7.1.1(e)
1, 4, 7, 10, 13, 16, 19, 22, 25, 28
increasing, non-decreasing

7.1.2(b)
non-decreasing

7.2.1(a)
1, 2, 2, 4, 8, 32

7.3.1(e)
60702

7.3.2(a)
$\sum_{n=-2}^{7} n$^5

7.4.2(b)
Theorem: $\sum_{j=1}^{n} j * 2^j$ = (n – 1)2^{n+1} + 2, for any positive integer n

Proof.
By induction on n.

Base Case: n = 1
When n = 1, the left side of the equation is $\sum_{j=1}^{1} j * 2^j = 2$
When n = 1, the right side of the equation is (1-1)2^{1+1} + 2 = 2
Therefore $\sum_{j=1}^{1} j * 2^j$ = (1-1)2^{1+1} + 2

Inductive step: Suppose that for positive integer k, $\sum_{j=1}^{k} j * 2^j$ = (k – 1)2^{k+1} + 2,
then we will show that $\sum_{j=1}^{k+1} j * 2^j$ = k2^{k+2} + 2
starting with the left side of the equation to be proven:
$\sum_{j=1}^{k+1} j * 2^j$ = $\sum_{j=1}^{k} j * 2^j + (k+1)$ by separating out the last term

= (k-1)2^{k+1} + 2 +(k + 1) by the inductive hypothesis
= k2^{k+2} + 2 by algebra
Therefore, $\sum_{j=1}^{k+1} j * 2^j$ = k2^{k+2} + 2 ■

7.5.1(b)
Theorem: For every positive integer n, 6 evenly divides 7^n – 1.

Proof: By induction on n.

Base case: n = 1
7^1 – 1 =6. Since 6 evenly divides 6, the theorem holds for the case n = 1

Inductive step: Suppose that for positive integer k, 6 evenly divides $7^n - 1$.
Then we will show that 6 evenly divides $7^{k+1} - 1$.
By the inductive hypothesis, 6 evenly divides $7^k - 1$, which means that $7^k - 1 = 6m$ for some integer m.
By adding 1 to both sides of the equation $6m = 7^k - 1$, we get $7^k = 6m + 1$ which is an equivalent statement of the inductive hypothesis.
We must show that $7^{k+1} - 1$ can be expressed as 6 times an integer.
$7^{k+1} - 1 = (6m+1) - 1 = 6m$
Since m is an integer, (6m) is also an integer.
Therefore $7^{k+1} - 1$ is equal to 3 times an integer which means that $7^{k+1} - 1$ is divisible by 6 ■

7.5.3(b)
Theorem: for $n \geq 0$, $b_n = 2^{n+1} - 1$.

Proof: By induction on n.

Base case: n = 1
$b_1 = 2(b_{1-1}) + 1 = 2(1) + 1 = 3$
$b_1 = 2^{1+1} - 1 = 3$
$2^{1+1} - 1 = 2(b_{1-1}) + 1$

Inductive step: Suppose that for $k \geq 0$, $b_k = 2^{k+1} - 1$.
Then we will show that $b_{k+1} = 2^{(k+1)+1} - 1$
By the inductive hypothesis, $b_k = 2^{k+1} - 1$, which means that $2^{(k+1)+1} - 1 = 2(b_k) + 1$
$2^{1+1+1} - 1 = 7$
$2(b_1) + 1 = 7$
therefore $2^{(k+1)+1} - 1 = 2(b_k) + 1$■

7.6.1(a)
Theorem: any amount of postage worth 8 cents or more can be made from 3-cent or 5-cent stamps

Proof. By strong induction

Base case: Prove P(8), P(9), P(10) directly

Inductive step: for $k \geq 10$, assume that P(j) is true for any j in range 8 through k
P(k-2) falls under range of 8 through k because $k \geq 10$ therefore $k-2 \geq 8$■

7.8.2(d)
Base case:
$\lambda \in$ bCount(x)
Recursive rule:
if x $\in$ bCount(x)

$x1 \in bCount(x)$

7.8.4(c)
Base case: $|\lambda| = 0$
Recursive rule:

same number of 0's and 1's

7.9.2(b)
a is the only base case, therefore every x is going to be an s. There is one x in all of the rules, therefore every string in S will contain exactly one a

7.10.1(a)
g(n):
$g_0 = 0$
$g_n = g_{n-1} + n^3$

7.11.1(a)
$g_1 = 1$
$g_n = n^3 + g_{n-1}$

assume $g_k = k^3 + g_{k-1}$, then $g_{k+1} = (k+1)^3 + g_k$
$g_{2+1} = (2+1)^3 + g_2 = 36$
$g_3 = 3^3 + g_2 = 36$

$g_{k+1} = (k+1)^3 + g_k = g_n = n^3 + g_{n-1}$

7.11.10(a)
if x and y are ≥0

$FastMult_{x,0} = 0$

$FastMult_{x,y} = FastMult(x, \lfloor y/2 \rfloor)$

if y is an even return $2p$
else return $2p + x$

7.12.5(a)
$T(n) = T(n-1) + T(n-2) + O(1)$

7.13.4(b)
Best run time: 15
Worst run time: 35