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

|  |
| --- |
| **B = 5** |
| **A = 3** |
| **Return addr to outer** |
| **D = TRUE** |
| **C = 3** |
| **Return addr to Inner** |
| **F = -50** |
| **D = 3.14** |
| **E = 3** |
| **Return addr to**  **Innermost(3)** |
| **F = -50** |
| **D = 3.14** |
| **E = 2** |
| **Return addr to**  **Innermost(2)** |
| **F = -50** |
| **D = 3.14** |
| **E = 1** |
| **Return addr to**  **Innermost(1)** |
| **F = -50** |
| **D = 3.14** |
| **E = 0** |
| **Return addr to**  **Innermost(0)** |

**OUTER**

**INNER**

**INNERMOST (3)**

**INNERMOST (2)**

**INNERMOST(1)**

|  |  |  |
| --- | --- | --- |
|  |  |  |

**INNERMOST(0)**

**DISPLAY FUNCTION (Size of the display record is 3 – nesting level is 3)**

**Curently active record**

**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))