

Equations and constants you may need:

$$\Delta E_{\text{system}} = q + w \quad PV = nRT \quad R = 0.0821 \text{ (L*atm)/(mole*K)} \quad \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$P_T = p_1 + p_2 + p_3 \quad \chi = \text{moles A/total moles} \quad \chi_1 P_T = p_1$$

$$w = -P\Delta V \quad \text{K.E.} = \frac{1}{2} m * \mu_{rms}^2 \quad \mu_{rms} = \sqrt{\frac{3RT}{M}} \quad R = 8.314 \text{ J/(mole*K)}$$

$$d = \frac{PM}{RT} \quad J = \frac{\text{kg} * \text{m}^2}{\text{s}^2} \quad M = \text{molar mass}$$

$$101\text{J} = \text{L} \times \text{atm} \quad 14.7 \text{ psi} = 1 \text{ atm} \quad 101325 \text{ Pa} = 1 \text{ atm} \quad 760 \text{ torr} = 1 \text{ atm}$$

At constant pressure,  $q_p = \Delta H$ ,  $\Delta H =$  enthalpy of the reaction

$$q_{\text{gained}} = -q_{\text{lost}} \quad q = m * C_s * \Delta T \quad q = n * C_m * \Delta T$$

$$\Delta H_{\text{rxn}} = \Delta H_{\text{products}} - \Delta H_{\text{reactants}}$$

- (5 points) What is the change in internal energy ( $\Delta E$ ) when a system is heated with 60.0 J of energy while it does 15J of work?
- (5 points) What is the final temperature of a solution when a 10.0 g copper rod at 220.0°C is added to 200.0 mL of water at 20.0°C?
- (3 points) Which statement A–D about energy units is correct?
  - The SI unit of energy is the kilo Joule (kJ).
  - In terms of SI base units,  $1 \text{ J} = 1 \text{ kg m}^2 \text{ s}^{-2}$ .
  - A nutritional calorie (1 Cal) is 4.184 J.
  - A nutritional calorie (1 Cal) is equal to 1,000 cal.
  - Statements A–D all are correct.
- (3 points) If a chemical reaction causes the temperature of the container to drop, it is a(n) \_\_\_\_\_ reaction.
  - exothermic
  - fast
  - spontaneous
  - slow
  - endothermic

5. (15 points) Using the following data for water, determine how much energy is needed to change 75 g of ice at  $-18^{\circ}\text{C}$  to steam at  $260^{\circ}\text{C}$ . Show all of your work to earn any points.

Boiling point	$100^{\circ}\text{C}$
Melting point	$0^{\circ}\text{C}$
Enthalpy of vaporization	$2,260\text{ J/g}$
Enthalpy of fusion	$334\text{ J/g}$
Specific heat capacity (solid)	$2.11\text{ J/(g } \times^{\circ}\text{C)}$
Specific heat capacity (liquid)	$4.18\text{ J/(g } \times^{\circ}\text{C)}$
Specific heat capacity (gas)	$2.08\text{ J/(g } \times^{\circ}\text{C)}$

6. (5 points) The total pressure of a gas cylinder that contains both oxygen and nitrogen is 1.8 atm. The mole fraction of oxygen in the cylinder is 0.21 atm, what is the partial pressure of the oxygen gas in the cylinder?
7. (3 points) Which of the following is not important when using the ideal gas law?
- The chemical identity of the gas sample.
  - The temperature of the gas sample.
  - The amount of gas.
  - The pressure of the gas sample.
  - The volume of the container holding the gas sample.
  - All of these are important
8. (3 points) Which of the following reactions will result in a decrease in total pressure?
- $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$
  - $2\text{HI}(\text{g}) \rightarrow \text{H}_2(\text{g}) + \text{I}_2(\text{g})$
  - $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
  - $2\text{N}_2\text{O}(\text{g}) \rightarrow 2\text{N}_2(\text{g}) + \text{O}_2(\text{g})$
  - none of these
9. (3 points) In a mixture of gases, the gas with the smallest mole fraction (X) will have the:
- largest number of molecules present.
  - smallest number of molecules present.
  - largest molar mass.
  - highest kinetic energy.
  - smallest molar mass.

10. (5 points) Propane is the fuel that many people use to grill delicious hamburgers. When 152 g of propane ( $C_3H_8$ ) reacts with excess oxygen in a constant pressure calorimeter, the temperature of the calorimeter increases by  $20.3^\circ C$ . The heat capacity of the calorimeter is  $5.46 \text{ kJ}/^\circ C$ . Determine the molar enthalpy of combustion of propane.

11. (5 points) A sample of gas at 1.5 atm and 350.0 mL is heated from  $10^\circ C$  to  $120^\circ C$ . If the pressure remains constant, what is the final volume of the gas?

12. (5 points) A balloon is filled with 6.00 L of helium at a pressure of 772 torr. What is the volume of the balloon at an altitude where the pressure in the balloon is 300 torr? The temperature is constant.

13. (10 points) One of the gas laws is related to breathing. What is the name of the gas law? What is this gas law? Fully describe how this gas law is related to breathing.

14. (15 points) How much ice is needed to chill 30 cans of Diet Pepsi from 22°C to 4°C. Show your work. The ice is at -10°C. The cans weigh 13 grams and are made of Aluminum. Each can contains 355 mL of Diet Pepsi. The density of the Diet Pepsi is 1.0 g/mL. The table contains constants for water (use them for the Diet Pepsi and for the ice). The specific heat capacity of Aluminum is 24.4 J/mole°C. Show all of your work to earn any points.

Boiling point	100 °C
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