

Fizix-Power



# ***Fizix*** **Power**

***Interactive Discovery, Exploration,  
and Application of Physics***

***A Learning Tool for  
High-School and College Physics***

***Actus Potentia, Inc. (Patent Pending)***

**START**

# What will it do for the students?

- High School
  - Build problem solving skills
  - Expose the reality behind the equations
  - Change perception that “physics is hard”
  - Attract more students in science & engineering
  - Help disadvantaged students

# What will it do for the students?

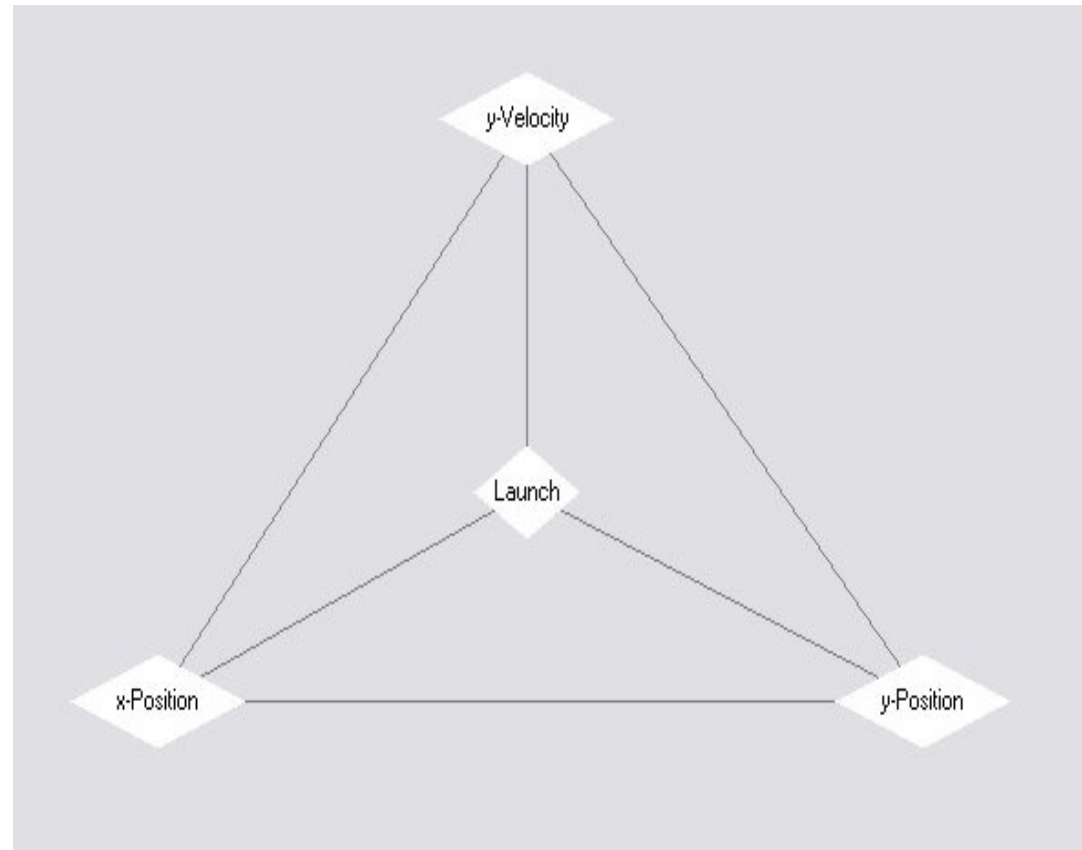
- College
  - 24-7 help in large classes
  - Change perception that “Physics is a weed-out class”
  - Excite them about what lies beyond Introductory Physics
  - Better prepared for specializations
  - Retention

# What will it do for the students?

- Helps entire spectrum of performers
  - High performers can explore on their own and go beyond the expectations in a beginning Physics course
  - Low performers improve their ability with more practice and help from the software.

# How Concept-Map Works-1

Concept Map for  
Projectiles



# How Concept-Map Works-2

Pose problem  
on “Variables”  
window

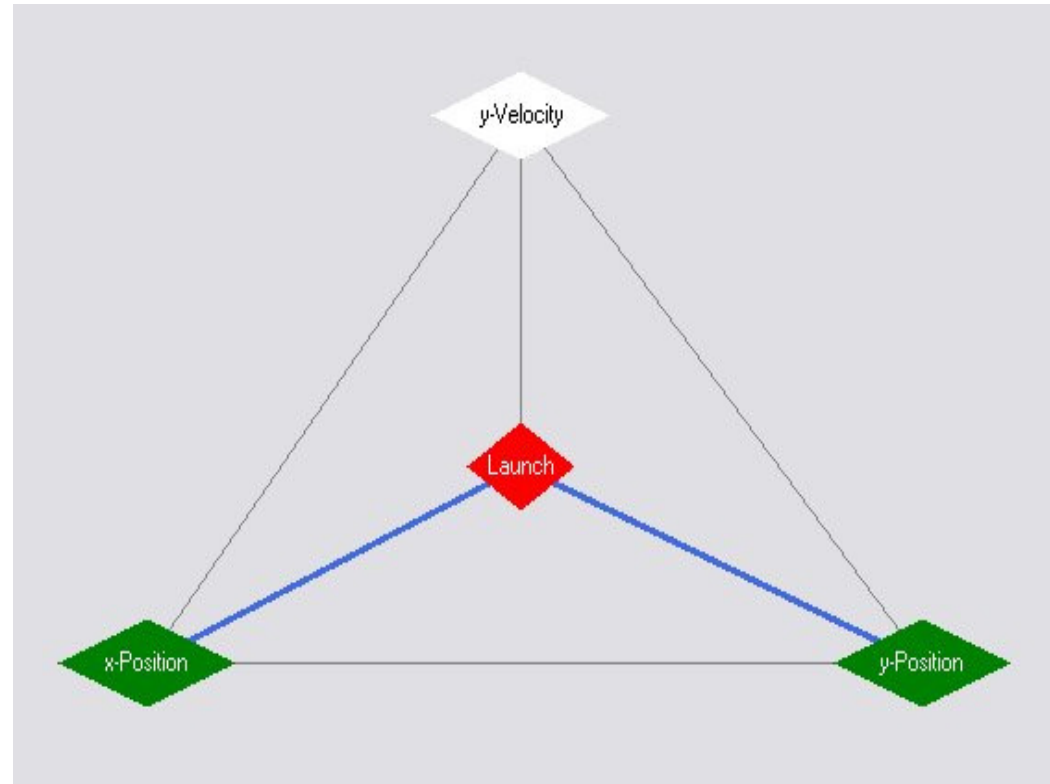
Displaying all variables in map

Accept Changes (Enter)    Discard Changes (Esc)    Add Derived Variables

KNOWN variables Check all the variables you know.	DESIRED variables Check the one variable you need.
<input checked="" type="checkbox"/> Gravity - g	<input type="radio"/> Gravity - g
<input checked="" type="checkbox"/> Launch Angle - theta	<input type="radio"/> Launch Angle - theta
<input type="checkbox"/> Launch Velocity - V	<input checked="" type="radio"/> Launch Velocity - V
<input type="checkbox"/> Time - t	<input type="radio"/> Time - t
<input checked="" type="checkbox"/> x-Final - x <sub>f</sub>	<input type="radio"/> x-Final - x <sub>f</sub>
<input checked="" type="checkbox"/> x-initial - x <sub>i</sub>	<input type="radio"/> x-initial - x <sub>i</sub>
<input type="checkbox"/> x-Velocity - V <sub>x</sub>	<input type="radio"/> x-Velocity - V <sub>x</sub>
<input checked="" type="checkbox"/> y-Final - y <sub>f</sub>	<input type="radio"/> y-Final - y <sub>f</sub>
<input checked="" type="checkbox"/> y-Initial - y <sub>i</sub>	<input type="radio"/> y-Initial - y <sub>i</sub>
<input type="checkbox"/> y-Velocity Final - V <sub>yf</sub>	<input type="radio"/> y-Velocity Final - V <sub>yf</sub>
<input type="checkbox"/> y-Velocity Initial - V <sub>yi</sub>	<input type="radio"/> y-Velocity Initial - V <sub>yi</sub>

# How Concept-Map Works-3

Concept-Map  
displays  
solution-path



# How Concept-Map Works-4

Concept-Map  
displays  
solution-steps

Post Processing

Step 1: Solved variable "x-Velocity"  
in equation "Launch"

Step 1: Solved variable "Launch  
Velocity" in equation "Launch"

Step 1: Solved variable "y-Velocity  
Initial" in equation "Launch"

Step 1: Solved variable "Time" in  
equation "x-Position"



# How Concept-Map Works-5

Computations in  
“Solution”  
window.

**Simultaneous Equations**

**Simultaneous Equations Solution**

Node Launch

V - Launch Velocity = 0

theta - Launch Angle = 0

V\_x - x-Velocity = 0

Node Launch

V - Launch Velocity = 0

theta - Launch Angle = 0

V\_yi - y-Velocity Initial = 0

Node x-Position

x\_i - x-initial = 0

V\_x - x-Velocity = 0

t - Time = 0

x\_f - x-Final = 0

Node y-Position

y\_i - y-Initial = 0

V\_yi - y-Velocity Initial = 0

t - Time = 0

g - Gravity = 0

y\_f - y-Final = 0

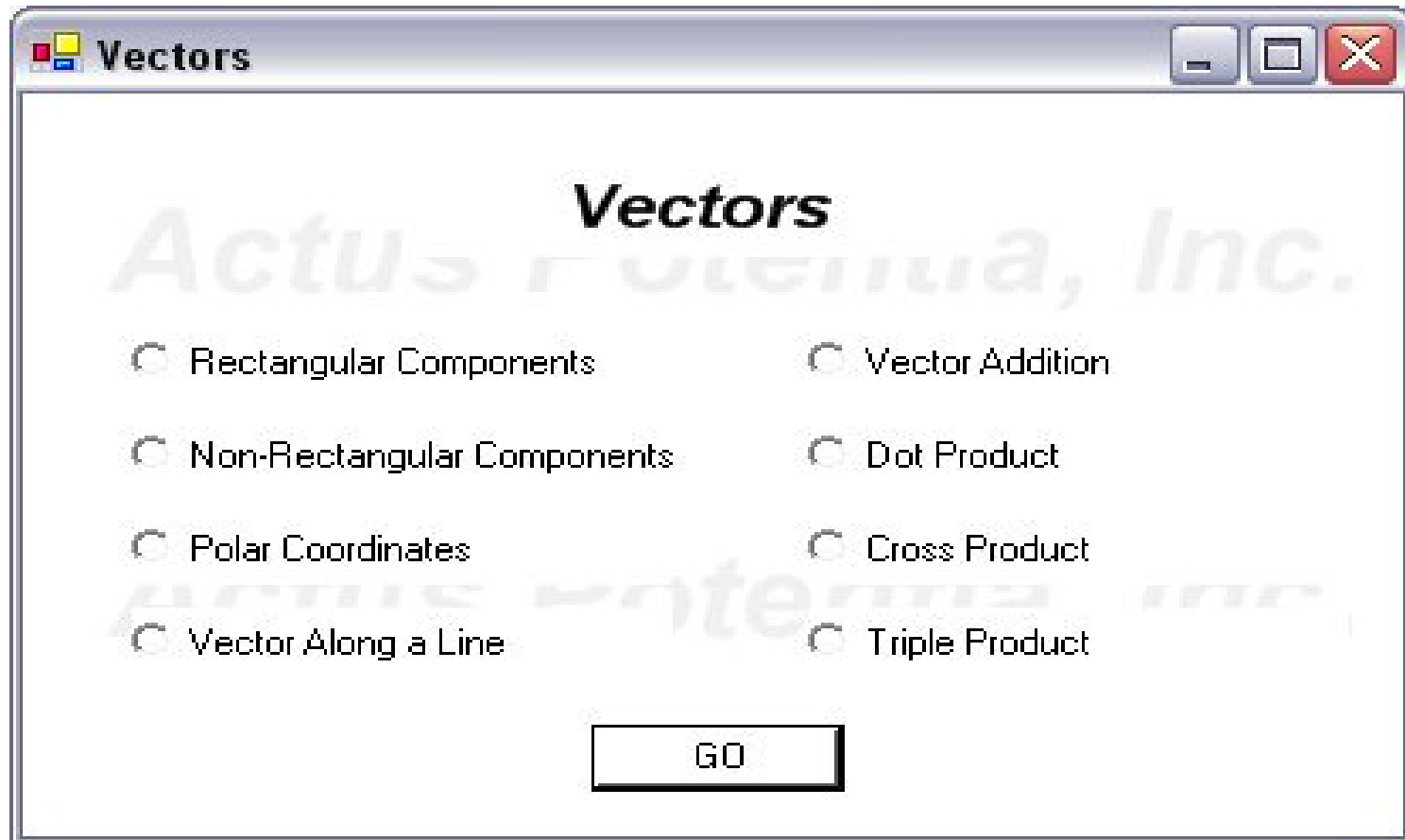
Solve Clear Solution Finished

Solution:

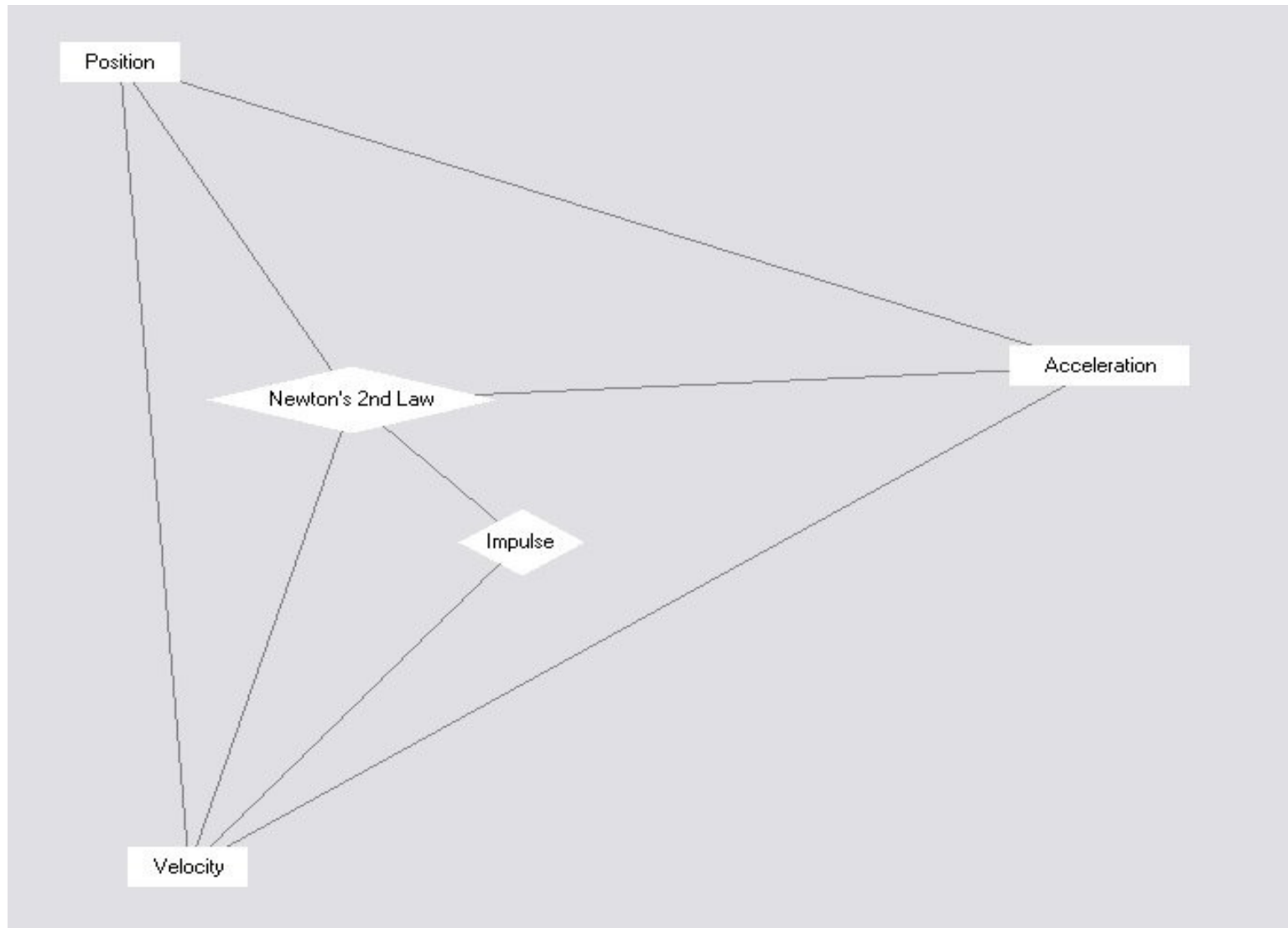
# Contents

- Vectors
- Mechanics
  - 1-D Kinematics, Newton's Law
  - Projectile
  - Relative Velocity
  - Circular Motion
  - Coupled Motion of Multiple Bodies
  - Rigid Body Rotation
  - Collision and Momentum
  - Conservation of Energy
  - Planets & Satellites
- Heat & Thermodynamics
  - Ideal Gas Law
  - 1<sup>st</sup> Law of Thermodynamics
  - Cyclic Processes
  - Carnot Cycle
  - Gas-Diesel Engines
  - Efficiency
- Waves/Oscillation/Sound
  - Simple-Harmonic-Motion
  - Organ Pipe
  - Doppler Effect
- Fluid Mechanics
  - Bernoulli Equation.
- Electricity
  - Point charges, field, potential, lines of force
  - Distributed charges on Cylinder, sphere, disk, rod, plane
  - Capacitors
  - Capacitors in Series & Parallel
  - Resistors in Series & Parallel
  - RC Circuits
- Magnetism (under preparation)
- Optics
  - Lenses
  - Mirrors

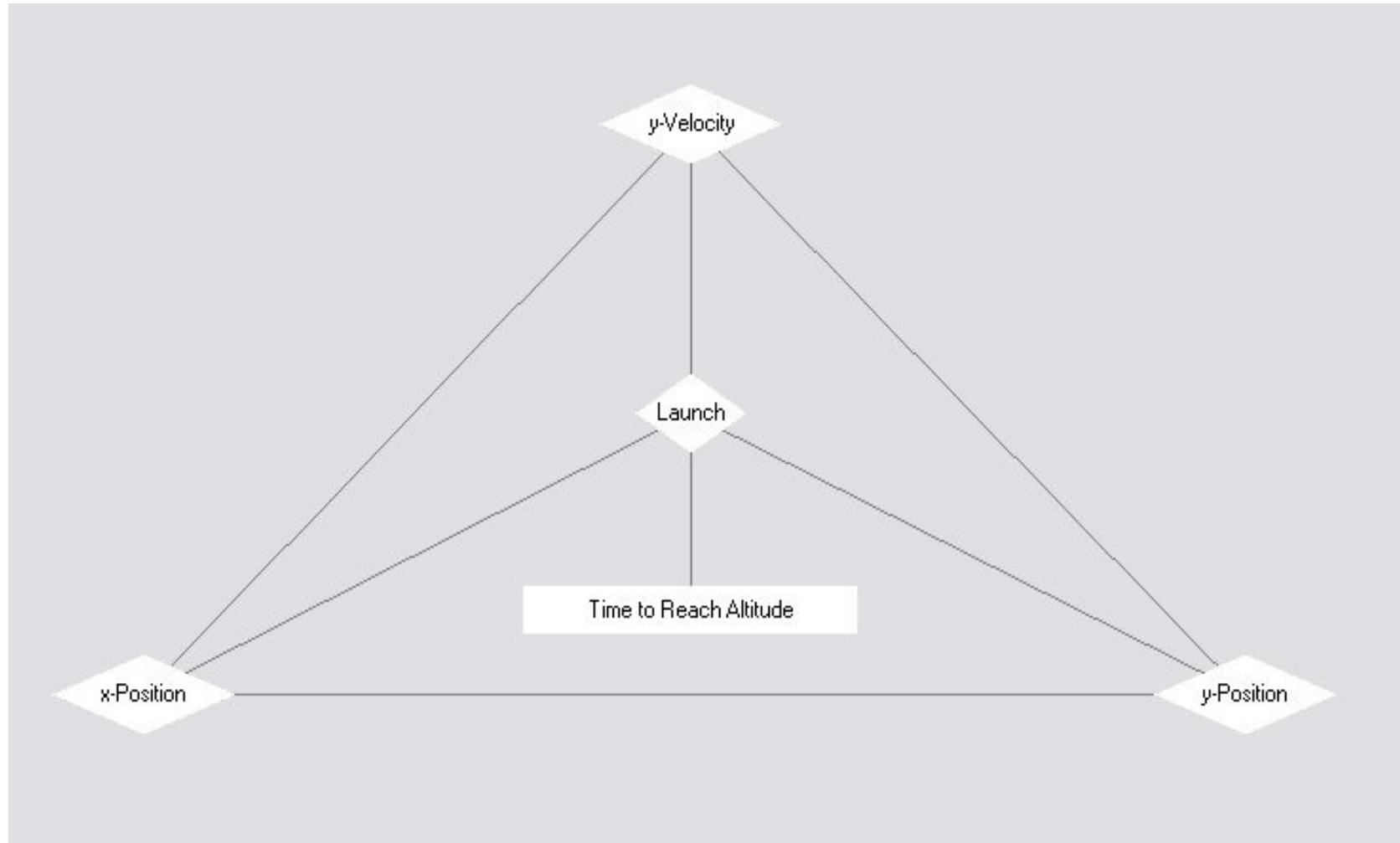
# Vectors



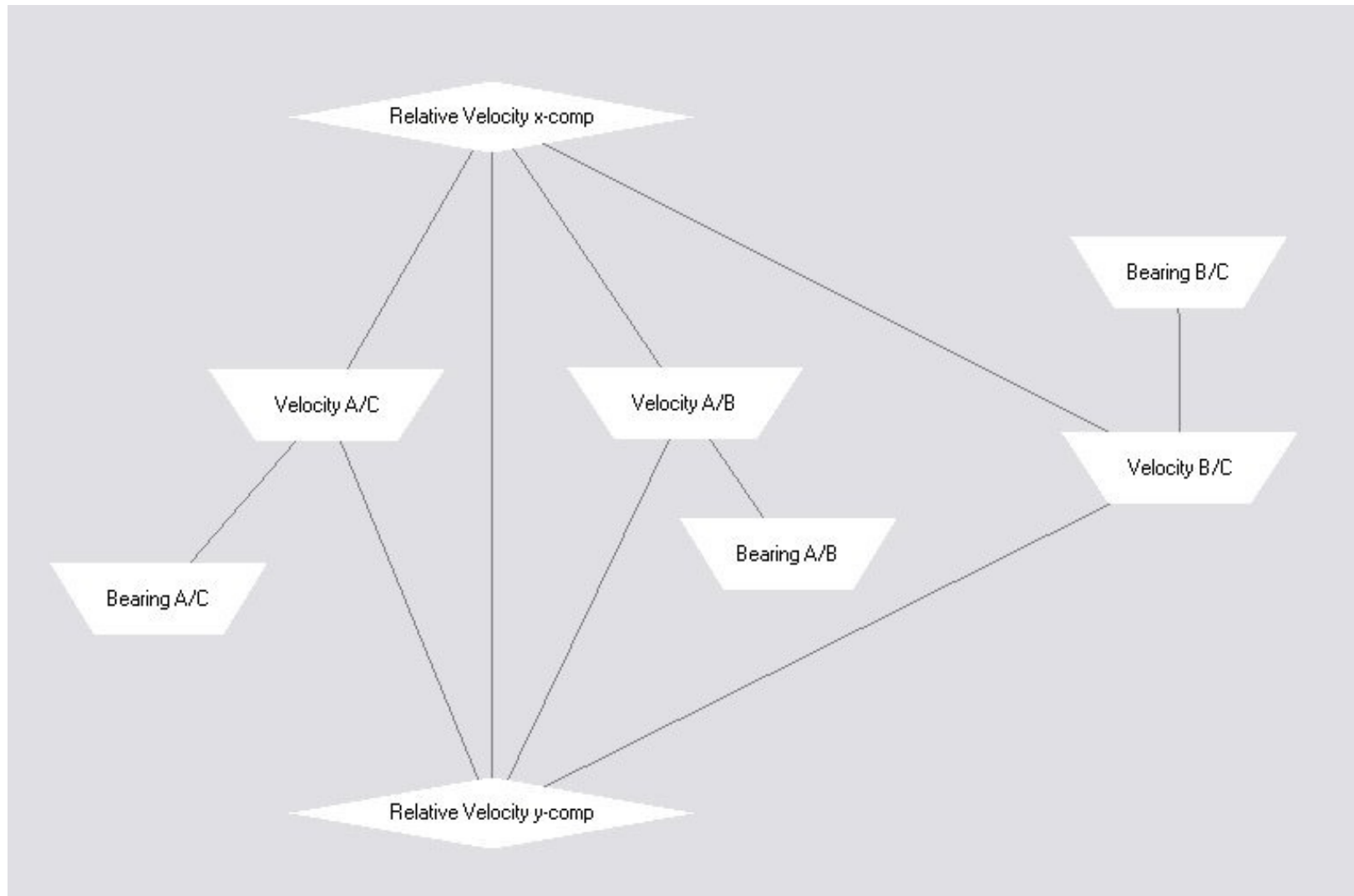
# 1-D Kinematics & Newton's Law



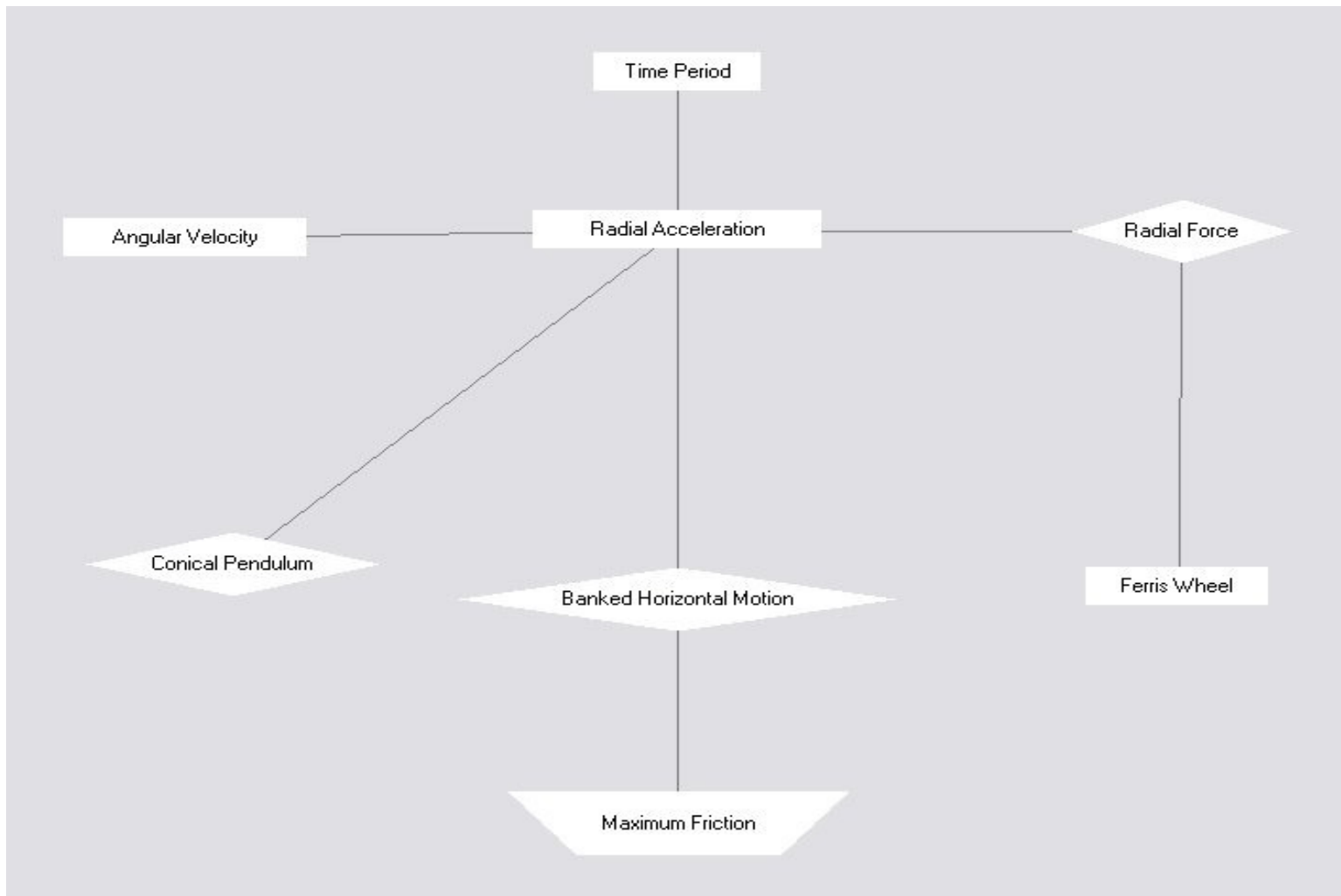
# Projectile



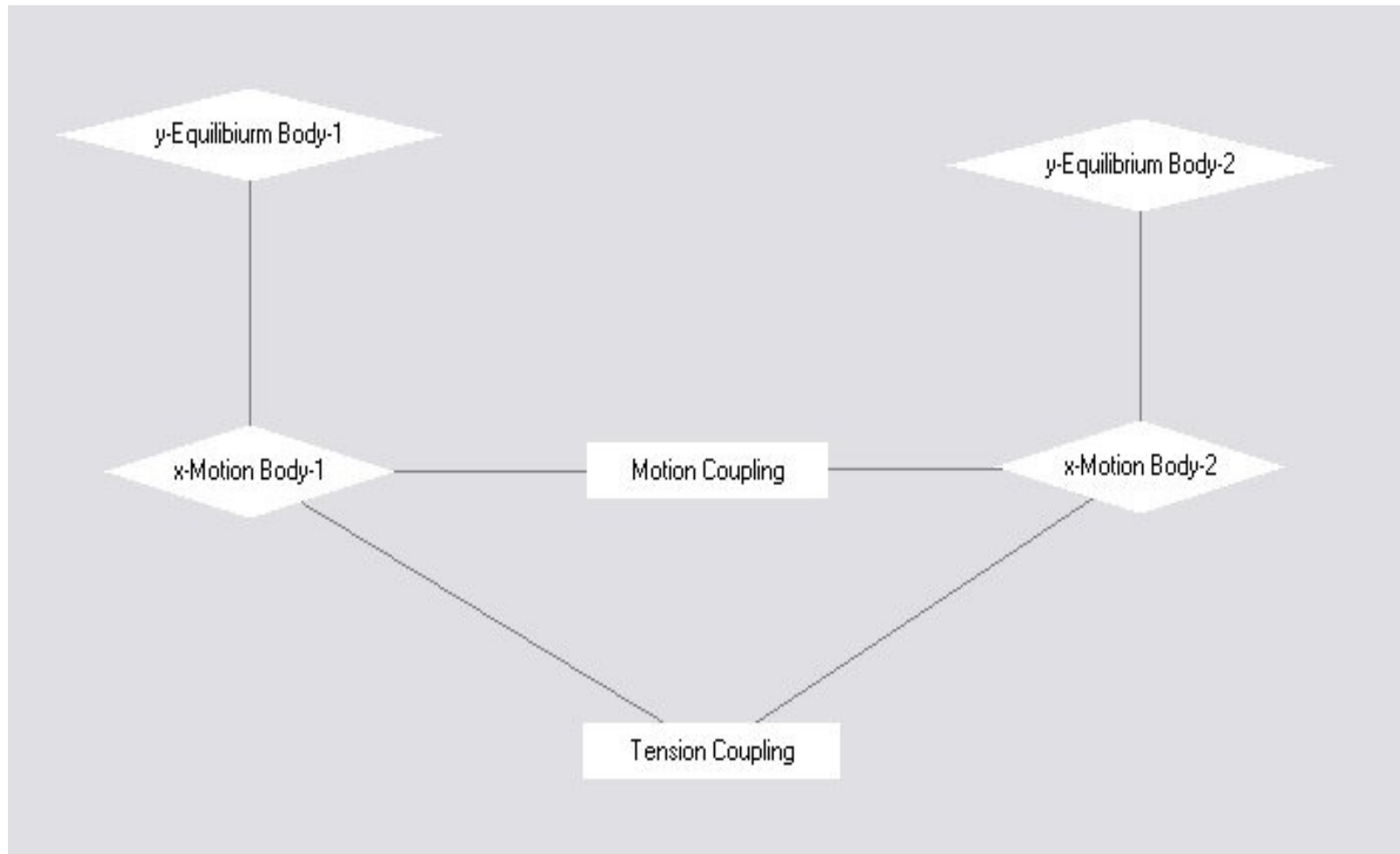
# Relative Velocity



# Circular Motion

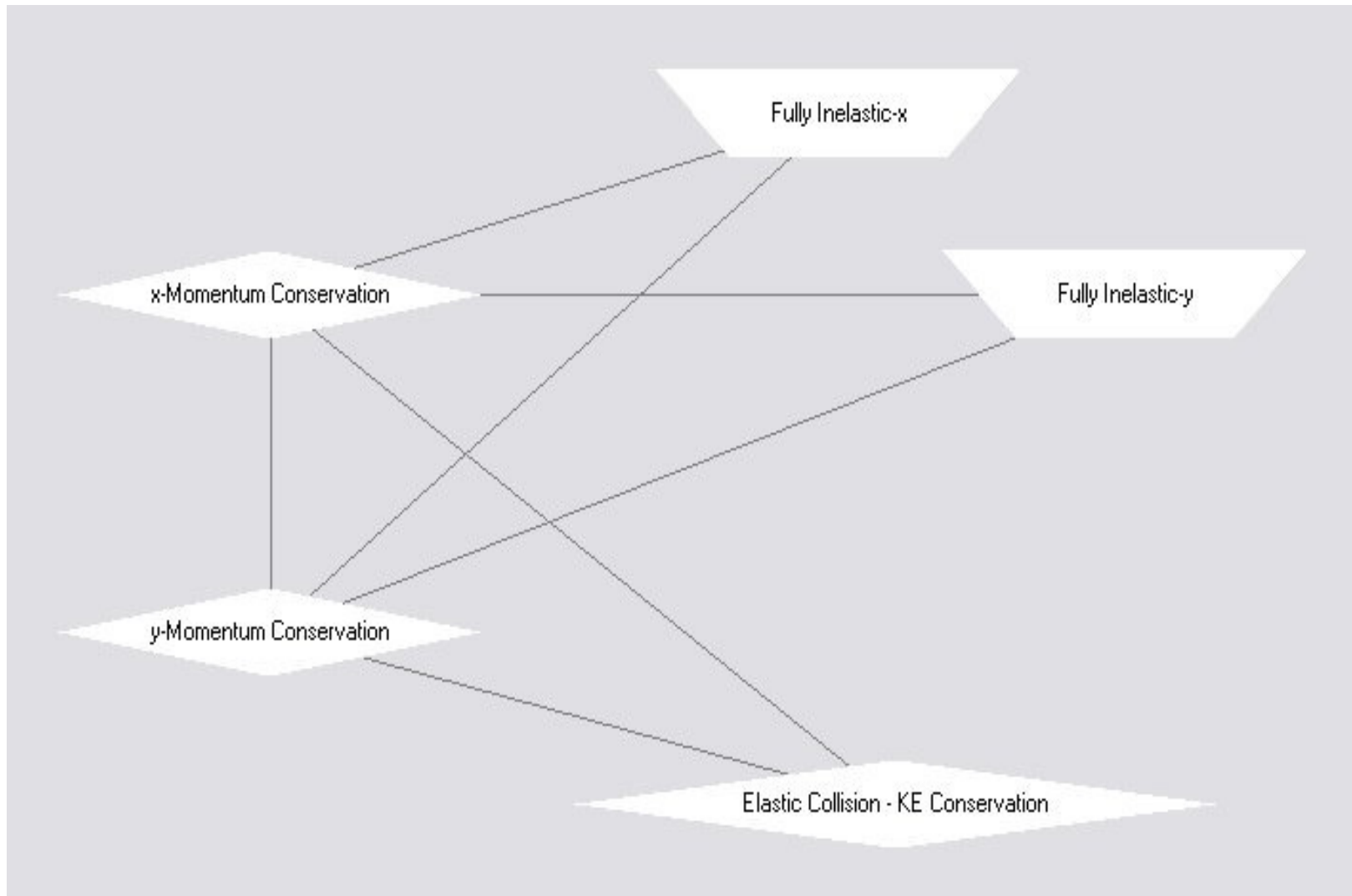


# Coupled Motion of Two Bodies

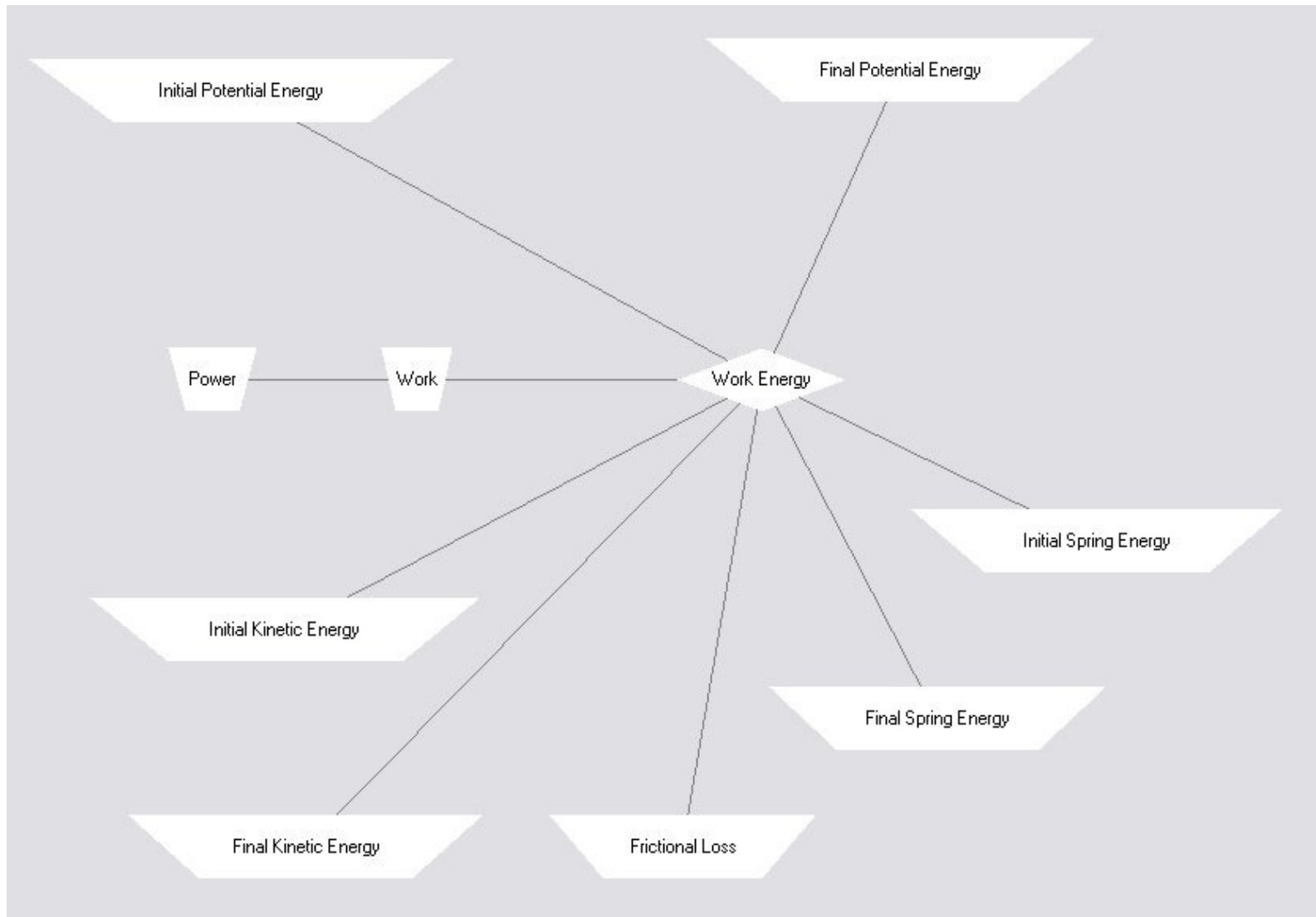




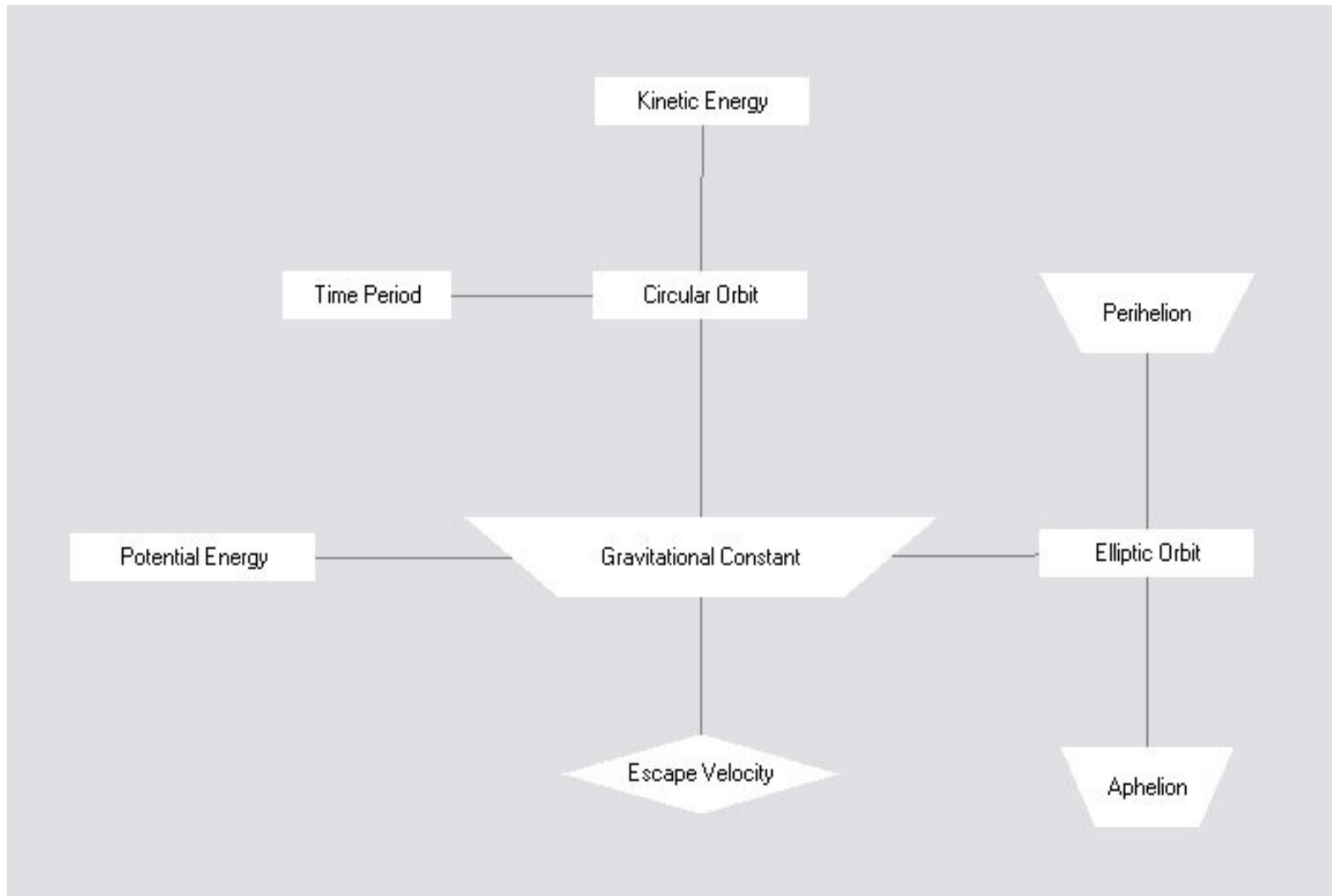
# Collision & Momentum



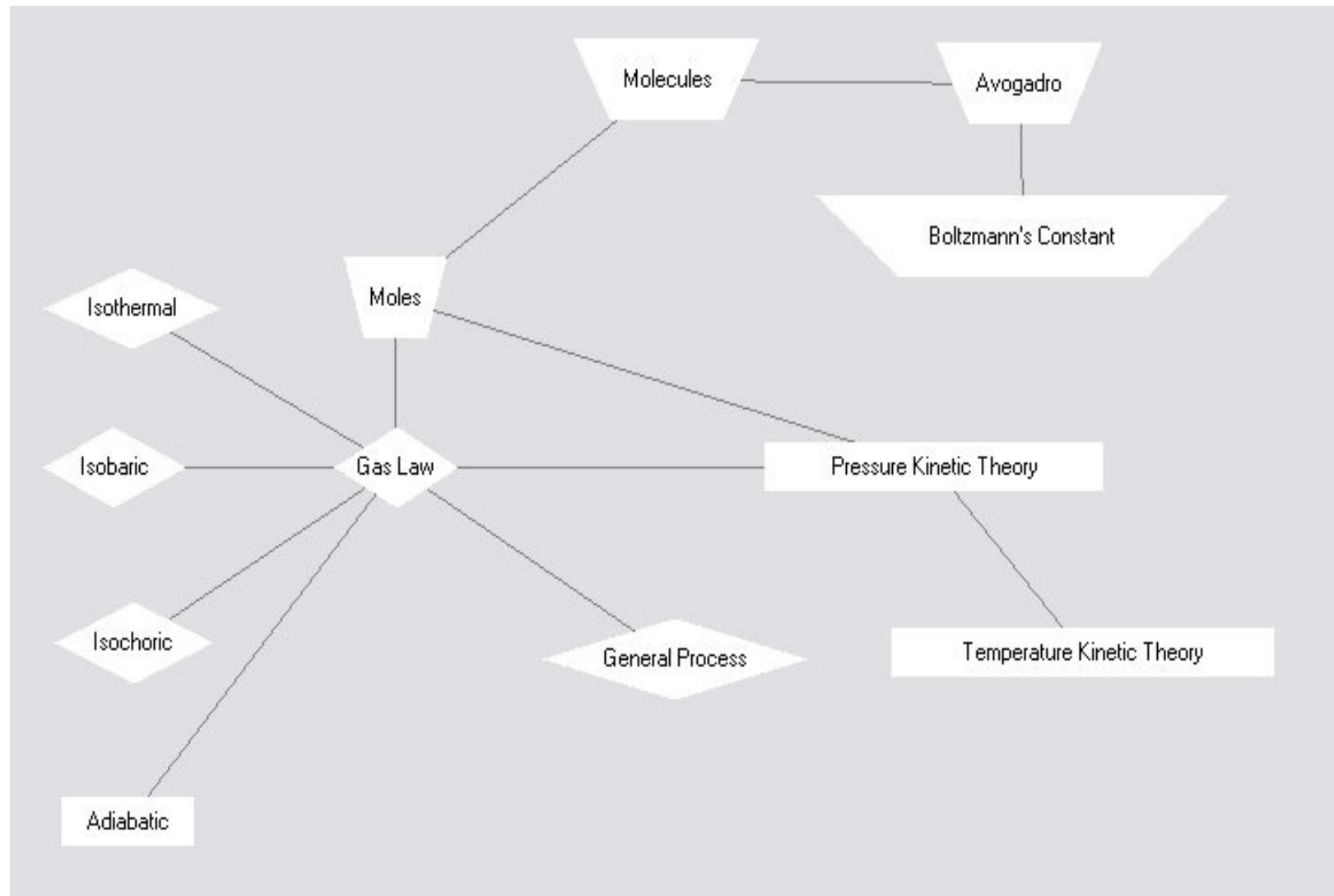
# Conservation of Energy



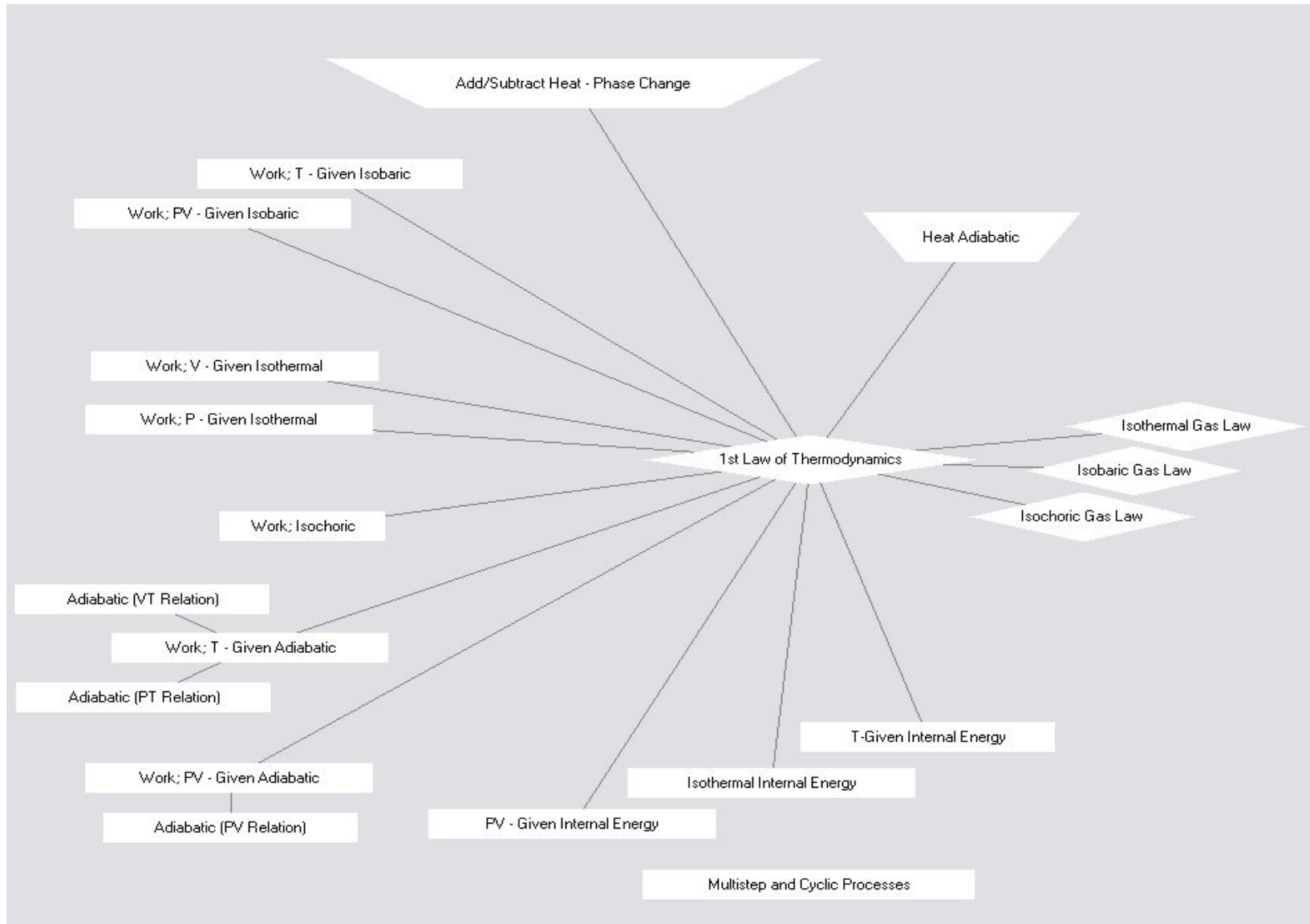
# Planets and Satellites



# Ideal Gas Law



# 1<sup>st</sup> Law of Thermodynamics



# Carnot Cycle

**Carnot Cycle**
\_ □ ×

**Carnot Cycle**

Gamma of gas:  Cv of gas:

Given at state-a; choose any three

Pressure  
  Volume  
  Temperature  
  number of moles

Ready   Calculate

Given at state-b; choose one

Pressure  
  Volume  
  Temperature

Ready   Calculate

Given at state-c; choose one

Pressure  
  Volume  
  Temperature

Ready   Calculate

State-d

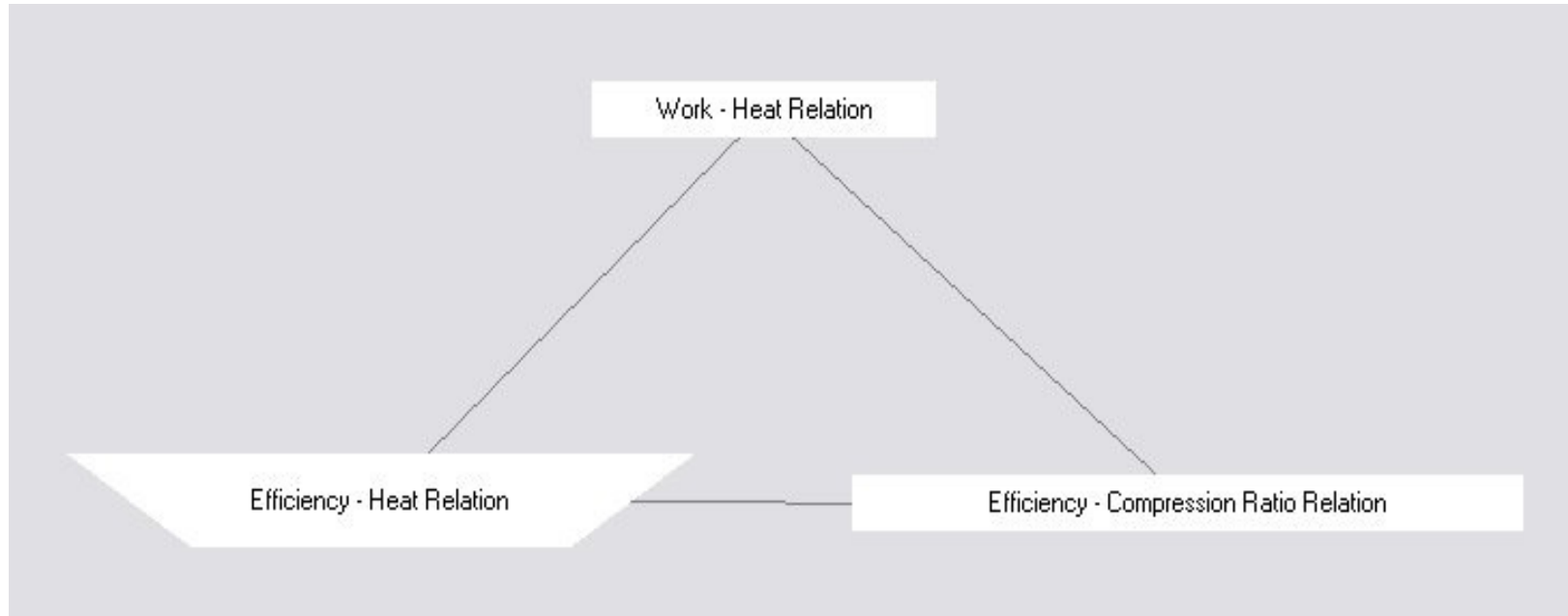
Calculate Work, Heat, and Energy

	Work	Heat	Energy
Isothermal Process a-b: Change in Energy is zero	6915.39	6915.39	0
Adiabatic Process b-c: Heat is zero	9976	0	-9976
Isothermal Process c-d: Change in Energy is zero	-2305.13	-2305.13	0
Adiabatic Process d-a: Heat is zero	-9976	0	9976
Net Work, Heat, and Energy for Cycle	4610.26	4610.26	0

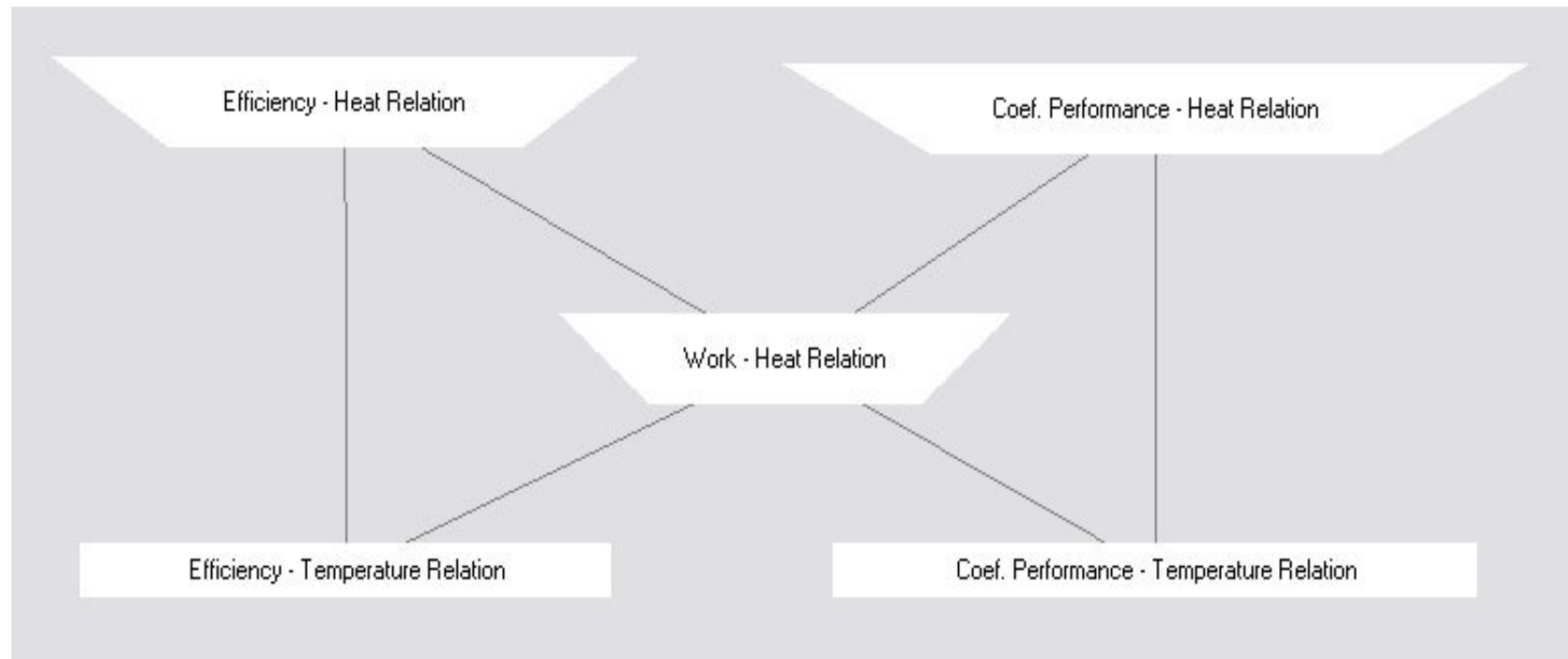
Efficiency (Net Work/ Heat Inflow)   
Efficiency (T<sub>hot</sub> - T<sub>cold</sub>)/T<sub>hot</sub>  

Help  
 Refresh  
 Close

# Gas/Diesel Engines

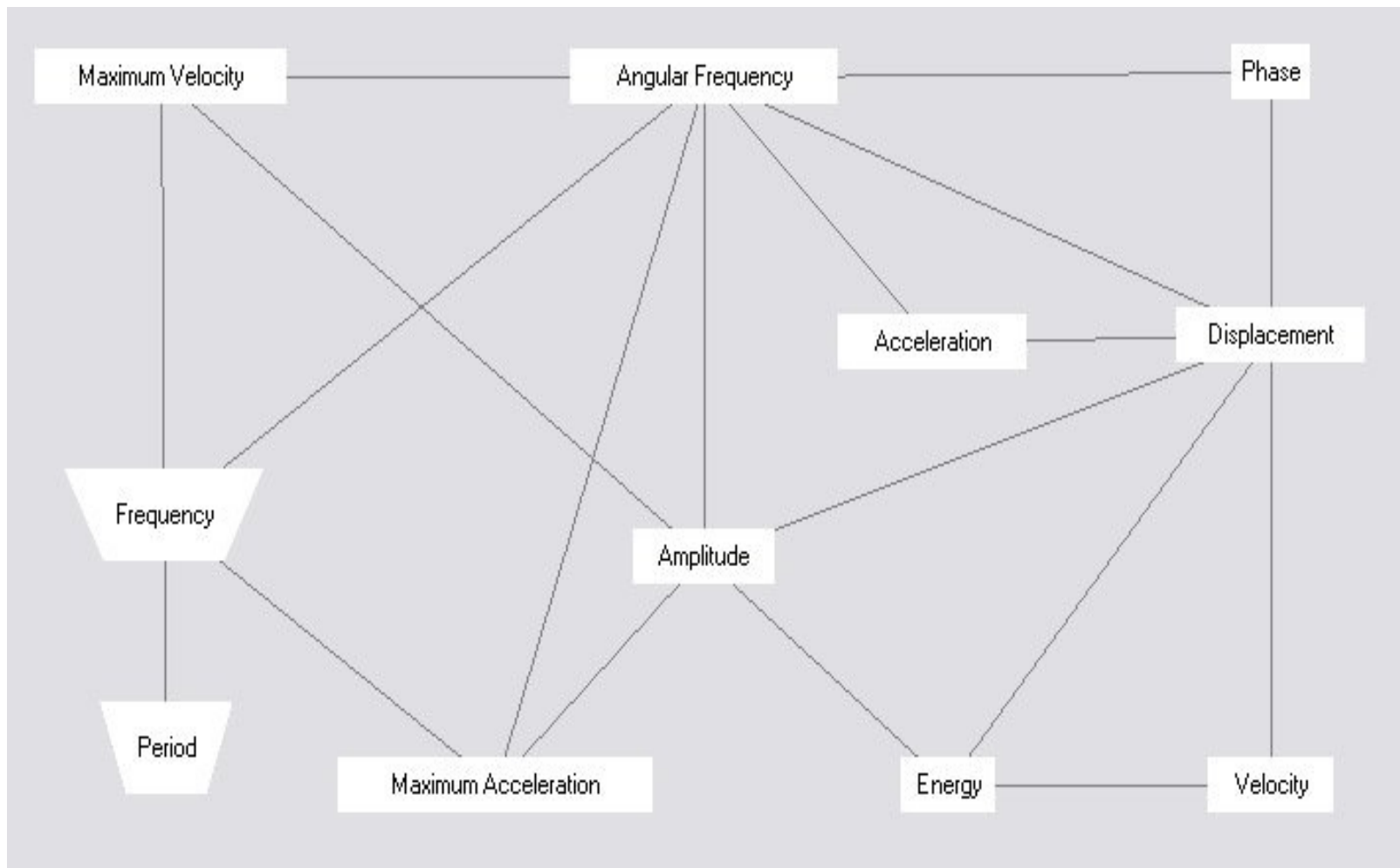


# Efficiency

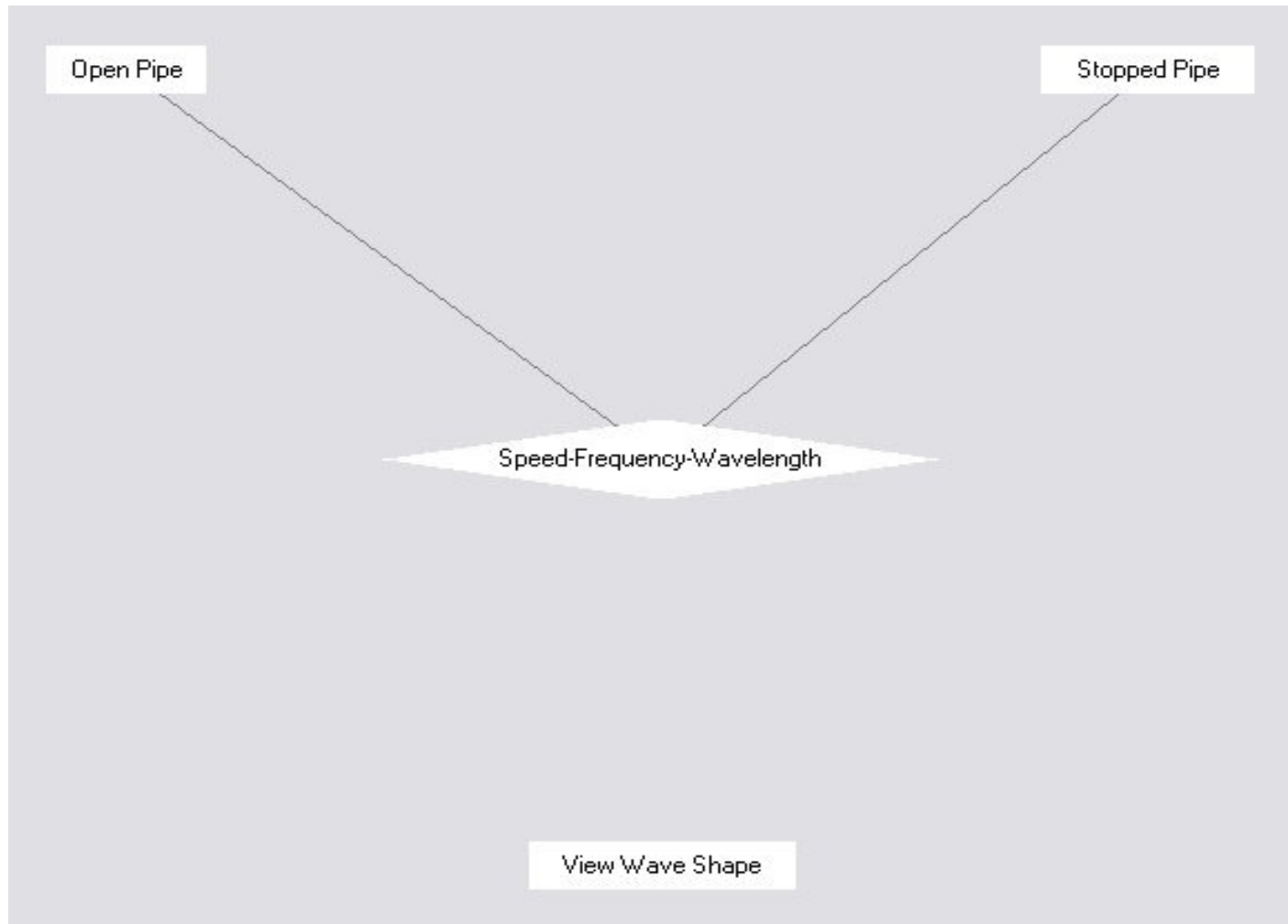




# Simple Harmonic Motion



# Organ Pipe



# Organ-Pipe (contd.)

**Organ Pipes**

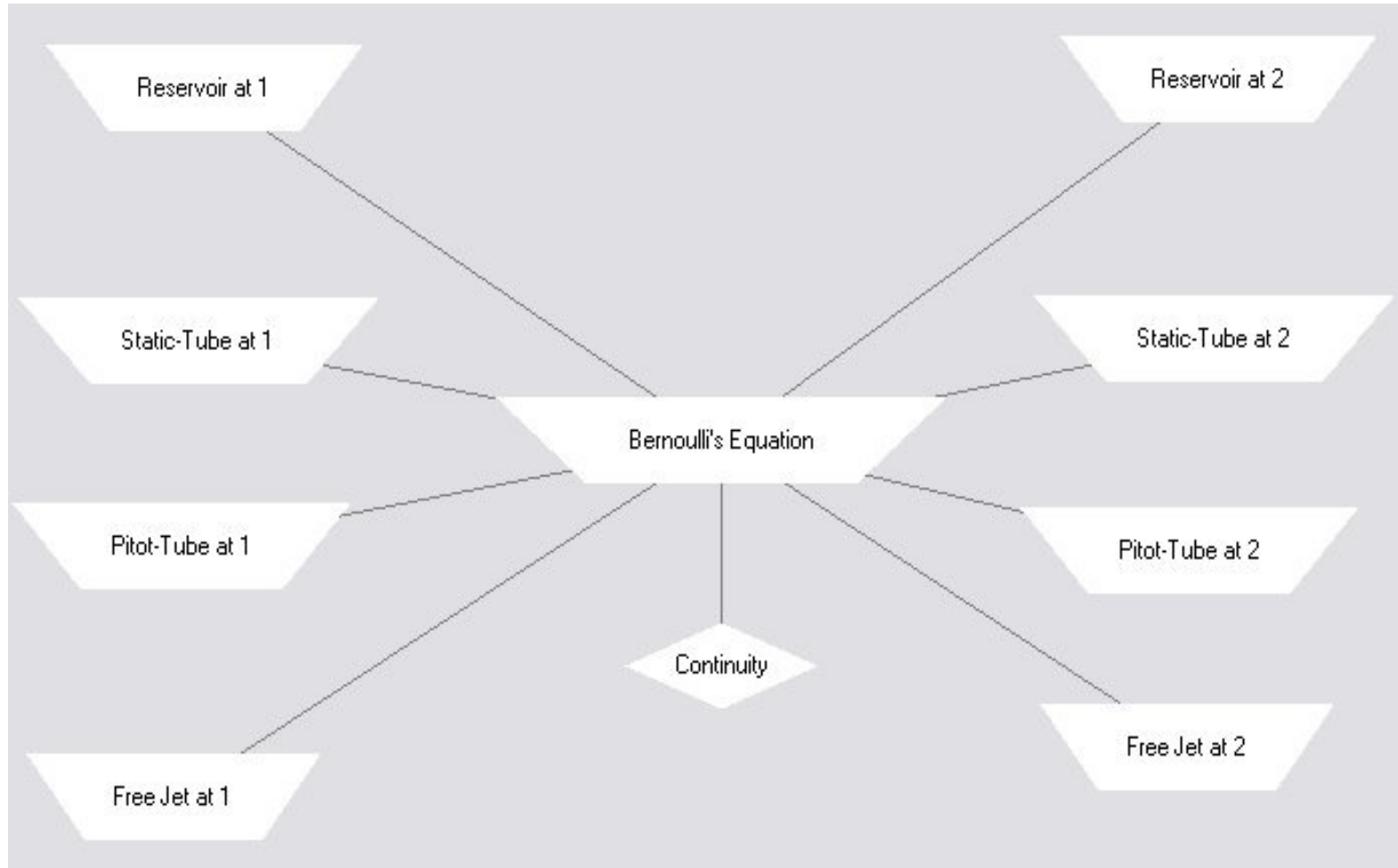
**Open and Stopped Organ-Pipes**

Open Pipe     Stopped Pipe        Enter 1,2,3,... (harmonics for Open Pipe and overtones for Stopped Pipe)   

*Velocity Antinodes shown (pressure nodes = velocity antinodes)*

Pipe Length =  Wavelength

# Bernoulli Equation



# Point Charges

**Electric Potential, Field, and Lines of Force**

Charge	X	Y	
<input type="text" value="2e-6"/>	<input type="text" value="-2"/>	<input type="text" value="3"/>	Charge 1
<input type="text" value="3e-6"/>	<input type="text" value="4"/>	<input type="text" value="-4"/>	Charge 2
<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	Charge 3
<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	Charge 4

$k = 8.988E9$

Enter System Potential Energy ( x . xxx format )

x E-2           

Calculate Field and Potential at a Location

Enter Location                 

Enter Field at Location ( x . xxx format )

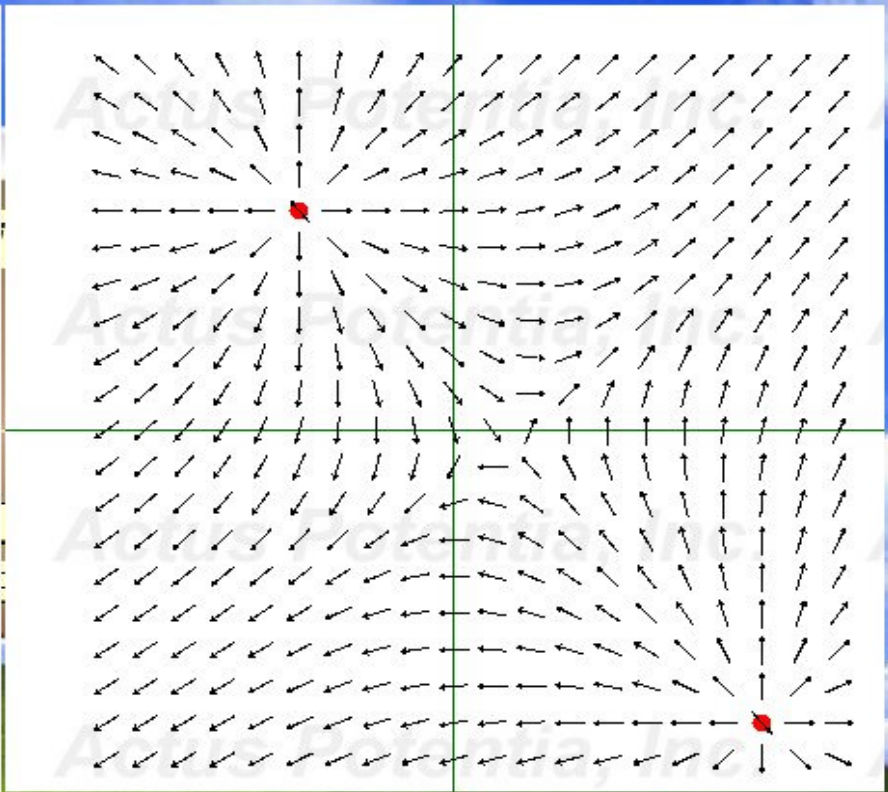
x E2

x E3

x E4



# Distributed Charges

sphere

Charge "Q" on Sphere

Radius "R" of the Sphere

Location on r-Axis

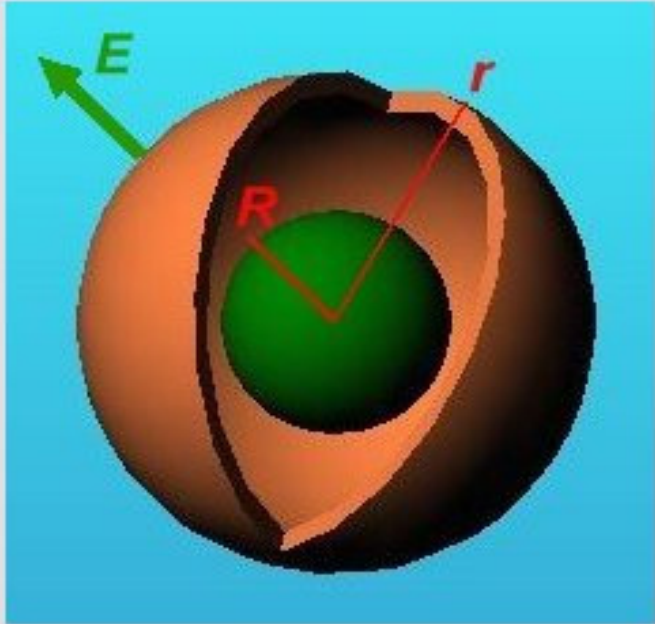
K=8.988 E9

OK

Enter Field Component (x.xxx format)

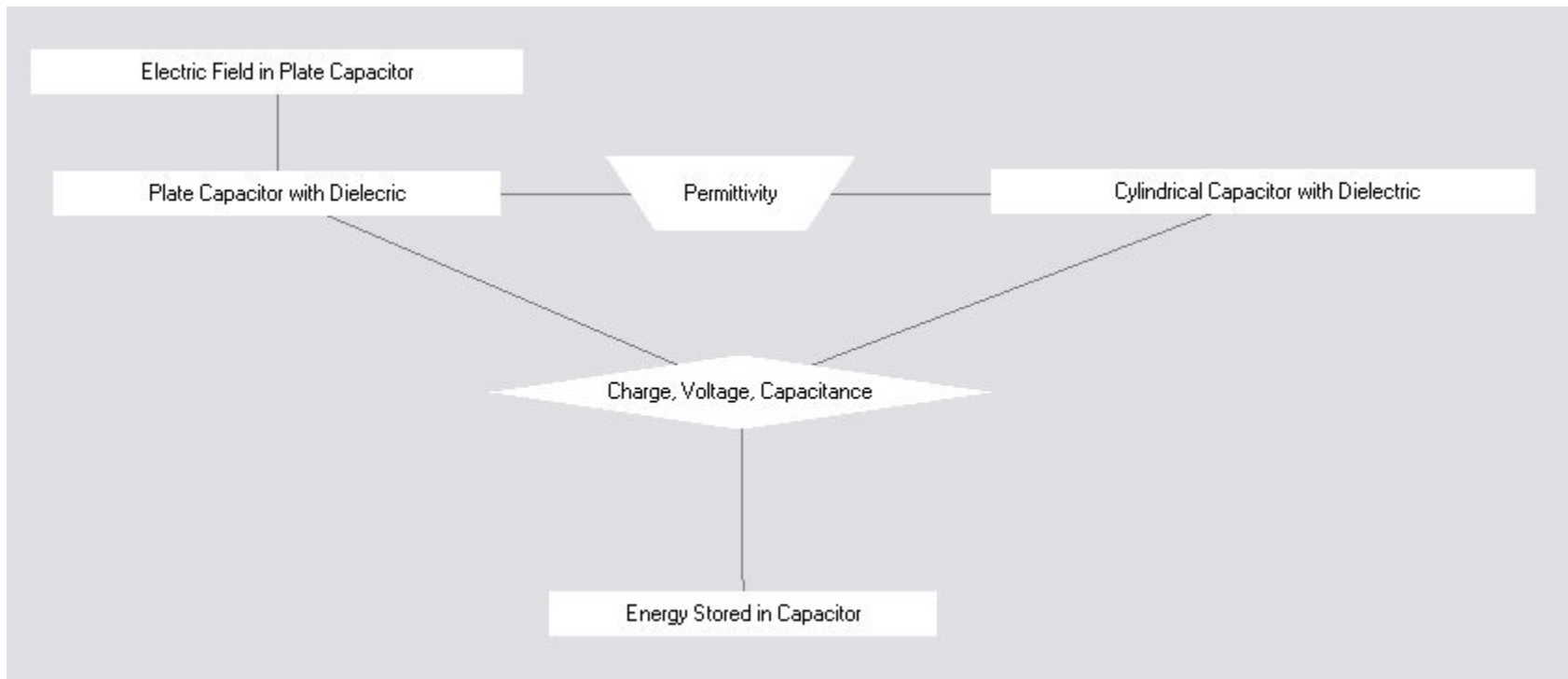
Enter Potential (x.xxx format)

Check Answer



The diagram shows a 3D cutaway view of a sphere. The outer surface is orange, and the inner core is green. A red arrow labeled 'R' points from the center to the outer surface. A green arrow labeled 'E' points away from the sphere, representing the electric field. The background is a light blue gradient.

# Capacitors



# RC - Circuits

The screenshot shows two windows from a software application. The left window, titled "Electrical Circuits", is titled "RC Circuits" and contains several input sections:

- Enter # of Nodes (Max. 10):** 3
- Ground Node:** 3
- Enter Voltage Sources:** A table with columns "Red Node" and "Blue Node". Values are: (1, 2), (0, 0), (0, 0). A voltage source symbol is shown to the right.
- Enter Current Sources:** A table with columns "Red Node" and "Blue Node". Values are: (2, 3), (0, 0), (0, 0). A current source symbol is shown to the right.
- Enter Resistors:** A table with columns "End-1" and "End-2". Values are: (1, 2), (1, 3), (2, 3), (0, 0), (0, 0), (0, 0).
- Enter Capacitors:** A table with columns "End-1" and "End-2". Values are: (0, 0), (0, 0), (0, 0).

Buttons include "Done", "HELP", "Show Equations", and "CLOSE".

The right window, titled "equations", displays the following equations:

$$+ (1 / R1) (v1 - v2) + (1 / R2) (v1 - v3) - IV1 = 0$$
$$+ (1 / R1) (v2 - v1) + (1 / R3) (v2 - v3) + IV1 - IC1 = 0$$

Below the equations, the following definitions are provided:

$v1 - v2 =$  Voltage Source-1  
 $IC1 =$  Current Source-1  
 $v3 = 0$



# Lenses

**Lenses**

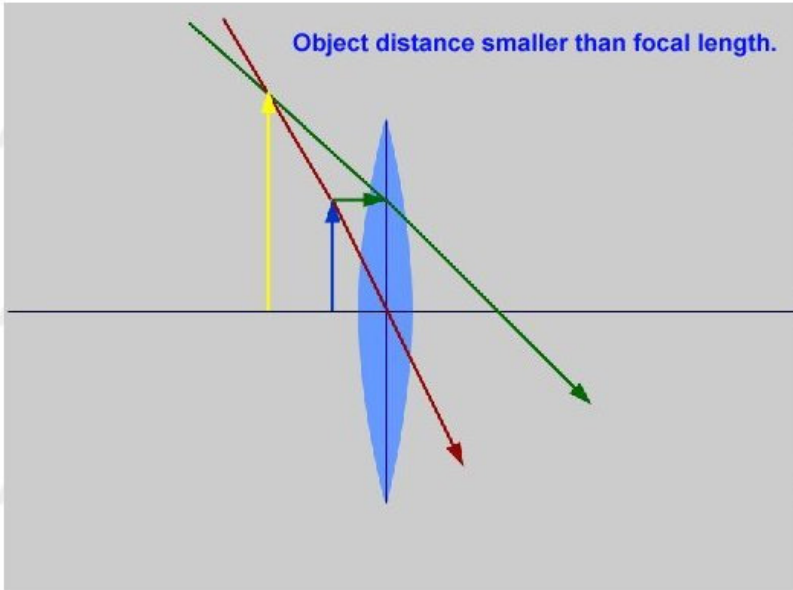
Select any Two Enter Values

Object Distance  Image Distance Object Distance

Focal Length  Magnification Focal Length

**Be careful about the signs of the variables.**

Object distance smaller than focal length.



Object  Image  Focal  Magnification

# Mirrors

**Mirrors**

Select any Two

Object Distance     Image Distance

Radius of Curvature     Magnification

Enter Values

Object Distance     Sign Convention

Radius

Ready

Be careful about the signs of the variables.

Compute

Object distance larger than R

OC = radius of curvature R  
OF = R/2

Object     Image     Radius     Magnification