Answer on Question #46530, Physics, Mechanics | Kinematics | Dynamics

Question:

A cubic box of volume 6.15 x 10-2 m3 is filled with air at atmospheric pressure at 15C. The box is closed and heated to 185C. What is the net force on each side of the box?

Answer:

Net force on each side of the box equals:

$$F = (P - P_a)A$$

where P_a is atmospheric pressure, P is pressure in the box, A is area of the side.

The ideal gas law:

$$PV = nRT$$

where P is the absolute pressure of the gas, V is the volume of the gas, n is the amount of substance of gas (measured in moles), R is the ideal, or universal, gas constant, and T is the absolute temperature of the gas.

For initial and final states:

$$P_a V = nRT_0$$

$$PV = nRT_1$$

Therefore:

$$P = P_a \frac{T_1}{T_0}$$

Area of the side equals:

$$A = a^2$$

where a is length of the side. Assuming $V = a^3$:

$$A = V^{\frac{2}{3}}$$

Therefore:

$$F = P_a \left(\frac{T_1}{T_0} - 1 \right) V^{\frac{2}{3}} = 9320\ N$$

Answer: $9320\ N$

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