Dr. Zellmer | Chemistry 1250 | T, R
Time: 7 PM Sun. | Spring Semester 2022 | February 13, 2022
40 min | Quiz IV

Name _____ Rec. TA/time _____

Show **ALL** your work or **EXPLAIN** to receive full credit.

1. (4 pts) The work done when a gas is compressed in a cylinder is 580.7 J. A heat transfer of 85.68 kJ occurs from the gas to the surroundings. Calculate ΔE of the gas in kJ.

2. (4 pts) A piston is pushed down on a reaction vessel containing a gas phase reaction.

   a) Does the system do work on the surroundings or is work done on the system by the surroundings?

   b) What would be the sign of the work, w?

   c) If the process is also endothermic is heat being added to or removed from the system?

   d) What would be the sign of ΔE or can that not be determined based on the information given? Explain!

3. (3 pts) The reaction below was carried out in a bomb calorimeter.

$$4\ Al(s) + 3\ O_2(g) \longrightarrow 2\ Al_2O_3(s)$$

A thermometer in the calorimeter registered an increase in temperature. Choose words correctly to complete the following statements for this system.

The reaction is _____. (exothermic, endothermic)
The products have _____(lower, higher) heat content than the reactants.
The quantity of heat determined is a measure of _____. (ΔH, ΔE)

a) exothermic	lower	ΔH
b) exothermic	higher	ΔE
c) exothermic	lower	ΔE
d) endothermic	lower	ΔH
e) endothermic	higher	ΔE

4. (5 pts) Given the following equation, how many **grams** of **acetylene** gas are required to produce 1208 kcal of heat energy by combustion with oxygen? (Atomic weights: C = 12.01, H = 1.008, O = 16.00; Mol. Wts.: C_2H_2 = 26.04, O_2 = 32.00, CO_2 = 44.01, H_2O = 18.02)

$$2\ C_2H_2\ (g) + 5\ O_2\ (g) \longrightarrow 4\ CO_2\ (g) + 2\ H_2O\ (g) \qquad \Delta H = -302\ kcal$$

5. (6 pts) A 28.2 g sample of a metal was heated to 99.81 °C. It was placed in 150.0 g of water at 23.50 °C. After the metal cools, the final temperature of the metal and water is 25.011 °C. Calculate the **specific heat** of the **metal** (in J/g• °C), assuming no heat was lost to the calorimeter. Specific heat of water = 4.184 J/g• °C

6. (6 pts) Using reactions (1) and (2) calculate the ΔH_{rxn} for reaction (3). **<u>ALSO</u>** is reaction (3) endothermic or exothermic? **Show your work**.

(1) $2\ C(s) + O_2(g) \rightarrow 2\ CO(g)$ $\Delta H_1 = -221.0$ kJ

(2) $2\ C(s) + O_2(g) + 4\ H_2(g) \rightarrow 2\ CH_3OH(g)$ $\Delta H_2 = -402.4$ kJ

(3) $3/2\ CH_3OH(g) \rightarrow 3/2\ CO(g) + 3\ H_2(g)$ $\Delta H = ?$

7. (2 pts) Which of the following reactions corresponds to a heat of formation, ΔH^{o}_{f} ?

a) $1/2\ N_2(g) + 5/2\ H_2(g) + C(s) + 3/2\ O_2(g) \rightarrow NH_4HCO_3(s)$

b) $N_2(g) + 2\ O_2(g) \rightarrow 2\ NO_2(g)$

c) $6\ C(s) + 12\ H(g) \rightarrow C_6H_{12}(\ell)$

d) $N(g) + 4\ H(g) + Br(g) \rightarrow NH_4Br(\ell)$

e) $6\ C(g) + 11\ H_2(g) + 11\ O(g) \rightarrow C_6H_{22}O_{11}(s)$

8. (4 pts) Determine ΔH° (kJ) for the following reaction using the listed heats of formation.

$$3\ H_2S(g) + 2\ HNO_3(\ell) \longrightarrow 2\ NO(g) + 4\ H_2O(\ell) + 3\ S\ (s)$$

$H_2S\ (g)$	ΔH_f° =	-20.6 kJ/mol
$HNO_3(\ell)$	ΔH_f° =	-174.1 kJ/mol
$NO(g)$	ΔH_f° =	90.25 kJ/mol
$H_2O\ (\ell)$	ΔH_f° =	-285.6 kJ/mol

9. (3 pts) What is the wavelength of a photon with an energy of 2.69×10^{-19} J ?

10. (4 pts) What is the energy (kJ/mol) of one mole of photons which have a wavelength of 250 nm?

USEFUL INFORMATION

1 amu = 1.66×10^{-24} g

Avogadro's number, N_A, = 6.02×10^{23} particles/mole

1 A = 10^{-10} m

h = 6.626×10^{-34} J•s c = 3.00×10^{8} m/s $R_H = 1.097 \times 10^{7}$ m^{-1} 1 J = 1 kg•m^2/s^2

$E = h\nu$ $c = \lambda\nu$ $E_{Hydrogen} = (-hcR_H)(1/n^2)$ $\Delta E_{Hydrogen} = -(2.18 \times 10^{-18}\ J)(1/n_f^2 - 1/n_i^2)$

$1/\lambda = R_H\,(1/n_f^2 - 1/n_i^2)$ $\lambda = h/(mv)$ $p = mv$ $\Delta x \bullet \Delta p \geq h/4\pi$,

electron charge, e = 1.602×10^{-19} C 1D = 3.34×10^{-30} C•m $\mu = Q \bullet r$

	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIIIB			IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1.008 **H** 1																	4.003 **He** 2
2	6.941 **Li** 3	9.012 **Be** 4											10.811 **B** 5	12.011 **C** 6	14.007 **N** 7	15.999 **O** 8	18.998 **F** 9	20.179 **Ne** 10
3	22.990 **Na** 11	24.305 **Mg** 12											26.98 **Al** 13	28.09 **Si** 14	30.974 **P** 15	32.06 **S** 16	35.453 **Cl** 17	39.948 **Ar** 18
4	39.098 **K** 19	40.08 **Ca** 20	44.96 **Sc** 21	47.88 **Ti** 22	50.94 **V** 23	52.00 **Cr** 24	54.94 **Mn** 25	55.85 **Fe** 26	58.93 **Co** 27	58.69 **Ni** 28	63.546 **Cu** 29	65.38 **Zn** 30	69.72 **Ga** 31	72.59 **Ge** 32	74.92 **As** 33	78.96 **Se** 34	79.904 **Br** 35	83.80 **Kr** 36
5	85.47 **Rb** 37	87.62 **Sr** 38	88.91 **Y** 39	91.22 **Zr** 40	92.91 **Nb** 41	95.94 **Mo** 42	98 **Tc** 43	101.07 **Ru** 44	102.91 **Rh** 45	106.42 **Pd** 46	107.87 **Ag** 47	112.41 **Cd** 48	114.82 **In** 49	118.69 **Sn** 50	121.75 **Sb** 51	127.60 **Te** 52	126.90 **I** 53	131.39 **Xe** 54
6	132.91 **Cs** 55	137.33 **Ba** 56	138.91 **La** 57	178.39 **Hf** 72	180.95 **Ta** 73	183.85 **W** 74	186.21 **Re** 75	190.23 **Os** 76	192.22 **Ir** 77	195.08 **Pt** 78	196.97 **Au** 79	200.59 **Hg** 80	204.38 **Tl** 81	207.2 **Pb** 82	208.98 **Bi** 83	209 **Po** 84	210 **At** 85	222 **Rn** 86
7	223 **Fr** 87	226.03 **Ra** 88	227.03 **Ac** 89	261 **Rf** 104	262 **Ha** 105	263 **Sg** 106	262 **Ns** 107	265 **Hs** 108	266 **Mt** 109	269 110	272 111	277 112						

Lanthanide Series	140.12 **Ce** 58	140.91 **Pr** 59	144.24 **Nd** 60	145 **Pm** 61	150.36 **Sm** 62	151.96 **Eu** 63	157.25 **Gd** 64	158.93 **Tb** 65	162.50 **Dy** 66	164.93 **Ho** 67	167.26 **Er** 68	168.93 **Tm** 69	173.04 **Yb** 70	173.04 **Lu** 71
Actinide Series	232.04 **Th** 90	231.04 **Pa** 91	238.03 **U** 92	237.05 **Np** 93	**Pu** 94	**Am** 95	**Cm** 96	**Bk** 97	**Cf** 98	**Es** 99	**Fm** 100	**Md** 101	**No** 102	**Lr** 103

A PERIODIC CHART OF THE ELEMENTS
(Based on ^{12}C)