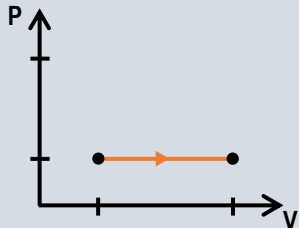
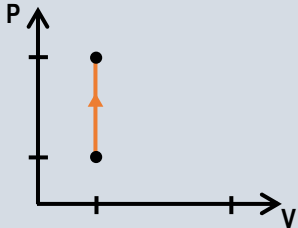
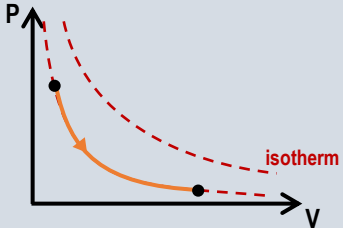
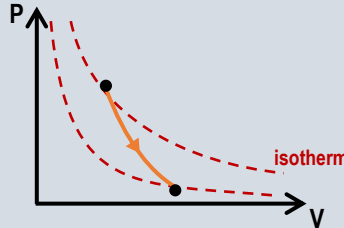


CONCEPT: HEAT EQUATIONS FOR ISOBARIC AND ISOVOLUMETRIC PROCESSES

- We know the work equations for isobaric and isovolumetric processes, but you'll also need to know the heat equations.

SPECIAL THERMODYNAMIC PROCESSES				
Isobaric (Constant P)		Isovolumetric (Constant V) a.k.a. "Isochoric"		Isothermal (Constant T)
 Straight Horizontal line		 Straight Vertical line		 "Isotherm" Curve (1 for each T) - Farther from origin = Higher T
ΔE_{int}	$Q - W$	$\Delta E_{int} = Q$		0
Q	$Q = \underline{\hspace{2cm}}$	$Q = \underline{\hspace{2cm}}$		$Q = W$
W	$P\Delta V$	0		$nRT \cdot \ln\left(\frac{V_f}{V_i}\right)$
				Adiabatic ($Q = 0$)
				 - No Heat Transfer - Steeper than isotherms
				$\Delta E_{int} = -W$
				0

- Remember: we used $Q = mc\Delta T$ for solids & liquids, but we use a different EQ for gases.

- Remember: c = specific heat *per kg*.
- For gases, we use C = specific heat *per* _____ (a.k.a molar specific heat)

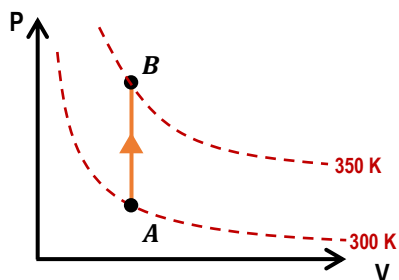
C_P = Molar Specific Heat at constant pressure

C_V = Molar Specific Heat at constant volume

- Values for C_V & C_P depend only on gas type.

GAS TYPE	C_V	C_P
Monoatomic	$\frac{3}{2}R$	$\frac{5}{2}R$
Diatomic	$\frac{5}{2}R$	$\frac{7}{2}R$
THERMO CONSTANTS		
$R = 8.314 \frac{J}{mol \cdot K}$		

EXAMPLE: 3 mol of a monoatomic gas undergo the process shown below. Calculate ΔE_{int} .



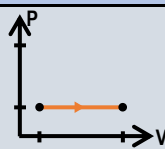
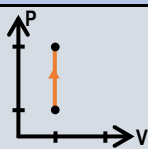
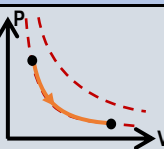
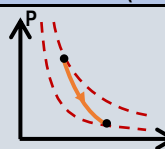
- Remember: the farther away from the origin, the higher the temperature.

If process goes away from origin, Q & ΔT are $[+ | -]$

If process goes toward origin, Q & ΔT are $[+ | -]$,

PROBLEM: How much heat energy is needed to increase the temperature of 5 mol of an ideal diatomic gas by from 273K to 300K if the **a)** pressure is held constant; **b)** the volume is held constant?

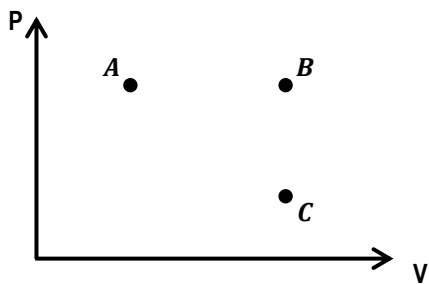
- A) 3928 J ; 2806 J
- B) 3928 J; 1683 J
- C) 135 J ; 135 J
- D) 3.97×10^4 J ; 4.36×10^4 J

Iso- P		Iso- V	Iso- T	Adiabatic ($Q=0$)
				
ΔE_{int}	$Q - W$	$\Delta E_{int} = Q$	0	$\Delta E_{int} = -W$
Q	$nC_P\Delta T$	$nC_V\Delta T$	$Q = W$	0
W	$P\Delta V$	0	$nRT \cdot \ln\left(\frac{V_f}{V_i}\right)$	

GAS TYPE	C_V	C_P
Monoatomic	$\frac{3}{2}R$	$\frac{5}{2}R$
Diatomic	$\frac{5}{2}R$	$\frac{7}{2}R$

THERMO CONSTANTS
$R = 8.314 \frac{J}{mol \cdot K}$

PROBLEM: 3 mol of a monoatomic gas are initially at 293K at point **A**. You add 2000J of heat to the gas at constant pressure until it reaches point **B**, then remove 2000J of heat at constant volume until it reaches point **C**. Draw these processes on the PV diagram and calculate the temperature of the gas at point **C**.



Iso- <i>P</i>		Iso- <i>V</i>		Iso- <i>T</i>		Adiabatic (<i>Q</i> =0)	
ΔE_{int}	$Q - W$	$\Delta E_{int} = Q$		0		$\Delta E_{int} = -W$	
Q	$nC_P\Delta T$	$nC_V\Delta T$		$Q = W$		0	
W	$P\Delta V$	0		$nRT \cdot \ln\left(\frac{V_f}{V_i}\right)$			

GAS TYPE	C_V	C_P
Monoatomic	$\frac{3}{2}R$	$\frac{5}{2}R$
Diatomic	$\frac{5}{2}R$	$\frac{7}{2}R$

THERMO CONSTANTS
$R = 8.314 \frac{J}{mol \cdot K}$