

Home Game

<u>Gameboard</u>

Chemistry

Physical

Entropy

Essential Pre-Uni Chemistry G1.6

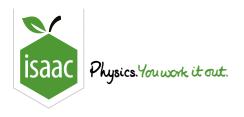
Essential Pre-Uni Chemistry G1.6



Use the following standard molar entropy values in $J K^{-1} mol^{-1}$ to help answer the questions in this section.

$\mathrm{H_{2}O}\left(\mathrm{l}\right)$	69.9	HCl(g)	186.8	NaCl(s)	72.1
$ m H_2O\left(g ight)$	188.7	$\mathrm{Cl}_{2}\left(\mathrm{g}\right)$	223.1	$\mathrm{ZnCl}_{2}\left(\mathrm{s} ight)$	111.5
$ m H_{2}\left(g ight)$	130.7	$\mathrm{H_{2}SO_{4}}\left(\mathrm{l}\right)$	156.9	$\mathrm{Zn}\left(\mathrm{s}\right)$	41.6
Na(s)	51.2	$\mathrm{Zn}\left(\mathrm{g} ight)$	150.0	$\mathrm{NaHSO_{4}\left(s\right) }$	113.0
$\mathrm{O}_{2}\left(\mathrm{g} ight)$	205.2	$\mathrm{CO}_2(\mathrm{g})$	213.6	$\mathrm{C}\left(\mathrm{s}\right)$ graphite	5.7

Calculate the entropy of $1.00\,\mathrm{kg}$ of solid zinc.



Home Gameboard Chemistry

Physical

Entropy Essential Pre-Uni Chemistry G1.8

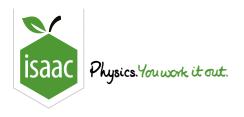
Essential Pre-Uni Chemistry G1.8



Use the following standard molar entropy values in $J K^{-1} mol^{-1}$ to help answer the questions in this section.

$ m H_2O\left(l ight)$	69.9	$\mathrm{HCl}(\mathrm{g})$	186.8	NaCl(s)	72.1
$ m H_2O\left(g ight)$	188.7	$\mathrm{Cl}_{2}\left(\mathrm{g}\right)$	223.1	$\mathrm{ZnCl}_{2}\left(\mathrm{s} ight)$	111.5
$\mathrm{H}_{2}\left(\mathrm{g}\right)$	130.7	$\mathrm{H}_{2}\mathrm{SO}_{4}\left(\mathrm{l}\right)$	156.9	$\mathrm{Zn}\left(\mathrm{s}\right)$	41.6
Na(s)	51.2	$\mathrm{Zn}\left(\mathrm{g}\right)$	150.0	$\mathrm{NaHSO_{4}}\left(\mathrm{s}\right)$	113.0
$\mathrm{O}_{2}\left(\mathrm{g} ight)$	205.2	$\mathrm{CO}_{2}\left(\mathrm{g} ight)$	213.6	$\mathrm{C}\left(\mathrm{s}\right)$ graphite	5.7

Calculate the mass of sodium chloride that has standard entropy of $100\,J\,K^{-1}.$



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Essential Pre-Uni Chemistry G1.10



Use the following standard molar entropy values in $J K^{-1} mol^{-1}$ to help answer the questions in this section.

$\mathrm{H_{2}O}\left(\mathrm{l}\right)$	69.9	HCl(g)	186.8	NaCl(s)	72.1
$ m H_2O\left(g ight)$	188.7	$\mathrm{Cl}_{2}\left(\mathrm{g}\right)$	223.1	$\mathrm{ZnCl}_{2}\left(\mathrm{s} ight)$	111.5
$ m H_{2}\left(g ight)$	130.7	$\mathrm{H_{2}SO_{4}}\left(\mathrm{l}\right)$	156.9	$\mathrm{Zn}\left(\mathrm{s}\right)$	41.6
Na(s)	51.2	$\mathrm{Zn}\left(\mathrm{g}\right)$	150.0	$\mathrm{NaHSO_{4}\left(s\right) }$	113.0
$\mathrm{O}_{2}\left(\mathrm{g} ight)$	205.2	$\mathrm{CO}_2(\mathrm{g})$	213.6	$\mathrm{C}\left(\mathrm{s}\right)$ graphite	5.7

Calculate the total entropy of $250\,\mathrm{cm^3}$ of hydrogen and $500\,\mathrm{cm^3}$ of chlorine held separately at room temperature and pressure.



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Entropy Essential Pre-Uni Chemistry G2.1

Essential Pre-Uni Chemistry G2.1



Use the following standard molar entropy values in $J K^{-1} mol^{-1}$ to help answer the questions in this section.

$\mathrm{H_{2}O}\left(\mathrm{l}\right)$	69.9	HCl(g)	186.8	NaCl(s)	72.1
$\mathrm{H_{2}O}\left(\mathrm{g}\right)$	188.7	$\mathrm{Cl}_{2}\left(\mathrm{g}\right)$	223.1	$\mathrm{ZnCl}_{2}\left(\mathrm{s} ight)$	111.5
$\mathrm{H}_{2}\left(\mathrm{g}\right)$	130.7	$\mathrm{H_{2}SO_{4}}\left(\mathrm{l}\right)$	156.9	$\mathrm{Zn}\left(\mathrm{s}\right)$	41.6
Na(s)	51.2	$\mathrm{Zn}\left(\mathrm{g}\right)$	150.0	$\mathrm{NaHSO_{4}\left(s\right) }$	113.0
$O_2(g)$	205.2	$\mathrm{CO}_2(\mathrm{g})$	213.6	$\mathrm{C}\left(\mathrm{s}\right)$ graphite	5.7

Calculate the standard entropy change per mole for the following reactions:

(a) Part A

 $H_2O\left(l\right)\longrightarrow H_2O\left(g\right)$ Give your answer to 1 decimal place.

Part B (b)

 $Zn\left(s\right)+Cl_{2}\left(g\right)\longrightarrow ZnCl_{2}\left(s\right) \quad \text{ Give your answer to 1 decimal place}.$

Part C (c)

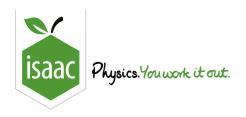
 $H_{2}\left(g
ight)+Cl_{2}\left(g
ight)\longrightarrow2\,HCl\left(g
ight)$ Give your answer to 1 decimal place.

Part D (d)

 $NaCl\left(s\right) + H_{2}SO_{4}\left(l\right) \longrightarrow NaHSO_{4}\left(s\right) + HCl\left(g\right) \quad \text{ Give your answer to 1 decimal place}.$

Part E (e)

 $Zn(s) + 2HCl(g) \longrightarrow ZnCl_2(s) + H_2(g)$ Give your answer to 1 decimal place.



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Essential Pre-Uni Chemistry G2.2



Use the following standard molar entropy values in $J\,K^{-1}\,\mathrm{mol}^{-1}$ to help answer the questions in this section.

$\mathrm{H_{2}O}\left(\mathrm{l}\right)$	69.9	$\mathrm{HCl}(\mathrm{g})$	186.8	NaCl(s)	72.1
$\mathrm{H_{2}O}\left(\mathrm{g}\right)$	188.7	$\mathrm{Cl}_{2}\left(\mathrm{g}\right)$	223.1	$\mathrm{ZnCl}_{2}\left(\mathrm{s} ight)$	111.5
$\mathrm{H}_{2}\left(\mathrm{g}\right)$	130.7	$\mathrm{H}_{2}\mathrm{SO}_{4}\left(\mathrm{l}\right)$	156.9	$\mathrm{Zn}\left(\mathrm{s}\right)$	41.6
Na(s)	51.2	$\mathrm{Zn}\left(\mathrm{g}\right)$	150.0	$\mathrm{NaHSO_{4}(s)}$	113.0
$O_2(g)$	205.2	$\mathrm{CO}_{2}\left(\mathrm{g} ight)$	213.6	$\mathrm{C}\left(\mathrm{s}\right)$ graphite	5.7

Calculate the standard entropy change when...

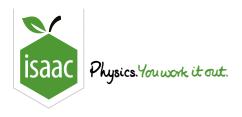
Part A (a)

 $2.50\,\mathrm{mol}$ of solid zinc chloride decomposes into its gaseous elements.

Part B (b)

 $2.0\,\mathrm{g}$ of sodium reacts fully with chlorine gas.





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Essential Pre-Uni Chemistry G2.3

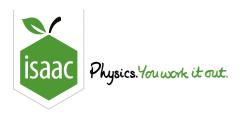
Essential Pre-Uni Chemistry G2.3



Use the following standard molar entropy values in $J K^{-1} mol^{-1}$ to help answer the questions in this section.

$\mathrm{H_{2}O}\left(\mathrm{l}\right)$	69.9	HCl(g)	186.8	NaCl(s)	72.1
$ m H_2O\left(g ight)$	188.7	$\mathrm{Cl}_{2}\left(\mathrm{g}\right)$	223.1	$\mathrm{ZnCl}_{2}\left(\mathrm{s} ight)$	111.5
$ m H_{2}\left(g ight)$	130.7	$\mathrm{H_{2}SO_{4}}\left(\mathrm{l}\right)$	156.9	$\mathrm{Zn}\left(\mathrm{s}\right)$	41.6
Na(s)	51.2	$\mathrm{Zn}\left(\mathrm{g}\right)$	150.0	$\mathrm{NaHSO_{4}\left(s\right) }$	113.0
$\mathrm{O}_{2}\left(\mathrm{g} ight)$	205.2	$\mathrm{CO}_2(\mathrm{g})$	213.6	$\mathrm{C}\left(\mathrm{s}\right)$ graphite	5.7

The decomposition of hydrogen peroxide has a standard entropy change of $62.9\,\mathrm{J\,K^{-1}\,mol^{-1}}$. Find the standard molar entropy of hydrogen peroxide. Give your answer to 1 decimal place.



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Essential Pre-Uni Chemistry G2.4

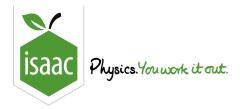
Essential Pre-Uni Chemistry G2.4



Use the following standard molar entropy values in $J K^{-1} mol^{-1}$ to help answer the questions in this section.

$\mathrm{H_{2}O}\left(\mathrm{l}\right)$	69.9	HCl(g)	186.8	NaCl(s)	72.1
$ m H_2O\left(g ight)$	188.7	$\mathrm{Cl}_{2}\left(\mathrm{g}\right)$	223.1	$\mathrm{ZnCl}_{2}\left(\mathrm{s} ight)$	111.5
$ m H_{2}\left(g ight)$	130.7	$\mathrm{H_{2}SO_{4}}\left(\mathrm{l}\right)$	156.9	$\mathrm{Zn}\left(\mathrm{s}\right)$	41.6
Na(s)	51.2	$\mathrm{Zn}\left(\mathrm{g}\right)$	150.0	$\mathrm{NaHSO_{4}\left(s\right) }$	113.0
$\mathrm{O}_{2}\left(\mathrm{g} ight)$	205.2	$\mathrm{CO}_2(\mathrm{g})$	213.6	$\mathrm{C}\left(\mathrm{s}\right)$ graphite	5.7

The combustion of methane has a standard molar entropy change of $-243.2\,\mathrm{J\,K^{-1}\,mol^{-1}}$. Calculate the standard molar entropy of methane. Give your answer to one decimal place.



Home Gameboard Chemistry Physical Energetics Reaction Feasibility

Reaction Feasibility



A process is described as being thermodynamically feasible when it results in an increase in the entropy of the universe. For a chemical reaction to be feasible, the sum of the entropy changes of the reaction system and the surroundings needs to be positive. The entropy change of the surroundings arises as a result of heat flow between the surroundings and the reaction system.

Part A Universe entropy change

The entropy change of the surroundings is calculated by dividing the heat flowing into the surroundings by the temperature.

For a reaction with an entropy change (of the system) of x and an enthalpy change of y, write down an inequality that needs to hold for the reaction to be spontaneous at a temperature T.

The following symbols may be useful: >, T, x, y

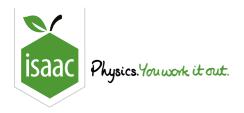
Part B Gibbs Free Energy

Alternatively, chemists often phrase the requirement in terms of Gibbs free energy (G) of the reaction, a function of temperature (T), enthalpy (H) and entropy (S):

$$G = H - TS$$

If the change in Gibbs free energy of the reaction at a given temperature is z, write down an inequality that needs to hold for this reaction to be feasible.

The following symbols may be useful: <, z

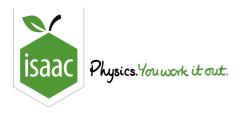


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Essential Pre-Uni Chemistry H2.3



The standard enthalpy change on decomposition of magnesium carbonate is $100.6\,\mathrm{kJ\,mol^{-1}}$, and the standard entropy change is $174.8\,\mathrm{J\,K^{-1}\,mol^{-1}}$. Find the temperature at which its decomposition becomes spontaneous under standard conditions.



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Essential Pre-Uni Chemistry H2.4



The standard enthalpy of formation of copper(II) oxide at $290\,^{\circ}\mathrm{C}$ is $-157\,\mathrm{kJ\,mol^{-1}}$. The standard entropy change for the same process is $-41.9\,\mathrm{J\,K^{-1}\,mol^{-1}}$. Find the standard Gibbs free energy change of formation of copper(II) oxide at this temperature.