
Q1. True or False — statements about the KMT

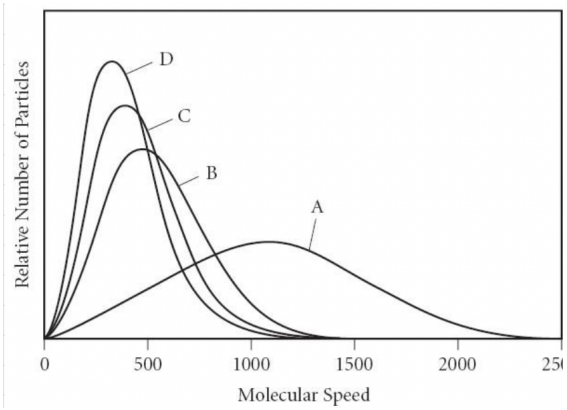
(a) The collisions of particles with one another are completely elastic.

(b) Kinetic energy of the gas particles is proportional to the temperature in Celsius.

(c) The assumptions of kinetic molecular theory break down at high pressures.

(d) The volume of the particles is negligible compared to the volume of the gas.

Q2. Using the graph below, determine the gas that has the highest density at STP.



Q3. An apparatus consists of three temperature-jacked 1 L bulbs connected by stopcocks. Bulb A contains a mixture of $H_2O_{(g)}$, $CO_{2(g)}$, and $N_{2(g)}$ at 25°C and a total pressure of 564 mm Hg. Bulb B is empty and held at a temperature of −70°C. Bulb C is also empty and held at a temperature of −190°C. The stopcocks are closed, and the volume of the lines connecting the bulbs is zero. CO_2 sublimes at −78°C and N_2 boils at −196°.

(a) The stopcock between A and B is opened, and the system is allowed to come to equilibrium. The pressure in A and B is now 219 mm Hg. What do bulbs A and B contain?

(i) A: $CO_{2(g)}$, $N_{2(g)}$, $H_2O_{(g)}$
B: $CO_{2(g)}$, $N_{2(g)}$, $H_2O_{(s)}$

(ii) A: $CO_{2(g)}$,$N_{2(g)}$
B: $CO_{2(g)}$, $N_{2(g)}$, $H_2O_{(s)}$

(iii) A: $CO_{2(g)}$
B: $N_{2(g)}$, $H_2O_{(s)}$

(iv) A: $CO_{2(g)}$, $H_2O_{(g)}$
B: $N_{2(g)}$, $H_2O_{(s)}$

(b) How many moles of H_2O are in the system?

(c) Both stopcocks are opened, and the system is again allowed to come to equilibrium. The pressure throughout the system is 33.5 mm Hg. What do bulbs A, B and C contain?

(i) A: $N_{2(g)}$

(ii) B: $N_{2(g)}$, $H_2O_{(s)}$

(iii) C: $N_{2(g)}$, $CO_{2(g)}$

(d) Find out how many moles of N_2 and CO_2 are in the system.

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Q4. (a) Write the balanced chemical equation for the combustion of isooctane, C_8H_{18} if the only products are CO_2 and H_2O

(b) Assume that gasoline is 100% isooctane. Canada consumes 8.525×10^6 barrels of gasoline a day. If the density of isooctane is 0.792 g/mL, how many kilograms of carbon dioxide is produced per day in Canada due to the gasoline consumption. Note: 1 bbl of oil is about 158.99 L.

(c) If air is 21.0% oxygen (O_2) by volume, how many liters of air at STP are required to combust 1 mol of isooctane?

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Q5. Nitrogen dioxide NO_2 is typically found in equilibrium with gaseous N_2O_4. A mixture of the two gases has a density of 2.5 g/L at 23°C and 0.975 atm. Determine the partial pressure of each gas in this mixture. (Hint: you can calculate the average molar mass of the mixture, which can then be related to the mole fractions of the gases.)

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Q6. A gas sample is known to be a mixture of ethane and butane. A bulb having a 195 cm^3 capacity is filled with the gas to a pressure of 103×10^3 Pa at 17.5°C. If the weight of the gas in the bulb is 0.2988 g, what is the mole percent of butane in the mixture?

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Q7. The total pressure of a mixture of oxygen and hydrogen is 2.00 atm. The mixture is ignited, and the water is removed. The remaining gas is pure hydrogen and exerts a pressure of 0.155 atm when measured at the same values of T and V as the original mixture. What was the composition of the original mixture in mole percent?