INSTRUCTIONS TO CANDIDATES

To be read by the external invigilator to all candidates.

1. The subject code for Advance Mathematics is 3.
2. There are 8 printed pages in the question booklet.
3. An Electronic Answer Sheet for Part A, 2 pages Part B Answer Booklet and a 1 page formula sheet are inserted in the question booklet.
4. There are two parts in this paper. Answer all questions.

Part A: Multiple Choice (Questions 1-30) 30 Marks

This part will be electronically marked.

All answers to the Multiple Choice Part MUST be answered on the ELECTRONIC ANSWER SHEET provided.

Carefully following the instructions, fill in your Candidate Information and Subject Information.

Choose A, B, C or D from the alternatives given and use a HB pencil to shade in the correct letter to each question on the Electronic Answer Sheet.

If you make a mistake, rub the shading out completely using an eraser and shade in your correct alternative clearly.

Part B: Short Answers (Questions 31-50) 20 Marks

Write your name, your school and complete your 10-digit candidate number on the Answer Booklet provided for Part B.

5. You are required to write only the correct answer in the space provided on the Answer Sheet.
6. Calculators may be used.
7. Answer all questions on the answer sheet. Answers on any other paper including rough work paper and the question paper will not be marked.
8. Correction fluid is not allowed. Where you have made an error, cross out all the working and start on a new line.

Penalty For Cheating Or Assisting To Cheat In National Examinations Is Non-Certification.

DO NOT TURN OVER THE PAGE AND DO NOT WRITE UNTIL YOU ARE TOLD TO START.
PART A: MULTIPLE CHOICE

(Questions 1 to 30) 30 MARKS

Answer each question by shading in with HB pencil the circle directly under the correct alternative A, B, C or D. If you make a mistake, rub it out completely using an eraser rubber and shade the correct answer on the Electronic Answer Sheet.

**Question 1**
What is 1.08772 correct to four significant figures?
A. 1.088  
B. 1.090  
C. 1.0877  
D. 1.0880

**Question 2**
The quadratic equation $x^2 - 4x + 3 = 0$ has roots $\alpha$ and $\beta$. What is the value of $\alpha + \beta$?
A. -1  
B. -3  
C. 4  
D. -4

**Question 3**
Express $\frac{x^5 - 4x}{x^2 + 2}$ in its simplest form.
A. $\frac{x}{x^2 + 2}$  
B. $\frac{x^2 + 2}{x}$  
C. $x(x^2 - 2)$  
D. $x(x^2 + 2)$

**Question 4**
The expression $2\log_2 x^3 - \log_2 x^2$ is equivalent to
A. $\log_2 x$  
B. $4\log_2 x$  
C. $\log_2 x^5$  
D. $\log_2 \left( \frac{1}{x} \right)$

**Question 5**
The parabola $y = x^2 - 3x - 1$ intersect the line $y = 3$ at the point
A. $x = -4$ and $x = 1$  
B. $x = 1$ and $x = 2$  
C. $x = -1$ and $x = 2$  
D. $x = 4$ and $x = -1$

**Question 6**
The domain of the logarithm function $y = \log(2x + 1)$ is
A. $x > -\frac{1}{2}$  
B. $x > 0$  
C. $0 \leq x \leq \frac{1}{2}$  
D. $-\frac{1}{2} < x < 0$

**Question 7**
What is the probability of picking a diamond card from a deck of 52 cards?
A. $\frac{1}{3}$  
B. $\frac{1}{2}$  
C. $\frac{1}{4}$  
D. $\frac{1}{52}$

**Question 8**
What is the average for a set of results given below?
10, 14, 15, 16, 20
A. 12  
B. 13  
C. 15  
D. 18
QUESTION 9
The figure below gives two similar triangles.

What is the value of $a$?
A. 3  
B. 6  
C. 8  
D. 10

QUESTION 10
The value of the determinant
\[
\begin{vmatrix} 
1 & 2 & 3 \\
-1 & 2 & 3 \\
-2 & -4 & -6 \\
\end{vmatrix}
\]
is equal to ______.
A. 24  
B. 0  
C. -12  
D. -24

QUESTION 11
The total number of subsets of the set
\[
\{ \alpha, \beta, \ a, \ b \}
\]
is
A. 4  
B. 6  
C. 8  
D. 16

QUESTION 12
Given $\cos\theta = \frac{4}{5}$ and $\theta$ is in the 1st quadrant. Find the angle equivalent to $\theta$ between 0 and 360 degrees.
A. 36.86°  
B. 143.14°  
C. 216.86°  
D. 323.14°

QUESTION 13
In the diagram below, X, Y, Z are mid points of AB, BC and CA respectively.

If $AX = r$ and $AZ = s$.
Find $AY$.
A. $s + r$  
B. $s - r$  
C. $r - s$  
D. $\frac{1}{2}s + r$

QUESTION 14
The value of $\int x^2 \, dx$ is
A. $\frac{1}{2}x^2 + c$  
B. $\frac{1}{3}x^3 + c$  
C. $x^3 + c$  
D. $2x + c$
QUESTION 15
Given that \( y = 2x^3 - \cos x \), \( \frac{dy}{dx} \) is equal to

A. \( \frac{1}{2}x^4 - \sin x \)  
B. \( \frac{1}{2}x^4 + \sin x \)

C. \( 6x^2 - \sin x \)  
D. \( 6x^2 + \sin x \)

QUESTION 16
Evaluate \( \left( \frac{571}{2\pi} \right)^\frac{1}{3} \) correct to four significant figures.

A. 0.4496  
B. 4.496  
C. 44.96  
D. 4496

QUESTION 17
The solution to the inequality \(-2x - \frac{1}{2} \leq -x - 2\) is

A. \( x \leq -\frac{3}{2} \)  
B. \( x \geq \frac{3}{2} \)

C. \( x \leq \frac{3}{2} \)  
D. \( x \geq -\frac{3}{2} \)

QUESTION 18
What would a scatter graph for the relationship of height versus weight look like for the given data?

<table>
<thead>
<tr>
<th>Weight (kg)</th>
<th>15</th>
<th>30</th>
<th>45</th>
<th>60</th>
<th>75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (cm)</td>
<td>75</td>
<td>100</td>
<td>110</td>
<td>160</td>
<td>170</td>
</tr>
</tbody>
</table>

QUESTION 19
What would a cumulative-histogram of the relationship in Question 18 look like?
QUESTION 20
In the diagram, the vertices of \( \triangle ABC \) lie on the circle with centre 0. The point D lies on AC such that \( \triangle ABD \) is isosceles and \( \angle BAC = x \).

What is \( \angle BDC \) in terms of \( x \)?
A. \( x \)  
B. \( 90 - x \)  
C. \( 180 - x \)  
D. \( 2x \)

QUESTION 21
Kapi is making a pattern using triangular tiles. The pattern has 3 tiles in the first row, 5 tiles in the second row and each successive row has 2 more tiles than the previous row.

How many tiles would Kapi use altogether to make the first 50 rows?
A. 2,600  
B. 2,400  
C. 2,500  
D. 3,000

QUESTION 22
The 4\(^{th} \) term of the expansion \( (2x - 3y^2)^{10} \) is
A. 414,720 \( x^6 y^7 \)  
B. -414,720 \( x^7 y^6 \)  
C. -414,720 \( x^6 y^7 \)  
D. 414,720 \( x^7 y^6 \)

QUESTION 23
The sketch of the function \( f(x) = 2 + \sin x \) is given by

QUESTION 24
What is the value of \( \theta \) in radians, given \( \sin \theta + \frac{1}{2} = 1 \)
A. \( \pi \)  
B. \( \frac{\pi}{6} \)  
C. \( \frac{\pi}{3} \)  
D. \( \frac{\pi}{2} \)
QUESTION 25
Given that \( \int \cos(\beta x) \, dx = \frac{1}{\beta} \sin(\beta x) + c \).

The exact value of \( \int_{0}^{\frac{\pi}{4}} \cos 2x \, dx \) is

A. 0  
B. \(-\frac{1}{2}\)  
C. \(\frac{1}{2}\)  
D. -1

QUESTION 26
A pmv bus uses 30 litres of diesel to travel 210 km. If diesel costs K3.00 per litre, how much would it cost the bus operator on diesel to travel 300 km? (Assume fuel consumption rate is constant).

A. K50.00  
B. K128.57  
C. K210.00  
D. K90.00

QUESTION 27
The graph of the absolute value function \( y = \left| 2x - \frac{1}{2} \right| \) is given by

A.  
B.  
C.  
D.

QUESTION 28
How many 3-digit even numbers can you make from the values 2, 3 and 4? You are to use them once.

A. 1  
B. 2  
C. 3  
D. 4

QUESTION 29
A regular polygon of \( n \) sides has a sum of 1260. Find \( n \)?

A. 6  
B. 8  
C. 9  
D. 12

QUESTION 30
What is the expression of the area between these curves?

A. \( \int_{a}^{b} [g(x) - f(x)] \, dx \)  
B. \( \int_{a}^{b} [f(x) - g(x)] \, dx \)  
C. \( \int_{a}^{b} [g(x) - f(x)] \, dx \)  
D. \( -\int_{a}^{b} [f(x) - g(x)] \, dx \)
PART B: SHORT ANSWERS 20 MARKS
Write your answers on the Answer Sheet provided.

QUESTION 31
Express the recurring decimal $0.1\overline{1}$ as a fraction.

QUESTION 32
The speed of a particle is 100 metres per second. What is this speed in km/ hr?

QUESTION 33
Find the exact distance between the points $(5, -5)$ and $(1, 1)$.

QUESTION 34
What is the solution to the linear inequality, $-5x - 3 < 2 + x$?

QUESTION 35
The function $f(x) = |2x - 3|$ can be expressed as

$$f(x) = \begin{cases} 
3 - 2x, & x < \frac{3}{2} \\
-3 + 2x, & x \geq \frac{3}{2} 
\end{cases}$$

Find $t$, the domain of $(-3 + 2x)$.

QUESTION 36
Express the logarithmic function $f(x) = \log_e e^x - 2 \log_e e^{x^2}$ in its equivalent form without the log function.

QUESTION 37
A bag contains 3 yellow, 2 red and 5 blue marbles. The first marble drawn out of the bag was not blue. If the marble was not placed back into the bag, what would be the probability of drawing out a blue marble in the second pick?

QUESTION 38
From question 37, if the marbles are to be placed back into the bag, what is the probability of picking a yellow and then a blue?

QUESTION 39
Find the value of “b” given in the diagram below.

QUESTION 40
What test is used to show that these two triangles are congruent?
QUESTION 41
What is the equation of a circle of radius 5, with centre at (3, 4)?

QUESTION 42
Given that sets;
\[ A = \{ x \in \mathbb{Z} : x \text{ is even} \} \]
\[ B = \{ 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 \} \]
\[ C = \{ x \in \mathbb{Z} : -5 \leq x < 9 \} \]

Determine the set \( A \cap B \cap C \).

QUESTION 43
Find the sum of the first 40 terms of a geometric series with first term \(-3\) and common ratio \(\frac{1}{2}\).

QUESTION 44
Evaluate the determinant.
\[
\begin{vmatrix}
  x & 1 & 2 \\
  -3 & -2x & 1 \\
  0 & \frac{1}{x} & 2 \\
\end{vmatrix}
\]

QUESTION 45
Find the angle \( \angle ACB \) of the given triangle with sides \( AB = 9 \text{ cm} \) and \( BC = 5 \text{ cm} \). (Give your answer to the nearest degree).

QUESTION 46
Find \( 2\mathbf{u} - \mathbf{v} \), if \( \mathbf{u} = -i + j - 2k \) and \( \mathbf{v} = -2i + 3j + k \).

QUESTION 47
Find the unit vector of \( \mathbf{v} = 3i + 4j \).

QUESTION 48
Evaluate \( \int 2x \, dx \).

QUESTION 49
What is the gradient of the curve \( y = \sin x \) at the point where \( x = \frac{\pi}{3} \)?

QUESTION 50
At what point is the slope of the tangent line to the curve \( y = e^x \) equal to one?

END OF EXAMINATION
Write your 10-digit candidate number, your name and your school name in the spaces provided below.

<table>
<thead>
<tr>
<th>Year</th>
<th>Province</th>
<th>School</th>
<th>Candidate No</th>
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</thead>
<tbody>
<tr>
<td>13</td>
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</tbody>
</table>

Candidate Name: __________________________________________

School Name: _____________________________________________

This answer booklet is for you to write the answers to Part B only.

All Multiple Choice Answers should be on the Electronic Mark Sheet.

All answers must be written neatly in the appropriate spaces in this booklet. Answers written elsewhere on the question paper (or any other paper) will not be marked.

TOTAL SCORE

Recorded by: ________________

Checked by: ________________
<table>
<thead>
<tr>
<th>Question 31</th>
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<td>Question 40</td>
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<td>Question 50</td>
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</table>
MENSURATION

Arc Length
\[ L = \frac{\theta}{360} \times 2\pi r \]

Area of Sector
\[ A = \frac{\theta}{360} \times 2\pi r^2 \]

Surface Area of Cylinder
\[ A = 2\pi r^2 + 2\pi rh \]

Surface Area of Sphere
\[ A = 4\pi r^2 \]

Curved Surface Area of Cone
\[ A = \pi rl \]

Volume of Sphere
\[ V = \frac{4}{3}\pi r^3 \]

Interior Angles of Polygon
\[ s_n = (n - 2) \times 180^\circ \]

INTEREST

Compound Interest
\[ A = P \left(1 + \frac{r}{100}\right)^n \]

TRIGONOMETRY

Sin Rule
\[ \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \]

Cosine Rule
\[ c^2 = a^2 + b^2 - 2ab \cos C \]

Area of Triangle
\[ A = \frac{1}{2} ab \sin C \]

Conversion
\[ \pi^c = 180^\circ \]

Arc Length
\[ L = r\theta^c \]

Area of Sector
\[ A = \frac{1}{2} r^2 \theta \]

Area of Minor Segment
\[ A = \frac{1}{2} r^2 \left(\theta^c - \sin \theta^c\right) \]

PERMUTATION
\[ ^nP_r = \frac{n!}{(n-r)!} \]

SERIES

Arithmetic Progression
\[ T_n = a + (n - 1)d \]

Geometric progression
\[ T_n = ar^{n-1} \]

\[ S_n = \frac{n}{2} \left(a + T_n\right) \]
\[ S_n = \frac{n}{2} \left(2a + [n - 1]d\right) \]
\[ S_{\infty} = \frac{a}{1-r}, \text{ for } -1 < r < 1 \]

ALGEBRA

Quadratic Formula
\[ x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \]

First Derivative
\[ f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h} = \lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x)}{\Delta x} \]

ANALYTIC GEOMETRY

Distance between two points
\[ d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \]

Mid-point of Interval
\[ \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right) \]

Gradient of a Line
\[ m = \tan \theta \]

ABSOLUTE VALUE
\[ |x| = \begin{cases} 
- x, & \text{if } x < 0 \\
 x, & \text{if } x \geq 0 
\end{cases} \]

BINOMIAL EXPANSION
\[ (x + y)^n = x^n + \binom{n}{1} x^{n-1} y + \binom{n}{2} x^{n-2} y^2 + \cdots + y^n \] 
\[ \binom{n}{r} = \frac{n!}{r!(n-r)!} \]