}{\times} OH^{-1}$	LiOH
Li₂NO₃	X $Li^{+2} \underset{2 1}{\times} NO_3^{-1}$	Li(NO₃)₂
CaCrO₄	✓ $Ca^{+2} \underset{2 2}{\times} CrO_4^{-2}$	CaCrO₄ OK
B₃PO₄	✓ $B^{+3} \underset{3 3}{\times} PO_4^{-3}$	BPO₄ ok

8. A veterinarian may prescribe magnesium phosphate supplements to combat intestinal issues in pets. Which of the following represents the chemical formula for magnesium phosphate?

    A) Mg₃P₂   B) MgPO₄   (C) Mg₃(PO₄)₂   D) Mg₂(PO₄)₃

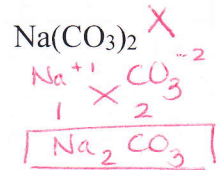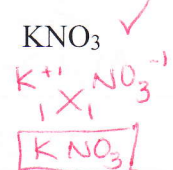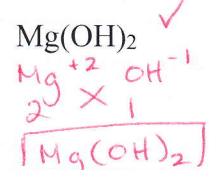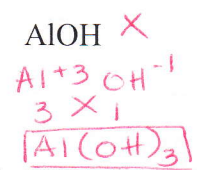$Mg^{+2} \underset{2 3}{\times} PO_4^{-3}$

$Mg_3(PO_4)_2$

9. The law requires that chemical containers which have been refilled be properly identified. Five container labels are shown in the table below.

$Na^{+1} \underset{1 2}{\times} SO_4^{-2}$

$\boxed{Na_2SO_4}$

Container 1	Container 2	Container 3	Container 4	Container 5
NaSO₄ X	Ca₂PO₄ X	MgSO₄ ✓	B(NO₃)₃ ✓	K₂Cr₂O₇ ✓

A new lab technician labelled 2 of the 5 above containers incorrectly. Using the table below determine which 2 of the 5 containers have an **INCORRECT** label.

$K^{+1} \underset{1 2}{\times} Cr_2O_7^{-2}$

$K_2Cr_2O_7$

$Ca^{+2} \underset{2 3}{\times} PO_4^{-3}$

$Ca_3(PO_4)_2$

    A) Container 2 and 3   C) Container 1 and 5
    B) Container 3 and 4   (D) Container 1 and 2

$Mg^{+2} \underset{2 2}{\times} SO_4^{-2}$ $B^{+3} \underset{3 1}{\times} NO_3^{-1}$

$MgSO_4$ $B(NO_3)_3$

10. Determine which bonds are incorrectly written:

AlOH X   Mg(OH)₂ ✓   KNO₃ ✓   Na(CO₃)₂ X

$Al^{+3} OH^{-1}$ $Mg^{+2} \underset{2 1}{\times} OH^{-1}$ $K^{+1} \underset{1 1}{\times} NO_3^{-1}$ $Na^{+1} \underset{1 2}{\times} CO_3^{-2}$

$\underset{3 1}{}$

$\boxed{Al(OH)_3}$ $\boxed{Mg(OH)_2}$ $\boxed{KNO_3}$ $\boxed{Na_2CO_3}$

11. The following molecules are all correctly bonded. What is the charge of each radical?

Mg(NO₃)₂   AlPO₄ $\boxed{-3}$ Al₂(CrO₄)₃   KOH

$\boxed{-1}$ Al^{+3} $\boxed{-2}$ $\boxed{-1}$

                        ∴ PO₄⁻³

                        since only
                        1 of each needed