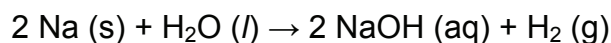


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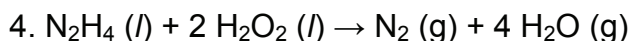
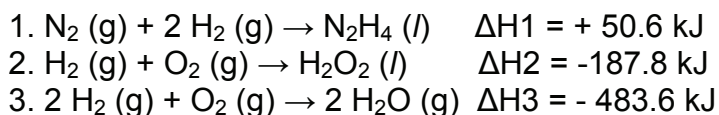
Thermochemistry worksheet – many different types of problems exist below. Be patient and work through them – pay attention to units and read the question **twice**.

1. What is the specific heat, s , ($\text{J}\cdot\text{g}^{-1}\cdot\text{K}^{-1}$) of a substance if 51 J of heat are required to raise the temperature of 1.7 grams of this substance from 20.5 °C to 25.5 °C?
2. In a calorimetry experiment, the temperature of 500. mL of water rose from 19.78 °C to 23.61 °C when 1.0 g of sodium metal reacted according to the following balanced equation:



Using the assumption that the calorimeter's heat capacity is due only to the 500 gram of water (specific heat = 4.184 J/(g K)), calculate q_{rxn} for the reaction. (How much heat is evolved?)

3. Consider that the following enthalpy changes are known for the stated reactions 1-3 below. Using Hess' Law, calculate the enthalpy change for reaction #4.



4. Calculate the specific heat of copper ($\text{J/g } ^\circ\text{C}$), if 77.0 g of copper requires 16.14 kJ to raise its temperature from 22.5 °C to 567.0 °C.
5. The specific heat of nickel is 0.444 J/g °C. How many J and cal of heat are needed to raise the temperature of 300.0 g of nickel by 78.0 °C?
6. The specific heat of zinc is 0.388 J/g °C. How many kJ and kcal of heat are needed to raise the temperature of 4.00 lb of zinc from 100.0 to 350.0 °C? 1 lb = 453.59 g
7. A sheet of Au weighing 10.0 grams at a T of 18.0 °C is placed flat on a sheet of Fe weighing 20.0 grams and is at a T of 55.6 °C. What is the final temperature of the combined metals? (hint – heat gained by gold must be equal to heat lost by iron, also you will need to find the s values for gold and iron from a book)
8. The reaction between hydrogen and nitrogen will produce ammonia with an overall enthalpy of -92.6 kJ. What amount of heat would be given off if 1.26×10^4 g of ammonia is produced?

9. Calculate the amount of heat in kJ required to convert 74.6 g of water to steam at 100 °C. The molar heat of vaporization of water is 40.79 kJ/mol.
10. How much heat in kJ is needed to convert 866 grams of ice at -10 °C to steam at 126 °C? The specific heat of ice and steam are 2.03 J/g °C and 1.99 J/g °C; the heat of fusion of water is 6.01 kJ/mol, the heat of vaporization is given in question 9. You should know the specific heat for liquid water. Take a breath and write out the number of actual **steps** this will take. Go from there.
11. Use the table of enthalpy values to calculate the following ΔH_{rxn} for each reaction:
- ethene (g) is combusted to form gaseous carbon dioxide and liquid water.
 - $\text{H}_2\text{S}(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{SO}_2(\text{g})$
 - Gaseous Hydrogen and oxygen form liquid water

12. Pentaborane-9 (B_5H_9) is highly reactive with oxygen. The reaction is as follows:



Calculate the heat released per gram of B_5H_9 when reacted with oxygen. The ΔH_f for pentaborane-9 is 73.2 kJ/mol.

13. Write an elementary reaction that would allow you to determine the heat of formation (ΔH_f°) for silver oxide. No need to perform a calculation. This is simple; do not overthink the problem.
14. Calculate the heat of decomposition at 1 atm and 298 K for solid calcium carbonate decomposing to solid calcium oxide and CO_2 gas. (use table)

Some values – more comprehensive list is on the site. You will need the longer list for exams.

Compound	$\Delta H_f^\circ/\text{kJ mol}^{-1}$	$\Delta H_f^\circ/\text{kcal mol}^{-1}$	Compound	$\Delta H_f^\circ/\text{kJ mol}^{-1}$	$\Delta H_f^\circ/\text{kcal mol}^{-1}$
AgCl(s)	-127.068	-30.35	H ₂ O(g)	-241.818	-57.79
AgN ₃ (s)	+620.6	+148.3	H ₂ O(l)	-285.8	-68.3
Ag ₂ O(s)	-31.0	-7.41	H ₂ O ₂ (l)	-187.78	-44.86
Al ₂ O ₃ (s)	-1675.7	-400.40	H ₂ S(g)	-20.63	-4.93
Br ₂ (l)	0.0	0.00	HgO(s)	-90.83	-21.70
Br ₂ (g)	+30.907	+7.385	I ₂ (s)	0.0	0.0
C(s), graphite	0.0	0.00	I ₂ (g)	+62.438	+14.92
C(s), diamond	+1.895	+0.453	KCl(s)	-436.747	-104.36
CH ₄ (g)	-74.81	-17.88	KBr(s)	-393.798	-94.097
CO(g)	-110.525	-26.41	MgO(s)	-601.7	-143.77
CO ₂ (g)	-393.509	-94.05	NH ₃ (g)	-46.11	-11.02
C ₂ H ₂ (g)	+226.73	+54.18	NO(g)	+90.25	+21.57
C ₂ H ₄ (g)	+52.26	+12.49	NO ₂ (g)	+33.18	+7.93
C ₂ H ₆ (g)	-84.68	-20.23	N ₂ O ₄ (g)	+9.16	+2.19
C ₆ H ₆ (l)	+49.03	+11.72	NF ₃ (g)	-124.7	-29.80
CaO(s)	-635.09	-151.75	NaBr(s)	-361.062	-86.28
CaCO ₃ (s)	-1206.92	-288.39	NaCl(s)	-411.153	-98.24
CuO(s)	-157.3	-37.59	O ₃ (g)	+142.7	+34.11
Fe ₂ O ₃ (s)	-824.2	-196.9	SO ₂ (g)	-296.83	-70.93
HBr(g)	-36.4	-8.70	SO ₃ (g)	-395.72	-94.56
HCl(g)	-92.307	-22.06	ZnO(s)	-348.28	-83.22
HI(g)	+26.48	+6.33			