

[PROGRAMMING LANGUAGE] ( 25% )

1. Show the values printed by the following program when parameters are passed by (a) value, (b) reference, and (c) value-result.

```
begin integer a
  procedure P(b); integer b
    begin b:=b+1; print(b,a) end
  a:=1; P(a); print(a);
end
```

(d) What is "aliasing" ? (e) Under what condition, aliasing will happen in the above program ? (15%, 3% each)

2. (a) What is "dangling else" ? (4%) (b) Please give at least two methods to solve this problem. (6%)

[ALGORITHM] ( 25% )

1. A procedure PRG(.) is given as below:

```
procedure PRG(i)
  global integer n,A(1:n),j,k;
  integer i
  if i < n then j <- PRG(i+1)
    if A(i) > A(j) then k <- i
      else k <- j
    endif
  else k <- n
  endif
  return(k)
endPRG
```

(a) What is the function of the above procedure ? (5%)  
 (b) Please write a nonrecursive version of the above program. (5%)

2. You have 1200 dollars to purchase stocks. Please use a greedy method to achieve maximum profit if the market conditions are given as below.

STOCK	Available (unit)	price (dollar)	profit (dollar)
A	16	30	10
B	18	10	2
C	15	25	8
D	20	15	4
E	16	20	7

(a) Explain the greedy method in mathematic formular.  
 ( Maximize .....  
 Subject to .....  
 and explain ... ) 5%

(b) Get the result combination (e.g. A 15, B 17, C 10, ..) and resulted profit. 5%

(c) If you are only allowed to buy stock by set, which consists of five stock units, what is the maximum profit you can make? 5%

[DATA STRUCTURE] (50%)

1. Obtain the tight upper bound of  $\sum_{i=1}^n i^k$ . (10%)
2. Assume that you find two algorithms for a given problem, one of which is  $O(2^n)$  and the other  $O(1.9^n)$ . Is  $1.9^n = O(2^n)$ ? If so, explain why? If not, explain which bound is better. (15%)
3. Though the worst case running time of the quick sort algorithm is  $O(n^2)$ , comparable to Bubble sort and other relatively inefficient sorting algorithms, it is nonetheless considered an efficient and useful algorithm. Briefly explain why. (15%)
4. Do you believe  $P \neq NP$ ? Argue accordingly. (10%).