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GATE 2021

COMPUTER SCIENCE & IT

Memory based
**Questions
& Solutions**

Exam held on 13/02/2021
Forenoon Session



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SECTION - A

GENERAL APTITUDE

- Q.1 _____ is to surgery as writer is to _____?
- (a) Medicine, book (b) Hospital, library
(c) Doctor, book (d) Doctor, library

Ans. (c)

End of Solution

- Q.2 The presence of anti-obesity measures such as calorie value in the restaurant menus. Such presence side out the core problems of obesity : poverty and inequality income. Give the correct summarization.
- (a) (b)
(c) (d)

Ans. (?)

End of Solution

- Q.3 Below are the two given statements:
- I. Everybody in the class is prepared for the exam.
II. Rahul invited Danish to his home because he enjoys playing chess.
- (a) I is grammatically correct II is unambiguous
(b) I grammatically correct II ambiguous
(c) I grammatically incorrect II ambiguous
(d) I grammatically incorrect II unambiguous

Ans. (b)

End of Solution

- Q.4 In a classroom the ratio of boys and girls is 7 : 3. Which of the following can be the population of the class?
- (a) (Some number not divisible by 10) (b) 21
(c) 50 (d) 49

Ans. (c)

End of Solution

- Q.5 **Statement:**
- I. All pathogens are micro-organisms.
II. All bacteria are micro-organisms.
- Conclusions:**
- I. Some pathogens are bacteria.
II. All pathogens are not bacteria.
- (a) Both conclusion I and II are true (b) Only conclusion I is true
(c) Only conclusion II is true (d) Neither I nor II is true

Ans. (d)

End of Solution

Q.6

Items	Cost	Profit	Marked price
P	5400	–	5486
Q	–	25%	10000

Discount = Marked price – Selling price

$$\text{Profit\%} = \left\{ \frac{\text{Selling price} - \text{Cost price}}{\text{Cost price}} \right\} \times 100$$

Find the discount for Q, as a percentage of its marked price. Given ratio of cost price

of P to Q is $\frac{3}{4}$.

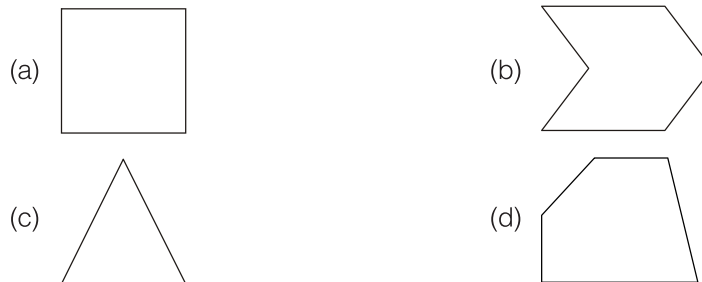
- (a) 5 (b) 12.5
(c) 25 (d) 10

Ans. (d)

End of Solution

Q.7 Which of the following is not a convex polygon?

If every vertex P and Q makes a segment line and it is present on the polygon or inside the polygon then that polygon is a convex polygon.



Ans. (b)

End of Solution

Q.8 Five bag, each have set of 10 distinct chocolates 1 chocolate picked from each bag. Probability of having atleast two same chocolates.

Ans. (0.6976)

Atleast 2 same

Req probability =

= total – all different

P(at least 2 same) = 1 – P(all diff)

$$= 1 - \frac{10 \times 9 \times 8 \times 7 \times 6}{10 \times 10 \times 10 \times 10 \times 10} = 0.6976$$

End of Solution



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- Q.9** Given a $M \times N$ rectangle of size 6×1 . A cylinder is made by folding shortest side of rectangle and is its is closed from both sides. A cube of maximum possible area is made by cutting squares from rectangle. Then the ratio of volume of cylinder to that of cube is ?

Ans. (1)

$$2\pi R = 6, h = 1$$

$$V_{\text{avg}} = \pi \left(\frac{6}{2\pi} \right)^2 \times 1 = \frac{9}{\pi}$$

$$\text{cube} = (1)^3 = 1$$

End of Solution

■■■■

SECTION - B

TECHNICAL

Q.1 $S_1: r_1(x) r_1(y) r_2(x) r_2(y) w_2(y) w_1(x)$

$S_2: r_1(x) r_2(y) r_2(y) w_2(y) r_1(y) w_1(y)$

Which of the above are conflict serializable schedule?

- (a) S1 only (b) S2 only
(c) Both S1 and S2 (d) None of these

Ans. (b)

S1 have cycle in Precedence Graph.

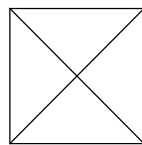
S2 don't have cycle in Precedence Graph so it is conflict serializable.

End of Solution

Q.2 A connected undirected planar graph whose faces $f = 5$ and vertices = 8 then edges will be _____.

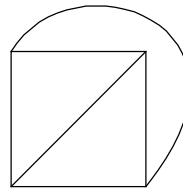
Ans. (11)

$$\begin{aligned} v - e + f &= 2 \\ 8 - e + 5 &= 2 \\ e &= 11 \end{aligned}$$



G(4, 6)

$\cong$



End of Solution

Q.3 Consider the functions $f_1 = 10^n$, $f_2 = n^{\log n}$ and $f_3 = n^{\sqrt{n}}$. Which of the following will be the ascending order of functions?

- (a) f_1, f_2, f_3 (b) f_2, f_3, f_1
(c) f_2, f_1, f_3 (d) f_3, f_1, f_2

Ans. (b)

$$f_1 = 10^n$$

$$f_2 = n^{\log n}$$

$$f_3 = n^{\sqrt{n}}$$

$$\log f_1 = n > \log f_2 = (\log n)^2$$

$$n^{\log n} < n^{\sqrt{n}} < 10^n$$

$$\log f_1 > \log f_2 \text{ then}$$

$$f_1(n) = 10^n$$

$$f_3 : n^{\sqrt{n}} < 10^n$$

$$\log f_1 = n > \log f_3$$

$\Rightarrow$

$$f_2 < f_3 < f_1$$

End of Solution

- Q.4** H is a Subgroup of G. $|G| = 6$
 $1 < |H| \leq 6$
 Then which of the following is guaranteed to be cyclic
 (a) G but not H (b) H but not G
 (c) Both G and H (d) Neither G nor H

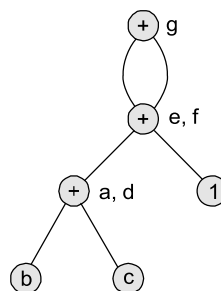
Ans. (b)

End of Solution

- Q.5** In DAT, find the number of nodes:

$$\begin{aligned} a &= b + c; \\ d &= b + c; \\ e &= a + 1; \\ f &= d + 1; \\ g &= e + f; \end{aligned}$$

Ans. (6)



$$\begin{aligned} a &= b + c \\ d &= a \\ e &= a + 1 \\ f &= e \\ g &= e + e \end{aligned}$$

6 nodes

End of Solution

- Q.6** Which of the following statements are true?
 I. All SLR(1) grammars are unambiguous but there are some unambiguous grammars which are not SLR(1).
 II. There exist a parser with $O(n^3)$ time complexity which can parse all CFG grammars.
 (a) Only I (b) Only II
 (c) Both I and II (d) None of these

Ans. (c)

End of Solution

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Q.7 $T(n) = T\left(\frac{n}{2}\right) + T\left(\frac{2n}{5}\right) + 7n; n \geq 1$

$= 1;$

$n = 1$

Find $T(n)$?

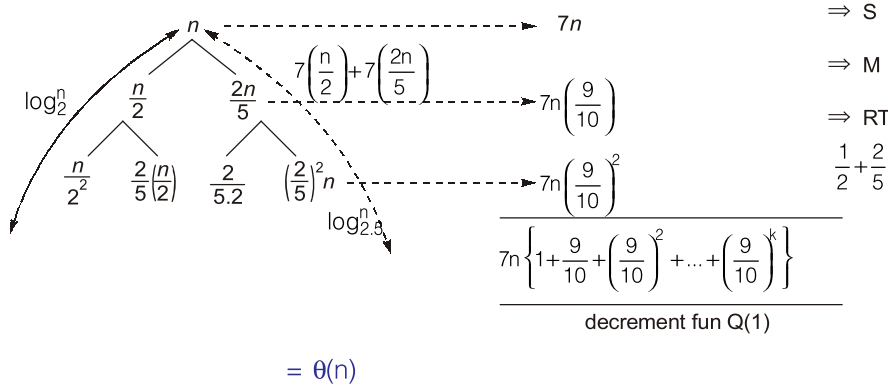
(a) $\theta(n)$

(b) $\theta(n^{5/2})$

(c) $\theta((\log n)^{5/2})$

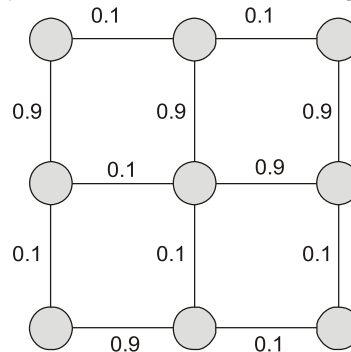
(d) $\theta(n \log n)$

Ans. (a)

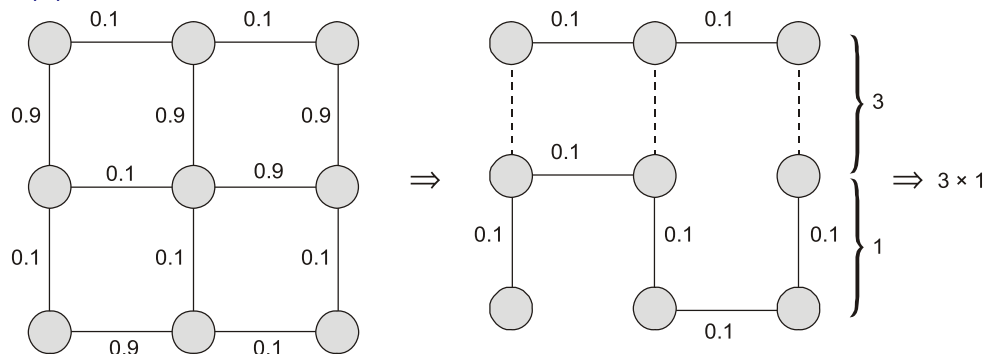


End of Solution

Q.8 Find the undirected graph number of minimum weight spanning trees _____.



Ans. (3)



End of Solution

Q.9 Consider BST T, time to find element smaller than maximum element in T?

- (a) $O(n)$ (b) $O(1)$
(c) $O(n \log n)$ (d) $O(\log n)$

Ans. (b)

End of Solution

Q.10 Which one will give minimum number of comparisons of things array?

23	32	40	44	54	63	72	89
----	----	----	----	----	----	----	----

- (a) Selection (b) Insertion
(c) Quick taking last as pivot (d) Merge

Ans. (b)

End of Solution

Q.11 A connected graph G is given and apply DFS and create DFT. Which of the following is true? (Articulation point was defined as normal).

- (a) If root has 2 or more children then root will be articulation point.
(b) Root will never be articulation point.
(c) Leaf will never be articulation point.
(d) _____.

Ans. (a, c)

End of Solution

Q.12 Find the lowest upper bound of an algorithm on number of comparisons to find maximum and minimum element in an array of total n elements

- (a) $t > 2n - 2$ (b) $t > \text{ceil}\left(\frac{3n}{2}\right)$ and $T < 2n - 2$
(c) $t > \text{ceil}(\log n)$ and $t \leq n$ (d) $t > n$ and $t \leq \text{ceil}\left(\frac{3n}{2}\right)$

Ans. (d)

Straight – Max Min
Max comp.
($2n - n$ comp.)
min comp.
($n - 1$) comp.

Divide and comparisons

$$T(n) = \underbrace{\frac{3n}{2} - 2}_{\text{all cases}} \quad n - 1$$

End of Solution

Q.13 Consider rod of n units. You are allowed to partially cut the rod into smaller units of integer sized lengths. Below are the profits given in association with different lengths. Find the maximum profit which can be obtained with a rod length of 7 units?

$$P[1] = 1$$

$$P[2] = 5$$

$$P[3] = 8$$

$$P[4] =$$

$$P[5] =$$

$$P[6] = 17$$

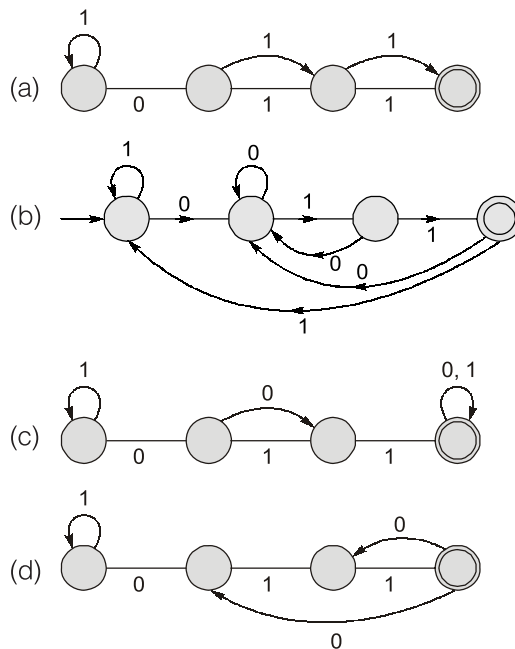
$$P[7] = 18$$

Ans. (18)

Maximum profit is 18

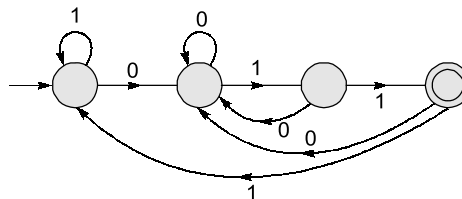
End of Solution

Q.14 $L = 001$ is a substring which is ending with 011. Find the DFA for this L :



Ans. (b)

MIN DFA for all strings ending with "011" on alphabet $\Sigma = \{0, 1\}$



End of Solution



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Q.15 Which will not be necessarily CFL?

- (a) $\text{Reg} \bullet \text{CFL}$
- (b) $\text{Reg} \cup \text{CFL}$
- (c) $\text{Reg} \cap \text{CFL}$
- (d) $\text{Reg} - \text{CFL}$

Ans. (d)

End of Solution

Q.16 Consider a turing machine M.

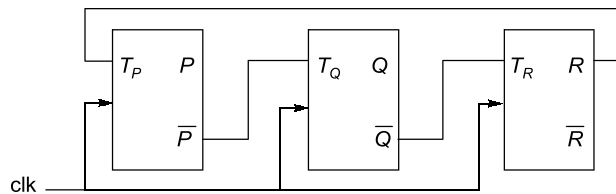
- I. M will take more than 2021 steps on all inputs.
 - II. M will take more than 2021 steps on SOME inputs.
- Which of the above is decidable?

- (a) Only I
- (b) Only II
- (c) Both I and II
- (d) None of these

Ans. (c)

End of Solution

Q.17 A counter circuit using T-FF's is designed as shown below, initially all the FF's are cleared i.e. PQR = 000, for next 3 clock pulses the content of the counter is



- (a) 011, 101, 111
- (b) 001, 101, 000
- (c) 001, 101, 111
- (d) 011, 101, 000

Ans. (d)

CLK	PQR	TFF	PFF	QFF
		$T_P = \bar{R}$	$T_Q = \bar{P}$	$T_R = \bar{Q}$
	000	0	1	1
1	011	1	1	0
2	101	1	0	1
3	000			

End of Solution

Q.18 210 base 3 to hexadecimal _____.

Ans. (15)

$$(210)_3 = 9 \times 2 + 3 \times 1 + 0 = 21$$

$$(210)_3 = (21)_{10} = (15)_{16}$$

End of Solution

Q.19 Arrival time of all the process is 0. All processes arrival together and non-preemptive scheduling used. Burst time are 10, 16 and 20. Find the minimum average writing time?

Ans. (12)

WT	CT	P. No.	AT	BT
0	10	A	0	10
26	46	B	0	20
10	26	C	0	16

A	C	B	
0	10	26	46

$$\text{Average writing time} = \frac{0 + 26 + 10}{3}$$

$$= \frac{36}{3} = 12$$

End of Solution

Q.20 Consider the code for a process with counter = 0 and semaphore S = 5

Void penroic (void)

```
{
    wait(s);
    wait(s);
    counter ++; //counter is not atomic
    signal(s);
    signal(s);
}
```

If 5 process runs concurrently then the possible value of counter after executing all process is

- (a) Counter = 0 and all process exits
- (b) Counter = 1 and all process exits
- (c) Counter = 5 and all process exits
- (d) Deadlock can occur

Ans. (b, c, d)

End of Solution

Q.21 In the context of operating system which are correct with respect to paging?

- (a) Paging incurs memory overhead.
- (b) Multi level paging necessary for pages with different size.
- (c) Page size has no impact on internal fragmentation.
- (d) Paging help solve the issue of external fragmentation.

Ans. (a, d)

End of Solution

Q.22 Consider the sequence of operations given below $S + R = \underline{\hspace{2cm}}$.

Stack	Queue
push (52);	enqueue (43);
push (56);	enqueue (24);
pop ();	dequeue ();
push (62);	enqueue (57);
S = pop ()	R = Dequeue ()

Ans. (86)

	62
52	

$S = 62$

$R = 24$

43	24	57
----	----	----

$S + R = 86$

End of Solution

Q.23 In 'C' library which function will always execute system call when single threaded process is running in unix.

- (a) Sleep
- (b) Strten
- (c) Exit
- (d) Malloc

Ans. (a, c, d)

End of Solution



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Q.24 $\lim_{x \rightarrow -3} \frac{\sqrt{2x+22} - 4}{x+3}$

Find limit at $x = -3$ _____.

Ans. (0.25)

$$\lim_{x \rightarrow -3} \left[\frac{\sqrt{2x+22} - 4}{x+3} \right] \left(\frac{0}{0} \right)$$

$$\lim_{x \rightarrow -3} \left[\frac{2}{2\sqrt{2x+22}} \right] = \lim_{x \rightarrow -3} \left[\frac{1}{\sqrt{2x+22}} \right]$$

$$= \frac{1}{\sqrt{16}} = \frac{1}{4}$$

End of Solution

Q.25 Considering the following matrix :

$$\begin{bmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{bmatrix}$$

The maximum eigen value is _____.

Ans. (3)

End of Solution

Q.26 Consider the following program?

Count = 0

$i = 0$

for ($j = -3; j \leq 3; j++$)

{

if($(j \leq 0) \ \&\& \ (i++)$)

count = count + j ;

}

count = count + i ;

printf("%d", count);

(a) 13

(b) 10

(c) 9

(d) Infinite loop

Ans. (b)

End of Solution

Q.27 A five stage pipeline has stage delays of 150, 120, 150, 160 and 140 nsec. The registers that are used between the pipeline stages have a delay of 5 nsec each. The total time to execute 100 independent instructions on this pipeline, assuming there are no pipeline stalls is _____ nsec.

Ans. (17160)

$$\begin{aligned} K &= 5 \\ t_p &= \max(\text{Stage delay} + \text{Buffer delay}) \\ t_p &= \max(155, 125, 155, 165, 140) \\ &= 165 \text{ ns} \\ n &= 100 \text{ (finite)} \\ &\downarrow \\ ET_{\text{pipe}} &= (k + n - 1)t_p \\ &= (5 + 100 - 1)165 \\ &= 17160 \text{ ns} \end{aligned}$$

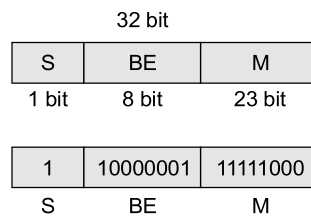
End of Solution

Q.28 IEEE 754 single precision floating point format with a bias of 127.

S : 1 E : 10000001 E : 111100000 0

The decimal value corresponding to above representation (round upto 2 decimal places) is _____.

Ans. (- 7.75)



Bias = 127

Value

$$\begin{aligned} BE &= \text{Biase} \\ S &= (1) (1.M) \times 2 \\ &= (-1)^1 (1.111100) \times 2 \\ &= (-1)^1 (1.111100 \dots) \times 2^{129-127} \\ &= - (1.111100 \dots) \times 2^2 \end{aligned}$$

Align to left 2 times

$$\begin{aligned} &\downarrow \\ &- 111.1100 \dots \times 2 = - 7.75 \end{aligned}$$

End of Solution

Q.29 Main memory size is 2^{32} bytes
Direct mapped cache of size 32 KB
Cache block size is 64 bytes
Find the number of tag bits?

Ans. (17)

Given,

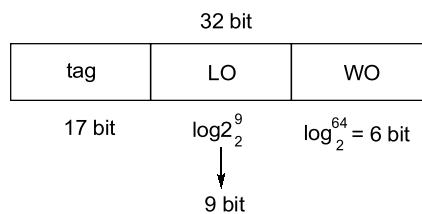
Direct map

CM size = 32 KB

Block size = 64 B

MM size = 2^{32} B

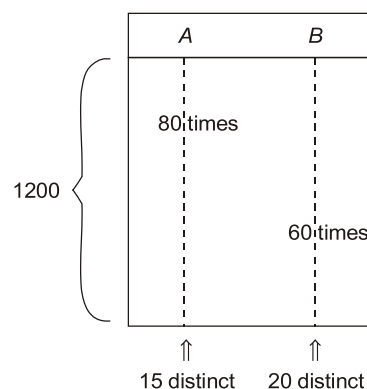
$$\begin{aligned}\# \text{LINES (N)} &= \frac{\text{CM size}}{\text{Block size}} \\ &= \frac{32\text{K}}{64} \Rightarrow \frac{2^{15}}{2^6} = 2^9\end{aligned}$$



End of Solution

Q.30 (A, B) relation has 1200 tuples
A Values range from 6 to 20.
B Values range from 11 to 20.
What will be the estimated number of tuples returned for the below
 $\sigma_{(A > 10 \vee B = 16)}(R)$

Ans. (830)



$$80 \times 10 = 800 \text{ min}$$

$$800 + 60 = 860 \text{ max}$$

$$\text{Estimated value} = \text{average of 800 and 860} = 830$$

End of Solution





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