

1 H 1.008	IIA																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	VIIIB										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° , (in kJ/mol) for some substances at 25°C and 1atm

Al ₂ O ₃ (s)	-1669.8	C ₂ H ₅ OH(l)	-277.7	HCHO ₂ (l)	-424.7	N ₂ O ₄ (g)	9.2
AgCl(s)	-127.0	CO(g)	-110.5	H ₂ O(g)	-241.8	N ₂ O ₅ (g)	11.3
C(diamond)	1.9	CO ₂ (g)	-393.5	H ₂ O(l)	-285.9	NaHCO ₃ (s)	-947.7
CCl ₄ (l)	-135.4	COCl ₂ (g)	-218.8	H ₂ O ₂ (l)	-187.8	Na ₂ O(s)	-415.9
CH ₄ (g)	-74.8	CS ₂ (l)	89.7	H ₂ S	-20.2	Na ₂ O ₂ (s)	-504.6
C ₂ H ₂ (g)	226.7	CaCO ₃ (s)	-1207.1	KCl(s)	-435.9	O ₃ (g)	142.3
C ₂ H ₄ (g)	52.30	CaO(s)	-635.5	KClO ₃ (s)	-391.2	PCl ₃ (g)	-287.0
C ₂ H ₆ (g)	-84.7	ClO ₂ (g)	102.5			PCl ₅ (g)	-374.9
		Cl ₂ O(g)	80.3			PH ₃ (g)	5.4
C ₆ H ₆ (l)	49.0	Fe ₂ O ₃ (s)	-822.2	NH ₃ (g)	-46.2	P ₄ O ₁₀ (s)	-2940.1
CHCl ₃ (g)	-80.8	Fe ₃ O ₄ (s)	-1117.1	N ₂ H ₄ (g)	95.4	PbSO ₄ (s)	-919.9
CH ₂ Cl ₂ (g)	-92.5	HBr(g)	-36.2	NO(g)	90.4	SO ₂ (g)	-296.9
CH ₃ Cl(g)	-134.5	HCl(g)	-92.3	NO ₂ (g)	33.8	SO ₃ (g)	-395.2
CH ₂ O(g)	-117.0	HF(g)	-268.6	N ₂ O(g)	81.6	ZnO(s)	-348.0
CH ₃ OH(l)	-238.6	HI(g))	25.9	N ₂ O ₃ (g)	83.7	ZnS(s)	-202.9

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 °F b) 351 °F c) 78 °F d) 72 °F e) 68 °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) S₈ b) I₂ 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. $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$

- 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 CuI₂

Sulfur hexafluoride SF₆

Hypobromous Acid HBrO(aq)

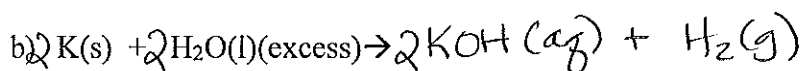
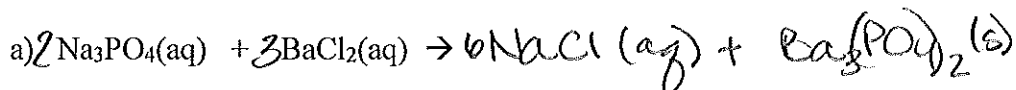
12) Write the names of the following compounds. (3 points each)

Sn(SO₃)₂ tin(IV) sulfite

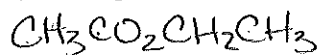
P₂O₁₀ diphosphorous decoxide

H₂C₂O₄(aq) oxalic acid

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



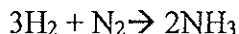
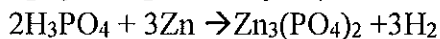
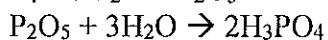
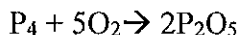
c) Complete Combustion of CH₃CO₂CH₂CH₃



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:



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)

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

$30.3 \text{ g } NH_3$

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

$$C_{\text{metal}} = ?$$

$$T_{i \text{ metal}} = 87.0^\circ\text{C}$$

$$T_{f \text{ metal}} = 22.50^\circ\text{C}$$

$$M_{\text{metal}} = 10.0 \text{ g}$$

$$C_{H_2O} = 4.184 \text{ J/g}\cdot^\circ\text{C}$$

$$T_{i \text{ H}_2O} = 22.00^\circ\text{C}$$

$$T_{f \text{ H}_2O} = 22.50^\circ\text{C}$$

$$M_{H_2O} = 125 \text{ g}$$

$$q = mc\Delta T$$

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

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

$$C_{\text{metal}} = \frac{-(125 \text{ g})(4.184 \text{ J/g}\cdot^\circ\text{C})(0.50^\circ\text{C})}{(10.0 \text{ g})(-64.5^\circ\text{C})}$$

$$= -0.4054 \text{ J/g}\cdot^\circ\text{C}$$

$-0.41 \text{ J/g}\cdot^\circ\text{C}$

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)



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

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)

$$33.5 \text{ mg CO}_2 \times \frac{1 \text{ g}}{1000 \text{ mg}} \times \frac{1 \text{ mol CO}_2}{44.01 \text{ g}} \times \frac{1 \text{ mol C}}{1 \text{ mol CO}_2} \times \frac{12.01 \text{ g C}}{1 \text{ mol C}} = 9.14 \times 10^{-3} \text{ g C}$$

$$41.1 \text{ mg H}_2\text{O} \times \frac{1 \text{ g}}{1000 \text{ mg}} \times \frac{1 \text{ mol H}_2\text{O}}{18.02 \text{ g}} \times \frac{2 \text{ mol H}}{1 \text{ mol H}_2\text{O}} \times \frac{1.01 \text{ g H}}{1 \text{ mol}} = 4.61 \times 10^{-3} \text{ g H}$$

$$35.0 \text{ mg} - 9.14 \text{ mg C} - 4.61 \text{ mg H} = 21.25 \text{ mg N}$$

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

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

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

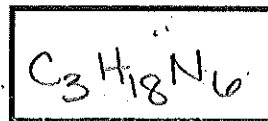
CH_6N_2

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

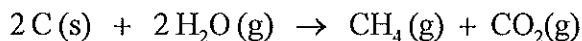
$$\frac{69.1 \text{ g}}{0.500 \text{ mol}} = 138.2 \text{ g/mol}$$

$$\text{Mwt } \text{CH}_6\text{N}_2 = \frac{46.09 \text{ g}}{\text{mol}}$$

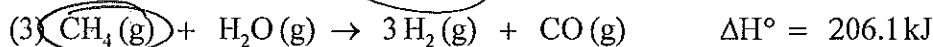
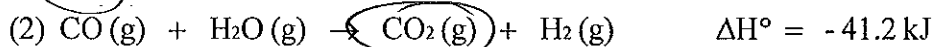
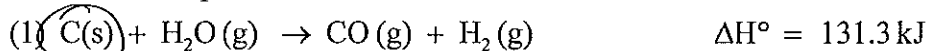
$$\frac{138.2 \text{ g/mol}}{46.09 \text{ g/mol}} = 3$$



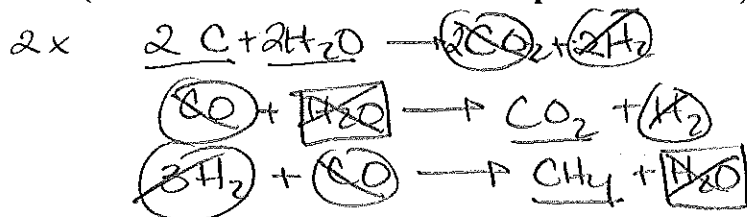
18) a) The combination of coal and steam produces a mixture called coal gas, which can be used as a fuel or as a starting material for other reactions. If we assume coal can be represented by graphite, the equation for the production of coal gas is



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



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



$$[\Delta H^\circ = 131.3 \text{ kJ}] \times 2$$

$$\Delta H^\circ = -41.2 \text{ kJ}$$

$$\Delta H^\circ = -206.1 \text{ kJ}$$



$$[2(131.3 \text{ kJ}) + (-41.2 \text{ kJ}) + (-206.1 \text{ kJ})]$$

$$= 15.3 \text{ kJ}$$

$$\boxed{15.3 \text{ kJ}}$$

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

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

$$\boxed{15.9 \text{ kJ}}$$