# 0. Content

1. **Mathematical Background:**

* Real Sequences, Limits of Real Sequences.
* n-Dimensional Real Space Rn\mathbb{R}^nRn, Bounds, Interior, Superior, Sequence of Points in Rn\mathbb{R}^nRn.

2. **Topology:**

* Open, Closed, and Compact Sets.
* Matrices, Mappings, Continuous Functions.

3. **Differentiability of Functions.**

4. **Unconstrained Optimization:**

* First-order Conditions.
* Second-order Conditions.

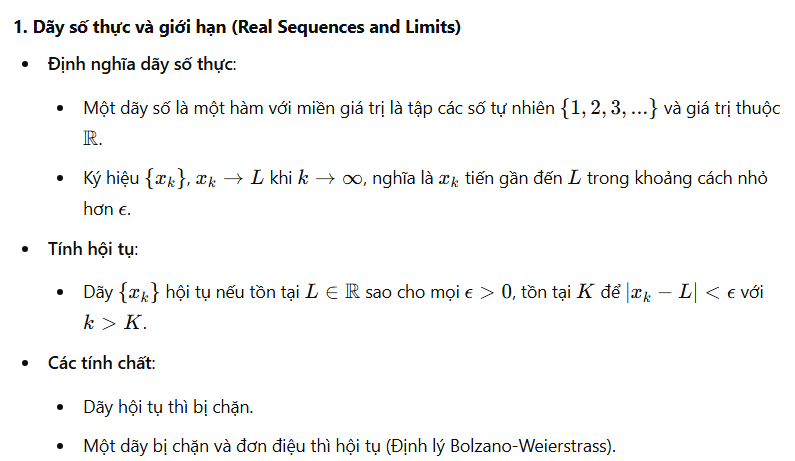
5. **Convex Functions:**

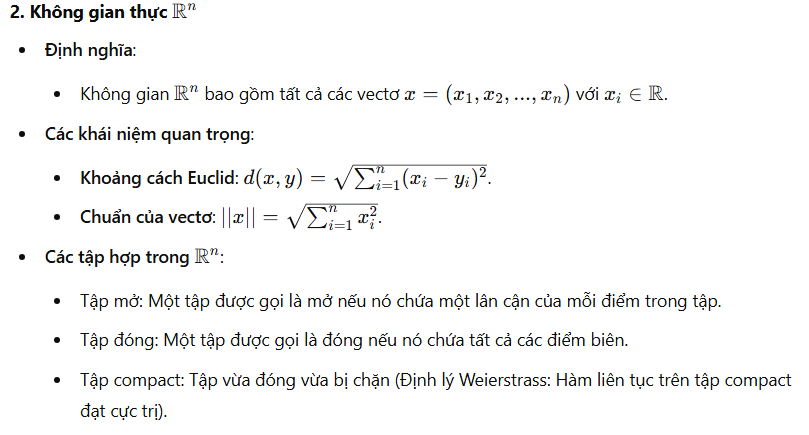
* Definitions, Properties, Continuity Theorems.

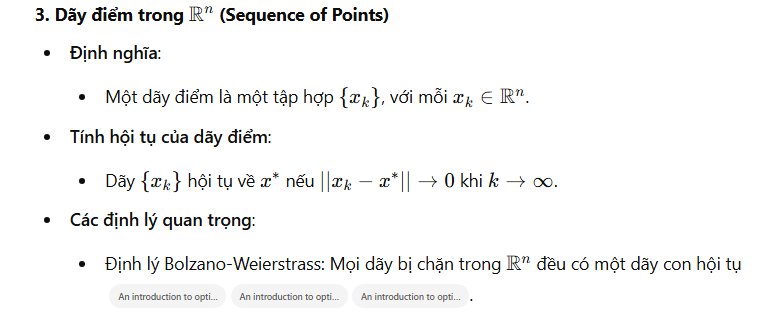
6. **Convex Optimization:**

* Convex Optimization Problems.
* Separation Theorems.
* Slater Conditions.
* Kuhn-Tucker Conditions.
* Lagrangian of Convex Optimization Problems.
* Duality in Convex Programming.

# Mathematical Background

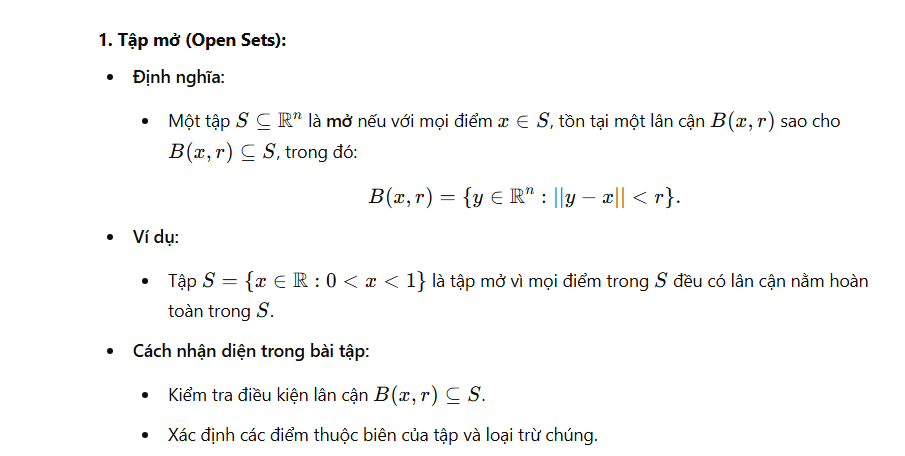


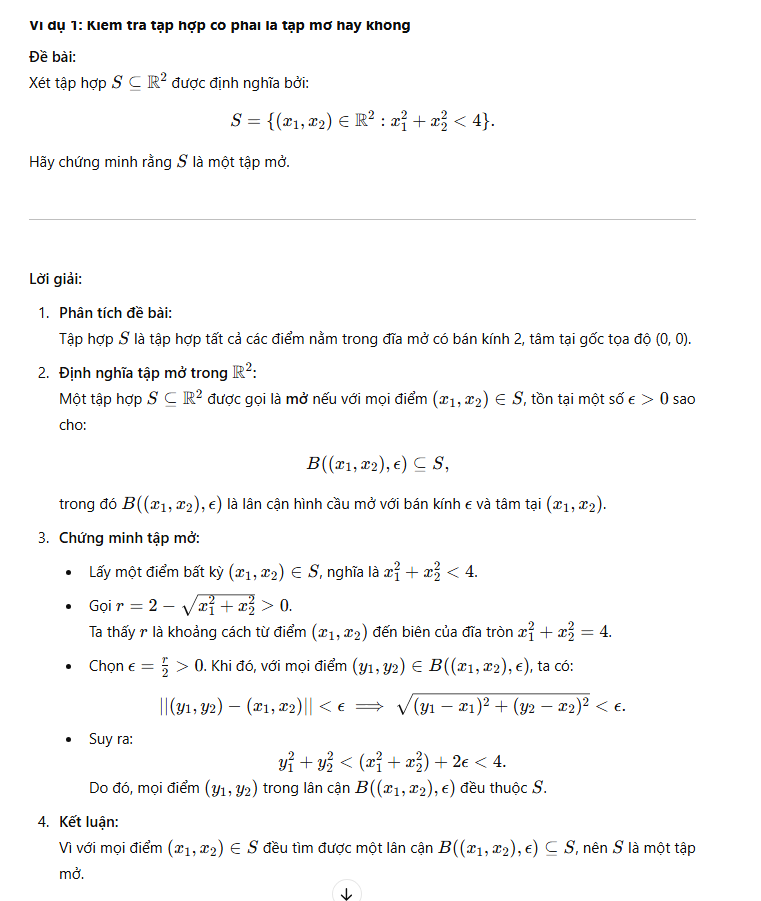




# Topology

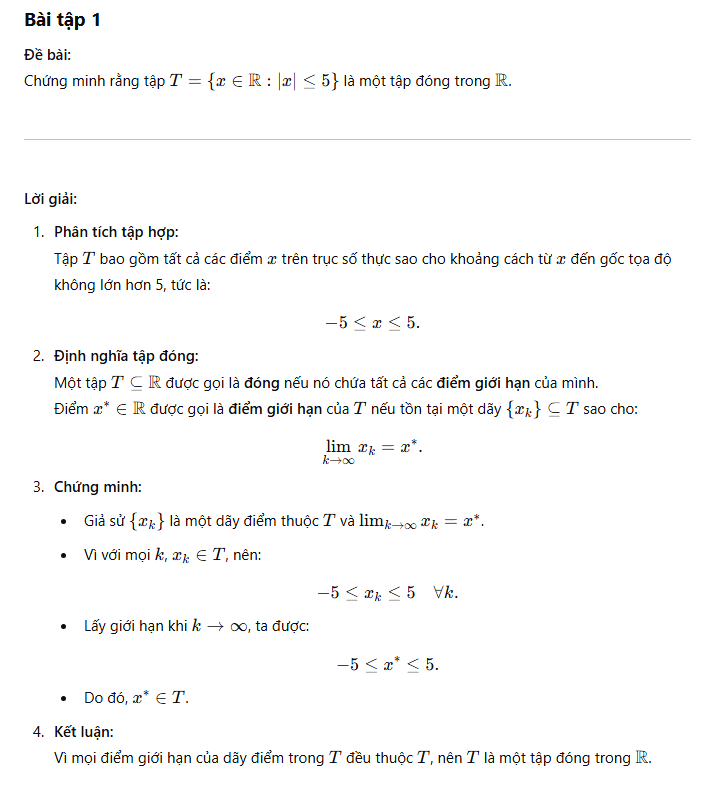
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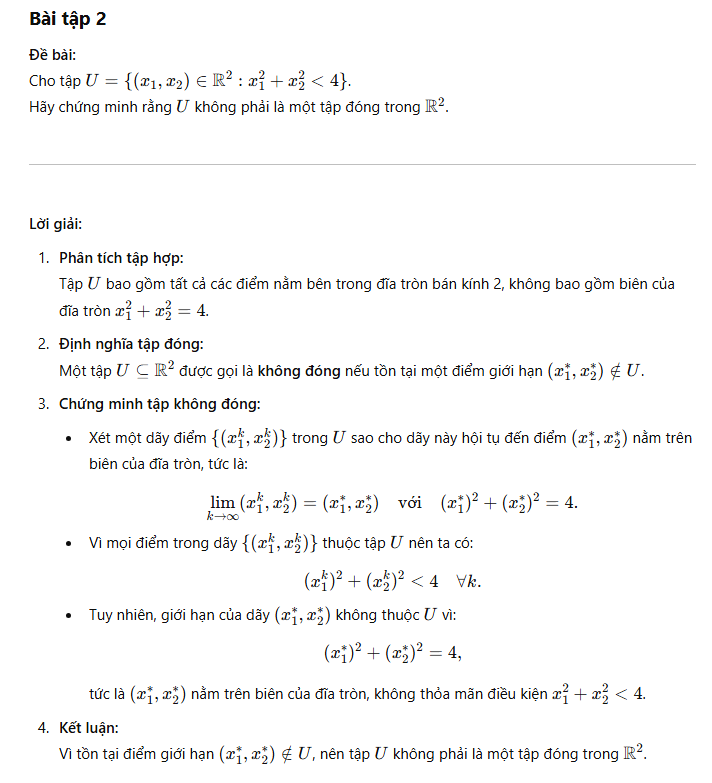




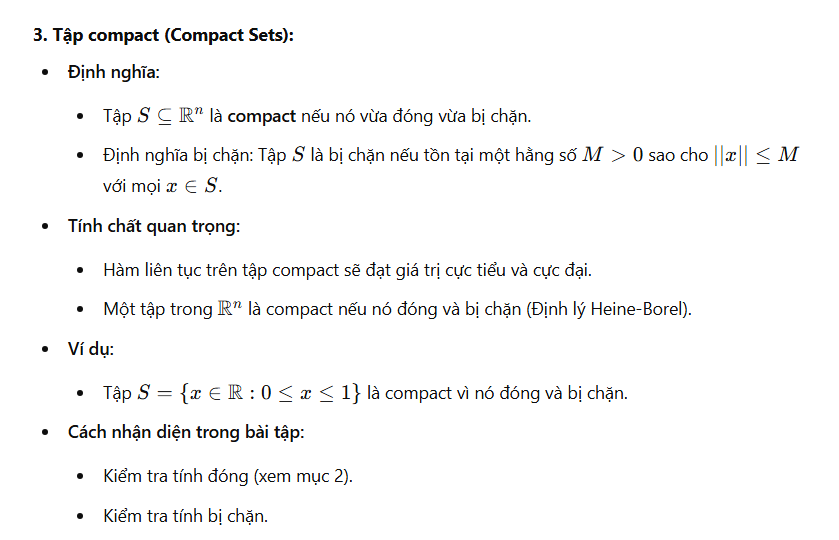
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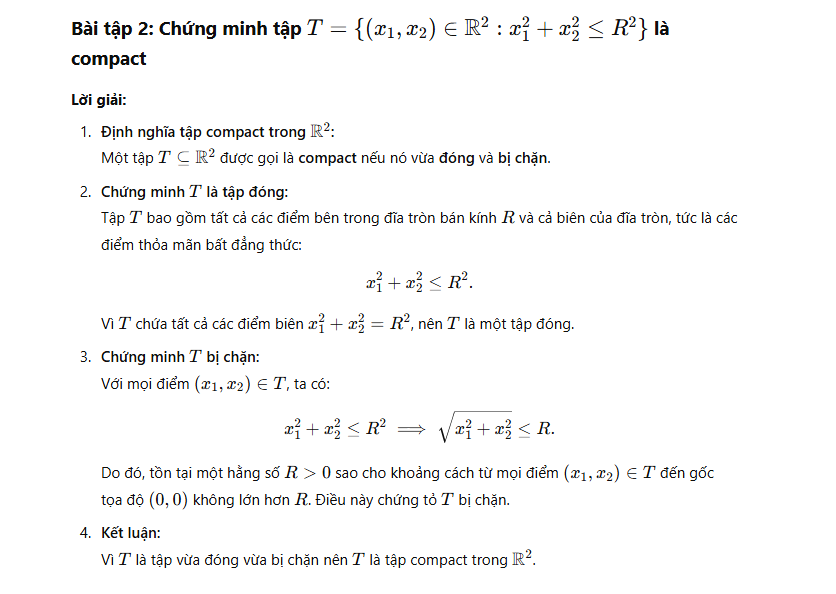




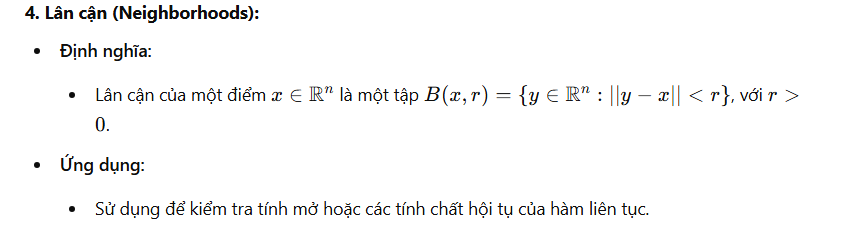


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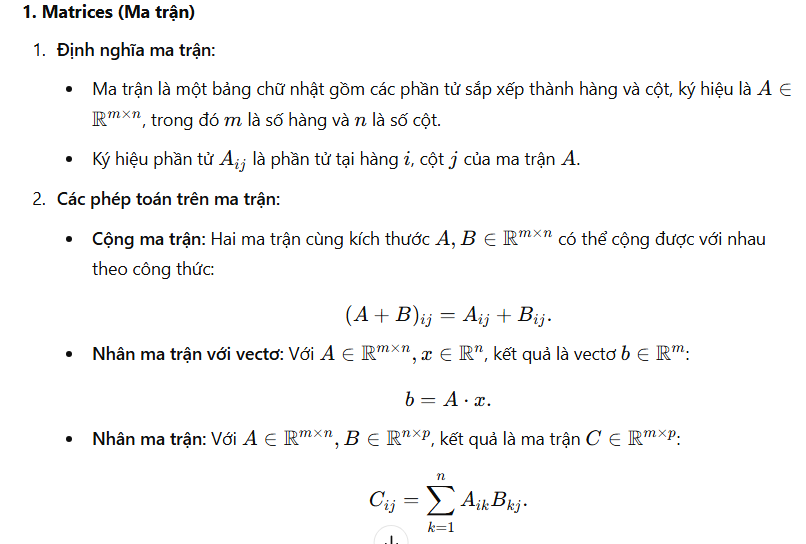




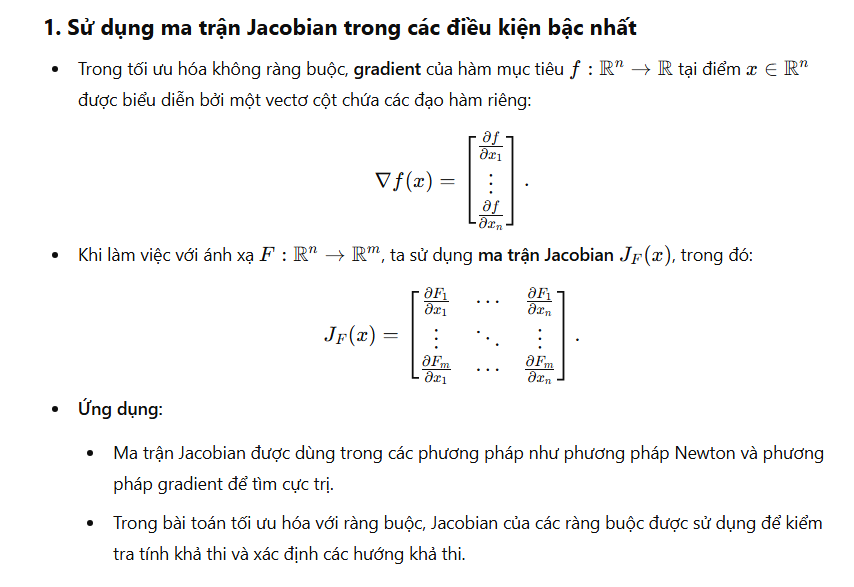
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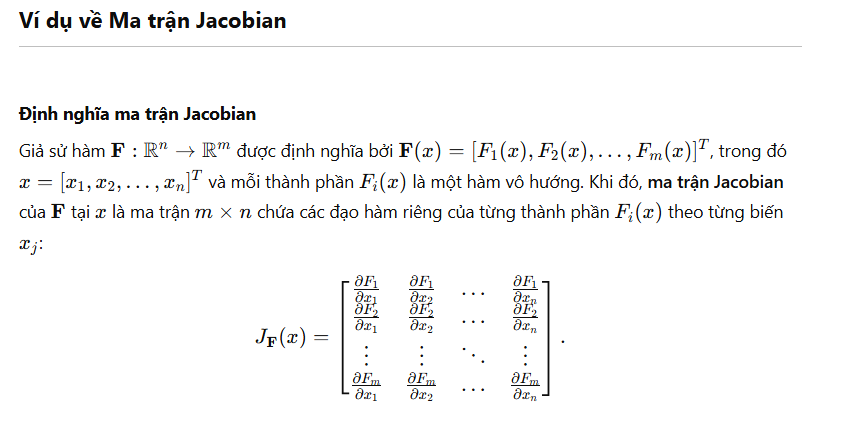


## Matrices

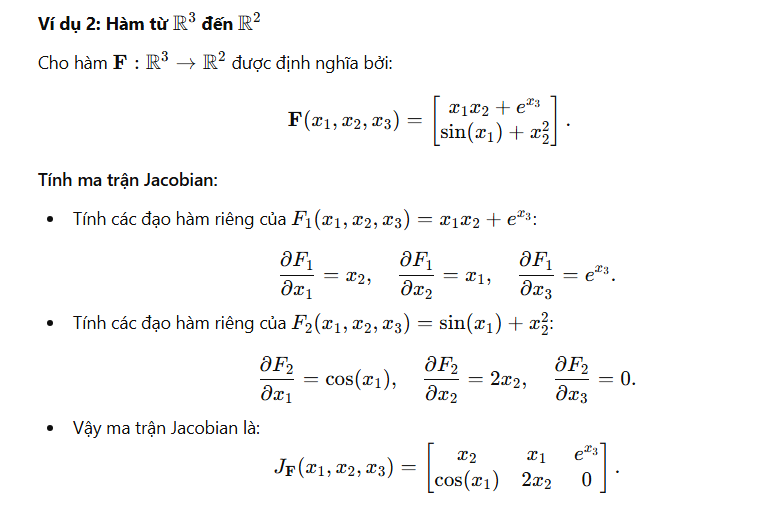


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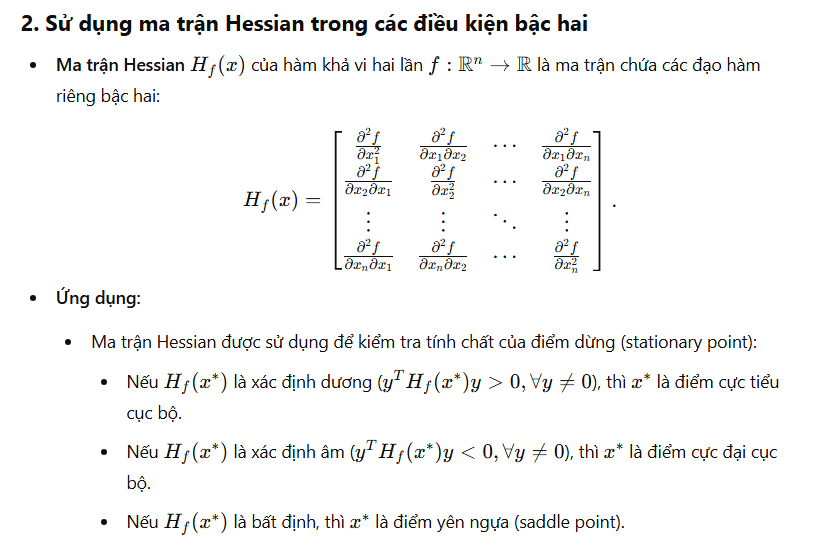


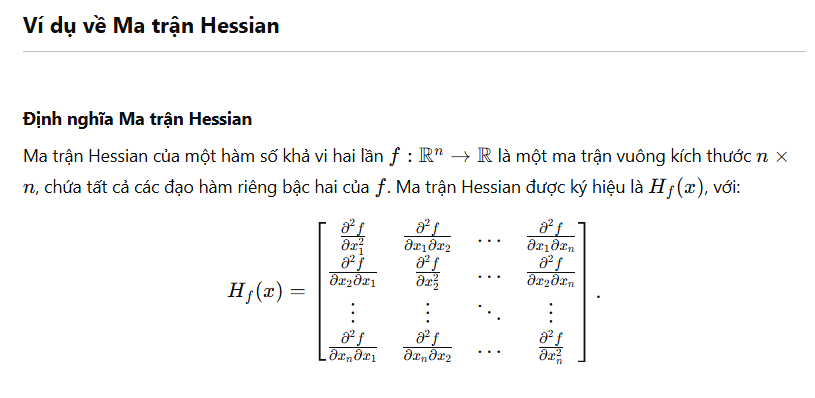


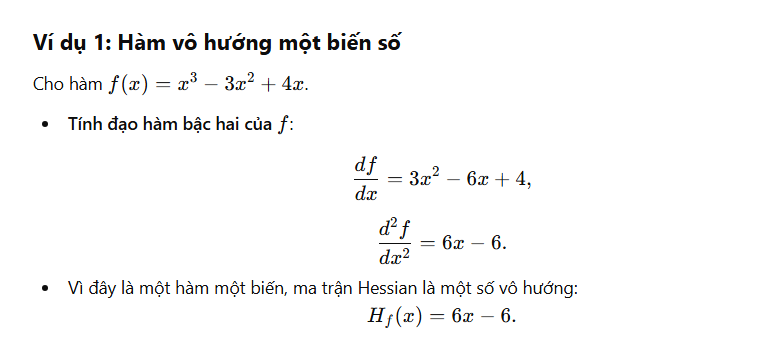


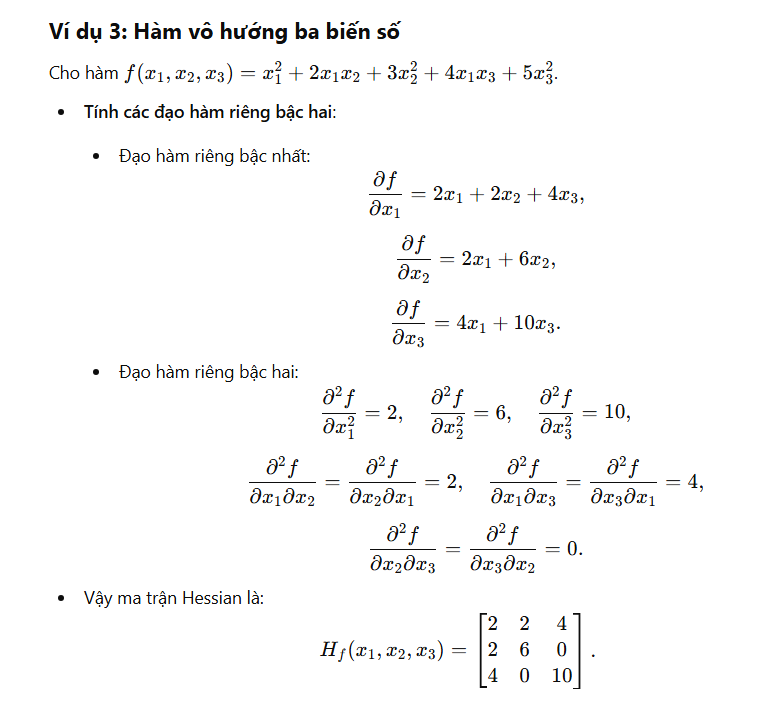


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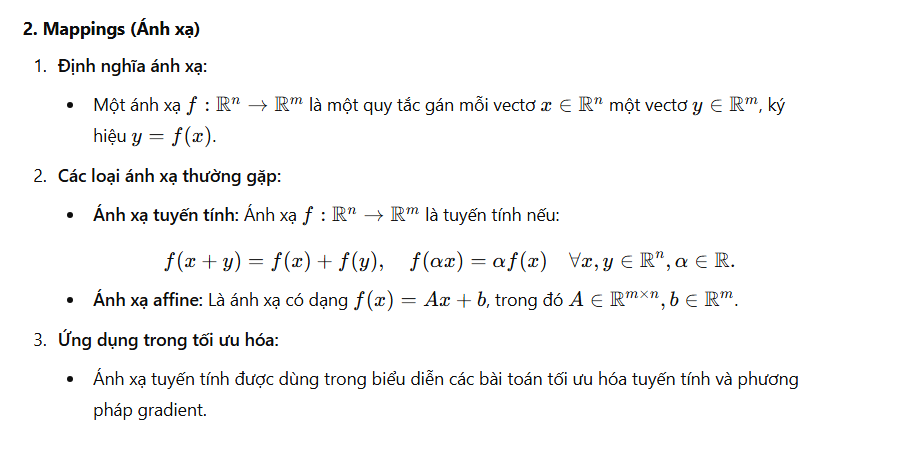


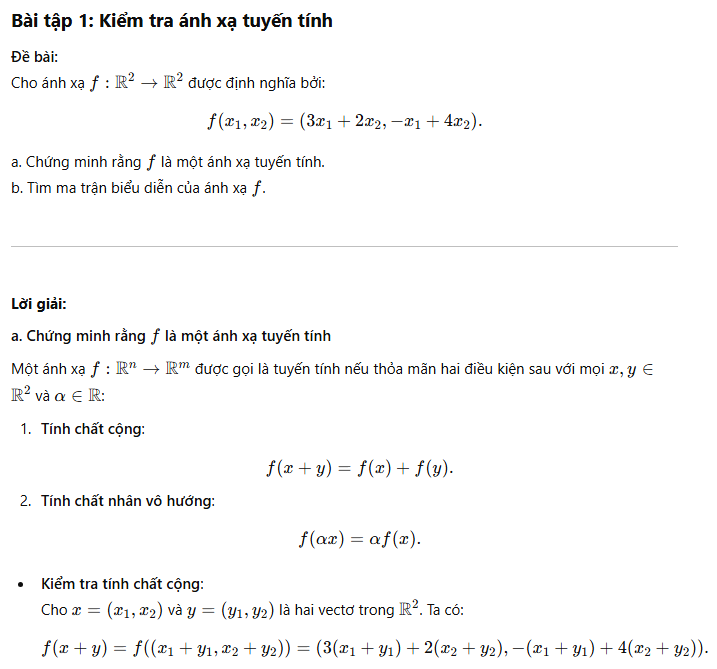


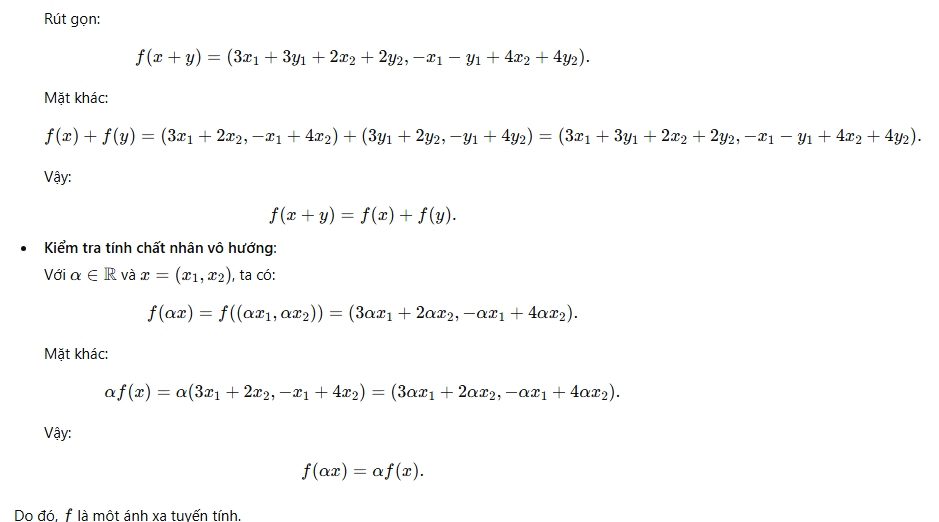




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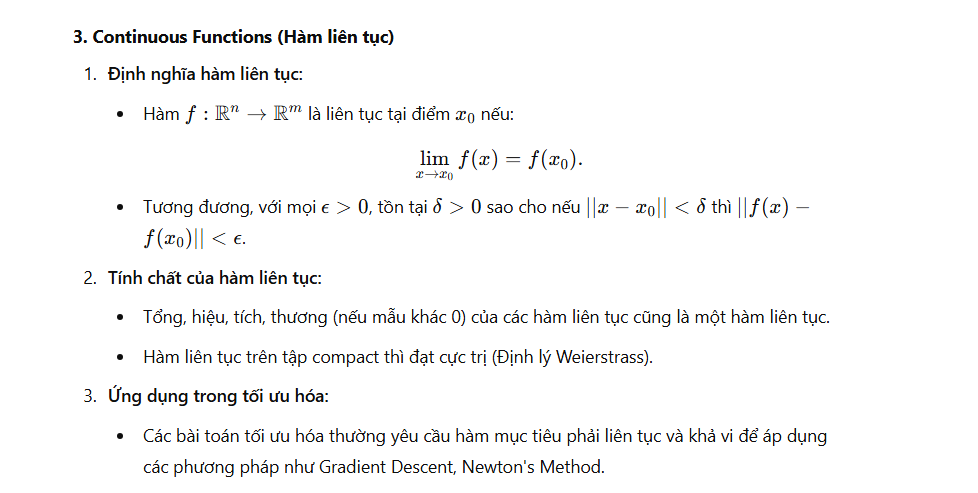


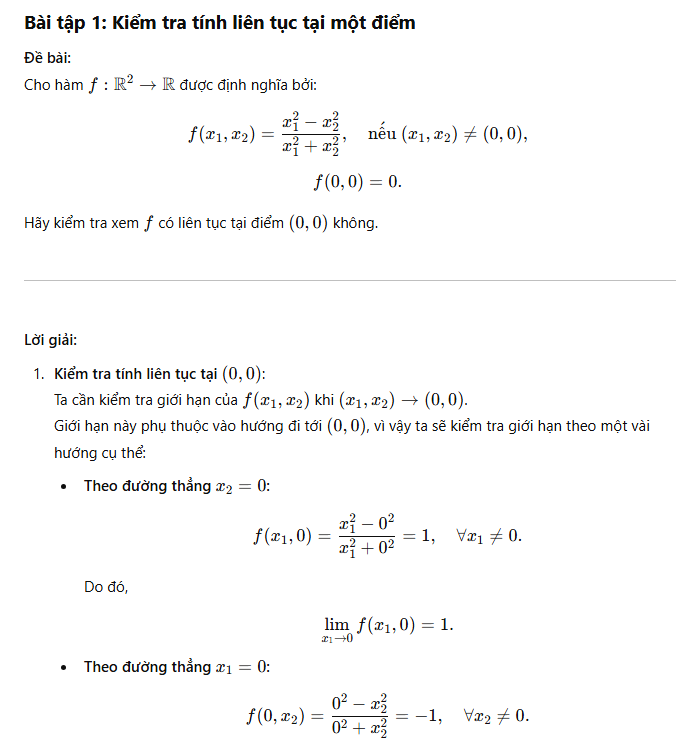






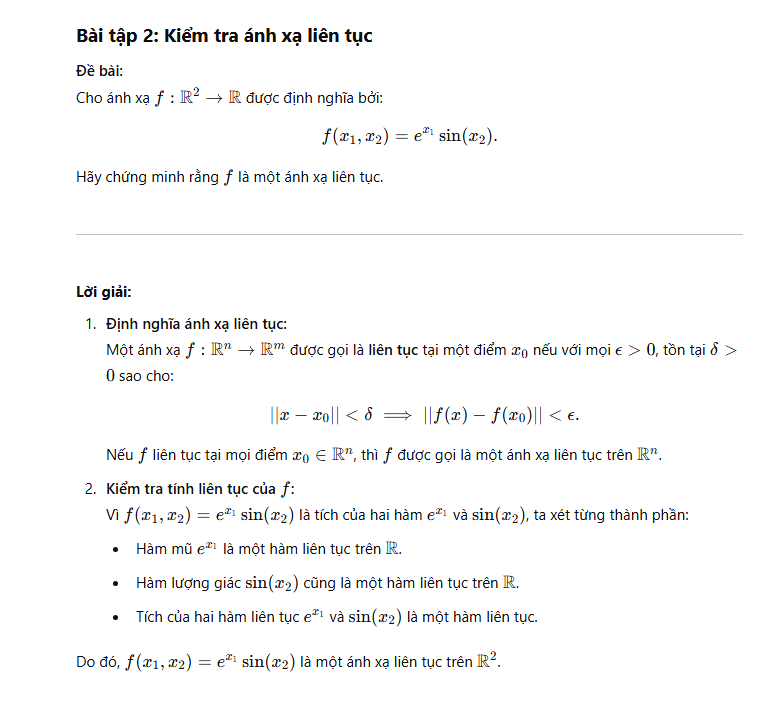
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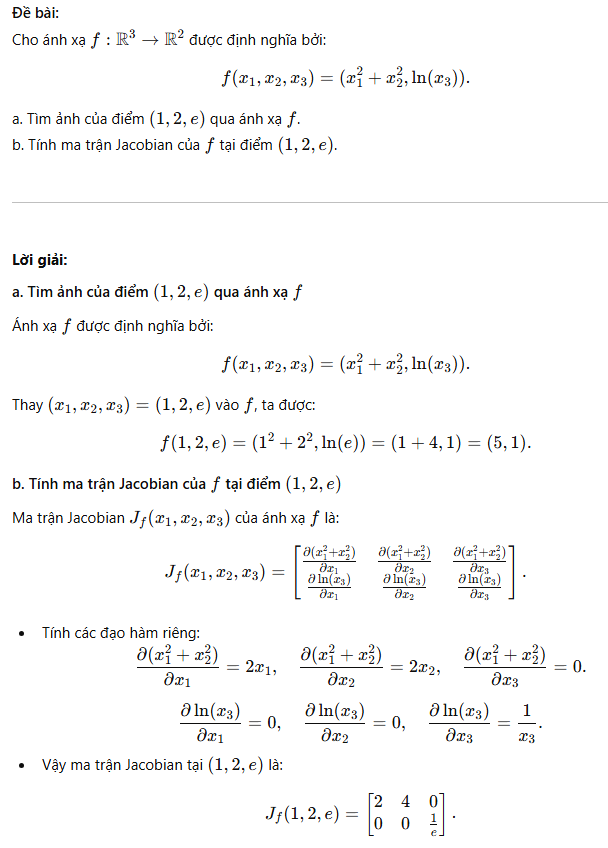


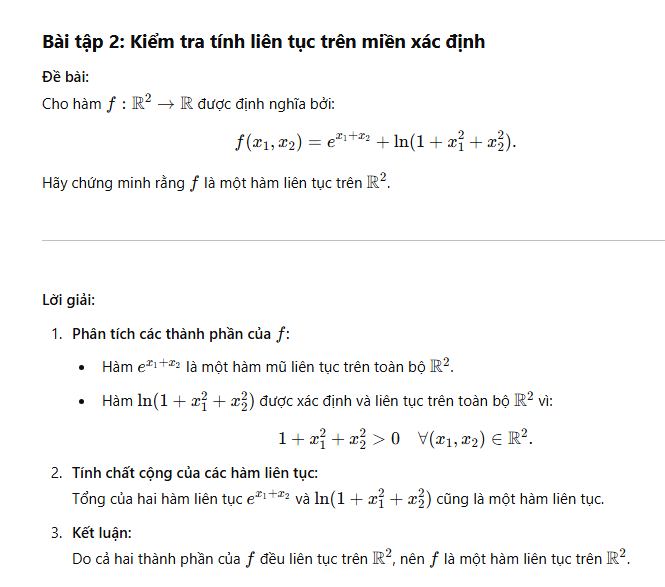


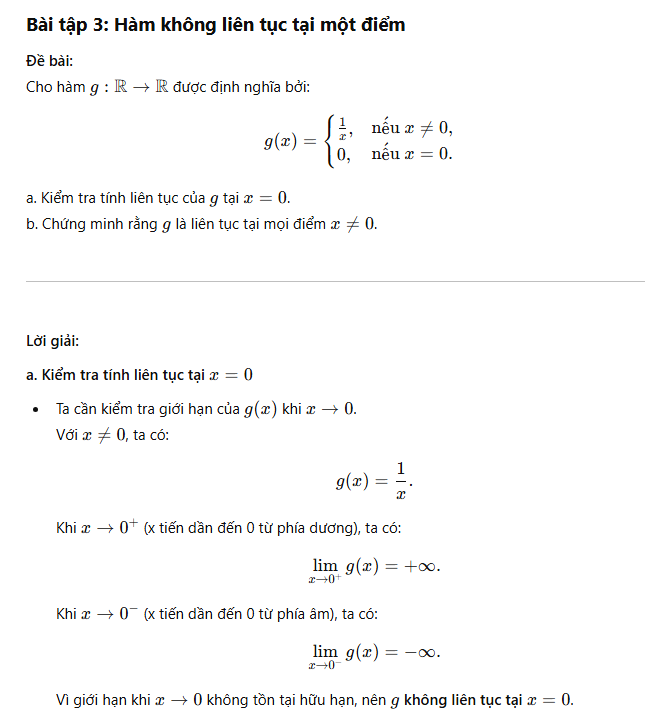


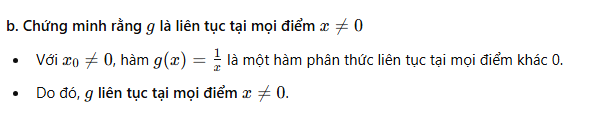
## Excercises

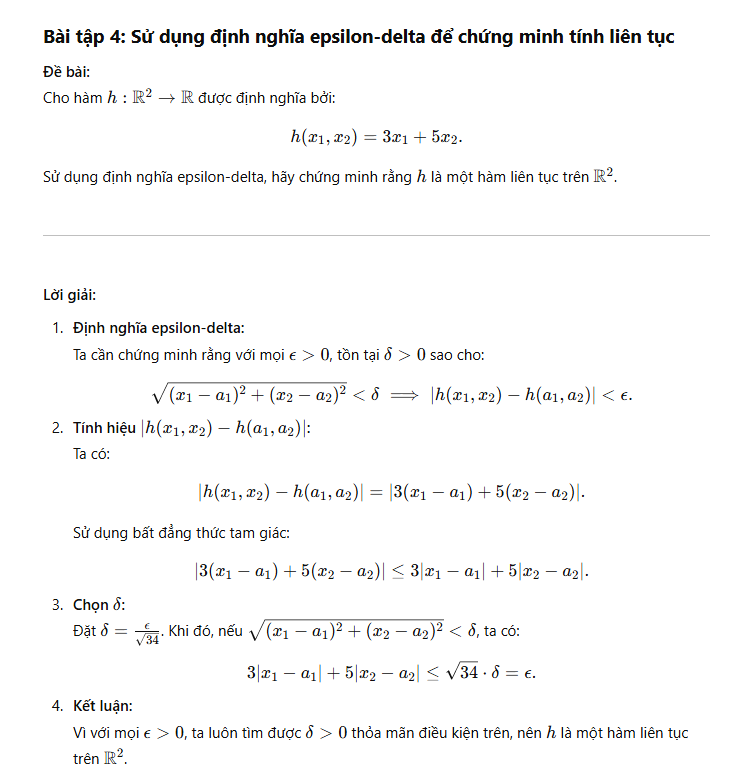




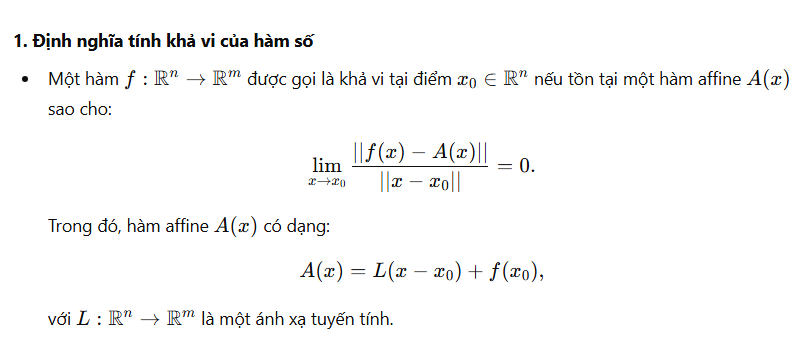


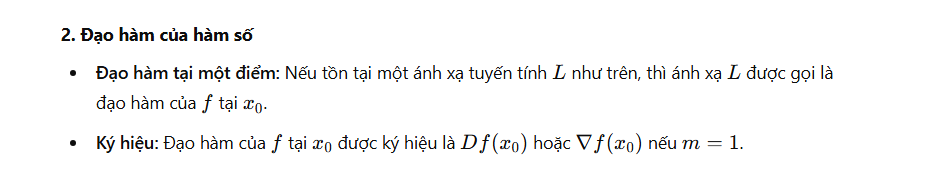


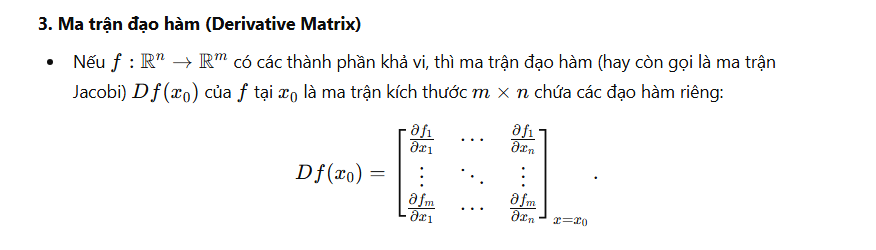


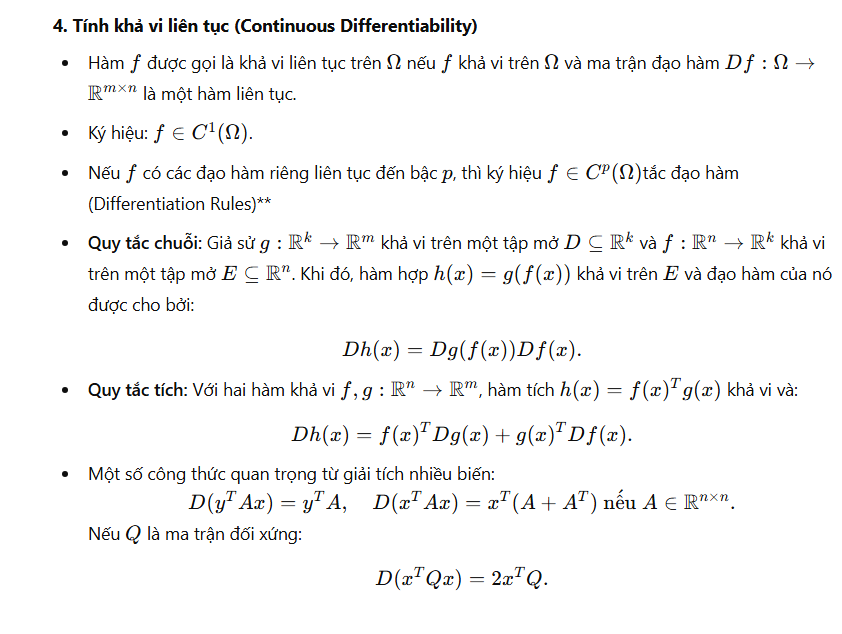


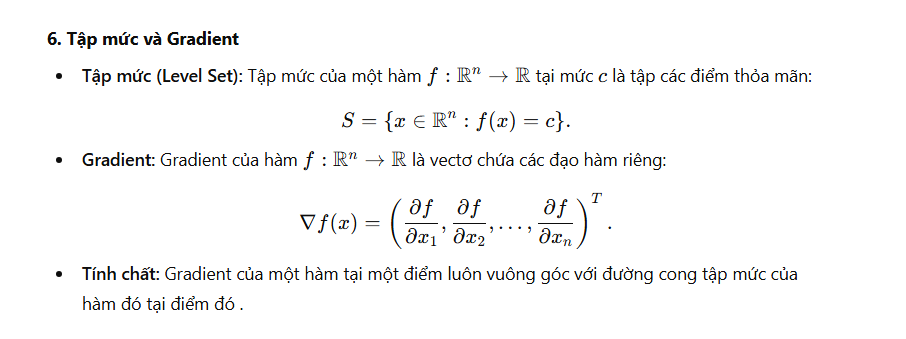
# Differentiability of Functions

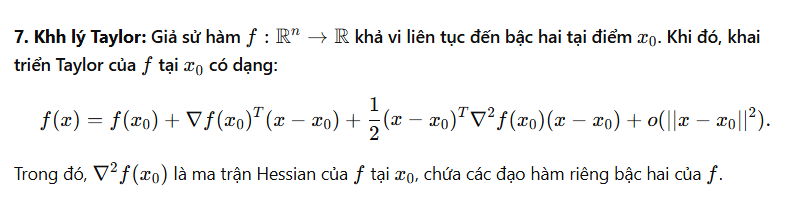


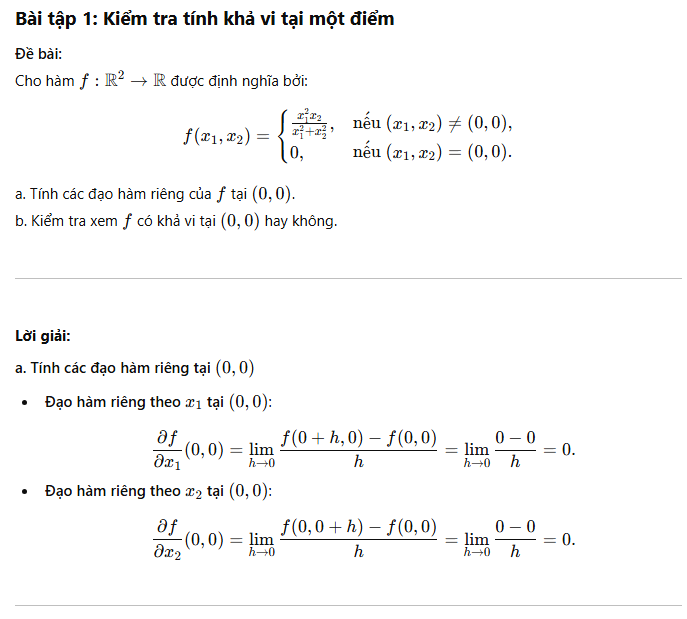


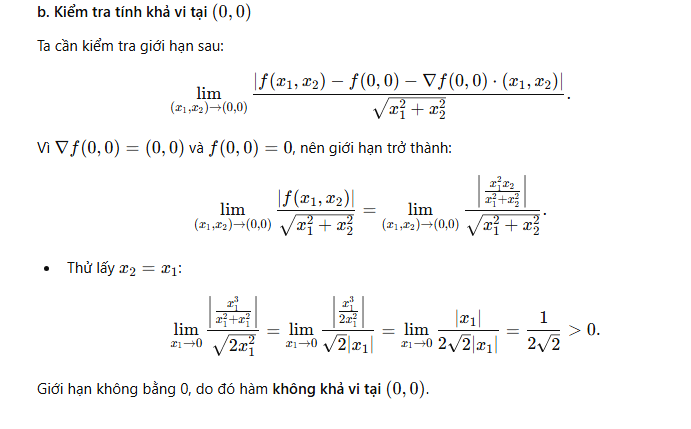


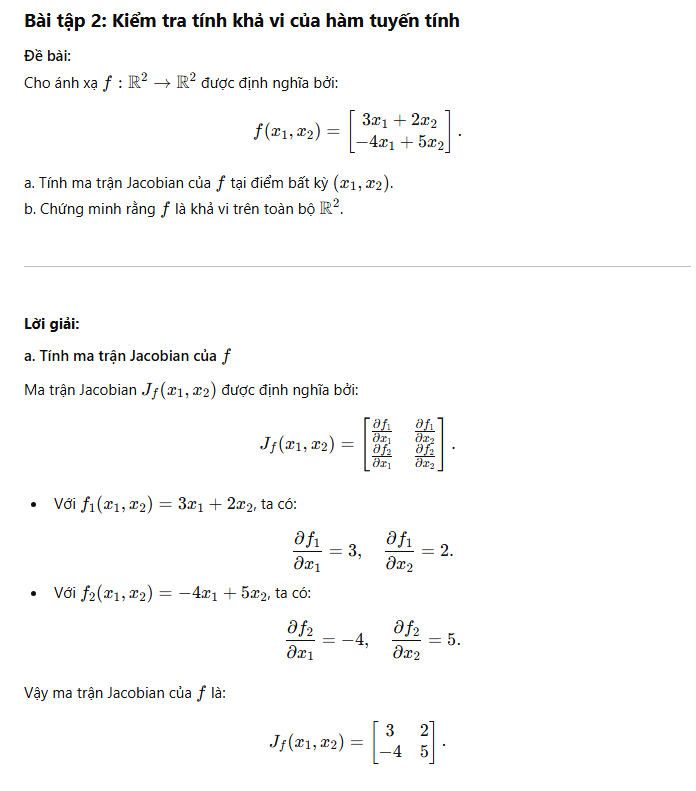


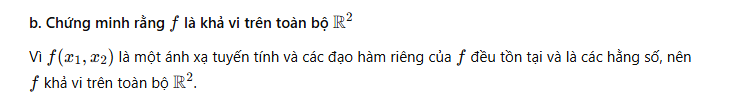


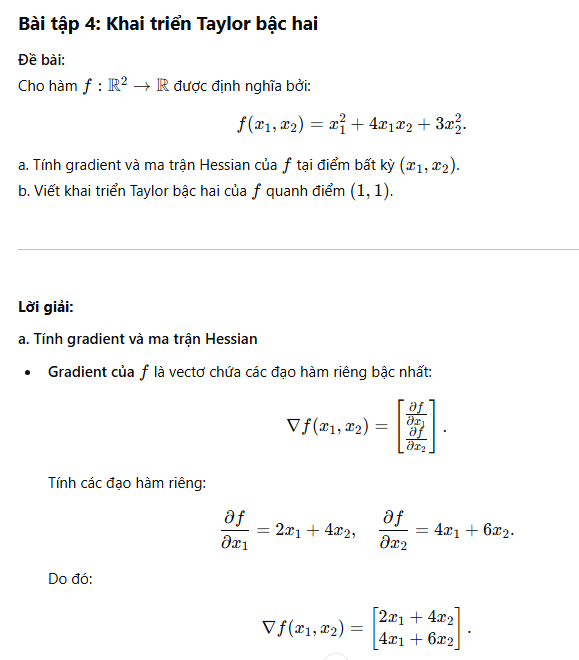


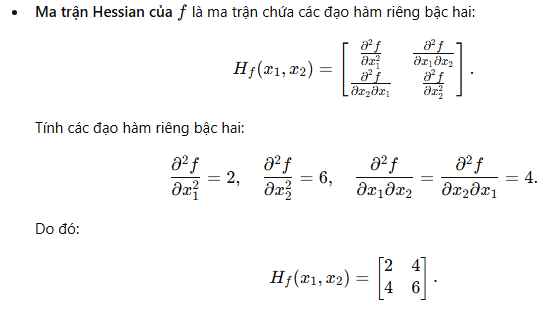


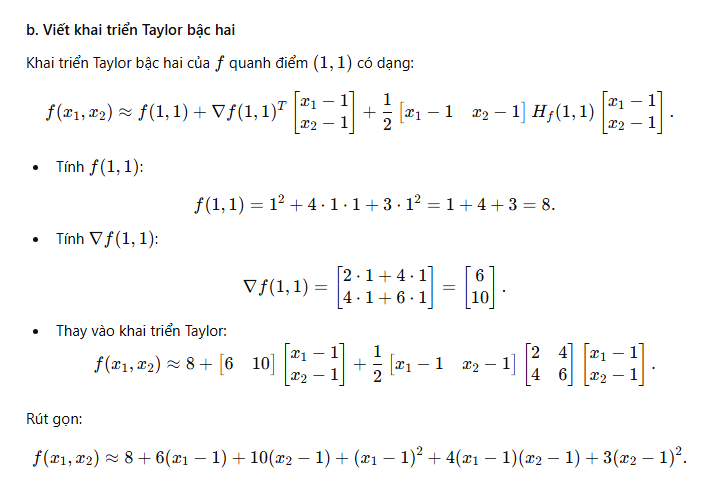


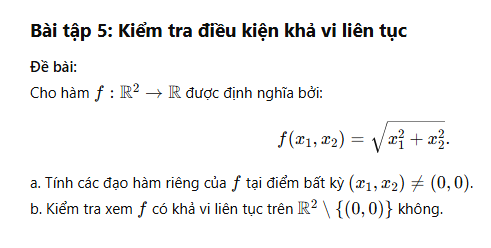


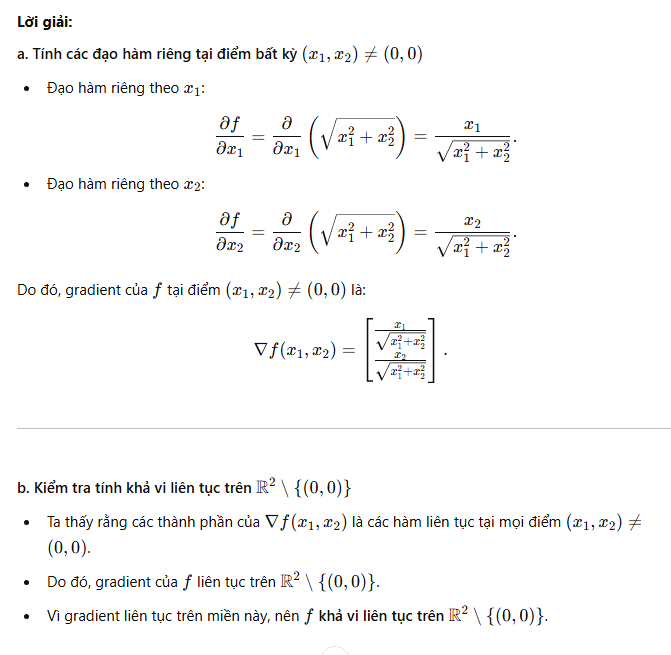


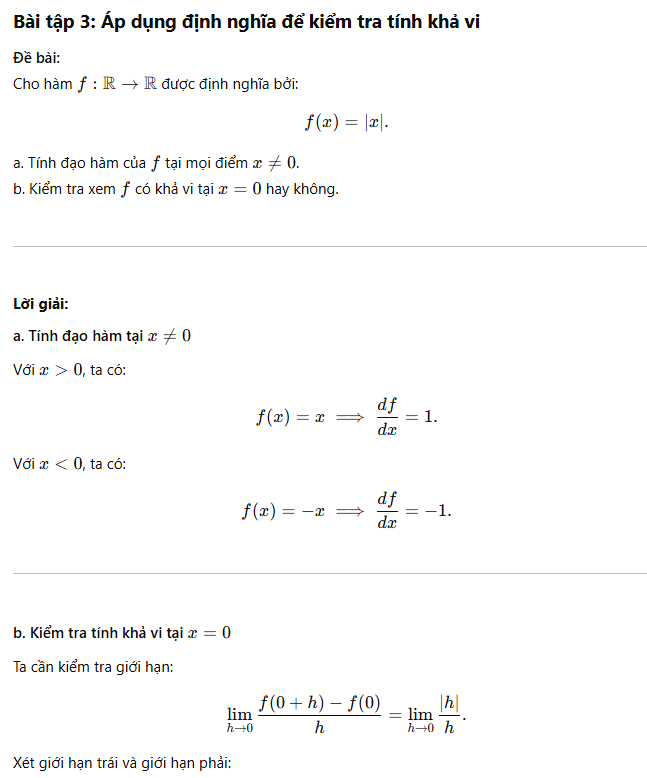


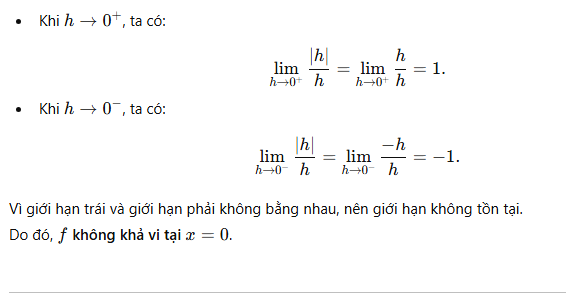






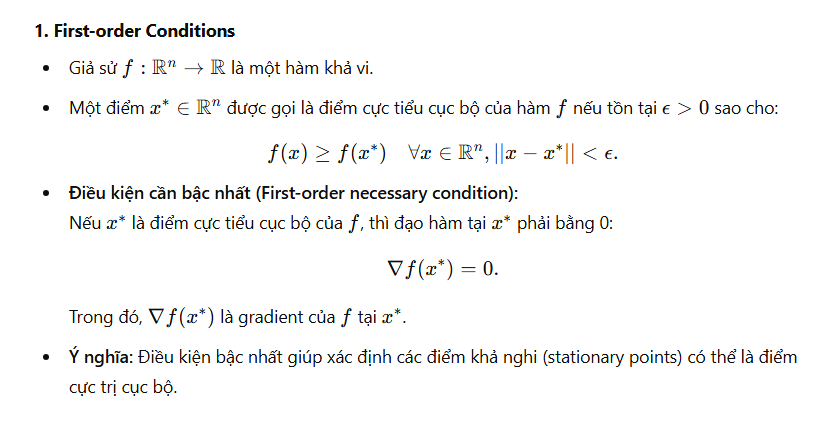


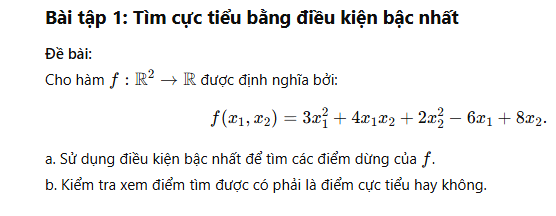


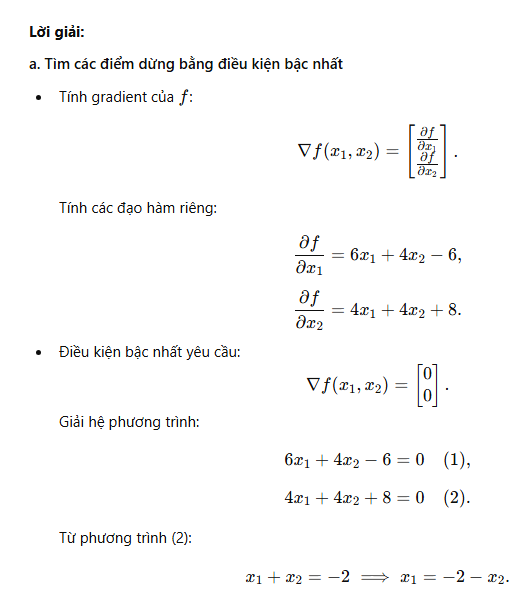


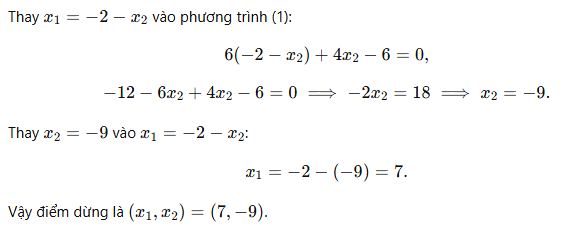
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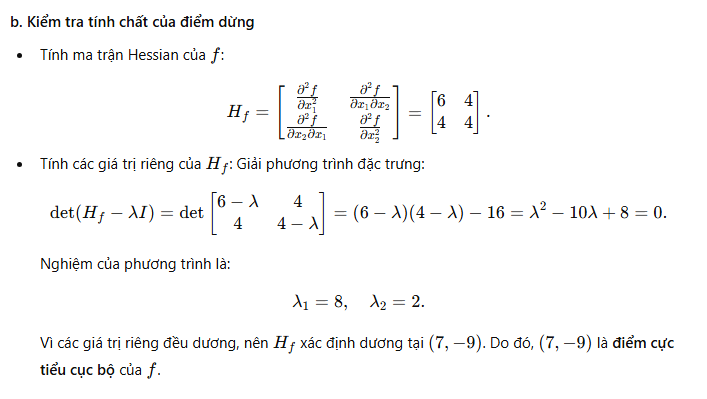
## 4.1 First-order Conditions.

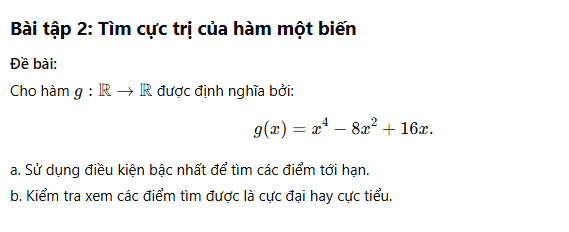


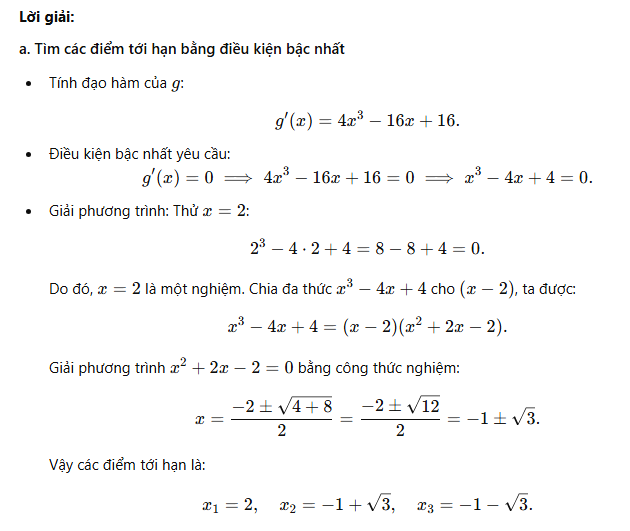


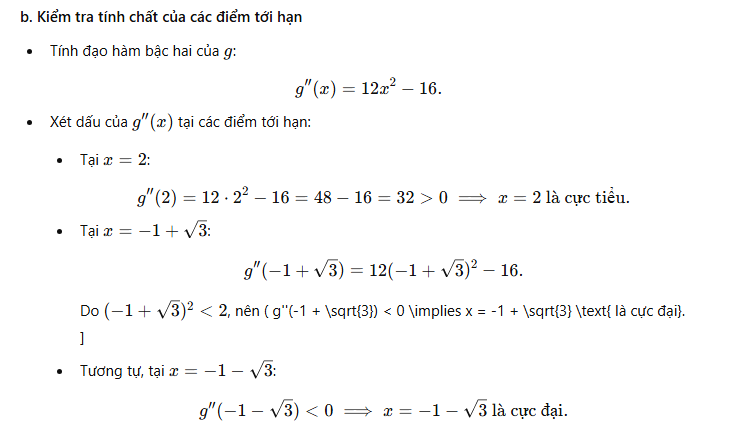


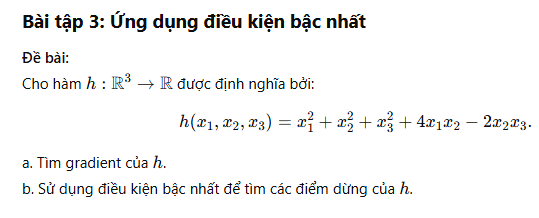


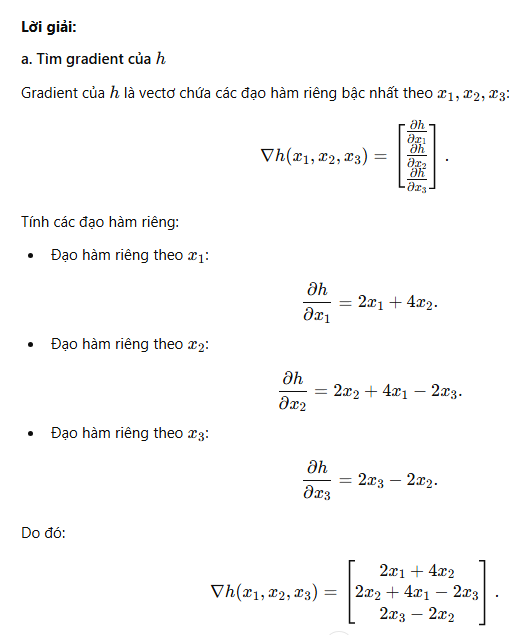


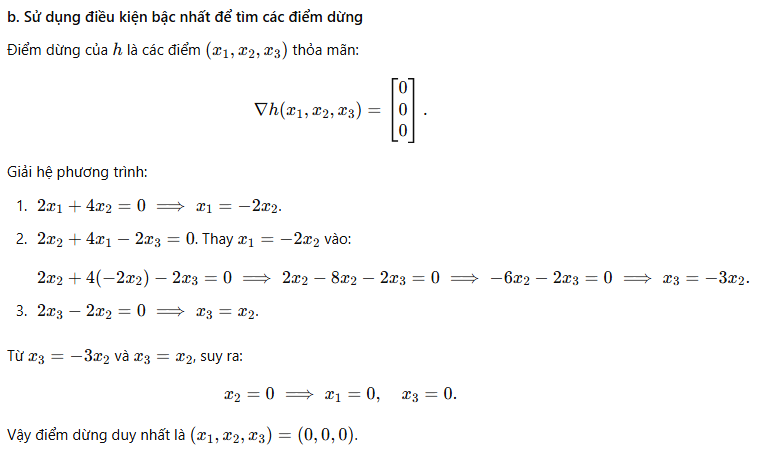


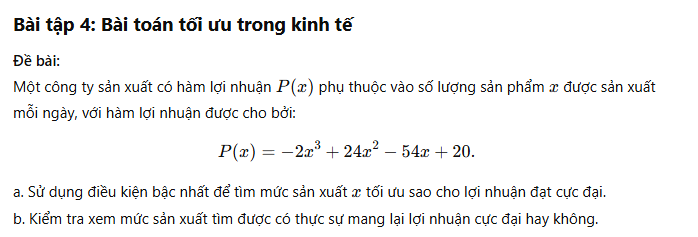


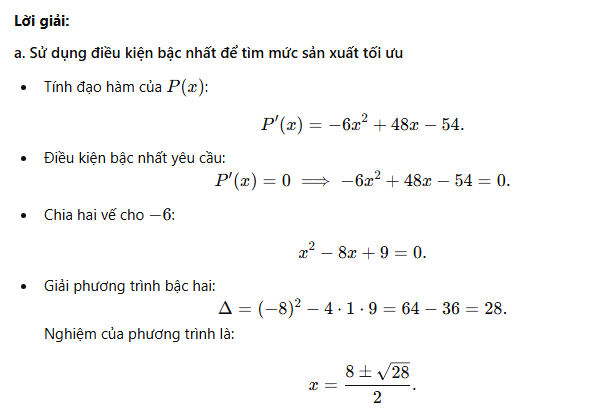




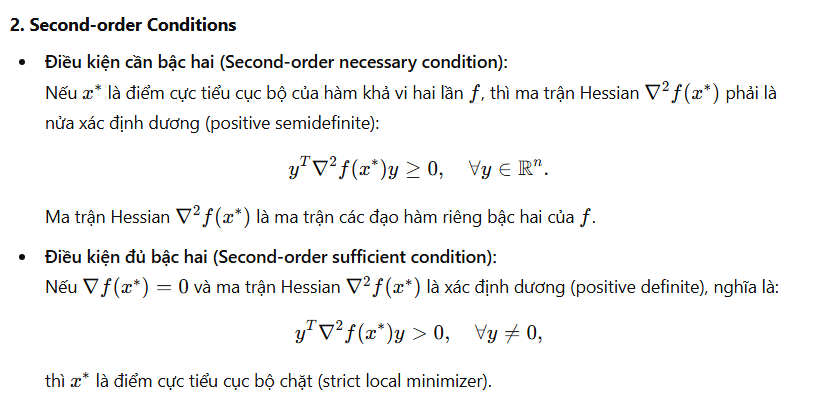


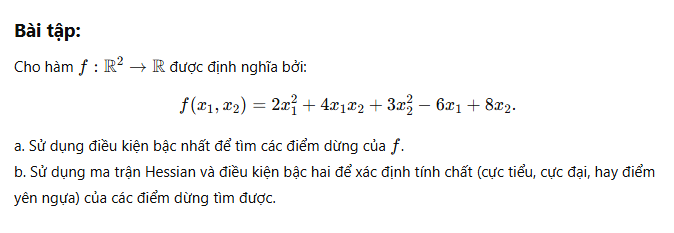


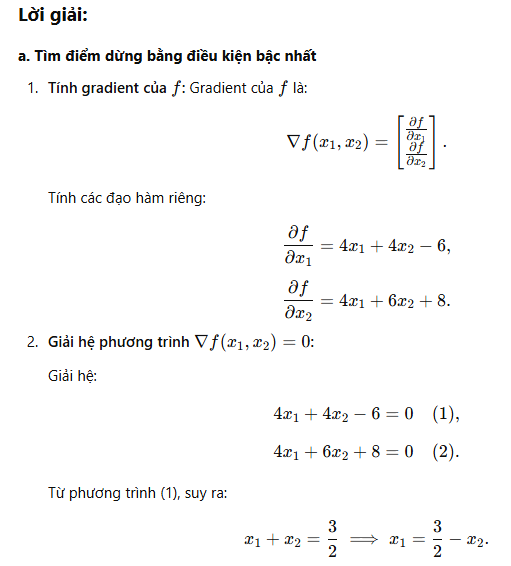


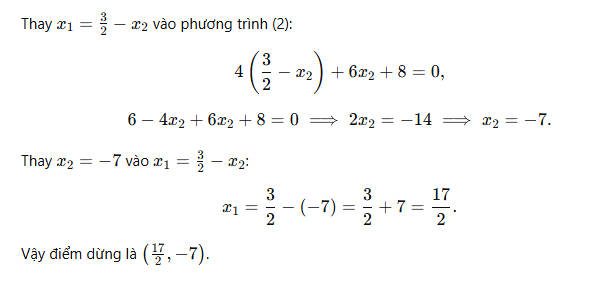


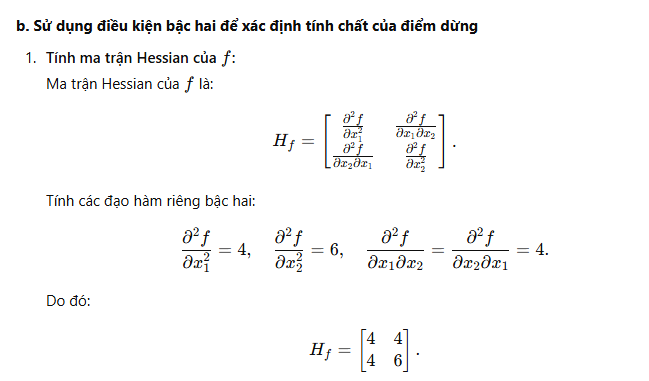
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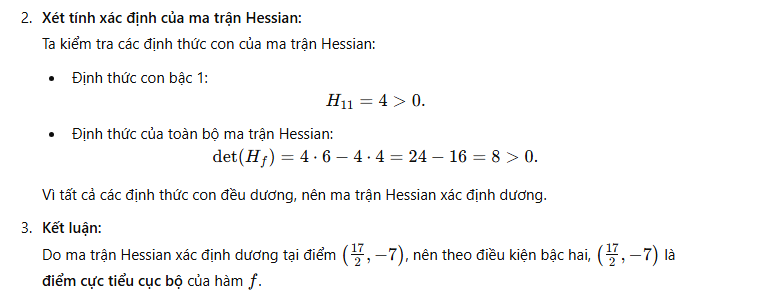


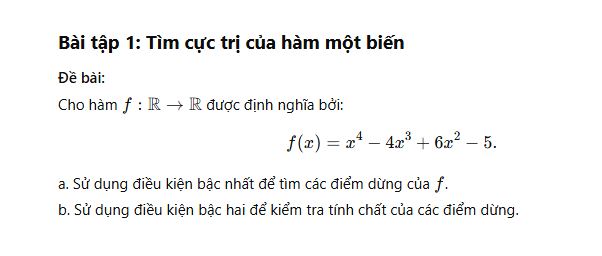


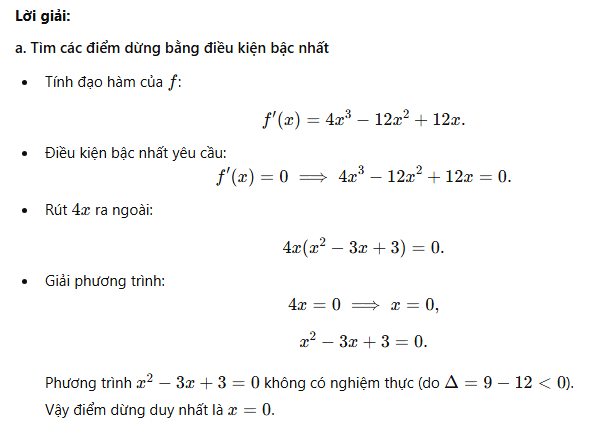


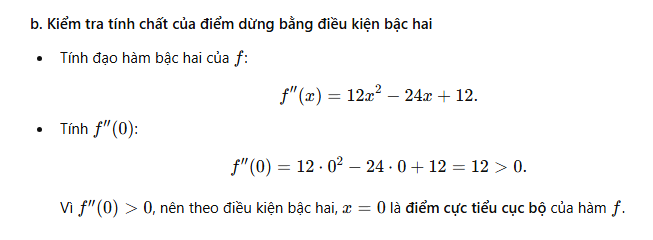
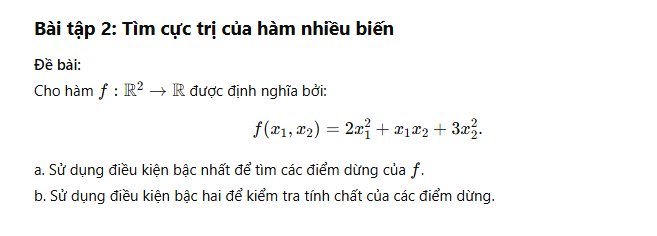


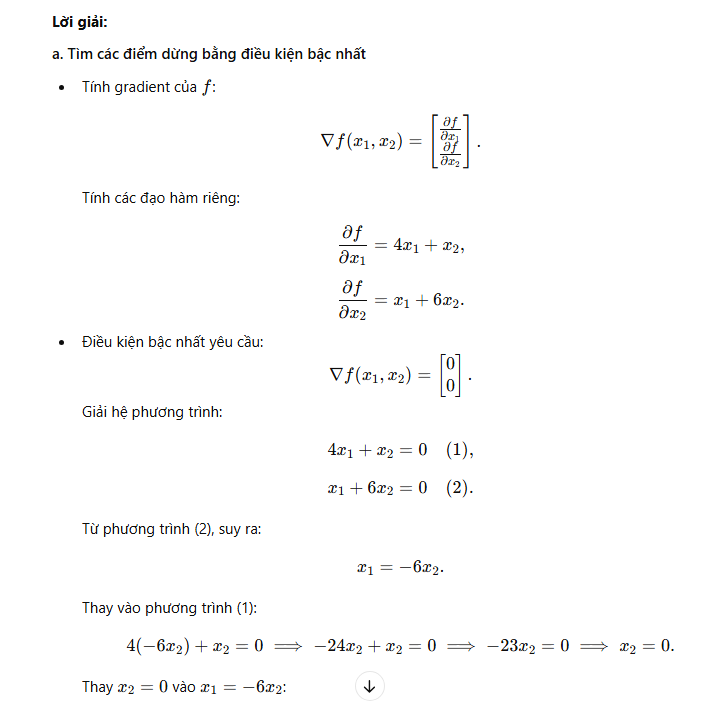


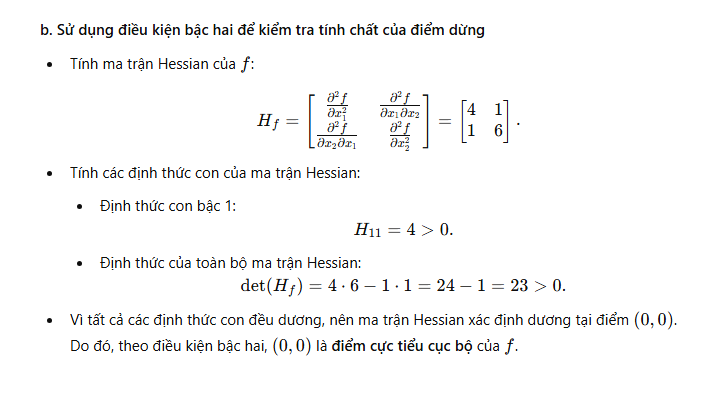


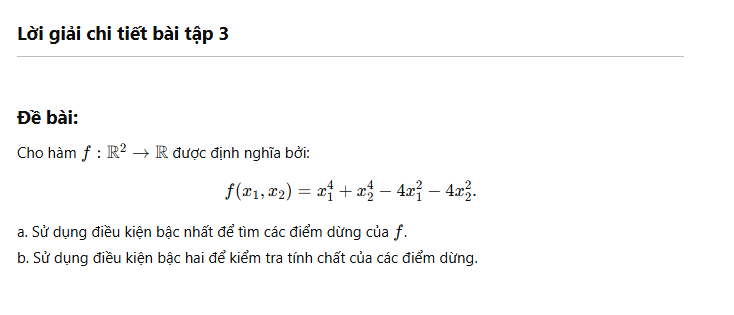
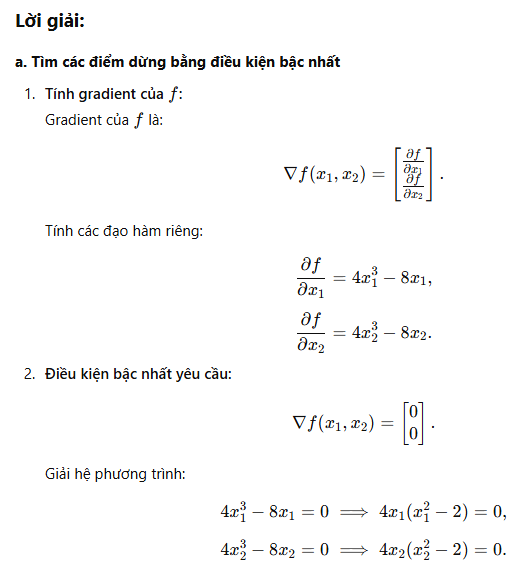


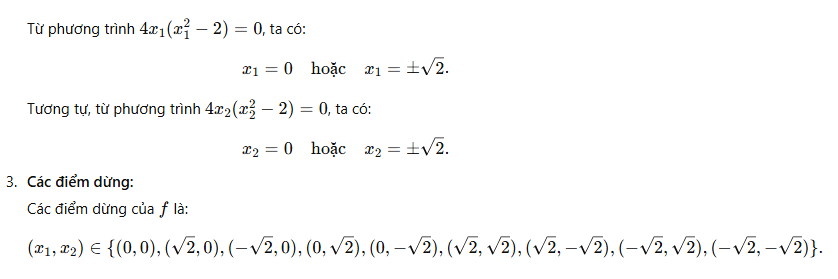


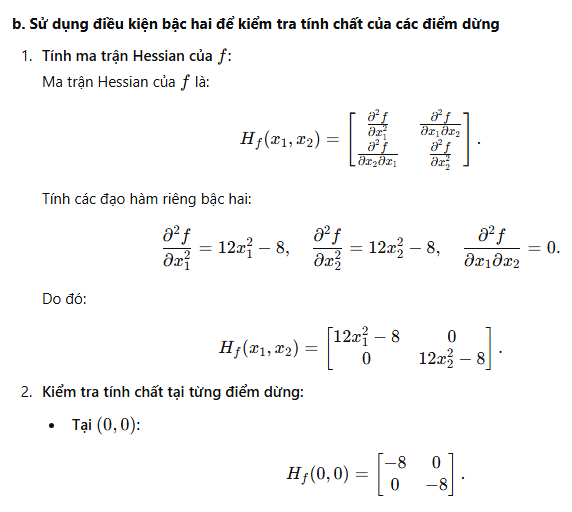
 

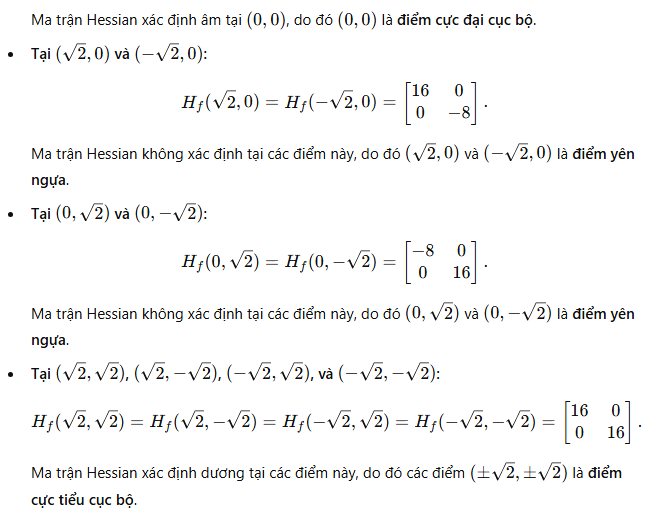




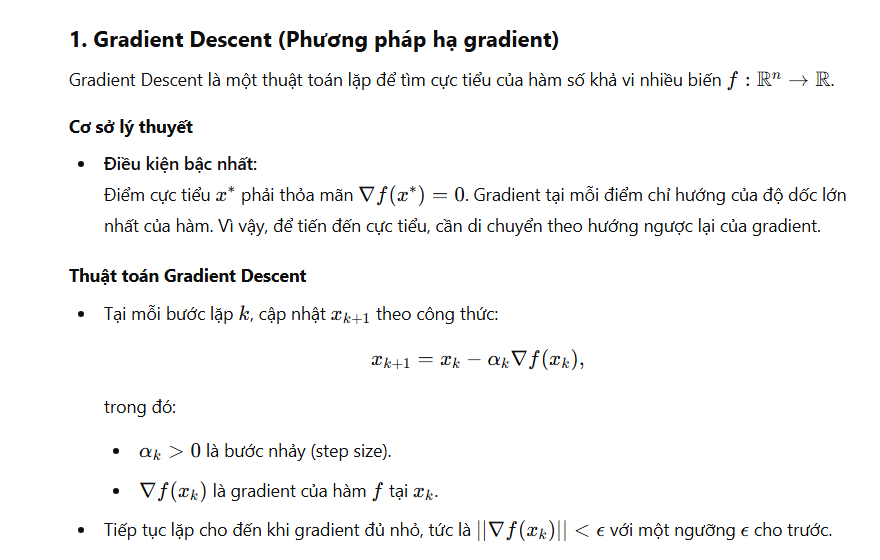
 

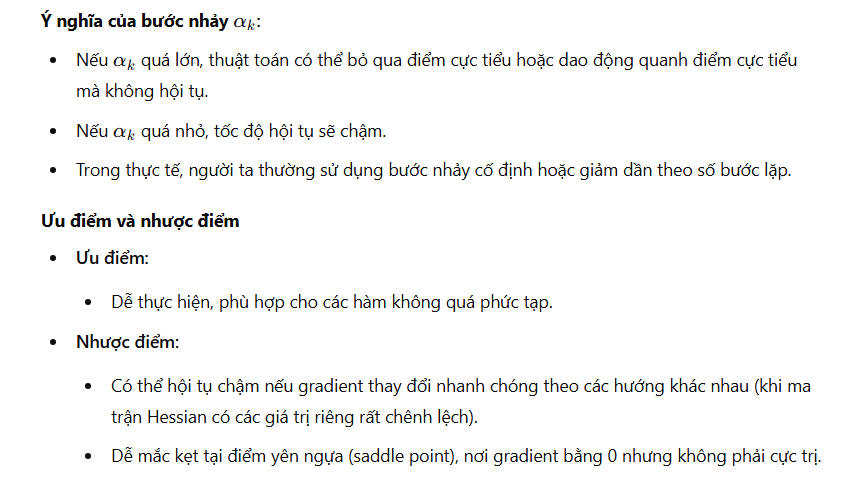


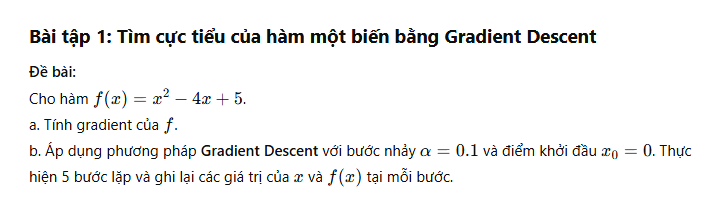


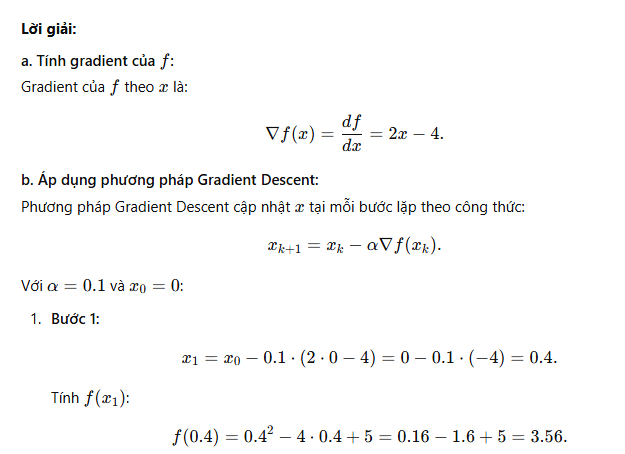


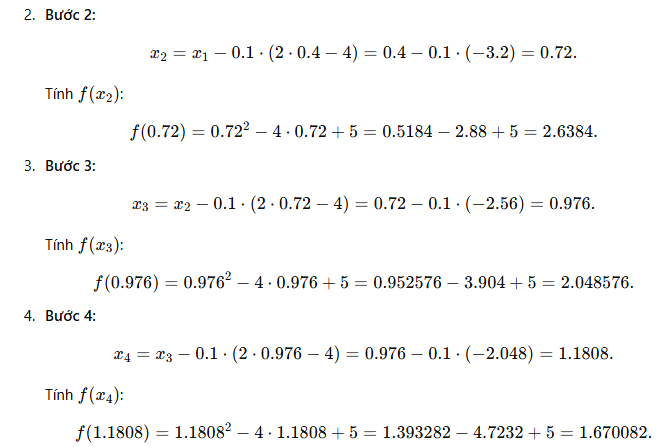
## 4.3 Gradient Descent Method

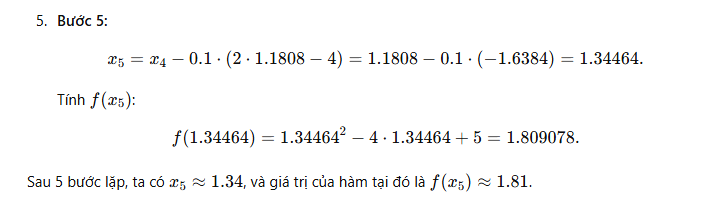


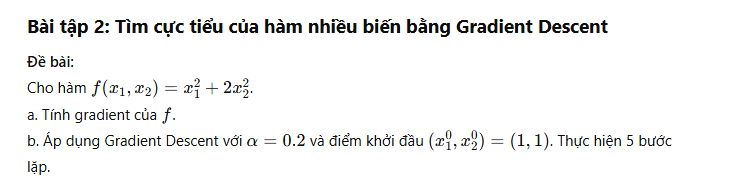


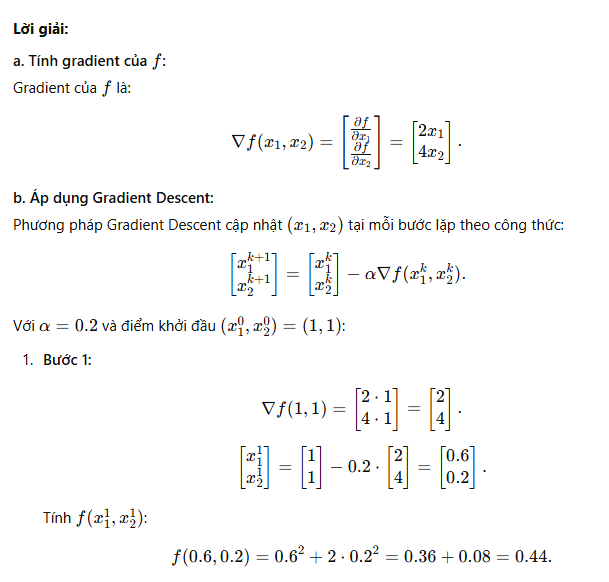




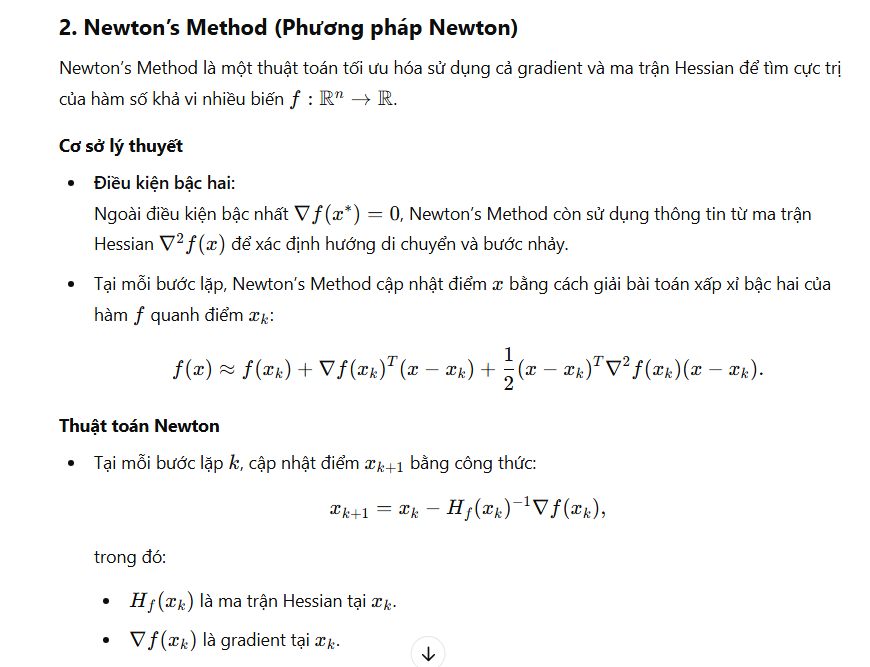




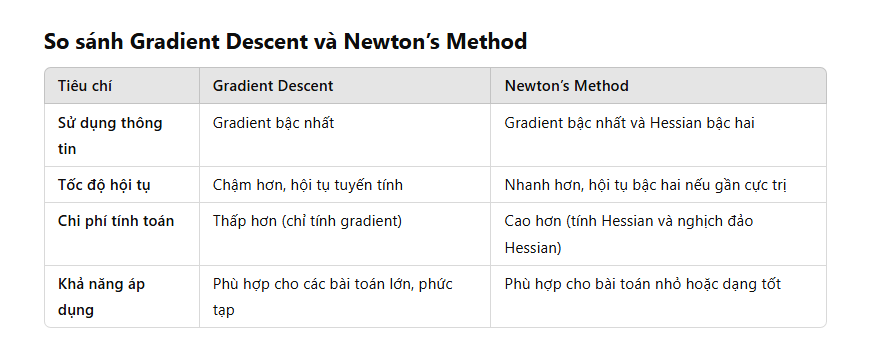


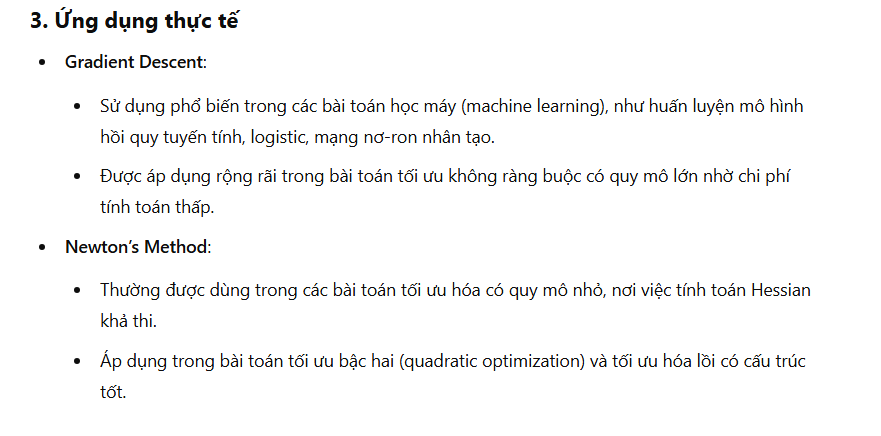


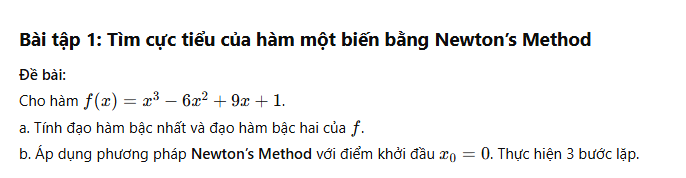
## 4.4 Newton’s Method

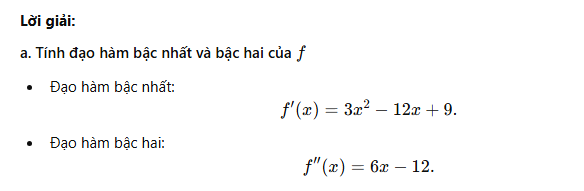


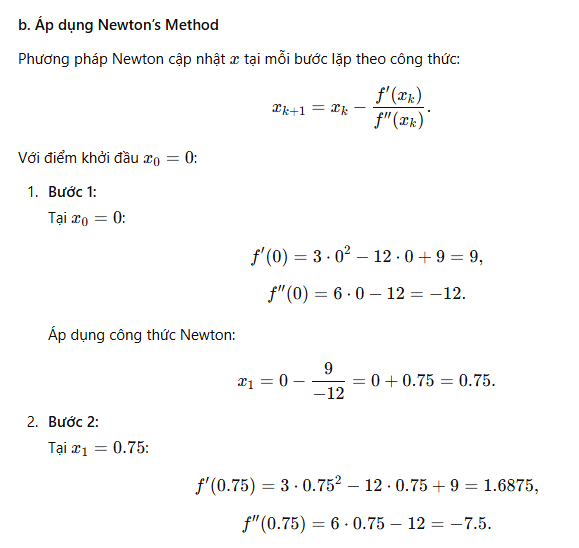


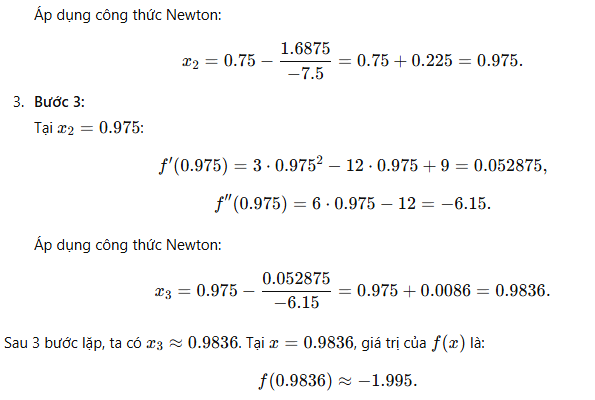


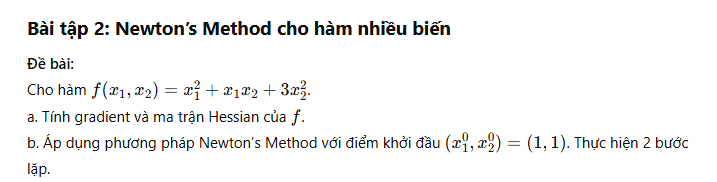


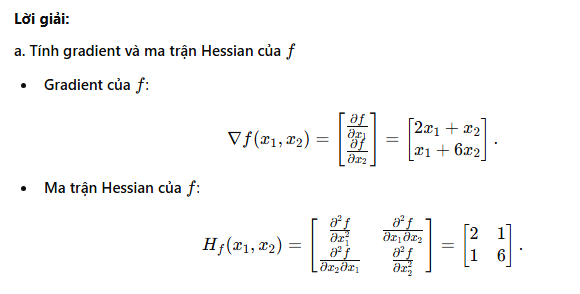


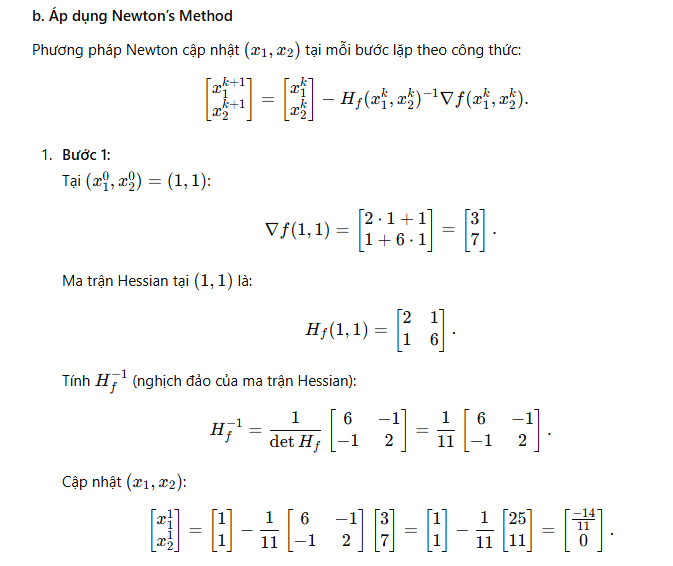
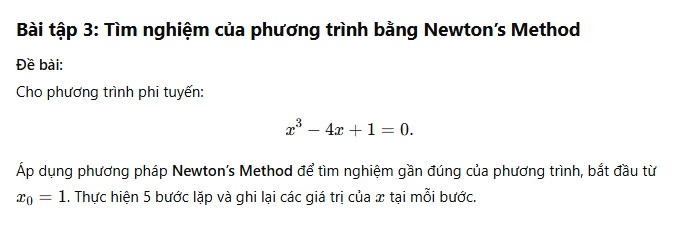


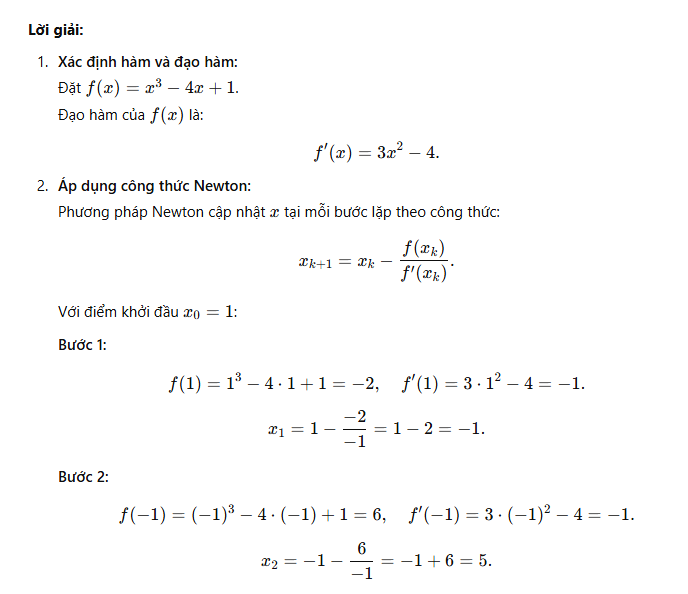


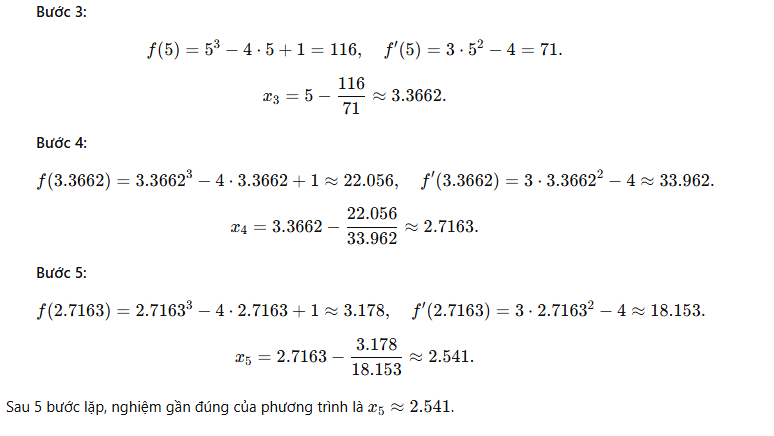


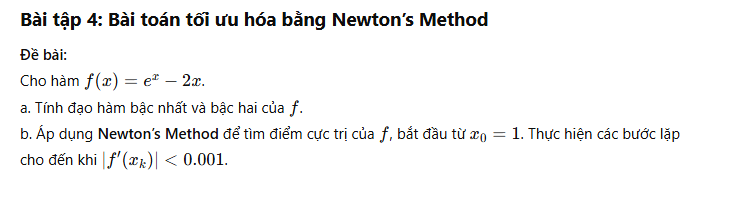


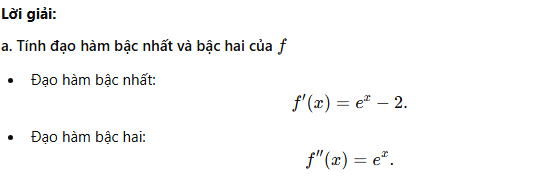


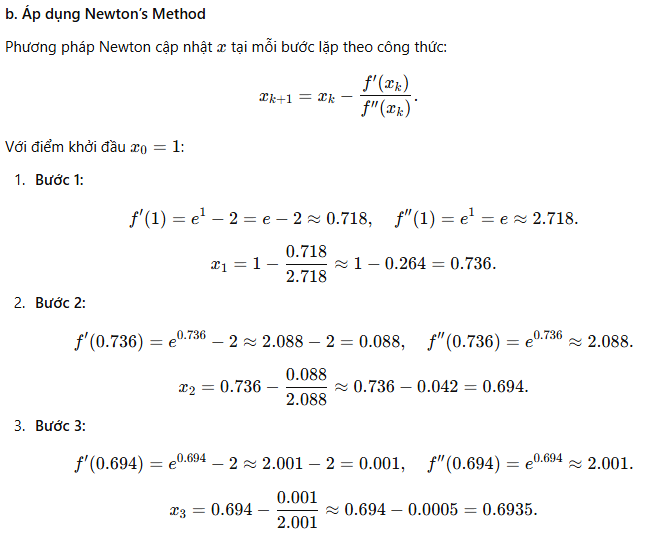
 

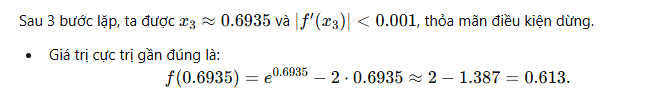






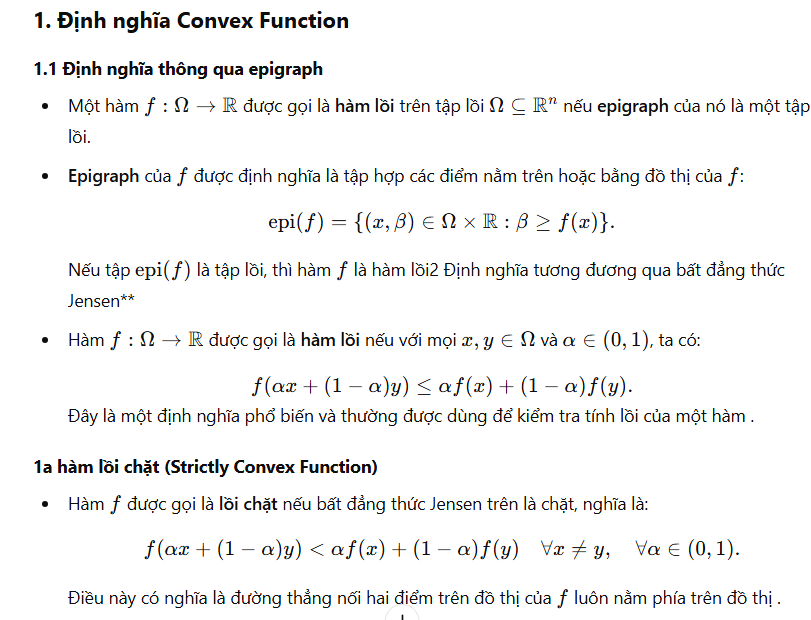


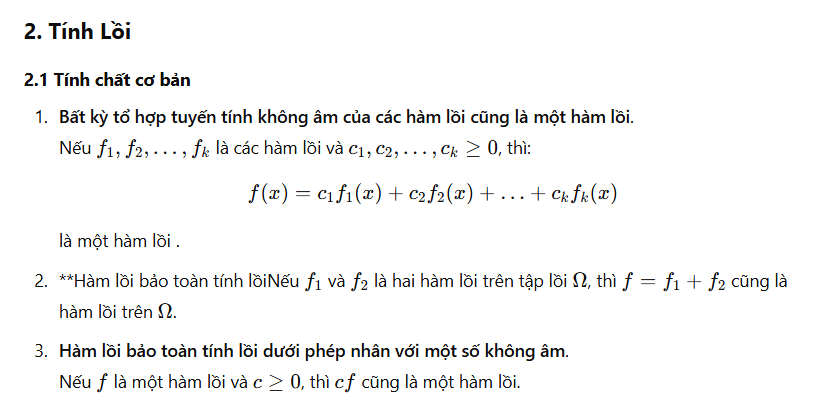


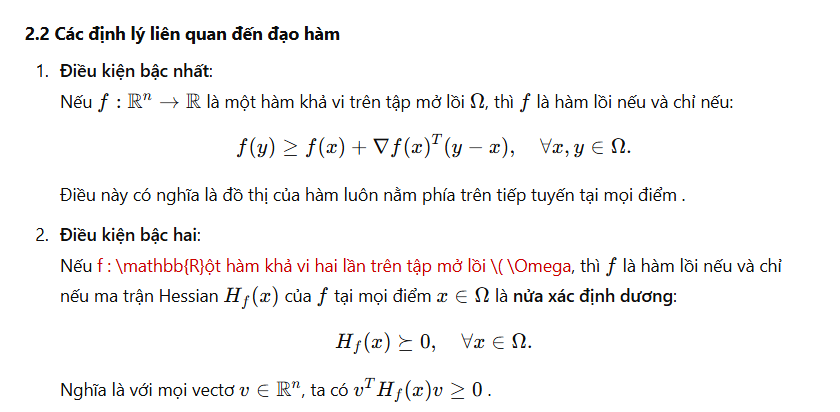


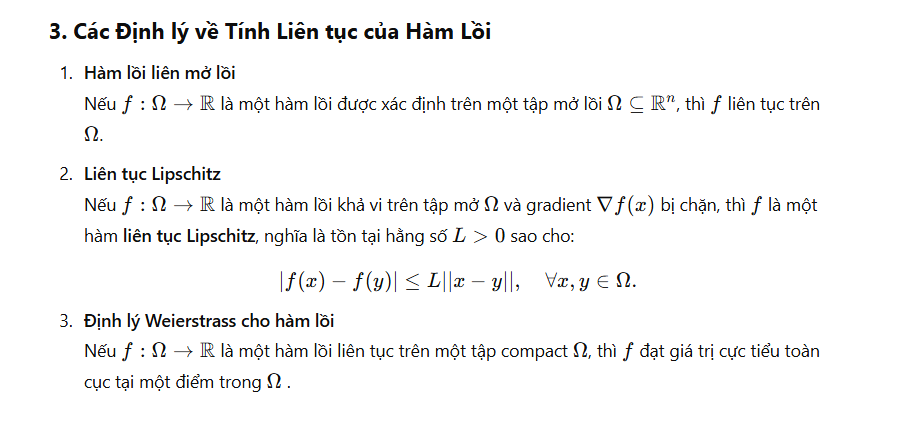
# 5.Convex Functions:

## Definitions



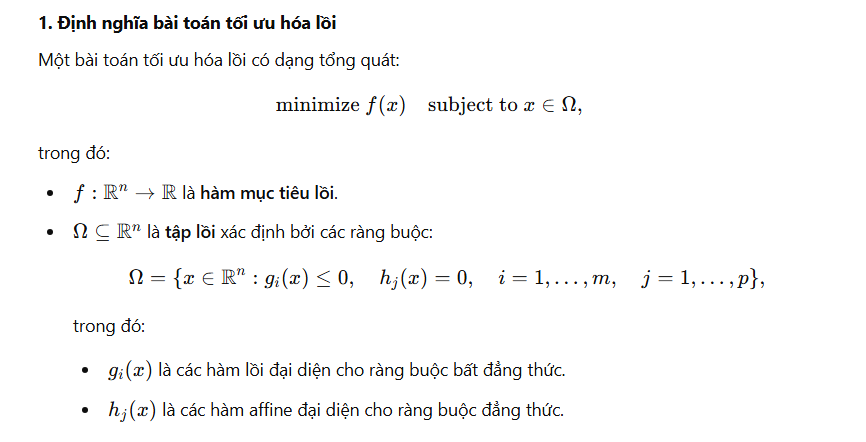


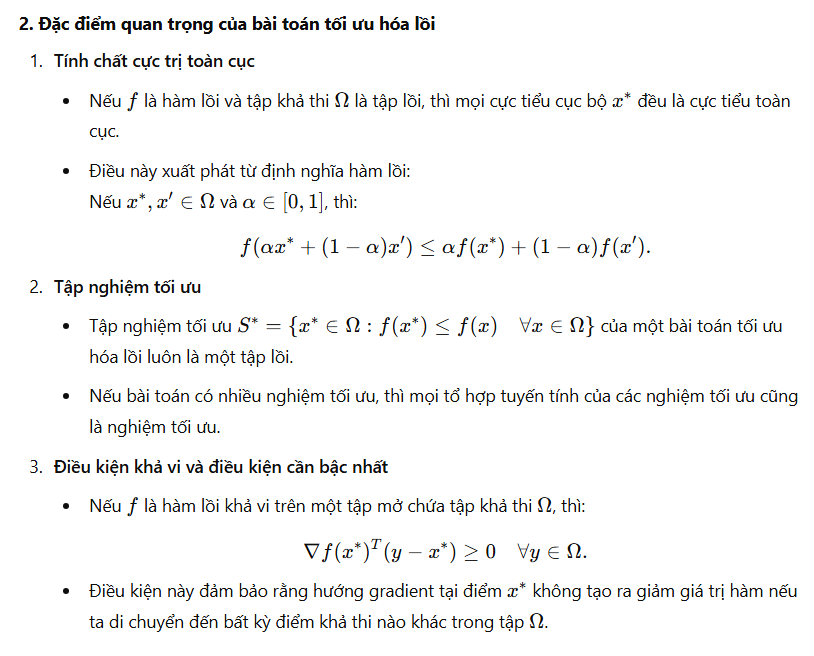


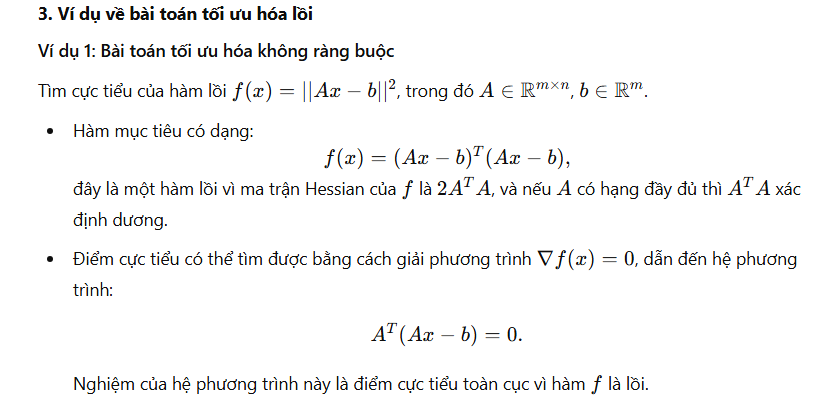


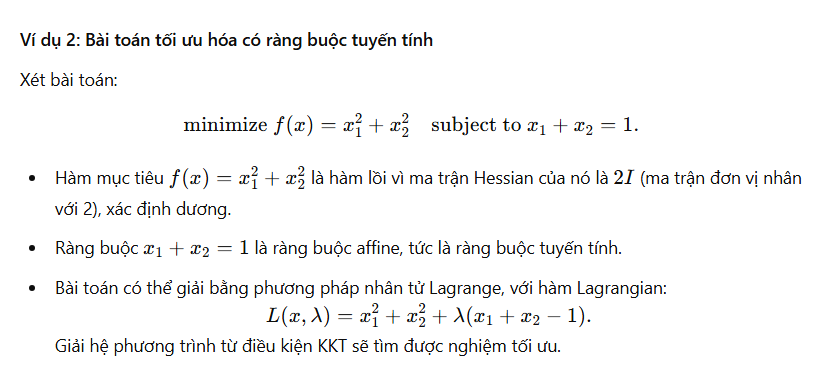
# Convex Optimization:

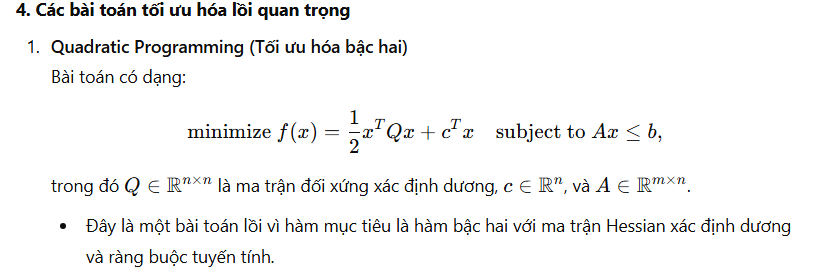
## Convex Optimization Problems

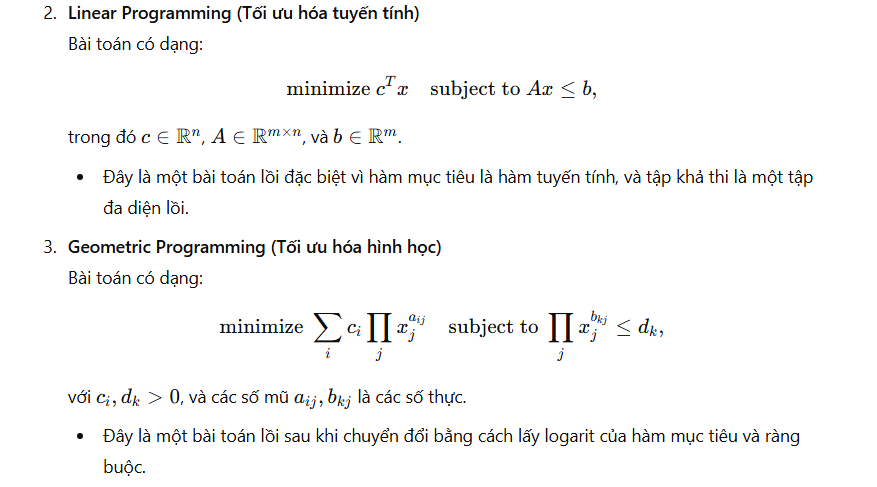






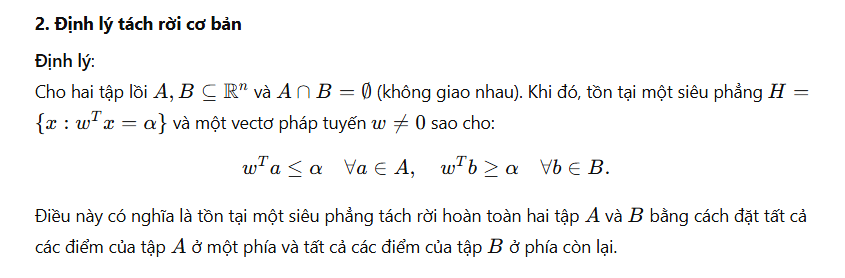


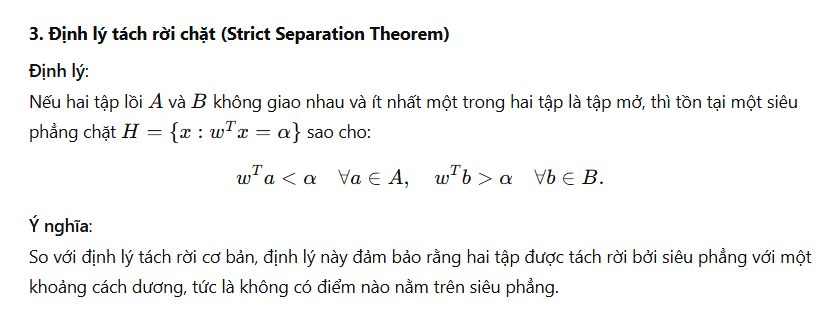


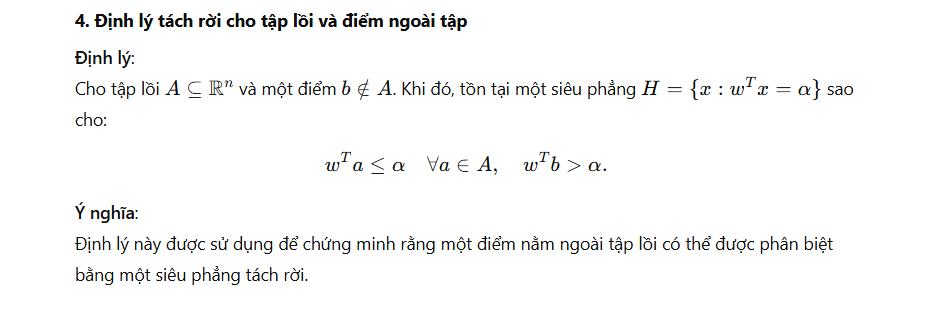


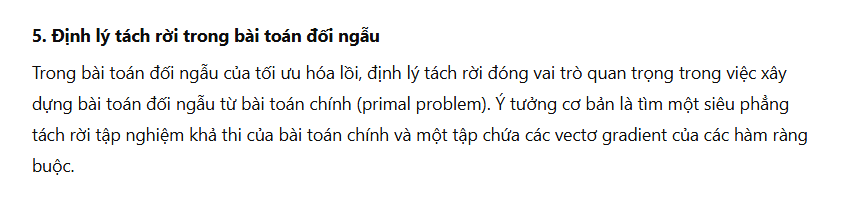
## Separation Theorems

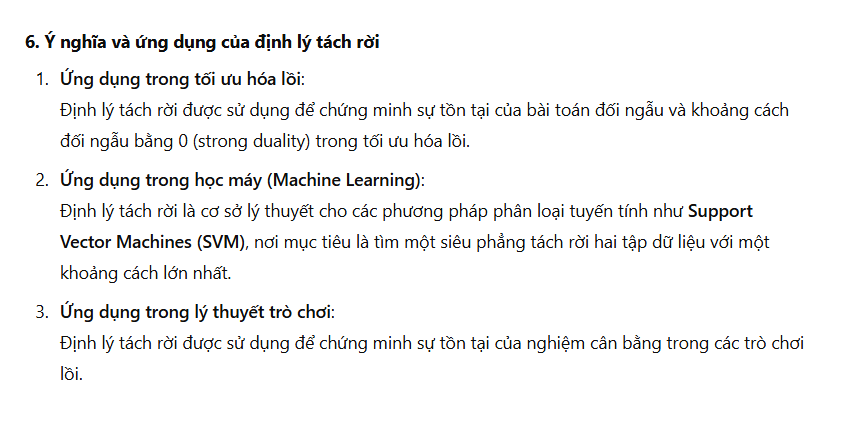


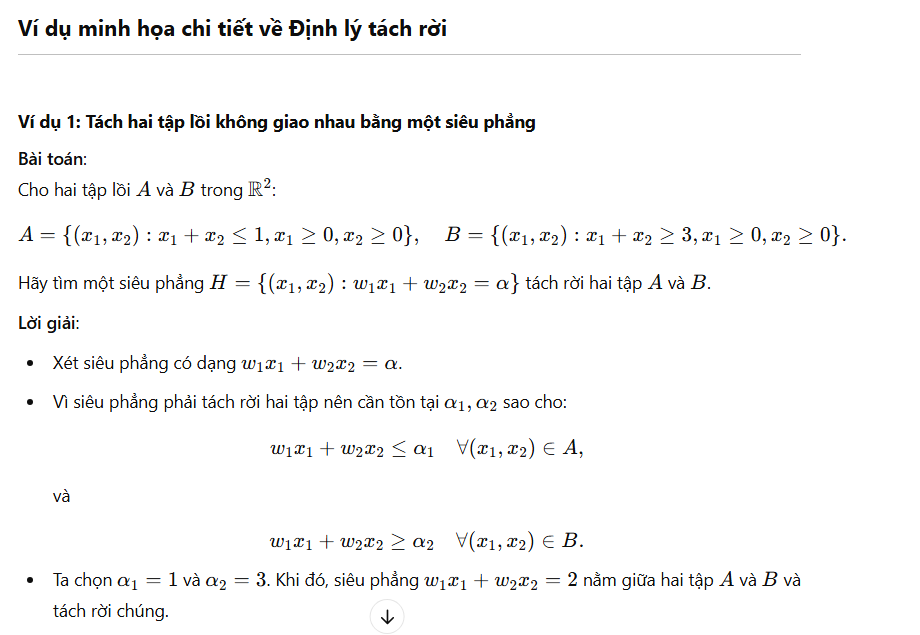


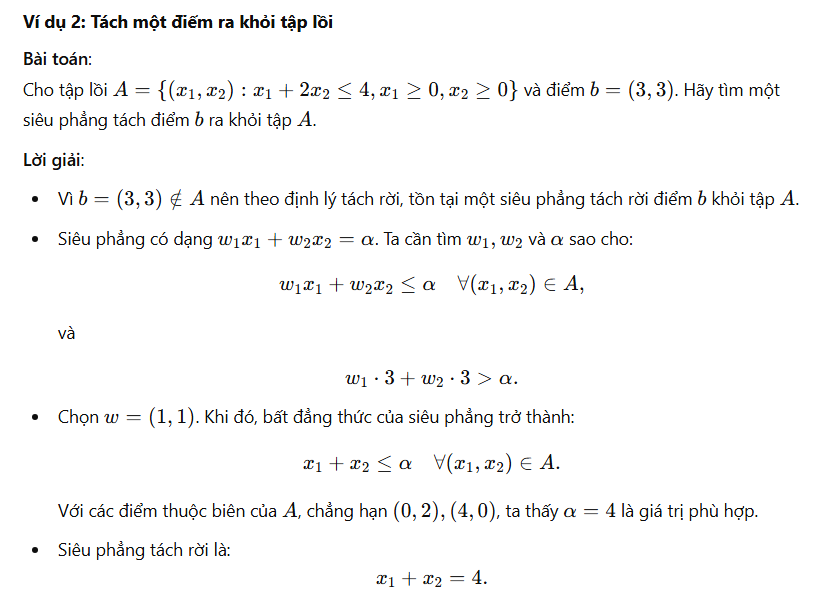


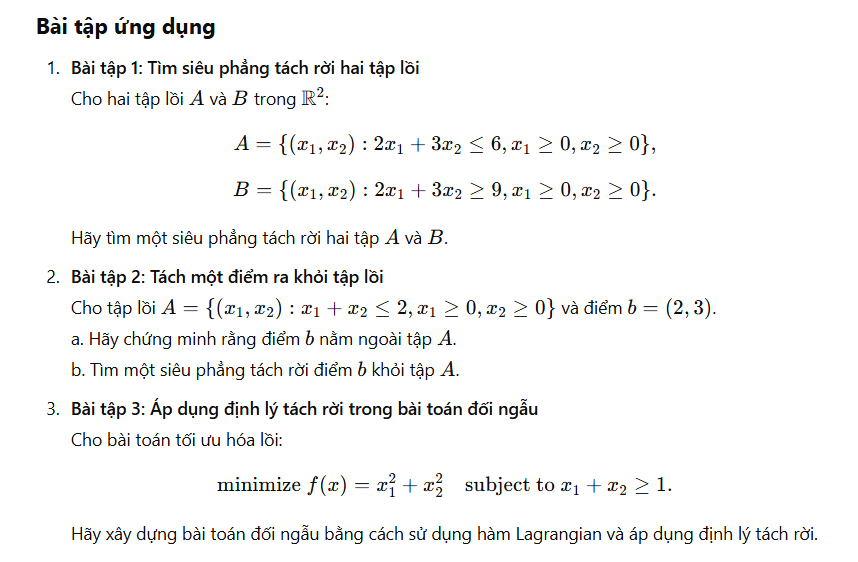




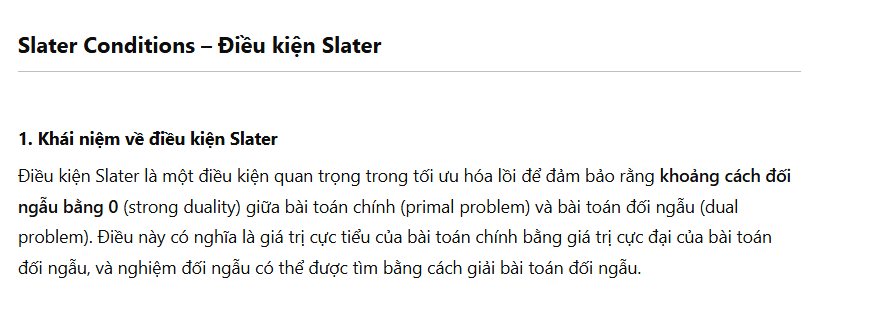


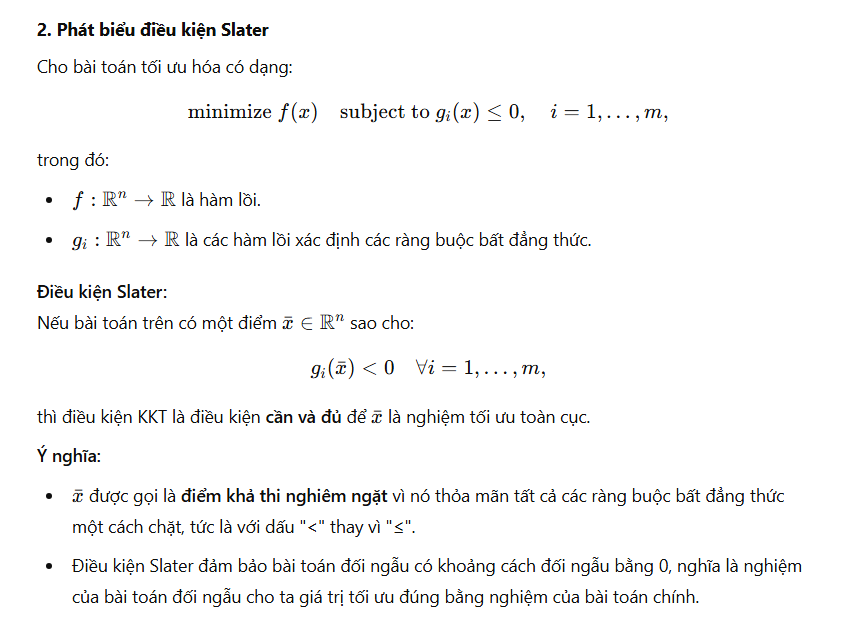


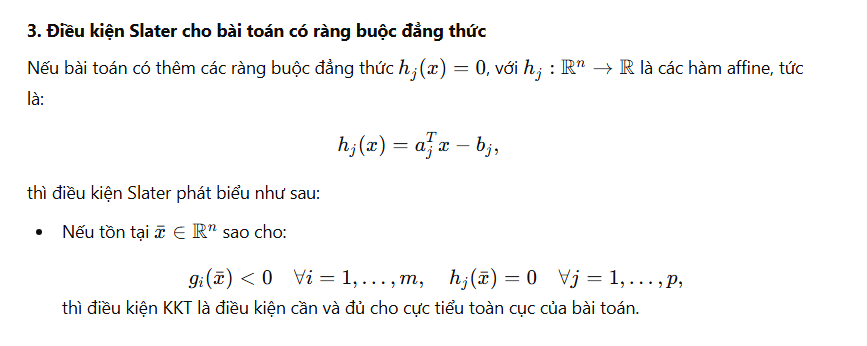


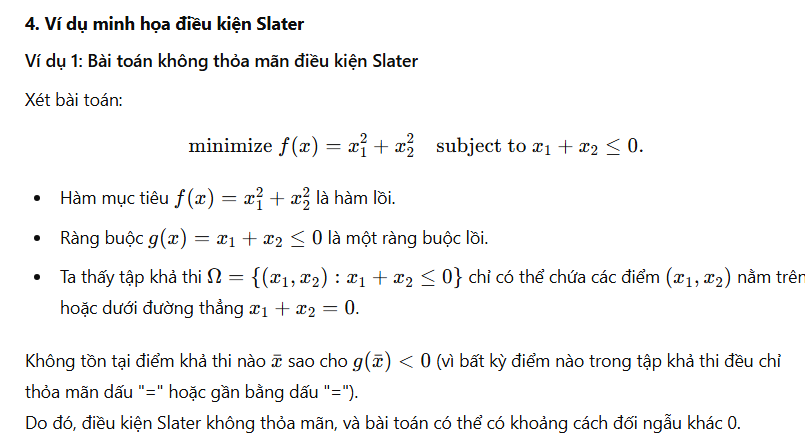


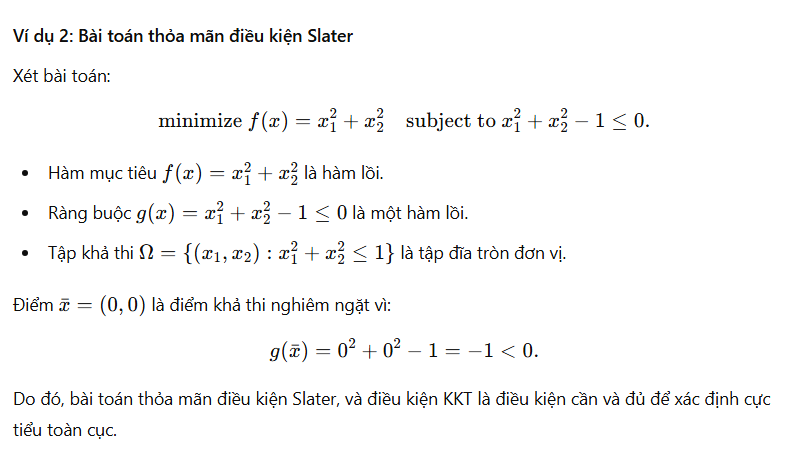
## Slater Conditions

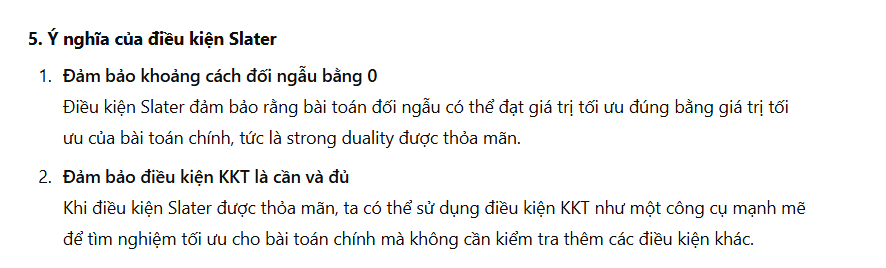


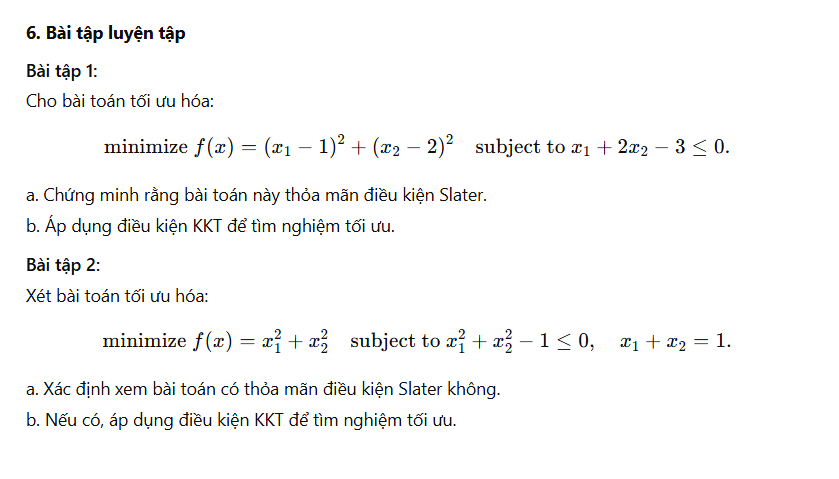


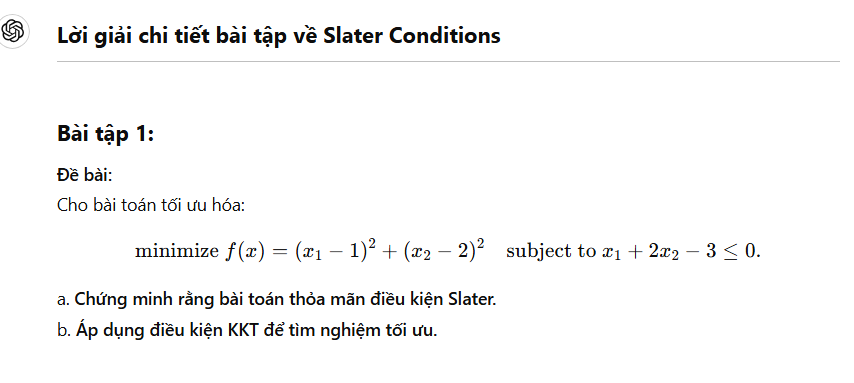


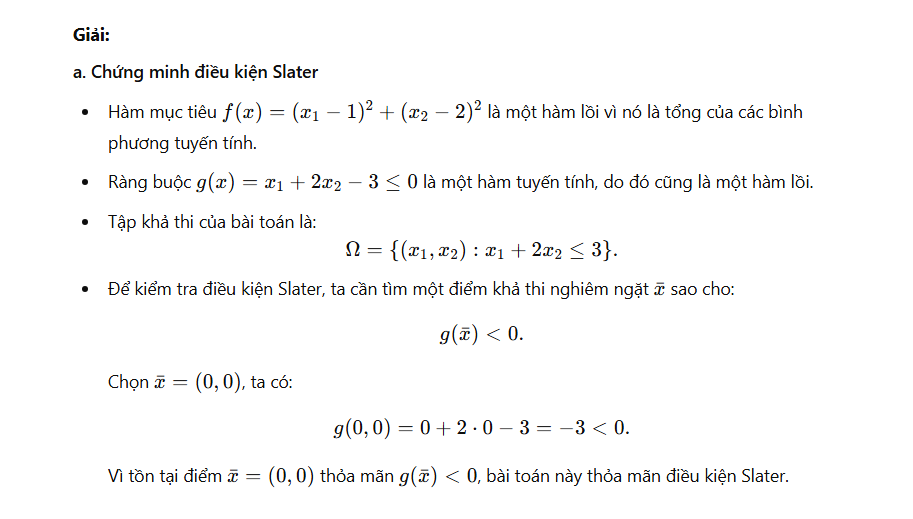


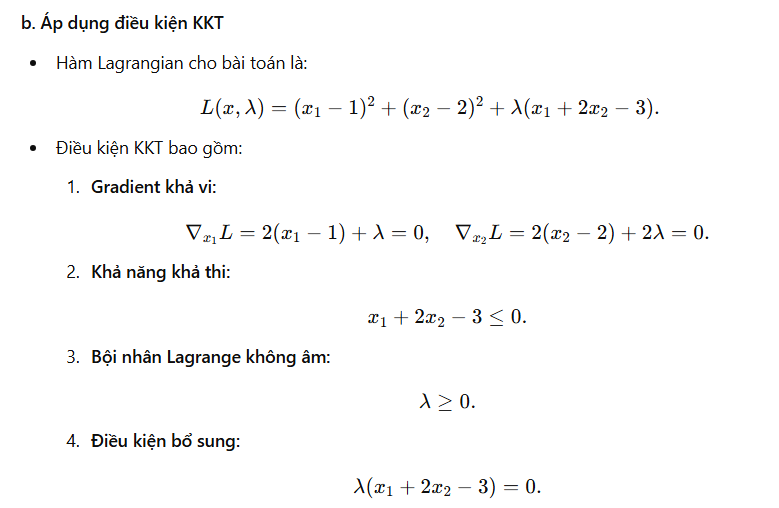


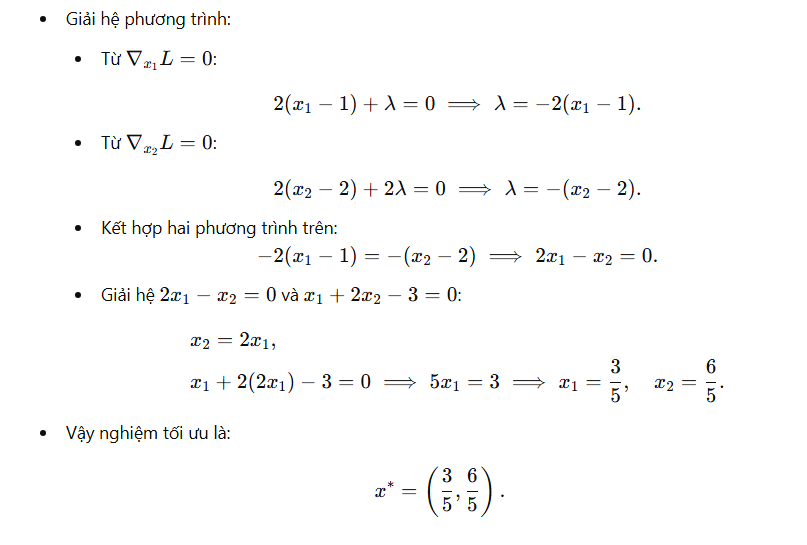


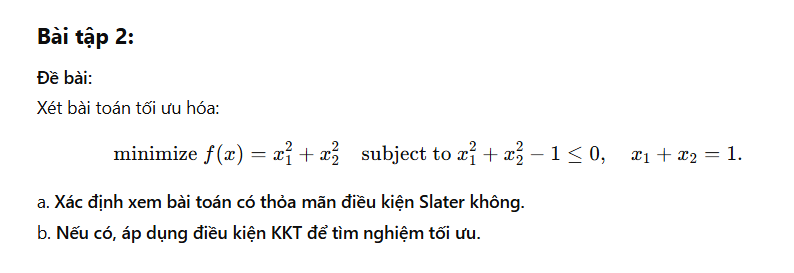


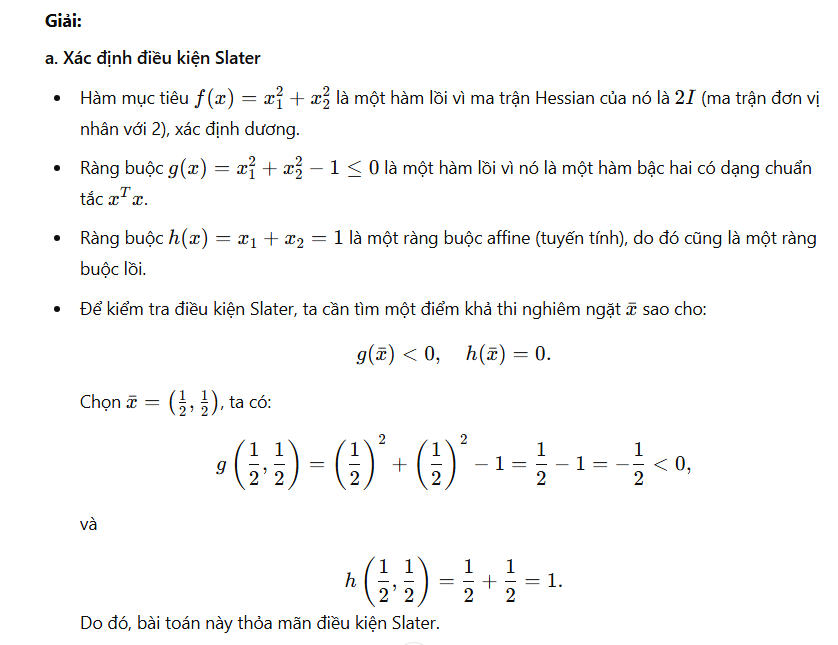


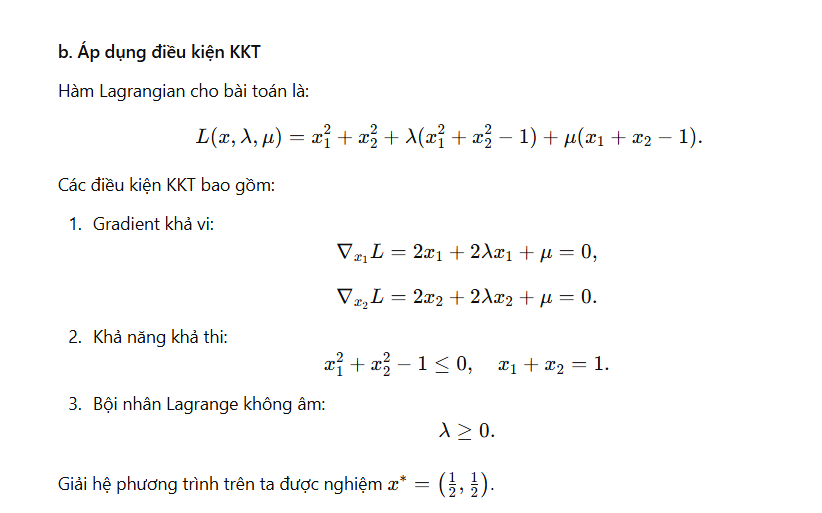




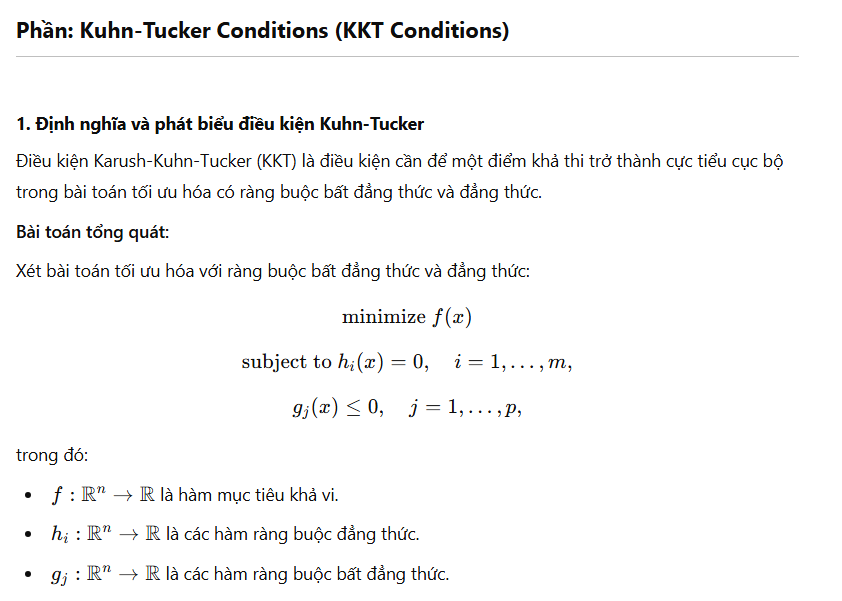


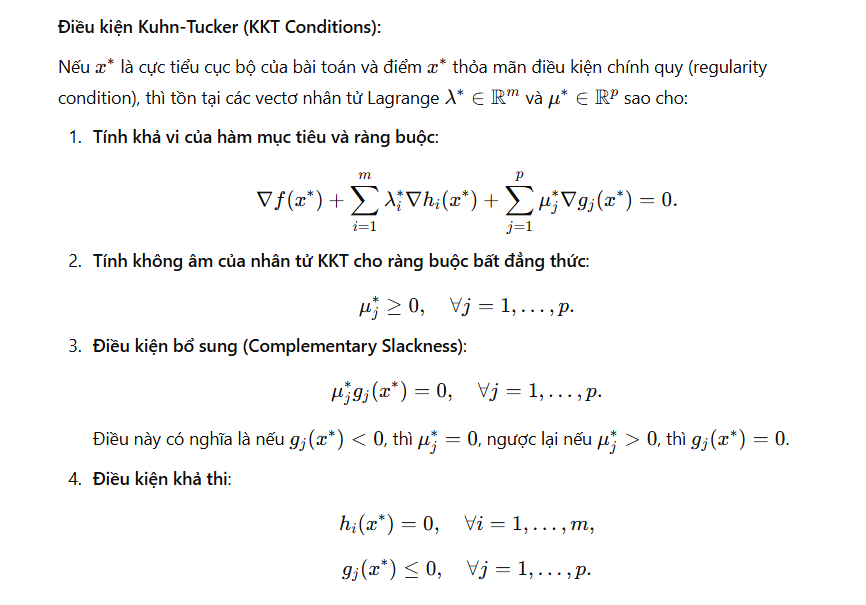


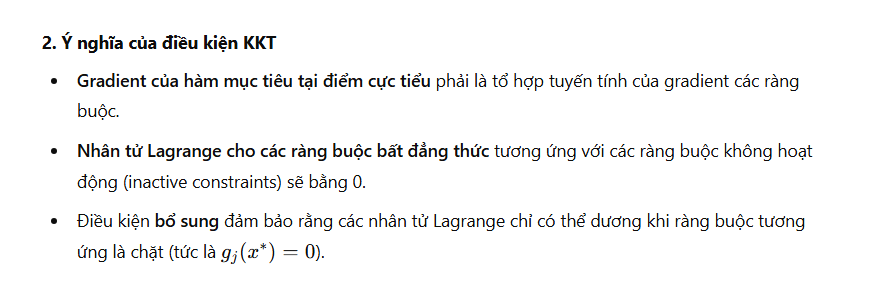


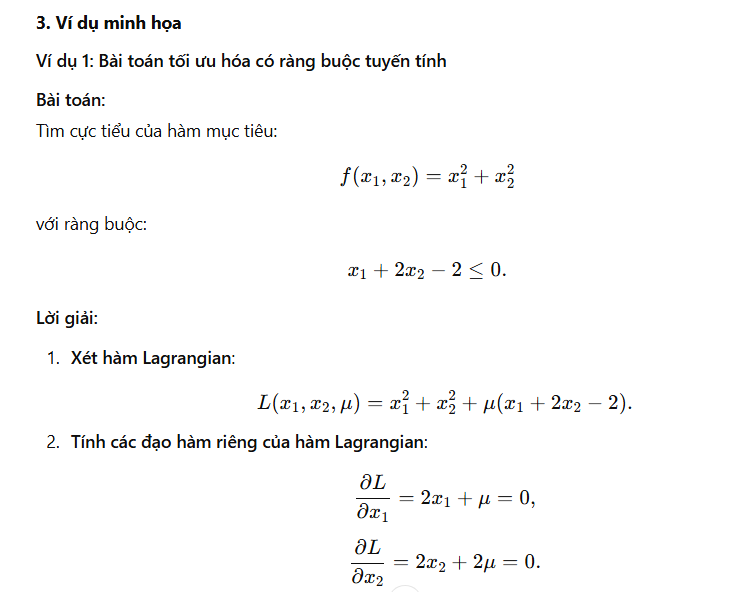


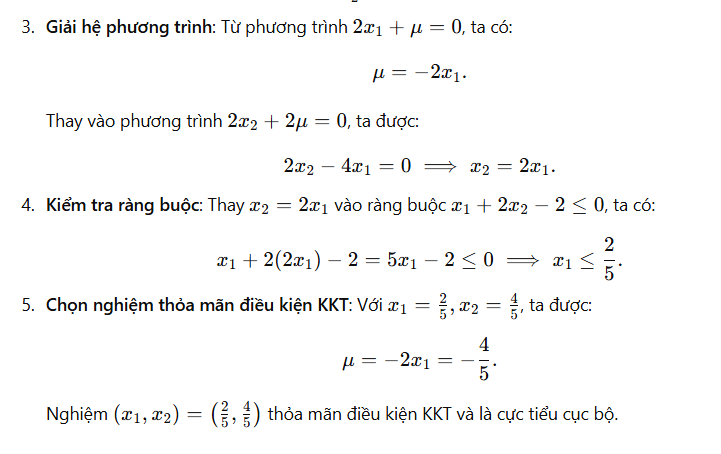
## Kuhn-Tucker Conditions

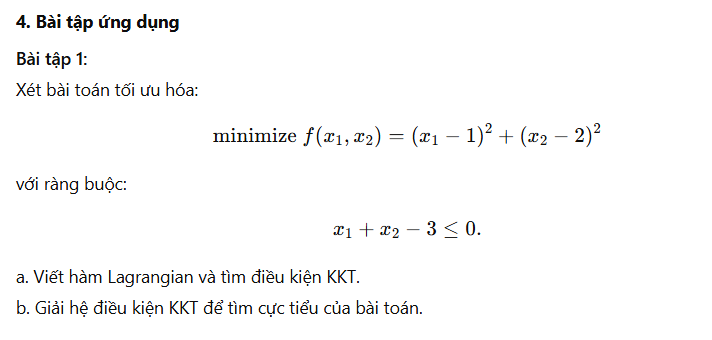


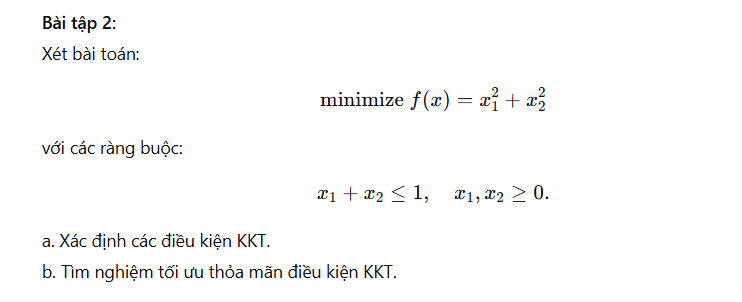




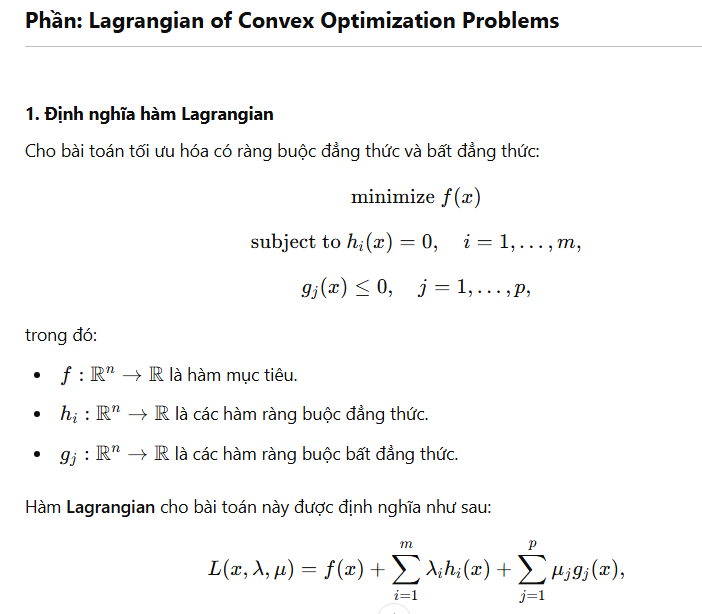


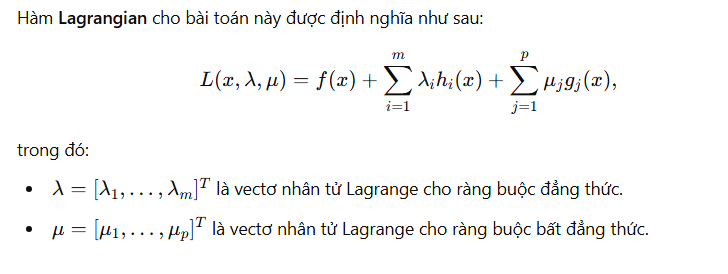


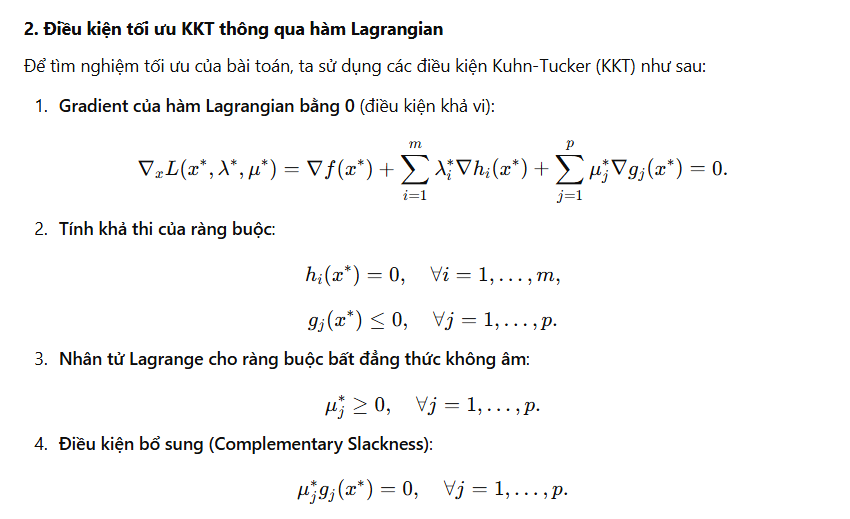


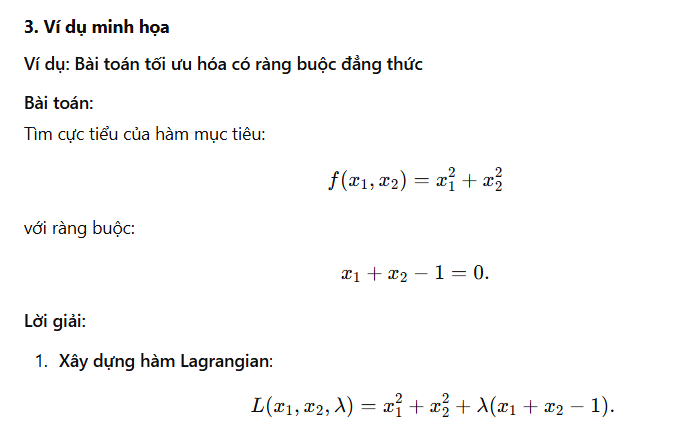


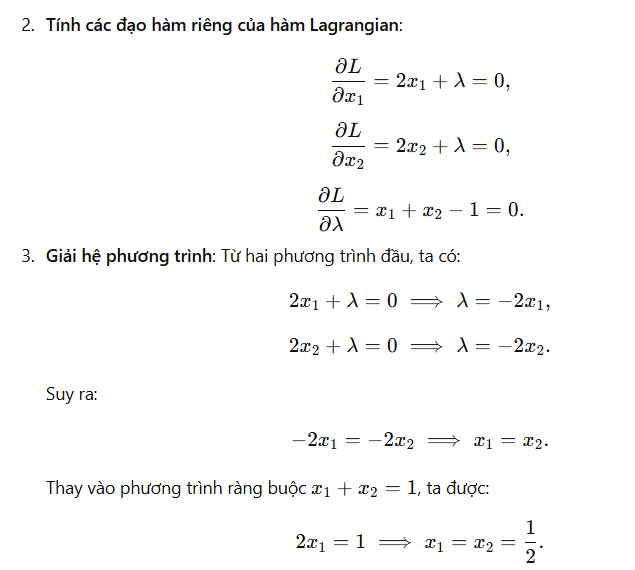
## Lagrangian of Convex Optimization Problems

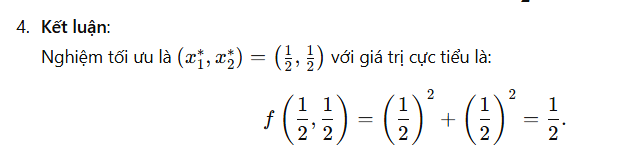


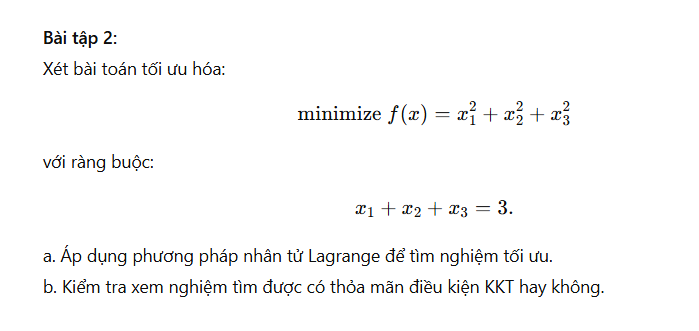
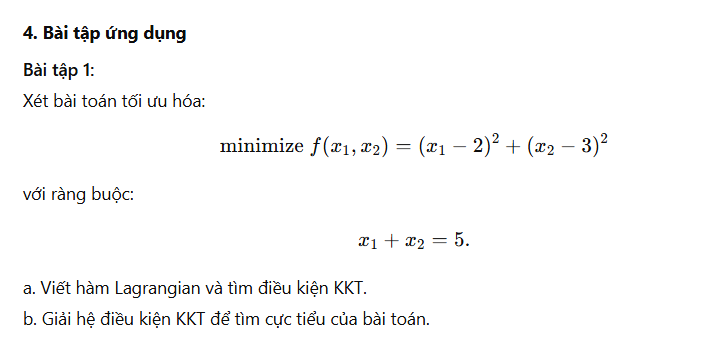








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## Duality in Convex Programming.

