



## AP Chemistry 1999 Sample Student Responses

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a)  $MM = \frac{gRT}{PV}$ ,  $R = .0821 \text{ L}\cdot\text{atm}/\text{K}\cdot\text{mol}$

b.)  $g$ , grams of gas = mass full container - mass empty container (analytical balance)

$T$ , temperature of gas (thermometer)

$P$ , pressure of gas = pressure of system - equilibrium vapor pressure of water (barometer)

$V$ , volume of gas (graduated cylinder)

c.) ~~Errors~~ pressures inside and outside of tube are equal. Otherwise would affect volume calculations

d.)  $\% \text{ error} = \frac{|\text{Theoretical} - \text{Expt}|}{\text{Theor.}} = \frac{|68 - 64|}{58}$

e.) If not accounted for, the gas pressure is assumed too high. Since gas pressure is in the denominator of the equation, its increase will result in a net decrease (smaller value).

a)  $d = \frac{PMW}{RT}$  where  $d = \text{density}$   
 $MW = \frac{dRT}{P}$   
 $R = \text{gas constant } (0.0821 \frac{\text{L atm}}{\text{mol} \cdot \text{K}})$   
 $T = \text{temperature}$   
 $P = \text{pressure}$

b.) the temperature (T) - thermometer  
 the volume (V) graduated tube  
 the density (g/L [mass/volume]) analytical balance (mass)  
 the gas constant (R [0.0821  $\frac{\text{atm} \cdot \text{L}}{\text{mol} \cdot \text{K}}$ ])  
 the mass (see density)  
 the pressure (using the table of the equilibrium vapor pressure)

c.) Equalizing the water levels inside and outside the gas collection tube is done to make sure that all of the gas has been collected. This is why the collection of gas over water is so efficient. Once the water levels inside and outside the tube are equal, the gas will stop being released because it's already been collected.

d.) percent error =  $\frac{\text{actual value}}{\text{theoretical value}} \cdot 100\%$   
 $= \frac{61 \text{ g/mol}}{58 \text{ g/mol}} \times 100\% = \text{percent error}$

e.) The information in the table of the equilibrium vapor pressures of water are given ~~at~~ with the corrected pressure. When a gas is collected over water, it must be corrected. The student did not use a corrected pressure for the gas. Therefore, because the <sup>pressure of</sup> gas is not corrected, the student's calculated value would be smaller than the actual value.

(a) molar mass =  $\frac{\text{grams}}{\text{moles}}$

(b) grams and moles

(c) The purpose of equalizing the water inside and outside the gas collection tube is to keep the volume constant so you don't mess up the calculations.

(d) % error =  $\left( \frac{\text{actual} - \text{experimental}}{\text{actual}} \right) \times 100\%$

$$= \frac{64 - 58}{64} \times 100\%$$

$$= \frac{6}{64} \times 100\%$$

(e) The molar mass will be smaller because he will be multiplying it by a less amount.