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* **[Question 1]**

1. , thus , and observed that which has *k* = 1. It is Case 2; thus, answer is:

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|  |

1. Observed that , and , thus which means that for any . It is Case 1, thus the answer is:

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|  |

1. Observed that thus . , and , and = for any . Moreover:

, which is ,

which means

which means

which means

which means(and is roughly equal to).

Since there exists a value *k* such that , thus it is Case 3, therefore the answer is:

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|  |

1. , thus . And for any . It is Case 3, thus answer is:

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|  |

1. Use the change of variables , to get . Then denote , so now we can transform:

and from the new algorithm we have , which leads to . And observe that which has *k = 0*. Thus, it is Case 2, and answer is:

and since we used the change of variables, and observed that , thus the real answer is:

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1. Cannot be solved by Master Theorem, since and the cannot be negative.
2. Cannot be solved by Master Theorem, since *a* is not constant.
3. , thus . And observed that = for any *0.01 > > 0*. Furthermore, if plugin *a* and *b* to , then we have:

, then

, then

we have , which means there exists a value *k* such that . Thus, it is Case 3, so answer is:

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|  |

1. Cannot be solved by Master Theorem, since *a* is less than 1.
2. , thus . Moreover, observed that for any *> 0*. Furthermore, if plugin the values of *a* and *b* into , then we have:

, then

, then

, then

, then

, then

, then (for ).

Therefore, we have seen that when , then there exists a value *k* such that . Thus, it is Case 3, so answer is:

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* **[Question 2]**

Sort

* **[Question 3]**

1. Define Subproblem:

2. Recurrence Relation:

3. Pseudo Code:

4. Runtime Complexity:

* **[Question 4]**

1. Define Subproblem:

2. Recurrence Relation:

3. Pseudo Code:

4. Runtime Complexity:

* **[Question 5]**

1. Define Subproblem:

2. Recurrence Relation:

3. Pseudo Code:

4. Runtime Complexity: