1 - Functions of Multiple Variables

MATH 211

The pressure p (in Pa) of a gas as a function of its volume V and temperature T is $p = nRT/V$. If $n = 3$ mol and $R = 8$ J/mol·K, find p for $T = 300$ K and $V = 50$ m^3.

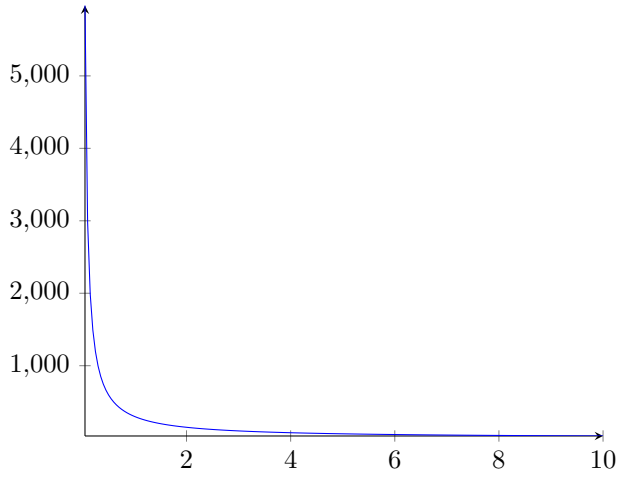
$$p(V,T) = \frac{(3)(8)T}{V} = \frac{24T}{V}$$

$$p(50,300) = \frac{24(300)}{50} = 144 \text{ Pa}$$

Consider the ideal gas law presented in the previous problem. Find and physically interpret the limit of the pressure of the gas if $V \to 0^+$ cm^3 and temperature is fixed. Now, give an example in the engineering sciences where something like this may occur.

$$p\,(V,T) = \frac{24T}{V}$$

$$\lim_{V\to 0^+} p = \lim_{V\to 0^+} \frac{24T}{V} = \infty$$



Pressure and volume are inversely proportional to each other. This means that as the pressure decreases, the volume increases, and as the pressure increases, the volume decreases. One way to think of this: if you push on a gas by decreasing its volume, it pushes back by increasing its pressure. This relationship is called Boyle's Law and makes up part of the ideal gas law. As the volume decreases, the pressure inside the container increases without bound. This could be seen in the application of combustion and explosives. A much simpler (and safer) object to consider is a can of whipped cream.