Chemistry 221 Oregon State University Worksheet 7 Notes

1. A student dissolves 13.13 grams of NaOH (0.3282 moles) in 239.61 grams of water in a calorimeter (the total solution has a mass of 13.13 grams + 239.61 grams = 252.74 grams). The specific heat capacity of this solution is 4.18 J/g·ºC. The temperature increases from 34.14 ºC to 47.91 ºC. The calorimeter heat capacity is 58.84 J/ºC. How much heat is given off from the dissolving of the NaOH? How much heat would be given off from dissolving 1 mole of NaOH?



-qdissolving = qsolution + qcalorimeter

-qdissolving = msolution csolution ΔTsolution + Ccalorimeter ΔTcalorimeter

-qdissolving = (252.74 g)(4.18 J/ g·ºC)( 47.91 ºC -34.14 ºC) + (58.84 J/ºC)(47.91 ºC -34.14 ºC)

-qdissolving = 14,547 J + 810.2 J

-qdissolving = 15,357 J

qdissolving = -15,357 J

qdissolving =  = -46,792 J = -46.8 kJ

2. A student dissolves 30.0 grams of a solid into 540.0 grams of water in a calorimeter. The solution takes in 55 J of heat and the calorimeter takes in 175 J of heat. How much heat was released from the reaction when the solid was dissolved?



 The reaction releases 55 J + 175 J = 230 J

3. Determine H° for this reaction:

2 N2(g) + 5 O2(g) → 2 N2O5(g)

using the following three equations:

|  |  |
| --- | --- |
| (1) H2(g) + (1/2) O2(g) → H2O(l)  | H1° = -285.8 kJ  |
| (2) N2O5(g) + H2O(l) → 2HNO3(l)  | H2° = -76.6 kJ  |
| (3) 2 N2(g) + 6 O2(g) + 2 H2(g) → 4 HNO3(l)  | H3° = -696.4 kJ  |

Flip (2) and multiply by 2:

 4 HNO3(l) → 2 N2O5(g) + 2 H2O(l) H2’° = (-2)(-76.6 kJ) = + 153.2 kJ

Leave (3) unchanged:

 2 N2(g) + 6 O2(g) + 2 H2(g) → 4 HNO3(l) H3° = -696.4 kJ

Flip (1) and multiply by 2:

 H2O(l) → H2(g) + (1/2) O2(g) H1’° = (-2)(-285.8 kJ) = 571.6 kJ

Test:

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4 HNO3(l) → 2 N2O5(g) + 2 H2O(l)

2 N2(g) + 6 O2(g) + 2 H2(g) → 4 HNO3(l)

2 H2O(l) → 2 H2(g) + O2(g)

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2 N2(g) + 5 O2(g) → 2 N2O5(g)

H° for this reaction = the sum of H2’° + H3° + H1’° = 28.4 kJ

4. Consider:

C7H16 (l) + 11 O2 (g) → 7 CO2 (g) + 8 H2O (l) ΔH˚reaction = - 4130 kJ

 How much energy is released when 2.000 moles of C7H16, is combusted?

 2 mol C7H16  = -8260 kJ or “8260 kJ are released”

5. What is ΔH˚reaction for the following reaction?

CH3OH (g) + 3/2 O2 (g) → CO2 (g) + 2 H2O (g)

 -201.2 kJ/mol 0 kJ/mol -393.5 kJ/mol -241.8 kJ/mol



ΔH˚reaction = Σproducts – Σreactants

ΔH˚reaction = [(1 mol)(-393.5 kJ/mol) + (2 mol)(-241.8 kJ/mol)] –

 [(1 mol)(-201.2 kJ/mol) + (3/2 mol)(0 kJ/mol)]

 = -675.9 kJ