Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 10 11 12 1 2 3 4 5 6

(15 points) Check the (single) box that best characterizes each item.

$T(1) = d$
$T(n) = 2T(n/4) + n$

$\Theta(\log n)$ ☐ $\Theta(\sqrt{n})$ ☐ $\Theta(n)$ ☑ $\Theta(n \log n)$ ☐
$\Theta(n^2)$ ☐ $\Theta(n^3)$ ☐ $\Theta(2^n)$ ☐ $\Theta(3^n)$ ☐

The running time of mergesort

$\Theta(\log n)$ ☐ $\Theta(n)$ ☐ $\Theta(n \log n)$ ☑ $\Theta(n^2)$ ☐
$\Theta(n^3)$ ☐ $\Theta(n^{\log_3 2})$ ☐ $\Theta(n^{\log_2 3})$ ☐ $\Theta(2^n)$ ☐

All ways to assign True/False values to n input variables

$\Theta(\log n)$ ☐ $\Theta(n)$ ☐ $\Theta(n \log n)$ ☐ $\Theta(n^2)$ ☐
$\Theta(n^3)$ ☐ $\Theta(n^{\log_3 2})$ ☐ $\Theta(n^{\log_2 3})$ ☐ $\Theta(2^n)$ ☑

The Travelling Salesman Problem

polynomial ☐ exponential ☐ in NP ☑

NP Complete problems require exponential time.

true ☐ false ☐ not known ☑

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 10 11 12 1 2 3 4 5 6

(15 points) Check the (single) box that best characterizes each item.

$T(1) = d$
$T(n) = 3T(n-1) + d$

$\Theta(n)$ ☐ $\Theta(n \log n)$ ☐ $\Theta(n^2)$ ☐ $\Theta(n^3)$ ☐
$\Theta(n^{\log_3 2})$ ☐ $\Theta(n^{\log_2 3})$ ☐ $\Theta(2^n)$ ☐ $\Theta(3^n)$ ☑

Dividing a list in half

$\Theta(\log n)$ ☐ $\Theta(n)$ ☑ $\Theta(n \log n)$ ☐ $\Theta(n^2)$ ☐
$\Theta(n^3)$ ☐ $\Theta(n^{\log_3 2})$ ☐ $\Theta(n^{\log_2 3})$ ☐ $\Theta(2^n)$ ☐

Algorithm A takes n^5 time. On one input, A takes x time. How long will it take if I double the input size?

$2x$ ☐ $5x$ ☐ $32x$ ☑ x^5 ☐

Problems in class P (as in P vs. NP) require exponential time

true ☐ false ☑ not known ☐

Producing all parses for a sentence requires exponential time.

true ☑ false ☐ not known ☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 10 11 12 1 2 3 4 5 6

(15 points) Check the (single) box that best characterizes each item.

$T(1) = d$
$T(n) = 3T(n/2) + d$

$\Theta(n)$ ☐ $\Theta(n \log n)$ ☐ $\Theta(n^2)$ ☐ $\Theta(n^3)$ ☐
$\Theta(n^{\log_3 2})$ ☐ $\Theta(n^{\log_2 3})$ ☑ $\Theta(2^n)$ ☐ $\Theta(3^n)$ ☐

Merging two sorted lists

$\Theta(\log n)$ ☐ $\Theta(n)$ ☑ $\Theta(n \log n)$ ☐ $\Theta(n^2)$ ☐
$\Theta(n^3)$ ☐ $\Theta(n^{\log_3 2})$ ☐ $\Theta(n^{\log_2 3})$ ☐ $\Theta(2^n)$ ☐

Algorithm A takes 2^n time. On one input, A takes x time. How long will it take if I add one to the input size?

$x + 2$ ☐ $2x$ ☑ 2^x ☐ x^2 ☐

Problems in class NP need exponential time

true ☐ false ☐ not known ☑

The chromatic number of a graph with n nodes can be found in polynomial time.

true ☐ false ☐ not known ☑

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 10 11 12 1 2 3 4 5 6

(15 points) Check the (single) box that best characterizes each item.

$T(1) = d$
$T(n) = 2T(n/3) + d$

$\Theta(n)$	☐	$\Theta(n \log n)$	☐	$\Theta(n^2)$	☐	$\Theta(n^3)$	☐
$\Theta(n^{\log_3 2})$	☑	$\Theta(n^{\log_2 3})$	☐	$\Theta(2^n)$	☐	$\Theta(3^n)$	☐

The Towers of Hanoi solver

$\Theta(\log n)$	☐	$\Theta(n)$	☐	$\Theta(n \log n)$	☐	$\Theta(n^2)$	☐
$\Theta(n^3)$	☐	$\Theta(n^{\log_3 2})$	☐	$\Theta(n^{\log_2 3})$	☐	$\Theta(2^n)$	☑

Algorithm A takes $\log_2 n$ time. On one input, A takes x time. How long will it take if I double the input size?

$x + 1$	☑	$2x$	☐	2^x	☐	x^2	☐

Deciding if a graph is 2-colorable

polynomial	☑	exponential	☐	in NP	☐

The Towers of Hanoi puzzle requires exponential time.

true	☑	false	☐	not known	☐

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 10 11 12 1 2 3 4 5 6

(15 points) Check the (single) box that best characterizes each item.

$T(1) = c$
$T(n) = 3T(n/3) + n$

$\Theta(n)$	☐	$\Theta(n \log n)$	☑	$\Theta(n^2)$	☐	$\Theta(n^3)$	☐
$\Theta(n^{\log_3 2})$	☐	$\Theta(n^{\log_2 3})$	☐	$\Theta(2^n)$	☐	$\Theta(3^n)$	☐

Karatsuba's integer multiplication algorithm

$\Theta(\log n)$	☐	$\Theta(n)$	☐	$\Theta(n \log n)$	☐	$\Theta(n^2)$	☐
$\Theta(n^3)$	☐	$\Theta(n^{\log_3 2})$	☐	$\Theta(n^{\log_2 3})$	☑	$\Theta(2^n)$	☐

Finding a value in a sorted array is $\Theta(2^n)$. true ☐ false ☑

Circuit satisfiability is NP complete. true ☑ false ☐ not known ☐

The Marker Making problem can be solved in polynomial time. true ☐ false ☐ not known ☑

Name:_____

NetID:_____ **Lecture: A B**

Discussion: Thursday Friday 10 11 12 1 2 3 4 5 6

(6 points) Fill in the missing bits of the recursive algorithm for solving the Towers of Hanoi puzzle.

hanoi(A,B,C: pegs, $d_1, d_2 \ldots d_n$: disks) \\ move n disks from peg A to peg B

if $(n = 1)$ move d_1 from A to B

else

Solution:
hanoi(A,C,B: pegs, $d_1, d_2 \ldots d_{n-1}$: disks) \\ move smaller disks to C

move d_n from A to B

Solution:
hanoi(C,B,A: pegs, $d_1, d_2 \ldots d_{n-1}$: disks) \\ move smaller disks to B

(9 points) Check the (single) box that best characterizes each item.

$T(1) = c$
$T(n) = 4T(n/2) + n$

$\Theta(n)$	☐	$\Theta(n \log n)$	☐	$\Theta(n^2)$	☑	$\Theta(n^3)$	☐
$\Theta(n^{\log_3 2})$	☐	$\Theta(n^{\log_2 3})$	☐	$\Theta(2^n)$	☐	$\Theta(3^n)$	☐

The running time of binary search

$\Theta(\log n)$	☑	$\Theta(n)$	☐	$\Theta(n \log n)$	☐	$\Theta(n^2)$	☐
$\Theta(n^3)$	☐	$\Theta(n^{\log_3 2})$	☐	$\Theta(n^{\log_2 3})$	☐	$\Theta(2^n)$	☐

Marker Making

polynomial	☐	exponential	☐	in NP	☑