One mole of an ideal monatomic gas initially at 300.0 K absorbs 500.0 J of heat, but since it is in an enclosed container, it cannot expand.

1. What is the mean kinetic energy of an atom before the heat is absorbed?

   A) $4.14 \times 10^{-21}$ J     C) $7.04 \times 10^{-21}$ J
   B) $6.21 \times 10^{-21}$ J     D) Not enough information.

2. By what factor does the pressure change during the process?

   A) 0.88     C) 1.06
   B) 1.00     D) 1.13

Some useful equations:

$$\Delta E_{\text{int}} = Q - W \quad Q = nc\Delta T = mc\Delta T \quad W = \int p \, dV$$

$$\Delta E_{\text{int}} = nC_V\Delta T \quad pV = nRT = NkT$$

$$C_V = (3/2) \, R \quad <K> = (3/2) \, kT$$

$$v_{\text{rms}} = (3RT/M)^{1/2} = (3kT/m)^{1/2}$$

$$R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1} \quad k = 1.38 \times 10^{-23} \text{ J/K}$$
One mole of an ideal monatomic gas initially at 300.0 K absorbs 500.0 J of heat, but since it is in an enclosed container, it cannot expand.

1. How much has the internal energy changed in the process?
   
   A) 0 J  
   B) 250 J  
   C) 500 J  
   D) Not enough information.

2. If the atoms are helium (molar mass 4.0026 g/mol, actual mass 6.65 \times 10^{-27} \text{ kg/atom}), what is the final root-mean square velocity?
   
   A) 43.2 m/s  
   B) 46.0 m/s  
   C) 1.37 km/s  
   D) 1.46 km/s

Some useful equations:

\[
\Delta E_{\text{int}} = Q - W  
Q = nc\Delta T = mc\Delta T  
W = \int p \, dV
\]

\[
\Delta E_{\text{int}} = nC_v\Delta T  
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\[
C_v = (3/2) \, R  
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\]

\[
\nu_{\text{rms}} = (3RT/ \, M)^{1/2} = (3kT/ \, m)^{1/2}
\]

\[
R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}  
k = 1.38 \times 10^{-23} \text{ J/K}
\]
One mole of a monatomic ideal gas initially at 12°C (285 K) expands when it absorbs 420.0 J of heat. The pressure throughout remains at 2 atm (202 kPa).

1. What volume does the gas initially occupy?
   - A) $7.9 \times 10^{-16} \text{ m}^3$
   - B) $4.9 \times 10^{-4} \text{ m}^3$
   - C) $1.2 \times 10^{-2} \text{ m}^3$
   - D) $0.82 \text{ m}^3$

2. If the temperature changes by 20°C (or K), how much work is done by the expanding gas?
   - A) 0 J
   - B) 170 J
   - C) 250 J
   - D) 420 J

Some useful equations:

\[
\Delta E_{\text{int}} = Q - W \quad Q = n c \Delta T = m c \Delta T \quad W = \int p \, dV
\]

\[
\Delta E_{\text{int}} = n C_V \Delta T \quad pV = nRT = NkT
\]

\[
C_V = (3/2) \, R \quad <K> = (3/2) \, kT
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v_{\text{rms}} = (3RT/M)^{1/2} = (3kT/m)^{1/2}
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R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1} \quad k = 1.38 \times 10^{-23} \text{ J/K}
\]