

C101 Exam One

Version 1

Instructions for filling out your answer sheet:

1. Use a #2 pencil only.
2. Print your **LAST NAME** and then your **FIRST NAME** in the name field, and then blacken in the bubbles that correspond to the letters of your name. Leave a space between your last and first name; blacken in the blank circle below the blank space.
3. In the "Grade or Educ" vertical column, blacken in the version number of the exam.

This is Version 1

4. Fill in your 10-digit identification number in the Identification in columns A-J and then blacken in the corresponding circles.
5. Fill in only ONE answer for each multiple choice question. If multiple answers are given, no points can be awarded; therefore, make sure you erase your answers well.
6. Do not make stray marks in any other portions of the answer sheet.
7. Failure to follow the above instructions will delay the posting of your grade. If you do not bring problems to our attention within one week, we reserve the right to not make adjustments. It is your responsibility to be about entering your ID number and version number correctly.

You have two hours to complete the exam. This exam has 36 questions (30 multiple choice at 2 points each and 6 short answer for 40 points) for a total of 100 points.

You may tear off this instruction/periodic table page. Then legibly put your whole name on the first and last page of the exam in the bank for name. Fill out your scantron completely with correct version number.

Useful Constants & Equations

$$E = \frac{hc}{\lambda}$$

$$c = 3.00 \times 10^8 \text{ m/s}$$

$$h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$$

$$1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$$

$$1 \text{ mL} = 1 \text{ cm}^3$$

$$1 \text{ lb} = 453.6 \text{ g}$$

$$q = m \times c \times \Delta T$$

$$1 \text{ kcal} = 1 \text{ Cal} = 1000 \text{ cal}$$

$$1 \text{ cal} = 4.184 \text{ J}$$

$$K = ^\circ\text{C} + 273.15$$

$$^\circ\text{C} = \frac{5}{9}(\text{^\circ F} - 32)$$

$$1 \text{ in} = 2.54 \text{ cm}$$

H	2.1	B	C	N	O	F	
Li	1.0	Be	2.0	2.5	3.0	3.5	4.0
Na	0.9	Mg	1.5	1.8	2.1	2.5	3.0
K	0.8	Ca	1.0	1.6	1.8	2.0	2.4
Rb	0.8	Sr	1.0	1.6	1.8	2.0	2.4
Cs	0.7	Ba	0.9				

Many elements have been colored to emphasize the basic pattern of electronegativity variation.

Periodic Table of the Elements

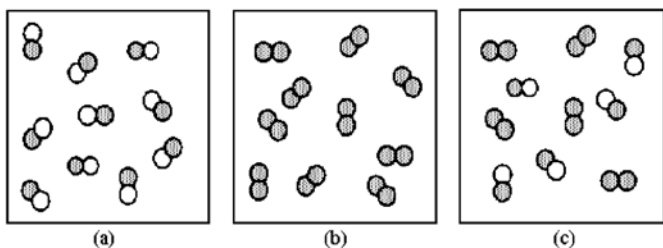
1 1A H Hydrogen 1.008	2 2A He Helium 4.003																																
3 Li Lithium 6.941	4 Be Beryllium 9.012																																
11 Na Sodium 22.990	12 Mg Magnesium 24.305	13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948																										
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.933	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.723	32 Ge Germanium 72.61	33 As Arsenic 74.922	34 Se Selenium 78.09	35 Br Bromine 79.904	36 Kr Krypton 84.80																
37 Rb Rubidium 84.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.71	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.29																
55 Cs Cesium 132.905	56 Ba Barium 137.327	57-71 Lanthanide Series	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [209]	85 At Astatine [210]	86 Rn Radon [222]																
87 Fr Francium [223]	88 Ra Radium [226]	89-103 Actinide Series	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [269]	111 Rg Roentgenium [272]	112 Cn Copernicium [277]	113 Nh Nihonium [284]	114 Fl Flerovium [289]	115 Uup Ununpentium [289]	116 Lv Livermorium [293]	117 Uus Ununseptium [293]	118 Uuo Ununoctium [294]																
57 La Lanthanum 138.906	58 Ce Cerium 140.115	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.24	61 Pm Promethium [144.913]	62 Sm Samarium 150.36	63 Eu Europium 151.966	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.50	67 Ho Holmium 164.930	68 Er Erbium 167.26	69 Tm Thulium 168.934	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967																			
89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]																			

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) Dirt is an example of a(n) _____.
 - A) element
 - B) compound
 - C) heterogeneous mixture
 - D) homogeneous mixture

- 2) Which of the following represents a physical change only?
 - A) adding electricity to water to produce hydrogen and oxygen gas
 - B) condensing of steam
 - C) burning a propane camping stove
 - D) barbecuing a steak

- 3) Which of the following is an example of a compound?
 - A) chicken noodle soup
 - B) saltwater
 - C) filtered apple juice
 - D) carbon dioxide
 - E) silver



- 4) Which of the above drawings represents a pure substance?
 - A) drawing (a)
 - B) drawing (b)
 - C) drawing (c)
 - D) drawing (a) and (c)
 - E) drawing (a) and (b)

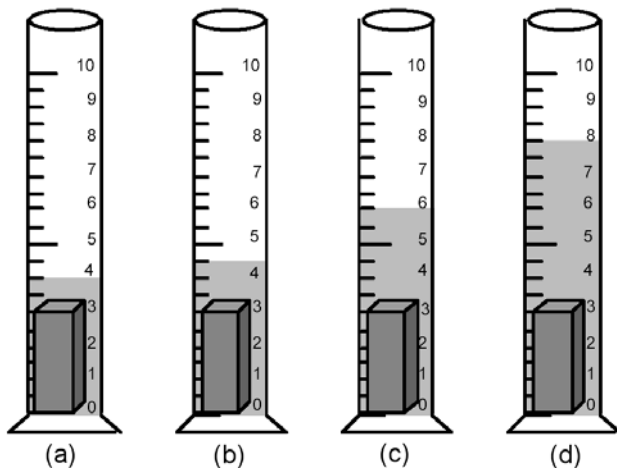
- 5) Which of the following represents a chemical property of a specific metal?
 - A) When in contact with air it corrodes.
 - B) It has magnetic properties.
 - C) Its density is higher than that of water.
 - D) It melts at 800 °C.

- 6) The term used to describe the conversion from a liquid state to a gaseous state is _____.
 - A) vaporization
 - B) melting
 - C) sublimation
 - D) condensation

7) With correct significant figures, the sum for the operation $1.2315 + 0.116 + 15.10$ is _____.

- A) 16.45
- B) 16.4475
- C) 16.4
- D) 16

8) A certain solid has a density of 4.0 g/mL . If 8.0 g of this solid are poured into 4.00 mL of water, which drawing below most closely represents the volume of water **after** the solid is added?



- A) drawing (a)
- B) drawing (b)
- C) drawing (c)
- D) drawing (d)

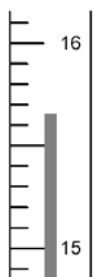
9) 500 cal are added to 10 g of water (specific heat of $1.000 \text{ cal/g } ^\circ\text{C}$) originally at $20 \text{ }^\circ\text{C}$. The final temperature is _____.

- A) $25 \text{ }^\circ\text{C}$
- B) $70 \text{ }^\circ\text{C}$
- C) $22.5 \text{ }^\circ\text{C}$
- D) $50 \text{ }^\circ\text{C}$

10) A liquid boils at $68 \text{ }^\circ\text{F}$ at one atmosphere pressure. This is roughly equal to _____ K.

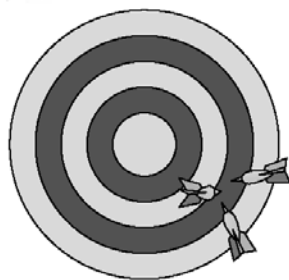
- A) 205
- B) 253
- C) 293
- D) 341

11) To the correct number of significant figures, what is the temperature reading on the following Celsius thermometer?



- A) 15.67°C
- B) 16°C
- C) 15°C
- D) 15.6°C

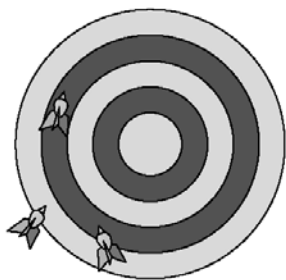
Use the drawings below to answer the following questions.



(a)



(b)



(c)

12) If hitting the bull's-eye is the desired result, Figure (b) represents

- A) good accuracy and good precision.
- B) good accuracy and poor precision.
- C) poor accuracy and good precision.
- D) poor accuracy and poor precision.

13) What is the mass of the single product that is formed from the complete reaction of 2.5 g hydrogen with 7.5 g oxygen?

- A) 7.5 g
- B) 10.0 g
- C) 9.5 g
- D) 5.0 g

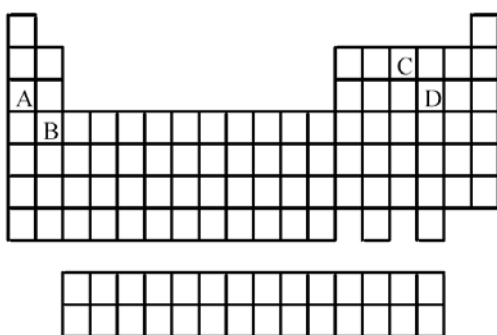
14) Which element would have a similar chemical reactivity in water as K?

- A) Ar
- B) Cu
- C) Ca
- D) Rb

15) An element has two natural occurring isotopes. One has an abundance of 37.4% and an isotopic mass of 184.953 amu, and the other isotope has an abundance of 62.6% and a mass of 186.956 amu. What is the atomic weight of the element?

- A) 186.207 amu
- B) 186.956 amu
- C) 185.955 amu
- D) 185.702 amu

Use the periodic table below to answer the following questions.

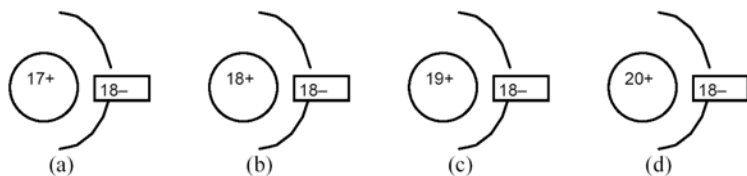


16) Which elements commonly form anions?

- A) A and B
- B) A and C
- C) B and D
- D) C and D

17) Which element belongs to the alkaline earth metals family on the periodic table?

- A) A
- B) B
- C) C
- D) D

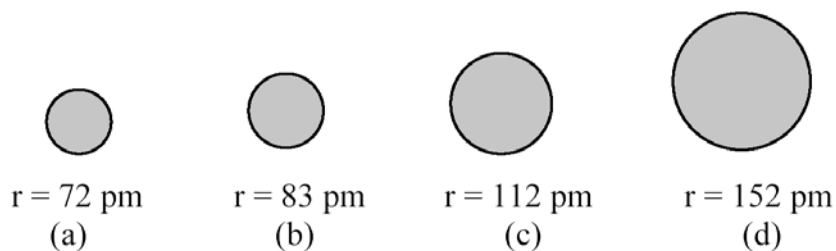


18) All of the drawing above represent species that are

- A) isoelectronic
- B) isotopes
- C) ions
- D) allotropes

- 19) Arrange the following spectral regions in order of **increasing** energy:
infrared, microwave, ultraviolet, red light, indigo light.
- A) ultraviolet < infrared < red light < indigo light < microwave
 B) microwave < indigo light < red light < infrared < ultraviolet
 C) ultraviolet < indigo light < red light < infrared < microwave
 D) microwave < infrared < red light < indigo light < ultraviolet
- 20) Of the following transitions in the Bohr hydrogen atom, which transition results in the emission of photons with the **shortest** wavelength?
- A) $n = 1 \rightarrow n = 6$
 B) $n = 4 \rightarrow n = 2$
 C) $n = 3 \rightarrow n = 1$
 D) $n = 4 \rightarrow n = 1$
- 21) A non-metal is an element that tends to _____ valence electrons in chemical reactions, becoming a(n) _____ in the process.
- A) lose; anion
 B) lose; cation
 C) gain; anion
 D) gain; cation
- 22) Of the following, which element has the highest first ionization energy?
- A) At
 B) Cs
 C) Li
 D) F

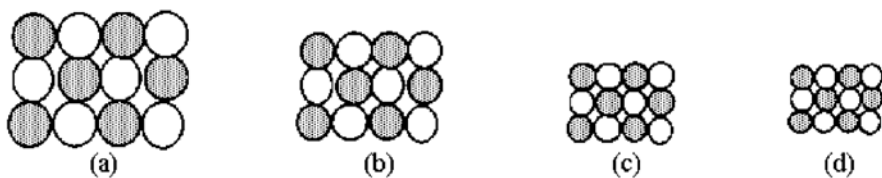
The spheres below represent atoms of Li, Be, B, and F (not necessarily in that order).



- 23) Which one of these spheres represents an atom of F?
- A) sphere (a)
 B) sphere (b)
 C) sphere (c)
 D) sphere (d)
- 24) For an electron in a given atom, the larger n , the
- A) smaller the average distance from the nucleus and the higher the orbital energy.
 B) larger the average distance from the nucleus and the higher the orbital energy.
 C) smaller the average distance from the nucleus and the lower the orbital energy.
 D) larger the average distance from the nucleus and the lower the orbital energy.

- 25) Which ion has the same electron configuration as Kr?
- A) Rb^+
 - B) Se^{2-}
 - C) Br^-
 - D) All of the above ions have identical electron configurations.
- 26) Which is the longest bond?
- A) $\text{N}-\text{N}$
 - B) $\text{N}\equiv\text{N}$
 - C) $\text{N}=\text{N}$
 - D) All of the above bonds are the same length.
- 27) The compound CCl_4 contains
- A) polar covalent bonds, with partial negative charges on the Cl atoms.
 - B) ionic bonds.
 - C) polar covalent bonds, with partial negative charges on the C atoms.
 - D) nonpolar covalent bonds.
- 28) Identify the most polar covalent bond.
- A) C-Cl
 - B) C-H
 - C) C-C
 - D) C-F
- 29) Covalent bonding is a
- A) gain of electrons.
 - B) transfer of electrons.
 - C) sharing of electrons.
 - D) loss of electrons.

The following pictures represent alkali halide salts (ionic compound formed between an alkali metal and a halogen).



- 30) Which salt has the **lowest** lattice energy?
- A) picture (a)
 - B) picture (b)
 - C) picture (c)
 - D) picture (d)

ESSAY. Write your answer in the space provided. Show your work and be sure to include units on all numbers.

31) (10 points) Unit Conversions: **Show your work. Be sure to use correct sig figs and units for full credit. Circle your final answer.**

a) 2.7 g/mL to kg/m³

b) 75 μg to ng

c) 256 Gbytes to byte

d) 145 lb (pounds) to kg (1 lb = 453.6 g)

e) 5.20 in² to cm²

32) (5 points) Fill in the following table.

Complete symbol	${}^{96}\text{Mo}^{6+}$	
Mass number		
Atomic number		
Number of protons		7
Number of neutrons		7
Number of electrons		7
Charge		

33) (5 points) Electron Configurations

a) Fill in the blanks for the element with an electron configuration of: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$

Group # _____ Period # _____ Element symbol _____ Valence electrons _____

Short-hand notation _____

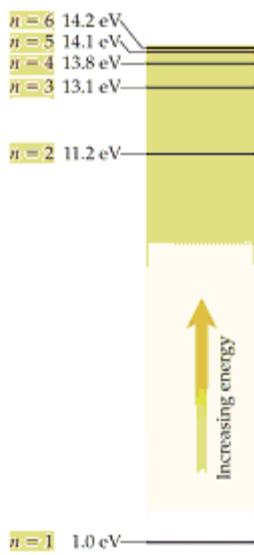
b) Write the electron configuration for the aluminum atom and the aluminum ion.

aluminum atom: _____ aluminum ion: _____

Does the aluminum form a cation or anion? circle one: cation anion

The aluminum ion is isoelectronic with what noble gas? _____

34) (4 points) What is the wavelength, in nanometers, of light emitted when the electron in a hydrogen atom relaxes from the $n = 5$ to $n = 3$ shell.



Is this wavelength in visible spectrum (380–750 nm)? YES or NO

35) (8 points total)

Total Valence Electrons	Dot Structure	# of bonding pairs of electrons	# of lone pairs of electrons
H ₂ O			
BF ₃			
CO ₂			
NH ₄ ⁺			

36) (8 points) Fill in the table with either the missing chemical name or chemical formula.

Name:	Formula:
HNO ₃ (aq)	
HgS	
Cu ₂ O	
N ₂ O ₅	
	silver acetate
	sodium sulfate
	ammonia
	vanadium(IV) oxide

NAME: (print clearly)_____

Short Answer Total

Q31_____/10
Q32_____/5
Q33_____/5
Q34_____/4
Q35_____/8
Q36_____/8
Total_____/40

Answer Key

Testname: C101 F18 E1

- 1) C
- 2) B
- 3) D
- 4) E
- 5) A
- 6) A
- 7) A
- 8) C
- 9) B
- 10) C
- 11) A
- 12) A
- 13) B
- 14) D
- 15) A
- 16) D
- 17) B
- 18) A
- 19) D
- 20) D
- 21) C
- 22) D
- 23) A
- 24) B
- 25) D
- 26) A
- 27) A
- 28) D
- 29) C
- 30) A
- 31)
- 32)
- 33)
- 34)
- 35)
- 36)

ESSAY. Write your answer in the space provided. Show your work and be sure to include units on all numbers.

31) (10 points) Unit Conversions: Show your work. Be sure to use correct sig figs and units for full credit. Circle your final answer.

a) 2.7 g/mL to kg/m³

$$\frac{2.7 \text{ g}}{\text{mL}} \times \frac{1 \text{ Kg}}{1000 \text{ g}} \times \frac{1 \text{ mL}}{1 \text{ cm}^3} \times \frac{100^3 \text{ cm}^3}{1^3 \text{ m}^3} = \boxed{2.7 \times 10^3 \frac{\text{Kg}}{\text{m}^3}}$$

b) 75 μg to ng

$$75 \mu\text{g} \times \frac{10^9 \text{ ng}}{10^6 \mu\text{g}} = \boxed{7.5 \times 10^4 \text{ ng}}$$

or $75 \mu\text{g} \times \frac{1 \times 10^{-6} \text{ g}}{1 \mu\text{g}} \times \frac{1 \text{ ng}}{1 \times 10^{-9} \text{ g}} = \boxed{7.5 \times 10^4 \text{ ng}}$

c) 256 Gbytes to byte

$$256 \text{ Gbyte} \times \frac{10^9 \text{ byte}}{1 \text{ GByte}} = \boxed{2.56 \times 10^{11} \text{ bytes}}$$

d) 145 lb (pounds) to kg (1 lb = 453.6 g)

$$\frac{145 \text{ lb}}{1 \text{ lb}} \times \frac{453.6 \text{ g}}{1000 \text{ g}} \times \frac{1 \text{ Kg}}{1000 \text{ g}} = \boxed{65.8 \text{ Kg}}$$

e) 5.20 in² to cm²

$$5.20 \text{ in}^2 \times \frac{2.54^2 \text{ cm}^2}{1^2 \text{ in}^2} = \boxed{33.5 \text{ in}^2}$$

32) (5 points) Fill in the following table.

Complete symbol	${}^{96}\text{Mo}^{6+}$	${}^{14}\text{N}$
Mass number	96	14
Atomic number	42	7
Number of protons	42	7
Number of neutrons	54	7
Number of electrons	36	7
Charge	+6	0

33) (5 points) Electron Configurations

a) Fill in the blanks for the element with an electron configuration of: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$

Group # 1 or IA Period # 5 Element symbol Rb Valence electrons 1

Short-hand notation $[\text{Kr}] 5s^1 \leftarrow 1$

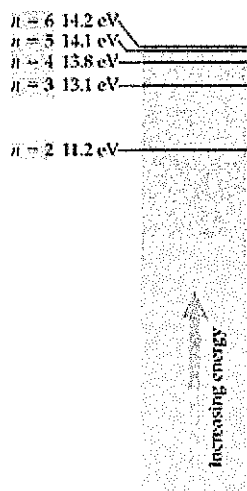
b) Write the electron configuration for the aluminum atom and the aluminum ion.

aluminum atom: $1s^2 2s^2 2p^6 3s^2 3p^1$ aluminum ion: $1s^2 2s^2 2p^6$ \Rightarrow lost $3e^-$
 Al^{3+}

Does the aluminum form a cation or anion? circle one: cation anion

The aluminum ion is isoelectronic with what noble gas? Ne

34) (4 points) What is the wavelength, in nanometers, of light emitted when the electron in a hydrogen atom relaxes from the $n = 5$ to $n = 3$ shell.



$$n=5 - n=3: 14.1 \text{ eV} - 13.1 \text{ eV} = 1.0 \text{ eV}$$

$$1.0 \text{ eV} \times \frac{1.602 \times 10^{-19} \text{ J}}{1 \text{ eV}} = 1.602 \times 10^{-19} \text{ J}$$

$$\lambda = \frac{hc}{E} = \frac{6.626 \times 10^{-34} \text{ J}\cdot\text{s} \times 3.00 \times 10^8 \text{ m/s}}{1.602 \times 10^{-19} \text{ J}} = 1.24 \times 10^{-6} \text{ m}$$

$$1.24 \times 10^{-6} \text{ m} \times \frac{10^9 \text{ nm}}{1 \text{ m}} = 1.24 \times 10^3 \text{ nm} \text{ or } \boxed{1240 \text{ nm}}$$

Is this wavelength in visible spectrum (380–750 nm)? YES or NO

35) (8 points total)

(8 points total)	Total Valence Electrons	Dot Structure	# of bonding pairs of electrons	# of lone pairs of electrons
H ₂ O	8	$\text{H}-\overset{\cdot\cdot}{\underset{\cdot\cdot}{\text{O}}}-\text{H}$	2	2
BF ₃	24	$\begin{array}{c} \text{:}\ddot{\text{F}}\text{:} \\ \text{:}\ddot{\text{F}}\text{:}-\text{B}-\text{:}\ddot{\text{F}}\text{:} \\ \text{:}\ddot{\text{F}}\text{:} \end{array}$	3	9
CO ₂	16	$\overset{\cdot\cdot}{\text{O}}=\text{C}=\overset{\cdot\cdot}{\text{O}}$	4	4
NH ₄ ⁺	8	$\left[\begin{array}{c} \text{H} \\ \\ \text{H}-\text{N}-\text{H} \\ \\ \text{H} \end{array} \right]^+$	4	0

36) (8 points) Fill in the table with either the missing chemical name or chemical formula.

Name:	Formula:
HNO ₃ (aq)	nitric acid → everyone got this point!
HgS	mercury(II) sulfide
Cu ₂ O	copper(I) oxide
N ₂ O ₅	dinitrogen pentoxide
AgC ₂ H ₃ O ₂	silver acetate
Na ₂ SO ₄	sodium sulfate
NH ₃	ammonia
VO ₂	vanadium(IV) oxide