CHAPTER 7 – 8 PRACTICE QUIZ **Name** _____

MULTIPLE CHOICE – NO CALCULATOR ALLOWED

Element	Atomic Radius (pm)	First Ionization Energy (kJ/mol)
Calcium	174	590
Potassium	?	?

1. Based on periodic trends and the data in the table above, which of the following are the most probable values for atomic radius and first ionization energy for potassium?

   (A) 144 pm, 419 kJ/mol

   (B) 144 pm, 633 kJ/mol

   (C) 196 pm, 419 kJ/mol

   (D) 196 pm, 633 kJ/mol

2. Which of the following properties tends to decrease as you move from top to bottom down Group 14?

   (A) atomic radius

   (B) ionization energy

   (C) metallic character

   (D) reactivity with oxygen

Successive Values of Ionization Energy (kJ/mol) for an Element in Period 3					
I_1	I_2	I_3	I_4	I_5	I_6
578	1817	2745	11577	14830	18376

3. Based on the information in the table above, what is the most likely identity of this element?

   (A) Mg (B) Al (C) Si (D) P

4. Which of the following series is listed in order of increasing radius?

	smallest radius	----->	largest radius
(A)	K^+	K	Rb
(B)	Ca^{2+}	Ca	Mg
(C)	O^{2-}	O	S
(D)	P^{3-}	P	N

5. Based on the trends in chemical reactivity for the alkali metals and the halogens, which of the following reactions should NOT occur?

(A) $I_2 + 2\,KCl \rightarrow 2\,KI + Cl_2$

(B) $F_2 + 2\,NaBr \rightarrow 2\,NaF + Br_2$

(C) $2\,K + 2\,H_2O \rightarrow 2\,KOH + H_2$

(D) $2\,Na + H_2 \rightarrow 2\,NaH$

6. A certain substance is dissolved in water, forming a basic (pH > 7) solution. With respect to the possible identity of the substance and its reaction with water, which of the following choices is most likely to be correct?

	Possible Identity of the Substance	Chemical Reaction with Water
(A)	CO_2	$CO_2 + H_2O \rightarrow H_2CO_3$
(B)	SO_2	$SO_2 + H_2O \rightarrow HSO_2^+ + OH^-$
(C)	CaO	$CaO + H_2O \rightarrow Ca(OH)_2$
(D)	BaO	$BaO + H_2O \rightarrow Ba + H_2O_2$

7. A pure sample of XCl_3 exists as a colorless liquid and has a boiling point of 76°C. Which of the following choices represents a possible identity of element X and the type of bonding present in XCl_3?

	Possible Identity of Element X	Type of Bonding in XCl_3
(A)	phosphorus	ionic
(B)	phosphorus	covalent
(C)	nickel	ionic
(D)	nickel	covalent

8. Which of the following processes would release the largest quantity of energy?

(A) $KBr(s) \rightarrow K^+(g) + Br^-(g)$

(B) $MgO(s) \rightarrow Mg^{2+}(g) + O^{2-}(g)$

(C) $K^+(g) + Br^-(g) \rightarrow KBr(s)$

(D) $Mg^{2+}(g) + O^{2-}(g) \rightarrow MgO(s)$

9. Which of the following bonds has the largest dipole moment?

(A) C–N (B) P–S (C) As–F (D) Se–Br

10. Which of the following molecules has a Lewis structure that is identical to nitrogen triiodide?

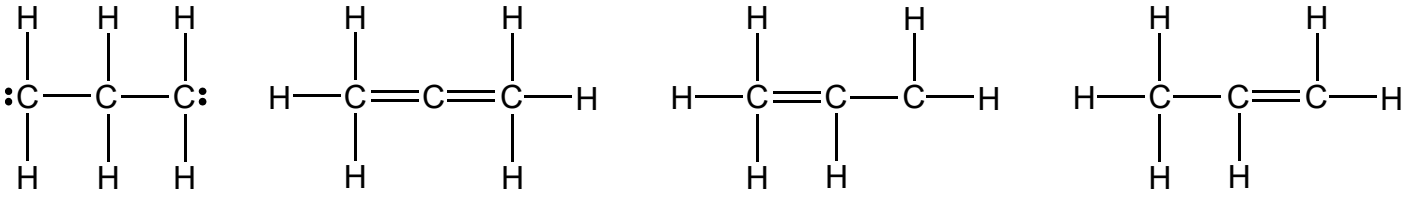
(A) sulfur trioxide

(B) boron trichloride

(C) chlorine trifluoride

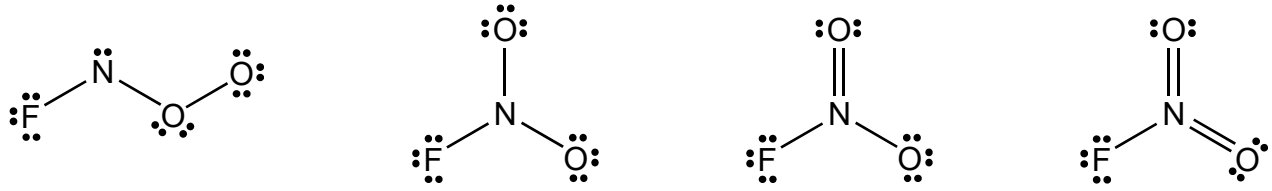
(D) arsenic tribromide

11. Which of the Lewis structures below best represents the molecule C_3H_6 ?

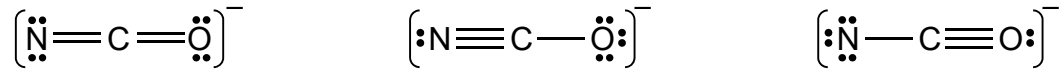


(A) (B) (C) (D)

12. Which of the Lewis structures below best represents the molecule NO_2F ?



(A) (B) (C) (D)



#1 #2 #3

13. Three different Lewis structures for the cyanate ion (NCO^-) are shown above. Which structure, if any, is the most favorable (or dominant)?

(A) #1, because the C–N bond length is nearly equal to the C–O bond length.

(B) #2, because the most electronegative atom carries the negative formal charge

(C) #3, because the most electronegative atom is part of a strong triple bond

(D) All three Lewis structures for the cyanate ion are equally favorable.

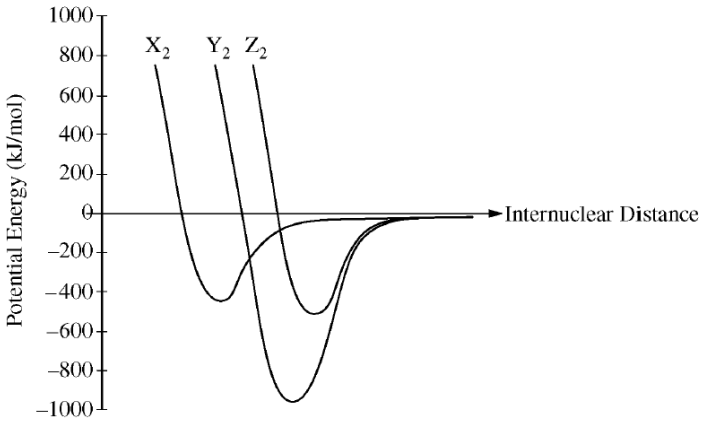
14. Which of the following series is listed in order of increasing O–O bond length (from shortest O–O bond to longest O–O bond)?

(A) O_2, O_3, H_2O_2

(B) O_2, H_2O_2, O_3

(C) O_3, O_2, H_2O_2

(D) O_3, H_2O_2, O_2



15. The potential energy as a function of internuclear distance for three diatomic molecules, X_2, Y_2, and Z_2, is shown in the graph above. Based on the data in the graph, which of the following correctly identifies the diatomic molecules, X_2, Y_2, and Z_2 ?

	X_2	Y_2	Z_2
(A)	H_2	N_2	O_2
(B)	H_2	O_2	N_2
(C)	N_2	O_2	H_2
(D)	O_2	H_2	N_2

$$I_2(g) + 3\ Cl_2(g) \rightarrow 2\ ICl_3(g) \qquad \Delta H^o = ?$$

16. According to the data in the table below, what is the estimated value of $\Delta H°$ for the reaction shown above?

Bond	Average Bond Enthalpy (kJ/mol)
I–I	150
Cl–Cl	240
I–Cl	210

(A) –390 kJ

(B) –180 kJ

(C) +180 kJ

(D) +390 kJ

CHAPTER 7 – 8 PRACTICE QUIZ **Name** _____

FREE RESPONSE – CALCULATOR IS ALLOWED

Element	1st ionization energy (kJ/mol)	2nd ionization energy (kJ/mol)
Sodium	496	4562
Magnesium	738	1451
Potassium	419	3052

1. The following questions refer to the information in the table above.

   (a) Write the complete electron configuration for each of the following atoms or ions.

   Na _____ Na^+ _____

   Mg _____ Mg^+ _____

   K _____ K^+ _____

   (b) Explain why the 1st ionization energy of sodium is less than the 1st ionization energy of magnesium. Your answer should refer to the atomic structures of sodium and magnesium. Identify the specific orbital from which each electron is removed.

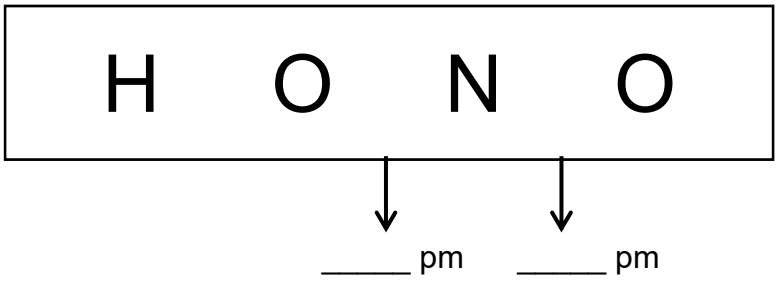
   (c) Explain why the 1st ionization energy of potassium is less than the 1st ionization energy of sodium. Your answer should refer to the atomic structures of potassium and sodium. Identify the specific orbital from which each electron is removed.

1. (d) Explain why the 2nd ionization energy of sodium is higher than the 2nd ionization energy of magnesium. Your answer should refer to the electronic configurations of Na^+ and Mg^+. Identify the specific orbital from which each electron is removed.

(e) Which metal (Na, Mg, or K) reacts most vigorously with water? Your answer should refer to specific information from the table above and how this property is related to the reactivity of metals.

2. Answer the following questions related to nitrous acid (HNO_2) and the nitrite ion (NO_2^-).

(a) Complete the Lewis electron-dot diagram for HNO_2 by drawing the required number of electrons, including bonding pairs and nonbonding pairs. Each atom should have a full valence shell and a formal charge of zero.



(b) When the HNO_2 molecule was analyzed, it was determined that one of the nitrogen-oxygen bonds has a length of 120 pm, and the other nitrogen-oxygen bond has a length of 146 pm.

Based on the Lewis electron dot structure that you drew in the box above, fill in the two blanks above with either a bond length of 120 pm or a bond length of 146 pm.

2. (c) Complete the Lewis electron-dot diagram for the nitrite ion, NO_2^-, by drawing the required number of electrons, including bonding pairs and nonbonding pairs.

(d) It was determined that the two nitrogen-oxygen bonds in the nitrite ion have the same length. Explain this result, using principles of chemical bonding.

(e) Estimate the bond length of the nitrogen-oxygen bond in the nitrite ion: _____ pm

Average Bond Enthalpies (kJ/mol)	
H–H	436
N–H	391
N–N	163
N=N	418
N≡N	941

3. Use the bond enthalpy data in the table above to estimate the value of ΔH for the following reaction. Show your calculations below in order to receive full credit.

$$4\ NH_3 + N_2H_4 \rightarrow 3\ N_2 + 8\ H_2$$