Ideal Gas Law and Heat

Directions: Show the solutions (i.e. your work) to these on a separate sheet of paper.

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| 2.24x10-2 m3  22.4 liters | 1. What is the volume of one mol of an ideal gas at standard temperature and pressure (STP)? (P = 1.000 atm = 1.013x105 Pa, T = 0oC = 273 K) What is the volume in liters (1 m3 = 1000 liters) |
| .545 mols  1.09x105 Pa  1.08 atm  8 x103 Pa, .08 atm | 2. Anita Breke fills a large helium balloon with 2.18 grams of Helium gas. How many mols of He is this? What is the pressure in the balloon if the gas occupies a volume of 12.05 liters (1000 liters = 1 m3) at a temperature of 18.0 oC? (Beware the ides of Celsius!) What is that pressure in atmospheres? What is the gauge pressure in Pa and Atmospheres? Pgauge = Pabsolute – 1 atm) |
| 3.18x105 Pa  10.3 mols  290. g | 3. A reaction vessel operates at 3.14 atmospheres. What is that pressure in Pa? If the vessel has a volume of .113 m3, is at a temperature of 145 oC, and contains pure Nitrogen gas, how many mols of nitrogen gas does it contain? How many grams of Nitrogen does it contain? (None Of Fred’s Clients Bring Iron Hats – Nitrogen is a diatomic gas) |
| 1.37x106 Pa  44.2 mols  804 K  531 oC | 4. A container has a volume of 216 liters. (1000 liters = 1 m3) If it can sustain a pressure of 13.5 atmospheres before bursting, and contains 89.1 grams of Hydrogen gas, a) what is its bursting pressure in Pa? b) how many mols of Hydrogen does it contain? and c) what is its maximum operating temperature in K and oC? |
| -26 oC | 5. A 2.00 liter bottle contains 18.15 grams of Bromine gas and is at a gauge pressure of .153 atm. What is its temperature in Celsius? |
| 1.27 atm | 6. A Tupperware container is at 1.00 atm at 21.0 oC. (Convert to K) It is heated in a microwave to 99.5 oC with the lid on. Assuming no gas escapes, what is the pressure inside in atm? |
| 8.81x104 Pa | 7. A quantity of ideal gas is compressed at constant temperature from 34.5 liters to 12.4 liters. What was the initial pressure if the final pressure was 2.45x105 Pa? |
| 240. K  -34 oC | 8. A balloon has a volume of 1.25 liters at 20.5 oC. At what temperature does it have a volume of 1.02 liters, assuming the pressure and mols remain constant? Find the temperature in K and oC |
| 23.5 liters | 9. One mol of an ideal gas occupies 22.4 liters at STP. (P = 1.000 atm T = 0.00oC) What volume does it occupy at 97.0 oC and 1.29 atm? |
| **(For H2O: Cice = 2100 J/kgoC, lf = 3.33 x 105 J/Kg, Cwater = 4186 J/KgoC, lv = 22.6 x 105 J/Kg, Csteam = 2010 J/kgoC)** | |
| 1.54x106 J | 10. What heat do you need to heat 2.15 Kg of ice at -34.0 oC to water at 75.0 oC? |
| 8.83x106 J | 11. What heat do you need to heat 3.61 Kg of water at 76.0 oC to steam at 142 oC? |
| 4640 J kg-1 oC-1 | 12. 112. grams of a mystery liquid at 83.0 oC is mixed with 564 grams of water initially at 22 oC. The final temperature of the mixture is 33.0 oC. What is the specific heat of the mystery liquid? (Assuming no heat was lost to the surroundings) |
| 5.02 kg | 13. A piece of lead (c = 130 J/kgoC) at 82.0 oC is mixed with 112 grams of water and a 87.5 g aluminum (c = 900. g/kgoC) calorimeter cup initially at 25.0 oC. The final temperature of the system is 56.0 oC. What is the mass of the piece of lead? (Assuming no heat was lost to the surroundings) |
| 2310 J | 14. How much work to isobarically compress a gas at 105 kPa from 0.067 m3 to 0.045 m3? |
| 7.6x105 Pa | 15. A piston compresses isobarically from a volume of 0.035 m3 to 0.017 m3. If this requires 13,700 J of work, what was the pressure? |
| 1: -240. J  2: 0  3: +30.0 J  4: 0  Net: -210. J | 16. The system starts at a pressure of 200. Pa and a volume of 1.40 m3 and goes through these four processes:   1. Isobaric (constant pressure) compression to 0.20 m3 2. Isochoric (constant volume) cooling to 25. Pa 3. Isobaric expansion to 1.40 m3 4. Isochoric heating to 200. Pa   Draw all four processes on a PV graph, and label them. Calculate the work done by each process, and the total (net) work done by the complete cycle. (all 4 processes) |