Basic Education

KwaZulu-Natal Department of Basic Education
REPUBLIC OF SOUTH AFRICA

MATHEMATICS

COMMON TEST

MARCH 2016

NATIONAL SENIOR CERTIFICATE

GRADE 11

MARKS: 75

TIME: 1½ hours

N.B. This question paper consists of 5 pages including this page.

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INSTRUCTIONS AND INFORMATION

Read the following instruction carefully before answering the questions.

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

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QUESTION 1

1.1 Simplify full, **without using a calculator**

1.1.1 $\sqrt[3]{3} \cdot 27^{\frac{-2}{3}} \cdot \sqrt[3]{3^2}$ (3)

1.1.2 $\dfrac{4^{2x+1}.10^{2x-3}}{32^{x-1}.2^{x}.5^{2x-2}}$ (4)

1.2 If the length and breadth of a rectangle is $\left(\sqrt{5-1}\right)$ and $\left(\sqrt{5+1}\right)$ units respectively. Determine the length of the diagonal. Leave your answer in its simplest surd form. (3)

1.3 **Solve for x:**

1.3.1 $\dfrac{27^{x-1}}{3^{x+2}} = \sqrt[3]{81^{x}}$ (4)

1.3.2 $5^{2-x} + 5^{-x} - 130 = 0$ (4)

[18]

QUESTION 2

2.1 **Solve for x:**

2.1.1 $2x^2 - 5x = 0$ (3)

2.1.2 $11x = 7x^2 + 3$ (Answer correct to 2 decimal places) (4)

2.1.3 $\sqrt{x+8} - 2 = x$ (4)

2.2

2.2.1 Write down the value(s) of x for which $\dfrac{(x+2)^2}{x}$ is undefined? (1)

2.2.2 Hence, solve the following inequality $\dfrac{(x+2)^2}{x} \geq 0$. (4)

2.3 Solve for x and y.

$3^{x+7} = 27^{3x-3}$ and
$x^2 + 2xy + x - 2y^2 = 0$ (6)

2.4 Simplify $25^{30} \times 2^{60}$ and determine the sum of the digits of the product. (3)

[25]

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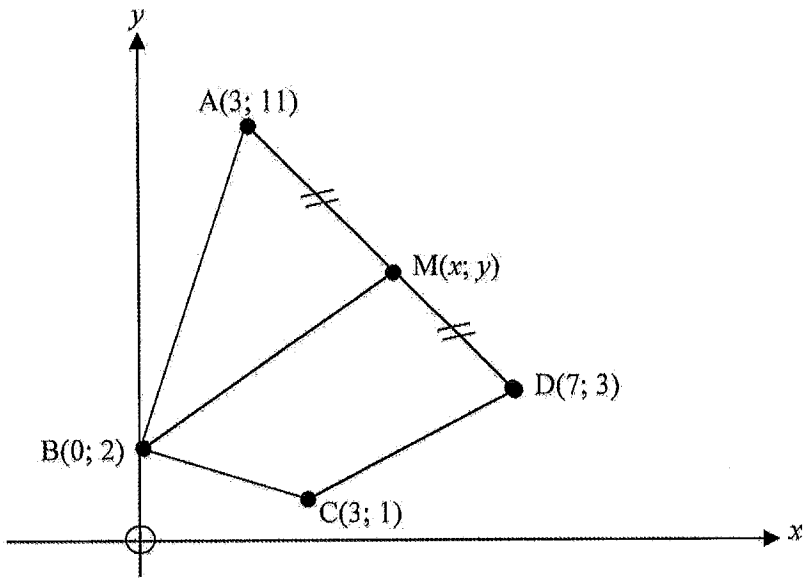
QUESTION 3

3.1 In the diagram below, ABCD is a quadrilateral with A(3;11), B(0;2), C(3;1), D(7;3)



Calculate:

3.1.1 The lengths of AB and AD. (4)

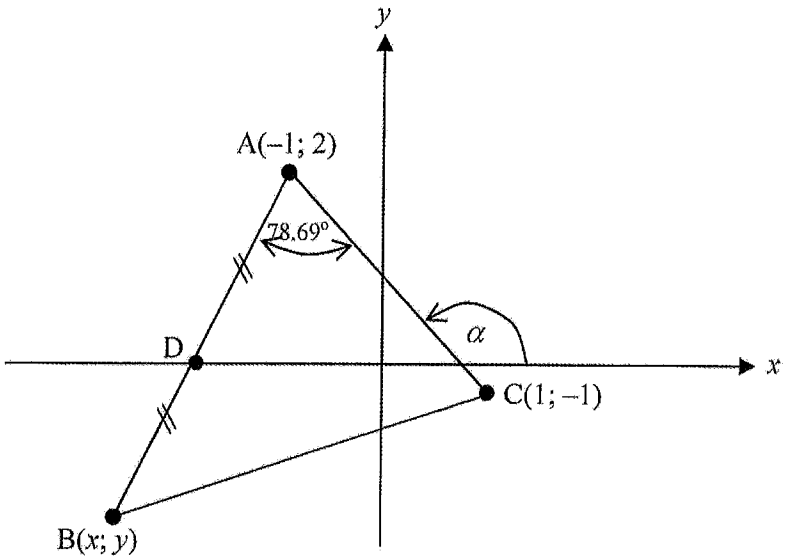
3.1.2 The coordinates of M, the midpoint of AD. (2)

3.1.3 The gradients of BC (2)

3.1.4 The equation of BM, in the form $y = mx + c$. (4)

3.2 Prove that AB $\perp$ BC. (4)

3.3 In the diagram below, A(–1;2), B(x; y) and C(1; –1) are the vertices of a triangle. D is the x-intercept and the midpoint of AB. B$\hat{A}$C is 78,69°.



3.3.1

3.3.1.1 Calculate the size of angle θ. (2)

3.3.1.2 Hence, find the equation of AB. (3)

3.3.2 Determine the coordinates of D. (2)

3.3.3 Determine the coordinates of B. (2)

3.3.4 Find the equation of a line passing through B and perpendicular to BC in the form:

$y = mx + c$. (4)

3.5 If the following points B(x ; –3), E(–4; 5) and F(2; 2) are collinear, calculate the value of x. (3)

[32]

TOTAL MARKS: 75

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Grades 11 + 10.

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MEMORANDUM

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GRADE 11

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QUESTION ONE

1.1.1 $\sqrt[3]{3} \cdot 27^{\frac{-2}{3}} \cdot \sqrt[3]{3^2}$	
$= (3)^{\frac{1}{3}} \cdot (3^{3x\frac{-2}{3}}) \cdot 3^{\frac{2}{3}}$ ✓	1A for converting all terms to base 3
$= 3^{\frac{1}{3}-2+\frac{2}{3}}$ ✓	2 for simplifying
$= \frac{1}{3}$ ✓	1A for correct answer (3)

1.1.2 $\frac{4^{2x+2} \cdot 10^{2x-2}}{32^{x-2} \cdot 2^x \cdot 5^{2x-2}}$	
$= \frac{2^{4x+2} \cdot 2^{2x-2} \cdot 5^{2x-2}}{2^{5x-5} \cdot 2^x \cdot 5^{2x-2}}$ ✓✓	2A for writing as base 2 and 5 in denominator and numerator
$= \frac{2^{4x+2+2x-2-5x+5-x}}{5^{2x-2-2x+2}}$ ✓	1A for simplifying
$= \frac{16}{5}$ ✓	1CA for answer (4)

1.2 diagonal^2 $= (\sqrt{5}-1)^2 + (\sqrt{5}-1)^2$ ✓	1M for using Pythagoras
$= 5+2\sqrt{5}+1+5-2\sqrt{5}+1$	
$= 12$ ✓	1A for answer
Diagonal $= \sqrt{12}$	
$= 2\sqrt{3}$ ✓	1CA for length of diagonal (3)

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1.3.1 $\frac{27^{x+1}}{3^{x+2}} = \sqrt[3]{81^x}$ ✓ $3^{3x-3-x-2} = 3^{\frac{4x}{3}}$ ✓ $2x-5 = \frac{4x}{3}$ ✓ $6x-15 = 4x$ $2x = 15$ $x = \frac{15}{2}$ ✓	2A for writing as base 3 1 CA for equating indices 1 CA for answer (4)
1.3.2 $5^{2-x} + 5^{-x} - 130 = 0$ $5^{-x}(5^2+1) = 130$ ✓ $5^{-x}(26)$ ✓ $= 130$ $5^{-x} = 5$ ✓ $x = -1$ ✓	1A for removing 5^{-x} as a common factor 1A for simplification 1CA for division 1CA for correct answer (4) **[18]**

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QUESTION TWO

2.1.1 $x(2x-5) = 0$ ✓ $x = 0$ ✓ or $x = \frac{5}{2}$ ✓	1A for factorizing 2A for answer (3)
2.1.2 $-7x^2 + 11x = 3$ $-7x^2 + 11x - 3 = 0$ $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$ ✓ $= \frac{-11 \pm \sqrt{11^2-4(-7)(-3)}}{2a}$ ✓ $= 0{,}35$ ✓ or $1{,}22$ ✓	1M for correct formula 1A for correct substitution 2CA for answer (4)
2.1.3 $\sqrt{x+8} - 2 = x$ $(\sqrt{x+8})^2 = (x+2)^2$ ✓ $x^2 + 4x + 4 - x - 8 = 0$ $x^2 + 3x - 4 = 0$ ✓ $(x+4)(x-1) = 0$ $x = -4$ or $x = -1$ ✓ SS $\{-1\}$ ✓	1M for squaring both sides 1CA for correct trinomial 1CA for correct values 1CA for choosing the correct solution (4)
2.2.1 $x = 0$ ✓	1A for correct answer (1)

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2.2.2 $\frac{(x+2)^2}{x} \geq 0$ C V $x=-2$ or $x=0$ ✓ + – + –2 0 $x/x \in R, \{x>0\}$ ✓✓✓	1A for both critical values 3A for correct inequality sign and correct value (4)

2.3 $3^{x+7} = 27^{3x-3}$ .....1 $x^2 + 2xy + x - 2y^2 = 0$ .....2 Solve eqn. 1 $3^{x+7} = 3^{3x-9}$ ✓ $x+7 = 9x-9$ ✓ $x=2$ ✓ substitute $x=2$ in eqn. 2 $2(2)^2+2y(2)+2-2y^2=0$ ✓ $-2y^2+4y+6=0$ $y^2-2y-3=0$ $(y-3)(y+1)=0$ ✓ $y=3$ or $y=-1$ ✓	1A for writing correctly as base 3 1A for equating the indices 1A for correct answer 1CA for substitution 1CA for correct factors 1A for correct y values (6)

2.4 $25^{30} \times 2^{60}$ $= 5^{60}$ ✓ x 2^{60} $= 10^{60}$ ✓ Sum of the digits = 1 ✓	1A writing as base 5 1A for writing as base 10 1A for correct answer (3) [25]

QUESTION 3

3.1		
3.1.1	AB = $\sqrt{9+81}$ ✓ = $\sqrt{90}$ = $3\sqrt{10}$ ✓ AD = $\sqrt{16+64}$ ✓ = $\sqrt{80}$ = $4\sqrt{5}$ ✓	1A correct substitution 1A simplification 1A correct substitution 1A simplification (4)
3.1.2	M = (5✓; 7)✓	2A correct values (2)
3.1.3	$M_{BC} = \frac{2-1}{0-3}$ ✓ $= \frac{1}{-3}$ ✓	1A correct substitution 1A correct answer (2)
3.1.4	$M_{BM} = 1$ ✓ $y = mx + c$ $2 = 1(0) + c$ ✓ $c = 2$ $y = x + 2$ ✓✓	1A gradient BM 1A correct substitution 2A correct equation (4)
3.2	$M_{BC} = \frac{-1}{3}$ ✓ $M_{AB} = \frac{11-2}{3-0}$ $= 3$ ✓ $\frac{-1}{3} \times 3 = -1$ ✓ BC is perpendicular to AB	1A gradient AB 1A conclusion (4)

3.3		
3.3.1.1	$M_{AC} = \frac{2+1}{-1-\cdot}$ $= \frac{3}{-2}$ RA = 56,31° ✓ α = 123,69° θ = 45° ✓	1A for RA 1A for θ
3.3.1.2	Tan θ = m Tan 45° = m m = 1 ✓ 2 = 1(–1) + c C = 3 ✓ $y = x + 3$ is the equation of AB ✓	1A for m (2) 1A for c value 1A for correct equation (3)
3.3.2	D = (–3✓; 0)✓	2A correct values (2)
3.3.3	$-3 = \frac{-1+x}{2}$ $x - 1 = -6$ $x = -5$ ✓ $0 = \frac{2+y}{2}$ $y = -2$ ✓ B = (–5; –2)	1A M 1A M (2)
3.3.4	$M_{BC} = \frac{-2+1}{-3-1}$ $= \frac{1}{6}$ ✓ Grad of a line = –6 ✓ –2 = –6(–5) + c c = –32 ✓ y = –6x = 32 ✓	1A gradient BC 1A gradient of a line 1A value of c 1A correct equation (4)

3.5	$M^{BE} = mEF$ $\frac{5+3}{-4+x} \checkmark = \frac{5-2}{-4-2}$ ✓ $\frac{8}{-4+x} = \frac{3}{-6}$ $3x = -36$ $x = -12$ ✓	1 M for equating gradients 1A for calculating correct gradients 1 CA for correct answer (3) **[32]**

TOTAL MARKS: 75