Your name: PRACTICE EXAM 2 (Your Exam is on March 11, 2015!)

Chem 1061-003 **Midsemester Exam 2 (Ch. 5-7)** Prof. John Ellis

March 12, 2014 **Form 1A**

Instructions: **DO NOT OPEN THE EXAM UNTIL TOLD TO DO SO.**

1. This is a closed book and notes exam. Calculators and the information sheet may not be exchanged between students during the exam. You must not consult other students or their exams in any manner during this exam period. Please use the periodic table appended to this exam or the one on the wall. No other periodic table may be used on this exam.

2. You will have about 60 minutes to work the exam (unless you arrived late!).

3. The test contains 20 multiple choice questions worth 5 points each. Select the best choice for each. For the multiple choice questions with numerical answers, select the answer that is the closest to the number you calculate. There is NO partial credit on any questions.

4. Mark all your answers on the answer sheet in the spaces provided with a number 2 pencil and hand it in when finished. We will only grade the answer sheet. You should do your work right on the test sheets. You can keep the exam so if you mark your answers there also, you can evaluate your performance from the posted answer key. Be sure that your answers on the answer sheet and this exam are identical! However, remember that the answers shown on the answer sheet represent the only valid record of your exam.

On your answer sheet make sure your **name and X500(Internet ID)** are bubbled in correctly. Also, be sure to **sign your name**.

5. The Answer Sheet will be collected promptly at 10:00 p.m.

STOP AND WAIT UNTIL THE EXAM STARTS

Keep this exam for your own records!
Only hand in the answer sheet.

1. The density of a gas at 100°C and 300 torr is 0.490 gL^{-1}. Identify the gas.

   a. H_2
   b. CH_2
   c. N_2
   d. O_2
   e. F_2

2. Which value of the angular momentum or "shape" quantum number l, corresponds to a d orbital?

   a. 0
   b. 1
   c. 2
   d. 3
   e. 4

3. Aluminum carbide undergoes hydrolysis to generate methane gas, CH_4, and aluminum hydroxide. What is the correct formula of aluminum carbide?

   a. Al_2C_3
   b. AlC
   c. AlC_2
   d. Al_4C_3
   e. Al_2C

4. If 5.00 moles of H_2 and 2.00 moles of O_2 react in a 22.4 L flask to produce water, determine the final pressure in the flask at 0°C, assuming a quantitative reaction and ignoring the very small vapor pressure of water. (Hint: first balance the equation and then determine the quantity of gases after the reaction.)

   a. 3.00 atm
   b. 2.00 atm
   c. 1.00 atm
   d. 0.50 atm
   e. 0.00 atm

5. Which gas is the most likely to behave ideally, i.e. obey the ideal gas law?

   a. neon
   b. helium
   c. fluorine
   d. nitrogen
   e. oxygen

6. Which compound is the reducing agent in the following reaction?

   $2\,KMnO_4 + CH_3OH + 2\,HF \rightarrow CO_2 + 2\,KF + 2\,MnO_2 + 2\,H_2O$

   a. $KMnO_4$
   b. MnO_2
   c. HF
   d. CO_2
   e. CH_3OH

7. Which of the following 0.100 M aqueous solutions will have the lowest electrical conductivity?

   a. sulfuric acid
   b. nitric acid
   c. hydrochloric acid
   d. phosphoric acid
   e. perchloric acid

8. Which is the correct equation representing the standard enthalpy of formation of CO(g), where $\Delta H^\circ_f = -110.5$ kJ/mol and C(s) is graphite?

   a. $2\,C(s) + O_2(g) \rightarrow 2\,CO(g)$
   b. $C(s) + (1/2)O_2(g) \rightarrow CO(g)$
   c. $C(s) + O(g) \rightarrow CO(g)$
   d. $C(s) + CO_2(g) \rightarrow 2\,CO(g)$
   e. $CO(g) \rightarrow C(s) + (1/2)O_2(g)$

9. If a 70.0% yield of $C_{12}H_{16}$ was obtained from 150g of C_3H_6O, what mass of the product, $C_{12}H_{16}$, was isolated from the following reaction? (C_3H_6O, MM = 58.0; $C_{12}H_{16}$, MM = 160, where MM = molar mass in grams)

$$4\ C_3H_6O \rightarrow C_{12}H_{16} + 4\ H_2O$$

a. 72.4 g
b. 103 g
c. 78.8 g
d. 49.6 g
e. 48.0 g

10. Which substance has a standard enthalpy of formation defined to be zero?

a. $O_2(g)$
b. $He(l)$
c. $H(g)$
d. $Na(g)$
e. $H_2O(l)$

11. At 25°C, the following heats of reaction are known:

	ΔH (kJ)
$2\ ClF + O_2 \rightarrow Cl_2O + F_2O$	167.4
$Cl_2O + 3\ F_2O \rightarrow 2\ ClF_3 + 2\ O_2$	-341.4
$ClF + F_2 \rightarrow ClF_3$	-108.7

At the same temperature, calculate ΔH for the reaction: $2\ F_2O \rightarrow 2\ F_2 + O_2$

a. +217.4 kJ
b. -43.4 kJ
c. -187.4 kJ
d. +43.4 kJ
e. -217.4 kJ

12. On earth, the ionization energy of hydrogen is 1312 kJ/mol. On a distant planet, it is so hot that all hydrogen atoms have their electron in the quantum state with n = 5. On this distant planet, the ionization energy of hydrogen in kJ/mol is:

a. 656
b. 328
c. 262
d. 82
e. 52

13. 130 mL of gas is collected over water at 22°C and 753 torr. What volume (in mL) will the dry gas occupy at STP? Vapor pressure of water at 22°C is 20 torr.

a. 116 mL
b. 119 mL
c. 127 mL
d. 130 mL
e. 133 mL

14. When 0.200 g of graphite is completely burned in a calorimeter containing 3800 g of water, a temperature increase of 0.42°C was observed. The heat capacity of water is 4.184 joule/g-K. Assume no heat is absorbed by the colorimeter in this process. Calculate the enthalpy of combustion of 6.00 g of graphite (or elemental carbon).

a. -27.5 kJ/mol
b. -33.3 kJ/mol
c. -52.5 kJ/mol
d. -200 kJ/mol
e. -401 kJ/mol

15. Using the enthalpies of combustion for C_4H_4(-2341 kJ/mol), C_4H_8 (-2755 kJ/mol), and H_2 (-286 kJ/mol), calculate ΔH for the following reaction in kJ/mol:

$C_4H_4 + 2\,H_2 \rightarrow C_4H_8$

Hint: First write equations for the full combustion (reaction with O_2) of C_4H_4, C_4H_8, and H_2, then add these together in the correct proportions so they provide the desired equation, shown above.

a. -128
b. -158
c. +128
d. +158
e. -5382

16. A sample of compound containing only the elements C, O, and F contains 21.2% carbon and 50.4% fluorine by mass. Determine the empirical formula of this substance.

a. C_2OF
b. COF_2
c. C_2OF_2
d. COF
e. $C_2O_2F_3$

17. Calculate the maximum wavelength of light in nanometers (nm) required to remove an electron from a hydrogen atom from the n = 3 energy level.

a. 103nm
b. 274 nm
c. 821 nm
d. 13300 nm
e. 39900 nm

18. When the electron in atomic hydrogen makes a transition from n = 6 to n = 2 which of the following statements are true?

1. Energy is emitted.
2. Energy is absorbed.
3. The electron gains energy.
4. The electron loses energy.
5. The electron cannot make this transition.

a. 1, 4
b. 2, 4
c. 2, 3
d. 1, 3
e. 5

19. When a mole of NH_3 forms from the elements, 42.2 kJ of energy is released as heat. What is ΔH for this reaction for the formation of 34.0 g of NH_3? (Molecular mass of NH_3 is 17.0 $gmol^{-1}$)

a. -21.1 kJ
b. -42.2 kJ
c. -84.4 kJ
d. +42.2 kJ
e. +84.4 kJ

20. Of the following types of radiation, how many have an energy per photon lower than that of infrared light?

visible blue	microwave	radio frequency
visible green	visible red	ultraviolet

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

- End of Exam -

Activity Series of Metals

Li
K
Ba
Ca
Na
Mg
Al
Mn
Zn
Cr
Fe
Cd
Co
Ni
Sn
Pb
H_2
Cu
Hg
Ag
Au

Solubility Guidelines for Ionic Compounds in Water

Soluble	Exceptions
NH_4^+	None
Na^+	None
K^+	None
NO_3^-	None
ClO_4^-	None
$C_2H_3O_2^-$	None
Cl^-, Br^-, I^-	Cu^+, Ag^+, Hg_2^{2+}, and Pb^{2+} compounds
SO_4^{2-}	Ba^{2+}, Sr^{2+}, Ca^{2+}, Ag^+, and Pb^{2+} compounds

Insoluble	Exceptions
OH^-	Li^+, Na^+, K^+, Ba^{2+}, Sr^{2+}, Ca^{2+} compounds
S^{2-}	Mg^{2+}, Ca^{2+}, Sr^{2+}, and Ba^{2+}, Li^+, Na^+, K^+, NH_4^+ compounds
CO_3^{2-}	Li^+, Na^+, K^+, NH_4^+ compounds
PO_4^{3-}	Li^+, Na^+, K^+, NH_4^+ compounds

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speed of light = $c = 2.9979 \times 10^8$ m/s

Planck's constant = $h = 6.626 \times 10^{-34}$ J•s

$E_n = -2.178 \times 10^{-18}$ J(Z^2/n^2)/atom = -1312.0 kJ (Z^2/n^2)/mol

$E = 1.197 \times 10^5/\lambda$ for E in kJ/mol, λ in nm

$E = 2.31 \times 10^{-19}$ kJ•pm (Q_1Q_2/d); $E_{molar} = 1.39 \times 10^5$ kJ•pm (Q_1Q_2/d).

$PV = nR_{gas}T$

$N_A = 6.022 \times 10^{23}$ mol^{-1}

$R_{gas} = 0.0821$ L•atm•mol^{-1}•K^{-1} = 8.314 J•K^{-1}•mol^{-1}

molar volume of an ideal gas at STP = 22.414 L

STP = 0 °C and 1 atm pressure; 0 K = -273.2 °C

1 atm = 101.3 kPa = 14.7 lb/in^2 = 760 torr

$\Delta H°_{rxn} = \Sigma n_p \Delta H_f°$ (products) - $\Sigma n_r \Delta H_f°$ (reactants)

$\Delta H°_{rxn} = \Sigma$BE (reactant bonds broken) - ΣBE (product bonds formed)

PERIODIC CHART OF THE ELEMENTS

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII	VIII	VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	INERT GASES
1 H 1.00797																1 H 1.00797	2 He 4.0026
3 Li 6.939	4 Be 9.0122											5 B 10.811	6 C 12.0112	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.183
11 Na 22.9898	12 Mg 24.312											13 Al 26.9815	14 Si 28.086	15 P 30.9738	16 S 32.064	17 Cl 35.453	18 Ar 39.948
19 K 39.102	20 Ca 40.08	21 Sc 44.956	22 Ti 47.90	23 V 50.942	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.71	29 Cu 63.54	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.909	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.905	40 Zr 91.22	41 Nb 92.906	42 Mo 95.94	43 Tc [99]	44 Ru 101.07	45 Rh 102.905	46 Pd 106.4	47 Ag 107.870	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.904	54 Xe 131.30
55 Cs 132.905	56 Ba 137.34	*57 La 138.91	72 Hf 178.49	73 Ta 180.948	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 196.967	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.980	84 Po [210]	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 [262]	108 Hs [265]	109 Mt [266]	110 ? [271]	111 ? [272]	112 ? [277]						

*Lanthanide Series														
58 Ce 140.12	59 Pr 140.907	60 Nd 144.24	61 Pm [147]	62 Sm 150.35	63 Eu 151.96	64 Gd 157.25	65 Tb 158.924	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.97

‡Actinide Series														
90 Th 232.038	91 Pa [231]	92 U 238.03	93 Np [237]	94 Pu [242]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [249]	99 Es [254]	100 Fm [253]	101 Md [256]	102 No [256]	103 Lr [257]

Numbers in parenthesis are mass numbers of most stable or most common isotope.

Atomic weights corrected to conform to the 1963 values of the Commission on Atomic Weights.

The group designations used here are the former Chemical Abstract Service numbers.

ANNOTATED ANSWER KEY WITH AVERAGES SHOWN FOR INDIVIDUAL QUESTIONS

Form 1A March 12, 2014	Chemistry 1061-003 AVERAGE ON EXAM = 68%	Midsemester Exam 2 Dr. John E. Ellis

1. The density of a gas at 100°C and 300 torr is 0.490 gL^{-1}. Identify the gas.

$PV = nRT = \left(\frac{m}{MM}\right)RT$; MM = MOLEC. MASS $= \left(\frac{m}{V}\right)\frac{RT}{P}$

88%. $MM = \left(\frac{0.490\ g}{L}\right)\left(0.0821\ \frac{L\cdot atm}{mol\ K}\right)\left(\frac{373\ K}{300\ torr}\right)\left(\frac{760\ torr}{1\ atm}\right) = 38.0\ g/mol$

gas density

a. H_2
b. CH_2
c. N_2
d. O_2
(e.) F_2

F_2 HAS A MM = 38.0 g/mol

2. Which value of the angular momentum or "shape" quantum number l, corresponds to a d orbital?

$l = 0, 1, 2, 3, 4, 5$
orbital s p d f, g, h

77%. a. 0
b. 1
(c.) 2
d. 3
e. 4

3. Aluminum carbide undergoes hydrolysis to generate methane gas, CH_4, and aluminum hydroxide. What is the correct formula of aluminum carbide?

62%. a. Al_2C_3
b. AlC
c. AlC_2
(d.) Al_4C_3
e. Al_2C

$Al_4C_3 + 12H_2O \longrightarrow 4Al(OH)_3 + 3CH_4$

↖ THIS IS THE ONLY CMPD SHOWN CONTAINING Al(3+) AND C(4−)

4. If 5.00 moles of H_2 and 2.00 moles of O_2 react in a 22.4 L flask to produce water, determine the final pressure in the flask at 0°C, assuming a quantitative reaction and ignoring the very small vapor pressure of water. (Hint: first balance the equation and then determine the quantity of gases after the reaction.)

53%. $2H_2 + O_2 \longrightarrow 2H_2O$

	H_2	O_2	H_2O
INITIAL Q's (MOLES)	5.00	2.00	0.00
AMT CONSUMED	−4.00	−2.00	—
FINAL AMT PRESENT	1.00	0.00	X

SINCE H_2O DOES NOT CONTRIBUTE TO THE PRESSURE, WE IGNORE THE AMT OF H_2O FORMED

a. 3.00 atm
b. 2.00 atm
(c.) 1.00 atm
d. 0.50 atm
e. 0.00 atm

ACTUAL H_2/O_2 MOLE RATIO = 5.00/2.00 = 2.50 > 2.00 ; THEREFORE, H_2 IS PRESENT IN EXCESS AND O_2 IS THE LR (i.e., ALL O_2 IS CONSUMED!)

AMT H_2 CONSUMED : $(2.00\ mol\ O_2)\left(\frac{2\ mol\ H_2}{1\ mol\ O_2}\right) = 4.00\ mol\ H_2$

$P = \frac{nRT}{V}$; $n = 1.00\ mol\ H_2$; $P = \frac{(1.00)(0.0821)(273)}{22.4} = 1.00\ atm$

5. Which gas is the most likely to behave ideally, i.e. obey the ideal gas law?

88%.

a. neon
b. helium
c. fluorine
d. nitrogen
e. oxygen

lowest atomic mass; F_2, N_2, O_2 are much higher boiling (+ less ideal) owing to their diatomic nature and for higher formula masses. Ne, F_2, N_2 + O_2 are less ideal than He owing to their far greater attractive forces (related to their "a" values in the Van der Waal's equation) compared to He

6. Which compound is the reducing agent in the following reaction?

$$2\,KMnO_4 + CH_3OH + 2\,HF \rightarrow CO_2 + 2\,KF + 2\,MnO_2 + 2\,H_2O$$

45%.

a. $KMnO_4$
b. MnO_2
c. HF
d. CO_2
e. CH_3OH

MnO_4^- undergoes reduction to MnO_2, therefore $KMnO_4$ is the oxidizing agent.

CH_3OH (with C having an O.N. of −2) undergoes oxidation to CO_2, therefore CH_3OH is the reducing agent (since it is losing electrons (or transferring electrons) to the MnO_4^-)

7. Which of the following 0.100 M aqueous solutions will have the lowest electrical conductivity?

See page 146 of text (6th Ed) or p. 151 of 5th Ed.

40%.

a. sulfuric acid
b. nitric acid
c. hydrochloric acid
d. phosphoric acid
e. perchloric acid

Table 4.2, which we discussed in lecture (more than once) shows that phosphoric is the only weak acid on the list (which I asked you to remember!) I am really surprised so many of you missed this question, because it is very closely related to Q7 on Practice Exam 2 from 2011!!

8. Which is the correct equation representing the standard enthalpy of formation of CO(g), where $\Delta H^\circ_f = -110.5$ kJ/mol and C(s) is graphite?

88%.

× a. $2\,C(s) + O_2(g) \rightarrow 2\,CO(g)$ ← 2 moles of CO form ($\Delta H = -221.0$ kJ)

b. $C(s) + (1/2)O_2(g) \rightarrow CO(g)$

× c. $C(s) + O(g) \rightarrow CO(g)$ ← ATOMIC OXYGEN IS NOT THE STABLE FORM OF ELEMENTAL OXYGEN AT 25°C, 1 atm P.

d. $C(s) + CO_2(g) \rightarrow 2\,CO(g)$

e. $CO(g) \rightarrow C(s) + (1/2)O_2(g)$

d + e ARE NOT DEFINING EQNS FOR ΔH°_f BECAUSE THEY INVOLVE COMPOUNDS (+ NOT ELEMENTS) AS REACTANTS. ΔH(eq e) = $-\Delta H^\circ_f$(CO) = +110.5 kJ

9. If a 70.0% yield of $C_{12}H_{16}$ was obtained from 150g of C_3H_6O, what mass of the product, $C_{12}H_{16}$, was isolated from the following reaction? (C_3H_6O, MM = 58.0; $C_{12}H_{16}$, MM = 160, where MM = molar mass in grams)

$4\ C_3H_6O \rightarrow C_{12}H_{16} + 4\ H_2O$

% YIELD $= \left(\frac{\text{ACTUAL YIELD OF PRODUCT}}{\text{THEORETICAL YIELD OF PRODUCT}}\right) \times 100 = \left(\frac{x}{y}\right) 100$

$y = (150\text{g } C_3H_6O)\left(\frac{1\text{ mol } C_3H_6O}{4\text{ mol } C_3H_6O}\right)\left(\frac{1\text{ mol } C_{12}H_{16}}{58.0\text{ g}}\right)\left(\frac{160\text{ g } (C_{12}H_{16})}{1\text{ mol } C_{12}H_{16}}\right) = 103.4$

$x = \frac{(70.0)(103.4)}{100} = 72.4\text{ g}$

877. a. 72.4 g
b. 103 g
c. 78.8 g
d. 49.6 g
e. 48.0 g

10. Which substance has a standard enthalpy of formation defined to be zero?

787. a. $O_2(g)$
b. $He(l)$ ← He IS A GAS AT 25°C, 1 atm P
c. $H(g)$ ← HYDROGEN IS H_2 " " "
d. $Na(g)$ ← Na IS A SOLID " "
e. $H_2O(l)$ ← IS NOT AN ELEMENT.

11. At 25°C, the following heats of reaction are known:

		ΔH (kJ)
EQ1 $2\ ClF + O_2 \rightarrow Cl_2O + F_2O$	ΔH_1	167.4
EQ2 $Cl_2O + 3\ F_2O \rightarrow 2\ ClF_3 + 2\ O_2$	ΔH_2	-341.4
EQ3 $ClF + F_2 \rightarrow ClF_3$	ΔH_3	-108.7

562.

At the same temperature, calculate ΔH for the reaction: $2\ F_2O \rightarrow 2\ F_2 + O_2$ EQ4 ΔH_4

BY INSPECTION

EQ4 = EQ1 + EQ2 − 2EQ3

or $\Delta H_4 = \Delta H_1 + \Delta H_2 - 2\Delta H_3$

$= 167.4 - 341.4 - (-108.7) = +43.4$ kJ

a. +217.4 kJ
b. -43.4 kJ
c. -187.4 kJ
d. +43.4 kJ
e. -217.4 kJ

12. On earth, the ionization energy of hydrogen is 1312 kJ/mol. On a distant planet, it is so hot that all hydrogen atoms have their electron in the quantum state with n = 5. On this distant planet, the ionization energy of hydrogen in kJ/mol is:

957. a. 656
b. 328
c. 262
d. 82
e. 52

$n = \infty$ $E_f = \frac{-1312}{\infty^2} = 0$

$n = 5$ $E_i = \frac{-1312}{5^2}$

$\Delta E = E_f - E_i = 0 - \left(\frac{-1312}{25}\right)$

$= +52\ \frac{\text{kJ}}{\text{mol}}$

13. 130 mL of gas is collected over water at 22°C and 753 torr. What volume (in mL) will the dry gas occupy at STP? Vapor pressure of water at 22°C is 20 torr.

627.

a. 116 mL
b. 119 mL
c. 127 mL
d. 130 mL
e. 133 mL

AT 22°C, 753 torr, $P_{total} = P_{gas} + P_{H_2O} = 753$ torr; $P_{H_2O} = 20$ torr

so $P_{gas} = 753 - 20 = 733$ torr $= P_1$; $V_1 = 130$ mL; $T_1 = 295$ K

SINCE $n_{gas} = \frac{P_1V_1}{RT_1} = \frac{P_2V_2}{RT_2}$ FOR DRY GAS AT STP; SOLVE FOR V_2; $T_2 = 273$K; $P_2 = 760$ torr

$$V_2 = \left(\frac{P_1V_1}{T_1}\right)\left(\frac{T_2}{P_2}\right) = \left(\frac{(733)(130\text{mL})}{295}\right)\left(\frac{273}{760}\right) = \boxed{116\text{ mL}}$$

14. When 0.200 g of graphite is completely burned in a calorimeter containing 3800 g of water, a temperature increase of 0.42°C was observed. The heat capacity of water is 4.184 joule/g-K. Assume no heat is absorbed by the colorimeter in this process. Calculate the enthalpy of combustion of 6.00 g of graphite (or elemental carbon).

507.

a. -27.5 kJ
b. -33.3 kJ
c. -52.5 kJ
d. -200 kJ
e. -401 kJ

$q_{rxn} + q_{cal} = 0$

$q_{rxn} + 6.68\text{ kJ} = 0$

$q_{rxn} = \left(\frac{-6.68\text{ kJ}}{0.200\text{ g C}}\right)(6.00\text{ g C}) =$

$= -200$ kJ for 6.00 g of C

$q_{cal} = mC\Delta T$

$= (3800\text{g})\left(\frac{4.184\text{J}}{\text{g°C}}\right)(0.42)\text{°C}\left(\frac{1\text{ kJ}}{1000\text{ J}}\right)$

$= 6.68$ kJ

15. Using the enthalpies of combustion for C_4H_4(-2341 kJ/mol), C_4H_8 (-2755 kJ/mol), and H_2 (-286 kJ/mol), calculate ΔH for the following reaction in kJ/mol:

EQ4 $C_4H_4 + 2\,H_2 \rightarrow C_4H_8$ ΔH_4

EQ1 $C_4H_4 + 5O_2 \rightarrow 4CO_2 + 2H_2O$ $\Delta H_1 = -2341$ kJ

EQ2 $C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$ $\Delta H_2 = -2755$ kJ

EQ3 $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$ $\Delta H_3 = -286$ kJ

317.

Hint: First write equations for the full combustion (reaction with O_2) of C_4H_4, C_4H_8, and H_2, then add these together in the correct proportions so they provide the desired equation, shown above. BY INSPECTION

EQ4 = EQ1 − EQ2 + 2EQ3 or

$\Delta H_4 = \Delta H_1 - \Delta H_2 + 2\Delta H_3$

$= -2341 - (-2755) + 2(-286)$

$= \boxed{-158\text{ kJ}}$

a. -128
b. -158
c. +128
d. +158
e. -5382

16. A sample of compound containing only the elements C, O, and F contains 21.2% carbon and 50.4% fluorine by mass. Determine the empirical formula of this substance.

767.

a. C_2OF
b. COF_2
c. C_2OF_2
d. COF
e. $C_2O_2F_3$

100 g of $C_xO_yF_z$ contains 21.2 g C, 28.4 g O, 50.4 g F

or expressed in moles: $C_{\frac{21.2}{12.0}}\ O_{\frac{28.4}{16.0}}\ F_{\frac{50.4}{19.0}}$

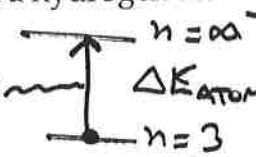
$= C_{1.77}O_{1.78}F_{2.65} = C_1O_1F_{1.50}$

or $\boxed{C_2O_2F_3}$

17. Calculate the maximum wavelength of light in nanometers (nm) required to remove an electron from a hydrogen atom from the n = 3 energy level.

a. 103nm
b. 274 nm
c. 821 nm
d. 13300 nm
e. 39900 nm

86%



$\Delta E_{ATOM} = E_{PHOTON} = E_{final} - E_{initial} = 0 - \left(-\frac{1312}{9}\right)$

$= +145.8$ kJ/mol

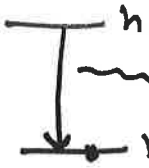
λ_{PHOTON} (nm) $= \frac{1.197 \times 10^5}{\Delta E_{ATOM}} = \frac{119700}{145.8} =$ **821 nm**

18. When the electron in atomic hydrogen makes a transition from n = 6 to n = 2 which of the following statements are true?

1. Energy is emitted.
2. Energy is absorbed.
3. The electron gains energy.
4. The electron loses energy.
5. The electron cannot make this transition.

a. 1, 4
b. 2, 4
c. 2, 3
d. 1, 3
e. 5

90%



(PHOTON EMITTED (OR ENERGY EMITTED)

E_{final} IS MORE NEGATIVE THAN $E_{initial}$, SO $\Delta E_{ATOM} < 0$

THUS THE ELECTRON LOSES ENERGY (BECAUSE IT IS MORE STABLE AND CLOSER TO NUCLEUS!)

19. When a mole of NH_3 forms from the elements, 42.2 kJ of energy is released as heat. What is ΔH for this reaction for the formation of 34.0 g of NH_3? (Molecular mass of NH_3 is 17.0 $gmol^{-1}$)

a. -21.1 kJ
b. -42.2 kJ
c. -84.4 kJ
d. +42.2 kJ
e. +84.4 kJ

60%

$\Delta H_f^\circ = -42.2$ kJ / mol NH_3

ΔH IS NEGATIVE!

ΔH for 34.0g NH_3 $= \left(\frac{-42.2\ \text{kJ}}{\text{mol } NH_3}\right)\left(\frac{\text{mol } NH_3}{17.0\ \text{g}}\right)(34.0\ \text{g}) =$ **−84.4 kJ**

20. Of the following types of radiation, how many have an energy per photon lower than that of infrared light?

REL ENERGIES BLUE > GREEN > RED > INFRARED > MICROWAVE > RADIOWAVE

visible blue
visible green
microwave
visible red
radio frequency
ultraviolet

HIGHEST

LOWEST

These two have lower E_{photon} values than for IR light

69%

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

- End of Exam -

RESULTS ON EXAM 2
GENERALLY QUITE GOOD!