Name: _____

Class: _____

Due Date: _____

Physics Topic 26A Thermodynamics – First and Zeroth Law

Answer the following questions. The solutions to this worksheet can be found on the YouTube channel Go Physics Go.

1. C: Define *thermodynamics*.

2. C: Define a *closed system*.

3. C: Define an *isolated system*.

4. C: State the *first law of thermodynamics*.

5. C: Consider a system filled with an ideal gas and the equation for the law of conservation of energy $Q = \Delta U + W$.

   a. Define ΔU. What is the meaning if $\Delta U > 0$ Joules? $\Delta U = 0$ Joules? $\Delta U < 0$ Joules?

b. Define W. What is the meaning if $W > 0$ Joules? $W = 0$ Joules? $W < 0$ Joules?

c. Define Q. What is the meaning if $Q > 0$ Joules? $Q = 0$ Joules? $Q < 0$ Joules?

6. E: 8.42×10^3 J of heat is given to a closed system while the system does 4.37×10^3 J of work. What is the change in internal energy of the system during this process?

7. E: A closed system absorbs 2.33×10^3 J and at the same time 1.24×10^3 J of work is done on it. What is the change in internal energy of the system during this process?

8. E: 9.97×10^3 J is removed from a gas held at a constant volume. What is the change in internal energy of the system during this process?

9. E: 246 J of thermal energy is used to compress a gas while its internal energy increases by 122 J. Determine the amount of energy leaving the system.

10. E: In a slow isothermal compression 3.45×10^4 J of work is done on an ideal gas. Determine the work done on the gas.

11. E: During a slow isothermal expansion 3.45×10^4 J of work is done by an ideal gas. Determine the work done by the gas.

12.C: Describe the equation $W = P\Delta V$.

13.E: An ideal gas in a piston is compressed from an initial volume of 1.87×10^{-1} m^3 to a final volume of 1.03×10^{-1} m^3 at a constant pressure of 4.04×10^5 Pa. The initial temperature of the ideal gas, before expansion, is 406 K. Determine the work done on the ideal gas and the final temperature of the ideal gas.

14.E: An ideal gas in a piston is expanded from an initial volume of 9.87×10^{-1} m^3 to a final volume of 1.23×10^{0} m^3 at a constant pressure of 3.03×10^{5} Pa. The initial temperature of the ideal gas, before expansion, is 398 K. Determine the work done by the ideal gas and the final temperature of the ideal gas.

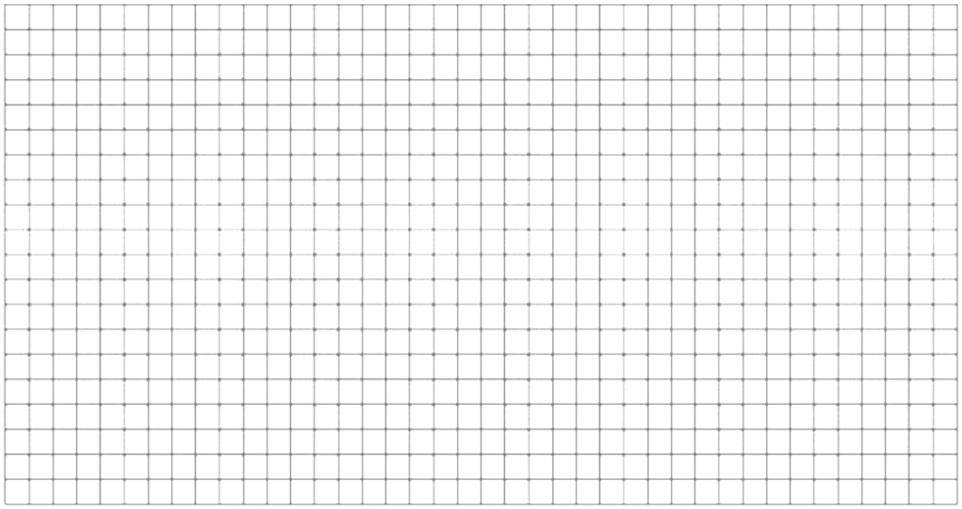
15.C: Describe the equation $\Delta U = \frac{3}{2} N k_{\mathrm{B}} \Delta T = \frac{3}{2} nR\Delta T$.

16.C: Define *thermal equilibrium.*

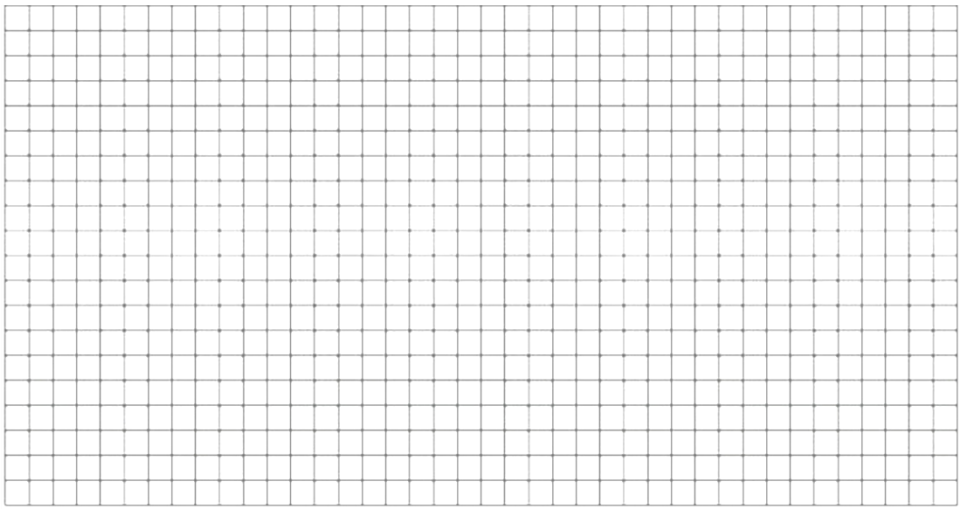
17.C: State the *zeroth law of thermodynamics.*

18.C: What does the area under a *pressure vs. volume graph* tell us?

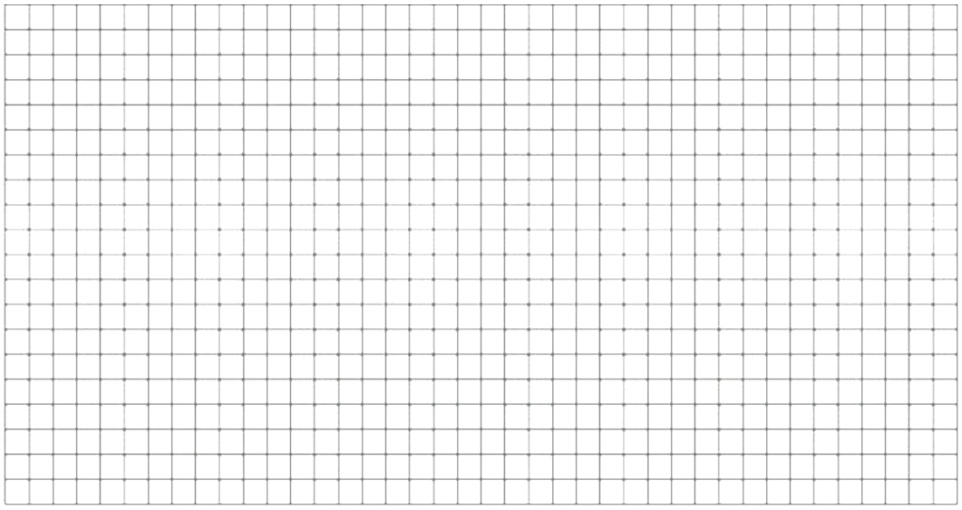
a. Define *isothermal process*. Draw three *isothermal processes (isotherms)* on a *pressure vs. volume* graph.



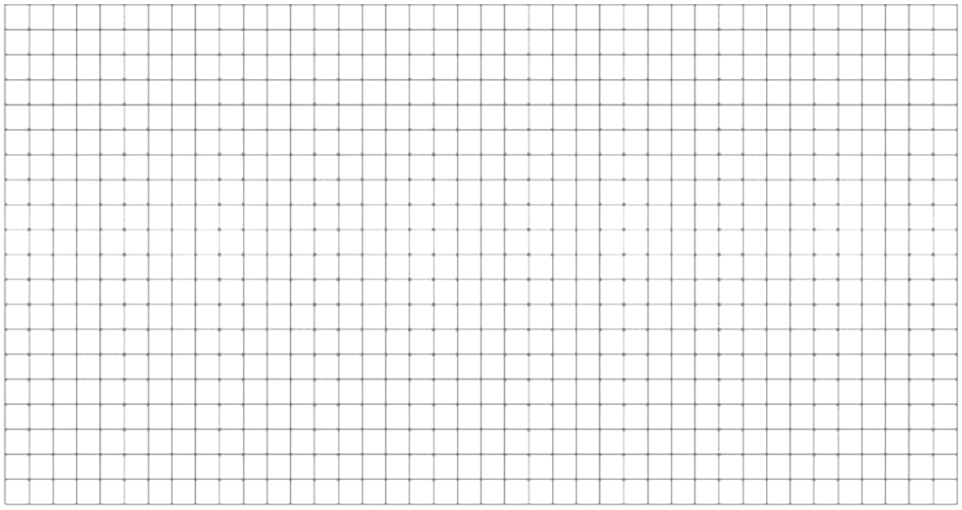
b. Define *isobaric process*. Draw an *isobaric process* on a *pressure vs. volume graph*.



c. Define *isochoric/isovolumetric process*. Draw an *isochoric/isovolumetric* process on a *pressure vs. volume* diagram.



d. Define *adiabatic process*. Draw an *adiabatic process* on a *pressure vs. volume* graph.



19.E: A gas does 1.00×10^3 J of work while a closed system expands adiabatically. Determine the change in internal energy.

20.E: 1.23×10^3 J of work is done on a closed system during an adiabatic compression. Determine the change in internal energy.