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Written Test of Scientist/Engineer Examination

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Exam held on 12.01.2020

Sl.	Subjects	No. of Qs.	Level of Difficulty
1	Programming and Data Structures	16	Moderate to high
2	Digital Logic	8	Moderate to high
3	Algorithms	5	Moderate
4	Operating System	9	Easy to moderate
5	Computer Networks	5	Easy
6	Databases	4	Moderate
7	Computer organization and Architecture	13	High
8	Software Engineering and others	9	Easy to moderate
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- Q.1** Regression testing is primarily related to
 (a) Functional testing (b) Development testing
 (c) Data flow testing (d) Maintenance testing

Ans. (a)

The purpose of regression testing is to select test cases partially or fully to ensure existing functionalities work fine. Thus, regression testing is primarily related to functional testing.

End of Solution

- Q.2** Of the following sort algorithms, which has execution time that is least dependant on initial ordering of the input?
 (a) Insertion sort (b) Quick sort
 (c) Merge sort (d) Selection sort

Ans. (c)

Insertion sort gives $O(n)$ time when inputs are already sorted.

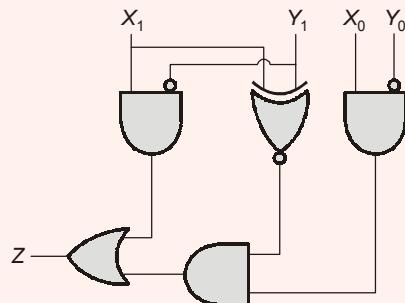
Quick sort gives $O(n^2)$ time when inputs are almost sorted.

Merge sort is independent of initial ordering and always gives $O(n \log n)$

Select sort gives $O(n^2)$ always but if elements are always sorted, number of swaps will be less.

End of Solution

- Q.3** The following circuit compares two 2-bit binary numbers, X and Y represented by X_1X_0 and Y_1Y_0 respectively. (X_0 and Y_0 represent Least Significant Bits)



Under what condition Z will be 1?

- (a) $X > Y$ (b) $X < Y$
 (c) $X = Y$ (d) $X \neq Y$

Ans. (a)

$$Z = X_1\bar{Y}_1 + (X_1 \odot Y_1)X_0\bar{Y}_0$$

If $X > Y$, then

$$Z = 1$$

End of Solution

Q.4 What is the availability of the software with following reliability figures.

Mean Time Between Failures (MTBF) is 20 days

Mean Time To Repair (MTTR) is 20 hours.

- | | |
|---------|---------|
| (a) 90% | (b) 96% |
| (c) 24% | (d) 50% |

Ans. (d)

$$\text{Software availability} = \frac{\text{MTBF}}{(\text{MTBF} + \text{MTTR})} = \left(\frac{20}{20+20} \right) = 50\%$$

End of Solution

Q.5 What is the defect rate for Six sigma?

- | |
|---|
| (a) 1.0 defect per million lines of code |
| (b) 1.4 defects per million lines of code |
| (c) 3.0 defects per million lines of code |
| (d) 3.4 defects per million lines of code |

Ans. (d)

End of Solution

Q.6 Consider a 5-segment pipeline with a clock cycle time 20 ns in each sub operation. Find out the approximate speed-up ratio between pipelined and non-pipelined system to execute 100 instructions. (If an average, every five cycles, a bubble due to data hazard has to be introduced in the pipeline)

- | | |
|----------|----------|
| (a) 5 | (b) 4.03 |
| (c) 4.81 | (d) 4.17 |

Ans. (b)

$$K = 5$$

$$\text{Clock time} = 20 \text{ ns}$$

$$\text{Number of instructions} = 100$$

$$\text{Number of cycles taken by non-pipelined processor} = 100 \times 5 = 500$$

$$\text{Total inputs in the pipeline} = 100 + \frac{100}{5} = 120 \quad \left[\frac{100}{5} = 20 \text{ stalls} \right]$$

$$\text{Speed up} = \frac{(5 \times 100) \times 20 \text{ ns}}{(5 + 120 - 1) \times 20 \text{ ns}} = 4.03$$

End of Solution

Q.7 Consider a 32-bit processor which supports 70 instructions. Each instruction is 32 bit long and has 4 fields namely opcode, two register identifiers and an immediate operand of unsigned integer type. Maximum value of the immediate operand that can be supported by the processor is 8191. How many registers the processor has?

- | | |
|---------|--------|
| (a) 32 | (b) 64 |
| (c) 128 | (d) 16 |

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Ans. (b)

32-bit processor.

Number of instructions supported = 70

Opcode	Reg1	Reg2	Immediate operand
--------	------	------	-------------------

Maximum value of immediate operand supported = 8191 which can be generated using 13 bits.

For opcode = 7 bits are needed.

Number of bits left to represent register bits = 12
i.e., 6 bits for 1 register.

Hence, at max. 64 registers can be there.

So, option (b) is correct.

End of Solution

Q.8 In a 8-bit ripple carry adder using identical full adders, each full adder takes 34 ns for computing sum. If the time taken for 8-bit addition is 90 ns, find time taken by each full adder to find carry.

- | | |
|-----------|----------|
| (a) 6 ns | (b) 7 ns |
| (c) 10 ns | (d) 8 ns |

Ans. (d)

$n = 8$ Ripple Carry Adder

SUM delay from each Full Adder S_{delay} = 34 ns

CARRY delay from each Full Adder C_{delay} = ?

Overall delay = $T = 90$ ns

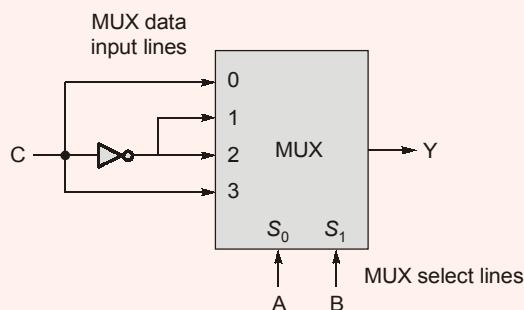
$$T = S_{\text{delay}} + (n - 1)C_{\text{delay}}$$

$$90 = 34 + 7 \times C_{\text{delay}}$$

$$C_{\text{delay}} = 8 \text{ ns}$$

End of Solution

Q.9 Following Multiplexer circuit is equivalent to



- (a) Sum equation of full adder
- (b) Carry equation of full adder
- (c) Borrow equation for full subtractor
- (d) Difference equation of a full subtractor

Ans. (a, d)

$$Y = \bar{S}_1 \bar{S}_0 I_0 + \bar{S}_0 S_0 I_1 + S_1 \bar{S}_0 I_2 + S_1 S_0 I_3$$

$$S_1 = B; I_0 = I_3 = C$$

$$S_0 = A; I_1 = I_2 = \bar{C}$$

$$Y = \bar{B} \bar{A} \cdot C + \bar{B} A \cdot \bar{C} + B \bar{A} \bar{C} + BAC$$

$$= \bar{A} \bar{B} C + A \bar{B} \bar{C} + \bar{A} B \bar{C} + ABC$$

$$(1) \quad (4) \quad (2) \quad (7)$$

$$= \Sigma m(1, 2, 4, 7)$$

∴ Y = Sum equation of full adder and also difference equation of a full subtractor.
Both option (a) and (d) are correct.

End of Solution

Q.10 A stack is implemented with an array of ' $A[0...N - 1]$ ' and a variable 'pos'. The push and pop operations are defined by the following code.

```

push (x)
    A[pos] ← x
    pos ← pos - 1
end push
pop ( )
    pos ← pos + 1
    return A[pos]
end pop

```

Which of the following will initialize an empty stack with capacity N for the above implementation?

- | | |
|--------------|-------------------|
| (a) pos ← -1 | (b) pos ← 0 |
| (c) pos ← 1 | (d) pos ← $N - 1$ |

Ans. (d)

As can be seen through above code stack is growing from larger index to lower index.
Thus, for empty stack pos ← $N - 1$ is correct.

End of Solution

Q.11 Given that

$B(a)$ means "a is a bear"

$F(a)$ means "a is a fish" and

$E(a, b)$ means "a eats b"

Then what is the best meaning of

$$\forall x[F(x) \rightarrow \forall y(E(y, x) \rightarrow b(y))]$$

- | | |
|--------------------------------------|-------------------------|
| (a) Every fish is eaten by some bear | (b) Bears eat only fish |
| (c) Every bear eats fish | (d) Only bears eat fish |

Ans. (d)

$$\forall x[F(x) \rightarrow \forall y(E(y, x) \rightarrow b(y))]$$

whenever x is a fish and if it is eaten by something, then that something is a bear.
This translates to option (d), "only bears eat fish".

End of Solution

Q.12 Following declaration of an array of struct, assumes size of byte, short, int and long are 1, 2, 3 and 4 respectively. Alignment rule stipulates that n -byte field must be located at an address divisible by n . The fields in a struct are not rearranged, padding is used to ensure alignment. All elements of array should be of same size.

Struct complx

 Short s

 Byte b

 Long l

 Int i

End complx

Complx C[10]

Assuming C is located at an address divisible by 8, what is the total size of C , in Bytes?

- | | |
|---------|---------|
| (a) 150 | (b) 160 |
| (c) 200 | (d) 240 |

Ans. (b)

Size of complex data type will be $2 + 1 + 4 + 3 = 10$ Bytes

But due to padding to align with rules size becomes 16 Bytes (after 6 Bytes of padding)

Hence, Total size = $16 \times 10 = 160$ Bytes

End of Solution

Q.13 The immediate addressing mode can be used for

1. Loading internal registers with initial values
2. Perform arithmetic or logical operation on data contained in instructions

Which of the following is true?

- | | |
|------------------|--|
| (a) Only 1 | (b) Only 2 |
| (c) Both 1 and 2 | (d) Immediate mode refers to data in cache |

Ans. (c)

The immediate addressing mode can be used for loading value in register and performed arithmetic operations.

For example LOAD R1, #100.

So, both the statements are correct.

End of Solution



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- Q.14** Statements associated with registers of a CPU are given. Identify the false statement.
- The program counter holds the memory address of the instruction in execution.
 - Only opcode is transferred to the control unit.
 - An instruction in the instruction register consists of the opcode and the operand
 - The value of the program counter is incremented by 1 once its value has been read to the memory address register.

Ans. (c)

End of Solution

- Q.15** Which of the following affects the processing power assuming they do not influence each other.
1. Data bus capability
 2. Addressing scheme
 3. Clock speed
- | | |
|------------------|------------------|
| (a) 3 only | (b) 1 and 3 only |
| (c) 2 and 3 only | (d) 1, 2 and 3 |

Ans. (b)

End of Solution

- Q.16** Convert the pre-fix expression to in-fix

$-^* + ABC^* - DE + FG$

- | | |
|-------------------------------------|-------------------------------------|
| (a) $(A - B)^*C + (D^*E) - (F + G)$ | (b) $(A + B)^*C - (D - E)^*(F - G)$ |
| (c) $(A + B - C)^*(D - E)^*(F + G)$ | (d) $(A + B)^*C - (D^*E) - (F + G)$ |

Ans. (*)

Given Prefix operation:

$-^* + ABC^* - DE + FG$

Infix:

$(A + B)^*C - (D - E)^*(F + G)$

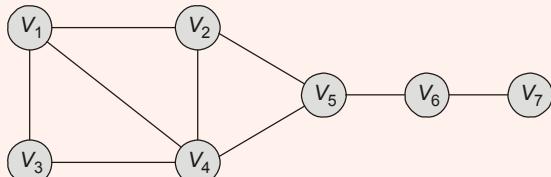
None of the option matches.

End of Solution

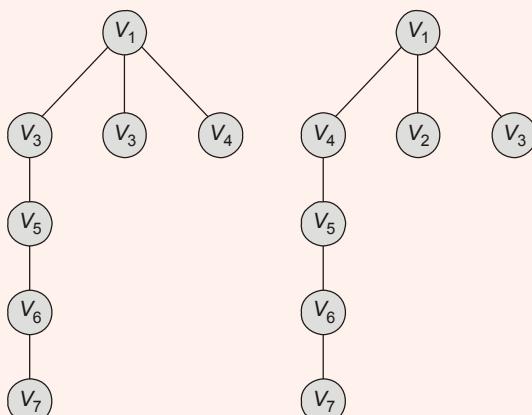
Q.17 G is an undirected graph with vertex set $\{v_1, v_2, v_3, v_4, v_5, v_6, v_7\}$ and edge set $\{v_1v_2, v_1v_3, v_1v_4, v_2v_4, v_2v_5, v_3v_4, v_4v_5, v_4v_6, v_5v_6, v_6v_7\}$. A breadth first search of the graph is performed with v_1 as the root node. Which of the following is a tree edge?

- (a) v_2v_4 (b) v_1v_4
(c) v_4v_5 (d) v_3v_4

Ans. (b)



Possible BFS traversals on above graph starting from v_1 is given.



Clearly, v_2v_4 , v_3v_4 cannot be the tree edge while v_1v_4 and v_4v_5 can be the tree edge. It happens that v_4v_5 may not be present in every traversal but v_1v_4 surely will be in the traversals.

So most correct answer is option (b).

End of Solution

Q.18 If the array A contains the items 10, 4, 7, 23, 67, 12 and 5 in that order, what will be the resultant array A after third pass of insertion sort?

- (a) 67, 12, 10, 5, 4, 7, 23 (b) 4, 7, 10, 23, 67, 12, 5
(c) 4, 5, 7, 67, 10, 12, 23 (d) 10, 7, 4, 67, 23, 12, 5

Ans. (b)

Given array: 10, 4, 7, 23, 67, 12, 5

After 1st pass: 4, 10, 7, 23, 67, 12, 5

After 2nd pass: 4, 7, 10, 23, 67, 12, 5

After 3rd pass: 4, 7, 10, 23, 67, 12, 5

Hence, option (b) is correct.

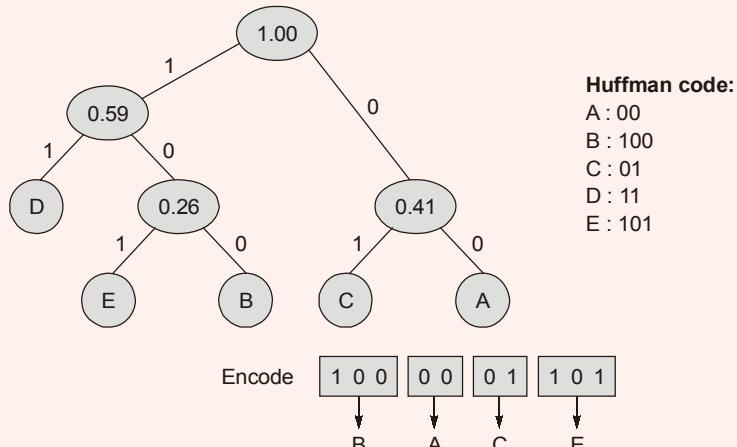
End of Solution

Q.19 Huffman tree is constructed for the following data: {A, B, C, D, E} with frequency {0.17, 0.11, 0.24, 0.33 and 0.15} respectively. 100 00 01101 is decoded as

- (a) BACE (b) CADE
(c) BAD (d) CADD

Ans. (a)

A = 0.17, B = 0.11, C = 0.24, D = 0.33, E = 0.15



Hence, option (a) is correct.

End of Solution

Q.20 Given the grammar:

$$\begin{aligned}s &\rightarrow T^* S \mid T \\ T &\rightarrow U + T \mid U \\ U &\rightarrow a \mid b\end{aligned}$$

Which of the following statement is wrong?

- (a) Grammar is not ambiguous
(b) Priority of + over * is ensured
(c) Right to left evaluation of * and + happens
(d) None of these

Ans. (d)

Following points can be drawn from above grammar :

1. * is right associative.
2. + is right associative.
3. Priority of + is higher than *.
4. Grammar is not ambiguous since preferences are defined.

End of Solution



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|---|--|

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Q.21 What is the complexity of the following code?

```
sum = 0;
for (i = 1; i <= n; i*= 2)
    for(j = 1; j <= n; j++)
        sum++;
```

Which of the following is not a valid string?

- | | |
|--------------|--------------------------|
| (a) $O(n^2)$ | (b) $O(n \log n)$ |
| (c) $O(n)$ | (d) $O(n \log n \log n)$ |

Ans. (c)

Inner loop runs for n times while outer loop runs for $\log n$ times.

Hence, Total TC = $O(n \log n)$

So, option (c) is not valid all others are valid.

End of Solution

Q.22 In the following procedure

Integer procedure P(X, Y);

Integer X,Y;

value x;

begin

 K = 5;

 L = 8;

 P = x + y;

end

X is called by value and Y is called by name. If the procedure were invoked by the following program fragment

 K = 0;

 L = 0;

 Z = P(K, L);

then the value Z would be set equal to

- | | |
|--------|-------|
| (a) 5 | (b) 8 |
| (c) 13 | (d) 0 |

Ans. (d)

End of Solution



Q.23 Consider product of three matrices M_1 , M_2 and M_3 having w rows and x columns, x rows and y columns, and y rows and z columns. Under what condition will it take less time to compute the product as $(M_1 M_2) M_3$ than to compute $M_1(M_2 M_3)$?

- (a) Always take the same time (b) $\left(\frac{1}{x} + \frac{1}{z}\right) < \left(\frac{1}{w} + \frac{1}{y}\right)$
 (c) $x > y$ (d) $(w + x) > (y + z)$

Ans. (b)

$$M_{1w \times x} \quad M_{2x \times y} \quad M_{3y \times z}$$

$$(M_1 M_2) M_3 \text{ cost} = wxy + wyz$$

$$\text{while } M_1(M_2 M_3) \text{ cost} = xyz + wxz$$

$(M_1 M_2) M_3$ will take less time than $M_1(M_2 M_3)$ when

$$wxy + wyz < xyz + wxz$$

Dividing both sides by $wxyz$,

$$\frac{1}{z} + \frac{1}{x} < \frac{1}{w} + \frac{1}{y} \text{ which is option (b).}$$

End of Solution

Q.24 A new flipflop with inputs X and Y , has the following property

Inputs		Current state	Next state
X	Y		
0	0	Q	1
0	1	Q	\bar{Q}
1	1	Q	0
1	0	Q	Q

Which of the following expresses the next state in terms of X , Y , current state?

- (a) $(\bar{X} \wedge \bar{Q}) \vee (\bar{Y} \wedge Q)$ (b) $(\bar{X} \wedge Q) \vee (\bar{Y} \wedge \bar{Q})$
 (c) $(X \wedge \bar{Q}) \vee (Y \wedge Q)$ (d) $(X \wedge \bar{Q}) \vee (\bar{Y} \wedge Q)$

Ans. (a)

	Current state			Next state
	X	Y	Q_n	
0	0	0	0	1
1	0	0	1	1
2	0	1	0	1
3	0	1	1	0
4	1	0	1	0
5	1	0	1	1
6	1	1	0	0
7	1	1	1	0



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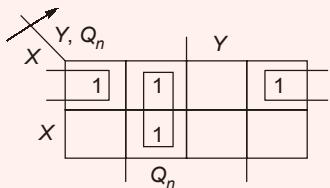
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$$Q_{n+1}(X, Y, Q_n) = \sum m(0, 1, 2, 5)$$



$$\begin{aligned} Q_{n+1} &= \bar{X}\bar{Q}_n + \bar{Y}Q_n \\ &= (\bar{X} \wedge \bar{Q}_n) \vee (\bar{Y} \wedge Q_n) \end{aligned}$$

So option (a) is correct.

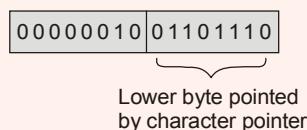
End of Solution

- Q.25** What is the output of the following 'c' code assuming it runs on a byte addressed little endian machine?

```
#include <stdio.h>
int main()
{
    int x; char *ptr;
    x = 622,100,101;
    printf("%d", (*(char *)&x) * (x % 3));
    return 0;
}
(a) 622 (b) 311
(c) 22 (d) 110
```

Ans. (d)

Since, comma (,) is left to right associative operator. So, *x* will store only 622. Binary value of 622 is given below:



Hence, $(\ast(\text{char}^*) \&x)$ will return 01101110, i.e., decimal 110 and $(x \% 3)$ gives 1.

$$\Rightarrow 110 * 1 = 110$$

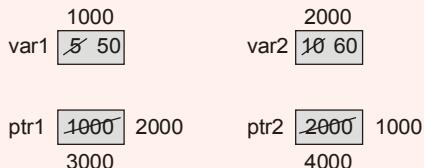
So, option (d) is correct.

End of Solution

Q.26 What is the output in a 32 bit machine with 32 bit compiler?

```
#include <stdio.h>
rer(int **ptr2, int **ptr1)
{
    int* ii;
    ii = *ptr2;
    *ptr2 = *ptr1;
    *ptr1 = ii;
    **ptr1 *= **ptr2;
    **ptr2 += **ptr1;
}
void main( )
{
    int var1 = 5, var2 = 10;
    int *ptr1 = &var1, *ptr2 = &var2;
    rer(&ptr1, &ptr2);
    printf("%d %d ", var2, var1);
}
(a) 60 70
(c) 50 60
(b) 50 50
(d) 60 50
```

Ans. (d)



Under rer functions:

- $\text{ptr2} = \boxed{3000}$ $\text{ptr1} = \boxed{4000}$
- $ii = 1000$
- $*(3000) = *(4000)$
i.e., outer $\text{ptr1} = 2000$
- $*(4000) = 1000$
i.e., outer $\text{ptr2} = 1000$
- $**\text{ptr1} *= **\text{ptr2}$
will convert $\text{var1} = 50$
- $**\text{ptr2} += **\text{ptr1}$
will convert $\text{var2} = 60$

Hence, 60 50 gets printed.

End of Solution

Q.27 Which of the following is an efficient method of cache updating?

- (a) Snoopy writes
- (b) Write through
- (c) Write within
- (d) Buffered write

Ans. (c)

End of Solution

Q.28 In a columnar transposition cipher, the plain text is "the tomato is a plant in the night shade family", keyword is "TOMATO". The cipher text is

- (a) "TINESAX / EOAHTFX / HTLTHEY / MAIIAIX / TAPNGDL / OSTNHNMX"
- (b) "TINESAX / EOAHTFX / MAIIAIX / HTLTHEY / TAPNGDL / OSTNHNMX"
- (c) "TINESAX / EOAHTFX / HTLTHEY / MAIIAIX / OSTNHNMX / TAPNGDL"
- (d) "EOAHTFX / TINESAX / HTLTHEY / MAIIAIX / TAPNGDL / OSTNHNMX"

Ans. (a)

T	O	M	A	T	O
4	3	2	1	4	3

t	h	e	t	o	m
a	t	o	i	s	a
p	l	a	n	t	i
n	t	h	e	n	i
g	h	t	s	h	a
d	e	f	a	m	i
l	y	x	x	x	x

Writing column wise:

TINESAX / EDAHTFX / HTLTHEY / MAIIAIX / TAPNGDL / DSTNHNMX

So, option (a) is correct.

End of Solution

Q.29 Avalanche effect in cryptography refers

- (a) Large changes in cipher text when the keyword is changed minimally
- (b) Large changes in cipher text when the plain text is changed
- (c) Large impact of keyword change to length of the cipher text
- (d) None of the above

Ans. (b)

In the case of high-quality block ciphers such a small change in either the key or the plain text should cause a drastic change in cipher text.

Hence, option (b) is true.

End of Solution



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- Q.30** A magnetic disk has 100 cylinders, each with 10 tracks of 10 sectors. If each sector contains 128 Bytes, what is the maximum capacity of the disk in kilobytes?
- 1,280,000
 - 1280
 - 1250
 - 128,000

Ans. (b)

$$\begin{aligned}\text{Disk capacity} &= 10 \times 100 \times 10 \times 128 \text{ Bytes} \\ &= 1280000 \text{ Bytes} = 1280 \text{ KB}\end{aligned}$$

End of Solution

- Q.31** How many total bits are required for a direct-mapped cache with 128 KB of data and 1 word block size, assuming a 32-bit address and 1 word size of 4 bytes?
- 2 Mbits
 - 1.7 Mbits
 - 2.5 Mbits
 - 1.5 Mbits

Ans. (d)

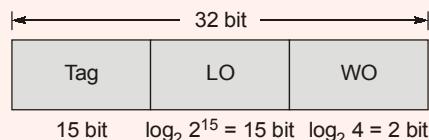
$$\text{Data cache} = 128 \text{ KB}$$

$$\text{Block size} = 1 \text{ W} = 4 \text{ Bytes}$$

$$\text{MM Address} = 32 \text{ bit}$$

$$\text{Number of lines} = \frac{\text{CM Site}}{\text{Block Size}} \Rightarrow \frac{128 \text{ K}}{4} = \frac{2^{17}}{2^2} = 2^{15}$$

Address format:



$$\begin{aligned}\text{So, } \text{Tag memory size} &= \text{Number of lines in cm} \times \text{Tag space in the line} \\ &= 2^{15} \times 15 \text{ bit}\end{aligned}$$

$$\begin{aligned}\text{Total cache} &= \text{Tag memory} + \text{Data memory} \\ &= (2^{15} \times 15 \text{ bit}) + 128 \text{ KB} \\ &= (15 \times 32 \text{ K}) \text{ bit} + (128 \times 8) \text{ K bit} \\ &= 480 \text{ K bit} + 1024 \text{ K bit} \\ &= 1504 \text{ K bit} = 1.5 \text{ M bit}\end{aligned}$$

End of Solution

- Q.32** Properties of 'DELETE' and 'TRUNCATE' commands indicate that
- After the execution of 'TRUNCATE' operation, COMMIT and ROLLBACK statements cannot be performed to retrieve the lost data, while 'DELETE' allow it.
 - After the execution of 'DELETE' and 'TRUNCATE' operation retrieval is easily possible for the lost data.
 - After the execution of 'DELETE' operation, COMMIT and ROLLBACK statements can be performed to retrieve the lost data, while TRUNCATE do not allow it.
 - After the execution of 'DELETE' and 'TRUNCATE' operation no retrieval is possible for the lost data.

Ans. (c)

Delete is DML command and can be rolled back (undo)
 TRUNCATE is DDL command and can not be rolled back.

End of Solution

Q.33 Remote Procedure Calls are used for

- (a) communication between two processes remotely different from each other on the same system.
- (b) communication between two processes on the same system.
- (c) communication between two processes on separate system.
- (d) None of the above

Ans. (c)

Remote procedure calls are used to communicate between process which are not in same address space mainly on different systems.

End of Solution

Q.34 Consider the following recursive C function that takes two arguments

```
unsigned int rer (unsigned int n, unsigned int r) {
    if (n > 0) return (n% r + rer(n/r, r));
    else return 0;
}
```

What is the return value of the function rer when it is called as rer (513, 2)?

- | | |
|-------|-------|
| (a) 9 | (b) 8 |
| (c) 5 | (d) 2 |

Ans. (d)

$513 \% 2 + 256 \% 2 + 128 \% 2 + 64 \% 2 + 32 \% 2 + 16 \% 2 + 8 \% 2 + 4 \% 2 + 2 \% 2 + 1 \% 2$

Hence, output will be $1 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 1 = 2$, i.e., sum of bits when 513 represented in binary.

End of Solution

Q.35 A given grammar is called ambiguous if

- (a) two or more productions have the same non-terminal on the left hand side
- (b) a derivation tree has more than one associated sentence
- (c) there is a sentence with more than one derivation tree corresponding to it
- (d) brackets are not present in the grammar

Ans. (c)

A grammar is ambiguous if there is a sentence with more than one derivation tree corresponding to it.

End of Solution



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Q.36 What is the output of the code given below?

```
#include <stdio.h>
int main( )
{
    char name[ ]="satellites";
    int len;
    int size;
    len = strlen(name);
    size = sizeof(name);
    printf("%d", len * size);
    return 0;
}
(a) 100          (b) 110
(c) 40          (d) 44
```

Ans. (b)

100	101	102	103	104	105	106	107	108	109	110
s	a	t	e			i	t	e	s	\0

len = strlen (name)

strlen returns length of string without null character.

$$\begin{aligned} \Rightarrow \quad & \text{len} = 10 \\ & \text{Size} = \text{Size of (name)} \\ & = 11 \end{aligned}$$

Hence, 110 gets printed.

End of Solution

Q.37 Checksum field in TCP header is

- (a) ones complement of sum of header and data in bytes
- (b) ones complement of sum of header, data and pseudo header in 16 bit words
- (c) dropped from IPv6 header format
- (d) better than md5 or sh1 methods

Ans. (b)

Checksum calculation in TCP header involves header, payload (data) and pseudo header. All these values gets added and stored in one's complemented form.

End of Solution

Q.38 If $x + 2y = 30$, then $\left(\frac{2y}{5} + \frac{x}{3}\right) + \left(\frac{x}{5} + \frac{2y}{3}\right)$ will be equal to

- (a) 8 (b) 16
 (c) 18 (d) 20

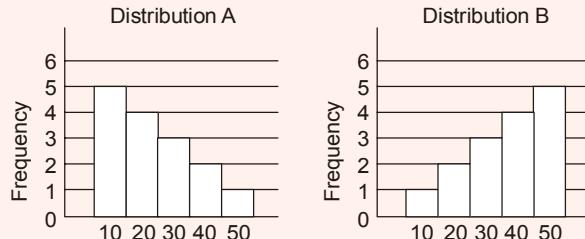
Ans. (b)

$$x + 2y = 30$$

$$\begin{aligned} &= \left(\frac{2y}{5} + \frac{x}{3}\right) + \left(\frac{x}{5} + \frac{2y}{3}\right) = \frac{6y + 5x}{15} + \frac{3x + 10y}{15} \\ &= \frac{8(30)}{15} = 16 \end{aligned}$$

End of Solution

Q.39 For the distributions given below :



Which of the following is correct for the above distributions?

- (a) Standard deviation of A is significantly lower than standard deviation of B
 (b) Standard deviation of A is slightly lower than standard deviation of B
 (c) Standard deviation of A is same as standard deviation of B
 (d) Standard deviation of A is significantly higher than standard deviation of B

Ans. (c)

Distribution A:

x_i	f_i	$x_i f_i$	$x_i^2 f_i$
10	5	50	500
20	4	80	1600
30	3	90	2700
40	2	80	3200
50	1	50	2500
	15	350	10500

$$\sigma_1 = \sqrt{\frac{n \sum x_i^2 f_i - (\sum x_i f_i)^2}{n}}$$

where

$$n = \sum f_i = 15$$

$$\sigma_1 = \sqrt{\frac{15(10500) - (350)^2}{(15)^2}} = 12.472$$



Distribution B:

x_i	f_i	$x_i f_i$	$x_i^2 f_i$
10	1	10	100
20	2	40	800
30	3	90	2700
40	4	160	6400
50	5	250	12500
	15	550	22500

So,

$$\sigma_2 = \sqrt{\frac{15(22500) - (550)^2}{(15)^2}} = 12.472$$
$$= \sigma_1 = \sigma_2$$

End of Solution

- Q.40** The hardware implementation which provides mutual exclusion is
(a) Semaphores (b) Test and set instruction
(c) Both options (d) None of the options

Ans. (c)

End of Solution

- Q.41** Which of the following algorithms defines time quantum?
(a) shortest job scheduling algorithm (b) round robin scheduling algorithm
(c) priority scheduling algorithm (d) multilevel queue scheduling algorithm

Ans. (b)

End of Solution

- Q.42** Dispatch latency is defined as
(a) the speed of dispatching a process from running to the ready state
(b) the time of dispatching a process from running to ready state and keeping the CPU idle
(c) the time to stop one process and start running another one
(d) none of these

Ans. (c)

Dispatcher is used to transit the process from ready state to running state. Thus, dispatch latency is the time taken to stop one process and start running another one.

End of Solution



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- Q.43** An aid to determine the deadlock occurrence is
 (a) resource allocation graph (b) starvation graph
 (c) inversion graph (d) none of the above

Ans. (a)

End of Solution

- Q.44** Consider the following page reference string.

1 2 3 4 2 1 5 6 2 1 2 3 7 6 3 2 1 2 3 6

What are the minimum number of frames required to get a single page fault for the above sequence assuming LRU replacement strategy?

- (a) 7 (b) 4
 (c) 6 (d) 5

Ans. (c)

Above question ambiguous but most probability option (c) should be the answer.

End of Solution

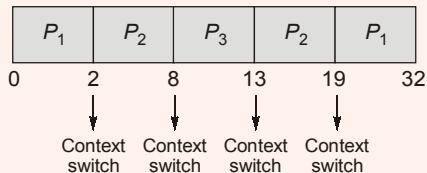
- Q.45** Three CPU-bound tasks, with execution times of 15, 12 and 5 time units respectively arrive at times 0, t and 8, respectively. If the operating system implements a shortest remaining time first scheduling algorithm, what should be the value of t to have 4 context switches? Ignore the context switches at time 0 and at the end.

- (a) $0 < t < 3$ (b) $t = 0$
 (c) $t \leq 3$ (d) $3 < t < 8$

Ans. (a)

Process	AT	BT
P_1	0	15
P_2	t	12
P_3	8	5

Using SRTF, if $t = 2$



Hence, to have 4 context switches t should be between $0 < t < 3$.

End of Solution

- Q.46** The post-order traversal of a binary tree is ACEDBHIGF. The pre-order traversal is
 (a) ABCDEFGHI (b) FBADCEGIH
 (c) FABCDEGHFI (d) ABDCEFGIH

Ans. (*)

End of Solution

Q.47 In linear hashing, if blocking factor bfr, loading factor i and file buckets N are known, the number of records will be

- (a) $cr = i + bfr + N$ (b) $r = i - bfr - N$
 (c) $r = i - bfr - N$ (d) $r = i * bfr * N$

Ans. (d)

End of Solution

Q.48 What is compaction refers to

- (a) a technique for overcoming internal fragmentation
 (b) a paging technique
 (c) a technique for overcoming external fragmentation
 (d) a technique for compressing the data

Ans. (c)

Compaction is a process in which the free space is collected in a large memory chunk to make some space available for processes.

In **memory management**, swapping creates multiple fragments in the memory because of the processes moving in and out.

Compaction refers to combining all the empty spaces together and processes.

End of Solution

Q.49 The operating system and the other processes are protected from being modified by an already running process because

- (a) they run at different time instants and not in parallel
 (b) they are in different logical addresses
 (c) they use a protection algorithm in the scheduler
 (d) every address generated by the CPU is being checked against the relocation and limit parameters

Ans. (d)

End of Solution

Q.50 A grammar is defined as

$$\begin{aligned} A &\rightarrow BC \\ B &\rightarrow x \mid Bx \\ C &\rightarrow B \mid D \\ D &\rightarrow y \mid Ey \\ E &\rightarrow z \end{aligned}$$

The non-terminal alphabet of the grammar is

- (a) {A, B, C, D, E} (b) {B, C, D, E}
 (c) {A, B, C, D, E, x, y, z} (d) {x, y, z}

Ans. (a)

By default, capital letters are the non-terminals.
Hence, the non-terminals set is {A, B, C, D, E}.

End of Solution

Q.51 If $A = \{x, y, z\}$ and $B = \{u, v, w, x\}$, and the universe is $\{s, t, u, v, w, x, y, z\}$. Then $(A \cup \bar{B}) \cap (A \cap B)$ is equal to

- | | |
|------------------------|---------------|
| (a) {u, v, w, x} | (b) {} |
| (c) {u, v, w, x, y, z} | (d) {u, v, w} |

Ans. (*)

$$(A \cup \bar{B}) \cap (A \cap B)$$

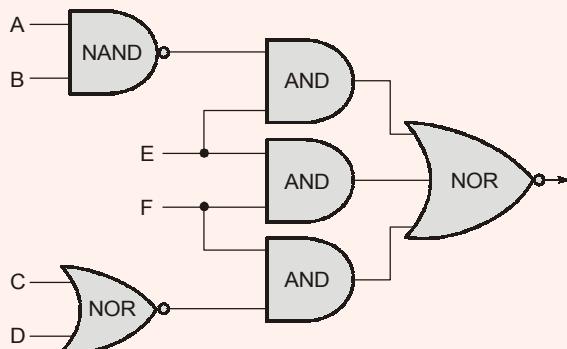
$$\begin{aligned} A &= \{x, y, z\} \\ B &= \{u, v, w, x\} \\ \cup &= \{s, t, u, v, w, x, y, z\} \\ \bar{B} &= \{s, t, y, z\} \\ A \cup \bar{B} &= \{x, y, z, s, t\} \\ A \cap B &= \{x\} \end{aligned}$$

$$(A \cup \bar{B}) \cap (A \cap B) = \{x\}$$

None of the option matches.

End of Solution

Q.52 Consider the following circuit



The function by the network above is

- | | |
|---|--|
| (a) $\overline{ABE} + EF + \overline{CDF}$ | (b) $(\bar{E} + AB\bar{F})(C + D + \bar{F})$ |
| (c) $(\overline{AB} + E)(\bar{E} + \bar{F})(C + D + \bar{F})$ | (d) $(A + B)\bar{E} + \overline{EF} + CDF$ |

Ans. (b)

$$\begin{aligned} \text{Output} &= \overline{\overline{AB} \cdot E + EF + (\overline{C + D}) \cdot F} \\ &= (\overline{\overline{AB} \cdot E})(\overline{EF})(\overline{\overline{C + D} \cdot F}) \\ &= (AB + \bar{E})(\bar{E} + \bar{F})(C + D + \bar{F}) \\ &= (AB\bar{E} + AB\bar{F} + \underline{\bar{E}} + \underline{\bar{E}\bar{F}})(C + D + \bar{F}) \end{aligned}$$



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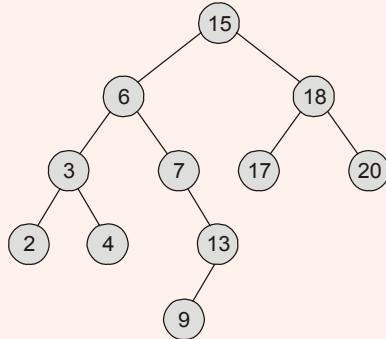
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$$\begin{aligned}
 &= (\bar{E}(1+AB+\bar{F}) + AB\bar{F})(C+D+\bar{F}) \\
 &= (\bar{E} + AB\bar{F})(C+D+\bar{F})
 \end{aligned}$$

End of Solution

Q.53 What is the in-order successor of 15 in the given binary search tree?



- (a) 18 (b) 6
 (c) 17 (d) 20

Ans. (c)

Inorder successor of a node is the next node in inorder traversal of the binary search tree.

OR

It can be defined as the node with the smallest key greater than the key of input node.
 Inorder traversal of given tree,

2 3 4 6 7 9 13 15 17 18 20

17 is the inorder successor of 15.

End of Solution

Q.54 The minimum height of an AVL tree with n nodes is

- | | |
|-------------------------------|---------------------|
| (a) Ceil ($\log_2(n + 1)$) | (b) $1.44 \log_2 n$ |
| (c) Floor ($\log_2(n + 1)$) | (d) $1.64 \log_2 n$ |

Ans. (c)

If there are n nodes in AVL tree, minimum height is Floor ($\log_2(n + 1)$).

End of Solution

Q.55 The Master theorem

- (a) assumes the subproblems are unequal sizes
- (b) can be used if the subproblems are of equal size
- (c) cannot be used for divide and conquer algorithms
- (d) cannot be used for asymptotic complexity analysis

Ans. (b)

Master theorem is used for subproblems which are equal in size.

End of Solution

- Q.56** Raymonds tree based algorithm ensures
 (a) no starvation, but deadlock may occur in rare cases
 (b) no deadlock, but starvation may occur
 (c) neither deadlock nor starvation can occur
 (d) deadlock may occur in cases where the process is already starved

Ans. (b)

Raymonds algorithm ensures no deadlock will occur but can cause starvation.

End of Solution

- Q.57** Consider the following pseudo-code:

```
I = 0; J = 0; K = 8;
while (I < K - 1) //while-1
{
    J = J + 1;
    while (J < K) //while-2
    {
        if (x[I] < x[J])
        {
            temp = x[I];
            x[I] = x[J];
            x[J] = temp;
        }
    } // end of while-2
    I = I +1;
} // end of while-1
```

The cyclomatic complexity of the above is

- | | |
|-------|-------|
| (a) 3 | (b) 2 |
| (c) 4 | (d) 1 |

Ans. (c)

End of Solution

- Q.58** In a class definition with 10 methods, to make the class maximally cohesive, number of direct and indirect connections required among the methods are

- | | |
|------------|------------|
| (a) 90, 0 | (b) 45, 0 |
| (c) 10, 10 | (d) 45, 45 |

Ans. (b)

End of Solution

Q.59 Of the following, which best approximates the ratio of the number of non-terminal nodes in the total number of nodes in a complete K -ary tree of depth N ?

- | | |
|-------------------|---------------------|
| (a) $\frac{1}{N}$ | (b) $\frac{N-1}{N}$ |
| (c) $\frac{1}{K}$ | (d) $\frac{K-1}{K}$ |

Ans. (c)
K-ary tree

Internal nodes	Total nodes
0	1
1	$K + 1$
2	$2K + 1$
3	$3K + 1$
4	$4K + 1$
⋮	⋮
n	$nK + 1$

$$\text{Ratio of internal nodes to the total nodes} = \frac{n}{nK+1} \approx \frac{1}{K}$$

End of Solution

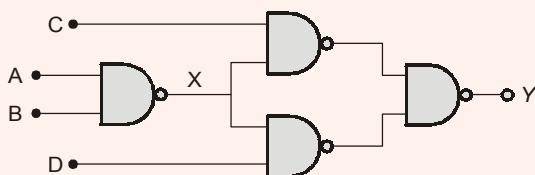
Q.60 Minimum number of NAND gates required to implement the following binary equation

$$Y = (\bar{A} + \bar{B})(C + D)$$

- | | |
|-------|-------|
| (a) 4 | (b) 5 |
| (c) 3 | (d) 6 |

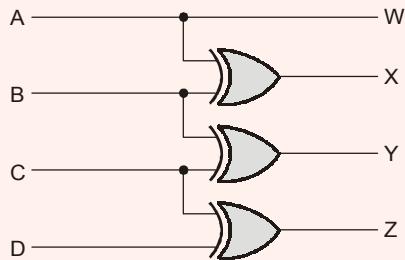
Ans. (a)

$$\begin{aligned}
 Y &= (\bar{A} + \bar{B})(C + D) \\
 &= \overline{AB}(C + D) \\
 &= XC + XD \text{ where } X = \overline{AB}
 \end{aligned}$$



End of Solution

Q.61 If ABCD is a 4-bit binary number, then what is code generated by the following circuit?



- (a) BCD code
(c) 8421 code
(b) Gray code
(d) Excess-3 code

Ans. (b)

$$\begin{aligned}W &= A, Y = B \oplus C \\X &= A \oplus B, Z = C \oplus D\end{aligned}$$

End of Solution

Q.62 The number of tokens in the following C code segment is

```
switch(inputvalue)
{
    case 1 : b = c * d; break;
    default : b = b++; break;
}
(a) 27
(b) 29
(c) 26
(d) 24
```

Ans. (c)

```
switch(|inputvalue|)
{
    case |1|:| b | = |c|*|d|;| break|;|
    default|:| b | = |b|++|;| break|;|
}
```

Total 26 tokens in the program.

So option (c) is correct.

End of Solution

Q.63 In a two-pass assembler, resolution of subroutine calls and inclusion of labels in the symbol table is done during

- (a) second pass
(b) first pass and second pass respectively
(c) second pass and first pass respectively
(d) first pass

Ans. (c)

End of Solution

Q.64 One instruction tries to write an operand before it is written by previous instruction. This may lead to a dependency called

- (a) True dependency (b) Anti-dependency
 (c) Output dependency (d) Control hazard

Ans. (c)

End of Solution

Q.65 If every non-key attribute functionally dependant on the primary key, then the relation will be in

- (a) First normal form (b) Second normal form
 (c) Third normal form (d) Fourth normal form

Ans. (c)

- Every non key attribute functionality dependent on primary key 3NF.
- According to 3NF inference rule every non key must determine by key.

End of Solution

Q.66 The SQL query

```
SELECT columns
FROM TableA
RIGHT OUTER JOIN TableB
ON A.columnName = B.columnName
WHERE A.columnName IS NULL
```

returns the following:

- (a) All rows in Table B, which meets equality condition above and, none from Table A, which meets the condition
 (b) All rows in Table A, which meets equality condition above and none from Table B, which meets the condition
 (c) All rows in Table B, which meets equality condition
 (d) All rows in Table A, which meets equality condition

Ans. (*)

```
SELECT columns
FROM TableA
RIGHT OUTER JOIN TableB
ON A.columnName = B.columnName
WHERE A.columnName IS NULL
```

Query returns records of table B which are failed equality condition of join.
 No option matching.

End of Solution



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Pramit Debmallik
Classroom Course

7
AIR
Abhishek Kumar
Classroom Course

3
AIR
Amarjeet
Classroom Course

8
AIR
Yogesh Kumar
Classroom Course

4
AIR
Aman Gulia
Classroom Course

9
AIR
Ankit Kumar
Classroom Course

5
AIR
Ayush Chandra Dwivedi
Postal Course

10
AIR
Tushar Garg
Classroom Course

Mechanical Engineering

10 in Top 10

85 Selections out of **87** vacancies

98% of Total Selections are from MADE EASY

1
AIR
BHOSALE H. DNYANESHWAR
Classroom Course

6
AIR
Ch. Pushpak Pramod
Classroom Course

2
AIR
Sahil Goyal
Interview Course

7
AIR
Manish Rajput
Classroom Course

3
AIR
Kumar Chandan
Classroom Course

8
AIR
Hemant Kumar Singh
Online T. S.

4
AIR
Saurav Kumar
Classroom Course

9
AIR
Sabapara D. Manishbhai
Interview Course

5
AIR
Himanshu Verma
Classroom Course

10
AIR
Sumit Bhamboo
Classroom Course

Electrical Engineering

10 in Top 10

79 Selections out of **86** vacancies

92% of Total Selections are from MADE EASY

1
AIR
KARTIKEYA SINGH
Classroom Course

6
AIR
Ritesh Lalwani
Classroom Course

2
AIR
Shambhavi Tripathi
Classroom Course

7
AIR
Kartikey Singh
Online T. S.

3
AIR
Abhishek Anand
Classroom Course

8
AIR
Anshuman Mitra
Classroom T. S.

4
AIR
Ankit Tayal
Classroom Course

9
AIR
Deepita Roy
Classroom Course

5
AIR
Kumar Mayank
Classroom Course

10
AIR
Ankita Sharma
Classroom Course

E&T Engineering

10 in Top 10

85 Selections out of **88** vacancies

97% of Total Selections are from MADE EASY

1
AIR
RAJAT SONI
Classroom Course

6
AIR
Janga Srinivasa Reddy
Classroom Course

2
AIR
Ankush Mangla
Classroom Course

7
AIR
Rahul Jain
Classroom Course

3
AIR
Rohit Kumar Singh
Classroom Course

8
AIR
Kuldeep Kumar
Classroom Course

4
AIR
Amir Khan
Classroom Course

9
AIR
Shubham Karnani
Classroom Course

5
AIR
Y. Naga Rahul
Classroom Course

10
AIR
Gaurav Srivastava
Classroom Course



- Q.67** To send same bit sequence, NRZ encoding require
 (a) Same clock frequency as Manchester encoding
 (b) Half the clock frequency as Manchester encoding
 (c) Twice the clock frequency as Manchester encoding
 (d) A clock frequency which depend on number of zeros and ones in the bit sequence

Ans. (b)

End of Solution

- Q.68** The persist timer is used in TCP to
 (a) To detect crashes from the other end of the connection
 (b) To enable retransmission
 (c) To avoid deadlock condition
 (d) To timeout FIN_WAIT1 condition

Ans. (c)

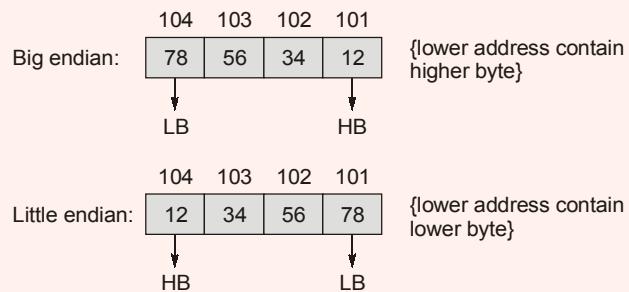
End of Solution

- Q.69** An array of 2 two byte integers is stored in big endian machine in byte address as shown below. What will be its storage pattern in little endian machine?

Address	Data
0 × 104	78
0 × 103	56
0 × 102	34
0 × 101	12

- | | |
|----------------|----------------|
| (a) 0 × 104 12 | (b) 0 × 104 12 |
| 0 × 103 56 | 0 × 103 34 |
| 0 × 102 34 | 0 × 102 56 |
| 0 × 101 78 | 0 × 101 78 |
| (c) 0 × 104 56 | (d) 0 × 104 56 |
| 0 × 103 78 | 0 × 103 12 |
| 0 × 102 12 | 0 × 102 78 |
| 0 × 101 34 | 0 × 101 34 |

Ans. (b)



End of Solution



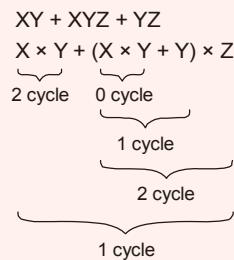
Q.70 A non-pipelined CPU has 12 general purpose registers (R0, R1, R2, R12). Following operation are supported

- | | |
|---|--|
| ADD Ra, Rb, Rr | Add Ra to Rb and store the result in Rr |
| MUL Ra, Rb, Rr | Multiply Ra to Rb and store the result in Rr |
| MUL operations takes two clock cycles, ADD takes one clock cycle. | |

Calculate minimum number of clock cycles required to compute the value of the expression $XY + XYZ + YZ$. The variables X, Y, Z are initially available in registers R0, R1 and R2 and contents of these registers must not be modified.

- | | |
|-------|-------|
| (a) 5 | (b) 6 |
| (c) 7 | (d) 8 |

Ans. (b)



$$\text{Total} = 2 + 1 + 2 + 1 = 6 \text{ cycles}$$

End of Solution

Q.71 Context free languages are closed under

- | | |
|------------------------------|--------------------------------|
| (a) union, intersection | (b) union, kleene closure |
| (c) intersection; complement | (d) complement, kleene closure |

Ans. (b)

CFL's are closed under union and kleene closure is true.

End of Solution

Q.72 Which of the following is true?

- | |
|---|
| (a) Every subset of a regular set is regular |
| (b) Every finite subset of non-regular set is regular |
| (c) The union of two non-regular set is not regular |
| (d) Infinite union of finite set is regular |

Ans. (b)

Every finite subset of a non-regular set is regular, because finite sets are always regular.

End of Solution

Q.73 The language which is generated by the grammar $S \rightarrow aSa \mid bSb \mid a \mid b$ over the alphabet $\{a, b\}$ is the set of

- (a) Strings that begin and end with the same symbol
- (b) All odd and even length palindromes
- (c) All odd length palindromes
- (d) All even length palindromes

Ans. (c)

The grammar $S \rightarrow aSa \mid bSb \mid a \mid b$ is the standard grammar for generating all the odd palindromes over the alphabet $\{a, b\}$.

End of Solution

Q.74 Which of the following classes of languages can validate an IPv4 address in dotted decimal format? It is to be ensured that the decimal values are between 0 and 255

- (a) RE and higher
- (b) CFG and higher
- (c) CSG and higher
- (d) Recursively enumerable language

Ans. (a)

As per given options (a) is most suitable

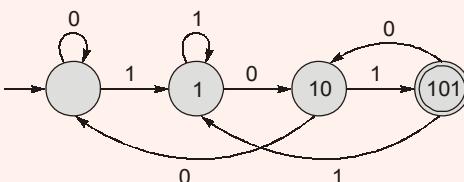
End of Solution

Q.75 Minimum number of states required in DFA accepting binary strings not ending in "101" is

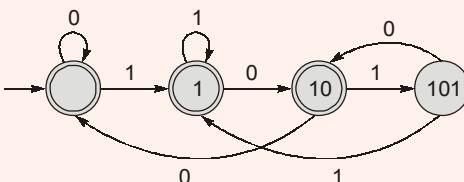
- (a) 3
- (b) 4
- (c) 5
- (d) 6

Ans. (b)

First design the DFA for not encoding with "101" as shown below:



The complement of above DFA will give required DFA as shown below with 4 states.



End of Solution

- Q.76** Which of the following is a type of a out-of-order execution, with the reordering done by a compiler
- (a) loop unrolling (b) dead code elimination
 (c) strength reduction (d) software pipelining

Ans. (a)

End of Solution

- Q.77** A stack organised computer is characterised by instructions with
- (a) indirect addressing (b) direct addressing
 (c) zero addressing (d) index addressing

Ans. (c)

End of Solution

- Q.78** A computer which issues instructions in order, has only 2 registers and 3 opcodes ADD, SUB and MOV. Consider 2 different implementations of the following basic block:

Case 1	Case2
$t1 = a + b;$	$t2 = c + d;$
$t2 = c + d;$	$t3 = e - t2;$
$t3 = e - t2;$	$t1 = a + b;$
$t4 = t1 - t2;$	$t4 = t1 - t2;$

Assume that all operands are initially in memory. Final value of computation also has to reside in memory. Which one is better in terms of memory accesses and by how many MOV instructions?

- (a) Case 2, 2 (b) Case 2, 3
 (c) Case 1, 2 (d) Case 1, 3

Ans. (a)

End of Solution

- Q.79** Which one indicates a technics of building cross compilers?
- (a) Beta cross (b) Canadian cross
 (c) Mexican cross (d) X-cross

Ans. (b)

End of Solution



Q.80 Consider a 2-dimensional array x with 10 rows and 4 columns, with each element storing a value equivalent to the product of row number and column number. The array row-major format. If the first element $x[0][0]$ occupies the memory location with address 1000 and each element occupies only one memory location, which all locations (in decimal) will be holding a value of 10?

- (a) 1018, 1019
- (b) 1022, 1041
- (c) 1013, 1014
- (d) 1000, 1399

Ans. (*)

End of Solution

