**PART 1**

**Q1. Find the time complexity of the below functions in Θ form. Write NA if the function does not apply to any case.**

**a) T (n) = 3T (n/2) + n**

**b) T (n) = 64T (n/8) − n^2(log n)**

**c) T (n) = 2nT (n/2) + n^n**

**d) T (n) = 3T (n/3) + n/2**

**e) T (n) = 7T (n/3) + n^2**

The Master Theorem applies to recurrences of the following form:

T (n) = aT (n/b) + f(n) where a ≥ 1 and b > 1 are constants and f(n) is an asymptotically positive function.

There are 3 cases:

1. If f(n) = O(n logb a− ) for some constant > 0, then T (n) = Θ(n logb a ).

2. If f(n) = Θ(n logb a logk n) with1 k ≥ 0, then T (n) = Θ(n logb a logk+1 n).

3. If f(n) = Ω(n logb a+ ) with > 0,

and f(n) satisfies the regularity condition, then T (n) = Θ(f(n)).

Regularity condition: af(n/b) ≤ cf(n) for some constant c < 1 and all sufficiently large n.

The time complexity of the below functions in Θ form are:

1. T (n) = 3T (n/2) + n

T (n) = Θ(n^log 3 ) (Case 1)

1. T (n) = 64T (n/8) − n^2(log n)

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1. T (n) = 2nT (n/2) + n^n

N.A.

1. T (n) = 3T (n/3) + n/2

T (n) = Θ(n log n) (Case 2)

1. T (n) = 7T (n/3) + n^2

T (n) = Θ(n^2 ) (Case 3)

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