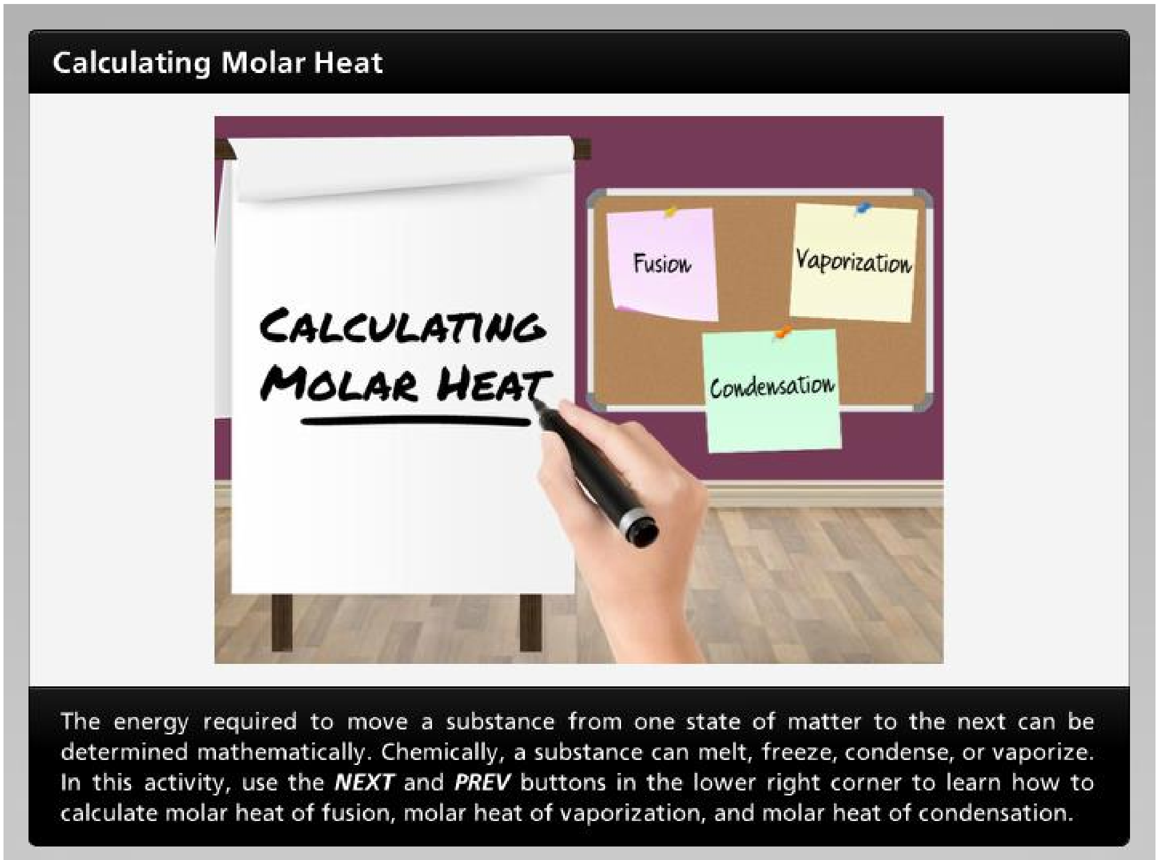
Module 8: Thermochemistry
Topic 7 Content: Calculating Molar Heat Notes



The energy required to move a substance from one state of matter to the next can be determined mathematically. Chemically, a substance can melt, freeze, condense, or vaporize. In this activity, use the ***NEXT*** and ***PREV*** buttons in the lower right corner to learn how to calculate molar heat of fusion, molar heat of vaporization, and molar heat of condensation.

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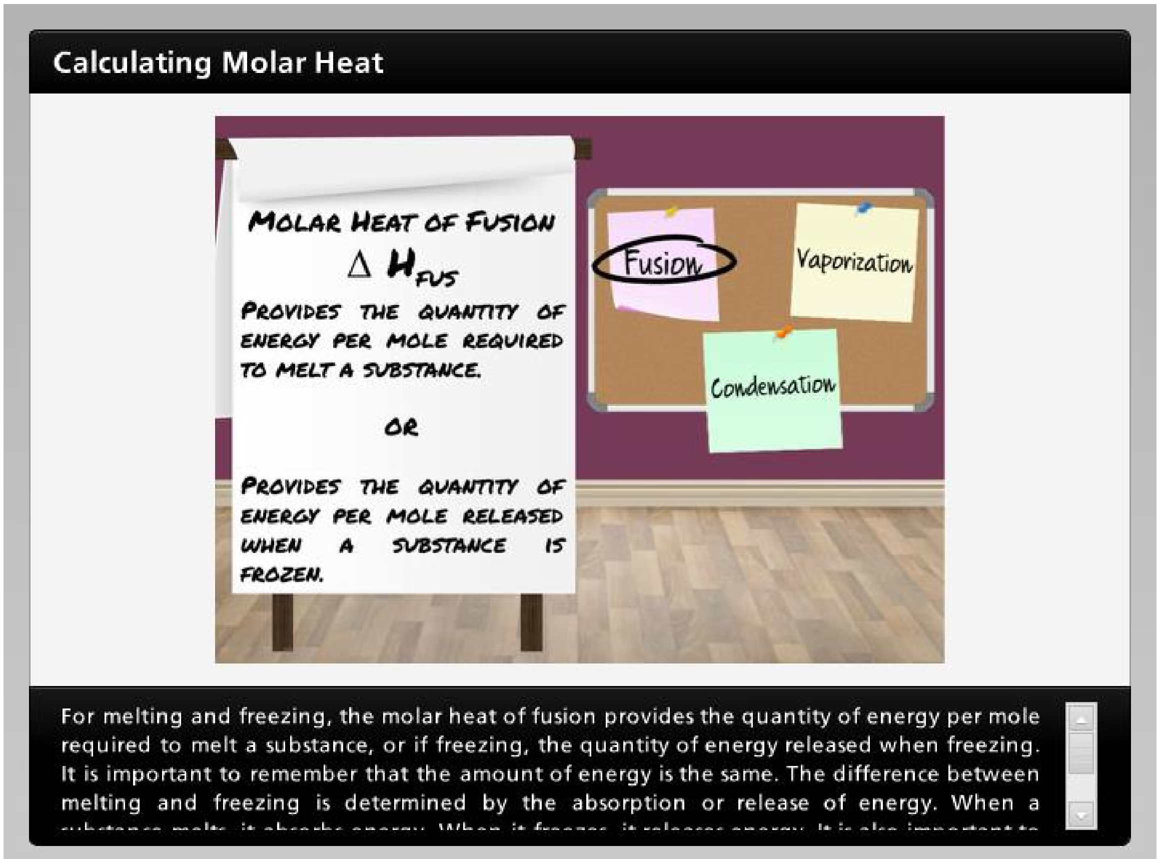
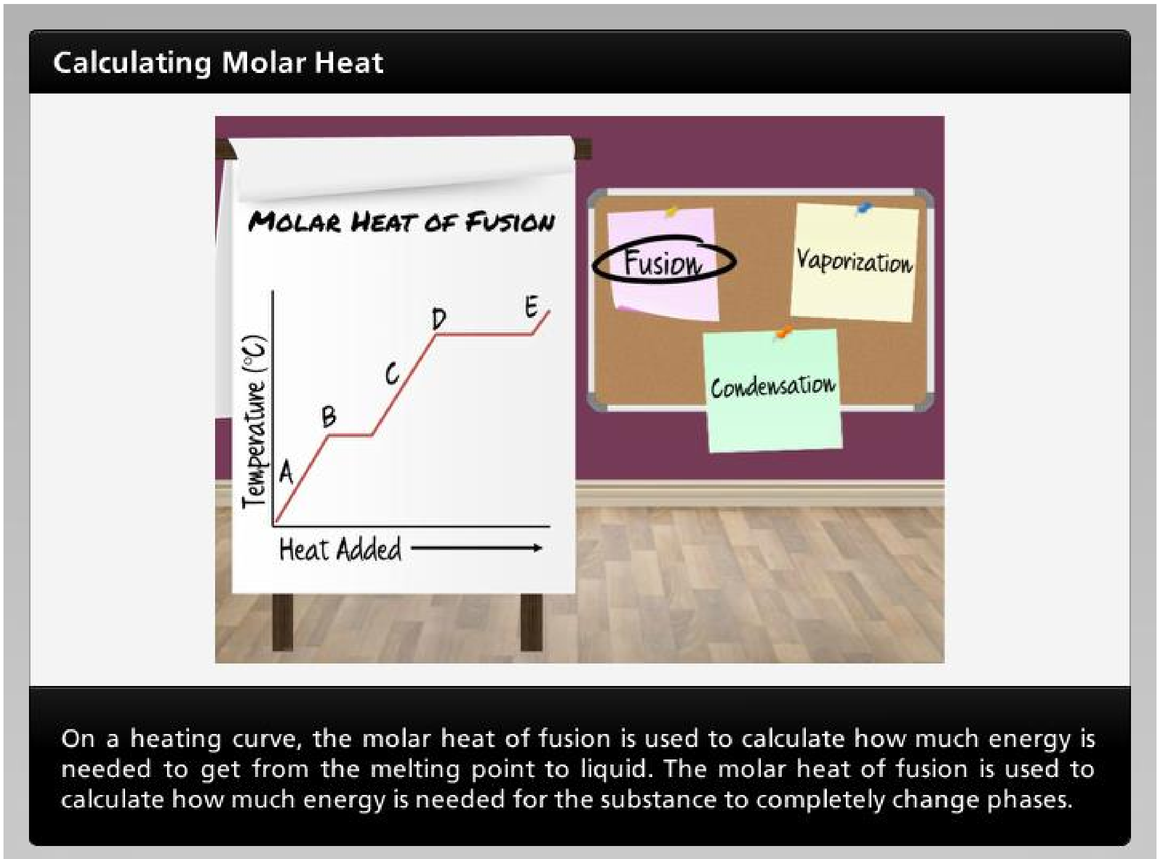
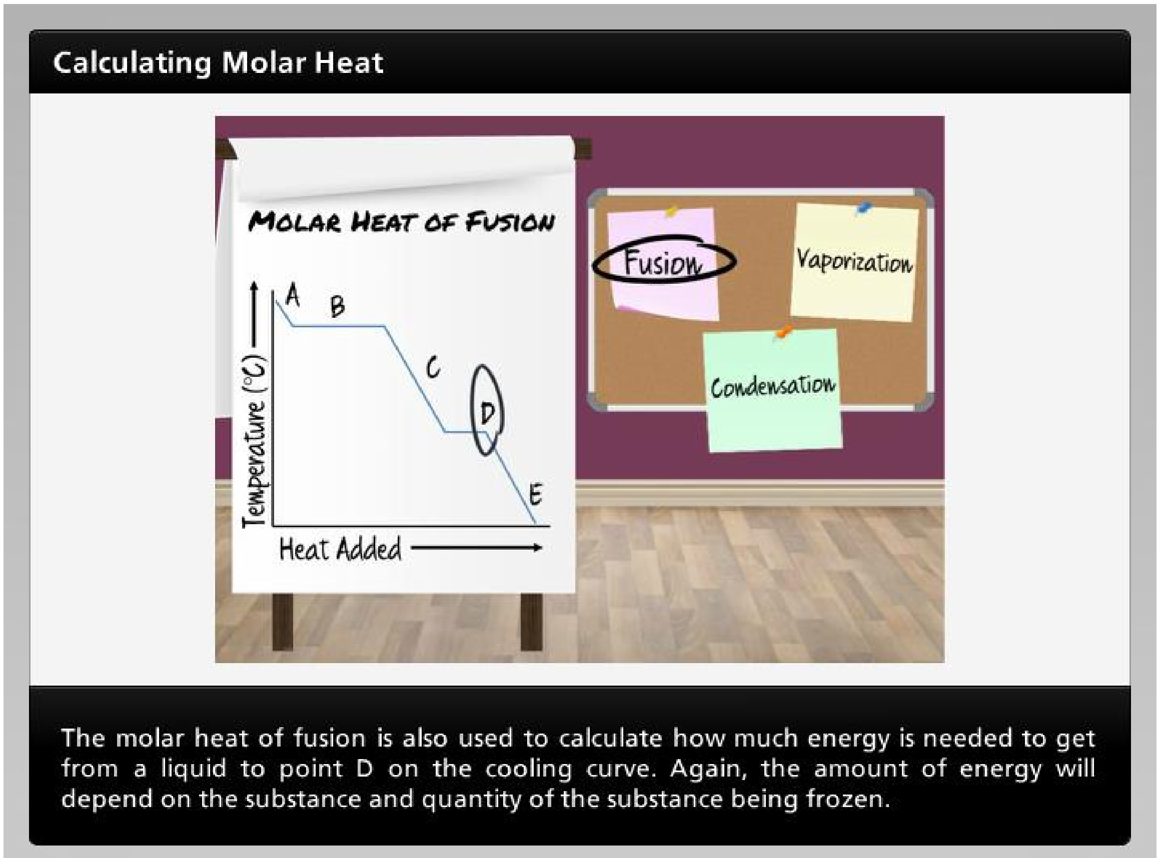


For melting and freezing, the molar heat of fusion provides the quantity of energy per mole required to melt a substance, or if freezing, the quantity of energy released when freezing. It is important to remember that the amount of energy is the same. The difference between melting and freezing is determined by the absorption or release of energy. When a substance melts, it absorbs energy. When it freezes, it releases energy. It is also important to note that both the melting and freezing occur at the same temperature. This temperature is most often called the melting point, but could also be called the freezing point.



On a heating curve, the molar heat of fusion is used to calculate how much energy is needed to get from the melting point to liquid. The molar heat of fusion is used to calculate how much energy is needed for the substance to completely change phases.



The molar heat of fusion is also used to calculate how much energy is needed to get from a liquid to point D on the cooling curve. Again, the amount of energy will depend on the substance and quantity of the substance being frozen.

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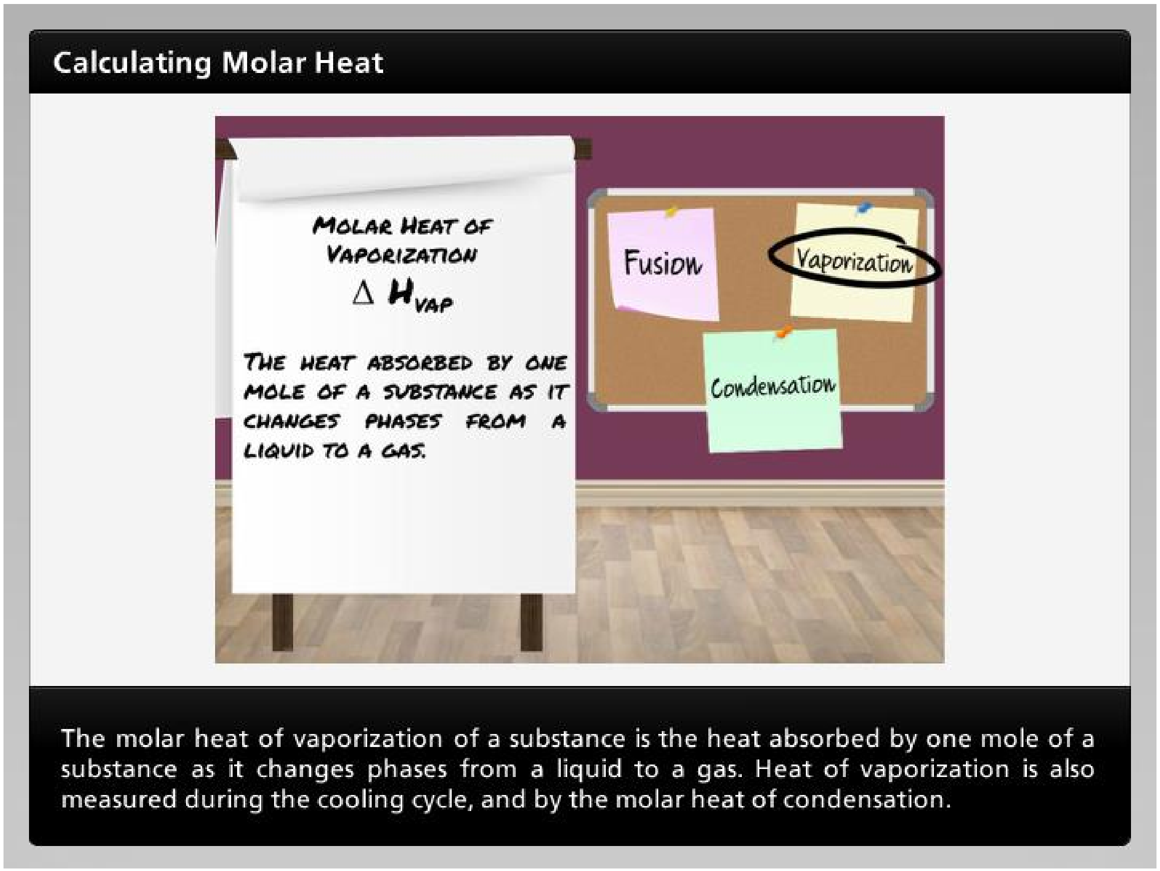

The molar heat of vaporization of a substance is the heat absorbed by one mole of a substance as it changes phases from a liquid to a gas. Heat of vaporization is also measured during the cooling cycle, and by the molar heat of condensation.

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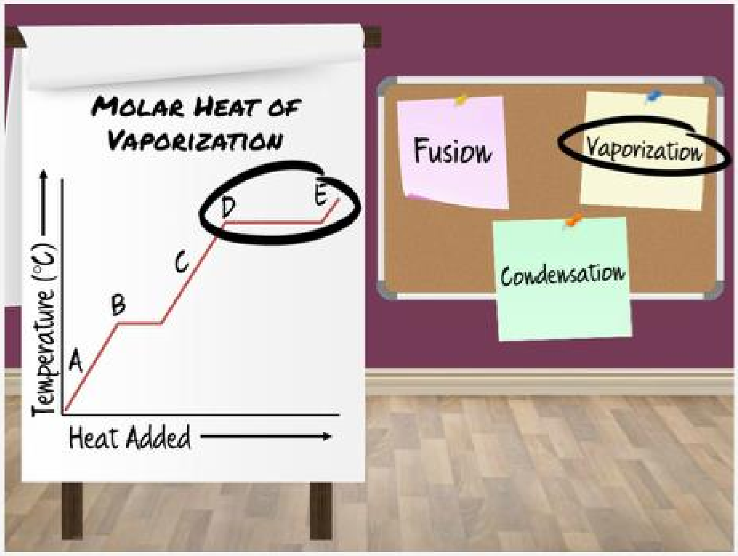

On a heating curve, the molar heat of vaporization is used to calculate how much energy is needed to get from liquid to gas. The molar heat of vaporization is used to calculate how much energy is needed for the substance to completely change phases.

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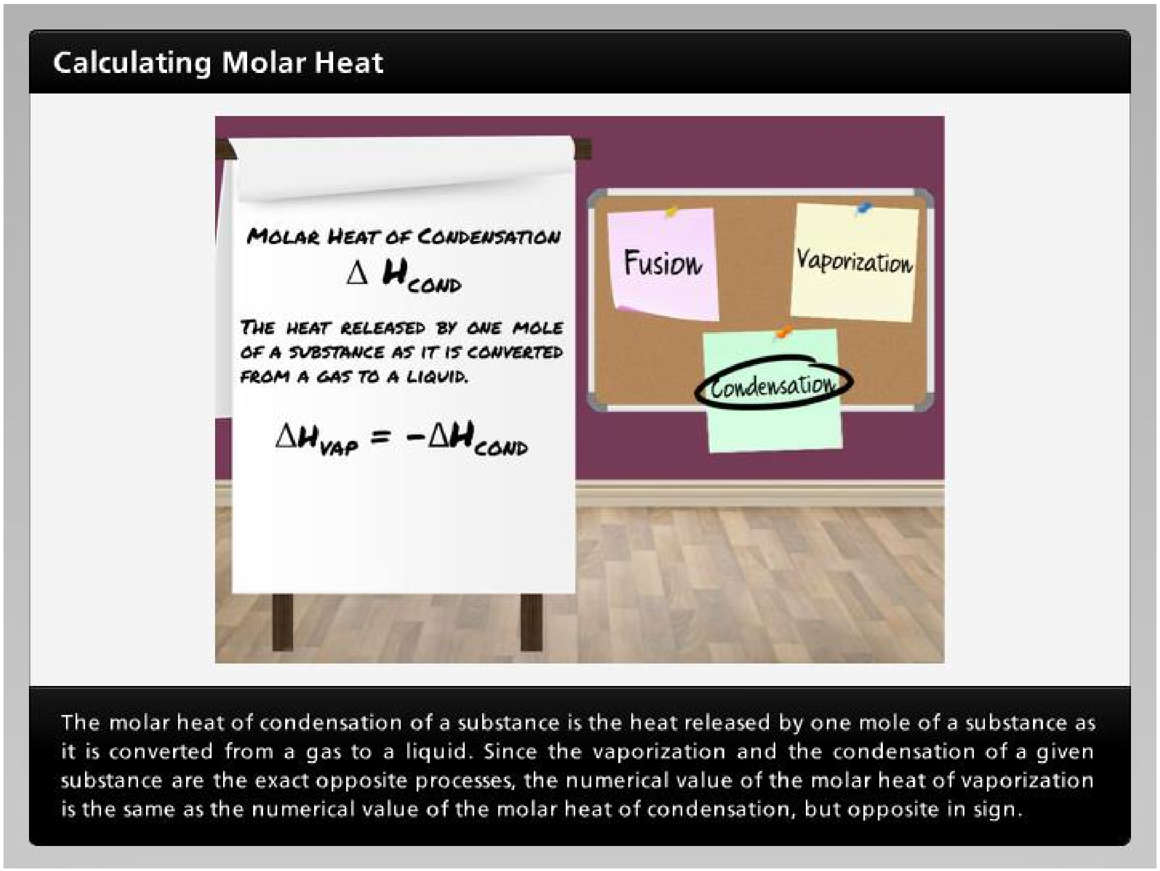
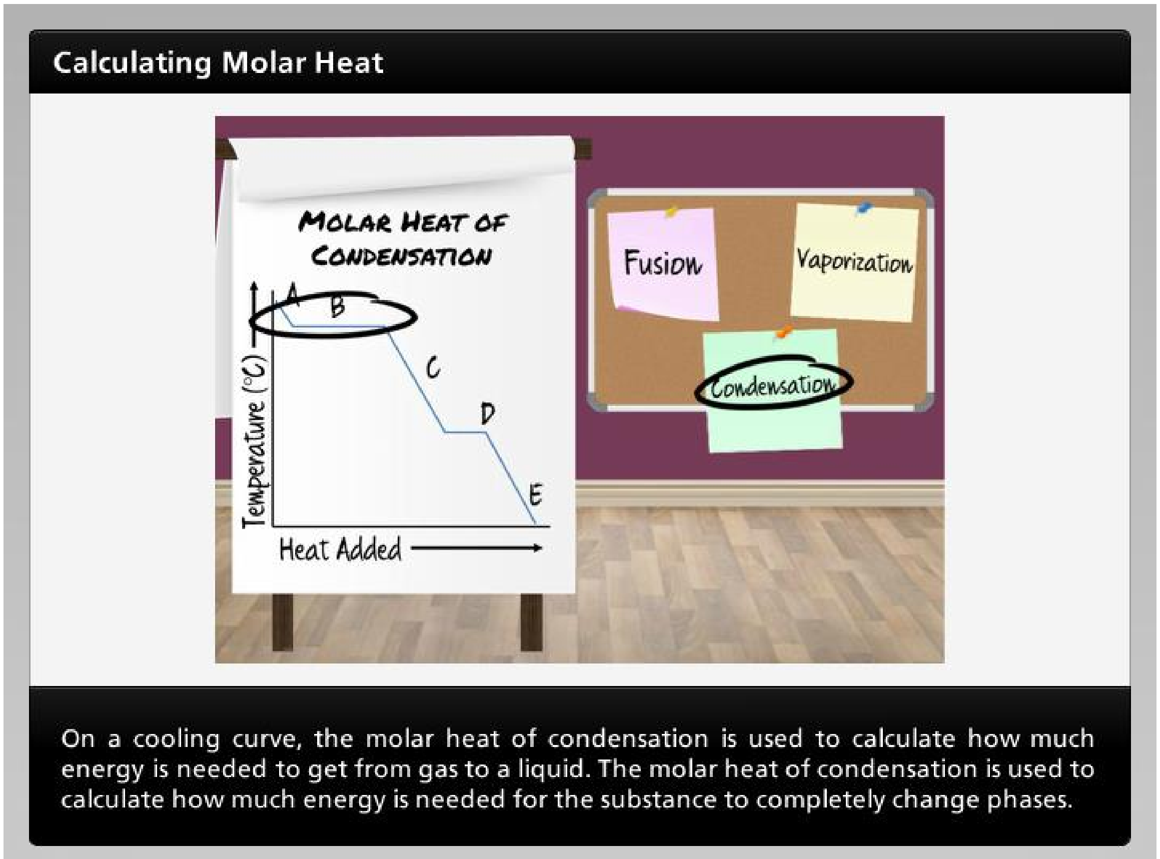
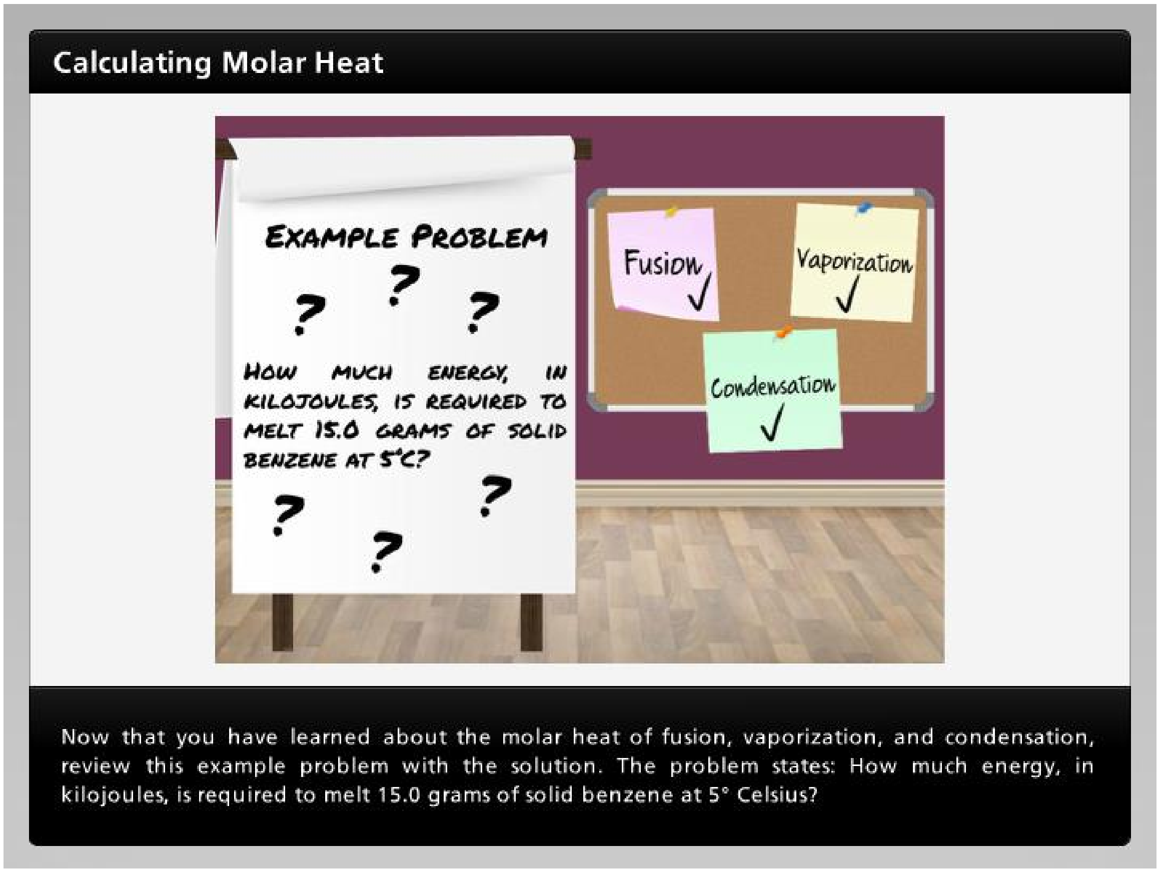


The molar heat of condensation of a substance is the heat released by one mole of a substance as it is converted from a gas to a liquid. Since the vaporization and the condensation of a given substance are the exact opposite processes, the numerical value of the molar heat of vaporization is the same as the numerical value of the molar heat of condensation, but opposite in sign.



On a cooling curve, the molar heat of condensation is used to calculate how much energy is needed to get from gas to a liquid. The molar heat of condensation is used to calculate how much energy is needed for the substance to completely change phases.



Now that you have learned about the molar heat of fusion, vaporization, and condensation, review this example problem with the solution. The problem states: How much energy, in kilojoules, is required to melt 15.0 grams of solid benzene at 5° Celsius?

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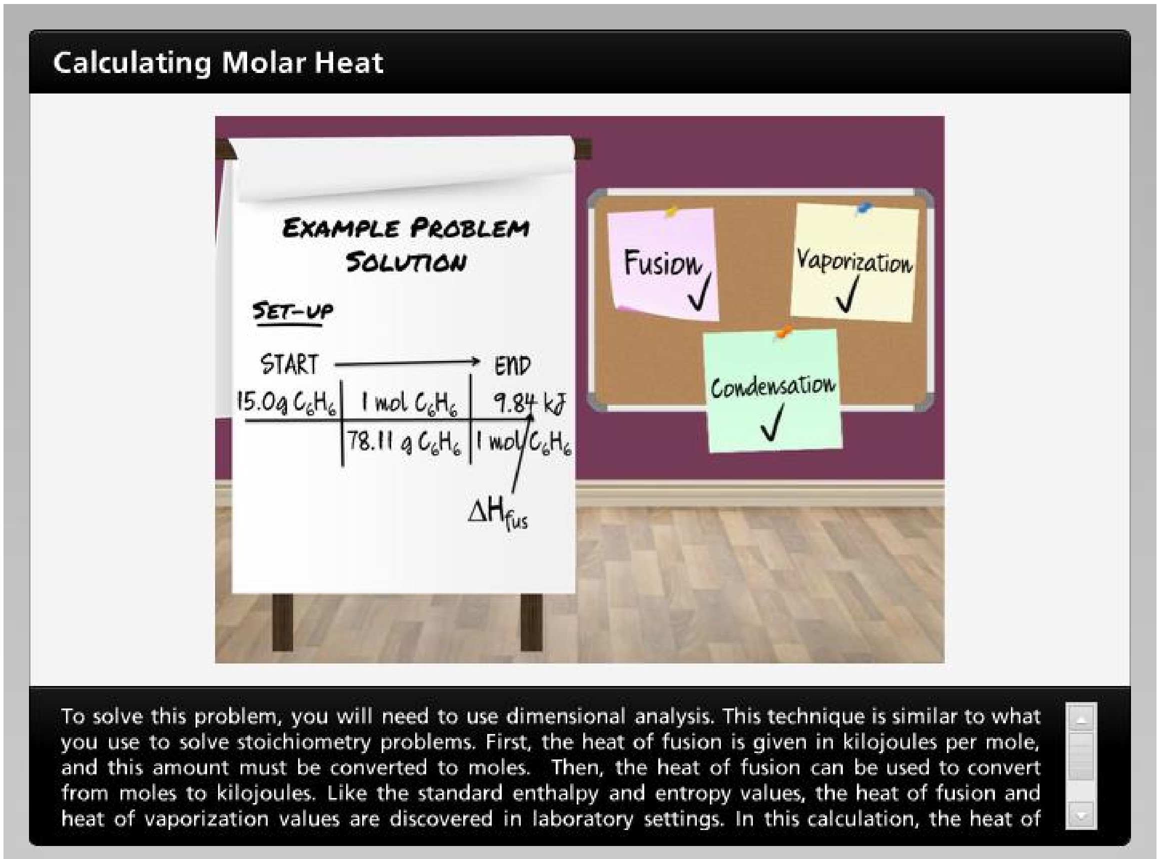
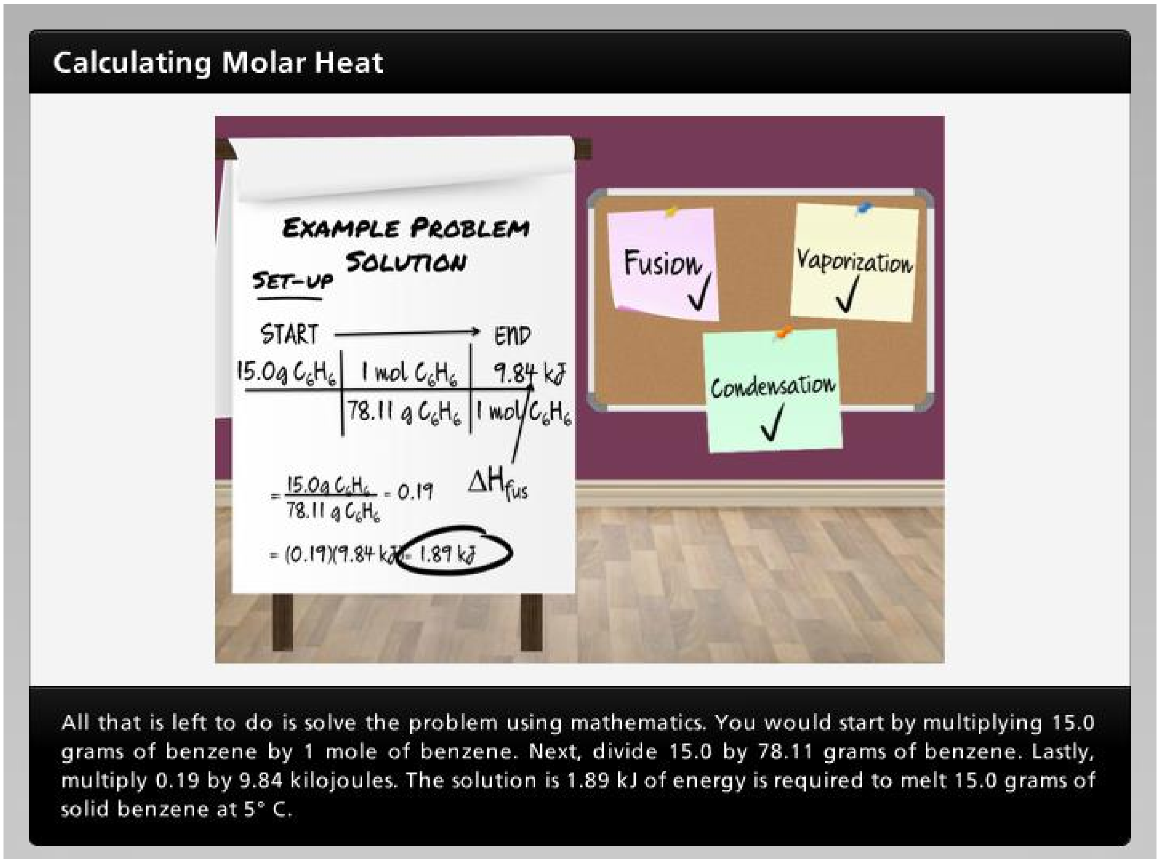


To solve this problem, you will need to use dimensional analysis. This technique is similar to what you use to solve stoichiometry problems. First, the heat of fusion is given in kilojoules per mole, and this amount must be converted to moles. Then, the heat of fusion can be used to convert from moles to kilojoules. Like the standard enthalpy and entropy values, the heat of fusion and heat of vaporization values are discovered in laboratory settings. In this calculation, the heat of fusion value is given. In any calculation, if the heat of fusion or heat of vaporization is not given, you will need to conduct research to find those values.



All that is left to do is solve the problem using mathematics. You would start by multiplying 15.0 grams of benzene by 1 mole of benzene. Next, divide 15.0 by 78.11 grams of benzene. Lastly, multiply 0.19 by 9.84 kilojoules. The solution is 1.89 kJ of energy is required to melt 15.0 grams of solid benzene at 5° C.