Name _____   **Honors Chemistry**   ___/___/___
Gas Laws Review – Practice Test II

1. _____ A sample of 5.16 grams of an ideal gas at 150.0 °C and 1.25 atmospheres pressure has a volume of 2.00 liters. What is the molar mass of the gas?
        (A) 0.0218 gram/mole   (B) 16.2 grams/mole   (C) 37.0 grams/mole
        (D) 45.8 grams/mole   **(E) 71.6 grams/mole**

2. _____ A gas has a volume of 4.0 L at a pressure of 0.80 atm. What is the volume if the pressure is changed to 0.20 atm at constant temperature?
        (A) 1.0 L   (B) 2.0 L   (C) 8.0 L   **(D) 16 L**   (E) 6 L

3. _____ Equal numbers of moles of $CO_2(g)$, $SO_2(g)$, and $H_2O(g)$ are placed in a glass vessel at 400. K. If the vessel has a pinhole-sized leak, which of the following will be true regarding the relative values of the partial pressures of the gases remaining in the vessel after some of the gas mixture has effused?
        (A) $P_{CO2} < P_{SO2} < P_{H2O}$ (B) $P_{CO2} < P_{H2O} < P_{SO2}$ (C) $P_{SO2} < P_{CO2} < P_{H2O}$
        (D) $P_{H2O} < P_{CO2} < P_{SO2}$ (E) $P_{CO2} = P_{SO2} = P_{H2O}$

4. _____ A 0.239 g sample of a gas in a 100-mL flask exerts a pressure of 1520 mmHg at 14 °C. What is the gas?
        (A) chlorine   **(B) nitrogen**   (C) krypton   (D) xenon   (E) oxygen

5. _____ A sample of neon gas has a volume of 333 mL at 30.°C and a certain pressure. What volume would it occupy if it were heated to 60.°C at the same pressure?
        (A) 366 mL   (B) 399 mL   (C) 333 mL   (D) 666 mL   (E) 167 mL

6. _____ Hydrogen gas is collected over water at 21°C. At 21°C the vapor pressure of water is 18.7 torr. If the barometric pressure is 758 torr what is the pressure of hydrogen gas?
        (A) 758 torr   (B) 777 torr   **(C) 739 torr**   (D) 48.2 torr   (E) 18.7 torr

7. _____ Calculate the root mean square velocity of a sample of 10.0 grams of helium atoms at 55.0 °C.
        (A) 45.2 m/s   (B) 142 m/s   (C) 1010 m/s   (D) 1110 m/s   **(E) 1430 m/s**

8. _____ When a sample of oxygen gas in a closed container of constant volume is heated until its Celsius temperature is doubled, which of the following is also doubled?
        (A) The density of the gas   (B) The potential energy of the molecules   (C) The pressure of the gas
        (D) The average velocity of the gas molecules   **(E) None of the above**

9. _____ Helium is often found with methane, CH_4. How do the diffusion rates of helium and methane compare at the same temperature? Methane diffuses:
        (A) ½ as fast as helium.   (B) four times as fast as helium.
        (C) twice as fast as helium.   (D) at the same rate as helium.
                (E) ¼ as fast as helium.

10. _____ Under which conditions will a gas behave most ideally?
        (A) high P and low T   (B) low P and low T   **(C) low P and high T**
        (D) high P and high T   (E) a gas will behave ideally at all conditions

11. _____ Xenon gas initially at 35°C is heated to 105°C in a closed container. Which statement is correct?
        (A) The average kinetic energy of the xenon atoms does not change.
        (B) The average kinetic energy of the xenon atoms triples.
        (C) The pressure of the gas increases by 23 percent.
        (D) The pressure of the gas triples.
        (E) The pressure of the gas increases by about 8 percent.

12._____Which gas has a density of 2.58 g·L^{-1} at 10.°C and 1.5 atm?
        (A) Ar   (B) Ne   (C) CO   (D) CH$_4$ (E) Kr

13._____ A gas mixture at 27°C and 760 mm Hg contains 1.0 g each of He, O$_2$, N$_2$ and CO. How do their average molecular speeds compare?
    (A) He = O$_2$ = N$_2$ = CO   **(B) O₂ < N₂ = CO < He**   (C) He < CO = N$_2$ < O$_2$
        (D) CO < O$_2$ < N$_2$ < He   (E) He < O$_2$ < CO < N$_2$

14. _____ Which of the following would express the approximate density of sulfur dioxide gas at 0°C and 3.00 atm pressure (in grams per liter)?
    (A) 2.2 g/L   (B) 4.3 g/L   (C) 6.5 g/L   **(D) 8.6 g/L**   (E) 5.5 g/L

15. _____ 2Li(s) + 2HCl (aq) → H$_2$(g) + 2LiCl(aq)
Calculate the volume of Hydrogen produced if 3.55 grams of Li react with excess HCl if the pressure is 0.98 atm and the temperature is 29.0 °C.
    (A) 6.50 L   (B) 13.0 L   (C) 3.25 L   (D) 44.9 L   (E) 89.8 L

16. _____ Three balloons are each filled to a volume of 40.0 L with Ar, Kr, and Xe, respectively. Which statement is true under the same conditions of temperature and pressure?
    (A) The balloons contain the same mass of gas.   **(B) All gases have the same kinetic energy.**
    (C) The densities of the three gases are the same.   (D) The gases will all effuse at the same rate.
        (E) All gases have the same root mean square velocity.

Questions 17–19 refer to the following gases at 0˚C and 1 atm.
    (A) Ne   (B) Xe   (C) O$_2$ (D) CO   (E) NO

17. **D** Has an average atomic or molecular speed closest to that of N$_2$ molecules at 0˚C and 1 atm.

18. **B** Has the greatest density.

19. **A** Has the greatest rate of effusion through a pinhole.

Questions 20–22 The phase diagram for the pure substance X is shown to the right.

20. _____ The temperature of a sample of pure solid X is slowly raised from 10˚C to 100˚C at a constant pressure of 0.5 atm. What is the expected behavior of the substance?

    (A) It first melts to a liquid and then boils at about 70˚C.
    (B) It first melts to a liquid and then boils at about 30˚C.
    (C) It melts to a liquid at a temperature of about 20˚C and remains a liquid until the temperature is greater than 100˚C.
    (D) It sublimes to vapor at an equilibrium temperature of about 20˚ C.
    (E) It remains a solid until the temperature is greater than 100˚C.
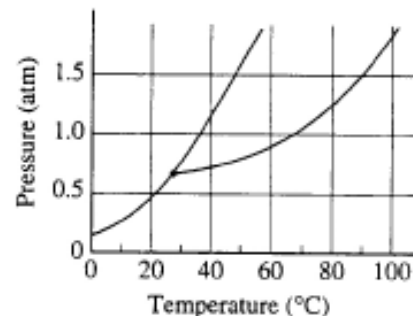
21. _____ What is the approximate normal boiling point for a pure sample of substance X?
    (A) 28 °C   (B) 37 °C   (C) 60 °C   **(D) 70°C**   (E) 102 °C

22. _____ Which state of matter of substance X is the most dense?
    (A) all states are equally dense
    (B) it is impossible to determine without more information
   **(C) solid X**
    (D) liquid X
    (E) gas X

23. _____

Substance	Equilibrium Vapor Pressure at 20°C (torr)
$C_6H_6(l)$	75
$C_2H_5OH(l)$	44
$CH_3OH(l)$	92
$C_4H_9OH(l)$	32
$C_2H_6O_2(l)$	0.06

Based on the data in the table above, which of the following liquid substances has the weakest intermolecular forces?

     (A) $C_6H_6(l)$ (B) $C_2H_5OH(l)$ **(C) $CH_3OH(l)$** (D) $C_4H_9OH(l)$ (E) $C_2H_6O_2(l)$

24. _____ Shown to the right is the phase diagram of a pure substance. The substance under the conditions corresponding to point X on the diagram is cooled to 40°C while the pressure remains constant. As the substance cools, the phase of the substance changes from

    (A) gas to liquid to solid   (B) gas to solid to liquid
    (C) solid to liquid to gas   (D) liquid to solid to gas
          (E) liquid to gas to solid
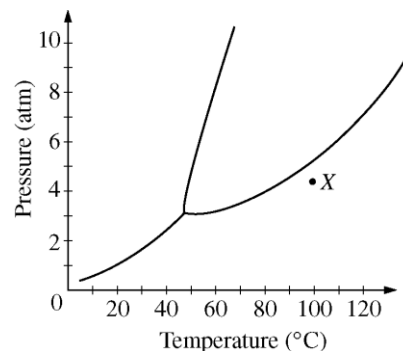
25. _____ At which temperature and pressure is substance X a liquid?

    (A) 1.0 atm, 20°C only   (B) 1.5 atm, 40°C only
    (C) 0.5 atm, 60°C only   (D) two of the above are true
       (E) none of the above are true.

26. _____ A flask contains 0.25 mole of $SO_2(g)$, 0.50 mole of $CH_4(g)$, and 0.50 mole of $O_2(g)$. The total pressure of the gases in the flask is 800 mm Hg. What is the partial pressure of the $SO_2(g)$ in the flask?

    (A) 800 mm Hg (B) 600 mm Hg (C) 250 mm Hg (D) 200 mm Hg **(E) 160 mm Hg**

27. _____ A gas shows most ideal behavior at:

    (A) high temperatures and high pressure   **(B) high temperatures and low pressure**
    (C) low temperatures and low pressure   (D) low temperature and high pressure
          (E) all temperatures and pressures

28. _____ A 2 L container will hold about 4 g of which of the following gases at 0˚C and 1 atm?

    (A) SO_2 (B) N_2 **(C) CO_2**   (D) C_4H_8 (E) NH_3

29· _____ Which of the following gasses shows most ideal behavior at 25°C and 1 atm?

    (A) Ar   (B) Cl_2 **(C) He**   (D) CH_4 (E) O_2

30· _____ Three gases in the amounts shown in the table to the right are added to a previously evacuated rigid tank. If the total pressure in the tank is 3.0 atm at 25 C, the partial pressure of $N_2(g)$ in the tank is closest to:

Gas	Amount
Ar	0.35 mol
CH_4	0.90 mol
N_2	0.25 mol

    (A) 0.75 atm   **(B) 0.50 atm**   (C) 0.33 atm
       (D) 0.25 atm   (E) 0.17 atm

31. _____ At approximately what temperature will 40. grams of argon gas at 2.0 atm occupy a volume of 22.4 L?

    (A) 1,200 K   (B) 600 K   **(C) 550 K**   (D) 270 K   (E) 140 K

32. _____ $8H_2(g) + S_8(s) \rightarrow 8H_2S(g)$

When 25.6 g of $S_8(s)$ reacts completely with an excess of $H_2(g)$ according to the equation above, the volume of $H_2S(g)$, measured at 0°C and 1.00 atm, produced is closest to:

    (A) 30 L   **(B) 20 L**   (C) 10 L   (D) 5 L   (E) 2 L

33. _____ At which of the following temperatures and pressures would a real gas be most likely to deviate from ideal behavior?

	Temperature (K)	Pressure (atm)
(A)	**100**	**50**
(B)	200	5
(C)	300	0.01
(D)	500	0.01
(E)	500	1

34. _____ Of the following gases, which has the greatest average molecular speed at 298 K?

(A) $Cl_2(g)$　　　(B) $NO(g)$　　　(C) $H_2S(g)$　　　**(D) HCN(g)**　　　(E) $PH_3(g)$

35. _____ Which liquid is most volatile at 25°C?

(A) butane, C_4H_{10}　　　(B) glycerol, $C_3H_5(OH)_3$　　　(C) octane, C_8H_{18}
(D) propanol, C_3H_7OH　　　(E) nonane, $C_{10}H_{22}$

Free Response
2003 - #2
A rigid 5.00 L cylinder contains 24.5 g of $N_2(g)$ and 28.0 g of $O_2(g)$.
(a) Calculate the total pressure, in atm, of the gas mixture in the cylinder at 298 K. **8.56 atm**
(b) The temperature of the gas mixture in the cylinder is decreased to 280. K. Calculate each of the following.
　　(i) The mole fraction of $N_2(g)$ in the cylinder **0.500**
　　(ii) The partial pressure, in atm, of $N_2(g)$ in the cylinder **4.02 atm**
(c) If the cylinder develops a pinhole-sized leak and some of the gaseous mixture escapes, would the ratio

$\dfrac{moles : Nitrogen}{moles : Oxygen}$ in the cylinder increase, decrease, or remain the same? Justify your answer. **Decrease because**

oxygen effuses slower because its molar mass is greater than nitrogen.

A different rigid 5.00 L cylinder contains 0.176 mol of $NO(g)$ at 298 K. A 0.176 mol sample of $O_2(g)$ is added to the cylinder, where a reaction occurs to produce $NO_2(g)$.
(d) Write the balanced equation for the reaction. **2NO + O$_2$ → 2NO$_2$**
(e) Calculate the total pressure, in atm, in the cylinder at 298 K after the reaction is complete. **1.29 atm**