Thermochemistry

1. I 0.315 moles of hexane (C_6H_{14}) burn in a bomb calorimeter containing 5.65 liters of water, what's the molar heat of combustion of hexane (the water temperature rises 55.4 ^{0}C)? The heat capacity of water is 4.184 J/g^{0}C.
    a) **4150 kJ/mol**
    b) 1310 kJ/mol
    c) 4150 J/mol
    d) 1310 J/mol

2. If I burn 22.0 grams of propane (C_3H_8) in a bomb calorimeter containing 3.25 liters of water, what's the molar heat of combustion of propane if the water temperature rises 88.5 ^{0}C?
    a) 1.20×10^3 kJ
    b) **2.40×10^3 kJ/mol.**
    c) 1.20×10^3 J
    d) 2.40×10^3 J/mol.

3. What units of energy are commonly used in chemistry?
    a) **Joules**
    b) Liters
    c) Kilogram
    d) Calories

Which of the following statements correctly describes the signs of *q* and *w* for the following exothermic process at P = 1 atm and T = 370 K?

$$H_2O(g) \rightarrow H_2O(l)$$

A) *q* and *w* are negative
B) *q* is positive, *w* is negative
C) *q* is negative, *w* is positive
D) *q* and *w* are both zero

4. What is the units for heat capacity?
    a) J
    b) g /°C
    c) J /g .°C
    d) **J / °C**

5. A piece of silver of mass 362 g has a heat capacity of 85.7 $J.°C^{-1}$. What is the specific heat of silver?
   a) 0.237 J / °C
   b) 237 J / °C
   c) 23 J / °C
   d) 47 J / °C

6. Calculate the amount of heat liberated (in kJ) from 366 g of mercury (specific heat of mercury 0.139 J /g .°C) when it cools from 77.0 to 12.0 °C.
   a) 33.1 kJ
   b) -3.31 kJ
   c) 3.31 J
   d) 1000 J

7. A 6.22 kg piece of copper metal (specific heat of copper 0.385 J /g .°C) is heated from 20.5 °C to 324.3 °C. Calculate the heat absorbed (in kJ) by the metal.
   a) 728 J
   b) 728 kJ
   c) 72J
   d) 27kJ

8. SI unit of work is
   a) Atmosphere
   b) Joule
   c) Calories
   d) Second

9. A chemical reaction that absorbs heat from the surroundings is said to be ___________ and has a ___________ ΔH at constant pressure
   a) endothermic, positive
   b) endothermic, negative
   c) exothermic, negative
   d) exothermic, positive

10. Which one of the following statements is true?
   a) Enthalpy is an intensive property.
   b) The enthalpy is not a state function
   c) Enthalpy is a state function.
   d) H is the value of q measured under conditions of constant volume.

11. ΔH for an endothermic process is _______ while ΔH for an exothermic process is ____.

a) zero, positive
b) zero, negative
c) positive, negative
d) negative, positive

12. Of the following, which one is a state function?

a) E
b) q
c) w
d) All of the above

13. When a system ________ ΔE is always negative.

a) absorbs heat and does work
b) gives off heat and does work
c) absorbs heat and has work done on it
d) none of the above is always negative

14. Consider the following standard heats of formation:

$P_4O_{10}(s)$ = –3110 kJ/mol , $H_2O(l)$ = –286 kJ/mol , $H_3PO_4(s)$ = –1279 kJ/mol

Calculate the change in enthalpy for the following process:

$$P_4O_{10}(s) + 6H_2O(l) \rightarrow 4H_3PO_4(s)$$

a) 290 kJ
b) 2117 kJ
c) 1720 kJ
d) 0 kJ

15. Calculate the work for the expansion of CO_2 from 1.0 to 2.5 liters against a pressure of 1.0 atm at constant temperature.

a) 1.5 liter · atm
b) 2.5 liter · atm
c) –1.5 liter · atm
d) –2.5 liter · atm

16. One mole of an ideal gas is expanded from a volume of 1.00 liter to a volume of 10.00 liters against a constant external pressure of 1.00 atm. How much work (in joules) is performed on the surroundings? (T = 300 K; 1 L atm = 101.3 J)

a) 456 J
b) 912 J
c) 2740 J

d) 2870 J

17. A 25.0 g piece of aluminum (which has a molar heat capacity of **24.03J/°C mol**) is heated to 82.4°C and dropped into a calorimeter containing water (specific heat capacity of water is **4.18J/g°C**) initially at 22.3°C. The final temperature of the water is 24.9°C. Calculate the mass of water in the calorimeter.

a) 187 g
b) 6.57 g
c) 3180 g
d) 2120 g

18 Consider the following data:

$Ca(s) + 2C\ (graphite) \rightarrow CaC_2(s)$	ΔH (kJ)= –62.8
$Ca(s) + \frac{1}{2} O_2(g) \rightarrow CaO(s)$	ΔH (kJ)= –635.5
$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq)$	ΔH (kJ)= –653.1
$C_2H_2(g) + 5/2\ O_2(g) \rightarrow 2CO_2 + H_2O(l)$	ΔH (kJ)= –1300
$C(graphite) + O_2(g) \rightarrow CO_2(g)$	ΔH (kJ)= –393.51

Use Hess's law to find the change in enthalpy at 25° C for the following equation:

$$CaC_2(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + C_2H_2(g)$$

a) –713 kJ
b) 713 kJ
c) –318.8 kJ
d) –3045 kJ