AP Chemistry
Chapter 5 and 19 Jeopardy

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Round 1 – Chapter 5

Energy	Stoichiometry	q = mCΔT	ΔH	Definitions	Calorimetry
100	100	100	100	100	100
200	200	200	200	200	200
300	300	300	300	300	300
400	400	400	400	400	400
500	500	500	500	500	500

Round 2 – Chapter 19

Click to go to Round 2

Energy 100

Calculate the ΔE for a process in which the system releases 57.5kJ of heat while doing 22.5kJ of work on the surroundings. Is the process endothermic or exothermic?

-80kJ exothermic

Energy 200

Calculate the ΔE for a process in which the system absorbs 105kJ of heat from its surroundings while doing 29kJ of work on the surroundings. Is the process exothermic or endothermic?

76kJ endothermic

Energy 300

If two positive particles are brought closer together, then explain what would happen to the electrostatic potential energy and why.

$E_{el} = \frac{kQ_1Q_2}{d}$ If both particles are positively charged, then Q_1 and Q_2 are positive making the value of E_{el} positive. As distance decreases, the magnitude of E_{el} increases, so it is not a favorable process.

Energy 400

Calculate the kinetic energy in joules of a 45g golf ball moving at 61 m/s.

84J

Energy 500

What is the kinetic energy of an 850 lb. motorcycle moving at 66 mph? (1 kg = 2.2047 lb. 1 mi = 1.6093 km)

$1.7 \times 10^5 J$

Stoichiometry 100

Calculate the ΔH for the production of 0.200 mol of AgCl by the following reaction:

$$Ag^{+}_{(aq)} + Cl^{-}_{(aq)} \rightarrow AgCl_{(s)}$$

$$\Delta H = -65.5kJ$$

-13.1kJ

Stoichiometry 200

For this reaction, ΔH for the formation of 0.632mol of O_2.

$2KClO_{3(s)} \rightarrow 2KCl_{(s)} + 3O_{2(g)}$

$\Delta H = -89.4kJ$

-18.8kJ

Stoichiometry 300

Calculate the amount of heat transferred when 2.4g of Mg reacts at constant pressure.

$2Mg_{(s)} + O_{2(g)} \rightarrow 2MgO$

$\Delta H = -1204kJ$

-59kJ

Stoichiometry 400

Calculate the amount of heat transferred when 45.0g of CH_3OH is decomposed by the following reaction at constant pressure.

$$CH_3OH_{(g)} \rightarrow CO_{2(g)} + 2H_{2(g)}$$

$$\Delta H = 90.7kJ$$

128kJ

Stoichiometry 500

Calculate the amount of heat transferred for the formation of 6.32g O_2.

$CH_3OH_{(l)} + 3/2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$

$\Delta H = -726.5kJ$

95.66kJ

q = mC∆T 100

Two solid objects, A and B, are placed in boiling water and allowed to come to temperature there. Each is then lifted out and placed in separate beakers containing 1000g of water at 10.0°C. Object A increases the water temperature by 3.50°C; B increases water temperature by 2.60°C. Which object has the larger heat capacity and what extra piece of information do you need to figure out which has the higher specific heat capacity?

Object A; mass of each object.

$q = mC\Delta T$ 200

How many kJ of heat are needed to raise the temperature of 10.00kg of liquid water from 24.6°C to 46.2°C?

904kJ

$q = mC\Delta T$ 300

The specific heat of iron metal is 0.450 J/gK. How many J of heat are necessary to raise the temperature of a 1.05kg block of iron from 25.0°C and 88.5°C?

3.00×10^4 J

$q = mC\Delta T$ 400

The specific heat of ethylene glycol is 2.42 J/gK. How many J of heat are needed to raise the temperature of 62.0g of ethylene glycol from 13.1°C to 40.5°C?

4.11×10^3 J

$q = mC\Delta T$ 500

What is the molar heat capacity of water?

75.31 J/mol^{o}C

ΔH 100

Calculate the ΔH for $3H_{2(g)} + O_{3(g)} \rightarrow 3H_2O_{(g)}$ using the following information:

$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(g)}$ ΔH = -483.6 kJ

$3O_{2(g)} \rightarrow 2O_{3(g)}$ ΔH = 284.6 kJ

-867.7kJ

ΔH 200

Calculate the ΔH for $C_2H_{4(g)} + 6F_{2(g)} \rightarrow 2CF_{4(g)} + 4HF_{(g)}$ using the following information:

$H_{2(g)} + F_{2(g)} \rightarrow 2HF_{(g)}$ ΔH = -537kJ

$C_{(s)} + 2F_{2(g)} \rightarrow CF_{4(g)}$ ΔH = -680kJ

$2C_{(s)} + 2H_{2(g)} \rightarrow C_2H_{4(g)}$ ΔH = 523kJ

-2486.3kJ

ΔH 300

Calculate the ΔH for $N_2O_{(g)} + NO_{2(g)} \rightarrow 3NO_{(g)}$ using the following information:

$N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$ ΔH = 180.7kJ

$2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$ ΔH = -113.1kJ

$2N_2O_{(g)} \rightarrow 2N_{2(g)} + O_{2(g)}$ ΔH = -163.2kJ

155.65kJ

ΔH 400

Calculate the ΔH for the following reaction using information from Appendix C.

$SiCl_{4(l)} + 2H_2O_{(l)} \rightarrow SiO_{2(s)} + 4HCl_{(g)}$

-68.34kJ

ΔH 500

When $C_{10}H_{8(s)}$ is combusted it yeilds $CO_{2(g)}$, $H_2O_{(l)}$, and 5154 kJ/mol. What is the standard enthalpy of formation for $C_{10}H_8$.

75.68kJ

Definitions 100

What is the internal energy of a system?

Total kinetic and potential energy

Definitions 200

What is a closed system?

A system in which heat can be transferred between the system and the surroundings but not mass.

Definitions 300

What is a state function?

A property that only depends on the initial and final states, not on the path taken.

Definitions 400

For a given process at constant pressure, ΔH is negative. Is the process exothermic or endothermic?

exothermic

Definitions 500

By what means can the internal energy of a closed system increase?

Increase in heat of the system or work done on the system.

Calorimetry 100

A 2.200g sample of $C_6H_4O_2$ is burned in a bomb calorimeter whose total heat capacity is 7.854 kJ/^oC. The temperature of the calorimeter increases from 23.44^oC to 30.57^oC. What is the heat of combustion per mole of $C_6H_4O_2$?

-2740.2 kJ/mol

Calorimetry 200

A 1.800g sample of C_6H_5OH was burned in a bomb calorimeter whose total heat capacity is 11.66kJ/^oC. The temperature of the calorimeter plus contents increased from 21.36^oC to 26.37^oC. What is the heat of combustion per mole of C_6H_5OH?

-3074.74kJ

Calorimetry 300

A 2.500g sample of glucose is burned in a bomb calorimeter. The heat of combustion of glucose is -15.57kJ/mol. The temperature of the calorimeter increases from 20.55°C to 23.25°C. What is the total heat capacity of the calorimeter?

14.42 kJ/°C

Calorimetry 400

What a 9.55g sample of solid NaOH dissolves in 100.0g of water in a coffee-cup calorimeter, the temperature rises from 23.6°C to 47.4°C. Calculate ΔH in kJ/mol of NaOH for the solution process.

-45.61 kJ/mol

Calorimetry 500

When a 3.88g sample of solid NH_4NO_3 dissolves in 60.0g of water in a coffee-cup calorimeter, the temperature drops from 23.0°C to 18.4°C. Calculate ΔH in kJ/mol of NH_4NO_3 for the solution process.

25.36 kJ/mol

Definitions	Spontaneous Processes	Entropy	Gibb's Free Energy	Q and K	Surprise
200	200	200	200	200	200
400	400	400	400	400	400
600	600	600	600	600	600
800	800	800	800	800	800
1000	1000	1000	1000	1000	1000

Definitions 200

What is a spontaneous process?

A spontaneous process is one that proceeds on its own without any assistance.

Definitions 400

What is a reversible process?

In a reversible process, a system is changed in such a way that the system and surroundings can be restored to their original state by exactly reversing the change. (DOES NOT EXIST)

Definitions 600

What is entropy?

Entropy is the measure of the randomness, disorder, or dispersal of energy in a system.

Definitions 800

What is the difference in translational, vibrational, and rotational energy?

Translational motion is the movement of an entire molecule. Vibrational motion is the stretching and bending of bonds. Rotational energy is the spinning of a molecule.

Definitions 1000

What are the 3 laws of thermodynamics?

1st Law = Energy is conserved.
2nd Law = Any irreversible process results in an increase in entropy.
3rd Law = The entropy of a pure crystalline solid is 0 at 0K.

Spontaneous Processes 200

Consider the vaporization of liquid water to steam at a pressure of 1atm. In what temperature range is it a spontaneous process?

Temperatures higher than $100^{o}C$.

Spontaneous Processes 400

Does the change in ΔE depend on the particular pathway taken to carry out a change of state?

No, it is a state function.

Spontaneous Processes 600

Consider what happens when TNT explodes. Determine the sign for q, w, and ΔE.

Explosions are combustion reactions so q is negative since it is exothermic. w is also negative because the reactants will expand to form products. Since q and w are negative, ΔE will also be negative.

Spontaneous Processes 800

Is the following process spontaneous, nonspontaneous, or at equilibrium?

The formation of CH_4 and O_2 molecules from CO_2 and H_2O.

Nonspontaneous – It would be spontaneous in the reverse direction because it would be combustion.

Spontaneous Processes 1000

Is the following process spontaneous, nonspontaneous, or at equilibrium?

Ice melting at $0^{o}C$

equilibrium

Entropy 200

Predict the sign of ΔS as the reaction proceeds to the right.

$$BCl_{3(g)} + NH_{3(g)} \leftrightarrow Cl_3BNH_{3(s)}$$

negative

Entropy 400

Which of the following reactions would have a $-\Delta S$?

1. $2Fe_2O_{3(s)} \rightarrow 4Fe_{(s)} + 3O_{2(g)}$
2. $Mg^{+2}_{(aq)} + 2OH^{-}_{(aq)} \rightarrow Mg(OH)_{2(s)}$
3. $H_{2(g)} + C_2H_{4(g)} \rightarrow C_2H_{6(g)}$

2 and 3

Entropy 600

Which reaction involves the largest decrease in entropy?

1. $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$
2. $Pb(NO_3)_{2(aq)} + 2KI_{(aq)} \rightarrow PbI_{2(s)} + 2KNO_{3(aq)}$
3. $4La_{(s)} + 3O_{2(g)} \rightarrow 2La_2O_{3(s)}$

3

Entropy 800

Which of the following reactions has the largest $+\Delta S$ value per mole of Cl_2?

1. $2NH_4Cl_{(s)} \rightarrow N_{2(g)} + 4H_{2(g)} + Cl_{2(g)}$
2. $Cl_{2(g)} \rightarrow 2Cl_{(g)}$
3. $H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl_{(g)}$

Entropy 1000

For the reaction $Cl_{2(g)} + 3F_{2(g)} \rightarrow 2ClF_{3(g)}$ the ΔH^{o}_{f} is -163.2 kJ/mol and the ΔG^{o}_{f} is -123kJ/mol for ClF_3. Calculate the ΔS^{o} in J/K for the reaction at 298K.

-269.8 J/K

Gibb's Free Energy 200

A cube of ice is added to some hot water in a rigid, insulated container, which is then sealed. There is no heat exchange with the surroundings. What happens to the total energy and the total entropy when the system reaches equilibrium?

Energy stays the same, but entropy increases.

Gibb's Free Energy 400

When solid NH_4SCN is mixed with solid $Ba(OH)_2$ in a closed container, the temperature drops and a gas is produced. What are the signs for ΔG, ΔH, and ΔS?

ΔG = - (spontaneous)
ΔH = + (temp. drops)
ΔS = + (gas is produced)

Gibb's Free Energy 600

The following reaction is spontaneous at 298K, but becomes nonspontaneous at higher temperatures. What are the signs for ΔG, ΔH, and ΔS?

$$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$$

ΔG = - (spontaneous)

ΔH = - ($\Delta G = \Delta H - T\Delta S$)

ΔS = - (less gas)

Gibb's Free Energy 800

For a particular reaction, $\Delta H = -32kJ$ and $\Delta S = -98J/K$. Assume that ΔH and ΔS do not change with temperature. If T is increased, will the reaction be spontaneous or nonspontaneous?

nonspontaneous

Gibb's Free Energy 1000

Classify the following reaction as spontaneous, nonspontaneous, or spontaneous at certain temperatures (specify the temperatures).

$N_2F_{4(g)} \rightarrow 2NF_{2(g)}$

$\Delta H^o = 85kJ$; $\Delta S^o = 198J/K$

Nonspontaneous at low temperatures, but spontaneous at high temperatures.

Q and K 200

What must be true about ΔG^o and K_{eq} for a reaction that proceeds spontaneously from initial standard conditions?

ΔG^o must be negative and K_{eq} must be larger than 1.

Q and K 400

Explain how ΔG changes for the following reaction as the partial pressure of O_2 is increased:

$$2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$$

ΔG becomes more negative.

Q and K 600

Consider the reaction $2NO_{2(g)} \rightarrow N_2O_{4(g)}$. Calculate ΔG at 298K if the partial pressures of NO_2 and N_2O_4 are 0.40atm and 1.60atm, respectively. $\Delta G^\circ = -5.40kJ$

0.30kJ

Q and K 800

For the reaction $Cl_{2(g)} + 3F_{2(g)} \rightarrow 2ClF_{3(g)}$ the ΔH^{o}_{f} is -163.2 kJ/mol and the ΔG^{o}_{f} is -123 kJ/mol. Calculate the value of the equilibrium constant for the reaction at 298K.

3.72×10^{21}

Q and K 1000

If ΔG^{o} is negative, then K must be _____.

Greater than one.

Surprise 200

What is a microstate?

A microstate is a single possible arrangement of particles in a system.

Surprise 400

What does it mean if $\Delta G = 0kJ$?

The system is at equilibrium.

Surprise 600

Which substance experiences more entropy when they are at the same temperature and contain the same amount of particles?

$CO_{2(g)}$ or $SO_{3(g)}$

$SO_{3(g)}$ since it has more bonds which means more vibrational energy.

Surprise 800

Can an endothermic process be spontaneous? Explain.

Yes, as long as there is an increase in the entropy that counteracts the decrease in enthalpy.

Surprise 1000

What are the common units for S?

J/K