

Class table1.Looking at the picture above of the barometer what is the pressure in atm? What would<br/>the pressure be if the mercury was 800 mm above the surface of the mercury pool in Pascals?1.2.If you have three balloons that have the same volume at the same temperature and<br/>pressure what else in the same? If they are the substances below what are the differences?<br/> $CH_4$  $H_2O$ MgO $NH_4CI$ 

3. Which gas above has the highest average velocity? (think about how mass affects velocity)

- 4. If you have two samples of the same gas at the same pressure and volume what is the ratio of temperature if you have 2 times as many moles of gas in flask 2 then in flask 1?
- 5. If you have two gases at the same pressure and temperature and you have 2L of gas 1 which holds 5 moles of gas how many liters of gas 2 will you have if you have 2.3 moles of gas 2?
- 6. Create and solve your own practice problem that has an initial volume and temperature (°C) and you change one (volume or temperature) to find the other (volume or temperature). Your temperatures should be finally in °C.
- 7. If you have three gases at the same temperature and pressure what else is the same between them?
- 8. How many molecules are contained in a 3.5L flask at 732mmHg and 20°C?
- 9. A sample of gas occupies 28.8 L at 12°C and 843 mmHg. What volume will it occupy at 30°C and 720 mmHg?
- 10. Describe the pressure, temperature and number of moles of an ideal gas.
- 11. 220g of water vapor is put in a 250ml container at 20°C. What is the pressure in the container?
- 12. It is found that 250. ml of a gas at 792mmHg and 24°C has a mass of 3.67 g. What is the molar mass?
- 13. What is the density of  $C_2H_5OH$  at a pressure of 800mmHg and 25°C?
- 14. If you increase the temperature of a gas from 30°C to 90°C what happens to the kinetic energy?
- 15. What is the partial pressure of a gas collected over water at 28°C in a room with a barometric pressure of 1atm?
- 16. What is the partial pressure of the water vapor in the question above?
- 17. Name all the kinetic molecular theories.
- 18. What can you tell me about average temperature and velocity of the molecules?
- 19. What is the number of moles of gas in a 500ml flask at 15°C with 795mmHg pressure?

## Answers

- 1) 1 atm, 800 mmHg 1.05 atm  $1.07x10^{5}$  Pa
- It will have the same number of moles. The mass of the molecules and the gas velocity will be different.
- 3) CH<sub>4</sub>
- 4) 2 flask 1 : 1 flask 2
- 5) 0.92L
- 6) Example: a gas at 2L and 20°C is heated and the gas expanse to 4L. What is the final temperature in °C? 586K = 313 °C
- 7) If the number of moles are constant then the volume in the same. If the volume is constant then the # of moles is the same.
- 8) 0.14moles = 8.43x10<sup>22</sup> molecules
- 9) 35.84L

- 10) Low pressure, high temperature, low number of moles
- 11) 1174atm
- 12) 343g/mole
- 13) 1.98g/L
- 14) It increases
- 15) 731.7mmHg = 0.96atm
- 16) 28.3mmHg
- 17) Gases consist of small particles far apart Collisions are elastic Gas particles are in continuous motion No attraction or repulsion between particles Kinetic energy directly related to temperature
- As temperature goes up so does the velocity of the molecules. The mass of a molecules affects how much the velocity changes light molecules more change
- 19) 0.022moles

Remember that you can have specific heat in °C or K, it doesn't matter which one. Celsius is traditional, but since it is a  $\Delta$  temperature value, and one K is the same size as one °C it doesn't really matter.

- A kilogram of aluminum and a kilogram of copper are placed into separate insolated container with room temperature water. Both substances are at 100°C. Which substance has the greatest change in temperature and why? Specific heat of aluminum is 0.90 J/g.K Specific heat of copper is 0.386 J/g.K
- 2. How much energy is required to heat a 25g cube of copper from 23°C to 75°C? Specific heat of copper is 0.386 J/g.K.
- 3. Suppose that 25g of gold absorbs 2.35kJ at an initial temperature of 27°C. What is the final temperature? Specific heat of gold 0.126 J/g.K
- 4. Explain the three types of heat transfer and give an example of each.
- 5. What is the mass of a brass cube that is heated form 25°C to 75°C using 12.3kJ of energy? Specific heat of brass is 0.380 J/g.K
- 6. How much energy is released when 50g of water cools from 75°C to 15°C?
- 7. How much energy is absorbed when 25g water at 25°C is heated to 105°C at 1atm?
- 8. How much energy is released when 10g of water at 115°C is cooled to -15°C at 1 atm?
- 9. Why can we not use  $q = MC\Delta T$  for a phase change problem and what do we use?
- 10. A silver block, initially at 58.6°C is submerged into 100g of water at 24.8°C in an insulated container. The final temperature of the mixture is 26.°C. What is the mass of the silver block? Specific heat of silver 0.233 J/g.K
- 11. A 5.74g unknown substance is heated to 72.1°C and submerged into 15.2g of water at 24.7°C. The final temperature of the mixture is 26.3°C. What is the specific heat of the substance and what metal above does it match?
- 12. 25g of lead at 100°C are placed into 10g of water at 25°C. What is the final temperature of the mixture? Specific heat of lead is 0.128 J/g.K
- 13. If you place a 100°C metal with a specific heat of 0.387 J/g.K into water at 25°C with a specific heat of 4.18 J/g.K which initial temperature would the final temperature be closest to if the masses are the same and explain your answer?
- 14. Determine the final temperature when 18.0 g of ice at 0.0 °C mixes with 275.0 grams of water at 80.0 °C.

## Answers.

- 1. aluminum
- 2. 502 J
- 3. 773°C
- 4. Conduction (touch) Convection (fluid) Radiation (EMW)
- 5. 647g
- 6. 12,540 J
- 7. 64,587 J
- 8. 30,720 J
- 9. No Change in temperature q = mL
- 10. 66 g
- 11. Copper
- 12. 30 °C
- 13. The water temperature because it has the highest specific heat and will not change temperature as much.
- 14. 75 °C

- How much heat is required to convert 30g of H<sub>2</sub>0 at -10°C to 110°C?
  - a. 8.26E4 J
  - b. 9.16E4 J
  - c. 2.19E4 J
  - d. 3.14E4 J
  - e. 8.54E4 J
- When 1.095g of a substances is melted in 150.00g of water in a calorimeter, the temperature changes from 23.5°C to 25.32°C. What is the latent heat for this unknown substance that melted? 2084 J/g
  - a. 1042 J
  - b. 521 J/g
  - c. 1042 J/g
  - d. 903 J/g
- Calculate the final temperature of 500.0 g of 37°C water if it receives 48 kJ of heat.
  - a. 25°C
  - b. 78°C
  - c. 60°C
  - d. 30°C
  - e. 10°C
- 4. N<sub>2</sub> (g) + H<sub>2</sub> (g) → NH<sub>3</sub>(g) (unbalanced)  $\Delta$ H(25°C) = -92.22 kJ How much heat will be produced if
  - 25.00 g of hydrogen are reacted?
  - a. 92.22 kJ
  - b. 380 kJ
  - c. 2305 kJ
  - d. 768.5 kJ
  - e. 946 kJ



4	В
5	А
6	E

- 5. When 72 g of a metal at  $97.0^{\circ}$ C is added to 100 g of water at 25.0 °C, the final temperature is 45.5 °C. What is the heat capacity per grams of the metal? (Heat capacity of H<sub>2</sub>O = 4.184 J/g. °C)
  - a. 2.24 J/g.K
  - b. 3.62 J/g.K
  - c. 4.18 J/g.K
  - d. 1.54 J/g.K
  - e. 5.32 J/g.K
- If a 40.1 g piece of iron at 652 °C is dropped into a sample of 328 g of water at 32.4 °C, what will the final temperature be after thermal equilibrium is established? Assume that no heat is lost during the process. (Iron Specific Heat 0.449J/g.K)
  - a. 32°C
  - b. 80°C
  - c. 71°C
  - d. 25°C
  - e. 40°C
- A 31.2g wafer of pure gold initially at 69.5°C is submerged into 63.7g of water at 27.6°C in an insulated container. Find the final temperature of both substances. (gold specific heat 0.129j/g.K)
  - a. 40°C
  - b. 35°C
  - c. 32°C
  - d. 28°C
  - e. 55°C
- 7 D

- A gas sample is held at constant pressure. The gas occupies 3.62 L of volume when the temperature is 21.6°C. Determine the temperature at which the volume of the gas is 3.40 L.
  - A) 314 K
  - B) 277 K
  - C) 20.3 K
  - D) 295 K
  - E) 550 K
- 2. A gas sample is heated from -20.0°C to 57.0°C and the volume is increased from 2.00 L to 4.50 L. If the initial pressure is 0.108 atm, what is the final pressure?
  - A) 0.0368 atm
  - B) -0.137 atm
  - C) 0.317 atm
  - D) 0.186 atm
  - E) 0.0626 atm
- 3. You fill a balloon with 2.50 moles of gas at 28°C at a pressure of 1.68 atm. What is the volume of the balloon?
  - A) 3.42 L
  - B) 16.6 L
  - C) 36.8 L
  - D) 103.7 L
  - E) 22.4 L
- 4. A 8.04-L sample of carbon monoxide is collected at 55°C and 0.892 atm. What volume will the gas occupy at 1.05 atm and 20.°C?
  - A) 2.48 L
  - B) 8.45 L
  - C) 6.10 L
  - D) 7.65 L
  - E) none of these
- 5. Body temperature is about 308 K. On a cold day, what volume of air at 265 K must a person with a lung capacity of 2.00 L breathe in to fill the lungs?
  A) 2.32 L
  - B) 1.72 L
  - B) 1.72 L
    C) 1.85 L
  - D) 3.44 L
  - E) none of these
- 6. Mercury vapor contains Hg atoms. What is the volume of 200. g of mercury vapor at 822 K and 0.478 atm?
  - A) 141 L
  - B)  $2.82 \times 10^4 \text{ L}$
  - C) 187 L
  - D) 32.3 L
  - E) 16.1 L

- 7. You are holding two balloons, an orange balloon and a blue balloon. The orange balloon is filled with neon (Ne) gas and the blue balloon is filled with argon (Ar) gas. The orange balloon has twice the volume of the blue balloon. Which of the following best represents the mass ratio of Ne:Ar in the balloons?
  - A) 1:1
  - B) 1:2
  - C) 2:1
  - D) 1:3
  - E) 3:1
- 8. You have 32.8 g of O<sub>2</sub> gas in a container with twice the volume as one with CO<sub>2</sub> gas. The pressure and temperature of both containers are the same. Calculate the mass of carbon dioxide gas you have in the container.
  - A) 45.1 g
  - B) 0.513 g
  - C) 22.6 g
  - D) 2.05 g
  - E) none of these
- 9. Which of the following is true about the kinetic molecular theory?
  - A) The volume of a gas particle is considered to be small about 0.10 mL.
  - B) Pressure is due to the collisions of the gas particles with the walls of the container.
  - C) Gas particles repel each other, but do not attract one another.
  - D) Adding an ideal gas to a closed container will cause an increase in temperature.
  - E) At least two of the above statements are correct.

Use the following to answer question 10:

Four identical 1.0-L flasks contain the gases He,  $Cl_2$ ,  $CH_4$ , and  $NH_3$ , each at 0°C and 1 atm pressure.

- 10. 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) all gases the same

- A 4.37 gram sample of a certain diatomic gas occupies a volume of 3.00-L at 1.00 atm and a temperature of 45°C. Identify this gas.
  - A) F<sub>2</sub>
  - B) N<sub>2</sub>
  - C) H<sub>2</sub>
  - D) O<sub>2</sub>
  - E) Cl<sub>2</sub>
- 12. Air has an average molar mass of 29.0 g/mol. The density of air at 0.96 atm and 30.0°C is:
  - A) 29.0 g/L
  - B) 38.6 g/mL
  - C) 1.12 g/L
  - D) 1.33 g/mL
  - E) 11.3 g/L
- 13. If a 1.05-g sample of a gas occupies 750. mL at STP, what is the molar mass of the gas at 125°C?
  - A) 0.0335 g/mol
  - B) 31.4 g/mol
  - C) 1.40 g/mol
  - D) 16.00 g/mol
  - E) Not enough information is given.

## **Answer Key**

1. B	6. A
2. E	7. A
3. C	8. C
4. C	9. B
5. B	10. A

- A substance contains 35.0 g nitrogen, 5.05 g hydrogen, and 60.0 g of oxygen. How many grams of hydrogen are there in a 161-g sample?
   A) 5.05 g
  - B) 16.3 g
  - C) 8.13 g
  - D) 31.9 g
  - E) 807 g

Use the following to answer questions 2-6: A combusted carbon compound is made up of carbon, hydrogen, and oxygen..2.78g of this sample is burned in excess oxygen to yield 5.68g of  $CO_2$ , and 1.75g of  $H_2O_4$ .

2. What is the mass of carbon in the compound?

A)	0.75g
л)	0.75g

- B) 1.01g
- C) 1.55g
- D) 0.62g
- E) 2.46g

- 14. A 130.-mL sample of gas is collected over water at 22°C and 753 torr. What is the volume of the dry gas at STP? (The vapor pressure of water at 22°C = 20. torr.)
  - A) 135 mL
  - B) 169 mL
  - C) 130. mL
  - D) 111 mL
  - E) none of these
- 15. Gaseous  $C_2H_4$  reacts with  $O_2$  according to the following equation:

 $C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(g)$ 

What volume of oxygen gas at STP is needed to react with  $3.94 \text{ mol of } C_2H_4$ ? (Ignore significant figures for this problem.)

- A) 11.8 L
- B) 29.4 L
- C) 265 L
- D) 88.3 L
- E) Not enough information is given to solve the problem.

11.	A
12.	С
13.	В
14.	Е
15.	С

- 3. What is the mass of hydrogen in the compound?
  - A) 0.12g
  - B) 0.36g
  - C) 0.20g
  - D) 0.56
  - E) 0.42g

4. What is the mass of oxygen in the compound sample?

- A) 0.65g
- B) 1.34g
- C) 1.24g
- D) 1.03g
- E) 0.32g
- 5. What is the empirical formula of the sample?
  - A) CH<sub>3</sub>O
  - B) CH<sub>2</sub>O
  - C) C<sub>4</sub>H<sub>32</sub>O<sub>2</sub>
  - $D) \quad C_2H_3O$
  - E) CHO

- 6. What is the molecular formula of the sample if its molecular mass is 129.15g/mol
  - A) C<sub>3</sub>H<sub>12</sub>O<sub>3</sub>
  - B) C<sub>6</sub>H<sub>9</sub>O<sub>3</sub>
  - C)  $C_4H_{16}O_2$
  - D) CHNO
  - E) C<sub>2</sub>H<sub>8</sub>O
- 7. A hydrocarbon (a compound consisting solely of carbon and hydrogen) is found to be 85.6% carbon by mass. What is the empirical formula for this compound?
  - A) CH<sub>2</sub>
  - B) CH<sub>6</sub>
  - C) CH
  - D) C<sub>3</sub>H
  - E) C<sub>6</sub>H
- 8. Adipic acid contains 49.32% C, 43.84% O, and 6.85% H by mass. What is the empirical formula?
  - A)  $C_2HO_3$
  - $B)\quad C_3H_5O_2$
  - $C)\quad C_2H_5O_4$
  - D)  $C_3HO_3$
  - E) C<sub>3</sub>H<sub>3</sub>O<sub>4</sub>

## Answer Key

1. C 2. C 3. C

- 9. A 0.4647-g sample of a compound known to contain only carbon, hydrogen, and oxygen was burned in oxygen to yield 0.8635 g of CO<sub>2</sub> and 0.1767 g of H<sub>2</sub>O. What is the empirical formula of the compound?
  - A)  $C_6H_3O_2$
  - B) CHO
  - C)  $C_3H_6O_2$ D)  $C_3H_3O_2$
  - E)  $C_{2}H_{2}O$
- Vitamin C contains the elements C, H, and O. It is known to contain 40.9% C and 4.58% H by mass. The molar mass of vitamin C has been found to be about
  - 180. The molecular formula for vitamin C is:
  - A)  $C_3H_4O_3$
  - B)  $C_4H_6O_4$
  - C) C<sub>6</sub>H<sub>8</sub>O<sub>6</sub>
  - $D)\quad C_2H_3O_2$
- 11. The characteristic odor of pineapple is due to ethyl butyrate, a compound containing carbon, hydrogen, and oxygen. Combustion of 2.78 g of ethyl butyrate leads to formation of 6.32 g of  $CO_2$  and 2.58 g of  $H_2O$ . The properties of the compound suggest that the molar mass should be between 100 and 150. What is the molecular formula?
  - A)  $C_6H_{24}O_2$
  - B)  $C_2H_3O_2$
  - C)  $C_6H_{12}O_2$
  - D) CH<sub>2</sub>O
  - E) C<sub>3</sub>H<sub>6</sub>O

4. D	8. B
5. D	9. D
6. B	10. C
7. A	11. C