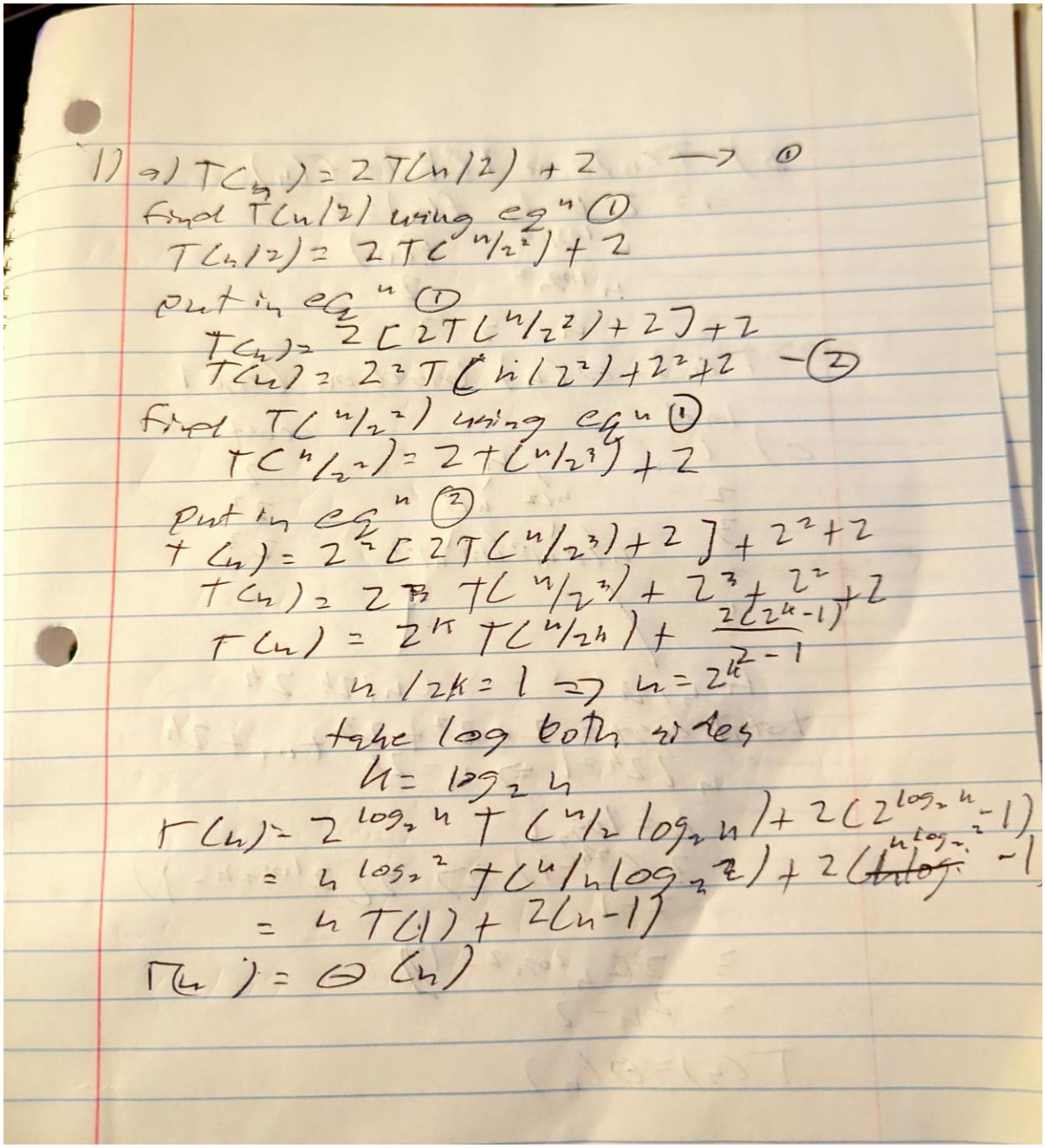
Assignment: Recursion, Recurrence Relations and Divide & Conquer

1. **Solve recurrence relation using three methods**:

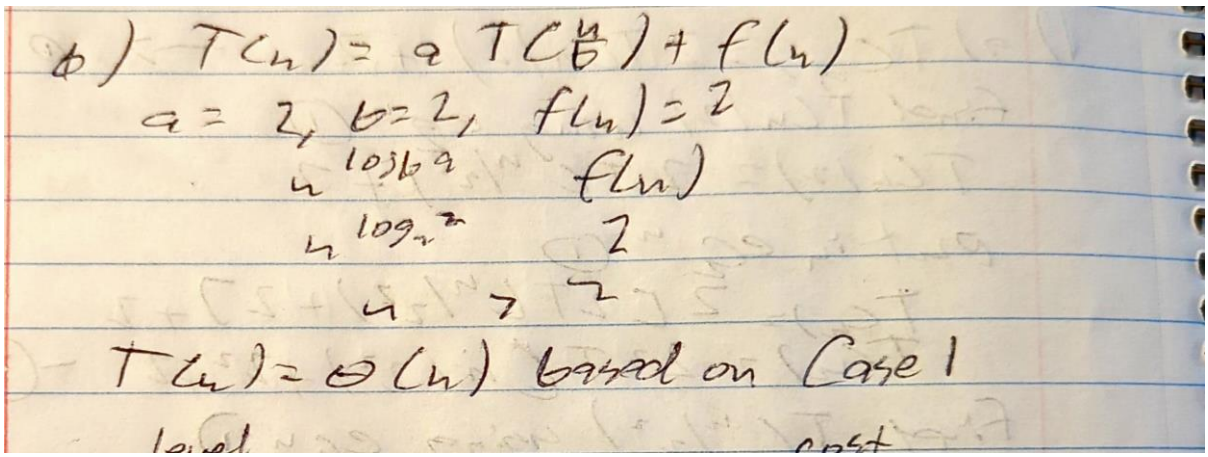
   Write recurrence relation of below pseudocode that calculates x^n, and solve the recurrence relation using three methods that we have seen in the explorations.

```
power2(x,n):
if n==0:
        return    1
if n==1:
        return x
if (n%2)==0:
return power2(x, n//2) * power2(x,n//2)
else:
return power2(x, n//2) * power2(x,n//2) * x
```

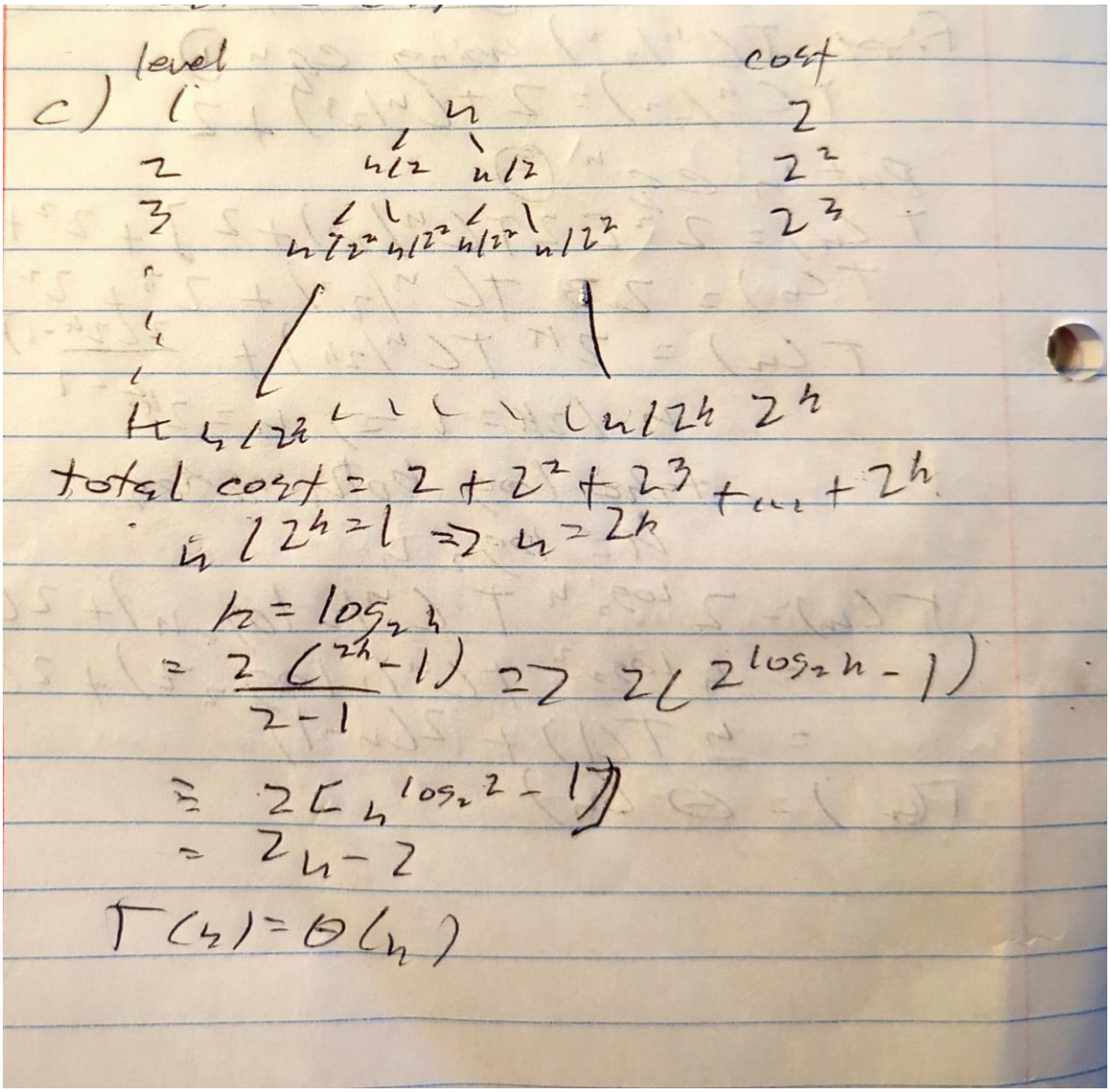
   a) Using substitution method:



b) Using master method:



c) Recursion-tree method:

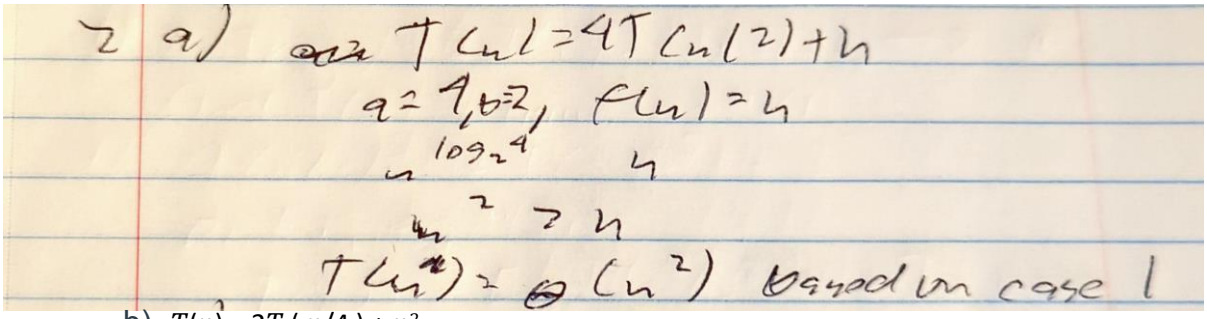


2. **Solve recurrence relation using any one method**:

   Find the time complexity of the recurrence relations given below using any one of the three methods discussed in the module. Assume base case T(0)=1 or/and T(1) = 1.

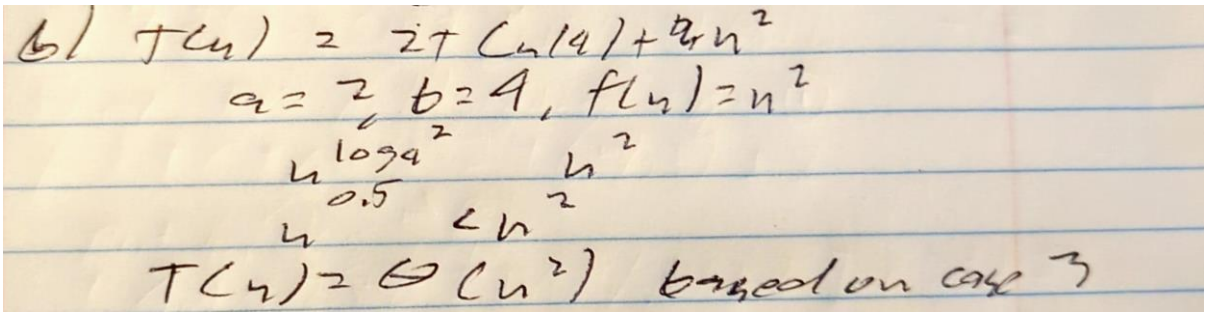
   a) $T(n) = 4T(n/2) + n$

      a.



   b) $T(n) = 2T(n/4) + n^2$

      a.



3. **Implement an algorithm using divide and conquer technique**: Given two sorted arrays of size m and n respectively, find the element that would be at the k^{th} position in combined sorted array.

   a. Write a pseudocode/describe your strategy for a function kthelement(Arr1, Arr2, k) that uses the concepts mentioned in the divide and conquer technique. The function would take two sorted arrays Arr1, Arr2 and position k as input and returns the element at the k^{th} position in the combined sorted array.

      i Function kethElement(Arr1, Arr2, k):

```
if Arr1 is empty:
    return Arr2[k - 1]
if Arr2 is empty:
    return Arr1[k - 1]
if k is 1:
```

```
    return min(Arr1[0], Arr2[0])

  mid1 = min(length(Arr1), k // 2)
  mid2 = min(length(Arr2), k // 2)

  if Arr1[mid1 - 1] < Arr2[mid2 - 1]:
    return kthelement(Arr1[mid1:], Arr2, k - mid1)
  else:
 return kthelement(Arr1, Arr2[mid2:], k - mid2)
```

b. Implement the function kthElement(Arr1, Arr2, k) that was written in part a. Name your file **KthElement.py**

Examples:

Arr1 = [1,2,3,5,6] ; Arr2= [3,4,5,6,7] ; k= 5

Returns: 4

Explanation: 5^{th} element in the combined sorted array [1,2,3,3,4,5,5,6,6,7] is 4