Answer on Question #65060, Physics / Other

An ideal gas undergoes a polytropic given by equation PV^(n) = constant . If molar heat capacity of gas during this process is arithmetic mean of its molar heat capacity at constant pressure and constant volume then value of n is

Solution:

For polytropic process

$$PV^n = constant$$

The molar specific heat for this process

$$C = \frac{R}{\gamma - 1} + \frac{R}{1 - n}$$

where C is molar specific heat and γ is adiabatic exponent.

$$\gamma = \frac{C_P}{C_V}$$

$$R = C_P - C_V$$

Thus,

$$C = \frac{C_P - C_V}{\frac{C_P}{C_V} - 1} + \frac{C_P - C_V}{1 - n} = C_V + \frac{C_P - C_V}{1 - n}$$

From given:

$$C = \frac{C_P + C_V}{2}$$

So,

$$\frac{C_P + C_V}{2} = C_V + \frac{C_P - C_V}{1 - n}$$

$$\frac{C_P}{2} - \frac{C_V}{2} = \frac{C_P - C_V}{1 - n}$$

$$1 - n = \frac{C_P - C_V}{\frac{C_P}{2} - \frac{C_V}{2}}$$

$$1 - n = 2$$

$$n = -1$$

Answer: $n = -1$