

- A pressure of 152 kPa is equal to how many atmospheres of pressure?
A) 1.00 B) 2.00 C) 0.670 D) 1.50
- The kinetic molecular theory assumes that the particles of an ideal gas
A) are in random, constant, straight-line motion
B) are arranged in a regular geometric pattern
C) have strong attractive forces between them
D) have collisions that result in the system losing energy
- A sample of a gas is contained in a closed rigid cylinder. According to kinetic molecular theory, what occurs when the gas inside the cylinder is heated?
A) The number of gas molecules increases.
B) The number of collisions between gas molecules per unit time decreases.
C) The average velocity of the gas molecules increases.
D) The volume of the gas decreases.
- Which statement describes the particles of an ideal gas based on the kinetic molecular theory?
A) The gas particles are relatively far apart and have negligible volume.
B) The gas particles are in constant, nonlinear motion.
C) The gas particles have attractive forces between them.
D) The gas particles have collisions without transferring energy.
- According to the kinetic molecular theory, which statement describes an ideal gas?
A) The gas particles are diatomic.
B) Energy is created when the gas particles collide.
C) There are no attractive forces between the gas particles.
D) The distance between the gas particles is small, compared to their size.
- According to kinetic molecular theory, collisions between gas particles in a sample of an ideal gas
A) increase the energy content of the gas sample
B) produce strong attractive forces between the gas particles
C) result in a net loss of energy by the gas sample
D) transfer energy between the gas particles
- What is the total pressure exerted by a mixture containing two gases if the partial pressure of one gas is 70 kPa and the partial pressure of the other gas is 30 kPa?
A) 30 kPa B) 40 kPa
C) 70 kPa D) 100 kPa
- A mixture of oxygen, nitrogen, and hydrogen gases exerts a total pressure of 74 kPa at 0°C. The partial pressure of the oxygen is 20 kPa and the partial pressure of the nitrogen is 40 kPa. What is the partial pressure of the hydrogen gas in this mixture?
A) 14 kPa B) 20 kPa
C) 40 kPa D) 74 kPa
- Gas samples *A*, *B*, and *C* are contained in a system at STP. The partial pressure of sample *A* is 38.0 kPa and the partial pressure of sample *B* is 19.0 kPa. What is the partial pressure of sample *C*?
A) 19.0 kPa B) 38.0 kPa
C) 44.3 kPa D) 63.3 kPa
- Which sample contains a total of 9.0×10^{23} atoms?
A) 0.50 mole of HCl B) 0.75 mole of H₂O
C) 1.5 moles of Cu D) 1.5 moles of H₂
- What is the total number of molecules in 1.0 mole of Cl₂(g)?
A) 35 B) 70
C) 6.0×10^{23} D) 12×10^{24}
- At STP, 44.8 liters of CO₂ contains the same number of molecules as
A) 1.00 mole of He B) 2.00 moles of Ne
C) 0.500 mole of H₂ D) 4.00 moles of N₂
- Which sample of O₂ contains a total of 3.01×10^{23} molecules at STP?
A) 1.00 mole B) 2.00 moles
C) 16.0 grams D) 32.0 grams
- Which quantity represents the total amount of N₂(g) in a 22.4 liter sample at STP?
A) 1.00 mole
B) 14.0 grams
C) 3.01×10^{23} molecules
D) 6.02×10^{23} atoms

15. What is the total number of molecules of SO_2 in a 0.10-mole sample of SO_2 ?
- A) 6.0×10^{21} B) 6.0×10^{22}
C) 6.0×10^{23} D) 6.0×10^{24}
16. At STP, 1 mole of $\text{He}(\text{g})$ contains the same number of atoms as
- A) 22.4 L of $\text{H}_2(\text{g})$ B) 44.8 L of $\text{H}_2(\text{g})$
C) 22.4 L of $\text{Ar}(\text{g})$ D) 44.8 L of $\text{Ar}(\text{g})$
17. What would be the volume of 0.500 mole of an ideal gas at STP?
- A) 0.500 L B) 11.2 L
C) 22.4 L D) 44.8 L
18. Which quantity is equivalent to 39 grams of LiF ?
- A) 1.0 mole B) 2.0 moles
C) 0.50 mole D) 1.5 moles
19. The total quantity of molecules contained in 5.6 liters of an ideal gas at STP is
- A) 1.0 mole B) 0.75 mole
C) 0.50 mole D) 0.25 mole
20. How many molecules are in 0.25 mole of CO ?
- A) 1.5×10^{23} B) 3.0×10^{23}
C) 6.0×10^{23} D) 9.0×10^{23}
21. In a sample of oxygen gas at STP, which represents the greatest number of molecules?
- A) one mole B) one gram
C) one molecule D) one liter
22. How many molecules are in 0.25 mole of O_2 ?
- A) 12×10^{23} B) 6.0×10^{23}
C) 3.0×10^{23} D) 1.5×10^{23}
23. What is the total mass of iron in 1.0 mole of Fe_2O_3 ?
- A) 160 g B) 112 g C) 72 g D) 56 g
24. What is the total number of moles of hydrogen in 1 mole of $(\text{NH}_4)_2\text{HPO}_4$?
- A) 5 B) 7 C) 8 D) 9
25. At STP, which gas sample has a volume of 11.2 liters?
- A) 1.00 mole of CO_2 B) 0.750 mole of NH_3
C) 0.500 mole of CO_2 D) 0.250 mole of NH_3
26. Compared to a 1 mole sample of hydrogen at 273 K and 1 atmosphere, a 1 mole sample of hydrogen at 298 K and 1 atmosphere contains
- A) more molecules
B) fewer molecules
C) molecules having higher average kinetic energy
D) molecules having lower average kinetic energy
27. Which quantity of N_2 gas has a volume of 11.2 liters at STP?
- A) 1.0 mole B) 2.0 moles
C) 14.0 grams D) 28.0 grams
28. What is the total number of atoms in 1.0 mole of CO_2 ?
- A) 1.5×10^{23} B) 12×10^{23}
C) 3.0×10^{23} D) 18×10^{23}
29. What is the mass in grams of 1.00 mole of O_2 gas?
- A) 11.2 B) 16.0 C) 22.4 D) 32.0
30. What is the gram formula mass of $(\text{NH}_4)_2\text{SO}_4$?
- A) 66.0 g B) 94.0 g
C) 114 g D) 132 g
31. What is the gram formula mass of K_2CO_3 ?
- A) 138 g B) 106 g C) 99 g D) 67 g
32. What is the formula mass of $\text{Al}_2(\text{SO}_4)_3$?
- A) 123 B) 150 C) 214 D) 342
33. What is the gram formula mass of $\text{Mg}(\text{ClO}_3)_2$?
- A) 107 g B) 142 g C) 174 g D) 191 g
34. What is the gram formula mass of $(\text{NH}_4)_3\text{PO}_4$?
- A) 113 g B) 121 g C) 149 g D) 404 g
35. What is the gram formula mass of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$?
- A) 160. g B) 178 g
C) 186 g D) 250. g
36. What is the gram formula mass of Li_2SO_4 ?
- A) 54 g B) 55 g C) 110 g D) 206 g
37. What is the gram formula mass of $\text{Ca}_3(\text{PO}_4)_2$?
- A) 135 g/mol B) 215 g/mol
C) 278 g/mol D) 310. g/mol
38. What is the gram formula mass of $\text{Ca}(\text{OH})_2$?
- A) 29 g B) 34 g C) 57 g D) 74 g

39. The gram-formula mass of $(\text{NH}_4)_2\text{CO}_3$ is
- A) 46.0 g B) 64.0 g
C) 78.0 g D) 96.0 g
40. What is the gram formula mass of $\text{Ca}_3(\text{PO}_4)_2$?
- A) 196 g B) 214 g
C) 245 g D) 310. g
41. A sample of neon gas at STP has a mass of 20. grams. An equal volume of argon gas at STP will have a mass of
- A) 10. g B) 20. g C) 30. g D) 40. g
42. Which rigid cylinder contains the same number of gas molecules at STP as a 2.0-liter rigid cylinder containing $\text{H}_2(\text{g})$ at STP?
- A) 1.0-L cylinder of $\text{O}_2(\text{g})$
B) 2.0-L cylinder of $\text{CH}_4(\text{g})$
C) 1.5-L cylinder of $\text{NH}_3(\text{g})$
D) 4.0-L cylinder of $\text{He}(\text{g})$
43. Which two samples of gas at STP contain the same total number of molecules?
- A) 1 L of $\text{CO}(\text{g})$ and 0.5 L of $\text{N}_2(\text{g})$
B) 2 L of $\text{CO}(\text{g})$ and 0.5 L of $\text{NH}_3(\text{g})$
C) 1 L of $\text{H}_2(\text{g})$ and 2 L of $\text{Cl}_2(\text{g})$
D) 2 L of $\text{H}_2(\text{g})$ and 2 L of $\text{Cl}_2(\text{g})$
44. The table below shows data for the temperature, pressure, and volume of four gas samples.

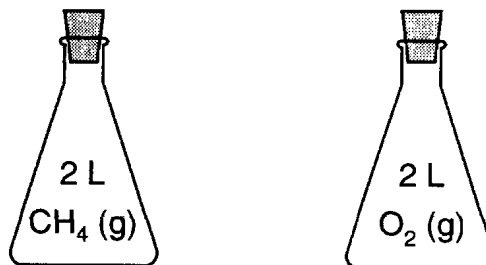
Data for Four Gas Samples

Gas Sample	Temperature (K)	Pressure (atm)	Volume (mL)
A	100.	2	400.
B	200.	2	200.
C	100.	2	400.
D	200.	4	200.

Which two gas samples have the same total number of molecules?

- A) *A* and *B* B) *A* and *C*
C) *B* and *C* D) *B* and *D*

45. At the same temperature and pressure, 1.0 liter of $\text{CO}(\text{g})$ and 1.0 liter of $\text{CO}_2(\text{g})$ have
- A) equal masses and the same number of molecules
B) different masses and a different number of molecules
C) equal volumes and the same number of molecules
D) different volumes and a different number of molecules
46. Each stoppered flask below contains 2 liters of a gas at STP.



Each gas sample has the same

- A) density
B) mass
C) number of molecules
D) number of atoms
47. A sample of $\text{H}_2(\text{g})$ and a sample of $\text{N}_2(\text{g})$ at STP contain the same number of molecules. Each sample must have
- A) the same volume, but a different mass
B) the same mass, but a different volume
C) both the same volume and the same mass
D) neither the same volume nor the same mass
48. At STP, 1 liter of O_2 would have the same number of molecules as
- A) 1 liter of H_2 B) 2 liters of CO
C) 3 liters of CO_2 D) 0.5 liter of Ne
49. Equal volumes of all gases at the same temperature and pressure contain an equal number of
- A) molecules B) atoms
C) electrons D) protons
50. Under which conditions of temperature and pressure would a 1-liter sample of a real gas behave most like an ideal gas?
- A) 100 K and 0.1 atm B) 100 K and 10 atm
C) 500 K and 0.1 atm D) 500 K and 10 atm

51. Under which conditions of temperature and pressure does a sample of neon behave most like an ideal gas?

- A) 100 K and 0.25 atm B) 100 K and 25 atm
C) 400 K and 0.25 atm D) 400 K and 25 atm

52. A real gas behaves *least* like an ideal gas under the conditions of

- A) low temperature and low pressure
B) low temperature and high pressure
C) high temperature and low pressure
D) high temperature and high pressure

53. Under which conditions of temperature and pressure would a sample of $\text{H}_2(\text{g})$ behave most like an ideal gas?

- A) 0°C and 100 kPa B) 0°C and 300 kPa
C) 150°C and 100 kPa D) 150°C and 300 kPa

54. A real gas differs from an ideal gas because the molecules of real gas have

- A) some volume and no attraction for each other
B) some volume and some attraction for each other
C) no volume and no attraction for each other
D) no volume and some attraction for each other

55. A real gas behaves more like an ideal gas when the gas molecules are

- A) close and have strong attractive forces between them
B) close and have weak attractive forces between them
C) far apart and have strong attractive forces between them
D) far apart and have weak attractive forces between them

56. Which of the following gases behaves most like an ideal gas?

- A) $\text{H}_2(\text{g})$ B) $\text{O}_2(\text{g})$
C) $\text{NH}_3(\text{g})$ D) $\text{CO}_2(\text{g})$

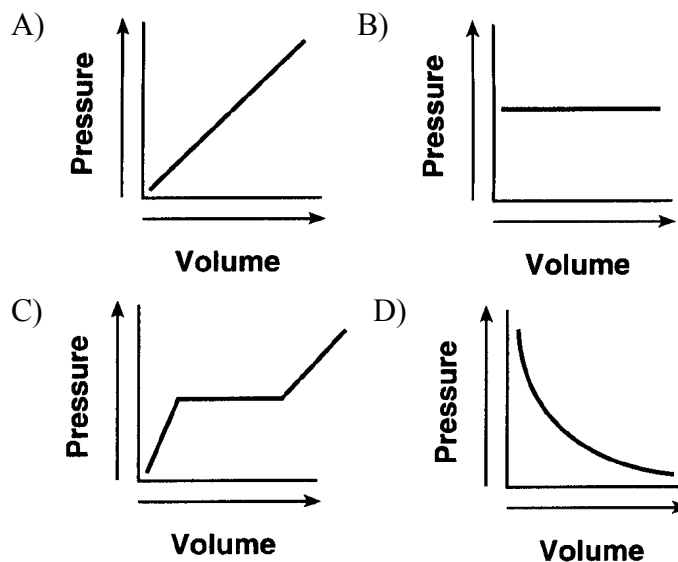
57. Which set of values represents standard pressure and standard temperature?

- A) 1 atm and 101.3 K
B) 1 kPa and 273 K
C) 101.3 kPa and 0°C
D) 101.3 atm and 273°C

58. Which temperature change would cause a sample of an ideal gas to double in volume while the pressure is held constant?

- A) from 400. K to 200. K
B) from 200. K to 400. K
C) from $400.^\circ\text{C}$ to $200.^\circ\text{C}$
D) from $200.^\circ\text{C}$ to $400.^\circ\text{C}$

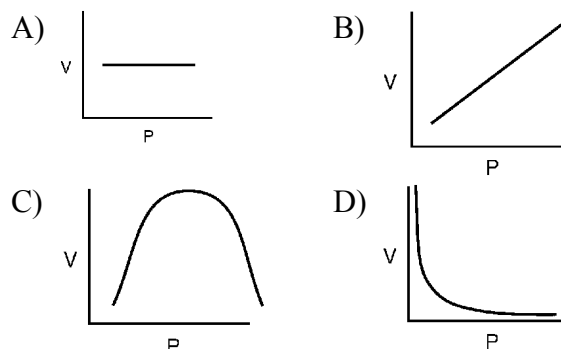
59. Which graph represents the relationship between pressure and volume for a sample of an ideal gas at constant temperature?



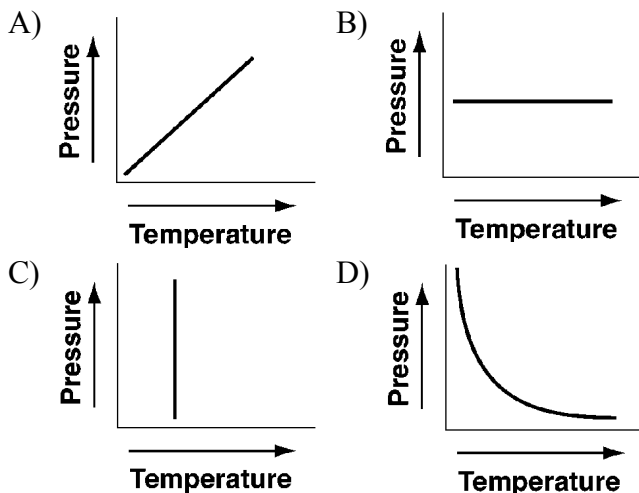
60. A rigid cylinder with a movable piston contains a 2.0-liter sample of neon gas at STP. What is the volume of this sample when its temperature is increased to $30.^\circ\text{C}$ while its pressure is decreased to 90. kilopascals?

- A) 2.5 L B) 2.0 L
C) 1.6 L D) 0.22 L

61. Which graph best represents the pressure-volume relationship for an ideal gas at constant temperature?



62. Which graph shows the pressure-temperature relationship expected for an ideal gas?



63. Which temperature change would cause the volume of a sample of an ideal gas to double when the pressure of the sample remains the same?

- A) from 200°C to 400°C
- B) from 400°C to 200°C
- C) from 200 K to 400 K
- D) from 400 K to 200 K

64. As the temperature of a gas increases at constant pressure, the volume of the gas

- A) decreases
- B) increases
- C) remains the same

65. As the temperature of a given sample of a gas decreases at constant pressure, the volume of the gas

- A) decreases
- B) increases
- C) remains the same

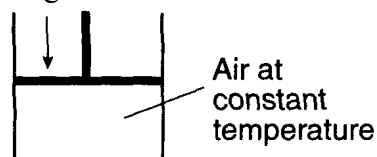
66. The temperature of a 2.0-liter sample of helium gas at STP is increased to 27°C and the pressure is decreased to 80. kPa. What is the new volume of the helium sample?

- A) 1.4 L
- B) 2.0 L
- C) 2.8 L
- D) 4.0 L

67. Standard temperature and pressure are

- A) 0°C and 1.00 kPa
- B) 0°C and 101.3 kPa
- C) 273°C and 1.00 kPa
- D) 273°C and 101.3 kPa

68. A cylinder with a tightly fitted piston is shown in the diagram below.



As the piston moves downward, the number of molecules of air in the cylinder

- A) decreases
- B) increases
- C) remains the same

69. Standard temperature and a pressure of 0.5 atmosphere are equal to

- A) 0°C and 51.6 kPa
- B) 32°C and 51.6 kPa
- C) 0°C and 101.3 kPa
- D) 32°C and 101.3 kPa

70. If 60. liters of hydrogen gas at 546 K is cooled to 273 K at constant pressure, the new volume of the gas will be

- A) 120 L
- B) 20. L
- C) 30. L
- D) 40. L

71. As the volume of a fixed mass of a gas increases at constant temperature, the pressure of the gas

- A) decreases
- B) increases
- C) remains the same

72. A 2.5 liter sample of gas is at STP. When the temperature is raised to 273°C and the pressure remains constant, the new volume of the gas will be

- A) 1.25 L
- B) 2.5 L
- C) 5.0 L
- D) 10. L

73. The volume of a sample of a gas at 273°C is 200. liters. If the volume is decreased to 100. liters at constant pressure, what will be the new temperature of the gas?

- A) 0 K
- B) 100. K
- C) 273 K
- D) 546 K

74. A gas sample has a volume of 25.0 milliliters at a pressure of 1.00 atmosphere. If the volume increases to 50.0 milliliters and the temperature remains constant, the new pressure will be

- A) 1.00 atm
- B) 2.00 atm
- C) 0.250 atm
- D) 0.500 atm

75. A sample of oxygen gas has a volume of 150. milliliters at 300 K. If the pressure of the sample is held constant and the temperature is raised to 600 K, the new volume of the sample will be

- A) 75.0 ml
- B) 150. ml
- C) 300. ml
- D) 600. ml

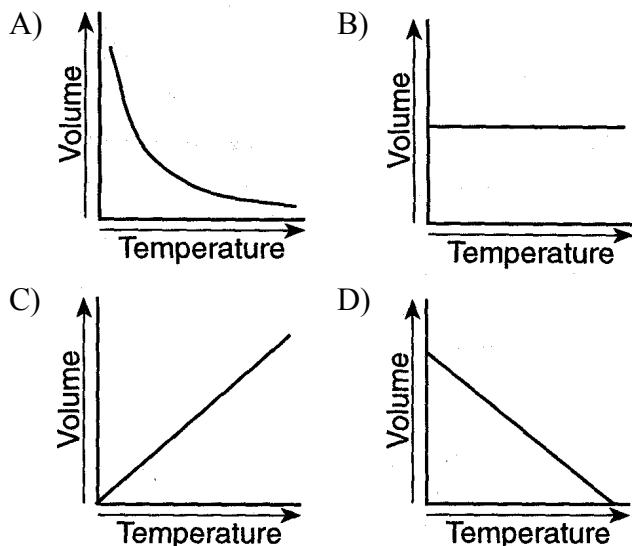
76. At a temperature of 273 K, a 400.-milliliter gas sample has a pressure of 760. millimeters of mercury. If the pressure is changed to 380. millimeters of mercury, at which temperature will this gas sample have a volume of 551 milliliters?

- A) 100 K B) 188 K C) 273 K D) 546 K

77. The volume of a 1.00-mole sample of an ideal gas will decrease when the

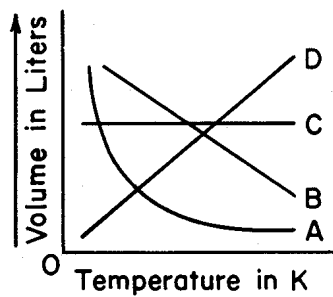
- A) pressure decreases and the temperature decreases
 B) pressure decreases and the temperature increases
 C) pressure increases and the temperature decreases
 D) pressure increases and the temperature increases

78. Which graph represents the relationship between volume and Kelvin temperature for an ideal gas at constant pressure?



79. When 500. milliliters of hydrogen gas is heated from 30°C to 60°C at constant pressure, the volume of the gas at 60°C is equal to

- A) $500 \text{ ml} \times \frac{213}{243}$ B) $500 \text{ ml} \times \frac{243}{213}$
 C) $500 \text{ ml} \times \frac{333}{303}$ D) $500 \text{ ml} \times \frac{333}{333}$



80. At constant pressure, which curve best shows the relationship between the volume of an ideal gas and its absolute temperature?

- A) A B) B C) C D) D

81. When the pressure exerted on a confined gas at constant temperature is doubled, the volume of the gas is

- A) halved B) doubled
 C) tripled D) quartered

82. If the Kelvin temperature of a gas sample is doubled while the pressure is halved, the volume of the gas will

- A) remain the same B) increase 2 times
 C) decrease by half D) increase 4 times

83. Which compound has the *lowest* vapor pressure at 50°C?

- A) ethanoic acid B) ethanol
 C) propanone D) water

84. At which temperature is the vapor pressure of ethanol equal to 80. kPa?

- A) 48°C B) 73°C
 C) 80°C D) 101°C

85. Based on intermolecular forces, which of these substances would have the highest boiling point?

- A) He B) O₂ C) CH₄ D) NH₃

86. Using your knowledge of chemistry and the information in Reference Table H, which statement concerning propanone and water at 50°C is true?

- A) Propanone has a higher vapor pressure and stronger intermolecular forces than water.
 B) Propanone has a higher vapor pressure and weaker intermolecular forces than water.
 C) Propanone has a lower vapor pressure and stronger intermolecular forces than water.
 D) Propanone has a lower vapor pressure and weaker intermolecular forces than water.

87. According to Reference Table *H*, what is the vapor pressure of propanone at 45°C?

- A) 22 kPa B) 33 kPa
C) 70 kPa D) 98 kPa

88. As the temperature of a liquid increases, its vapor pressure

- A) decreases B) increases
C) remains the same

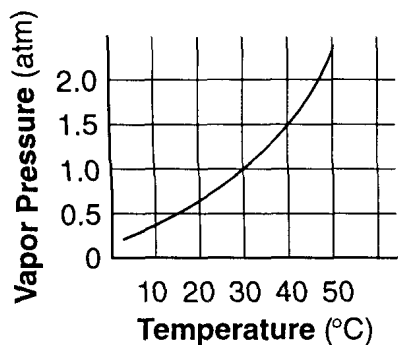
89. Based on Reference Table *H*, which sample has the highest vapor pressure?

- A) water at 20°C B) water at 80°C
C) ethanol at 50°C D) ethanol at 65°C

90. Which sample of water has the *lowest* vapor pressure?

- A) 100 mL at 50°C B) 200 mL at 30°C
C) 300 mL at 40°C D) 400 mL at 20°C

91. The graph below shows the relationship between vapor pressure and temperature for substance *X*.



What is the normal boiling point for substance *X*?

- A) 50°C B) 20°C C) 30°C D) 40°C

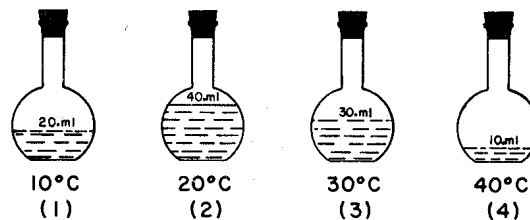
92. Which sample of water will have the highest vapor pressure?

- A) 10.0 ml at 62°C B) 20.0 ml at 52°C
C) 30.0 ml at 42°C D) 40.0 ml at 32°C

93. A sample of pure water at 50.°C has a vapor pressure closest to

- A) 5.0 kPa B) 12 kPa
C) 50 kPa D) 101.3 kPa

94. Base your answer to the following question on the diagrams below of four sealed flasks, each of which contains H₂O(ℓ) at the temperature shown.



In which flask is the equilibrium vapor pressure of water the greatest?

- A) 1 B) 2 C) 3 D) 4

95. When the temperature of a sample of water is changed from 45°C to 70.°C, the change in its vapor pressure is

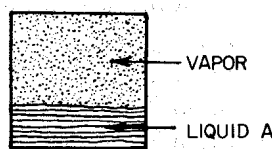
- A) 1.0 kPa B) 20. kPa
C) 25 kPa D) 101.3 kPa

96. The vapor pressure of 25 milliliters of water at 25°C will be the same as

- A) 50. ml of water at 25°C
B) 25 ml of water at 50°C
C) 50. ml of alcohol at 25°C
D) 25 ml of alcohol at 50°C

97. The vapor pressure of ethanol at its normal boiling point is

- A) 80 kPa B) 100 kPa
C) 101.3 kPa D) 273 kPa



98. CONTAINER Liquid *A* is confined in a container as shown in the diagram above. The equilibrium vapor pressure of liquid *A* depends on the

- A) amount of vapor in the container
B) amount of liquid in the container
C) temperature of liquid *A*
D) size of the confining container

99. What is the vapor pressure of water at 105°C?

- A) .60 kPa B) 101.3 kPa
C) 120 kPa D) 145 kPa