Absolute Entropy and Entropy charge

Entropy is seen all around us in the sciences; in physics, chemistry, astronomy, and more. In our general review of entropy, w
system, and that we can use entropy to observe and deduce where energy goes relative to a system.

But entropy isn't a static property. Just like the systems themselves that it describes, entropy changes. Not only that, but diff
characteristics within a system. In this lesson, we're going to cover these higher-level qualities that entropy plays a role in.

Overview

- In this lesson, we'll cover how to calculate entropy change within a system.
- Then, we'll learn what absolute entropy is, and how we calculate it as well.
- Afterwards, we'll step through a table of standard entropies for common substances, and elaborate on what trends we
- Lastly, we'll tie everything together with a few examples, and cover how each of these concepts are thermodynamicall

Calculating Standard Entropy Change

In our introductory lesson on entropy, we briefly discussed how to calculate the total change in entropy by subtracting a pro
If you want to see examples on how this is done, you can see our lesson on Entropy here. As a reminder, the formula looks li

$$\Delta S° = \Sigma n\Delta S°\text{products} - \Sigma n\Delta S°\text{reactants}$$

This formula takes advantage of the fact that we're working with standard entropies. Recall that the entropy values that are e
temperature and pressure: 298 K and 1 atm, respectively. Because of this, we can use the formula above to deduce the total

In the previous lesson, we went through a few simple examples where we take some given entropies, plug them into the for
the system. If you would like to see these examples, refer to that lesson. However, questions that involve entropy on the AP
formula correctly, and more about *applying* the formula when it comes to concepts you've already learned. To drive this poin
see on the AP exam.

Example

Find the total standard entropy change when liquid pentane undergoes a total combustion reaction to completion. Use
this lesson to help you.

Explanation:

We know that a combustion reaction always involves the products water and carbon dioxide. We can also deduce that penta
formula $C_nH_{(2n+2)}$. We also know that, lastly, combustion reactions always use oxygen gas as a reactant. Therefore, we have

$$C5H12(l) + O2(g) \rightarrow H2O(g) + CO2(g)$$

After balancing, we have a chemical reaction that looks like this.

$$C5H12(l) + 8O2(g) \rightarrow 6H2O(g) + 5CO2(g)$$

Then, we use our overall standard entropy change formula in the following formula.

ΔS° = ΣnΔS°products - ΣnΔS°reactantsΔS° = [(6 mol H2O(g) * 188.8 JK*mol) + (5 mol CO2(g) * 213.8 JK*mol)] - [(1 mol C5

This means that our final answer for this problem is 296.7 J/K. This problem is a good example of an AP Chemistry question. different types of reactions (how combustion reactions work), balancing chemical equations, and how to calculate overall sta AP Chemistry entropy problems won't always be as simple as plugging values into a formula.

Absolute Entropy

Insofar, we've been working with standard entropies that have been set to 298 K and 1 atm to allow for easy comparison. Ho have heard of the concept of **absolute zero**, which is the coldest conceivable temperature: 0 K. At this temperature, all entro Chemists exploit the fact that entropy and temperature are related, and conceived of the measurement of absolute entropy.

Definition

Absolute entropy is the total amount of entropy acquired when a pure substance is warmed from absolute zero to a spe

Recall that standard entropies are standardized at 298 K. This means that standard entropy is really just the absolute entrop matter of measuring heat capacity continuously as the object in question is heated from absolute zero to the desired temper

Deep dive

Absolute entropy can be determined by integrating an experimentally determined function, C(T), which describes the h divided by the current temperature.

$$S_{abs} = \int_0^T \frac{C(T)}{T} dT$$

This uses integration, which is beyond the scope of what AP Chemistry tests.

Therefore, calculating the absolute entropy of a substance isn't on the AP exam. However, knowing the definition of absolute

Table of Common Standard Entropies

Some molecules are more commonly dealt with in AP Chemistry than others. In order to help, here's a table of standard entr
substances are assumed to be in gaseous form unless otherwise stated.

Molecule	Standard Entropy (J/K)
C (graphite)	5.7
CH_4	186.3
C_2H_6	229.6
$C_5H_{12\ (l)}$	263.5
C_5H_{12}	348.0
$C_6H_{12}O_6$ (glucose)	212.0
CO	197.7
CO_2	213.8
H_2	130.7
$H_2O_{(l)}$	69.9
H_2O	188.8
He	126.2
N_2	191.6
NH_3	192.5
O_2	205.2

Entropy and Thermodynamics

By this point in your study of AP Chemistry, you should have a cursory understanding of the three laws of thermodynamics. I
relating everything we've learned to the three laws paints a picture that's easier to comprehend.

Insofar, over the past two lessons, we've learned that entropy is a measure of general randomness or disorder within a syste
can be used to predict entropy. In reality, all we're doing with these indicators is measuring the properties of particles throug
system is based off of that.

Next, we learned about how there are standard entropies that have been standardized to a common temperature and press
to allow for an easier method of calculating entropy change throughout a reaction. We also learned that you can measure er
of entropy needed to heat an object from absolute zero (where entropy and temperature are equal to zero) to a desired tem
298 K is it's standard entropy.

Now that we've briefed you on all of this, where do the three laws come into play?

The first law of thermodynamics states that energy can't be created or destroyed. This is the law of energy conservation, wh as much to the concept of entropy as the other two laws do.
The second law of thermodynamics states that the energy and matter of the universe is constantly dispersing and becoming entropy of the universe is always increasing. This means that we can derive that nature tends towards disorder through the s on Entropy.
The third law of thermodynamics states that a system's entropy is zero at a temperature of absolute zero (0 K). This law imp system increases the entropy. From this law, we're able to derive the definition of absolute entropy.

Hopefully, breaking down the three laws of thermodynamics helps to solidify your understanding on why entropy functions t understanding of entropy shouldn't be!

Absolute Entropy and Entropy Change - Key takeaways

- In this lesson, we covered how to calculate entropy change within a system.
- Afterwards, we learned what absolute entropy is, and how to calculate it as well.
- Then, we walked through a table of standard entropies for common substances, and explained the trends.
- Lastly, we tied everything together with a few examples, and covered how each of these concepts are thermodynamica