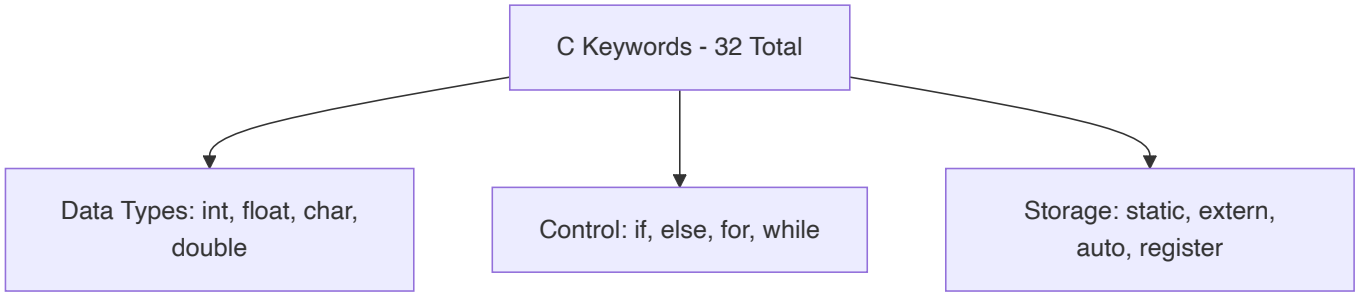
Question 1(a) [3 marks]

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

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) [4 marks]

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

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:

```
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) [7 marks]

Specify errors if any, in the following statements

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)

Question 1(c) OR [7 marks]

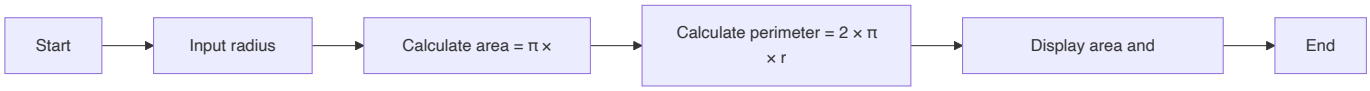
What is algorithm? What is flowchart? Draw a flowchart to find area and perimeter of circle.

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) [3 marks]

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

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) [4 marks]

State difference between while and do while loop.

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) [7 marks]

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

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:

```
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)

Question 2(a) OR [3 marks]

List arithmetic and relational operators of C language

Answer:

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

Examples:

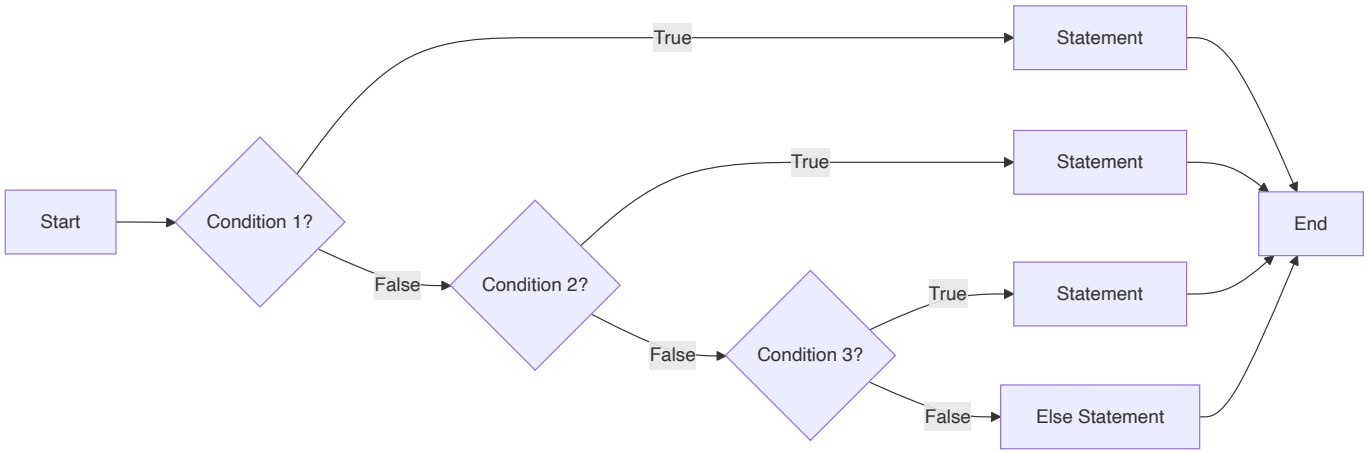
```c
// Arithmetic
int a = 10 + 5;     // Addition
int b = 10 % 3;     // Modulus (remainder)

// Relational
if(a > b)           // Greater than
if(a == b)          // Equal to
```

Mnemonic: "Add Multiply Compare" (AMC)

Question 2(b) OR [4 marks]

Draw flow chart of else if ladder.

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) OR [7 marks]

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

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:

```
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) [3 marks]

List Logical operators and explain it

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:

```
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) [4 marks]

Explain for loop with example.

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) [7 marks]

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

Answer:

```c
#include <stdio.h>

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

    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:

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

Mnemonic: "Assume Compare Update Display" (ACUD)

Question 3(a) OR [3 marks]

Explain conditional operator with example.

Answer:

Conditional Operator (Ternary):

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

Examples:

```
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) OR [4 marks]

Explain while loop with example.

Answer:

While Loop:

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

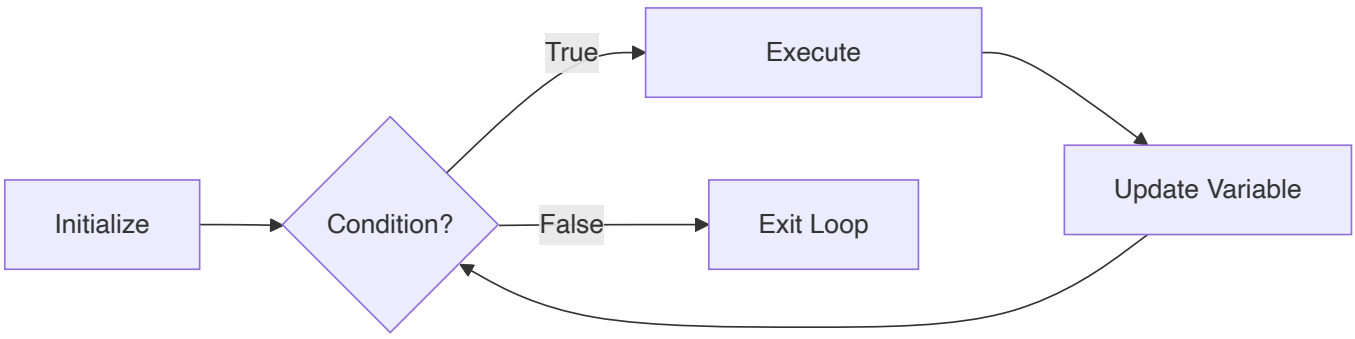
Example:

```c
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) OR [7 marks]

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

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:

```c
// 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) [3 marks]

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

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) [4 marks]

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

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:

Step	Action
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) [7 marks]

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

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;
}
```

Key Operators:

- **& (Address-of)**: Gets address of variable
- *** (Dereference)**: Gets value at address

Memory Diagram:

```
num: [25] at address 1000
ptr: [1000] at address 2000
```

Mnemonic: "Address Star Dereference" (ASD)

Question 4(a) OR [3 marks]

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

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) OR [4 marks]

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

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:

Step	Action
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) OR [7 marks]

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

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:

```
marks[0] marks[1] marks[2] marks[3] marks[4]
  [85]     [90]     [78]     [92]     [88]
 1000     1004     1008     1012     1016
```

Mnemonic: "Similar Data Consecutive Index" (SDCI)

Question 5(a) [3 marks]

Give an example of if ... else statement.

Answer:

If-else Example:

```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) [4 marks]

WAP to check the category of given character.

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:

```
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) [7 marks]

What is structure? Explain its syntax with suitable example

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;
```

```c
    // 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:

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

Structure Initialization:

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

Memory Layout:

```
s1: [roll_no][name...][marks][grade]
     4 bytes  50 bytes 4 bytes 1 byte
```

Mnemonic: "Group Related Data Together" (GRDT)

Question 5(a) OR [3 marks]

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

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) OR [4 marks]

WAP to find roots of quadratic equation.

Answer:

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

int main() {
    float a, b, c;
```

```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: $x = (-b \pm \sqrt{(b^2-4ac)}) / 2a$

Sample Output:

```
Enter coefficients: 1 -7 12
Roots are real and different
Root1 = 4.00
Root2 = 3.00
```

Mnemonic: "Discriminant Decides Root Nature" (DDRN)

Question 5(c) OR [7 marks]

Explain following built-in functions with examples

Answer:

Function Explanations:

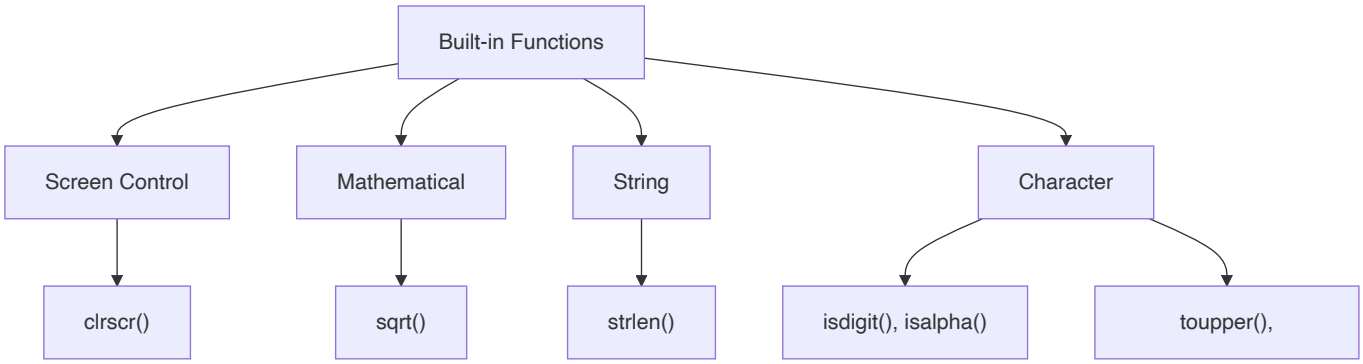
Function	Purpose	Header File	Example
clrscr()	Clear screen	conio.h	clrscr();
sqrt()	Square root	math.h	sqrt(16) = 4.0
strlen()	String length	string.h	strlen("Hello") = 5
isdigit()	Check if digit	ctype.h	isdigit('5') = true
isalpha()	Check if alphabet	ctype.h	isalpha('A') = true
toupper()	Convert to uppercase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

Example Program:

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

int main() {
    clrscr();  // Clear screen

    // 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));

    ch = 'B';
    printf("Lowercase of '%c' = '%c'\n", ch, tolower(ch));
```

```
    return 0;
}
```

Function Categories:



Key Points:

- **Header files**: Must include appropriate headers
- **Return values**: Most functions return specific types
- **Parameter types**: Check function parameter requirements

Mnemonic: "Clear Math String Character" (CMSC)