1 **H** 1.008	IIA											IIIA	IVA	VA	VIA	VIIA	2 **He** 4.003
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31	IIIB	IVB	VB	VIB	VIIB	VIIIB			IB	IIB	13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.87	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.61	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.8	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 **Ac** (227)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (266)	107 **Bh** (264)	108 **Hs** (269)	109 **Mt** (268)	110 **Uun** (271)	111 **Uuu** (272)	112 **Uub** (277)						

58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
90 **Th** 232.0	91 **Pa** (231)	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)

Standard Heats of Formation, ΔH_f^0, (in kJ/mol) for some substances at 25^{0}C and 1atm

$Al_2O_3(s)$	-1669.8	$C_2H_5OH(l)$	-277.7	$HCHO_2(l)$	-424.7	$N_2O_4(g)$	9.2
AgCl(s)	-127.0	CO(g)	-110.5	$H_2O(g)$	-241.8	$N_2O_5(g)$	11.3
C(diamond)	1.9	$CO_2(g)$	-393.5	$H_2O(l)$	-285.9	$NaHCO_3(s)$	-947.7
$CCl_4(l)$	-135.4	$COCl_2(g)$	-218.8	$H_2O_2(l)$	-187.8	$Na_2O(s)$	-415.9
$CH_4(g)$	-74.8	$CS_2(l)$	89.7	H_2S	-20.2	$Na_2O_2(s)$	-504.6
$C_2H_2(g)$	226.7	$CaCO_3(s)$	-1207.1	KCl(s)	-435.9	$O_3(g)$	142.3
$C_2H_4(g)$	52.30	CaO(s)	-635.5	$KClO_3(s)$	-391.2	$PCl_3(g)$	-287.0
$C_2H_6(g)$	-84.7	$ClO_2(g)$	102.5			$PCl_5(g)$	-374.9
		$Cl_2O(g)$	80.3			$PH_3(g)$	5.4
$C_6H_6(l)$	49.0	$Fe_2O_3(s)$	-822.2	$NH_3(g)$	-46.2	$P_4O_{10}(s)$	-2940.1
$CHCl_3(g)$	-80.8	$Fe_3O_4(s)$	-1117.1	$N_2H_4(g)$	95.4	$PbSO_4(s)$	-919.9
$CH_2Cl_2(g)$	-92.5	HBr(g)	-36.2	NO(g)	90.4	$SO_2(g)$	-296.9
$CH_3Cl(g)$	-134.5	HCl(g)	-92.3	$NO_2(g)$	33.8	$SO_3(g)$	-395.2
$CH_2O(g)$	-117.0	HF(g)	-268.6	$N_2O(g)$	81.6	ZnO(s)	-348.0
$CH_3OH(l)$	-238.6	HI(g))	25.9	$N_2O_3(g)$	83.7	ZnS(s)	-202.9

Chemistry 1A-EXAM 1 Name: Key

Part 1-Multiple Choice (30 points)
The following questions have only one correct answer. Please circle the correct answer. (3 points each)

1) Calculate the percent composition of sodium in Na_3PO_4?

a) 14.0% b) 56.5% c) 27.3% d) 42.1% e) 48.5%

2) Which of the following contains a halogen, a noble gas, and an alkaline earth metal (they don't have to be in that order)?

a) Na, Ne, F b) Mg, Br, Ar c) He, I, K d) Ca, Xe, Rb e)Rn,O, Sr

3) The boiling point temperature of ethanol at sea level is about 351 K. What would that temperature be in degrees Fahrenheit?

a) 172 ^{0}F b)351 ^{0}F c) 78^{0}F d) 72^{0}F e) 68^{0}F

4) The answer to the following operations should be rounded off to how many significant figures?

$$\frac{651.321\text{g} - 651.021\text{g}}{0.12325\text{ mL}} = 0.300$$

a) 1 b) 2 c) 3 d) 4 e) 5

5) What is the mass of one potassium atom (in grams)?

a) 39.1 g b) 6.02×10^{23} g c) 1.00g d) 6.50×10^{-23} g
e) 6.02×10^{-23}g

6) Which of the following scientists discovered the nuclear model of the atom?

a) R. A. Millikan b) J. J Thomson c) Ernest Rutherford
d) James Chadwick e) Marie Curie

7) An oxide of oxygen-16 has
a) 16 protons, 16 electrons, and 16 neutrons
b) 8 protons, 8 electrons, and 8 neutrons
c) 8 protons, 8 electrons, and 10 neutrons
d) 10 protons, 8 electron, and 8 neutrons
e) 8 protons, 10 electrons, and 8 neutrons

8) A 25.0 mL portion of 0.100 M sodium hydroxide solution is mixed with 75.0 mL of water. Calculate final concentration of sodium hydroxide in that solution. (assume the volumes add)

a) 0.0500M b) 0.0333 M c) 0.100 M d) 0.0125M e) 0.0250M

9) Which of the following elements is a partial conductor of electricity?

a) S_8 b) I_2 c) Ag d) Sb e) Cu

10) Calculate the mass of the excess reactant left behind at the end of the reaction of 7.00g of methane gas with 11.0g of oxygen gas according to the following balanced equation. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

a) 4.25g b) 17.0 g c) 0.0 g d) 3.55g e) 3.95g

Part II. Formulas, Names, Equations. (27 pts.)

11) Write the formulas of the following compounds. (3 pt. each)

Cupric iodide CuI_2

Sulfur hexafluoride SF_6

Hypobromous Acid $HBO(aq)$

12) Write the names of the following compounds. (3 points each)

$Sn(SO_3)_2$ tin (IV) sulfite

P_2O_{10} diphosphorous decoxide

$H_2C_2O_4(aq)$ oxalic acid

13) Complete (with states) and **balance** the following equations. (3 pts. each)

a) $2Na_3PO_4(aq) + 3BaCl_2(aq) \rightarrow 6NaCl(aq) + Ba_3(PO_4)_2(s)$

b) $2K(s) + 2H_2O(l)(excess) \rightarrow 2KOH(aq) + H_2(g)$

c) Complete Combustion of $CH_3CO_2CH_2CH_3$

$CH_3CO_2CH_2CH_3$

$C_4H_8O_2(l) + 5O_2(g) \rightarrow 4CO_2(g) + 4H_2O(g)$

Part III. Problems.(43 Points)

For the following questions you must show complete work and round off your answer to the correct number(s) of significant figure(s) when applied. Make sure your final answer is placed in the appropriate box.

14) Given the following balanced equations:

$P_4 + 5O_2 \rightarrow 2P_2O_5$
$P_2O_5 + 3H_2O \rightarrow 2H_3PO_4$
$2H_3PO_4 + 3Zn \rightarrow Zn_3(PO_4)_2 + 3H_2$
$3H_2 + N_2 \rightarrow 2NH_3$

Calculate the mass of ammonia gas that can theoretically be produced from 55.0 g of phosphorus (P_4) assuming the yield for all of the above reactions is 100%. (7 points)

$$55.0\text{g } P_4 \times \frac{1\text{mol } P_4}{123.88\text{g}} \times \frac{2\text{mol } P_2O_5}{1\text{mol } P_4} \times \frac{2\text{mol } H_3PO_4}{1\text{mol } P_2O_5} \times \frac{3\text{mol } H_2}{2\text{mol } H_3PO_4} \times \frac{2\text{mol } NH_3}{3\text{mol } H_2} \times \frac{17.04\text{g}}{1\text{mol } NH_3} =$$

30.3g NH_3

15) A 10.0g sample of an unknown metal was heated to 87.0 ^{0}C and dropped in 125 g of water at 22.00 ^{0}C inside a constant pressure calorimeter. The final temperature of the mixture after thermoequilibrium has been reached was 22.50 ^{0}C. Calculate the specific heat capacity of the metal assuming the calorimeter does not absorb any heat.(6 points)

$C_{metal} = ?$
$T_{i\,metal} = 87.0°C$
$T_{f\,metal} = 22.50°C$
$M_{metal} = 10.0\text{g}$
$C_{H_2O} = 4.184\ J/g·°C$
$T_{i\,H_2O} = 22.00°C$
$T_{f\,H_2O} = 22.50°C$
$M_{H_2O} = 125\text{g}$

$q = mC\Delta T$

$q_{metal} = -q_{H_2O}$

$(10.0\text{g})(C_{metal})(22.50°C - 87.0°C) = -[(125\text{g})(4.184\ J/g·°C)(22.50°C - 22.00°C)]$

$-64.5°C$ $\quad 0.50°C$

$$C_{metal} = \frac{-[125\text{g})(4.184\ J/g·°C)(0.50°C]}{(10.0\text{g})(-64.5°C)}$$

$= -0.4054\ J/g·°C$

$-0.41\ J/g·°C$

16) Calculate the mass of carbon needed in order to produce 100.0 g of copper if the yield for the following reaction is only 85.0%.(7 points)

$Cu_2O(s) + C(s) \rightarrow 2Cu(s) + CO(g)$ $\quad \frac{ACT}{Theo} \times 100 = 85.0\%$

$$100.0\,g\,Cu \times \frac{100\,g\,theo\,Cu}{85.0\,g\,Cu} \times \frac{1\,mol\,Cu}{63.55\,g} \times \frac{1\,mol\,C}{2\,mol\,Cu} \times \frac{12.01\,g}{1\,mol\,C} = 11.12\,g\,C$$

11.12 g C

17) A compound contains only C, H, and N. Combustion of 35.0 mg of the compound produces 33.5 mg CO_2, 41.1 mg H_2O, and an unknown mass of nitrogen gas.

a) Determine the empirical formula of that compound. (8 Points)

$$33.5\,mg\,CO_2 \times \frac{1\,g}{1000\,mg} \times \frac{1\,mol\,CO_2}{44.01\,g} \times \frac{1\,mol\,C}{1\,mol\,CO_2} \times \frac{12.01\,g\,C}{1\,mol\,C} = 9.14 \times 10^{-3}\,g\,C$$

$$41.1\,mg\,H_2O \times \frac{1\,g}{1000\,mg} \times \frac{1\,mol\,H_2O}{18.02\,g} \times \frac{2\,mol\,H}{1\,mol\,H_2O} \times \frac{1.01\,g\,H}{1\,mol} = 4.61 \times 10^{-3}\,g\,H$$

$$35.0\,mg - 9.14\,mg\,C - 4.61\,mg\,H = 21.25\,mg\,N$$

$$9.14 \times 10^{-3}\,g \times \frac{1\,mol\,C}{12.01\,g\,C} = \frac{7.61 \times 10^{-4}\,mol\,C}{7.61 \times 10^{-4}} = 1$$

$$4.61 \times 10^{-3}\,g \times \frac{1\,mol\,H}{1.01\,g\,H} = \frac{4.56 \times 10^{-3}\,mol\,H}{7.61 \times 10^{-4}} = 6$$

$$2.125 \times 10^{-2}\,g \times \frac{1\,mol\,N}{14.01\,g\,N} = \frac{1.52 \times 10^{-3}\,mol\,N}{7.61 \times 10^{-4}} = 2$$

CH_6N_2

b) If 0.500 mol of that compound has a mass of 69.1g, determine the molecular formula of that compound. (3 points)

$\frac{69.1\,g}{0.500\,mol} = 138.2\,g/mol$

$M_{wt}\ CH_2N_2 = 46.09\,\frac{g}{mol}$ $\qquad \frac{138.2\,\frac{g}{mol}}{46.09\,\frac{g}{mol}} = 3$ $\qquad \boxed{C_3H_{18}N_6}$

18) a)The combination of coal and steam produces a mixture called coal gas, which can be used as a fuel or as a starting material for other reactions. If we assume coal can be represented by graphite, the equation for the production of coal gas is

$2\,C(s) + 2\,H_2O(g) \rightarrow CH_4(g) + CO_2(g)$

Determine the standard enthalpy change for this reaction from the following standard enthalpies of reaction :

(1) $C(s) + H_2O(g) \rightarrow CO(g) + H_2(g)$ $\qquad \Delta H° = 131.3\,kJ$

(2) $CO(g) + H_2O(g) \rightarrow CO_2(g) + H_2(g)$ $\qquad \Delta H° = -41.2\,kJ$

(3) $CH_4(g) + H_2O(g) \rightarrow 3\,H_2(g) + CO(g)$ $\qquad \Delta H° = 206.1\,kJ$

(You must show Hess's Law set up for full credit)

$2\times$ $2C + 2H_2O \rightarrow 2CO_2 + 2H_2$ $\qquad [\Delta H° = 131.3\,kJ]\times 2$

$CO + H_2O \rightarrow CO_2 + H_2$ $\qquad \Delta H° = -41.2\,kJ$

$3H_2 + CO \rightarrow CH_4 + H_2O$ $\qquad \Delta H° = -206.1\,kJ$

$2C + 2H_2O \rightarrow CO_2 + CH_4$ ✓

$[2(131.3\,kJ) + (-41.2\,kJ) + (-206.1\,kJ)]$

$= 15.3\,kJ$

$\boxed{15.3\,kJ}$

b) Calculate the amount of heat released or absorbed when 25.0 g of coal (carbon) reacts with excess steam.(5 points)

$25.0\,g\,C \times \frac{1\,mol\,C}{12.01\,g} \times \frac{15.3\,kJ}{2\,mol\,C} = 15.924\,kJ$

$\boxed{15.9\,kJ}$