

Subject Name Solutions

4331105 – Summer 2025

Semester 1 Study Material

Detailed Solutions and Explanations

Question 1(a) [3 marks]

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

Solution

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

Diagram:

Mermaid Diagram (Code)

```
{Shaded}
{Highlighting}[]
graph TD
    A[C Keywords {- 32 Total}] --> B[Data Types: int, float, char, double]
    A --> C[Control: if, else, for, while]
    A --> D[Storage: static, extern, auto, register]
{Highlighting}
{Shaded}
```

- **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

Solution

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

Solution

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	Invalid keyword	Correct: float
f=2;		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.

Solution

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:

flowchart LR

```
A[Start] --> B[Input radius r]
B --> C[Calculate area =  $r^2$ ]
C --> D[Calculate perimeter =  $2\pi r$ ]
D --> E[Display area and perimeter]
E --> F[End]
```

Algorithm Steps:

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

Mnemonic

“Start Input Calculate Display End” (SICDE)

Question 2(a) [3 marks]

What is operator? List all the ‘C’ operators.

Solution

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.

Solution

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:

```
// 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

Solution

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

Solution

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

Examples:

```
// 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.

Solution

flowchart LR

```
A[Start] --> B[Condition 1?]\nB -- True --> C[Statement 1]\nB -- False --> D[Condition 2?]\nD -- True --> E[Statement 2]\nD -- False --> F[Condition 3?]\nF -- True --> G[Statement 3]\nF -- False --> H[Else Statement]\nC --> I[End]\nE --> I\nG --> I\nH --> I
```

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

Solution

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: \%-10dn", num);     // Left alignment
```

Escape Sequences:

- `****`: New line
- `****`: Tab space
- `\`: Backslash

Mnemonic

“Format Width Precision Align” (FWPA)

Question 3(a) [3 marks]

List Logical operators and explain it

Solution

Operator	Symbol	Description	Truth Table
AND	<code>&&</code>	True if both operands true	$T \& T = T$, others = F
OR	<code> </code>	True if any operand true	$F F = F$, others = T
NOT	<code>!</code>	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.

Solution

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 $i \leq 5$
- **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.

Solution

```
\#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.

Solution

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.

Solution

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:

```
flowchart LR
    A[Initialize] --> B{Condition?}
    B -- True --> C[Execute Statements]
    C --> D[Update Variable]
    D --> B
    B -- False --> E[Exit Loop]
```

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.

Solution

```
\#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) [3 marks]

**Evaluate following arithmetic expressions: $30/4*4 - 20\%6 + 17/2$ **

Solution

Step-by-step Evaluation:

Step	Expression	Calculation	Result
1	$30/4*4$	$(30/4)4 = 74$	28
2	$20\%6$	$20 \bmod 6$	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.

Solution

```
\#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.

Solution

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:

```
// 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:

```
\#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: $50 / 3 \% 3 + 5 * 7$

Solution

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.

Solution

```
\#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]

Solution

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]

Solution

If-else Example:

```
\#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]

Solution

```
\#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]

Solution

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("{n}Student 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:

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

Memory Layout:

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