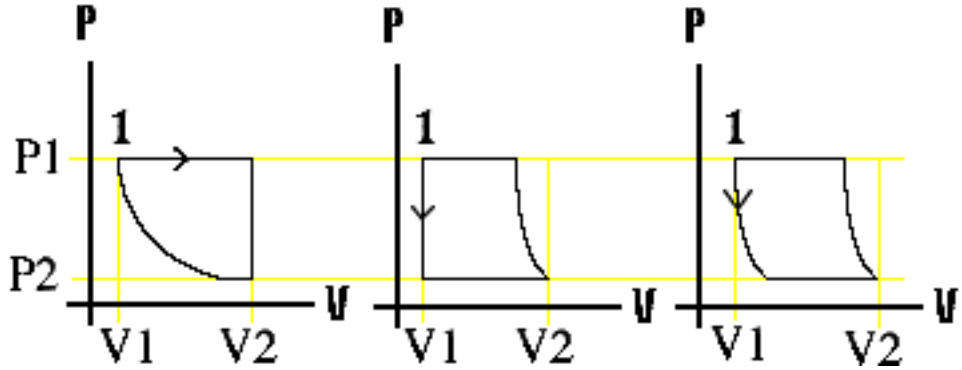
Three laboratory rats are placed inside three identical environmental chambers and subjected to three different cycles of changing volume and pressure. In each case, the maximum and minimum values of volume and pressure were the same. In each case, the chamber returns to its original volume and pressure at the end of the cycle. PV diagrams describing the three cycles are shown in the figure.



Which rat was subjected to the highest temperature? Explain.
Which rat was subjected to the lowest temperature? Explain.

The product of pressure and volume governs temperature

Since these are pressure vs volume graphs, **the ideal gas law should be used to see a relationship between pressure and volume to temperature**. Since pressure/temperature and volume/temperature have a direct relationship, as the pressure on the graph becomes greater on the y axis, the temperature will increase. The same thing would happen with volume, as the volume increases along the x axis, the temperature should increase. **Based on the graph, each rat will experience the same levels of high pressure and volume, just not at the same time. The first rat had experienced the greatest temperature because part of the pathway includes a point that is the highest P value and highest V value** which based on the ideal gas law would mean that rat experienced the highest temperature. **The second rat experienced the opposite. A point on its pathway includes the smallest values for pressure and volume indicating that it experienced the lowest temperature at this point**.

Net change around cycle is same for all (no change!) intermediate states differ

For this question, it is important to note that in each situation, **each chamber has the same starting and ending states, meaning their change in internal energy is the same**. The change in internal energy is defined by the equation:

deltaE_int=No(C_v)(delta T).

Because the environmental chambers are identical, the number of moles and the molar specific heat at a constant volume would be the same for all environments (assuming the chambers all filled with an ideal gas). Because these variables are the same, the change in temperature would be the same. Furthermore, **because the max and min values of volume and pressure are the same, the rats all experience the same max and min temperatures at some point in time.**

The readings discuss the molar specific heat at constant pressure and the molar specific heat at constant volume. Why have we not defined similar specific heats to describe the other two standard processes, isothermal and adiabatic? How should you find the amount of heat involved in those processes?

For these processes, once side of the equation is zero

First, the molar specific heat for an isothermal transformation would not make any sense. By definition, molar specific heat is the amount of heat required to raise one mole by one degree (i.e. how much is needed to change the temperature). **In isothermal process, there is no change in temperature, so it makes no sense to speak of specific heat of any sort**.

For an adiabatic process, the notion of a molar specific heat also makes no sense. Using the same definition as above, the molar specific heat implies that heat would be added. However, **in an adiabatic process, no heat is added or removed by definition.**

Thus, molar specific heat for adiabatic and isothermal processes don't exist because they can't exist conceptually.

But if there is heat involved, how is it found?

For isothermal processes, the internal energy does not change so the amount of heat is equal and opposite to the amount of work done. For an adiabatic process, no heat is added or removed so the internal energy cannot change.

Just a reminder to be careful about wording

A gas's molar specific heat capacity (c) is defined as the amount of thermal energy necessary to increase the temperature of one mole of gas by 1º C. In the context of isothermal and adiabatic processes the c is irrelevant. **Isothermal processes have no change in heat so the change in internal energy would have a Q of 0 so c is not needed.** Similarly, in an adiabatic process, no heat is involved only work therefore Q is once more 0 and c is not needed.

If you are recruited to a government position for which you are totally unqualified (a.k.a., a sinecure), what kind of jobs are you best suited for?

a. isothermal
b. isovolumetric
c. isobaric
d. adiabatic