ANSWERS TO MULTIPLE CHOICE QUESTIONS

1. $T_F = \frac{9}{5}T_C + 32 = \frac{9}{5}\;\; -25^\circ \;\; + 32^\circ = -13^\circ \text{ F}$, and the correct response is choice (e).

2. $T_C = \frac{5}{9}\;\; T_F - 32 \;\; = \frac{5}{9}\;\; 162 - 32 \;\; = 72.2^\circ\text{C}$, then , $T_K = T_C + 273 = 72.2 + 273 = 345 \text{ K}$ so choice (c) is the correct answer.

3. $\Delta L = \alpha_{\text{Cu}} L_0 \;\; \Delta T \;\; = \left[17 \times 10^{-6} \;\; {}^\circ\text{C} \;\; {}^{-1}\right] \;\; 93 \text{ m} \;\;\; 10^\circ\text{C} \;\; = 1.6 \times 10^{-2} \text{ m} = 1.6 \text{ cm}$

and choice (c) is the correct order of magnitude.

4. The correct choice is (b). When a solid, containing a cavity, is heated, the cavity expands in the same way as it would if filled with the material making up the rest of the object.

5. From the ideal gas law, with the mass of the gas constant, $P_2V_2/T_2 = P_1V_2/T_1$. Thus,

$$V_2 = \left(\frac{P_1}{P_2}\right)\left(\frac{T_2}{T_1}\right)V_1 = \;\; 4 \;\;\; 1 \;\;\; 0.50 \text{ m}^3 \;\;\; = 2.0 \text{ m}^3$$

and (c) is the correct choice.

6. From the ideal gas law, with the mass of the gas constant, $P_2V_2/T_2 = P_1V_2/T_1$. Thus,

$$P_2 = \left(\frac{V_1}{V_2}\right)\left(\frac{T_2}{T_1}\right)P_1 = \left(\frac{1}{2}\right) \;\; 4 \;\; P_1 \;\; = 2P_1$$

and (d) is the correct choice.

7. Remember that one must use absolute temperatures and pressures in the ideal gas law. Thus, the original temperature is $T_K = T_C + 273.15 = 25 + 273.15 = 298 \text{ K}$, and with the mass of the gas constant, the ideal gas law gives

$$T_2 = \left(\frac{P_2}{P_1}\right)\left(\frac{V_2}{V_1}\right)T_1 = \left(\frac{1.07 \times 10^6 \text{ Pa}}{5.00 \times 10^6 \text{ Pa}}\right) \;\; 3.00 \;\;\; 298 \text{ K} \;\;\; = 191 \text{ K}$$

and (d) is the best choice.

8. The internal energy of n moles of a monatomic ideal gas is $U = \frac{3}{2}nRT$, where R is the universal gas constant and T is the absolute temperature of the gas. For the given neon sample,

$T = T_C + 273.15 = (152 + 273.15)\ \text{K} = 425\ \text{K}$, and

$$n = \frac{26.0\ \text{g}}{20.18\ \text{g/mol}} = 1.29\ \text{mol}$$

Thus, $U = \frac{3}{2}(1.29\ \text{mol})(8.31\ \text{J/mol}\cdot\text{K})(425\ \text{K}) = 6.83 \times 10^3\ \text{J}$, and (b) is the correct answer.

9. The root-mean-square speed of molecules in a gas with molar mass M (expressed in *kilograms per mole*) and absolute temperature T is $v_{rms} = \sqrt{3RT/M}$. The molar mass of methane (CH_4) is

$$M = \left[12.0 + 4(1.00)\right]\frac{\text{g}}{\text{mol}}\left(\frac{1\ \text{kg}}{10^3\ \text{g}}\right) = 1.6 \times 10^{-2}\ \text{kg/mol}$$

and its absolute temperature is $T = T_C + 273.15 = (25.0 + 273.15)\ \text{K} = 298\ \text{K}$. Therefore,

$$v_{rms} = \sqrt{\frac{3(8.31\ \text{J/mol}\cdot\text{K})(298\ \text{K})}{1.60 \times 10^{-2}\ \text{kg/mol}}} = 681\ \text{m/s}$$

making (b) the correct response.

10. The kinetic theory of gases does assume that the molecules in a pure substance obey Newton's laws and undergo elastic collisions, and the average distance between molecules is very large in comparison to molecular sizes. However, it also assumes that the number of molecules in the sample is large so that statistical averages are meaningful. The untrue statement included in the list of choices is (a).

11. In a head-on, elastic collision with a wall, the change in momentum of a gas molecule is $\Delta p = m(v_f - v_0) = m(-v_0 - v_0) = -2mv_0$. If the molecule should stick to the wall instead of rebounding, the change in the molecule's momentum would be $\Delta p = m(0 - v_0) = -mv_0$, which is half that in the elastic collision. Since a gas exerts a pressure on its container by molecules imparting impulses to the walls during collisions, and the impulse imparted equals the magnitude of the change in the molecular momentum, decreasing the change in momentum during the collisions by a factor of 2 would halve the pressure exerted. Thus, the correct response is choice (b).

12. The rms speed of molecules in the gas is $v_{rms} = \sqrt{3RT/M}$. Thus, the ratio of the final speed to the original speed would be

$$\frac{v_{\text{rms}\ f}}{v_{\text{rms}\ 0}} = \frac{\sqrt{3RT_f/M}}{\sqrt{3RT_0/M}} = \sqrt{\frac{T_f}{T_0}} = \sqrt{\frac{600\text{ K}}{200\text{ K}}} = \sqrt{3}$$

Therefore, the correct answer to this question is choice (d).