

Name: KEY__KEY__KEY__KEY__KEY__KEY__KEY__KEY__KEY__KEY__K

- Supply answers to all questions on this examination, or paper provided.
- No calculators are permitted.
- Partial credit will be limited.
- The score for short answer questions is directly proportional to the completeness and quality of the answer provided.
- There are 113 points possible for this examination. Your score will be reported as a percentage of 113.

1. Distinguish between the following:
 - a. Binary and ternary compounds (2 pts.) A binary compound is made up of two different elements. A ternary compound is made up of three or more different elements.
 - b. Ammonia and ammonium ion (2 pts.) Ammonia is NH_3 . Ammonium ion is NH_4^+
 - c. Shape of a s orbital and a p orbital (2 pts.) The s orbital is a sphere. The p orbitals are dumbbell or pear shaped.
2. Why does the 3d orbital fill after the 4s orbital? (2 pts.) The 3d orbital is of higher energy than the 4s orbital
3. What is an isotope? What is different between two isotopes? What is the same? (3 pts.) An isotope is any atom having the same atomic number but a different atomic number. They have the same number of protons and electrons but a different number of neutrons.
4. How many electrons (at most) can be placed in the 6th energy level ($n = 6$)? (1 pt.) $2n^2 = 2(6^2) = 72$ electrons
5. How many electrons (at most) can be placed in the f sublevel (f orbital)? (2 pts.) 14 electrons are the maximum number that can be placed in the f orbital.
6. Distinguish between an ionic bond and a covalent bond. Include considerations regarding electrons, electronegativity, and the classification of elements in your response. (3 pts.)

Ionic	Consideration	Covalent
Transfer	Electrons	Sharing
1 Low/1 High	Electronegativity	2 High
1 Metal/ 1 Nonmetal	Classification of element	2 Non-metals

7. Define polar covalent bond. (2 pts.) Type of chemical bond, also known as a polar bond, formed by the unequal sharing of electrons between two atoms whose electronegativities differ.
8. Define coordinate covalent bond. (2 pts.) Type of chemical bond, also known as a coordinate bond, formed when one atom supplies both electrons of the electron pair bond, while the other atoms offers only an empty orbital.
9. The radius of the Mg atom is 160 pm, and the radius of the Mg^{2+} cation is 65 pm. Explain the change in size. (2 pts.) (1) Loss of electrons in the principal energy level and (2) increased nuclear charge.

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10. The following four questions refer to the following block of nine elements in the Periodic Table:

Al	Si	P
Ga	Ge	As
In	Sn	Sb

- a. Which element is the smallest in atomic size? (1 pt.) P
 - b. Which element has the highest electronegativity? (1 pt.) P
 - c. Which element has the highest first ionization energy? (1 pt.) P
 - d. Which element is most metallic in character? (1 pt.) In
11. Prior to the discovery of germanium (Ge) in 1886, Mendeleev predicted in 1869 the properties of this element, which he called “eka-silicon.” Using the periodic table, determine the following for germanium (atomic number 32)
- a. Would this element be classified as a metal, nonmetal, or metalloid? (1 pt.)
Metalloid
 - b. How many valence electrons would it have? (1 pt.) – 4
 - c. Write the electronic configuration in sublevels for both germanium and its group precursor, silicon. (2 pt.)
 Ge: $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^2$
 Si: $1s^2 2s^2 2p^6 3s^2 3p^2$
 - d. Would it be more metallic or more nonmetallic than its precursor, silicon? (1 pt.)
more metallic
12. What is the name and symbol of an element in the group or period provided? (10 pts. *You must have both the name and symbol correct to receive credit*)

Group	Name	Symbol
transition elements	Answers will vary...	
metalloids		
halogens		
chalogens		
actinide series		
noble gases		
alkali metals		
alkaline earth metals		
non-metals		
lanthanide series		

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13. Matching: (10 pts. Match both the formula to the common name and the common name to the characteristic)

Formula	Common Name	Characteristic
NaOH	Drain Cleaner	Strong base
NH ₃	Ammonia	Weak base
H ₂ SO ₄	Battery Acid	Strong acid
C ₁₂ H ₂₂ O ₁₁	Sugar	Non-electrolyte
HC ₂ H ₃ O ₂	Vinegar	Weak acid

14. Name the following acids. Classify them as strong or weak: (8 pts.)

Formula	Name	Strong or Weak
HNO ₃	nitric acid	strong
CH ₃ COOH	acetic acid	weak
HClO ₄	perchloric acid	strong
HCN	hydrocyanic acid	weak

15. Name the following compounds. Classify them as a strong acid, a weak acid, a strong base, a weak base, or a salt. Assume that all are soluble compounds in solution. (12 pts.)

Formula	Name	Classification
H ₃ PO ₄	phosphoric acid	weak acid
SrCO ₃	strontium carbonate	salt
Ca(OH) ₂	calcium hydroxide	strong base
HCH ₃ COOH	acetic acid	weak acid
LiOH	lithium hydroxide	strong base
Al(OH) ₃	aluminum hydroxide	weak base

16. Name the following compounds, or supply the formula if the name is provided (10 pts)

calcium hypochlorite	Ca(ClO) ₂
LiBrO ₄	lithium perbromate
diphosphorous pentasulfide	P ₂ S ₅
iron (II) phosphate	Fe ₃ (PO ₄) ₂
copper (II) chlorate	Cu(ClO ₃) ₂
SnI ₄	tin (IV) iodide
Al ₂ (Cr ₂ O ₇) ₃	aluminum dichromate
CH ₄	methane

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Ag_3PO_4	silver phosphate
Hg_2Cl_2	mercury (I) chloride

17. Name the following compounds, or supply the formula if the name is provided (10 pts)

barium acetate	$\text{Ba}(\text{CH}_3\text{COO})_2$
tetraphosphorous hexaoxide	P_4O_6
CaO	calcium oxide
PF_5	phosphorous pentafluoride
iron (III) perchlorate	$\text{Fe}(\text{ClO}_4)_3$
dinitrogen tetraoxide	N_2O_4
$(\text{NH}_4)_2\text{SO}_4$	ammonium sulfate
$\text{Cd}(\text{IO}_3)_2$	cadmium iodate
sulfur trioxide	SO_3
disodium hydrogen phosphate	NaHSO_4

18. For each of the following atoms or ions, calculate the number of protons and neutrons in the nucleus and the number of electrons outside the nucleus. Arrange the electrons in their *sublevels*; i.e. write the electronic configuration for each of the following atoms or ions (12 pts.):

- a. ${}^{36}_{18}\text{Ar}$ 18 protons 18 neutrons $1s^2, 2s^2, 2p^6, 3s^2, 3p^6$
- b. ${}^{27}_{13}\text{Al}^{3+}$ 13 protons 14 neutrons $1s^2, 2s^2, 2p^6$
- c. ${}^{31}_{15}\text{P}^{3-}$ 15 protons 16 neutrons $1s^2, 2s^2, 2p^6, 3s^2, 3p^6$
- d. ${}^{23}_{11}\text{Na}^+$ 11 protons 12 neutrons $1s^2, 2s^2, 2p^6$

19. Calculate the oxidation number for all the elements in the following compounds or ions (9 pts.):

- a. HBrO H +1 Br +1 O -2
- b. $\text{P}_2\text{O}_7^{4-}$ P +5 O -2
- c. MnO_4^{2-} Mn +3 O -2
- d. KrF_2 Kr +2 F -1