Programming in C (4331105) - Summer 2025 Solution

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Question 1 [a marks]

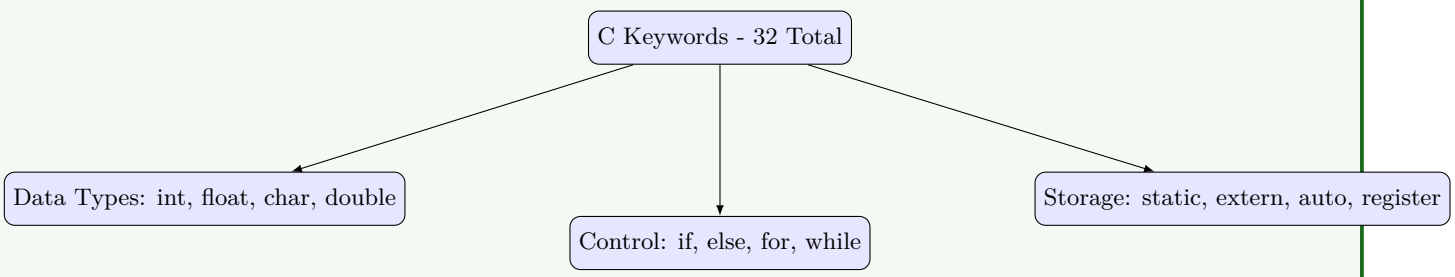
3 How many keywords are there in C? Write any four keywords

Solution

Answer:

Total Keywords	Examples
32 keywords	int, float, char, if

Diagram:



- **32 keywords**: Total reserved words in C language
- **Data type keywords**: int, float, char, double for variable declaration
- **Control keywords**: if, else, for, while for program flow

Mnemonic

"Cats In Four Colors" (char, int, float, const)

Question 1 [b marks]

4 What is variable? Explain rules for naming a variable with example

Solution

Answer:

Variable Definition:

Aspect	Description
Definition	Named memory location to store data
Purpose	Hold values that can change during program execution
Declaration	`datatype variable_name;`

Naming Rules:

- **First character**: Must be letter or underscore (_)
- **Subsequent characters**: Letters, digits, underscore only
- **Case sensitive**: 'Age' and 'age' are different
- **No keywords**: Cannot use reserved words like 'int', 'float'

Examples:

```c
int age;        // Valid
float _salary;  // Valid
char name123;   // Valid
int 2number;    // Invalid - starts with digit
float for;      // Invalid - keyword used
```

Mnemonic

"Letters First, No Keywords" (LF-NK)

Question 1 [c marks]

7 Specify errors if any, in the following statements

Solution

Answer:

Statement	Error	Reason
(1) `fLoat x;`	Invalid keyword	Correct: `float x;`
(2) `int min, max = 20;`	Partial initialization	Only max initialized, min uninitialized
(3) `long char c;`	Invalid combination	Cannot combine long with char
(4) `iNt a;`	Invalid keyword	Correct: `int a;`
(5) `FLOAT f=2;`	Invalid keyword	Correct: `float f=2;`
(6) `double m ; n;`	Missing datatype	Correct: `double m, n;`
(7) `Int score (100)0;`	Multiple errors	Invalid syntax, correct: `int score = 100;`

Key Points:

- **Case sensitivity**: Keywords must be lowercase
- **Multiple declaration**: Use comma separator
- **Initialization syntax**: Use = operator

Mnemonic

"Keywords Lower Case Always" (KLCA)

OR

Question 1 [c marks]

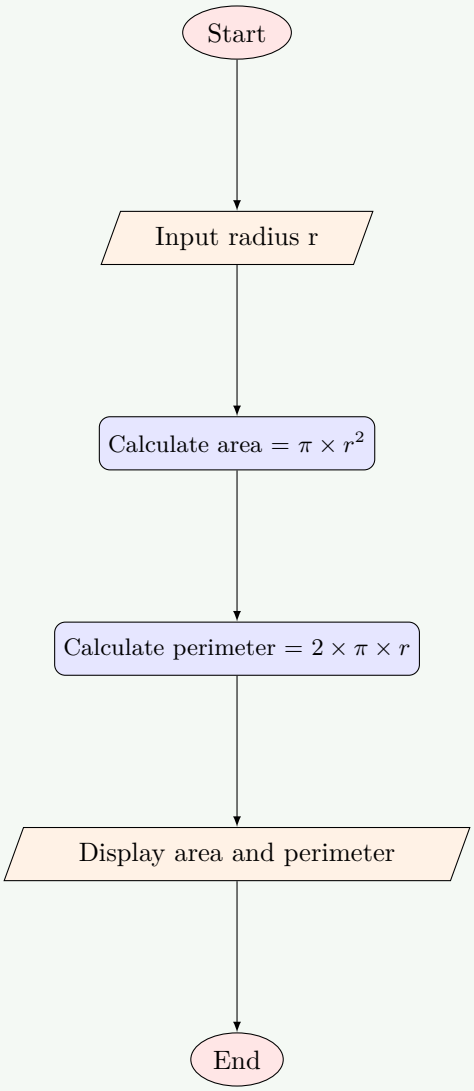
7 What is algorithm? What is flowchart? Draw a flowchart to find area and perimeter of circle.

Solution

Answer:
Definitions:

Term	Definition
Algorithm	Step-by-step procedure to solve a problem
Flowchart	Visual representation of algorithm using symbols

Flowchart for Circle Area and Perimeter:



Algorithm Steps:

- **Step 1**: Start
- **Step 2**: Input radius value
- **Step 3**: Calculate area using formula $\pi \times r^2$
- **Step 4**: Calculate perimeter using formula $2 \times \pi \times r$

Mnemonic

"Start Input Calculate Display End" (SICDE)

Question 2 [a marks]

3 What is operator? List all the 'C' operators.

Solution

Answer:

Operator Definition:

Aspect	Description
Definition	Special symbols that perform operations on operands
Purpose	Manipulate data and variables

C Operators List:

Category	Operators
Arithmetic	+, -, *, /, %
Relational	<, >, <=, >=, ==, !=
Logical	&&, ||, !
Assignment	=, +=, -=, *=, /=
Increment/Decrement	++, –
Conditional	?:

Mnemonic

"Add Relate Logic Assign Increment Condition" (ARLIC)

Question 2 [b marks]

4 State difference between while and do while loop.

Solution

Answer:

Aspect	while loop	do-while loop
Entry condition	Pre-tested	Post-tested
Minimum execution	0 times	At least 1 time
Syntax	`while(condition) { }`	`do { } while(condition);`
Semicolon	Not required after while	Required after while

Example:

```c
// while loop
while(i < 5) {
    printf("%d", i);
    i++;
}

// do-while loop
do {
    printf("%d", i);
    i++;
} while(i < 5);
```

Key Points:

- **Pre-tested**: Condition checked before execution
- **Post-tested**: Condition checked after execution

Mnemonic

"While Before, Do After" (WB-DA)

Question 2 [c marks]

7 How is scanf() function used for formatted input? Explain with example

Solution

Answer:

scanf() Function:

Feature	Description
Purpose	Read formatted input from keyboard
Syntax	`scanf("format_string", &variable);`
Return	Number of successfully read inputs

Format Specifiers:

Specifier	Data Type
%d	int
%f	float
%c	char
%s	string

Examples:

```c
int age;
float salary;
char grade;

scanf("%d", &age);           // Read integer
scanf("%f", &salary);        // Read float
scanf("%c", &grade);         // Read character
scanf("%d %f", &age, &salary); // Multiple inputs
```

Important Points:

- **Address operator (&)**: Required for variables
- **Format string**: Must match data types
- **Buffer issues**: Use `fflush(stdin)` if needed

Mnemonic

"Address Format Match" (AFM)

OR

Question 2 [a marks]

3 List arithmetic and relational operators of C language

Solution

Answer:

Operator Type	Operators	Purpose
Arithmetic	+, -, *, /, %	Mathematical operations
Relational	<, >, <=, >=, ==, !=	Comparison operations

Examples:

```c
// Arithmetic
int a = 10 + 5;    // Addition
int b = 10 % 3;    // Modulus (remainder)
```

```
4
5  // Relational
6  if(a > b)          // Greater than
7  if(a == b)         // Equal to
```

Mnemonic

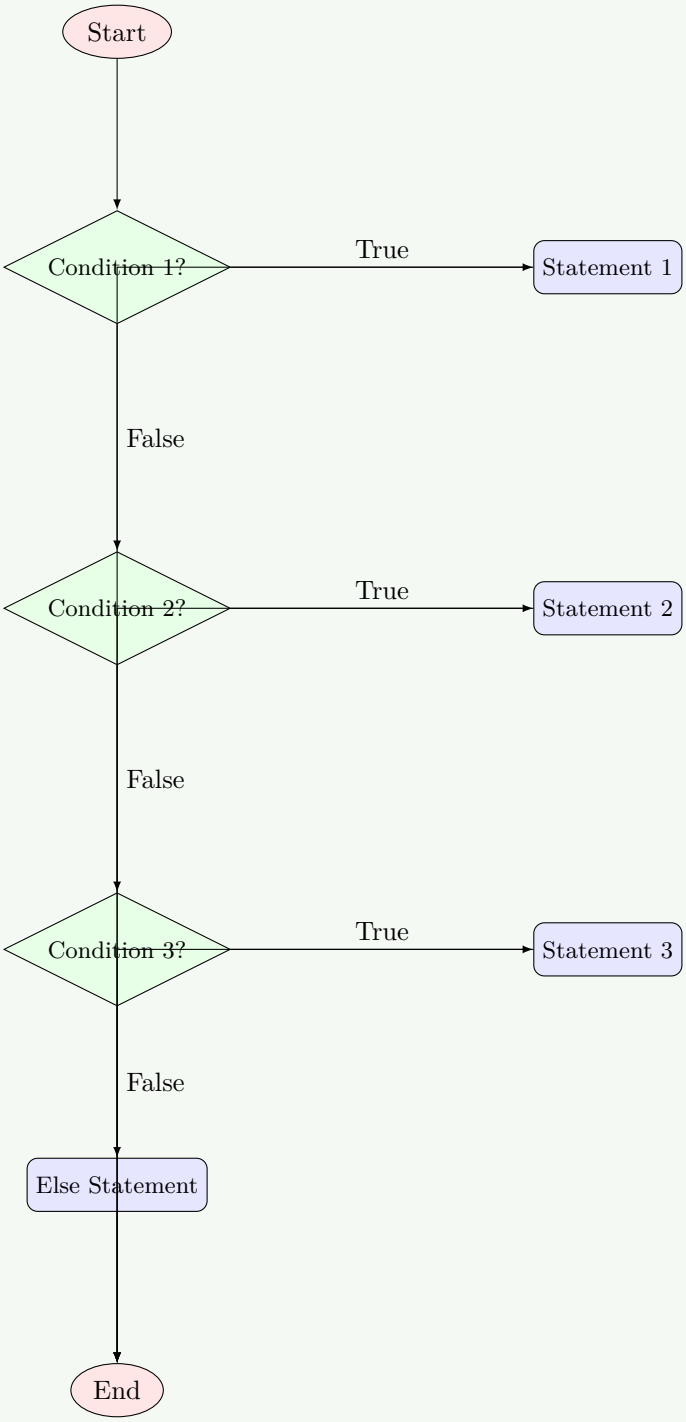
"Add Multiply Compare" (AMC)

Question 2 [b marks]

4 Draw flow chart of else if ladder.

Solution

Answer:



Structure:

- **Multiple conditions**: Checked sequentially
- **First true**: Corresponding block executes
- **Default case**: Else block for no match

Mnemonic

"Check First True Execute" (CFTE)

Question 2 [c marks]

7 How is printf() function used for formatted output? Explain with example

Solution

Answer:

printf() Function:

Feature	Description
Purpose	Display formatted output on screen
Syntax	`printf("format_string", variables);`
Return	Number of characters printed

Format Specifiers:

Specifier	Usage	Example
%d	Integer	`printf("%d", 25);`
%f	Float	`printf("%.2f", 3.14);`
%c	Character	`printf("%c", 'A');`
%s	String	`printf("%s", "Hello");`

Advanced Formatting:

```c
int num = 123;
float pi = 3.14159;

printf("Number: %5d\n", num);      // Width specification
printf("Pi: %.2f\n", pi);          // Precision specification
printf("Hex: %x\n", num);          // Hexadecimal
printf("Left aligned: %-10d\n", num); // Left alignment
```

Escape Sequences:

- **\n**: New line
- **\t**: Tab space
- \\: Backslash

Mnemonic

"Format Width Precision Align" (FWPA)

Question 3 [a marks]

3 List Logical operators and explain it

Solution

Answer:

Operator	Symbol	Description	Truth Table
AND	&&	True if both operands true	T&&T = T, others = F
OR	||	True if any operand true	F||F = F, others = T
NOT	!	Inverts the condition	!T = F, !F = T

Examples:

```c
int a = 5, b = 10;

if(a > 0 && b > 0)    // Both conditions must be true
if(a > 15 || b > 5)   // At least one condition true
if(!(a > 10))         // Negation of condition
```

Mnemonic

"And Or Not" (AON)

Question 3 [b marks]

4 Explain for loop with example.

Solution

Answer:

For Loop Structure:

Component	Purpose
Initialization	Set starting value
Condition	Test for continuation
Update	Modify loop variable

Syntax:

```
for(initialization; condition; update) {
    statements;
}
```

Example:

```
// Print numbers 1 to 5
for(int i = 1; i <= 5; i++) {
    printf("%d ", i);
}
// Output: 1 2 3 4 5
```

Execution Flow:

- **Step 1**: Initialize i = 1
- **Step 2**: Check condition i <= 5
- **Step 3**: Execute statements
- **Step 4**: Update i++, repeat from step 2

Mnemonic

"Initialize Check Execute Update" (ICEU)

Question 3 [c marks]

7 Write a program to find maximum out of three integer numbers x and y.

Solution

Answer:

```
#include <stdio.h>

int main() {
    int x, y, z, max;
```

```c

    printf("Enter three numbers: ");
    scanf("%d %d %d", &x, &y, &z);

    max = x;  // Assume first number is maximum

    if(y > max) {
        max = y;
    }
    if(z > max) {
        max = z;
    }

    printf("Maximum number is: %d", max);

    return 0;
}
```

Algorithm Steps:

Step	Action
1	Input three numbers
2	Assume first as maximum
3	Compare with second, update if larger
4	Compare with third, update if larger
5	Display maximum

Alternative Method:

```c
max = (x > y) ? ((x > z) ? x : z) : ((y > z) ? y : z);
```

Mnemonic

"Assume Compare Update Display" (ACUD)

OR

Question 3 [a marks]

3 Explain conditional operator with example.

Solution

Answer:
Conditional Operator (Ternary):

Feature	Description
Symbol	?:
Syntax	`condition ? value1 : value2`
Purpose	Shortcut for if-else

Examples:

```c
int a = 10, b = 20;
int max = (a > b) ? a : b;        // max = 20

char grade = (marks >= 60) ? 'P' : 'F';
printf("Status: %s", (age >= 18) ? "Adult" : "Minor");
```

Equivalent if-else:

```
if(a > b)
    max = a;
else
    max = b;
```

Advantages:
- **Concise**: Single line expression
- **Efficient**: Faster execution

Mnemonic

"Question Mark Colon Choice" (QMCC)

Question 3 [b marks]

4 Explain while loop with example.

Solution

Answer:
While Loop:

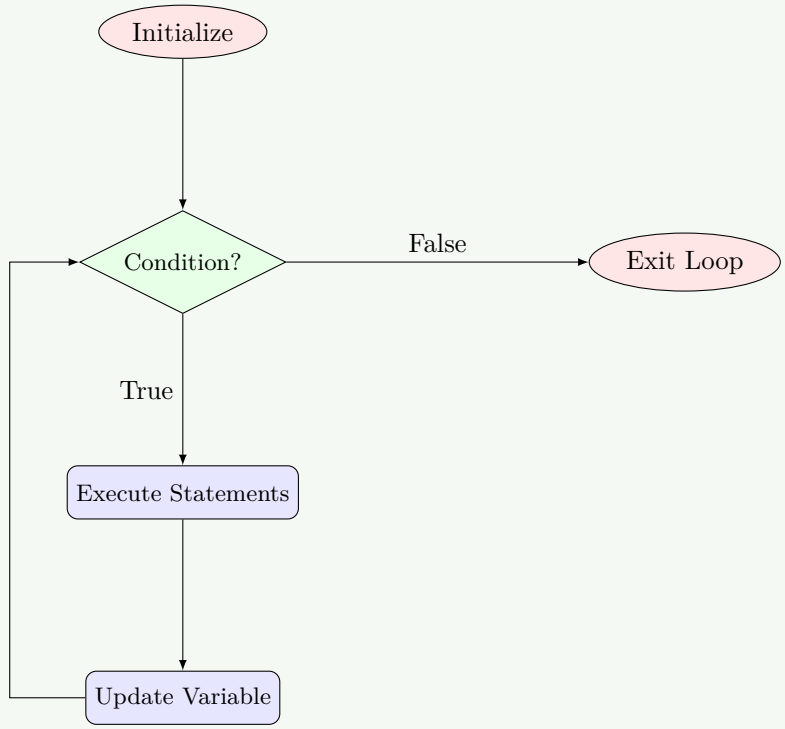
Feature	Description
Type	Entry-controlled loop
Syntax	`while(condition) { statements; }`
Execution	Repeats while condition is true

Example:

```
int i = 1;
while(i <= 5) {
    printf("%d ", i);
    i++;
}
// Output: 1 2 3 4 5
```

Important Points:
- **Initialization**: Before loop
- **Condition**: Checked at beginning
- **Update**: Inside loop body
- **Infinite loop**: If condition never becomes false

Flowchart Structure:



Mnemonic

"Initialize Check Execute Update" (ICEU)

Question 3 [c marks]

7 WAP to read an integer from key board and print whether given number is odd or even.

Solution

Answer:

```c
#include <stdio.h>

int main() {
    int number;

    printf("Enter an integer: ");
    scanf("%d", &number);

    if(number % 2 == 0) {
        printf("%d is Even number", number);
    }
    else {
        printf("%d is Odd number", number);
    }

    return 0;
}
```

Logic Explanation:

Concept	Description
Modulus operator (%)	Returns remainder after division
Even condition	`number % 2 == 0`
Odd condition	`number % 2 != 0`

Alternative Methods:

```
// Method 2: Using conditional operator
printf("%d is %s", number, (number % 2 == 0) ? "Even" : "Odd");

// Method 3: Using bitwise AND
if(number & 1)
    printf("Odd");
else
    printf("Even");
```

Sample Output:

```
Enter an integer: 7
7 is Odd number
```

Mnemonic

"Modulus Two Zero Even" (MTZE)

Question 4 [a marks]

3 Evaluate following arithmetic expressions: 30/4*4 – 20%6 + 17/2

Solution

Answer:

Step-by-step Evaluation:

Step	Expression	Calculation	Result
1	30/4*4	(30/4)*4 = 7*4	28
2	20%6	20 mod 6	2
3	17/2	Integer division	8
4	Final	28 - 2 + 8	34

Operator Precedence:

Priority	Operators
High	*, /, % (Left to right)
Low	+, - (Left to right)

Complete Calculation:

```
30/4*4 - 20%6 + 17/2
= 7*4 - 2 + 8       // Division and modulus first
= 28 - 2 + 8        // Multiplication
= 26 + 8            // Left to right for +,-
= 34                // Final answer
```

Mnemonic

"Multiply Divide Before Add Subtract" (MDBAS)

Question 4 [b marks]

4 WAP to find sum and average of an array of 5 integer numbers.

Solution

Answer:

```c
#include <stdio.h>

int main() {
    int numbers[5];
    int sum = 0;
    float average;

    printf("Enter 5 integers:\n");
    for(int i = 0; i < 5; i++) {
        scanf("%d", &numbers[i]);
        sum += numbers[i];
    }

    average = (float)sum / 5;

    printf("Sum = %d\n", sum);
    printf("Average = %.2f", average);

    return 0;
}
```

Algorithm:

1. Declare array of 5 integers
2. Initialize sum to 0
3. Input 5 numbers using loop
4. Add each number to sum
5. Calculate average = sum/5
6. Display results

Key Points:

- **Type casting**: `(float)sum` for accurate division
- **Loop usage**: Efficient for repetitive input

Mnemonic

"Declare Input Add Calculate Display" (DIACD)

Question 4 [c marks]

7 Define pointer. Explain how pointers are declared and initialized with example.

Solution

Answer:

Pointer Definition:

Aspect	Description
Definition	Variable that stores memory address of another variable
Purpose	Direct memory access and dynamic memory allocation
Symbol	* (asterisk) for declaration and dereferencing

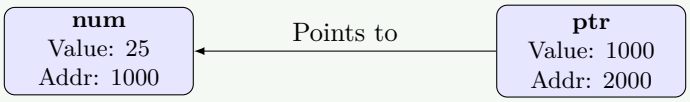
Declaration and Initialization:

```c
// Declaration
int *ptr;           // Pointer to integer
float *fptr;        // Pointer to float
char *cptr;         // Pointer to character

// Initialization
int num = 10;
int *ptr = &num;    // Initialize with address of num

// Alternative
int *ptr;
ptr = &num;         // Assign address later
```

Example Program:

```c
#include <stdio.h>

int main() {
    int num = 25;
    int *ptr = &num;

    printf("Value of num: %d\n", num);
    printf("Address of num: %p\n", &num);
    printf("Value of ptr: %p\n", ptr);
    printf("Value pointed by ptr: %d\n", *ptr);

    return 0;
}
```

Memory Diagram:



Mnemonic

"Address Star Dereference" (ASD)

OR

Question 4 [a marks]

3 Evaluate following arithmetic expressions: 50 / 3 % 3 + 5 * 7

Solution

Answer:

Step-by-step Evaluation:

Step	Expression	Calculation	Result
1	50/3	Integer division	16
2	16%3	16 mod 3	1
3	5*7	Multiplication	35
4	Final	1 + 35	36

Complete Calculation:

```
50 / 3 % 3 + 5 * 7
```

```
= 16 % 3 + 35      // Division and multiplication first
= 1 + 35           // Modulus operation
= 36               // Final answer
```

Operator Precedence Applied:

- **High priority**: /, %, * (left to right)
- **Low priority**: + (left to right)

Mnemonic

"Divide Mod Multiply Add" (DMMA)

Question 4 [b marks]

4 WAP to find the largest number in an array of N integers.

Solution

Answer:

```c
#include <stdio.h>

int main() {
    int n, i;
    int largest;

    printf("Enter number of elements: ");
    scanf("%d", &n);

    int arr[n];

    printf("Enter %d numbers:\n", n);
    for(i = 0; i < n; i++) {
        scanf("%d", &arr[i]);
    }

    largest = arr[0];  // Assume first element is largest

    for(i = 1; i < n; i++) {
        if(arr[i] > largest) {
            largest = arr[i];
        }
    }

    printf("Largest number is: %d", largest);

    return 0;
}
```

Algorithm:

1. Input array size
2. Input array elements
3. Assume first element as largest
4. Compare with remaining elements
5. Update largest if bigger found
6. Display result

Mnemonic

"Input Assume Compare Update Display" (IACUD)

Question 4 [c marks]

7 Define array. Explain the need for array variable. Explain 1-D array with example

Solution

Answer:

Array Definition:

Aspect	Description
Definition	Collection of similar data type elements
Storage	Consecutive memory locations
Access	Using index/subscript

Need for Arrays:

Problem	Solution with Array
Store multiple values	Single array variable
Avoid multiple variables	`arr[100]` instead of a1, a2, ..., a100
Efficient processing	Loop-based operations
Memory organization	Contiguous allocation

1-D Array Declaration:

```
datatype arrayname[size];

// Examples
int marks[5];           // Array of 5 integers
float prices[10];       // Array of 10 floats
char name[20];          // Array of 20 characters
```

Array Initialization:

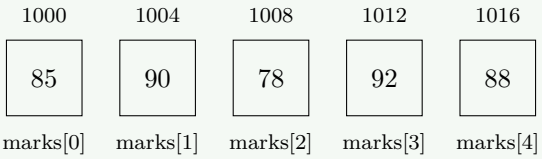
```
// Method 1: At declaration
int numbers[5] = {10, 20, 30, 40, 50};

// Method 2: Individual assignment
int arr[3];
arr[0] = 5;
arr[1] = 15;
arr[2] = 25;
```

Example Program:

```
#include <stdio.h>

int main() {
    int marks[5] = {85, 90, 78, 92, 88};
    int i, sum = 0;

    printf("Student marks:\n");
    for(i = 0; i < 5; i++) {
        printf("Subject %d: %d\n", i+1, marks[i]);
        sum += marks[i];
    }

```

```
    printf("Total marks: %d", sum);
    return 0;
}
```

Memory Layout:



Mnemonic

"Similar Data Consecutive Index" (SDCI)

Question 5 [a marks]

3 Give an example of if ... else statement.

Solution

Answer:

```c
#include <stdio.h>

int main() {
    int age;

    printf("Enter your age: ");
    scanf("%d", &age);

    if(age >= 18) {
        printf("You are eligible to vote");
    }
    else {
        printf("You are not eligible to vote");
    }

    return 0;
}
```

Structure:

Component	Purpose
if	Tests condition
condition	Boolean expression
if-block	Executes when condition true
else-block	Executes when condition false

Sample Outputs:

```
Input: 20    Output: You are eligible to vote
Input: 16    Output: You are not eligible to vote
```

Mnemonic

"If True Else False" (ITEF)

Question 5 [b marks]

4 WAP to check the category of given character.

Solution

Answer:

```c
#include <stdio.h>
#include <ctype.h>

int main() {
    char ch;

    printf("Enter a character: ");
    scanf("%c", &ch);

    if(isdigit(ch)) {
        printf("'%c' is a Digit", ch);
    }
    else if(isupper(ch)) {
        printf("'%c' is an Uppercase letter", ch);
    }
    else if(islower(ch)) {
        printf("'%c' is a Lowercase letter", ch);
    }
    else {
        printf("'%c' is a Special symbol", ch);
    }

    return 0;
}
```

Character Categories:

Function	Category	Range
isdigit()	Digit	0-9
isupper()	Uppercase	A-Z
islower()	Lowercase	a-z
Others	Special symbols	!@#$%^&* etc.

Alternative Method:

```c
if(ch >= '0' && ch <= '9')
    printf("Digit");
else if(ch >= 'A' && ch <= 'Z')
    printf("Uppercase");
else if(ch >= 'a' && ch <= 'z')
    printf("Lowercase");
else
    printf("Special symbol");
```

Mnemonic

"Digit Upper Lower Special" (DULS)

Question 5 [c marks]

7 What is structure? Explain its syntax with suitable example

Solution

Answer:

Structure Definition:

Aspect	Description
Definition	User-defined data type combining different data types
Purpose	Group related data under single name
Keyword	`struct`

Syntax:

```
struct structure_name {
    datatype member1;
    datatype member2;
    ...
};
```

Example - Student Structure:

```
#include <stdio.h>

struct Student {
    int roll_no;
    char name[50];
    float marks;
    char grade;
};

int main() {
    struct Student s1;

    // Input data
    printf("Enter roll number: ");
    scanf("%d", &s1.roll_no);

    printf("Enter name: ");
    scanf("%s", s1.name);

    printf("Enter marks: ");
    scanf("%f", &s1.marks);

    printf("Enter grade: ");
    scanf(" %c", &s1.grade);

    // Display data
    printf("\nStudent Details:\n");
    printf("Roll No: %d\n", s1.roll_no);
    printf("Name: %s\n", s1.name);
    printf("Marks: %.2f\n", s1.marks);
    printf("Grade: %c\n", s1.grade);

    return 0;
}
```

Structure Features:

- **Dot operator (.)**: Access structure members
- **Memory allocation**: Total size = sum of all members
- **Initialization**: Can initialize at declaration

Structure Initialization:

```
struct Student s1 = {101, "John", 85.5, 'A'};
```

Memory Layout:

s1 Structure

roll_no (4 bytes)
name (50 bytes)
marks (4 bytes)
grade (1 byte)

Mnemonic

"Group Related Data Together" (GRDT)

OR

Question 5 [a marks]

3 WAP to Print all numbers between -5 & +5.

Solution

Answer:

```c
#include <stdio.h>

int main() {
    int i;

    printf("Numbers between -5 and +5:\n");

    for(i = -5; i <= 5; i++) {
        printf("%d ", i);
    }

    return 0;
}
```

Output:

```
Numbers between -5 and +5:
-5 -4 -3 -2 -1 0 1 2 3 4 5
```

Alternative Methods:

```c
// Method 2: Using while loop
int i = -5;
while(i <= 5) {
    printf("%d ", i);
    i++;
}

// Method 3: Two separate loops
for(i = -5; i < 0; i++)
    printf("%d ", i);
printf("0 ");
for(i = 1; i <= 5; i++)
    printf("%d ", i);
```

Mnemonic

"Start Negative End Positive" (SNEP)

Question 5 [b marks]

4 WAP to find roots of quadratic equation.

Solution

Answer:

```c
#include <stdio.h>
#include <math.h>

int main() {
    float a, b, c;
    float discriminant, root1, root2;

    printf("Enter coefficients (a, b, c): ");
    scanf("%f %f %f", &a, &b, &c);

    discriminant = b*b - 4*a*c;

    if(discriminant > 0) {
        root1 = (-b + sqrt(discriminant)) / (2*a);
        root2 = (-b - sqrt(discriminant)) / (2*a);
        printf("Roots are real and different\n");
        printf("Root1 = %.2f\n", root1);
        printf("Root2 = %.2f\n", root2);
    }
    else if(discriminant == 0) {
        root1 = -b / (2*a);
        printf("Roots are real and equal\n");
        printf("Root = %.2f\n", root1);
    }
    else {
        float realPart = -b / (2*a);
        float imagPart = sqrt(-discriminant) / (2*a);
        printf("Roots are complex\n");
        printf("Root1 = %.2f + %.2fi\n", realPart, imagPart);
        printf("Root2 = %.2f - %.2fi\n", realPart, imagPart);
    }

    return 0;
}
```

Quadratic Formula Analysis:

Discriminant	Nature of Roots
$b^2 - 4ac > 0$	Real and different
$b^2 - 4ac = 0$	Real and equal
$b^2 - 4ac < 0$	Complex (imaginary)

Formula: $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

Mnemonic

"Discriminant Decides Root Nature" (DDRN)

Question 5 [c marks]

7 Explain following built-in functions with examples

Solution

Answer:

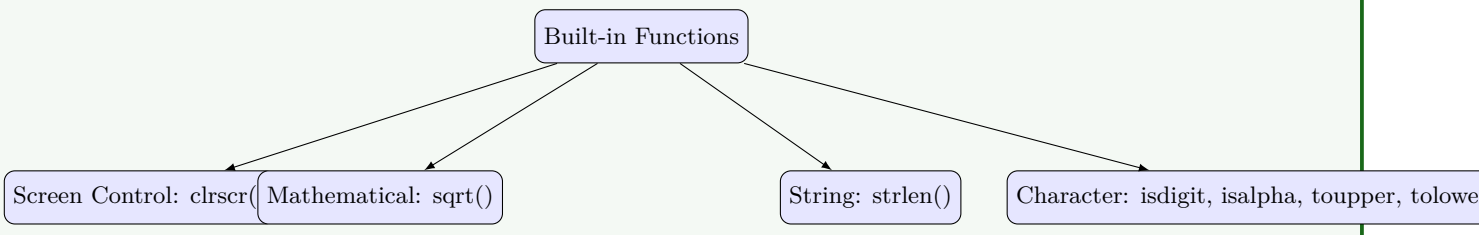
Function Explanations:

Function	Purpose	Header File	Example
`clrscr()`	Clear screen	conio.h	`clrscr();`
`sqrt()`	Square root	math.h	`sqrt(16) = 4.0`
`strlen()`	String length	string.h	`strlen("Hello") = 5`
`isdigit()`	Check if digit	ctype.h	`isdigit('5') = true`
`isalpha()`	Check if alphabet	ctype.h	`isalpha('A') = true`
`toupper()`	Convert to uppercase	ctype.h	`toupper('a') = 'A'`
`tolower()`	Convert to lowercase	ctype.h	`tolower('B') = 'b'`

Example Program:

```c
#include <stdio.h>
#include <math.h>
#include <string.h>
#include <ctype.h>

int main() {
    // clrscr(); // Not standard in modern compilers

    // sqrt() example
    float num = 25.0;
    printf("Square root of %.1f = %.2f\n", num, sqrt(num));

    // strlen() example
    char str[] = "Programming";
    printf("Length of '%s' = %d\n", str, strlen(str));

    // Character functions
    char ch = 'a';
    printf("'%c' is digit: %s\n", ch, isdigit(ch) ? "Yes" : "No");
    printf("'%c' is alphabet: %s\n", ch, isalpha(ch) ? "Yes" : "No");
    printf("Uppercase of '%c' = '%c'\n", ch, toupper(ch));

    return 0;
}
```

Function Categories:



Mnemonic

"Clear Math String Character" (CMSC)