

PS3

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1.) An example of a system that is not heated but its temperature increases, is a car piston. As the piston compresses the gas, it heats up the air until an ignition occurs.

An example of a system where it's heated but its temperature remains the same, is boiling water. Once the temperature of the water reaches 100°C , the added heat energy goes into the phase change, liquid to gas, rather than increasing the temperature.

$$2.) C_v - C_p = T \left(\frac{\partial S}{\partial P} \right)_T \left(\frac{\partial P}{\partial T} \right)_v$$

$$C_p = C_v - T \left(\frac{\partial S}{\partial P} \right)_T \left(\frac{\partial P}{\partial T} \right)_v$$

$$\left(\frac{\partial C_p}{\partial P} \right) = \frac{\partial}{\partial P} \left[C_v - T \left(\frac{\partial S}{\partial P} \right)_T \left(\frac{\partial P}{\partial T} \right)_v \right]$$

$$\left(\frac{\partial P}{\partial T} \right)_T \propto L^{-1} \propto P/T \left(\frac{\partial T}{\partial V} \right)$$

$$= 0 - T \left(\frac{\partial^2 S}{\partial P^2} \right)_T$$

$$\boxed{\left(\frac{\partial S}{\partial P} \right)_T = \left(\frac{\partial V}{\partial T} \right)_P}$$

$$\left(\frac{\partial C_p}{\partial P} \right)_T = -T \left(\frac{\partial^2 V}{\partial T^2} \right)_P$$

$$C_v = C_p + T \left(\frac{\partial S}{\partial P} \right)_T \left(\frac{\partial P}{\partial T} \right)_V$$

$$= C_p + T \left(\frac{\partial S}{\partial P} \right)_T \left(\frac{\partial S}{\partial V} \right)$$

$$\boxed{\frac{\partial P}{\partial T} = \frac{\partial S}{\partial V}}$$

$$\frac{\partial C_v}{\partial V} = \frac{\partial}{\partial V} \left[C_p + T \left(\frac{\partial S}{\partial P} \right)_T \left(\frac{\partial S}{\partial V} \right) \right]$$

$$= 0 + T \left(\frac{\partial^2 S}{\partial V^2} \right)$$

$$\frac{\partial C_v}{\partial V} = T \left(\frac{\partial^2 P}{\partial T^2} \right)_V$$

$$\frac{\partial C_v}{\partial V} = T \left(\frac{\partial^2 P}{\partial T^2} \right)_V$$

3.) 14 - 3 coins

$$a.) P = \frac{1}{2}$$

$$b.) P = \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{8}$$

$$c.) P = \frac{1}{2}$$

4.) 2 people, 1 coin

$$a.) P = \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{16}$$

$$b.) P = \frac{1}{2}$$

$$c.) P = \frac{1}{4}$$

5.) 200 spotted fish

$$\frac{25}{250} \text{ spotted}$$

$$\frac{25}{250} \cdot \frac{200}{N}$$

11 - 1000 total fish

V - 1000 100

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