Problem 1:

```
insert(string):void
	temp <-- head
	node <-- string
	success <-- false
	if (head is null)
		head <-- node
	else
	while (head.next is not null AND success is false)
		count <-- 0
		while (string.charAt(count) = head.charAt(count))
			increment count
		if (string.charAt(count) < head.charAt(count))
			node.next <-- head
			head <-- node
			success <-- true
		else
			if (string.charAt(count) > head.charAt(count))
				if (head.next = null)
					head.next <-- node
					success <-- true
				head <-- head.next
	if (head != node)
		head <-- temp
```

Problem 2:

```
isPalindrome(string):boolean
	counter <--0
	original <--""
	while counter is less than length of string
		character <-- string.charAt(counter)
		if ((character is greater than 64 AND character is less than 91) OR
				(character is greater than 96 AND character is less than 123))
			stack.push(character)
			original <-- original + character
		increment counter
	reverse <-- ""
	counter <-- 0
```

```
while counter is less than the length of the original
        reverse <-- reverse + stack.pop()
return reverse.equals(original)
```

Problem 3:

Assuming that the gender of b is unknown.

Reflexive : No, *a* can't be his own brother

Symmetric : Maybe, if b is male then b is also a's brother

Antisymmetric : No, not reflexive

Transitive : Maybe, if there is a third sibling c and b is a male. a is b's brother, b is c's brother and a is c's brother.

Therefore, R is not an equivalence relation.

Problem 4:

Reflexive : yes, all numbers are divisible by themselves

Symmetric: no, for example 3 divides 9 but 9 does not divide 3

Antisymmetric : yes

Transitive : yes, for example 3 divides 9, 9 divides 18, 3 divides 18

Therefore, R is not an equivalence relation

Problem 5:

Solving the Tower of Hanoi works recursively by acknowledging the number of disks and pegs so that the solution is found by assigning the correct moves based on number of disks and the moves before.

Problem 6:

Contrapositive: x^2 is odd, then x is odd

x = 2k + 1

$x^2 = 4x^2 + 4x + 1$

$= 2(2x^2 + 2x) + 1$ is odd

Therefore the conjecture is true

Problem 7:

Conjecture: $\sum_{i=1}^{n} i^2 = \frac{2n^3 + 3n^2 + n}{6}$

Proof (induction):

Basis step: $\sum_{i=1}^{1} i^2 = 1 \quad \frac{2(1)^3 + 3(1)^2 + 1}{6} = 1 \quad 1=1$

Inductive step: if $\sum_{i=1}^{k} i^2 = \frac{2k^3 + 3k^2 + k}{6}$, then $\sum_{i=1}^{k+1} i^2 = \frac{2(k+1)^3 + 3(k+1)^2 + k + 1}{6} = \frac{2n^3 + 9n^2 + 13n + 6}{6}$

Assume $\sum_{i=1}^{k} i^2 = \frac{2k^3 + 3k^2 + k}{6}$, add k + 1 to both sides

$\sum_{i=1}^{k} i^2 + (k+1) = \frac{2k^3 + 3k^2 + k}{6} + \frac{6(k+1)^2}{6} = \frac{2n^3 + 9n^2 + 13n + 6}{6}$

Since $\sum_{i=1}^{k+1} i^2 = \frac{2n^3 + 9n^2 + 13n + 6}{6}$, the inductive step holds

Since the Basis and the inductive steps both hold, then the conjecture is true.