Answer on Question #83879 - Physics – Molecular Physics| Thermodynamics

Liq O2 at 50k is heated to 300k at const pressure 1 atm. Rate of heating is constant. Represent variation of temperature with time.?

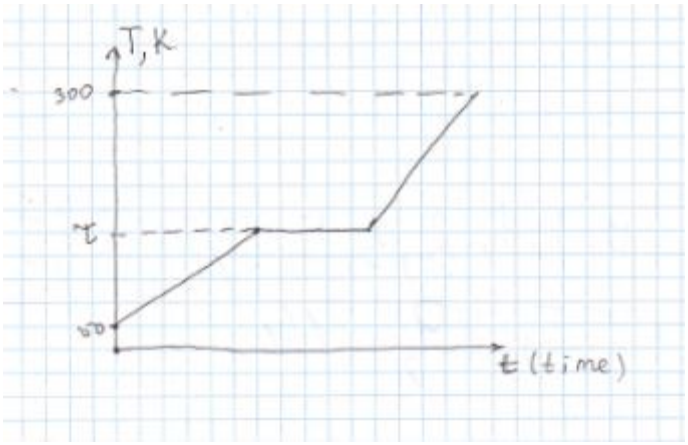
Solution. So, we have liquid oxygen at 50 K. We begin to heat it evenly at a pressure of 1 atmosphere. First, the heating will bring oxygen to the boiling point, let this point correspond to some temperature τ.

Consider a graph in the region from 50K to the boiling point of oxygen τ. The heat supplied to oxygen is calculated by the formula: Q=cmΔT, where c – liquid oxygen heat capacity; m – mass of oxygen; ΔT - temperature change. For our considered area, the amount of heat supplied to oxygen will be written as: Q=cm(τ-50) or the heat supplied during the time t will be $\frac{Q}{t} = \frac{mc(\tau-50)}{t}$. In this case, the ratio $\frac{Q}{t} = const$, because heat is supplied evenly. Then, mc(τ-50)=const×t. Then, addiction T-t will be expressed as an inclined straight line with the ratio of the heat to the time on the dependency graph T-t to a temperature τ from 50K.

Further, at the boiling point, heat will be expended to transfer oxygen from a liquid to a gaseous state, until all oxygen is converted to a gaseous state. In this case, the heat is expressed by the dependence: Q_1=mL, where L - latent heat of fluid transition to gas. Then the temperature dependence on time is expressed by a straight line parallel to the time axis.

When the evaporation process is complete, the temperature rises from the value of τ to value of 300K. In this interval, the amount of heat supplied to oxygen is written as: $Q_2=c_g m(300-\tau)$, where c_g - heat capacity of gaseous oxygen. The dependence of temperature on time will be expressed by a straight line inclined to the time axis.

Thus, the graph of temperature versus time when heating oxygen from 50K to 300K will look like this:



Answer: