Problem 2.15

The given equations are:

$$TV^{\gamma-1} = C \tag{1}$$
$$PV = \nu RT \tag{2}$$

Isolating T in (2),

$$T = \frac{PV}{\nu R} \tag{3}$$

Plugging this into (1),

$$\frac{PV}{\nu R}V^{\gamma-1} = C$$
$$PV^{\gamma} = C\nu R = C \tag{4}$$

Therefore,

$$\boxed{PV^{\gamma} = C} \tag{5}$$

Similarly, isolating V from (2),

$$V = \frac{\nu RT}{P} \tag{6}$$

Plugging this into (5),

$$P\left(\frac{\nu RT}{P}\right)^{\gamma} = C$$
$$(\nu RT)^{\gamma} P^{1-\gamma} = C$$
$$T^{\gamma}P^{1-\gamma} = \frac{C}{(\nu R)^{\gamma}}$$
$$T^{\gamma}P^{1-\gamma} = C \tag{7}$$

Raising both sides to $1/\gamma$,

$$\left(T^{\gamma}P^{1-\gamma}\right)^{\frac{1}{\gamma}} = C^{\frac{1}{\gamma}}$$
$$\boxed{TP^{\frac{1-\gamma}{\gamma}} = C} \tag{8}$$