

Entrance Examination **- Part A**
Department of Computer Science and Engineering, IIT Madras

Max. Marks: 30

Duration: 60 Minutes

Instructions to Candidates

1. This section needs to be answered in the enclosed OMR sheet.
2. You need to use a **black ball point pen** to answer this section in the OMR sheet.
3. Please write your name (one character per box) in the boxes provided in the OMR sheet.
4. Fill up the Date and Time of test at the place provided in the OMR sheet.
5. Write the last **5** characters of your Application number (for e.g., MXXXX), one character per box, in the boxes provided in the **Candidate Roll No.** section in the OMR sheet and shade the corresponding bubbles below the boxes.
6. Please sign in the box provided in the "Candidate's Signature" section in the OMR sheet.
7. You need to answer all the **30** objective questions provided in this question paper each carrying **2** marks. Answers need to be shaded in the OMR sheet against each question number.
8. While shading your answers, follow the Instructions given in the OMR sheet. Additional sheets are provided for rough work.
9. Take extreme care while shading the OMR. Changing or replacement of OMR sheet is **not** permitted.

Questions

1. Let $T(n)$ be defined by $T(1) = 7$ and $T(n + 1) = 3n + T(n)$ for all integers $n \geq 1$. Which of the following represents the order of growth of $T(n)$ as a function of n ?
A) $\Theta(n)$ B) $\Theta(n \log n)$ C) $\Theta(n^2)$ D) $\Theta(n^2 \log n)$
2. One approach to handling fuzzy logic data might be to design a computer using ternary (base-3) logic so that data could be stored as "True", "False" and "unknown". If each ternary logic element is called a flit, how many flits are required at least 256 different values?
A) 4 B) 5 C) 6 D) 7
3. Which of the following predicate calculus formulas must be true under all interpretations?
I $(\forall xP(x) \vee \forall xQ(x)) \rightarrow \forall x(P(x) \vee Q(x))$
II $\forall x(P(x) \vee Q(x)) \rightarrow (\forall xP(x) \vee \forall xQ(x))$
III $(\exists xP(x) \vee \exists xQ(x)) \rightarrow \exists x(P(x) \vee Q(x))$
A) I only B) III only C) I and II D) I and III

4. Consider the following function:

```
f(k)
{
  x = 2;
  for i = 1 to k
    x = x * x;
  return x;
}
```

If n and k are positive integers, then the least value of k such that $f(k) > n$ is approximately

- A)** $\log_2(\log_2 n)$ **B)** $\log_2 n$ **C)** n **D)** $n \log_2 n$
5. The total number of binary strings of length n with odd number of 1's
(A) $n/2$ **(B)** $\binom{n}{2}$ **(C)** $2^{n/2}$ **(D)** 2^{n-1} .
6. Number of unordered partitions of the set $\{1, \dots, n\}$ into exactly two parts:
(A) 2^{n-1} **(B)** $\binom{n}{n/2}$ **(C)** n^2 **(D)** $n!$
7. Suppose two identical six faced dice, with numbers 1 to 6 written on their faces are thrown in an unbiased manner. What is the probability that sum of the numbers written on two faces on the dice after throwing is 7?
(A) $1/36$ **(B)** $1/24$ **(C)** $1/6$ **(D)** $1/2$
8. Let A be the set of all natural numbers that are perfect squares, and B be the set of all prime numbers. Then $A \cap B =$
(A) The set of all composite numbers **(B)** $\{1\}$ **(C)** $\{0\}$ **(D)** \emptyset .
9. Five different paths lead up to the mountain. How many choices does a tourist have for a walk up to the mountain and back, if the descent is through a path different from the path used for climbing the mountain up?
(A) 25 **(B)** 10 **(C)** 20 **(D)** 2^{10} .
10. Let $m \leq n + 1$. What is the number of arrangements of m 1s and n 0s such that no two 1s are adjacent to each other?
(A) $\binom{n}{m}$ **(B)** n^m **(C)** $\binom{n+1}{m}$ **(D)** $\binom{n-1}{m}$.
11. Consider the following quadratic equation, where the quotients are represented in a number system with base r .

$$5x^2 - 50x + 125 = 0$$

If the roots of the equation in base r are 5 and 8, then what is the value of r .

- A)** 10 **B)** 13 **C)** 25 **D)** 40
12. Vinay started walking towards south to reach his school which is $5km$ away. From there he turns 180° in clockwise and then 45° in anti-clockwise direction. Which direction is he facing now from his school?
A) North **B)** North-West **C)** South **D)** South-East
13. Which of the following is a geometric representation of an irrational number?
(A) the area of a rectangle with sides of length 12 and 3
(B) the coordinate of the point on the number line halfway between 37 and 47
(C) the length of the diagonal of a rectangle with sides of length 3 and 4.
(D) the length of the line segment connecting the points $(0, 0)$ and $(4, 5)$ in the coordinate plane

14. The number of people who become infected with a contagious disease at time t is represented by $y = N(t)$. Which of the following conditions indicates that the number of newly infected people is increasing, but at a slower rate than in the previous time period? ($N'(t)$ and $N''(t)$ denote the first and second order derivatives of N .)
- (A) $N'(t) > 0$ and $N''(t) > 0$
 (B) $N'(t) > 0$ and $N''(t) < 0$
 (C) $N'(t) < 0$ and $N''(t) > 0$
 (D) $N'(t) < 0$ and $N''(t) < 0$

15. You walk into a room full of unknown people. There are 8 men and 4 women and you are told that there are 3 married couples. In how many ways can you guess the couples?

- A $\binom{8}{4}3!$
 B $\binom{8}{3}\binom{4}{3}3!$
 C $\binom{8}{3}4!$
 D $\binom{8}{3}\binom{4}{3}4!$

16. Consider the following **Statements** about a world that has computers. Assume they are **True** even if they seem to be at variance from commonly known facts:

Some computers are laptops.
 Some laptops are notebooks.
 All notebooks are papers.
 All papers are phones.

Consider the following **Conclusions**:

- I Some laptops are papers.
 II Some phones are notebooks.
 III Some computers are notebooks.
 IV No computer is notebook.

Find the correct choice from the four choices given below, based on which of the above **conclusions** *logically follow* from the above **statements** disregarding commonly known facts.

- A) None of the conclusions follow
 B) Only I and II follow
 C) Either III or IV follows and none of the others follow
 D) I, II and either III or IV follow

In the next **TWO** questions find that rearrangement of the words/phrases labeled a, b, c, \dots that shall form meaningful sentences:

17. voice there note was in sadness his a of
 a b c d e f g h i
- A) bdhCIFEGA B) abcdefghi
 C) bdacihfeg D) cifegabdh

18. living she encyclopedia of science is a
a b c d e f g
- A) abcdfge B) bfgaedc
C) bfgacde D) bfgcade

In the next **TWO** questions there are a set of sentences that form a paragraph. The first and last sentences are in the right order. Choose the order from the given options, in which the remaining sentences P, Q, and R should appear to complete the paragraph.

19. S1 The teeth are one of the most neglected parts of the body.
S2
S3
S4
S5 Ultimately it leads to problems like gingivitis, tooth decay, bad breath etc.
- P They wait until they are moaning in pain and can't eat properly.
Q People often cringe at the thought of visiting their dentist.
R Providing timely treatment becomes difficult and complicated.
- A) PQR B) PRQ C) RPQ D) QPR
20. S1 As the Sun had set, I was preparing to pass the night in a tree.
S2
S3
S4
S5 With a look of compassion, she told me to follow her.
- P She was returning from the field and had perceived my weariness.
Q An old woman stopped to observe me.
R I briefly explained my situation to her.
- A) PQR B) QPR C) QRP D) PRQ

Study the following information carefully and answer the next **FIVE** questions.

The six faces of a cube are painted in a manner that no two adjacent faces have the same color. The three colors used in painting the cube are red, blue and green. After painting the cube is then cut into 36 smaller cubes of two different sizes; 32 cubes are of one size and the rest are of a bigger size. Each of the bigger cube has no red side. Answer the following questions based on the above information.

21. How many cubes in all have a red side?
A) 0 B) 8 C) 16 D) 32
22. How many cubes have only one side colored?
A) 0 B) 8 C) 16 D) 20
23. How many cubes are colored on three sides?
A) 0 B) 8 C) 16 D) 20
24. How many cubes are there which have two or more sides painted?
A) 36 B) 32 C) 28 D) 20
25. How many cubes are there which are painted on two sides only?
A) 36 B) 32 C) 28 D) 20

Study the following information carefully and answer the next **FIVE** questions.

A, B, C, D, E, F and G are 7 people planning to go on an SOTC World Tour. A is the oldest person and is traveling with a son and a daughter. G's father is D, who is a businessman. D's wife is E and she is a social worker. C is a spinster. B, who is A's son and F are a newly married couple. Both the children of A are married and all stay together. G and C are siblings.

26. How is F related to A?
A) Daughter-in-law B) Daughter C) Son-in-Law D) Son
27. Who among the following is A's child?
A) E B) D C) C D) F
28. How is G related to E?
A) Daughter-in-law B) Daughter C) Son D) Data Inadequate
29. How is F related to C?
A) Niece B) Nephew C) Uncle D) Aunt
30. How is C related to A?
A) Grandson B) Granddaughter C) Son D) Daughter