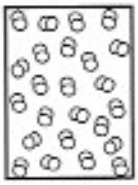
Standards Practice
Gases and Their Properties

Read each question, and choose the best answer. Then, on your answer sheet, mark the answer choice that you think is best.

4. a. **Students know the random motion of molecules and their collisions with a surface create the observable pressure on that surface.**

1. What causes the pressure on the inside walls of this container?



A. charge of the gas molecules in the container
B. temperature of the gas molecules in the container
C. collision of the gas molecules on the container
D. weight of the gas molecules on the container

2. How do the properties of a gas differ from those of a liquid?
A. Gas molecules have a greater random motion than liquid molecules.
B. Gas molecules have less energy than liquid molecules.
C. Gas molecules have more mass than liquid molecules.
D. Gas molecules put more pressure on the walls of a container than liquid molecules.

3. What does the random motion of molecules and their collisions with a surface produce?
A. mass
B. phase change
C. pressure
D. weight

4. What causes a balloon to hold its shape?
A. random motion of gas molecules
B. collisions of gas molecules against a balloon's walls
C. weight of the gas molecules inside of the balloon
D. energy held by each gas molecule within the balloon

4. b. **Students know the random motion of molecules explains the diffusion of gases.**

5. Which causes the addition of a colored gas to change the color of all of the gas in a container?
A. diffusion
B. mass
C. pressure
D. temperature

6. Diffusion is the term used to describe the movement of one material through another. The diffusion of gases can be explained by
A. relative molar masses.
B. differences in volume.
C. evaporation.
D. random motion.

7. Which is an example of diffusion?
A. disappearance of a puddle in sunlight
B. smell of a rotten egg across a room
C. filled balloon that shrinks over time
D. balloon that shrinks when it becomes cold

8. Which is not an example of diffusion?
A. boiling of water
B. smell of food cooking
C. colored gas moving throughout a room
D. poisonous gas leaking from an open container

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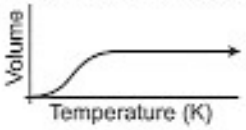
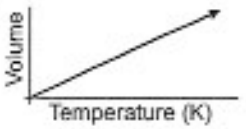
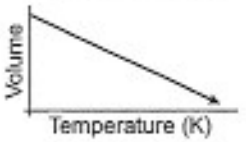
4. c. **Students know how to apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.**

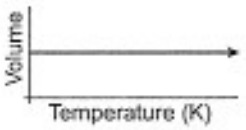
9. Charles's law explains the relationship between the temperature and volume of a gas. Which graph best represents this relationship?

A.


$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

B.


C.


D.


10. How are pressure and volume of gas related?
- **A.** As pressure decreases, volume increases.
- **B.** As pressure increases, volume increases.
- **C.** As pressure decreases, volume decreases.
- **D.** Pressure and the volume are not related.

11. Which of these decreases as a given volume of gas increases?
- **A.** number of gas particles
- **B.** temperature
- **C.** pressure
- **D.** kinetic energy

12. There are two containers of two different gases at the same temperature and pressure. Each statement below can be assumed except
- **A.** when the temperature is increased, the volume of both containers will increase.
- **B.** when the pressure is increased, the volume of both containers will decrease.
- **C.** both containers contain the same number of gas particles.
- **D.** when the pressure is decreased, the temperature of both containers will increase.

4. d. **Students know the values and meanings of standard temperature and pressure (STP).**

13. Standard temperature and pressure (STP) helps scientists to
- **A.** compare gases.
- **B.** compare liquids.
- **C.** calculate ionic charges.
- **D.** calculate entropy.

14. Standard temperature and pressure (STP) occurs at
- **A.** 32°F. K
- **B.** 100°F. K
- **C.** 273°F. K
- **D.** 373°F. K

15. Standard temperature and pressure (STP) occurs at
- **A.** 273°C.
- **B.** 273 K.
- **C.** 0°F.
- **D.** 100°F.

16. Standard temperature and pressure (STP) occurs at
- **A.** 76 atm.
- **B.** 76 mm Hg.
- **C.** 760 atm.
- **D.** 760 mm Hg.

17. Standard temperature and pressure (STP) occurs at
- **A.** 14.7 atm. 1 atm
- **B.** 14.7 mm Hg. 760 mmHg
- **C.** 14.7 psi.
- **D.** 14.7 torr. 760 Torr

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4. e. **Students know how to convert between the Celsius and Kelvin temperature scales.**

18. How do the units in the Kelvin scale and the Celsius scale compare?
- **A.** The kelvin units are smaller than the Celsius units.
- **B.** The kelvin units are larger than the Celsius units.
- **C.** The units are equal for both scales.
- **D.** The scales are 100 units apart.

19. What is the freezing point of water in kelvins?
- **A.** 32 K
- **B.** 100 K
- **C.** 212 K
- **D.** 273 K

20. What is 20°C in kelvins?
- **A.** 253 K
- **B.** 273 K
- **C.** 293 K
- **D.** 373 K

21. What is 100°C in kelvins?
- **A.** 32 K
- **B.** 100 K
- **C.** 212 K
- **D.** 373 K

22. What is 0 K in Celsius?
- **A.** –373°C
- **B.** –273°C
- **C.** 100°C
- **D.** 212°C

23. What is 100 K in Celsius?
- **A.** –273°C
- **B.** –173°C
- **C.** 0°C
- **D.** 100°C

4. f. **Students know there is no temperature lower than 0 Kelvin.**

24. The coldest temperature possible is called
- **A.** absolute cold.
- **B.** absolute freeze.
- **C.** absolute nil.
- **D.** absolute zero.

25. The Kelvin scale
- **A.** has larger units than the Celsius scale.
- **B.** has units about half the size of the Fahrenheit scale.
- **C.** does not have negative numbers.
- **D.** is a theoretical scale only.

26. Which temperature is impossible?
- **A.** 20°C
- **B.** –20°F
- **C.** 20 K
- **D.** –20 K

27. Which temperature is impossible?
- **A.** –273°C
- **B.** –273°F
- **C.** –273 K
- **D.** 0 K

28. At absolute zero,
- **A.** the Fahrenheit scale ceases to exist.
- **B.** no further heat could be removed from a body.
- **C.** H_2O is in the form of a liquid.
- **D.** every substance must be in a gaseous phase.

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4. g. **Students know the kinetic theory of gases relates the absolute temperature of a gas to the average kinetic energy of its molecules or atoms.**

29. The kinetic molecular theory of gases explains the behavior of gases at the molecular level. All of these statements are part of this theory except
- **A.** gas molecules experience completely elastic collisions.
- **B.** all gas molecules have the same average kinetic energy at the same temperature.
- **C.** gas particles are in constant, random motion.
- **D.** gas molecules are incompressible.

30. Gas particles
- **A.** move faster as temperature increases.
- **B.** move faster as temperature decreases.
- **C.** move slower as temperature increases.
- **D.** do not show a correlation between movement and temperature.

31. At higher temperatures, gas molecules
- **A.** contract.
- **B.** slow down in movement.
- **C.** hit the walls of the container harder.
- **D.** hit the walls of the container softer.

32. At higher temperatures, gas molecules
- **A.** slow down.
- **B.** exert more pressure.
- **C.** have less energy.
- **D.** have more organization.

33. At absolute zero, gas molecules
- **A.** move slower than liquid molecules.
- **B.** are converted to liquid molecules.
- **C.** show very little movement.
- **D.** move in a straight line.

4. h. **Students know how to solve problems by using the ideal gas law in the form $PV = nRT$.**

Use the ideal gas law below to answer questions 34–38.

$$PV = nRT$$

34. What happens to the volume of a gas when the pressure is increased by a factor of 4 (assuming all other factors remain the same)?
- **A.** It is reduced by a factor of 4.
- **B.** It is reduced by a factor of 2.
- **C.** It is increased by a factor of 2.
- **D.** It is increased by a factor of 4.

35. What happens to the volume of a gas when the temperature is increased by a factor of 4, if all other factors remain the same?
- **A.** It is reduced by a factor of 4.
- **B.** It is reduced by a factor of 2.
- **C.** It is increased by a factor of 2.
- **D.** It is increased by a factor of 4.

36. What is the pressure produced by 1.0 mol O_2 in a 22.4-L container at 273 K? Use R = 0.0821 (L•atm)/(mol•K).
- **A.** 0.5 atm
- **B.** 1.0 atm
- **C.** 2.0 atm
- **D.** 4.0 atm

$P = \frac{nRT}{V} = \frac{(1\,mol)(0.0821\,L\cdot atm/mol\cdot K)(273\,K)}{22.4\,L}$

37. What is the pressure produced by 1.0 mol O_2 in an 11.2-L container at 273 K? Use R = 0.0821 (L•atm)/(mol•K).
- **A.** 0.25 atm
- **B.** 0.5 atm
- **C.** 2.0 atm
- **D.** 4.0 atm

$P = \frac{nRT}{V} = \frac{(1\,mol)(0.0821\,L\cdot atm/mol\cdot K)(273\,K)}{11.2\,L}$

38. What is the pressure produced by 4.0 mol O_2 in a 22.4-L container at 273 K? Use R = 0.0821 (L• atm)/(mol•K).
- **A.** 0.25 atm
- **B.** 0.5 atm
- **C.** 2.0 atm
- **D.** 4.0 atm

$P = nRT = \frac{(4\,mol)(0.0821\,L\cdot atm/mol\cdot K)(273\,K)}{22.4\,L}$

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4. i. **Students know how to apply Dalton's law of partial pressures to describe the composition of gases and Graham's law to predict diffusion of gases.**

Use the table below to answer questions 39 and 40.

Composition of Air by Gas		
Gas	**Partial pressure (mmHg)**	**Percentage in air (%)**
Nitrogen (N_2)	594.0	78.1
Oxygen (O_2)	160.0	21.1
Carbon dioxide (CO_2)	0.3	0.04
Water vapor (H_2O)	5.7	0.75

39. In air, the partial pressures add up to
- **A.** 160.0 mm Hg.
- **B.** 594.0 mm Hg.
- **C.** 600.0 mm Hg.
- **D.** 760.0 mm Hg.

40. How does air illustrate Dalton's law of partial pressures?
- **A.** Gases are necessary to make up Earth's atmosphere.
- **B.** The amount of oxygen is 21.1 percent.
- **C.** The pressures of gases in air add up to 1 atm.
- **D.** Percentages of the gases in air add up to 100 percent.

41. According to Dalton's law of partial pressures, the addition of a gas from one tank to gas in another tank will cause the
- **A.** pressures of the tanks to be added together.
- **B.** pressure of the first tank to be subtracted from the pressure of the second tank.
- **C.** pressures of the tanks to be multiplied together.
- **D.** pressure of the first tank to be divided by the pressure of the second tank.

42. According to Graham's law, the distance traveled by a gas is inversely related to the square root of its molecular mass. If the molecular mass of Gas 1 was 4 times that of Gas 2, Gas 1 would travel

$$\frac{\text{Distance traveled by Gas 1}}{\text{Distance traveled by Gas 2}} = \frac{\sqrt{(\text{Molecular mass of Gas 1}}}{\sqrt{(\text{Molecular mass of Gas 2}}$$

- **A.** one-fourth the rate of Gas 2.
- **B.** one-half the rate of Gas 2.
- **C.** two times the rate of Gas 2.
- **D.** four times the rate of Gas 2.

43. A tank containing 0.5 atm of oxygen gas is combined with a tank containing 0.5 atm of oxygen gas and a tank containing 2.5 atm of oxygen gas. What is the final pressure in the tank?
- **A.** 0.5 atm
- **B.** 1.5 atm
- **C.** 3.5 atm
- **D.** 4.5 atm