

1. [10 points] How much heat is required to heat six moles of O_2 gas from 300 K to 375 K

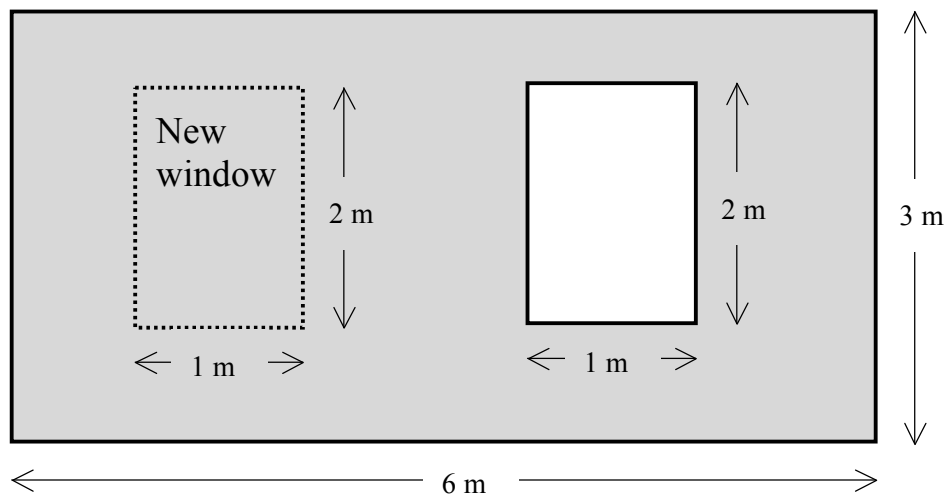
a) [5 points] at a constant volume of 0.2 m^3 ?

$$C_V = 5/2 nR \rightarrow Q = 5/2 n R (75 \text{ K}) = 9353 \text{ J}$$

b) [5 points] starting with $V=0.2 \text{ m}^3$, but heating at constant pressure?

$$C_P = 7/2 n R \rightarrow Q = 7/2 n R (75 \text{ K}) = 13094 \text{ J}$$

2. [10 points] A homeowner wants to add a new window to one of the walls in their house. The wall already has a window and the second window is planned to be identical in size:



The wall is 3 m high and 6 m wide, while the window is 2 m high and 1 m wide, as shown. The walls are 10cm thick and the glass is 1cm thick. On a cold day in Chicago, the outside temperature is -14° C , and the homeowner wants to keep the temperature inside his house at $+20^\circ \text{ C}$. Suppose the thermal conductivity of the solid part of the wall is $0.30 \text{ W/m}\cdot\text{K}$ and the thermal conductivity of the window is $4.50 \text{ W/m}\cdot\text{K}$, what is the ratio, $H_{\text{new}}/H_{\text{old}}$, of the new heat loss to the old heat loss through this wall? Explain your reasoning.

$$H = dT \left(\frac{k_{\text{wall}} A_{\text{wall}}}{d_{\text{wall}}} + \frac{k_{\text{window}} A_{\text{window}}}{d_{\text{window}}} \right) \rightarrow H_{\text{new}}/H_{\text{old}} = 1.943$$