Computer Science Foundation Exam

August 6, 2001

Section I B

No Calculators!

Name: KEY

SSN: ______________________

In this section of the exam, there are three (3) problems

You must do all of them.

The weight of each problem in this section is indicated with the problem. The algorithms in this exam are written in a combination of pseudocode and programming language notation. Any algorithms that you are asked to produce should use a syntax that is clear and unambiguous. Partial credit cannot be given unless all work is shown.

As always, be complete, yet concise, and above all be neat. Credit cannot be given when your results are unreadable.

(4, 10%) Write a **recursive** procedure (not a function), called **prob4**, that will correctly print the first **n** even integer numbers. Assume that **n** > **0**. For the purposes of this problem assume that the integer numbers begin with the number 1 (i.e., do not consider 0). The initial call is **prob4(n)**. For example, the call **prob4(5)** would print 2, 4, 6, 8, 10. You may use pseudocode, C, Java or Pascal syntax but points will be deducted if your meaning is not clear.

```
procedure prob4 (n  isoftype  in   Num)
    //purpose:  to print the first n even integer numbers recursively.
    //assumption:  n > 0
        if (n = 1) then
            print(2, " ")
        else
            prob4 (n – 1)
            print (2n, " ")
        endif
    endprocedure  //prob4
```

(5, 18%) Find the closed form or exact value for the following:

(k is an arbitrary positive integer):

a) $$\sum_{i=1}^{2k+5}(2i-4) = 2\times\sum_{i=1}^{2k+5} i - 4\times\sum_{i=1}^{2k+5} 1 = \frac{2(2k+5)(2k+6)}{2} - 4(2k+5)$$

$$= (2k+5)(2k+6) - 8k - 20 = 4k^2 + 12k + 10k + 30 - 8k - 20$$

$$\boxed{= 4k^2 + 14k + 10}$$

b) $$\sum_{i=0}^{35}(6i-3) = 6\times\sum_{i=0}^{65} i - 3\times\sum_{i=0}^{65} 1 = 6\times\left[\frac{(35)(36)}{2}\right] - 3(36)$$

$$= 3(35)(36) - 3(36) = (108)(35) - (108)$$

$$\boxed{= 3672}$$

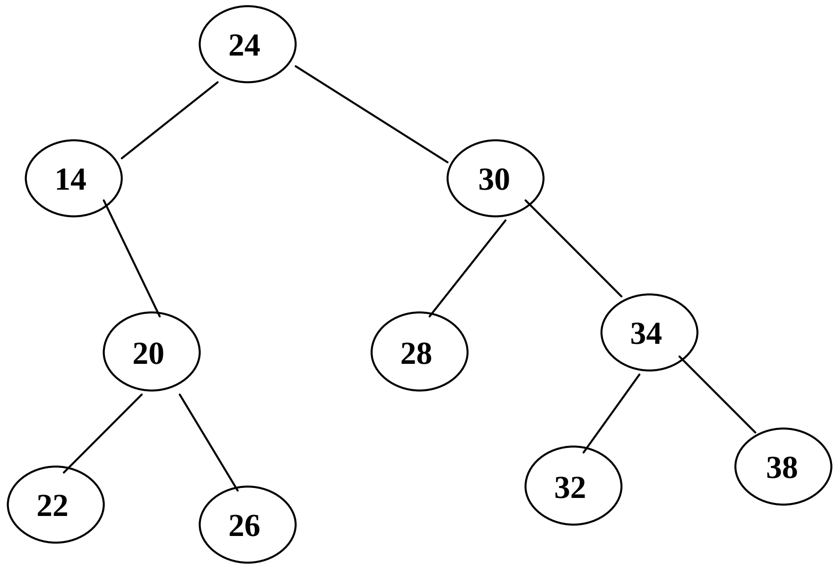
c) $$\sum_{i=20}^{65}(4i+6) = 4\times\sum_{i=20}^{65} i + 6\times\sum_{i=20}^{65} 1 = \left(4\times\sum_{i=1}^{65} i - 4\times\sum_{i=1}^{19} i\right) + \left(6\times\sum_{i=1}^{65} 1 - 6\times\sum_{i=1}^{19} 1\right)$$

$$= \left(4\left[\frac{(65)(66)}{2}\right] - 4\left[\frac{(19)(20)}{2}\right]\right) + \left(6(65) - 6(19)\right)$$

$$= \left[2(65)(66) - 2(19)(20)\right] + [390 - 114]$$

$$= \boxed{8096}$$

(6, 18%) Given the following Binary Tree, answer the questions below :



a) Is this a valid Binary Search Tree? (circle one) YES NO

b) List the nodes of this tree in the order that they are visited in a preorder traversal:

24	**14**	**20**	**22**	**26**	**30**	**28**	**34**	**32**	**38**

first node visited — last node visited

c) Perform the following procedure on the tree above, listing the output in the spaces below and leaving any unused spaces blank. Assume that the procedure is initially called with: **P6(root, 30)** and that the tree nodes and pointers are defined as:

tree_node definesa record
  data isoftype Num
  left, right isoftype ptr toa tree_node
endrecord
tree_ptr isoftype ptr toa tree_node

```
procedure P6 (node_ptr isoftype in tree_ptr,  key isoftype in Num)
  if (node_ptr <> NULL) then
     P6(node_ptr^.right, (key – 5))
     P6(node_ptr^.left,  (key + 5))
     if (node_ptr^.data < key) then
          print(node_ptr^.data)
     endif
  endif
endprocedure
```

28	**22**	**20**	**14**	**24**	______	______	______	______	______