CONSTANTS:

Avogadro's number: $N_A = 6.02 \times 10^{23}$

Boltzmann's constant: $k = 1.38 \times 10^{-23}$ J/K

Universal gas constant: $R = 0.0821$ L·atm/mol·K

Universal gas constant: $R = 8.314$ J/mol·K

Atomic mass unit: $u = 1.66 \times 10^{-27}$ kg

EQUATIONS:

$$PV = nRT \qquad \Delta L = \alpha L_0 \Delta T \qquad \Delta E = mc\Delta T$$

$$PV = NkT \qquad \Delta V = \beta V_0 \Delta T \qquad \Delta E = mL_f$$

$$\frac{3}{2}kT = \frac{1}{2}m\overline{v^2} \qquad T_C = T_K + 273^\circ \qquad \Delta E = mL_v$$

1. According to the kinetic theory of gases, the temperature of an ideal gas is directly proportional to the
   (a) volume of the gas.
   (b) mean distance between collisions between particles.
   (c) angular momentum of the particles.
   (d) average kinetic energy of the particles.
   (e) average momentum of the particles.

2. The hydrogen molecules in a container have the same root-mean-square speed as the oxygen molecules in another container. Which of the following conclusions can be made with certainty?
   (a) the oxygen gas will have the higher temperature.
   (b) the hydrogen gas will have the higher temperature.
   (c) both gases have the same temperature.
   (d) the hydrogen gas has the higher pressure.
   (e) both gases have the same pressure.

3. Which of the following is a notable failure of the ideal gas model?
   (a) the condensation of gases
   (b) the expansion of gases as they warm
   (c) the relationship between temperature and molecular kinetic energy
   (d) the proportionality of pressure and temperature

4. If you keep the volume of a sample of gas constant while its temperature is allowed to change,
   (a) the pressure of the gas will remain constant while the temperature increases.
   (b) the root-mean-square speed of its particles will remain constant.
   (c) the pressure will decrease as the temperature increases.
   (d) the pressure will be directly proportional to the Kelvin temperature.

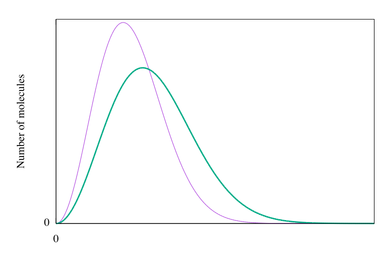
5. If the temperature of an ideal gas is kept constant, while its pressure and volume are permitted to change
   (a) its volume will vary directly as the pressure.
   (b) the product of its pressure and volume will remain constant.
   (c) its pressure will remain constant while its volume varies.
   (d) its volume will remain constant while its pressure varies.

6. A sample of oxygen gas and a sample of hydrogen gas are stored in the same store room at the same temperature. The mass of a molecule of oxygen is 32 u. The mass of a hydrogen molecule is 2 u. The ratio of the average kinetic energy of the oxygen molecules to that of the hydrogen molecules is
   (a) 1 to 1.
   (b) 4 to 1.
   (c) 16 to 1.
   (d) 1 to 16.

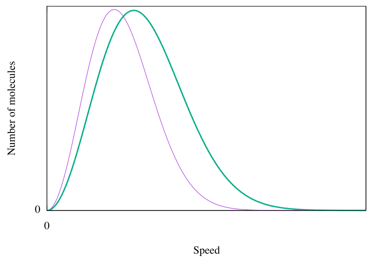
7. A sample of oxygen gas and a sample of hydrogen gas are stored in the same store room at the same temperature. The mass of a molecule of oxygen is 32 u. The mass of a hydrogen molecule is 2 u. The ratio of v_{rms} of the oxygen molecules to that of the hydrogen molecules is
   (a) 1 to 1.
   (b) 4 to 1.
   (c) 1 to 4.
   (d) 1 to 16.

8. The temperature of a gas is 10°C. To double the average kinetic energy of its molecules, the temperature of the gas must be raised to
   (a) 20°C.
   (b) 40°C.
   (c) 293°C.
   (d) 566°C.

9. Which of the green plots best represents the distribution of molecular speeds in a gas at 500 K if the purple curve represents this distribution for the same gas at 300 K?
   (a)

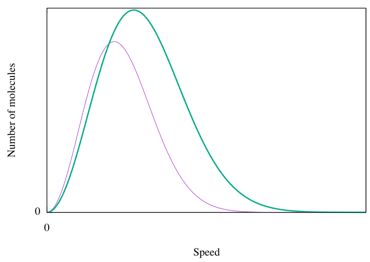


(b)



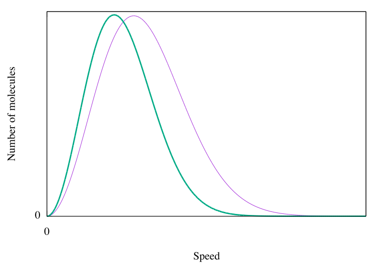
Number of molecules
0
0
Speed

(c)



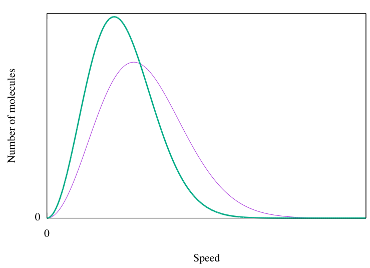
Number of molecules
0
0
Speed

(d)



Number of molecules
0
0
Speed

(e)



Number of molecules
0
0
Speed

1. Find v_{rms} for Ar gas at 20°C.

2. Find the ratio of v_{rms} for O_2 and H_2 at the same temperature.

3. (a) What is the average kinetic energy for nitrogen molecules, N_2, at 20°C? [Note: nitrogen *atoms* are denoted as ${}^{14}_{7}\mathrm{O}$.]

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   (b) What is the root-mean-square speed for these nitrogen molecules?

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4. A 0.02 m^3 sample of a gas at a pressure of 1000. kPa is allowed to expand at constant temperature until its pressure decreases to 500 kPa. What will the new volume of the gas be?

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