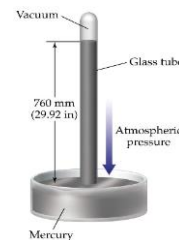


Remember that you can have specific heat in °C or K, it doesn't matter which one. Celsius is traditional, but since it is a Δ temperature value, and one K is the same size as one °C it doesn't really matter.



- 1) Looking at the picture to the right of the barometer, what is the pressure in atm? What would the pressure be if the Hg was 800 mm above the surface of the mercury pool in Pascals?
- 2) If you have three balloons that have the same volume at the same temperature and pressure what else is the same? If they are the substances below what are the differences? CH₄
H₂O MgO NH₄Cl
- 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 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 C₂H₅OH 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?
- 20) A kilogram of aluminum and a kilogram of copper are placed into separate insulated 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
- 21) 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.
- 22) 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

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- 23) Explain the three types of heat transfer and give an example of each.
- 24) What is the mass of a brass cube that is heated from 25°C to 75°C using 12.3kJ of energy? Specific heat of brass is 0.380 J/g.K
- 25) How much energy is released when 50g of water cools from 75°C to 15°C?
- 26) How much energy is absorbed when 25g water at 25°C is heated to 105°C at 1atm?
- 27) How much energy is released when 10g of water at 115°C is cooled to -15°C at 1 atm?
- 28) Why can we not use $q = MC\Delta T$ for a phase change problem and what do we use?
- 29) 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
- 30) 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?
- 31) 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
- 32) 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?
- 33) 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) 1 atm, 800 mmHg, 1.05 atm, 1.07×10^5 Pa | 12) 343g/mole | 22) 773°C |
| 2) It will have the same number of moles.
The mass of the molecules and the gas velocity will be different. | 13) 1.98g/L | 23) Conduction (touch) Convection (fluid)
Radiation (EMW) |
| 3) CH ₄ | 14) It increases | 24) 647g |
| 4) 2 flask 1 : 1 flask 2 | 15) 731.7mmHg = 0.96atm | 25) 12,540 J |
| 5) 0.92L | 16) 28.3mmHg | 26) 64,587 J |
| 6) Example: a gas at 2L and 20°C is heated and the gas expands to 4L. What is the final temperature in °C? $586K = 313^\circ C$ | 17) Gases consist of small particles far apart | 27) 30,714 J |
| 7) If the number of moles are constant then the volume is the same. If the volume is constant then the # of moles is the same. | a. Collisions are elastic | 28) No Change in temperature $q = mL$ |
| 8) $0.14 \text{ moles} = 8.43 \times 10^{22}$ molecules | b. Gas particles are in continuous motion | 29) 66 g |
| 9) 35.84L | c. No attraction or repulsion between particles | 30) Copper |
| 10) Low pressure, high temperature, low number of moles | d. Kinetic energy directly related to temperature | 31) 30 °C |
| 11) 1174atm | 18) 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 | 32) The water temperature because it has the highest specific heat and will not change temperature as much. |
| | 19) 0.022moles | 33) 75 °C |
| | 20) aluminum | |
| | 21) 502 J | |

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- 1) How much heat is required to convert 30g of H₂O 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
- 2) When 1.095g of a substance is melted in 150.00g of water in a calorimeter, the temperature changes from 25.32°C to 23.5°C. What is the latent heat for this unknown substance that melted?
 - a. 1042 J
 - b. 521 J/g
 - c. 1042 J/g
 - d. 903 J/g
- 3) 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) $\text{N}_2(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{NH}_3(\text{g})$
(unbalanced) $\Delta H(25^\circ\text{C}) = -92.22 \text{ kJ}$
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
- 5) When 72 g of a metal at 97.0°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 H₂O = 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
- 6) 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
- 7) 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
- 8) 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
- 9) A gas 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 final pressure?
 - A) 0.0368 atm
 - B) -0.137 atm
 - C) 0.317 atm
 - D) 0.186 atm
 - E) 0.0626 atm
- 10) You fill a balloon with 2.50 mol of gas at 28°C at a P 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
- 11) 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
- 12) 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
 - C) 1.85 L
 - D) 3.44 L
 - E) none of these

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- 13) 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) 2.82×10^4 L
 - C) 187 L
 - D) 32.3 L
 - E) 16.1 L
- 14) 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
- 15) You have 32.8 g of O₂ gas in a container with twice the volume as one with CO₂ 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
- 16) 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.
- 17) Four identical 1.0-L flasks contain the gases He, Cl₂, CH₄, and NH₃, each at 0°C and 1 atm pressure. For which gas do the molecules have the highest average velocity?
- A) He
 - B) Cl₂
 - C) CH₄
 - D) NH₃
 - E) all gases the same
- 18) 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) F₂
 - B) N₂
 - C) H₂
 - D) O₂
 - E) Cl₂
- 19) 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
- 20) 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.
- 21) 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
- 22) Gaseous C₂H₄ reacts with O₂: $\text{C}_2\text{H}_4(\text{g}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$ What volume of oxygen gas at STP is needed to react with 3.94 mol of C₂H₄? (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
- 23) 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

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Use the following to answer questions 24-28:

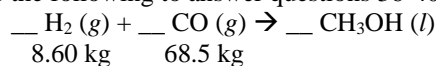
A combusted carbon compound is made up of carbon, hydrogen, and oxygen..2.78g of this sample is burned in excess oxygen to yield 5.68g of CO₂, and 1.75g of H₂O,.

- 24) What is the mass of carbon in the compound?
A) 0.75g
B) 1.01g
C) 1.55g
D) 0.62g
E) 2.46g
- 25) What is the mass of hydrogen in the compound?
A) 0.12g
B) 0.36g
C) 0.20g
D) 0.56
E) 0.42g
- 26) 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
- 27) What is the empirical formula of the sample?
A) CH₃O
B) CH₂O
C) C₄H₃₂O₂
D) C₂H₃O
E) CHO
- 28) What is the molecular formula of the sample if its molecular mass is 129.15g/mol
A) C₃H₁₂O₃
B) C₆H₉O₃
C) C₄H₁₆O₂
D) CHNO
E) C₂H₈O
- 29) 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) CH₂
B) CH₆
C) CH
D) C₃H
E) C₆H
- 30) Adipic acid contains 49.32% C, 43.84% O, and 6.85% H by mass. What is the empirical formula?
A) C₂HO₃
B) C₃H₅O₂
C) C₂H₅O₄
D) C₃HO₃
E) C₃H₃O₄

- 31). 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 CO₂ and 0.1767 g of H₂O. What is the empirical formula of the compound?
A) C₆H₃O₂
B) CHO
C) C₃H₆O₂
D) C₃H₃O₂
E) C₂H₂O
- 32) 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) C₃H₄O₃
B) C₄H₆O₄
C) C₆H₈O₆
D) C₂H₃O₂
- 33) 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 CO₂ and 2.58 g of H₂O. The properties of the compound suggest that the molar mass should be between 100 and 150. What is the molecular formula?
A) C₆H₂₄O₂
B) C₂H₃O₂
C) C₆H₁₂O₂
D) CH₂O
E) C₃H₆O
- 34) How many grams of H₂O will be formed when 32.0 g H₂ is mixed with 80.0 g of O₂ and allowed to react to form water?
A) 22.5 g
B) 144 g
C) 286 g
D) 45.0 g
E) 90.1 g
- 35) 28g of nitrogen dioxide and 18g of water are allowed to produce nitric acid (HNO₃) and nitrogen monoxide. If 22g of nitric acid are produced what is the percentage yield?
A) 100%
B) 56.27%
C) 86.05%
D) 113.64%
E) 72.43%

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Use the following to answer questions 36-40:



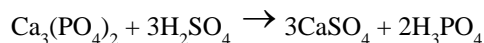
- 36) Which of the following sets of coefficients represent those of the balanced equation?
- A) 1, 1, 1
 B) 2, 2, 1
 C) 1, 2, 2
 D) 2, 1, 2
 E) 2, 1, 1
- 37) How many moles of the product are produced?
- A) 8.60×10^3
 B) 4.27×10^3
 C) 2.14×10^3
 D) 2.45×10^3
 E) 8.54×10^3
- 38) What is the percent yield if the actual yield is 3.57×10^4 g?
- A) 92%
 B) 88%
 C) 52%
 D) 103%
 E) 76%
- 39) Which of the following is the limiting reagent?
- A) All are limiting
 B) $\text{CH}_3\text{OH}(l)$
 C) $\text{H}_2(g)$
 D) $\text{CO}(g)$
 E) None of these
- 40) How many grams of the product are produced?
- A) 2.74×10^5
 B) 8.60×10^3
 C) 6.86×10^4
 D) 1.20×10^5
 E) 3.56×10^4

- 41) Suppose the unbalanced reaction

$\text{Ca}_3(\text{PO}_4)_2 + \text{H}_2\text{SO}_4 \rightarrow \text{CaSO}_4 + \text{H}_3\text{PO}_4$ is carried out starting with 103 g of $\text{Ca}_3(\text{PO}_4)_2$ and 59.3 g of H_2SO_4 . How much phosphoric acid (H_3PO_4) will be produced?

- A) 39.5 g
 B) 108.0 g
 C) 65.1 g
 D) 59.3 g
 E) 88.9 g

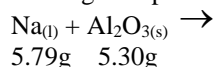
- 42) Phosphoric acid can be prepared by reaction of sulfuric acid with “phosphate rock” according to the equation:



Suppose the reaction is carried out starting with 103 g of $\text{Ca}_3(\text{PO}_4)_2$ and 75.0 g of H_2SO_4 . Which substance is the limiting reactant?

- A) CaSO_4
 B) H_3PO_4
 C) H_2SO_4
 D) $\text{Ca}_3(\text{PO}_4)_2$
 E) none of these

- 43) What mass of excess reactant remains at the end of the single displacement reaction below?



- A) 1.02g Na
 B) 1.02g Al_2O_3
 C) 2.16g Na
 D) 3.36g Al_2O_3
 E) 2.16g Al_2O_3

Answer Key

- 1) B
 2) C
 3) C
 4) B
 5) A
 6) E
 7) D
 8) B
 9) E
 10) C
 11) C
 12) B
 13) A

- 14) A
 15) C
 16) B
 17) A
 18) A
 19) C
 20) B
 21) E
 22) C
 23) C
 24) C
 25) C
 26) D
 27) D
 28) B

- 29) A
 30) B
 31) D
 32) C
 33) C
 34) E
 35) C
 36) E
 37) C
 38) C
 39) C
 40) C
 41) A
 42) C
 43) B