PURPOSE HOW CAN WE QUANTIFY THIS INVISIBLE ENERGY STUFF?

WARMUP: "When solving PV=nRT problems using 0.0821 what four units are required?

1) _____

2) _____

3) _____

4) _____

ENERGY COMING AND GOING IS LIKE MONEY COMING AND GOING FROM YOUR WALLET. Brainstorm some ways money could enter or leave. Make each word end in "ING"

Wallet $

increases	decreases
paychecking	bill paying
money finding	giving
gift opening	donating
	losing

THREE WAYS CHEMISTS STORE ENERGY

E_{th} is thermal energy.

E_{ph} is phase energy

high – gas
medium – same substance as liquid
low – solid

E_{ch} is chemical energy

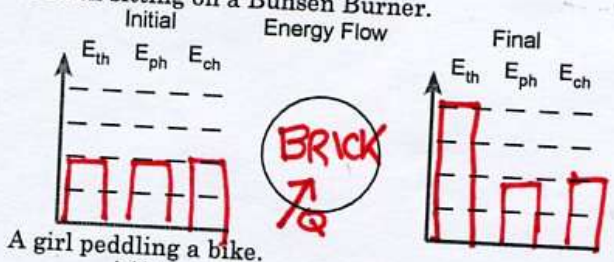
Three ways chemists show energy entering and leaving

Q is heating

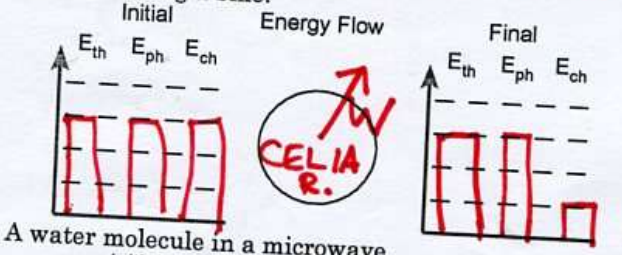
W is working (pushing)

R is radiating

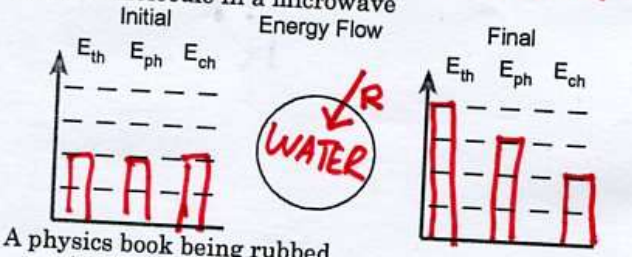
A brick sitting on a Bunsen Burner.



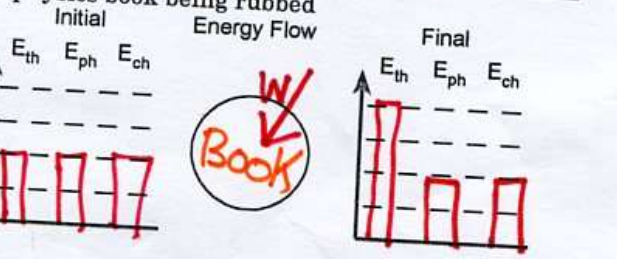
A girl peddling a bike.



A water molecule in a microwave



A physics book being rubbed



Answers to Giraffe Back Page

1) $n = 0.0199$ moles

2) (not a 426 mL NOW PROBLEM - OOPS)

3) $n = 1.39$ mol

4) $T = 95.3$ K

3.

You will always be given these numbers on tests and quizzes.

0 degrees C = 273 kelvins. 760. torr = 760. mmHg = 1.00 atm = 101 kPa = 101,300 pascals = 14.7 p.s.i.
R = 0.0821 liter-atm/mol-K (for PV=nRT problems, if you use this R value you must use these units)

SOLVE THESE FOUR PROBLEMS USING THE "NOW" FORMULA

1. Carbon monoxide, a poisonous gas, has a formula of CO. How many moles of carbon monoxide occupy a volume of 0.445 L at STP?

step ① $PV = nRT$

step ② $n = \frac{PV}{RT}$

step ③ $n = \frac{(1.00\,atm)(.445\,L)}{(0.0821 \frac{L\,atm}{mol\,K})(273K)}$

$n = 0.0199$ moles

2. Ammonia gas occupies a volume of 450 mL at a pressure of 720 mm Hg. What volume will it occupy at standard pressure?

SKIP 2

$V = \frac{nRT}{P}$

3. A gas filled weather balloon contains 33.0 L of air at 10.0°C at a pressure of 745. Torr. How many moles of gas are in the balloon?

$n = \frac{PV}{RT}$

$n = \frac{(0.980\,atm)(33.0\,L)}{(0.0821 \frac{L\,atm}{mol\,K})(283K)}$

$n = 1.39$ mol

4. At what temperature would you need to have He to have 5.75 moles occupy a volume of 45.0L at standard pressure?

$T = \frac{PV}{nR}$

$T = \frac{(1.00\,atm)(45.0\,L)}{(0.0821 \frac{L\,atm}{mol\,K})(5.75\,mol)}$

$T =$

$T = 953$ K

The Ideal Gas Law

CHeMis+ry: http://genest.weebly.com

Stop in for help every day at lunch and Tues, Weds., &Thurs after school!

After-hours question? Email me at home: eogenest@madison.k12.wi.us

ANSWERS

Name_____

Period_____

1. What volume will 0.693 moles of oxygen be at STP?

(check one) This problem's type is: ☐*before-and-after* ☒*now*

It can be solved using ☐*ratios* ☒*PV=nRT*

$PV = nRT \qquad V = \frac{nRT}{P} \qquad V = \frac{(0.693\,mol)\left(0.0831\,\frac{L\,atm}{mol\,K}\right)(273\,K)}{(1.0\,atm)}$

$V = 15.7\,L$

2. What will be the new volume if 250 mL of gas at STP changes to 4.0 atmospheres pressure and 30°C temperature?

(check one) This problem's type is: ☒*before-and-after* ☐*now*

It can be solved using ☒*ratios* ☐*PV=nRT*

$250\,mL \times \left(\frac{1.0\,atm}{4.0\,atm}\right) \times \left(\frac{303\,K}{273\,K}\right) = 69\,mL$

3. A 9.0L sample of gas is at STP. When the temperature is raised to 273°C and the pressure remains constant, what will be the new volume of the gas?

(check one) This problem's type is: ☒*before-and-after* ☐*now*

It can be solved using ☒*ratios* ☐*PV=nRT*

$9.0\,L \times \left(\frac{546\,K}{273\,K}\right) \times \left(\frac{1.00\,atm}{1.00\,atm}\right) = 18.0\,L$

4. Carbon monoxide, a poisonous gas, has a formula of CO. How many moles of carbon monoxide occupy a volume of 0.445 L at STP?

(check one) This problem's type is: ☐*before-and-after* ☒*now*

It can be solved using ☐*ratios* ☒*PV=nRT*

$PV = nRT \qquad n = \frac{PV}{RT} \qquad n = \frac{(1.00\,atm)(0.445\,L)}{\left(0.0831\,\frac{L\,atm}{mol\,K}\right)(273\,K)}$

$n = 0.0196\,mol$

5. Ammonia gas occupies a volume of 450 mL at a pressure of 720 mm Hg. What volume will it occupy at standard pressure?

(check one) This problem's type is: ☒*before-and-after* ☐*now*

It can be solved using ☒*ratios* ☐*PV=nRT*

~~$PV = nRT$~~ ~~$V = \frac{nRT}{P}$~~ ~~V~~

$450\,mL \times \left(\frac{720\,mmHg}{760\,mmHg}\right) = 426\,mL \approx 430\,mL$

6. A gas filled weather balloon with a volume of 30.0 L is released at sea level at 100.1 kPa and 18.0°C. Find the volume the balloon will be at maximum altitude where the temperature is 241.0 kelvins and the pressure is 0.604 atm.

(check one) This problem's type is: ☒*before-and-after* ☐*now*
It can be solved using ☒*ratios* ☐*PV=nRT*

$100.1\,kPa \times \left(\frac{1.00\,atm}{101.3\,kPa}\right) = 0.988\,atm$

$30.0\,L \times \left(\frac{0.988\,atm}{0.604\,atm}\right) \times \left(\frac{241.0\,K}{273\,K}\right) = 43.3\,L$

7. A gas filled weather balloon with a volume of 80.0 L is released at sea level at 102.0 kPa pressure and 27.0°C. The balloon expands to final volume of 835.0L at maximum altitude, where the temperature is 0.00°C. What will be the pressure at this time?

(check one) This problem's type is: ☒*before-and-after* ☐*now*
It can be solved using ☒*ratios* ☐*PV=nRT*

$102.0\,kPa \times \left(\frac{80.0\,L}{835.0\,L}\right) \times \left(\frac{273\,K}{300.00\,K}\right) = 8.89\,kPa$

8. A gas filled weather balloon contains 33.0 L of air at 10.0°C at a pressure of 745. Torr. How many moles of gas are in the balloon?

(check one) This problem's type is: ☐*before-and-after* ☒*now*
It can be solved using ☐*ratios* ☒*PV=nRT*

$PV = nRT \qquad \frac{PV}{RT} = n$

$\frac{(0.980\,atm)(33.0\,L)}{(0.0831\,\frac{L\,atm}{mol\,K})(283\,K)} = n$

$1.37\,moles = n$

9. At what temperature would you need to have He to have 5.75 moles occupy a volume of 45.0L at standard pressure?

(check one) This problem's type is: ☐*before-and-after* ☒*now*
It can be solved using ☐*ratios* ☒*PV=nRT*

$\frac{PV}{nR} = T \qquad \frac{(1.00\,atm)(45.0\,L)}{(5.75\,moles)(0.0831\,\frac{L\,atm}{mol\,K})} = T \qquad 94.2^{K} = T$

10. A sample of oxygen gas occupies a volume of 250 mL at 23.8 psi. What volume will it occupy at 19.5 psi pressure?

(check one) This problem's type is: ☒*before-and-after* ☐*now*
It can be solved using ☒*ratios* ☐*PV=nRT*

$250\,mL \times \left(\frac{23.8\,psi}{19.5\,psi}\right) = 305 \approx 310\,mL$