INSTRUCTIONS:
1. Write your Student Enrolment Number (SEN) on the top right-hand corner of this page.
2. This paper consists of SEVEN QUESTIONS and is out of 70 Skill Level.

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3. Answer ALL QUESTIONS. Write your answers in the spaces provided in this booklet.
4. Use a BLUE or BLACK ball point pen only for writing. Use a pencil for drawing if needed.
5. Additional sheets of paper can be obtained from your supervisor if necessary. Write your Student Enrolment Number (SEN) on each additional sheet, number the questions clearly and insert them in the appropriate part of your booklet.

NOTE:  
   i. There should be a Mathematics Formulae Sheet (No. 8/3) attached to this booklet.
   ii. Non-programmable calculators only are allowed into the examination room.
   iii. Unless stated, diagrams are not drawn to scale.
6. Check that this booklet contains pages 2 – 19 in the correct order and that none of the pages is blank.

YOU MUST HAND IN THIS BOOKLET TO THE SUPERVISOR BEFORE YOU LEAVE THE EXAMINATION ROOM.
It is for your best interest to **SHOW ALL NECESSARY WORKING**. Each question is worth different skill levels making up its total.

**QUESTION ONE: NUMBERS**

1. Simplify $\sqrt{125x^3}$

2. Express 256 as a power of 4.

3. Select the rational numbers from this list; $0, 1, \pi, \sqrt{3}, 0.1111\ldots, \frac{3}{5}$.

4. i. Find the conjugate of $(\sqrt{5} + \sqrt{3})$.
ii. Rationalise the denominator in \( \frac{5 + \sqrt{6}}{3 - \sqrt{2}} \).

5. Express \( 4 + 4 + 4 + 4 + 4 \) in sigma notation.

6. Evaluate \( \sum_{n=1}^{\infty} \left( \frac{1}{2} \right)^n \).
QUESTION TWO: ALGEBRA

1. Expand and simplify $-8(3y + 5) - 5$

2. Find the discriminant of $3x^2 - 5x + 1 = 0$.

3. Expand and simplify $(a - b)(a + b)(a^2 - b^2)$. 
4. Identify whether the following is a quadratic expression or not.

\[ x (3x + 4) = 3 \]

5. Solve \( 3x^2 = 9 - 6x \) by completing the square.

6. Solve \( \frac{2^{4x}}{8^{x+3}} = 1 \) (Use the Basic Properties of Exponents)
7. Julia spent $131 on a total of 7 shoes. Adidas cost $15 and Nike cost $28. Adidas and Nike are the two types of shoes that she bought:

Let \( x \) = number of Adidas shoes
\( y \) = number of Nike shoes

\[ x + y = 7 \]

is the equation for the total number of shoes Julia bought.

Calculate the number of each type of shoe that Julia bought.

[Hint: Identify the equation for the total amount of money Julia spent on shoes and then solve the pair of equations simultaneously]

<table>
<thead>
<tr>
<th>Skill level</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>NR</th>
</tr>
</thead>
</table>
QUESTION THREE  

GRAPHS OF FUNCTIONS

*Drawn below is the graph of a rectangular hyperbola* \( f(x) \).

1. Write down the equation of the hyperbola.

![Graph of a rectangular hyperbola](image)

Equation: ____________________________

2. Sketch the graph of \( y = (x - 2) \ (x + 3) \ (x - 1) \) on the axes given below, showing all intercepts.

![Graph paper](image)
3. Triangle \( \text{JKL} \) has vertices \( \text{J} = (0,5) \), \( \text{K} = (8,1) \) and \( \text{L} = (2, -1) \).
Prove that the perpendicular bisector of \( \text{KL} \) is parallel to \( \text{JL} \).
QUESTION FOUR: TRIGONOMETRY

1. Use a calculator to find the value of $\sin 115^0$ to four decimal places.

2. In Figure 1, ABC is a semicircle with 9cm radius and centre O. Line BD is perpendicular to diameter AC and angle $AOB = 2.4$ radians.

Figure 1

![Diagram of a semicircle with a radius of 9 cm, a perpendicular line BD from O to AC, and an angle AOB of 2.4 radians.]

a. Find the perimeter of the sector AOB.

Skill level 1

| 1 | 0 | NR |

Skill level 2

| 2 | 1 | 0 | NR |
b. Calculate the length of line $BD$.  
(correct your answer to 3 significant figures)
QUESTION FIVE: PROBABILITY

1. The possible outcomes of tossing a coin are equally likely.
   Define equally likely.

2. Marks of a Mathematics assignment are normally distributed with a mean (\(\mu\)) of 15.45 and a standard deviation (\(\sigma\)) of 5.00.
   On the normal curve below shade the area that represents the assignment marks to within two standard deviation of the mean.

   ![Normal Curve]

   Use Table 1 below to answer question 3.

   Table 1: Information about simplified weather over a 90-day period.

<table>
<thead>
<tr>
<th>Actual weather</th>
<th>Forecast</th>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Sunny day</td>
<td>Rainy day</td>
<td>Totals</td>
</tr>
<tr>
<td>Sunny day</td>
<td>49</td>
<td>8</td>
<td>57</td>
</tr>
<tr>
<td>Rainy day</td>
<td>5</td>
<td>28</td>
<td>33</td>
</tr>
<tr>
<td>Totals</td>
<td>54</td>
<td>36</td>
<td>90</td>
</tr>
</tbody>
</table>

3. One of the days is randomly selected. Calculate the probability that it actually rains, given that it was forecasted to rain.
4. A fair six-sided die has three red (R) faces, two green (G) faces and one blue (B) face.

If the die is tossed twice, complete the probability tree below and calculate the probability that both tosses turn up with the same colour faces.
5. The length of Mr. Principal’s collection of ties are normally distributed with a mean of 142cm and a standard deviation of 2cm. **Figure 2** below shows the area that represents the probability of ties that have length less than 140cm.

![Figure 2](image)

a. Mr. Principal has 150 ties in his collection. Calculate the number of ties that have lengths less than 140cm.

b. Based on your result from a. above; State whether the conclusion that 32% of the ties have lengths that are below 140cm is correct or incorrect.
QUESTION SIX: DIFFERENTIATION

1. Find the gradient of the tangent line to the curve \( y = x^2 + 1 \) at the point (1, 2)

2. Find the rate of change from the graph of Distance (mile) Vs Time (hr) shown below.

![Graph of Distance Vs Time](image-url)
3. Find the derivative of \( f(x) = 5x^{-2} \)

4. On the axes below, draw the graph of the function \( f(x) \) which satisfies the following features.

\[
\begin{align*}
  f'(x) &> 0, \ x > -1, \ x \in \mathbb{R} \\
  f'(x) &< 0, \ x < -1, \ x \in \mathbb{R} \\
  f(0) &= 2 \\
  f(-1) &= 1 \\
  f'(-1) &= 0
\end{align*}
\]
5. A farmer has 280m of fencing material available to make a rectangular enclosure. One side of the field is alongside a straight river as shown below and does not need to be fenced.

Calculate the maximum possible area of the field.
QUESTION SEVEN: INTEGRATION

1. Use the Power Rule to find \( \int x^{-3} \, dx \)

2. \( f'(x) = 2x - 3 \) is a derived function.

Calculate the constant of integration given that \( f(2) = 0 \).
3. Graphs of line $y = 4x + 4$ and parabola $y = 3x^2 - 2x + 4$ are shown on the grid below.

a. Shade the area enclosed by the two graphs.

b. State the notation for finding the area shaded in a. above.
c. Calculate the area between \( y = 4x + 4 \) and \( y = 3x^2 - 2x + 4 \).