

## Ch 5 Practice Problems

1. A glass column is filled with mercury and inverted in a pool of mercury. The mercury column stabilizes at a height of 735 mm above the pool of mercury. What is the pressure of the atmosphere?
  - A) 0.697 atm
  - B) 0.735 atm
  - C) 0.967 atm
  - D) 1.03 atm
  - E) 194 atm
2. The volume of a balloon is 3.78 L at 22.8°C. The balloon is heated to 42.4°C. Calculate the new volume of the balloon.
  - A) 7.03 L
  - B) 4.03 L
  - C) 2.03 L
  - D) 3.55 L
  - E) 3.78 L
3. A cylinder of oxygen gas contains 26.4 g of O<sub>2</sub>. Another cylinder, twice the volume of the cylinder containing oxygen (and at the same conditions of pressure and temperature), contains CO<sub>2</sub> gas. Assuming ideal behavior, what is the mass of the carbon dioxide?
  - A) 72.6 g
  - B) 52.8 g
  - C) 13.2 g
  - D) 36.3 g
  - E) none of these
4. A balloon contains 10.0 g of neon gas. With the temperature kept constant, 10.0 g of argon gas is added. What happens?
  - A) The balloon doubles in volume.
  - B) The volume of the balloon expands by more than 2 times.
  - C) The volume of the balloon expands by less than 2 times.
  - D) The balloon stays the same size, but the pressure increases.
  - E) none of these
5. The volume of a helium balloon is 1.85 L at 24.0°C and 1.00 atm at sea level. The balloon is released and floats upward. At a certain altitude, the balloon has a volume of 2.14 L and the temperature is 15.2°C. What is the atmospheric pressure at this altitude?
  - A) 0.538 atm
  - B) 0.839 atm
  - C) 0.891 atm
  - D) 1.36 atm
  - E) none of these
6. Body temperature is about 308 K. On a cold day, what volume of air at 273 K must a person with a lung capacity of 2.00 L breathe in to fill the lungs?
  - A) 2.26 L
  - B) 1.77 L
  - C) 1.13 L
  - D) 3.54 L
  - E) none of these

7. A 8.80-g piece of solid  $\text{CO}_2$  (dry ice) is allowed to sublime in a balloon. The final volume of the balloon is 1.30 L at 310. K. What is the pressure of the gas?
- A) 3.91 atm
  - B) 0.256 atm
  - C)  $6.88 \times 10^{-5}$  atm
  - D)  $1.72 \times 10^2$  atm
  - E) 47.7 atm
8. Given a cylinder of fixed volume filled with 1 mol of argon gas, which of the following is correct? (Assume all gases obey the ideal gas law.)
- A) If the temperature of the cylinder is changed from  $25^\circ\text{C}$  to  $50^\circ\text{C}$ , the pressure inside the cylinder will double.
  - B) If a second mole of argon is added to the cylinder, the ratio  $T/P$  will remain constant.
  - C) A cylinder of identical volume filled with the same *pressure* of helium must contain more atoms of gas because He has a smaller atomic radius than argon.
  - D) Two of these are correct.
  - E) None of these is correct.
9. Which of the following relationships is *not* true?
- A)  $PV = \text{constant}$  when temperature and moles of gas are held constant.
  - B)  $V/T = \text{constant}$  when pressure and moles of gas are held constant.
  - C)  $nT = \text{constant}$  when pressure and volume are held constant.
  - D)  $P/n = \text{constant}$  when volume and temperature are held constant.
  - E) All of these are true.
10. Consider a sample of neon gas in a container fitted with a movable piston (assume the piston is massless and frictionless). The temperature of the gas is increased from  $20.0^\circ\text{C}$  to  $40.0^\circ\text{C}$ . The density of neon
- A) increases less than 10%.
  - B) decreases less than 10%.
  - C) increases more than 10%.
  - D) decreases more than 10%.
  - E) does not change.
11. The valve between a 3.25-L tank containing  $\text{O}_2(g)$  at 8.64 atm and a 2.48-L tank containing  $\text{Ne}(g)$  at 5.40 atm is opened. Calculate the ratio of partial pressures ( $\text{O}_2:\text{Ne}$ ) in the container.
- A) 1.31
  - B) 1.60
  - C) 2.10
  - D) 0.477
  - E) 0.615
12. Air is 79%  $\text{N}_2$  and 21%  $\text{O}_2$  by volume. Calculate the density of air at 1.0 atm,  $25^\circ\text{C}$ .
- A) 0.590 g/L
  - B) 1.18 g/L
  - C) 2.46 g/L
  - D) 14.1 g/L
  - E) none of these
13. At STP the mass of 860.0 mL of a certain gas is 1.075 g. What is a possible identity of this gas?
- A)  $\text{H}_2$
  - B)  $\text{N}_2$
  - C)  $\text{O}_2$
  - D)  $\text{CO}_2$
  - E) Ne

Use the following to answer questions 14 - 15:

Four identical 1.0-L flasks contain the gases He, Cl<sub>2</sub>, CH<sub>4</sub>, and NH<sub>3</sub>, each at 0°C and 1 atm pressure.

14. Which gas sample has the greatest number of molecules?
- A) He
  - B) Cl<sub>2</sub>
  - C) CH<sub>4</sub>
  - D) NH<sub>3</sub>
  - E) All the gases have the same number of molecules.

15. Which gas has the highest density?
- A) He
  - B) Cl<sub>2</sub>
  - C) CH<sub>4</sub>
  - D) NH<sub>3</sub>
  - E) All the gases have the same density

16. Potassium chlorate decomposes upon heating as follows:



A 2.36-g sample of KClO<sub>3</sub> decomposes, and the oxygen at 23.8°C and 0.930 atm is collected. What volume of oxygen gas will be collected, assuming 100% yield?

- A) 0.504 mL
- B) 1.93 mL
- C) 0.756 mL
- D) 0.0607 mL
- E) 0.0404 mL

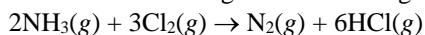
17. What volume of carbon dioxide measured at STP will be formed by the reaction of 1.30 mol of oxygen with  $9.00 \times 10^{-1}$  mol of ethyl alcohol (CH<sub>3</sub>CH<sub>2</sub>OH)?

- A) 8.70 L
- B) 19.4 L
- C) 28.0 L
- D) 40.3 L
- E) 91.9 L

18. Into a 3.50-liter container at 23°C are placed 1.18 mol of O<sub>2</sub> gas and 4.70 mol of solid C (graphite). If the carbon and oxygen react completely to form CO(g), what will be the final pressure in the container at 23°C?

- A) 16.4 atm
- B) 32.6 atm
- C) 0.636 atm
- D) 40.8 atm
- E) 8.19 atm

19. When a mixture is prepared from 15.0 L of ammonia and 15.0 L of chlorine measured at the same conditions, these compounds react according to the following equation:



When the reaction is completed, what are the volumes of the gases (NH<sub>3</sub>, Cl<sub>2</sub>, N<sub>2</sub>, and HCl, respectively)? Assume the final volumes are measured under identical conditions.

- A) 0.00 L, 5.00 L, 7.50 L, and 45.0 L
- B) 5.00 L, 0.00 L, 5.00 L, and 30.0 L
- C) 0.00 L, 0.00 L, 7.50 L, and 45.0 L
- D) 0.00 L, 0.00 L, 5.00 L, and 30.0 L
- E) 0.00 L, 10.0 L, 15.0 L, and 90.0 L

20. A mixture of KCl and KClO<sub>3</sub> weighing 1.80 g was heated; the dry O<sub>2</sub> generated occupied 1.40 × 10<sup>2</sup> mL at STP. What percent of the original mixture was KClO<sub>3</sub>? KClO<sub>3</sub> decomposes as follows:



- A) 28.4%  
B) 37.2%  
C) 42.6%  
D) 63.8%  
E) 72.6%
21. Magnesium metal reacts with hydrochloric acid to form aqueous magnesium chloride and hydrogen gas. An excess of magnesium is reacted with 20.0 mL of 3.00 M hydrochloric acid, and all of the hydrogen is collected in a balloon at 25°C and 1.00 atm. What is the expected volume of the balloon?
- A) 0.672 L  
B) 0.734 L  
C) 1.34 L  
D) 1.47 L  
E) 22.4 L
22. When 0.72 g of a liquid is vaporized at 110°C and 0.967 atm, the gas occupies a volume of 0.559 L. The empirical formula of the gas is CH<sub>2</sub>. What is the molecular formula of the gas?
- A) CH<sub>2</sub>  
B) C<sub>2</sub>H<sub>4</sub>  
C) C<sub>3</sub>H<sub>6</sub>  
D) C<sub>4</sub>H<sub>8</sub>  
E) none of these
23. A 3.50-g sample of lead(II) nitrate, Pb(NO<sub>3</sub>)<sub>2</sub>, molar mass = 331 g/mol, is heated in an evacuated cylinder with a volume of 1.75 L. The salt decomposes when heated, according to the equation
- $$2\text{Pb}(\text{NO}_3)_2(s) \rightarrow 2\text{PbO}(s) + 4\text{NO}_2(g) + \text{O}_2(g)$$
- Assuming complete decomposition, what is the pressure in the cylinder after decomposition and cooling to a temperature of 270. K? Assume the PbO(s) takes up negligible volume.
- A) 0.335 atm  
B) 0.134 atm  
C) 0.669 atm  
D) 0.469 atm  
E) 0.673 atm
24. The oxidation of nitric oxide to nitrogen dioxide is
- $$2\text{NO}(g) + \text{O}_2(g) \rightarrow 2\text{NO}_2(g)$$
- If 100.0 mL of NO (at STP) reacts with 400.0 mL of O<sub>2</sub> at STP, calculate the partial pressure of NO<sub>2</sub> in the final reaction mixture.
- A) 0.222 atm  
B) 0.333 atm  
C) 0.286 atm  
D) 0.250 atm  
E) 1.00 atm
25. A 275.0-mL sample of O<sub>2</sub> is collected over water at 60.0°C. The total pressure is 755 torr. What is the volume of the O<sub>2</sub> at STP? (The vapor pressure of water at 60°C is 149 torr).
- A) 180.0 mL  
B) 224.0 mL  
C) 244.0 mL  
D) 333.0 mL  
E) none of these

Use the following to answer questions 26-28:

Four identical 1.0-L flasks contain the gases He, Cl<sub>2</sub>, CH<sub>4</sub>, and NH<sub>3</sub>, each at 0°C and 1 atm pressure.

26. For which gas do the molecules have the highest average velocity?
- A) He
  - B) Cl<sub>2</sub>
  - C) CH<sub>4</sub>
  - D) NH<sub>3</sub>
  - E) The molecules of all the gases have the same average velocity.
27. For which gas are the collisions elastic?
- A) He
  - B) Cl<sub>2</sub>
  - C) CH<sub>4</sub>
  - D) NH<sub>3</sub>
  - E) The collisions are elastic for all the gases.
28. For which gas do the molecules have the smallest average kinetic energy?
- A) He
  - B) Cl<sub>2</sub>
  - C) CH<sub>4</sub>
  - D) NH<sub>3</sub>
  - E) The molecules of all the gases have the same average kinetic energy.
29. Under which of the following conditions does a gas behave most ideally?
- A) STP
  - B)  $P = 1.0 \text{ atm}, T = 100.0^\circ\text{C}$
  - C)  $P = 0.50 \text{ atm}, T = 100.0^\circ\text{C}$
  - D)  $P = 0.50 \text{ atm}, T = 0.0^\circ\text{C}$
  - E)  $P = 2.0 \text{ atm}, T = -100.0^\circ\text{C}$
30. The kinetic-molecular theory of gases does *not* assume that
- A) gases are made up of tiny particles in constant chaotic motion.
  - B) gas particles are very small compared to the average distance between the particles.
  - C) gas particles collide with the walls of their container in elastic collisions.
  - D) the average velocity of gas particles is directly proportional to the absolute temperature.
  - E) All of these are correct.
31. Which statement about kinetic energy (K.E.) is true?
- A) All objects moving with the same velocity have the same K.E.
  - B) As the velocity of a body increases, its K.E. decreases.
  - C) The K.E. of a body will double if its velocity doubles.
  - D) The K.E. of a body is independent of its mass.
  - E) None of these statements is true.
32. Which of the following statements is true concerning ideal gases?
- A) The temperature of the gas sample is directly related to the average velocity of the gas particles.
  - B) At STP, 1.0 L of Ar(g) contains about twice the number of atoms as 1.0 L of Ne(g) because the molar mass of Ar is about twice that of Ne.
  - C) A gas exerts pressure as a result of the collisions of the gas molecules with the walls of the container.
  - D) The gas particles in a sample exert attraction on one another.
  - E) All of these statements are false.

33. Calculate the temperature at which the average velocity of Ar(g) equals the average velocity of Ne(g) at 25°C.
- 317°C
  - 151°C
  - 49.5°C
  - 25°C
  - none of these
34. Order the following according to increasing rate of effusion:  
F<sub>2</sub>, Cl<sub>2</sub>, NO, NO<sub>2</sub>, CH<sub>4</sub>
- Cl<sub>2</sub> < NO<sub>2</sub> < F<sub>2</sub> < NO < CH<sub>4</sub>
  - Cl<sub>2</sub> < F<sub>2</sub> < NO<sub>2</sub> < CH<sub>4</sub> < NO
  - CH<sub>4</sub> < NO<sub>2</sub> < NO < F<sub>2</sub> < Cl<sub>2</sub>
  - CH<sub>4</sub> < NO < F<sub>2</sub> < NO<sub>2</sub> < Cl<sub>2</sub>
  - F<sub>2</sub> < NO < Cl<sub>2</sub> < NO<sub>2</sub> < CH<sub>4</sub>
35. The diffusion rate of H<sub>2</sub> gas is 6.45 times as great as that of a certain noble gas (both gases are at the same temperature).  
What is the noble gas?
- Ne
  - He
  - Ar
  - Kr
  - Xe

Answers:

- |       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. C  | 2. B  | 3. A  | 4. C  | 5. B  | 6. B  | 7. A  | 8. E  | 9. E  | 10. B | 11. C | 12. B |
| 13. B | 14. E | 15. B | 16. C | 17. B | 18. A | 19. B | 20. A | 21. B | 22. C | 23. A | 24. A |
| 25. A | 26. A | 27. E | 28. E | 29. C | 30. D | 31. E | 32. C | 33. A | 34. A | 35. D |       |