

Key

CH353 – Physical Chemistry I
Summer 2017, Unique 86861

Quiz 1, 11 July 2017

The tires of your car are supposed to be inflated to a pressure of 35 psi (2.38 atm). On a cool Texas spring morning where the outside temperature is 55°F (12.8°C), you get into your car to drive to Big Bend. After seeing that the low pressure light is on, you check the pressure of your tires and see that one tire is 27 psi. You are running late, and so instead of stopping at the gas station to fill up your tire with more air, you assume that it will eventually be warm enough for the pressure in the tire to increase to the correct amount. Is this a good assumption? Justify your answer, and clearly state any assumptions you must make.

The following constants may be useful:

$$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1} = 0.082 \text{ L atm mol}^{-1} \text{ K}^{-1}$$

$$P_{\text{ideal}} = 35 \text{ psi} \quad \text{Assume an ideal gas}$$

$$PV = nRT$$

$$P_i = 27 \text{ psi}; T_i = 12.8^\circ\text{C} \rightarrow 285.95 \text{ K}$$

Assume tires are rigid and do not leak (ie, constant $n+V$)

$$\frac{P}{T} = \frac{nR}{V} = \text{constant} \quad \Rightarrow \quad \frac{P_i}{T_i} = \frac{P_a}{T_a}$$

$$T_f = \frac{P_f \cdot P_i T_i}{P_i} = \frac{35 \text{ psi} \cdot 285.95 \text{ K}}{27 \text{ psi}} = 369.6 \text{ K} \rightarrow 96.5^\circ\text{C}$$

This is near the boiling point of water and 207.5°F!
This is not a good assumption! Should have filled up the tire!