PhyzJob: Phase Change Graphing

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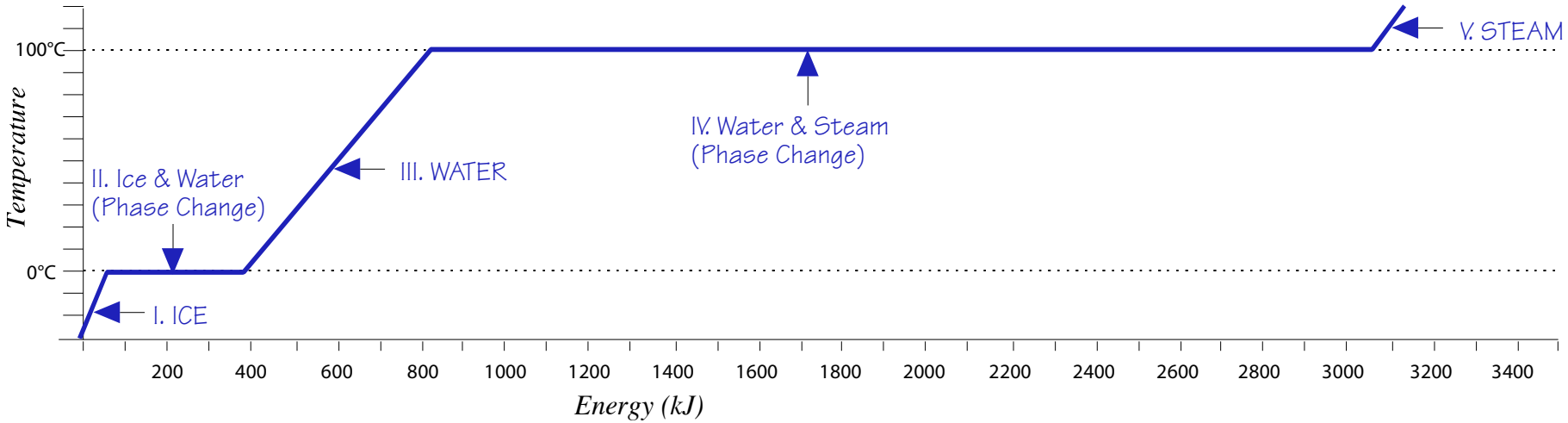
As you add heat to a substance, its temperature generally increases. During a change of phase, however, the energy that would usually force molecules into increased jiggling instead goes into breaking the bonds of the solid or liquid. Since the thermometer doesn't move during a phase change, the energy added during the phase change is sometimes called **latent heat**. On the graph below, we will chart the temperature of 1 kg of H_2O (initially ice at –30 °C) as we add enough energy to change it to steam at 120 °C.



I. How much energy is required to heat the ice from –30 °C to 0 °C?

m = 1kg, T = 30°C, c = 2090J/kg·°C

Q = mc T
Q = 1kg · 2090J/kg·°C · 30°C
Q = 62,700J

Q = 62.7kJ

II. How much **additional** energy is required to change the 0 °C ice to 0 °C water?

Q = mLf
Q = 1kg · 335,000J/kg

Q = 335kJ Tot: 397.7kJ

III. How much **additional** energy is required to heat the water from 0°C to 100 °C?

m = 1kg, T = 100°C, c = 4190J/kg·°C

Q = mc T
Q = 1kg · 4190J/kg·°C · 100°C
Q = 419,000J

Q = 419kJ Tot: 816.7kJ

IV. How much **additional** energy is required to change the 100 °C water to 100 °C steam?

Q = mLv
Q = 1kg · 2,260,000J/kg

Q = 2,260kJ Tot: 3076.7kJ

V. How much **additional** energy is required to heat the steam from 100 °C to 120 °C?

m = 1kg, T = 100°C, c = 2010J/kg·°C

Q = mc T
Q = 1kg · 2010J/kg·°C · 20°C
Q = 40,200J

Q = 40.2kJ Tot: 3116.9kJ

Question
Would the graph look any different if 0.1 kg of H_2O was used instead of 1 kg?

It would be condensed horizontally, involving only one tenth the heat shown in the graph above.

8/17/07 db