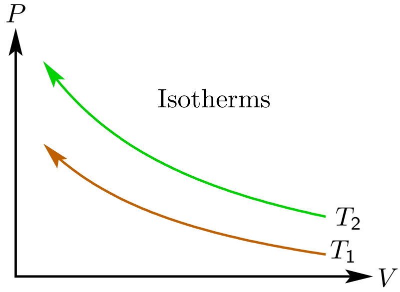
Answers

a. For an ideal gas $PV = NkT$, so the shape of $P(V)$ for any T is given by

$$P = \frac{\text{const}(T)}{V}\,.$$

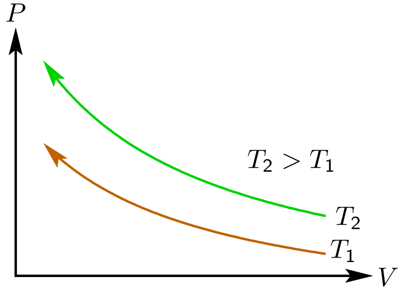
Thus, the curves look like:



b. Compression implies a decrease in volume, so the progression is upward and to the left.

Answers

c. Since $P = (Nk/V)T \propto T$ for given V, the curve with higher P has higher T. That is, $T_2 > T_1$:



Answers

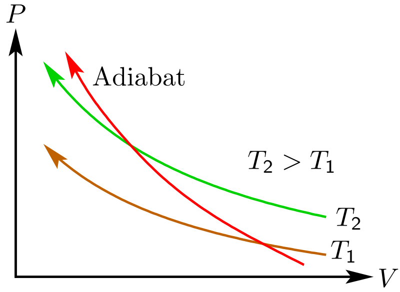
d. $W > 0$ for a compression process, and $Q = 0$ for an adiabatic process, so the first law gives $\Delta U = Q + W > 0$ for adiabatic compression. For an ideal gas

$$U = \frac{f}{2} NkT\,,$$

with f being the number of degrees of freedom per molecule. Thus, with $\Delta U > 0$, we must also have $\Delta T > 0$. So, as the compression proceeds (V decreases), T must rise.

Answers

e. Since T increases during the compression, an adiabat must cross isotherms (it's steeper than the isotherms):



Answers

f. Bubble A follows an adiabat, B an isotherm. The process is expansion, so $W < 0$ for both—they lose energy by doing work on the water. The isothermal process has $Q > 0$ (B absorbs heat from the water), and the adiabatic process has $Q = 0$ (A absorbs no heat). Thus A cools more than B and has lower T at the surface. For an ideal gas $V = (Nk/P)T$, so the cooler bubble ends up smaller: