KWAZULU-NATAL PROVINCE

EDUCATION

REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 11

MATHEMATICS
COMMON ASSESSMENT TASK
ASSIGNMENT – TERM 2
MAY 2025

MARKS: 50

TIME: 1½ hour

This question consists of 6 pages.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

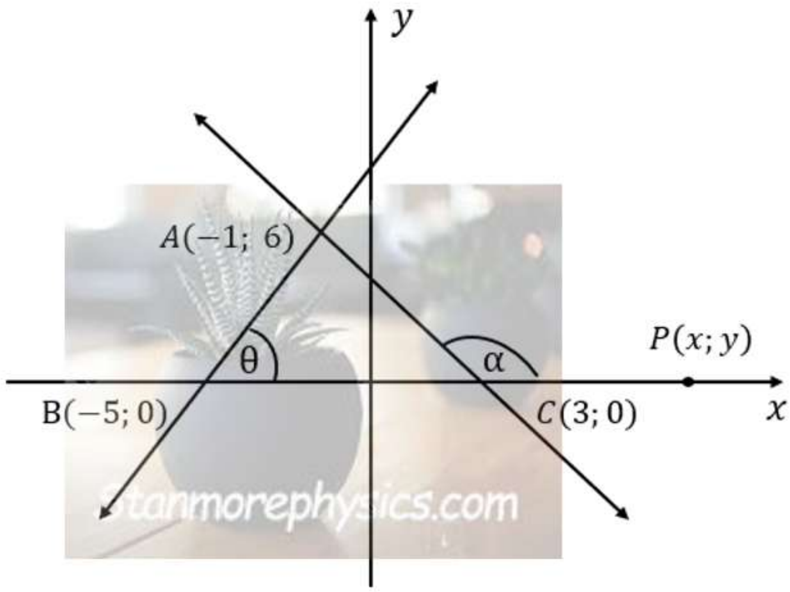
1. This question paper consists of **4** Questions.
2. Answer **ALL** the questions.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Clearly show ALL calculations, diagrams (which may not necessarily be drawn to scale), graphs, etc, that you have used in determining your answers
5. Answers only will NOT necessarily be awarded full marks.
6. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.
7. If necessary, round off answers correct to TWO decimal places, unless stated otherwise
8. Write neatly and legibly.

QUESTION 1: Analytical Geometry

1. Refer to the accompanying figure:

Lines AB and AC intersect at $A(-1; 6)$. $B(-5; 0)$ and $C(3; 0)$ are also depicted.

$\theta = A\hat{B}C$; $\alpha = A\hat{C}P$ where point $P(x; y)$ lies beyond C on the $x - axis$.



1.1. Is the line AB perpendicular to line AC? Show clearly all working details to justify your answer. (4)

1.2. Calculate the size of $B\hat{A}C$. (rounded off to one decimal digit). (4)

1.3. Calculate the length of AB. (Leave your answer in surd form). (2)

1.4. Show that ΔABC is isosceles (3)

1.5. If A, B and $D(a, 8)$ are three collinear points. Calculate the value of a. (3)

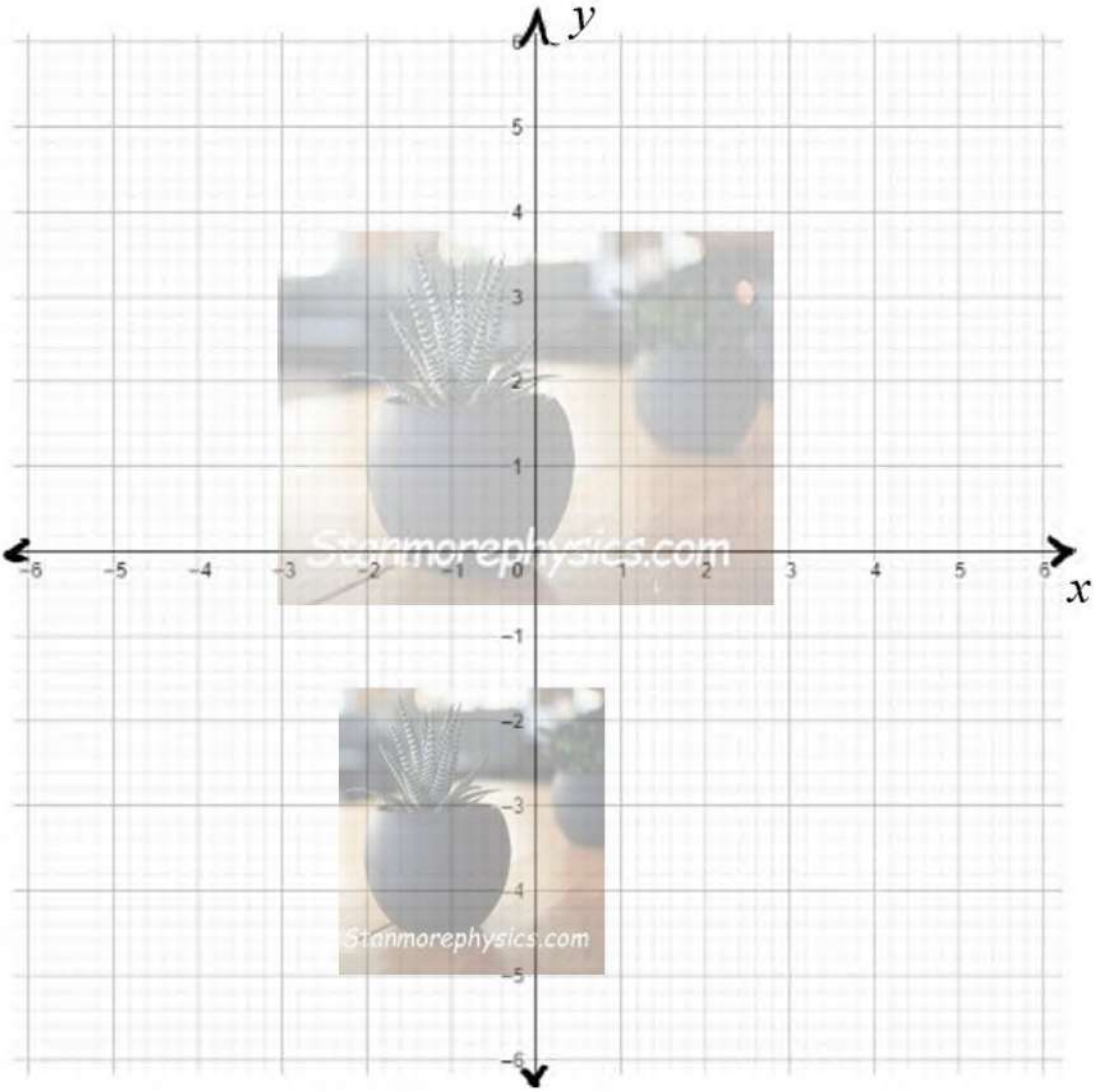
[16]

QUESTION 2 Functions (Linear, Quadratic and Hyperbolic Functions)

2. Given the following functions

- $f(x) = x^2 - 3x - 4$
- $g(x) = x + 1$

2.1. Sketch the $f(x)$ *and* $g(x)$ on the same cartesian plane provided. (5)



2.2. State the domain and range of $f(x)$. (3)

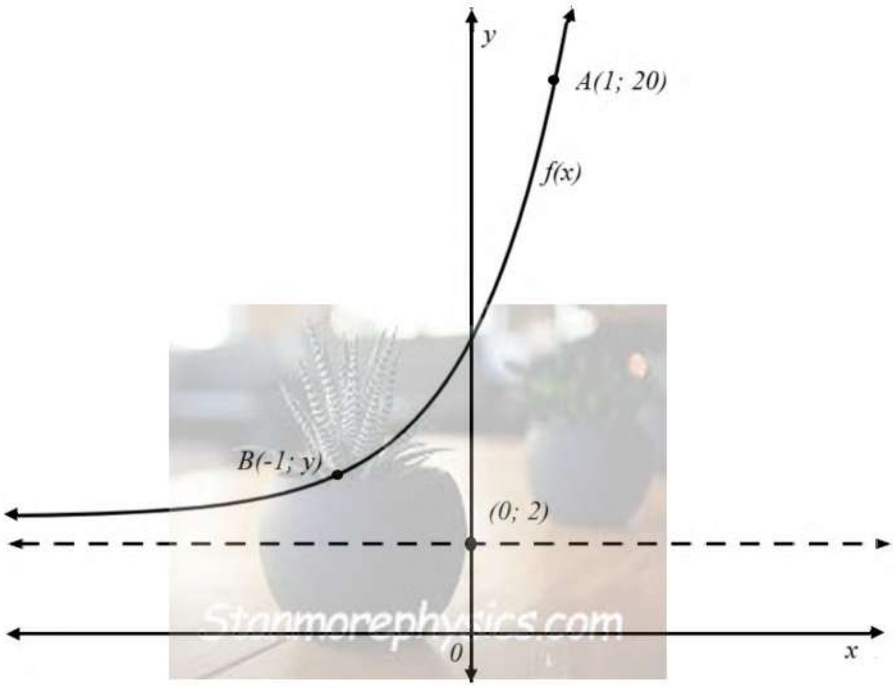
2.3. If $g(x)$ is the positive Axis of Symmetry line of the hyperbola: $h(x) = \frac{-2}{x+p} + 3$.

Determine the value of p. (2)

[10]

QUESTION 3 Functions (Exponential Functions)

3. The accompanying sketch is the graph of $f(x) = 2.b^{x+1} + q$. The graph of f passes through the points $A(1; 20) and\ B(-1; y)$. The line $y = 2$ is an asymptote of f.



3.1. Show that the equation of f is $f(x) = 2.(3)^{x+1} + 2$ (2)

3.2. Is the $graph\ of\ f$ strictly increasing, decreasing or neither? (1)

3.3. Calculate the $y - coordinate\ of\ the\ point\ B$. (1)

3.4. Determine the vertical distance between $point\ A$ and the closest point on the horizontal asymptote.
[Note: Euclid's Axiom states that the shortest path between two points on a cartesian plane is the straight-line segment between them] (2)

3.5. Determine the average gradient of the curve between the points A and B. (2)

3.6. A new function g is obtained when f is reflected about the $y - axis$, then reflected about its asymptote. Determine the equation of g. (2)

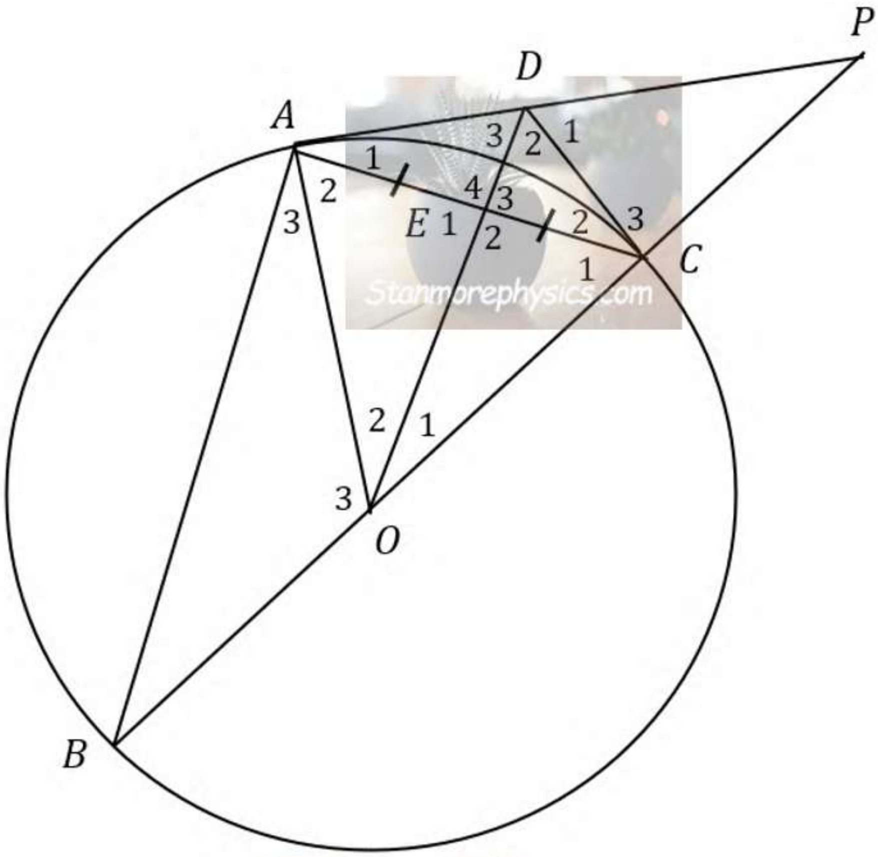
3.7. For which values of x is $f(x) > g(x)$. (1)

[11]

QUESTION 4 (Euclidean Circle Geometry)

4.

4.1. In the diagram below, BOC is a diameter of the circle. AP is a tangent to the circle at A and AE = EC.



Prove that:

4.1.1. BA // OD (4)

4.1.2. AOCD is a cyclic quadrilateral. (5)

4.1.3. DC is a tangent to the circle at C. (4)

[13]

TOTAL: 50

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MARKING GUIDELINES

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Question One: Analytical Geometry [16 marks]

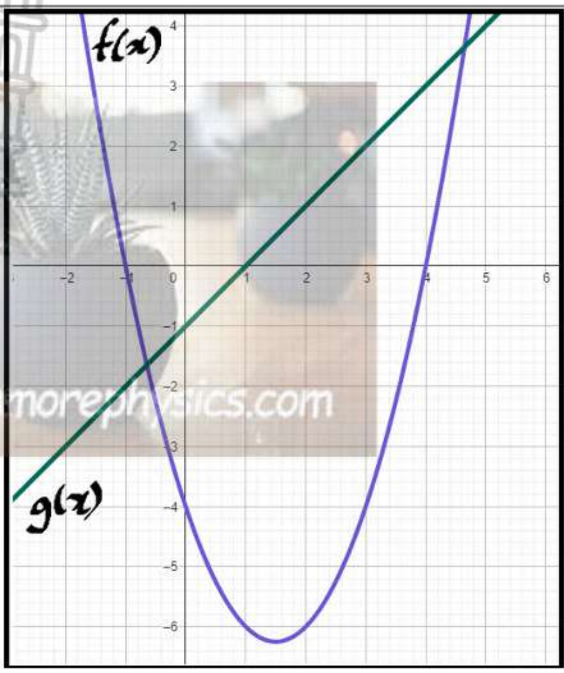
1.

1.1.	$RTP: m_{AB}.m_{AC} = -1\ if\ \perp$ $Proof: LHS = m_{AB}.m_{AC}$ ... (1) $m_{AB} = \frac{\Delta y}{\Delta x} = \frac{y_A - y_B}{x_A - x_B} = \frac{6-0}{-1+5} = \frac{6}{4} = \frac{3}{2}$ $m_{AC} = \frac{\Delta y}{\Delta x} = \frac{y_A - y_C}{x_A - x_C} = \frac{6-0}{-1-3} = \frac{6}{-4} = \frac{3}{2}$ $\therefore LHS = \frac{3}{2} \times \left(-\frac{3}{2}\right) = -\frac{9}{4} \neq -1$ $\therefore AB\ not\ \perp\ to\ AC$	✓A correct gradient value ✓A correct gradient value ✓A correct deduction ✓A correct conclusion (4)
1.2.	Now, $\tan\theta = m_{AB}$ $\tan\theta = \frac{3}{2} \Rightarrow \theta = \tan^{-1}\left(\frac{3}{2}\right) \Rightarrow \theta = 56.3°$ Moreover, $\tan\theta_{ref} = m_{AB}$ $\tan\alpha_{ref} = \frac{3}{2} \Rightarrow \alpha_{ref} = \tan^{-1}\left(\frac{3}{2}\right) \Rightarrow \alpha_{ref} = 56.3°$ $\therefore \alpha = 180° - \alpha_{ref} \Rightarrow \alpha = 180° - 56.3°$ $\Rightarrow \alpha = 123.7°$ $\therefore B\hat{A}C = \alpha - \theta\ (ext\ \angle\ of\ \Delta ABC)$ $B\hat{A}C = 123.7° - 56.3° \Rightarrow \therefore B\hat{A}C = 67.4°$	✓ $\theta = 56.3°$ ✓$\tan\theta_{ref} = m_{AB}$ ✓ $\alpha = 123.7°$ ✓ $B\hat{A}C = 67.4°$ (4)
1.3.	Now, AB = $\sqrt{(x_A - x_B)^2 + (y_A - y_B)^2}$ $AB = \sqrt{(-1+5)^2 + (6-0)^2} \Rightarrow AB = \sqrt{16+36}$ $AB = \sqrt{52}$ $\therefore AB = 2\sqrt{13}$	✓substitution ✓answer (2)
1.4.	**Method One: //Equal Sides** $Note: BC = 8\ units$ (By Observation) Now, AC = $\sqrt{(x_A - x_C)^2 + (y_A - y_C)^2}$ $AC = \sqrt{(-1-3)^2 + (6-0)^2} \Rightarrow AC = \sqrt{16+36}$ $AC = \sqrt{52}$ $\therefore AC = 2\sqrt{13}$	✓ $BC = 8\ units$ ✓substitution ✓answer (3)

	$\therefore AB = AC$ $\therefore \Delta ABC$ *is isosceles* **<u>Method Two: //Equal Angles (a)</u>** Now in ΔABC: $A\hat{C}B + \theta + B\hat{A}C = 180°$ $(\angle \text{ sum in } \Delta ABC)$ $\therefore A\hat{C}B = 180° - 56.3° - 67.4°$ $\therefore A\hat{C}B = 56.3°$ $\therefore A\hat{C}B = \theta$ ΔABC *is isosceles* **<u>Method Three: //Equal Angles (b)</u>** $A\hat{C}B + \propto = 180°$ $(\angle s \text{ on a str line})$ $\therefore A\hat{C}B = 180° - 123.7° \Rightarrow A\hat{C}B = 56.3°$ $\therefore A\hat{C}B = \theta$ ΔABC *is isosceles*	✓ $A\hat{C}B + \theta + B\hat{A}C = 180°$ ✓ $A\hat{C}B = 56.3°$ ✓ $A\hat{C}B = \theta$ ✓ $A\hat{C}B + \propto = 180°$ ✓ $A\hat{C}B = 56.3°$ ✓ $A\hat{C}B = \theta$ (3)
1.5.	Now, for collinear points, $\boldsymbol{m_{AB}} = \boldsymbol{m_{BD}} = m_{AD}$ $\frac{6-0}{-1+5} = \frac{0-8}{-5-a}$ $\frac{6}{4} = \frac{-8}{-5-a}$ $-30 - 6a = -32$ $-6a = -2$ $a = \frac{1}{3}$	✓ $\frac{6}{4} = \frac{-8}{-5-a}$ ✓ $-30 - 6a = -32$ ✓answer (3) **[16]**

Question Two: Functions (Linear, Quadratic and Hyperbolic Functions [10 marks]

2.

2.1.		✓A shape of $f(x)$ ✓A shape of $g(x)$ ✓A x-intercepts of $f(x)$ ✓A intercepts of $g(x)$ ✓A y-intercept of $f(x)$ (5)
2.2.	$D_f = \{x \mid x \in \mathbb{R}\}$ And $x = -\frac{b}{2a} \Rightarrow x = \frac{3}{2}$ $\therefore y = \left(\frac{3}{2}\right)^2 - 3\left(\frac{3}{2}\right) - 4 \Rightarrow y = -\frac{25}{4}$ $R_f = \{y \mid y \in \mathbb{R}\,;\ y \geq -\frac{25}{4}\}$ ***Note:*** Can Use Interval Notation or Inequalities	✓A Correct Domain ✓A correct y_{TP} ✓A correct Range (3)
2.3.	Now, *For the positive AOS*: $y = (x + p) + 3$ But $y = x + 1$ $\therefore x + 1 = x + p + 3$ $\therefore p = -2$	✓ $y = (x + p) + 3$ ✓answer (2) **[10]**

Question Three: Functions (Exponential Functions) [10 marks]

3.

3.1.	Now, $f(x) = 2(b)^{x+1} + 2$ Substitute $A(1\ ;\ 20)$ $\Rightarrow 20 = 2(b)^{1+1} + 2$ $\Rightarrow \frac{18}{2} = \frac{2}{2}b^2$ $\Rightarrow 9 = b^2$ $\therefore b = \pm\sqrt{9} \Rightarrow b = 3\ (Strictly\ increasing)$	✓sub $A(1\ ;\ 20)$ ✓answer (2)
3.2.	$f(x)\ is\ strictly\ increasing\ \forall\ x \in \mathbb{R}$	✓answer (1)
3.3.	Now, $f(x) = 2.(3)^{x+1} + 2$, Substitute $x = -1\ into\ f(x)$ $y_B = f(-1) = 2(3)^{-1+1} + 2$ $\therefore y_B = 4$ $\therefore B(-1; 4)$	✓$B(-1; 4)$ (1)
3.4.	Let H be the shortest distance/perpendicular height between the Horizontal Asymptote and A. H = $\Delta y = y_A - y_H$ H = 20 -2 $\therefore H = 18\ units$	✓ H = $\Delta y = y_A - y_H$ ✓answer (2)
3.5.	$Now, the\ Average\ m_{AB} = \frac{\Delta y}{\Delta y} = \frac{y_A - y_B}{x_A - x_B}$ $m_{AB} = \frac{20-4}{1-(-1)}$ $m_{AB} = 8\ (very\ steep)$	✓ substitute into formula ✓answer (2)
3.6.	$f(x)_{NEW} = f(-x)$ //Reflected about the $y - axis$ $f(x)_{NEW} = 2.(3)^{-x+1} + 2$ $\therefore g(x) = -2.(3)^{-x+1} + 2$	✓ $f(x)_{NEW} = 2.(3)^{-x+1} + 2$ ✓ $g(x) = -2.(3)^{-x+1} + 2$ (2)
3.7.	$\forall\ x \in \mathbb{R}$	✓answer (1) **[11]**

Question Four: Euclidean Geometry [13 marks]

4.

4.1.1.	$RTP: BA//OD$ $Proof:$ Now, $B\hat{A}C = 90°$ $(\angle\ in \frac{1}{2} \odot)$ In ΔAEO: $\hat{E}_1 = 90°$ $(OD\ bisects\ AC)$ $\therefore AB//$OD $(converse, co - int\ \angle s\ supp)$	✓S ✓R ✓R ✓S ✓R (4)
4.1.2.	$RTP: AOCD\ is\ cyclic\ quad$ $Proof:$ Now, $\hat{A}_1 = \hat{B}$ (tan $chord\ theorem$) But $\hat{B} = \hat{O}_1$ $(AB//OD, corresp\ \angle s\ =)$ $\therefore \hat{O}_1 = \hat{A}_1$ $AOCD\ is\ a\ cyclic\ quad$ (converse line subtends equal angles)	✓S ✓R ✓S ✓R ✓R (5)
4.1.3.	$\hat{C}_2 = \hat{O}_2$ $(\angle s\ in\ same\ segment)$ But $A\hat{O}C = \hat{O}_1 + \hat{O}_2 = 2\hat{B}$ $(\angle\ @\ centre$ 2x $\angle\ @\ circum)$ Now $OD\ is\ a\ \perp\ Bisector$ of $A\hat{O}C$ (proven in 4.1.1.) $\therefore \hat{O}_1 = \hat{O}_2$ Thus, $\hat{O}_2 = \hat{B}$ (Both = to $\hat{O}_1$) $\therefore \hat{B} = \hat{C}_2$ Hence, $CD\ is\ a\ tangent\ to \odot ABC\ @\ C$ $(converse$ tan $chord\ theorem)$	✓S/R ✓S ✓$\hat{O}_1 = \hat{O}_2$ ✓R (4) **[13]**