General Instructions to Candidates:

- There is a 'Cool off time' of 15 minutes in addition to the writing time.
- Use the 'Cool off time' to get familiar with questions and to plan your answers.
- Read the instructions carefully.
- Read the questions carefully before answering.
- Calculations, figures and graphs should be shown in the answer sheet itself.
- Malayalam version of the questions is also provided.
- Give equations wherever necessary.
- Electronic devices except nonprogrammable calculators are not allowed in the Examination Hall.

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Answer any six from question numbers 1 to 7. Each carries three scores. (6 × 3 = 18)

1. Find the sum to \( n \) terms of the sequence 4 + 44 + 444 + ...........

2. Solve:
   \[ \sin 2x - \sin 4x + \sin 6x = 0 \]

3. If \( A \) and \( B \) are events such that
   \[ P(A \cap B) = \frac{1}{6} \]
   then find:
   a) \( P(A \cup B) \) \hspace{1cm} (1)
   b) \hspace{1cm} (2)

4. In \( \triangle ABC \), prove that
   \[ \tan \left( \frac{B-C}{2} \right) = \frac{b-c}{b+c} \cot \frac{A}{2} \]

5. a) The maximum value of the function \( f(x) = \sin x \) is ............
   i) 1 ii) \( \frac{\sqrt{3}}{2} \) iii) \( \frac{1}{2} \) iv) 2 \hspace{1cm} (1)

b) Prove that, \hspace{1cm} (1)

   c) Find the maximum value of \( \sin x + \cos x \). \hspace{1cm} (1)

6. a) \[ \lim_{x \to 2} \left[ x \right] = ............ \hspace{1cm} (1) \]
   i) 2 ii) 3 iii) 0 iv) does not exist

b) Evaluate:
   \[ \lim_{x \to 2} \frac{x^3 - 4x^2 + 4x}{x^2 - 4} \hspace{1cm} (2) \]
7. One card is drawn at random from a pack of 52 playing cards. Find the probability that,
   a) the card drawn is black. (1)
   b) the card drawn is a face card. (1)
   c) the card drawn is a black face card. (1)

Answer any eight from question numbers 8 to 17. Each carries four scores. (8 × 4 = 32)

8. a) If $A=\{a, b, c\}$, then write Power Set $P(A)$. (1)
    b) If the number of subsets with two elements of a set $P$ is 10, then find the total number of
       elements in set $P$. (2)
    c) Find the number of elements in the power set of $P$. (1)

9. Consider Venn diagram of the Universal Set $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13\}$

   a) Write sets $A, B$ in Roster form. (1)
   b) Verify $(A \cup B)' = A' \cap B'$. (2)
   c) Find $n(A \cap B)'$. (1)
10. Consider the following graphs:

(a) Which graph does not represent a function?  (1)

(b) Identify the function \( f(x) = \frac{1}{x} \) from the above graphs.  (1)

(c) Draw the graph of the function.  (2)

11. The figure shows the graph of a function \( f(x) \) which is a semi circle centred at origin.

(a) Write the domain and range of .  (2)

(b) Define the function .  (2)
12. a) If \( n^2 - 3n - 8 \) is divisible by \( k \) for all \( n \in \mathbb{N} \) is true, then which one of the following is a value of \( k \)?

i) 8 ii) 6 iii) 3 iv) 12

b) Prove by using the principle of Mathematical Induction

\[ + 3^{n-1} - \frac{3^n - 1}{2} \text{ is true for all } n \in \mathbb{N}. \]

13. a) Solve the inequality

\[ 2x^2 - 3x - 2 \geq -x + 3 \]

b) Represent the solution on a number line.

14. a) Find the \( n \)th term of the sequence 3, 5, 7, ............

b) Find the sum to \( n \) terms of the series.

\[ 3x^2 + 5x^2 + 7x^2 + ............ \]

15. Find the equation of the circle passing through the points (4, 1) and (6, 5) and whose centre is on the line \( 4x + y = 16 \).

16. Consider a point \( A \) (4, 8, 10) in space.

a) Find the distance of the point \( A \) from XY-plane.

b) Find the distance of the point \( A \) from X-axis

c) Find the ratio in which the line segment joining the point \( A \) and \( B \) (6, 10, –8) is divided by YZ-plane.
17. a) Which one of the following sentences is a STATEMENT? (1)
   i) 275 is a perfect square.
   ii) Mathematics is a difficult subject.
   iii) Answer this question.
   iv) Today is a rainy day.

b) Verify by method of contradiction: 
   ' is irrational'. (3)

Answer any five from question numbers 18 to 24. Each carries six scores. (5 × 6 = 30)

18. Consider the quadratic equation.
   a) Solve the quadratic equation. (2)
   b) Write the polar form of one of the roots. (2)
   c) If the two roots of the given quadratic are and . Show that . (2)

19. The graphical solution of a system of linear inequalities is shown in the figure.

   a) Find the equation of the lines . (4)

18 19
20. a) Which one of the following has its middle term independent of \( x \)?
   
   i) 
   
   ii) 
   
   iii) 
   
   iv) 

b) Write the expansion of 

   \[
   \begin{pmatrix}
   4 \\
   x
   \end{pmatrix}
   \]

   c) Determine whether the expansion of

   \[
   \begin{pmatrix}
   18 \\
   x
   \end{pmatrix}
   \]

   will contain a term containing \( 10x \).

21. The figure shows an ellipse and a line \( L \).

   a) Find the eccentricity and focus of the ellipse.
   b) Find the equation of the line \( L \).
   c) Find the equation of the line parallel to line \( L \) and passing through any one of the foci.
22. a) Find the derivative of 
\[ y = \sin x \]
from the first principle. (3)

b) Find \( \frac{dy}{dx} \), if \( y = \sin x \). (3)

23. a) Find \( n \), if 
\[ 12 \times (n-1)P_3 = 5 \times (n+1)P_3 \] (2)

b) If \( ^nP_r = 840 \); \( ^nP_r = 35 \) find \( r \). (1)

c) English alphabet has 5 vowels and 21 consonants. How many 4 letter words with two different vowels and two different consonants can be formed without repetition of letters? (3)

24. Consider the following data:

<table>
<thead>
<tr>
<th>Class</th>
<th>10–20</th>
<th>20–30</th>
<th>30–40</th>
<th>40–50</th>
<th>50–60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>6</td>
<td>15</td>
<td>13</td>
<td>7</td>
<td>9</td>
</tr>
</tbody>
</table>

a) Calculate the mean of the distribution. (2)

b) Find the standard deviation of the distribution. (2)

c) Find the coefficient of variation of the distribution. (2)