



CHEMICAL ENGINEERING THERMODYNAMICS II (0905323)

06. BUBBLE-P AND DEW-P USING RAOULT'S LAW

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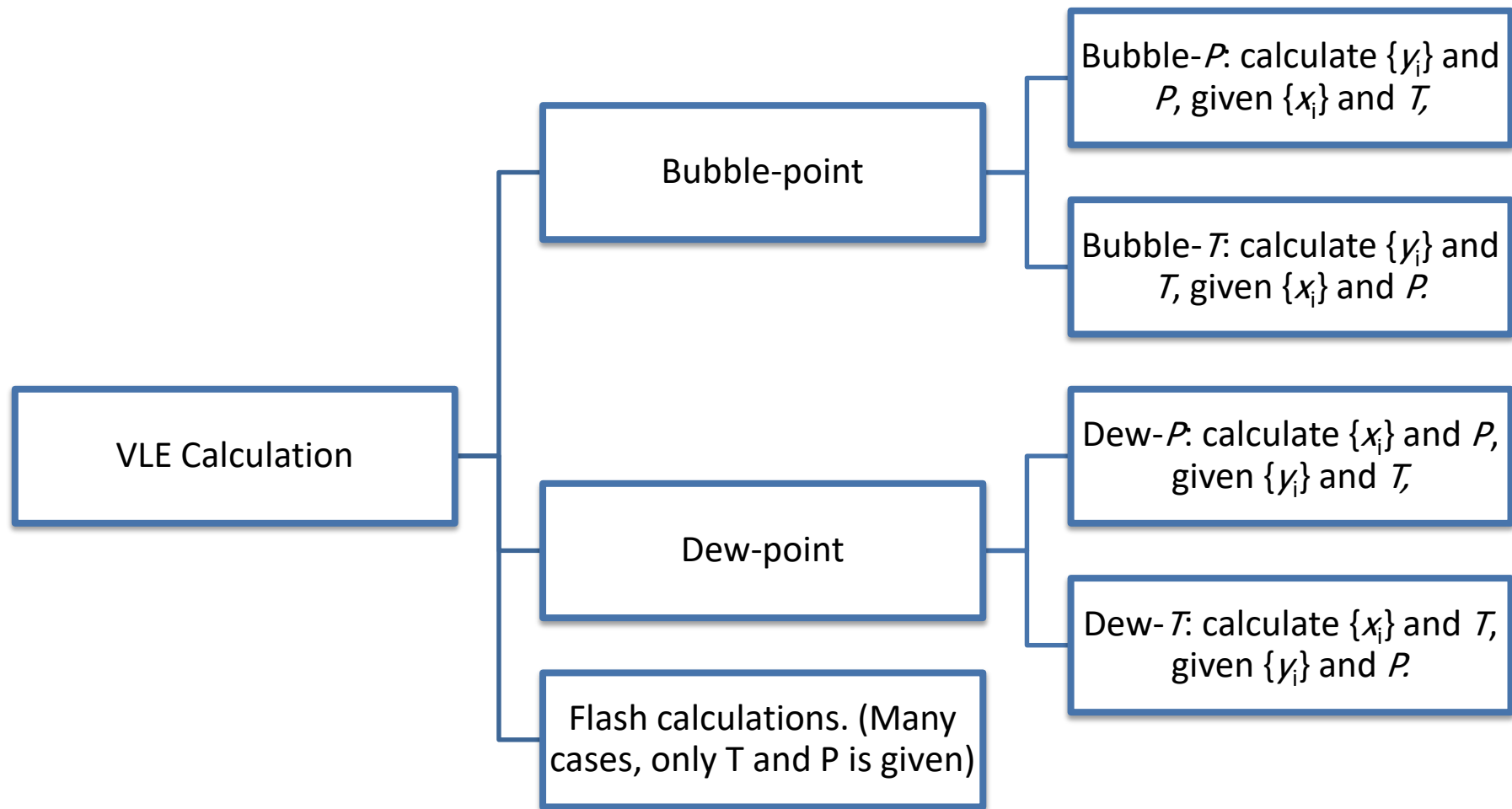
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Outline

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- Examples

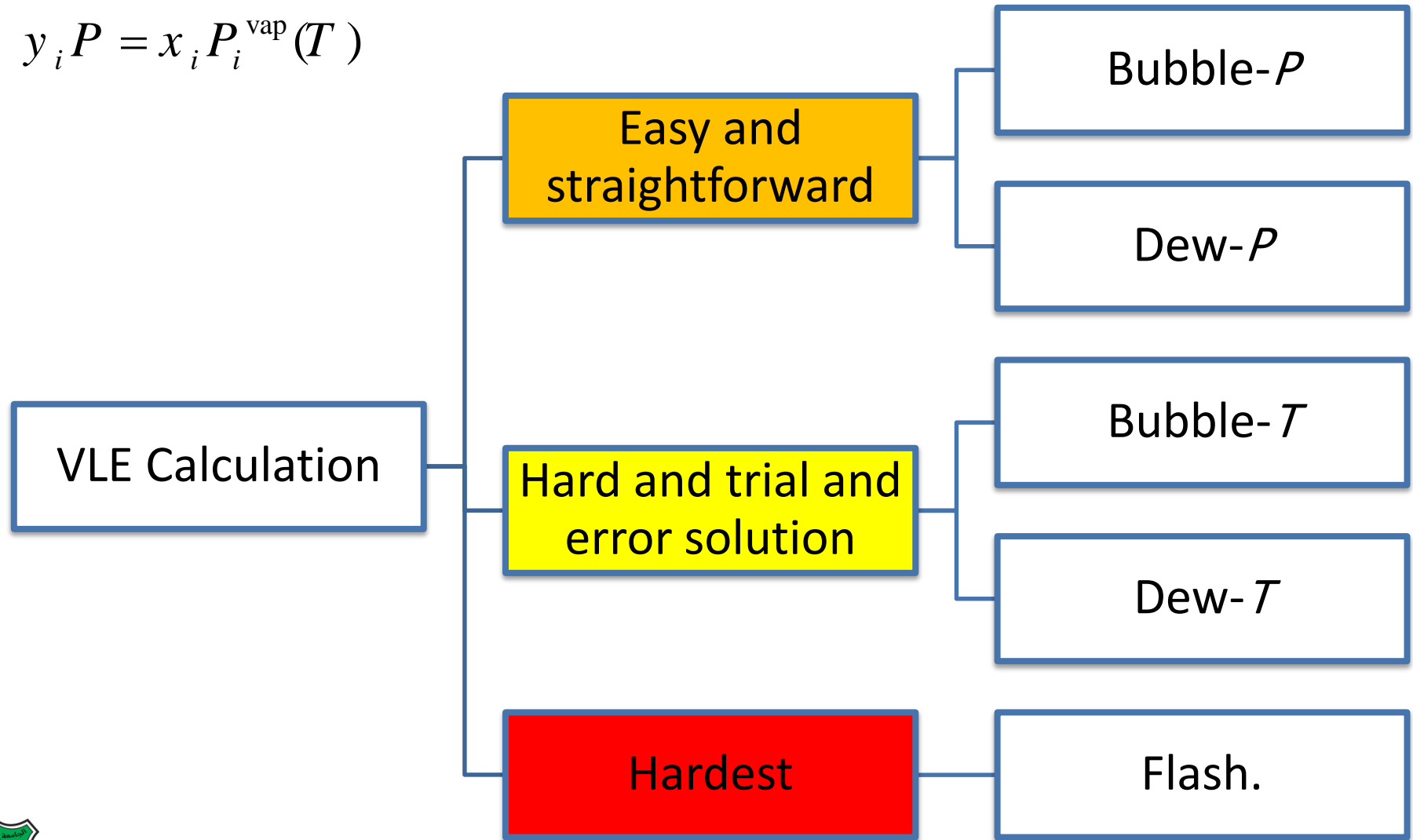


VLE Calculations: Ideal Solutions

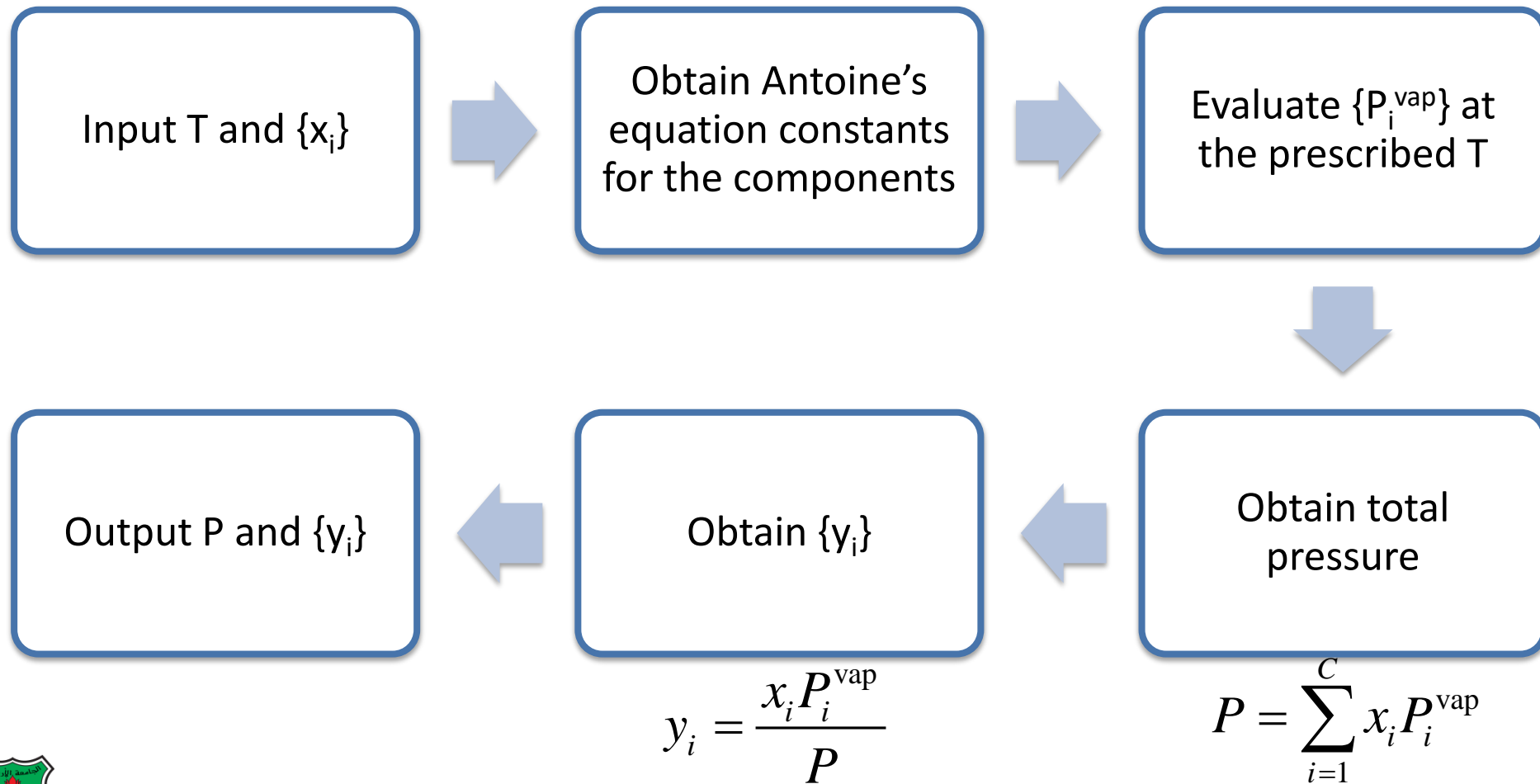


Hierarchy of Complexity

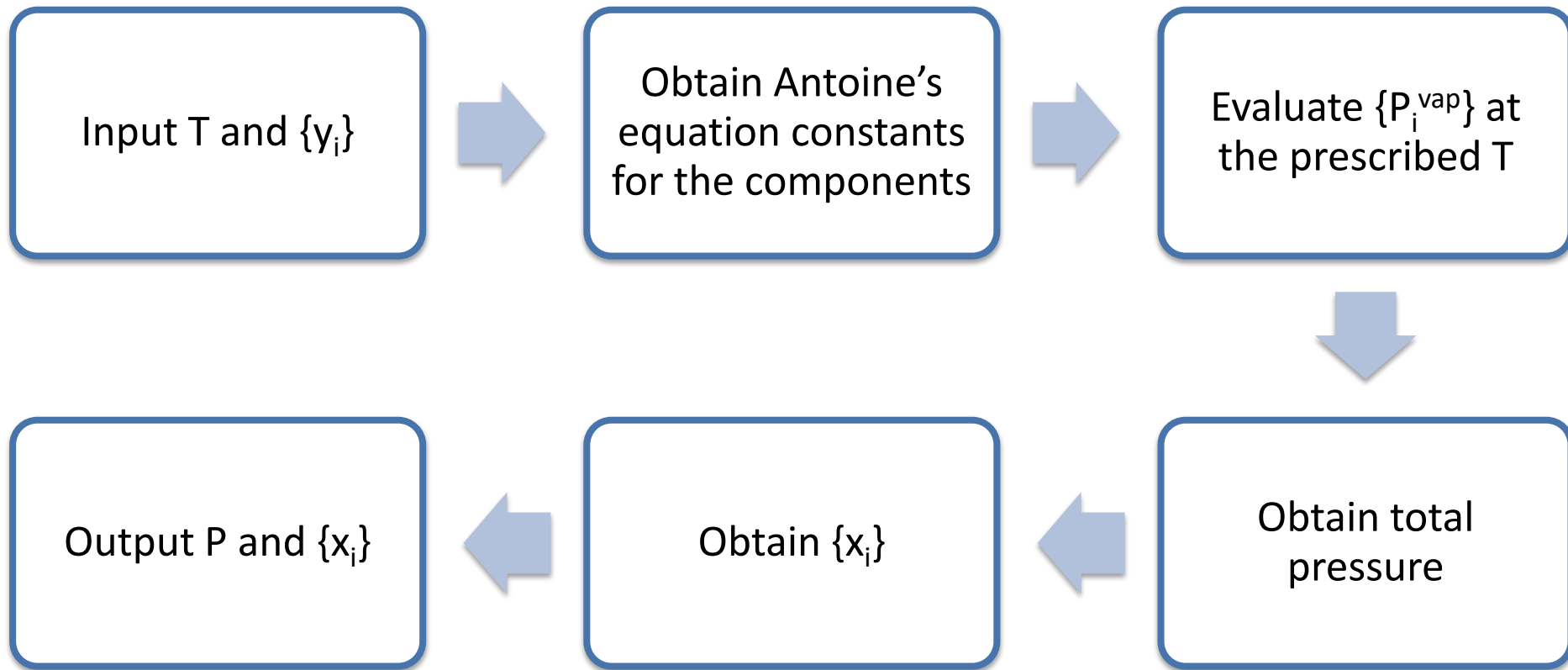
$$y_i P = x_i P_i^{\text{vap}}(T)$$



Bubble- P : Concept and Algorithm



Dew- P : Concept and Algorithm



$$x_i = \frac{y_i P}{P_i^{\text{vap}}}$$

$$\sum_{i=1}^c x_i = 1 \Rightarrow P = \frac{1}{\sum_{i=1}^c y_i / P_i^{\text{vap}}}$$



Example: Bubble-P

- Consider the system: benzene, toluene and m-xylene (BTX). A liquid solution of these components has the composition $\mathbf{x} = \{0.4, 0.3, 0.3\}$ for the components in their respective order at $T = 300$ K. Wanted: find the equilibrium pressure and vapor compositions at the prescribed conditions.



	xi	A	B	C	P*	xiP*	yi=xiP*/P
Benzene	0.4	9.2806	2788.51	-52.36	0.138105	0.055242	0.773166
Toluene	0.3	9.3935	3096.52	-53.67	0.041706	0.012512	0.175113
m-Xylene	0.3	9.5188	3366.99	-58.04	0.012318	0.003695	0.051721
					P	0.071449	1

K _i		
1.932914	α_{12}	3.311427
0.58371	α_{13}	11.21155
0.172404	α_{23}	3.385715



Example: Dew-P

- Consider the system: benzene, toluene and m-xylene (BTX). A vapor phase of these components has the composition $\mathbf{y} = \{0.4, 0.3, 0.3\}$ for the components in their respective order at $T = 300$ K. Wanted: find the equilibrium pressure and liquid compositions at the prescribed conditions.



	y_i	A	B	C	P^*i	y_i/P^*i	$x_i=y_iP/P^*i$
Benzene	0.4	9.2806	2788.51	-52.36	0.138105	2.896337	0.084089
Toluene	0.3	9.3935	3096.52	-53.67	0.041706	7.193255	0.20884
m-Xylene	0.3	9.5188	3366.99	-58.04	0.012318	24.35432	0.707072
					P	0.029033	1

K_i		
4.756892	α_{12}	3.311427
1.436509	α_{13}	11.21155
0.424285	α_{23}	3.385715



Quiz

- Determine the bubble point pressure for an equimolar binary system of components A and B. The vapor pressure of A and B are 10 and 12 kPa, respectively.
- Would you recommend ordinary distillation to separate these components? Justify your answer.



■ ■ Consider the system:
ethanol/and phenol at 1 bar.
Would you consider applying
Raoult's law to this system?
Justify your answer.

