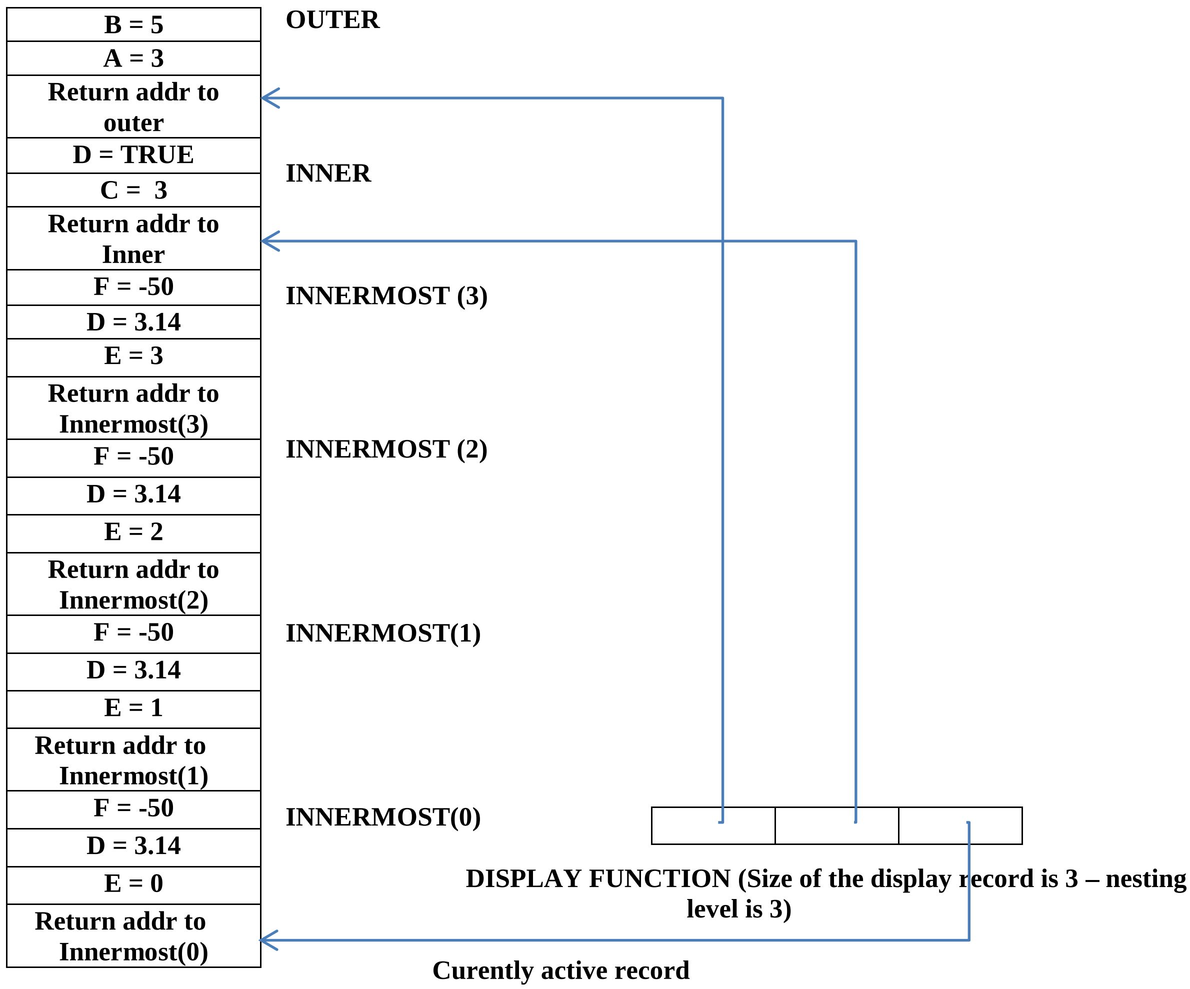
1. **There will be SEVEN activation records.**



2.

Call by Name:
In mystery procedure:

a1 = i
a2 = A[i+1]

interger tmp =3;
for c from 1 to 3 do
tmp = tmp + a2;
a1++;
end for;

Iteration c = 1:

a1 = i = 0
a2 = A[i+1] = 3
Tmp = tmp + a2 = 3 + 3 = 6
Tmp = 6;
a1++ => I = 1;

Iteration c = 2:

a1 = i = 1
a2 = A[i+1] = 2
Tmp = tmp + a2 = 6 + 2 = 8
Tmp = 8;
a1++ => I = 2;

Iteration c = 3:

a1 = i = 2
a2 = A[i+1] = 7
Tmp = tmp + a2 = 8 + 7 = 15
Tmp = 15;
A1++ => I = 3;

Call by Value:
Iteration c = 1:

a1 = 0
a2 = A[1+1] = 3
Tmp = tmp + a2 = 3 + 3 = 6
Tmp = 6;
a1++ ➔ a1=1;

Iteration c = 2:

a1 = 1
a2 = A[1+1] = 3
Tmp = tmp + a2 = 6 + 3 = 9
Tmp = 9;
a1++ ➔ a1=2;

Iteration c = 3:

a1 = 2
a2 = A[1+1] = 3
Tmp = tmp + a2 = 9 + 3 = 12
Tmp = 12;
a1++ ➔ a1=3;

3. Bindings

Unit	Var	Where Declared
Sub1	a, y, z x	Sub1 Main
Sub2	a, b, z y x	Sub2 Sub1 Main
Sub3	a, x, w y, z	Sub3 Main

4.
a.

S = λx.λy.λz.xz(yz)
K = λx.λy.x
SKK = (λx.λy.λz.xz(yz))K K

(λx.λy.λz.xz(yz)) (λx.λy.x) (λx.λy.x)

(λy.λz. (λx.λy.x) z(yz)) (λx.λy.x)

(λz. (λx.λy.x) z((λx.λy.x) z))

(λz. (λx.λy.x) z((λy.z)))

(λz. (λy.z) ((λy.z)))

(λz.z) == Identity Function

b. Reduce (λx. ∗ x x)(+ 2 3) in two different ways

Method 1:
(λx. ∗ x x)(+ 2 3)
(∗ (+ 2 3) (+ 2 3))
(∗ (5) (5))
25

Method 2:
(λx. ∗ x x)(+ 2 3)
(λx. ∗ x x)(5)
(∗ 5 5)
25

c. with and without alpha conversion
i.
(λxy . yx)(λx . x y)
(λy . y(λx . x y))
((λx . x y))
(y)

Alpha Conversion:
(λay . ya)(λx . x y)
(λy . y(λx . x y))
((λx . x y))
(y)

ii.
(λx . xz)(λxz . x y)
((λxz . x y)z)
((λz . z y))
(y)

Alpha Conversion:
(λy . yz)(λxz . x y)
(λxz . x y)z

(λz. z y)
(y)

iii.
(λx . x y)(λx . x)
((λx . x) y)
y

Alpha reduction

(λx . x y)(λx . x)
(λx . x y)(λy . y)
((λy. y) y)
Y

Therefore, alpha conversion evaluates to same values from the ones reduced without alpha conversion.

d. Reduce the lambda expression PLUS 1 1 and show that it reduces to 2
PLUS: (λm n f x . m f (n f x))
1   : (λfx . fx)
2   : (λf x . (f(fx))

(λm n f x . m f (n f x)) (λfx . fx) (λfx . fx)

(λn f x . (λfx . fx) f (n f x)) (λfx . fx)

(λf x .   (λfx . fx) f ((λfx . fx) f x))

(λf x .   (λx . fx) ((λfx . fx) f x))

(λf x .   (f((λfx . fx) f x)))

(λf x .   (f((λx . fx) x)))

(λf x .   (f(fx))