Use Induction to show: $3$ divides $\left(n^3 + 3n^2 + 2n\right)$ for all $n \geq 1$

Prove: $1/2 + 2/4 + 3/8 + \ldots + \frac{n}{2^n} = \frac{2^{n+1} - 2 - n}{2^n}$ for all $n \geq 1$

A computer is programmed to print subsets of $\{1, 2, 3, 4, 5\}$ at random. If the computer print 35 subsets, prove that some subset must have been printed twice.

Find the coefficient of $x^9$ in the expression $(x + x^2)^{10}$

Assume that you have 50 pennies and three jars, labeled A, B, and C.

a) In how many ways can you put the pennies in the jars, assuming that the pennies are distinguishable?

b) In how many ways can you put the pennies in the jars, assuming that the pennies are identical and each jar must have an even number of pennies put into it?

Urn 1 contains 2 blue tokens and 8 red tokens; urn 2 contains 12 blue tokens and 3 red tokens. You roll a die to determine which urn to choose: if you roll a 1 or 2 you choose urn 1; if you roll a 3, 4, 5, or 6 you choose urn 2. Once the urn is chosen, you draw out a token at random from that urn. Given that the token is blue, what is the probability that the token came from urn 1?

Suppose $f(n) = 2f(n/3) + 3n$; $f(1) = 1$. Using master theorem to deduce $O(f)$?

Consider the recurrence relation $a_n = 4a_{n-1} - 3a_{n-2} + 2n + 3 + 4*3^n$

a) Write the associated homogeneous recurrence relation.

b) Find the general solution to the associated homogeneous recurrence relation.

c) Find a particular solution to the given recurrence relation.

d) Write the general solution to the given recurrence relation.

For each integer $k \geq 0$, let $a_k$ be the number of bit strings of length $k$ that does not contain the pattern 101:

a) Show that $a_k = a_{k-1} + a_{k-3} + \ldots + a_0 + 2$ for all $k \geq 3$

b) Use part (a) to show: $a_k = 2a_{k-1} - a_{k-2} + a_{k-3}$ for all $k \geq 3$