Chapter 7 worksheet- CHM 2045

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1. A system releases 622 kJ of heat and does 105 kJ of work on the surroundings. What is the change in internal energy of the system?

2. The gas in a piston (defined as the system) warms and absorbs 655 J of heat. The expansion performs 344 J of work on the surroundings. What is the change in internal energy for the system?

3. How much work (in J) is required to expand the volume of a pump from 0.0 L to 2.5 L against an external pressure of 1.1 atm?

4. The air within a piston equipped with a cylinder absorbs 565 J of heat and expands from an initial volume of 0.10 L to a final vol- ume of 0.85 L against an external pressure of 1.0 atm. What is the change in internal energy of the air within the piston?

5. When 1 mol of a fuel burns at constant pressure, it produces 3452 kJ of heat and does 11 kJ of work. What are ΔE and ΔH for the combustion of the fuel?

6. Nitromethane (CH3NO2) burns in air to produce significant amounts of heat.
2 CH3NO2(*l*) + 32 O2(*g*) = 2 CO2(*g*) + 3 H2O(*l*) + N2(*g*)

ΔHr°xn = -1418kJ
How much heat is produced by the complete reaction of 5.56 kg of nitromethane?

7. A silver block, initially at 58.5 °C, is submerged into 100.0 g of water at 24.8 °C, in an insulated container. The final tempera- ture of the mixture upon reaching thermal equilibrium is 26.2 °C. What is the mass of the silver block?

8. A 31.1-g wafer of pure gold, initially at 69.3 °C, is submerged into 64.2 g of water at 27.8 °C in an insulated container. What is the final temperature of both substances at thermal equilibrium?

9. Zinc metal reacts with hydrochloric acid according to the balanced equation:
$Zn(s) + 2\ HCl\ (aq) \rightarrow > ZnCl(ag) + H2(8)$
When 0.103 g of Zn(s) is combined with enough HCl to make 50.0 mL of solution in a coffee-cup calorimeter, all of the zinc reacts, raising the temperature of the solution from 22.5 °C to 23.7 °C. Find (delta H of reaction) for this reaction as written. (Use 1.0 g/mL for the density of the solution and 4.18 J/g• °C as the specific heat capacity.)

10. When 0.514 g of biphenyl (C12H10) undergoes combustion in a bomb calorimeter, the temperature rises from 25.8 °C to 29.4 °C. Find (delta E of reaction) for the combustion of biphenyl in kJ/ mol biphenyl. The heat capacity of the bomb calorimeter, determined in a separate experiment, is 5.86 kJ/°C.

11. Hydrazine (N2H4) is a fuel used by some spacecraft. It is normally oxidized by N2O4 according to the equation:

N2H4(*l*) + N2O4(*g*) ¡ 2 N2O(*g*) + 2 H2O(*g*)

Calculate Δ*H*r°xn for this reaction using standard enthalpies of formation.

12. Top fuel dragsters and funny cars burn nitromethane as fuel according to the balanced combustion equation:

2 CH3NO2(*l*) + 32 O2(*g*) ¡ 2 CO2(*g*) + 3 H2O(*l*) + N2(*g*) Δ*H*r°xn = -1418kJ

Calculate the standard enthalpy of formation (Δ*H*f°) for nitromethane.

13. Calculate Δ*H*rxn for the reaction:

Fe2O3(*s*) + 3 CO(*g*) = 2 Fe(*s*) + 3 CO2(*g*)

Use the following reactions and given Δ*H*'s:

2 Fe(*s*) + 32 O2(*g*) = Fe2O3(*s*) Δ*H* = -824.2 kJ

$CO(g) + 12\ O2(g) = CO2(g)\ \Delta H = -282.7\ k$