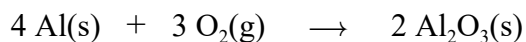


3. (3 pts) The reaction below was carried out in a bomb calorimeter.



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

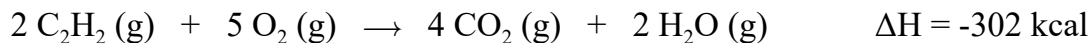
The reaction is _____ . (exothermic, endothermic)

The products have _____ (lower, higher) heat content than the reactants.

The quantity of heat determined is a measure of _____. (ΔH , ΔE)

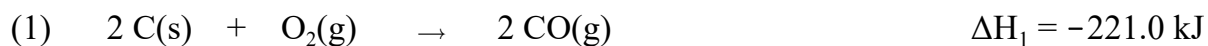
- | | | |
|----------------|--------|------------|
| a) exothermic | lower | ΔH |
| b) exothermic | higher | ΔE |
| c) exothermic | lower | ΔE |
| d) endothermic | lower | ΔH |
| e) endothermic | higher | ΔE |

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.: $\text{C}_2\text{H}_2 = 26.04$, $\text{O}_2 = 32.00$, $\text{CO}_2 = 44.01$, $\text{H}_2\text{O} = 18.02$)

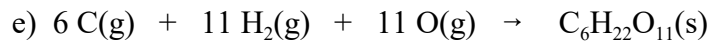
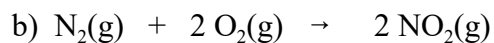
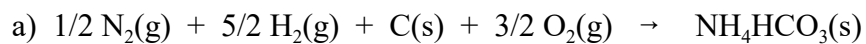


5. (6 pts) A 28.2 g sample of a metal was heated to 99.81 °C. It was placed in 150.0 g of water at 23.50 °C. After the metal cools, the final temperature of the metal and water is 25.011 °C. Calculate the **specific heat** of the **metal** (in J/g•°C), assuming no heat was lost to the calorimeter. Specific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

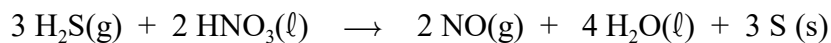
6. (6 pts) Using reactions (1) and (2) calculate the ΔH_{rxn} for reaction (3). **ALSO** is reaction (3) endothermic or exothermic? **Show your work.**



7. (2 pts) Which of the following reactions corresponds to a heat of formation, ΔH_f° ?



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



$$\text{H}_2\text{S}(\text{g}) \quad \Delta H_f^\circ = -20.6 \text{ kJ/mol}$$

$$\text{HNO}_3(\ell) \quad \Delta H_f^\circ = -174.1 \text{ kJ/mol}$$

$$\text{NO}(\text{g}) \quad \Delta H_f^\circ = 90.25 \text{ kJ/mol}$$

$$\text{H}_2\text{O}(\ell) \quad \Delta H_f^\circ = -285.6 \text{ kJ/mol}$$

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

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

USEFUL INFORMATION

$$1 \text{ amu} = 1.66 \times 10^{-24} \text{ g}$$

$$\text{Avogadro's number, } N_A = 6.02 \times 10^{23} \text{ particles/mole}$$

$$1 \text{ \AA} = 10^{-10} \text{ m}$$

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

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

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

$$\text{electron charge, } e = 1.602 \times 10^{-19} \text{ C} \quad 1\text{D} = 3.34 \times 10^{-30} \text{ C}\cdot\text{m} \quad \mu = Q\cdot r$$

	IA	IIA	IIIB	IVB	VB	VIB	VII B	VIII B	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	272	277						

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 ¹²C)