Name: _____

Supply answers to all questions on paper provided. Use a number 2 pencil.

Programmable calculators are permitted only if the proctor has cleared the memory.

There are 100 points possible for this examination. Your score will be reported as a percentage.

There are twenty eight questions. Each question has ONLY ONE correct answer.

Questions are worth 4 points unless otherwise noted.

A periodic table is supplied with this examination paper.

Mark all your answers on the enclosed answer sheet (all 28 questions).

1. A sample of an ideal gas at 27°C and 1 atm pressure is heated at constant volume until the pressure increases to 2.5 atm. At this point the pressure is fixed and the gas is again heated, now at constant pressure, until the volume increases from 10 liters to 20 liters. What is the final temperature of the gas?

a.	27°C	c.	-33°C	e.	427°C
b.	122°	d.	135°C	f.	1227°C

2. If two atoms are atoms of the same element,

   a. they must have the same mass numbers
   b. they must contain the same number of neutrons
   c. they must contain the same total number of subatomic particles
   d. the number of electrons must equal the number of protons
   e. they must contain the same number of protons in the nucleus
   f. the mass number minus the atomic number must be the same for both

3. Which of the following processes represents a physical, not a chemical, change?

   a. Sodium and chloride form sodium chloride
   b. A balloon of hydrogen is ignited in air
   c. Steam condenses on a bathroom mirror
   d. Gasoline is burned in an internal combustion engine
   e. Nitric acid acts upon copper to form a brown toxic gas
   f. Baking soda reacts with vinegar to produce carbon dioxide

4. Which one of the following formulas is incorrect?

a.	Li_2SO_3	lithium sulfite	d.	NH_4NO_3	ammonium nitrate
b.	Ca_3PO_4	calcium phosphate	e.	$BeBr_2$	beryllium bromide
c.	$NaOH$	sodium hydroxide	f.	PF_5	phosphorus pentafluoride

Name: _____

5. Which of the following samples contains the same number of atoms as 40 grams of calcium?

a.	40 g of anything	c.	19 g F_2	e.	18 g H_2O
b.	2.0 g H_2	d.	38 g F_2	f.	48 g O_3

6. If there are exactly 2.54 cm in one inch, what is the area in cm^2 of a rectangle having sides of lengths 8.00 inches and 1.00 ft?

a.	20.3 cm^2	c.	244 cm^2	e.	619 cm^2
b.	51.6 cm^2	d.	77.4 cm^2	f.	1570 cm^2

7. What is the average mass, in grams, of a single molecule of sulfur dioxide?

a.	3.86×10^{25}	c.	1.06×10^{-22}	e.	1.66×10^{-24}
b.	5.33×10^{-23}	d.	6.02×10^{23}	f.	3.76×10^{-25}

8. The molar mass of sodium sulfate is

a.	119.06 g mol^{-1}	c.	103.06 g mol^{-1}	e.	215.13 g mol^{-1}
b.	142.05 g mol^{-1}	d.	126.05 g mol^{-1}	f.	183.13 g mol^{-1}

9. Which statement is correct? *(5 point question*)

   a. All atoms of an element are identical
   b. The base SI unit of mass is the gram
   c. A molecule always contains at least two different elements
   d. Elements in the Periodic Table are arranged in order of increasing mass
   e. All molecules of the nonmetals are diatomic
   f. Mass divided by molar mass equals the number of moles
   g. A mole of hydrogen molecules contains Avogadro's number of hydrogen atoms
   h. The oxyanion of an element with the ending -ite contains more oxygen atoms than the oxyanion with the ending -ate

10. Ethanol molecules have the molecular formula CH_3CH_2OH. What is the approximate mass of 6 moles of ethanol molecules?

a.	7.7 grams	c.	46 grams	e.	276 grams
b.	23 grams	d.	138 grams	f.	552 grams

Name: _____

11. According to the equation:

$COCl_2 + 4NaOH \rightarrow Na_2CO_3 + 2NaCl + 2H_2O$

If 4.0 grams of sodium hydroxide is consumed in this reaction, what mass of water will be produced?

a.	0.18 g	c.	0.45 g	e.	1.0 g	g.	9.0 g
b.	0.36 g	d.	0.90 g	f.	2.0 g	h.	18 g

12. If 5 moles of boron atoms and 8 moles of hydrogen molecules are combined to form the maximum amount of diborane B_2H_6, how many moles of which reactant remain unused at the end?

$2\ B + 3\ H_2 \rightarrow B_2H_6$

a.	0.33 mol B	c.	0.5 mol H_2	e.	1 mol B
b.	0.33 mol H_2	d.	0.5 mol B	f.	1 mol H_2

For the next three questions, use the following key (3 points each question).

What are the oxidation numbers of the specified elements in the following compounds?

a.	+1	c.	+3	e.	+5	g.	+7	i.	+14
b.	+2	d.	+4	f.	+6	h.	+8	j.	+16

13. S in $Al_2(SO_4)_3$

14. Kr in KrF_2

15. Cr in $Cr_2O_7^{2-}$

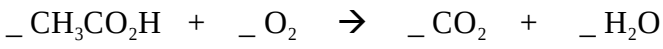
16. Hydrazine and dinitrogen tetroxide can be used in combination as a rocket propellant. Products of the reaction are nitrogen and water. What coefficients are necessary to balance the equation for this reaction?

$\_\ N_2H_4 + \_\ N_2O_4 \rightarrow \_\ N_2 + \_\ H_2O$

a.	1	1	1	2
b.	2	1	2	4
c.	2	2	4	2
d.	2	1	3	2
e.	2	1	3	4
f.	1	1	2	2

Name: _____

17. Acetic acid is ignited in the presence of oxygen and burns completely to produce carbon dioxide and water:



_ CH_3CO_2H + _ O_2 → _ CO_2 + _ H_2O

When properly balanced, the equation indicates that _ moles of O_2 are required to burn 1 mole of acetic acid CH_3CO_2H.

a.	1.0	c.	2.0	e.	3.0	g.	4.0	i.	5.0
b.	1.5	d.	2.5	f.	3.5	h.	4.5	j.	6.0

18. An unknown compound was analyzed and found to contain 26.7% carbon, 2.2% hydrogen, and 71.1% oxygen. In a separate experiment the molar mass was determined to be somewhere between 75 and 105 g/mol. What is a possible molecular formula of the unknown compound?

a.	$CH_3CH_2CH_2CO_2H$	c.	$(CO_2H)_2$	e.	C_6H_5OH
b.	C_4H_9CHO	d.	$(HO)CH_2CH_2CH_2CH_2(OH)$	f.	$CH_2(CO_2H)_2$

19. According to the auf-bau principle, which set of orbitals is filled after the 6p set?

a.	8s	c.	4d	e.	5d	g.	6d
b.	4f	d.	5f	f.	6s	h.	7s

20. Which of the following electron configurations is impossible?

a. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$
b. $1s^2\ 2s^2\ 2p^6\ 3s^1$
c. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6$
d. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^8\ 4s^2$
e. $1s^1$
f. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$

Name: _____

Consider the following elements in the n = 2 and n = 3 periods of the Periodic Table. (*2 points each question*)

a.	Li	c.	B	e.	C	g.	O	i.	F
b.	Na	d.	Al	f.	Si	h.	S	j.	Cl

21. Which element is the smallest in atomic size?

22. Which element has the highest electronegativity?

23. Which element has the highest first ionization energy?

24. Which element most readily forms an ion with a 3+ charge?

25. Which element never has a positive oxidation state?

26. Like chlorine, bromine has 4 polyatomic oxo-ions. Which of the following is the correct formula for the bromite anion?

a.	BrO^-	c.	BrO_2^-	e.	BrO_3^-
b.	BrO_4^-	d.	BrO_5^-	f.	Br^-

27. What is the percent yield when 1.40 g P_4 react with excess Cl_2 to form 4.84 g of PCl_3?

$P_4 + 6\ Cl_2 \rightarrow 4\ PCl_3$

a.	6.21%	c.	78.0%	e.	28.9%
b.	22.6%	d.	3.46%	f.	1.28%

28. Which element has the electron configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$?

a.	O	b.	S	c.	Se	d.	Si	e.	Ge