Basic Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

MATHEMATICS P1

JUNE 2016

COMMON TEST

NATIONAL SENIOR CERTIFICATE

GRADE 11

MARKS: 100

TIME: 2 hours

This question paper consists of 6 pages and 1 diagram sheet.

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INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of **5** questions.
2. Answer **ALL** the questions.
3. Clearly show **ALL** calculations, diagrams, graphs, et cetera which you have used in determining the answers.
4. Answers only will **NOT** necessarily be awarded full marks.
5. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.
6. If necessary, round off answers to **TWO** decimal places, unless stated otherwise.
7. Diagrams are not necessarily drawn to scale.
8. ONE diagram sheet for answering **QUESTION 4.1.2** and **4.1.5** is attached at the end of this question paper. Write your name in the space provided and insert it inside your **ANSWER SHEET.**
9. Number the answers correctly according to the numbering system used in this question paper.
10. Write neatly and legibly.

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QUESTION 1

1.1 Solve the following equations:

1.1.1 $2x - \frac{3}{x} = 1$ (4)

1.1.2 $3x^2 - 6x + 1 = 0$ (correct to two decimal places) (4)

1.1.3 $5x - 2(x^2 - 6) \leq 0$ (4)

1.1.4 $2 + \sqrt{x+2} = 6 - x$ (5)

1.1.5 $3^{1-2x} - 1 = 0$ (3)

1.2 Solve for p if the roots of $4x^2 = p - 5x$ are real. (3)

1.3 Solve for x and y simultaneously if: $x - 3 = 2y$ and $x^2 - y^2 = 45$ (6)

[29]

QUESTION 2

2.1 Simplify the following without using a calculator:

2.1.1 $81^{-\frac{3}{4}}$ (3)

2.1.2 $\frac{3.5^{x+1} - 5^{x+3}}{5^{x+1} - 3.5^{x}}$ (3)

2.2 Without using a calculator, show that:

$$\frac{2}{1+\sqrt{2}} - \frac{8}{\sqrt{8}} = -2$$ (4)

[10]

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QUESTION 3

3.1 The following sequence of numbers is given:

2; 7; 12; 17; .....

3.1.1 Write down the values of the next two terms of the sequence. (2)

3.1.2 Write down the value of the first term in the sequence that will have a value that is greater than 107. (1)

3.1.3 Determine an expression for the n^{th} term of the sequence. (2)

3.1.4 Which term of the sequence will be equal to 182? (2)

3.1.5 The terms of this sequence are also the first differences of a certain quadratic sequence. If the fourth term of this quadratic sequence is 22, write down its first, second and third terms. (3)

3.2 Given the following quadratic sequence:

51; 70; 95; 126; .....

3.2.1 Write the value of the next term of the sequence. (2)

3.2.2 Determine an expression for the n^{th} term of this quadratic sequence. (5)

3.2.3 Which term of the sequence will be equal to 4063? (4)

[21]

QUESTION 4

4.1 Given $f(x) = -x^2 - 2x + 3$.

4.1.1 Write f in the form $y = a(x+p)^2 + q$. (3)

4.1.2 Draw a neat sketch graph of f on the **DIAGRAM SHEET** provided.

Indicate all intercepts with the axes and the coordinates of the turning point. (5)

4.1.3 Write down the range of f. (2)

4.1.4 Describe the transformation from f to h if $h(x) = x^2 + 2x - 3$ (2)

4.1.5 On the same set of axes as f, draw a neat sketch graph of g if $g(x) = -2x + 2$, showing all intercepts with the axes. (2)

4.1.6 Now use your graphs to answer the following questions:

For which value(s) of x is:

(a) $f(x) - g(x) = 0$? (2)

(b) $f(x) > 0$? (2)

4.2 Draw a rough sketch graph of $k(x) = ax^2 + bx + c$, if it is given that

- k has no real roots;
- $b > 0$ and
- $c > 0$. (3)

[21]

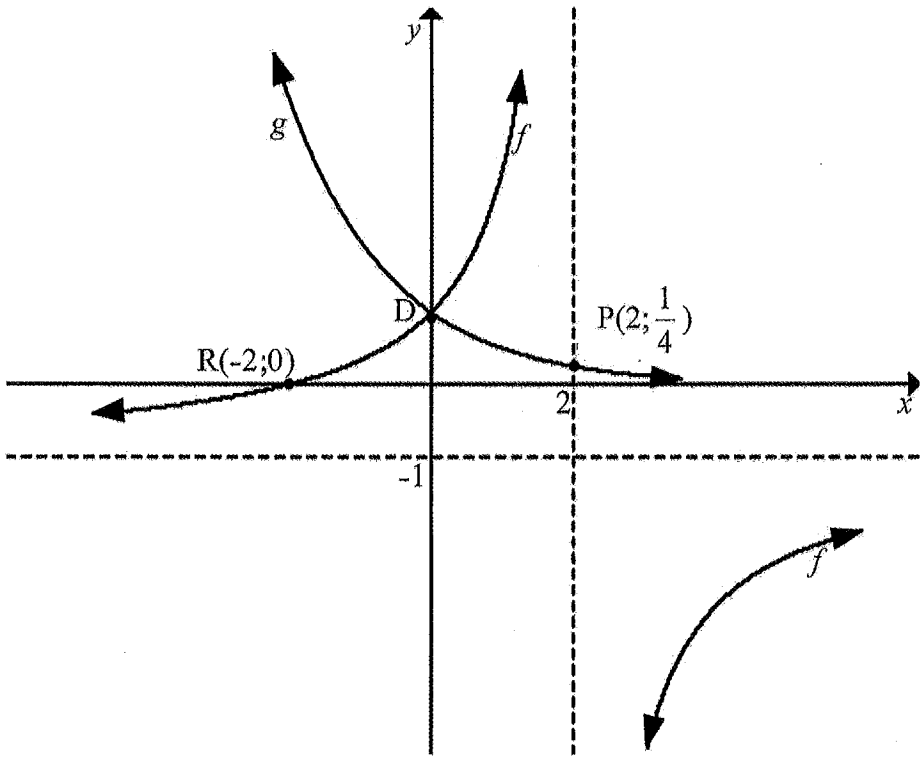
QUESTION 5

The diagram below represents the graphs of $f(x) = \frac{a}{x+p} + q$ and $g(x) = t^x$.

f cuts the x-axis at $R(-2;0)$ and the y-axis at D.

$P\left(2;\frac{1}{4}\right)$ is a point on the graph of g.

f and g intersect at point D.



5.1 Write down the values of p and q. (2)

5.2 Determine the value of a. (3)

5.3 Determine the value of t. (3)

5.4 Calculate the average gradient of g between $x=-2$ and $x=2$. (3)

5.5 Write down the equation of the asymptote of g. (1)

5.6 Write down the coordinates of D. (2)

5.7 Determine the equation of the axis of symmetry of f that has a negative gradient. (3)

5.8 Point D is reflected in the line determined in 5.7 to give point E.
Write down the coordinates of E. (2)

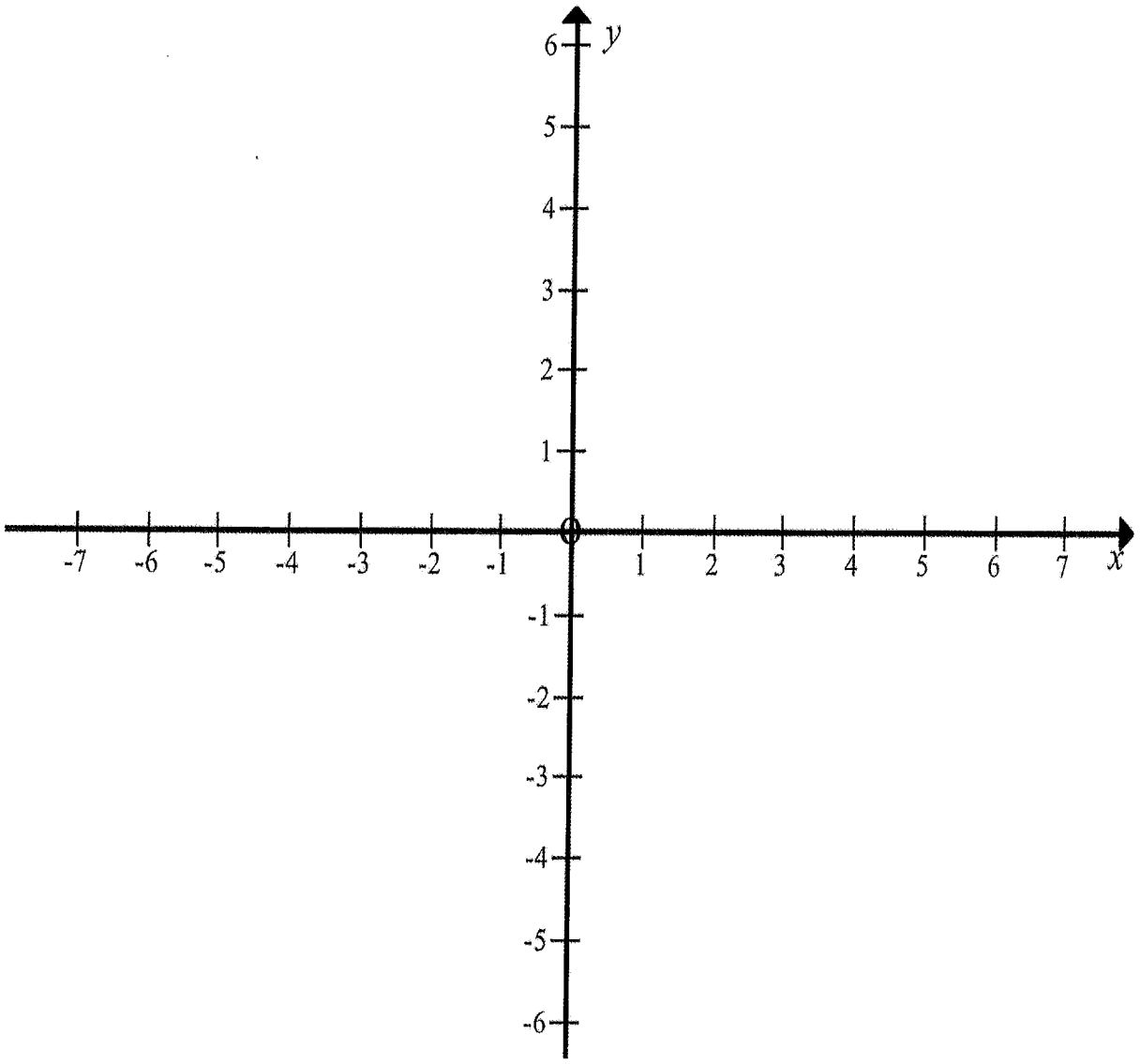
[19]

TOTAL: 100

DIAGRAM SHEET

NAME OF LEARNER: _____ **GRADE:**_____

QUESTION 4.1.2 and 4.1.5



TEAR – OFF SHEET

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GREENBURY

Basic Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

MATHEMATICS P1

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MEMORANDUM

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This memorandum consists of 8 pages.

QUESTION 1

1.1.1

$2x-\frac{3}{x}=1$

$2x^2-3=x$ ✓

$2x^2-x-3=0$ ✓

$(2x-3)(x+1)=0$ ✓

$x=\frac{3}{2}$ or $x=-1$ ✓

A for simplification
CA for standard form
CA for factorisation
CA for both answers

(4)

1.1.2

$3x^2-6x+1=0$

$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ ✓

$=\frac{-(-6)\pm\sqrt{(-6)^2-4(3)(1)}}{2(3)}$ ✓

$=\frac{6\pm\sqrt{24}}{6}$

$=1{,}82;\ 0{,}18$ ✓ ✓

A for formula
A for substitution
CA; CA for answers

(4)

1.1.3

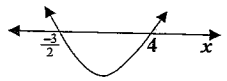
$5x-2(x^2-6)\le 0$

$5x-2x^2+12\le 0$

$2x^2-5x-12\ge 0$ ✓

$(2x+3)(x-4)\ge 0$ ✓

$CVs: -\frac{3}{2};\ 4$



✓ ✓

Solution : $x\le -\frac{3}{2}$ or $x\ge 4$

If "and": max ¾

A for simplification and change of sign
CA for factorisation
CA for $x\le -\frac{3}{2}$
CA for $x\ge 4$

(4)

1.1.4

$2+\sqrt{x+2}=6-x$

$(\sqrt{x+2})^2=(4-x)^2$ ✓

$x+2=16-8x+x^2$ ✓

$x^2-9x+14=0$

$(x-7)(x-2)=0$ ✓

$x=7$ or $x=2$ ✓

$x=2$ only ✓

A for squaring both sides
CA for simplification
CA for factorisation
CA for both answers
CA for rejecting $x=7$

(5)

1.1.5	$3^{1-2x}=1$ $3^{1-2x}=3^0$ ✓ $1-2x=0$ ✓ $x=\frac{1}{2}$ ✓	A for same bases A for equating exponents A for answer (3)
1.2.	$4x^2+5x-p=0$ $x=\frac{-5\pm\sqrt{5^2-(4)(4)(-p)}}{2(4)}$ $=\frac{-5\pm\sqrt{25+16p}}{8}$ Values of x will be real when $25+16p\geq 0$ $16p\geq -25$ $p\geq -\frac{25}{16}$ OR $4x^2+5x-p=0$ $b^2-4ac\geq 0$ ✓ $5^2-4(4)(-p)\geq 0$ ✓ $16p\geq -25$ $p\geq -\frac{25}{16}$ ✓	A for solving for x CA for $25+16p\geq 0$ CA for answer OR A for $b^2-4ac\geq 0$ A for substitution CA for answer (3)
1.3	$x=2y+3$ ✓ $(2y+3)^2-y^2=45$ ✓ $4y^2+12y+9-y^2=45$ $y^2+4y-12=0$ ✓ $(y+6)(y-2)=0$ ✓ $y=-6$ or $y=2$ ✓ Also: $x=2(-6)+3$ or $x=2(2)+3$ $=-9$ $=7$ ✓	A for making x subject of formula CA for substitution CA for standard form CA for factorisation CA for both y-values CA for both x-values (6) **[29]**

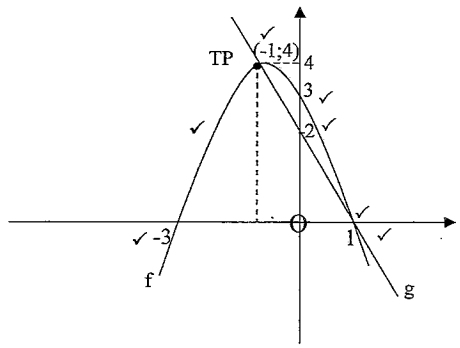
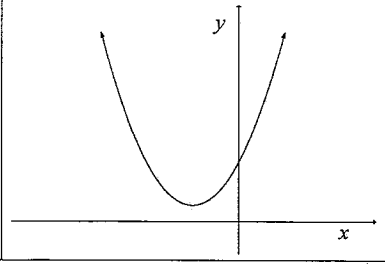
QUESTION 2

2.1.1	$81^{-\frac{3}{4}}=\left(3^4\right)^{-\frac{3}{4}}$ ✓ $=3^{-3}$ ✓ $=\frac{1}{27}$ ✓ OR $81^{-\frac{3}{4}}$ $=\frac{1}{81^{\frac{3}{4}}}$ ✓ $=\frac{1}{\sqrt[4]{81^3}}$ ✓ $=\frac{1}{3^3}$ $=\frac{1}{27}$ ✓	A for writing 81 as 3^4 CA for simplification CA for answer (3) OR A for positive exponent A for surd form A for answer (3)
2.1.2	$\frac{3.5^{x+1}-5^{x+3}}{5^{x+1}-3.5^x}$ $=\frac{5^x\left(3.5-5^3\right)}{5^x(5-3)}$ ✓ ✓ $=\frac{15-125}{2}$ $=\frac{-110}{2}$ $=-55$ ✓	A for factorisation of numerator A for factorisation of denominator CA for answer (3)
2.2	$\frac{2}{(1+\sqrt{2})}\cdot\frac{(1-\sqrt{2})}{(1-\sqrt{2})}-\frac{8}{\sqrt{8}}\cdot\frac{\sqrt{8}}{\sqrt{8}}$ ✓ ✓ $=\frac{2(1-\sqrt{2})}{1-2}-\frac{8\sqrt{8}}{8}$ $=-2(1-\sqrt{2})-\sqrt{8}$ ✓ $=-2+2\sqrt{2}-2\sqrt{2}$ ✓ $=-2$	AA for rationalising denominators A for simplification A for $\sqrt{8}=2\sqrt{2}$ (4) **[10]**

QUESTION 3

3.1.1	22; ✓ 27✓	AA for correct answers	(2)
3.1.2	112 ✓	A for correct answer	(1)
3.1.3	$T_n = 5n - 3$ ✓✓	AA for correct expression	(2)
3.1.4	$T_n = 5n - 3$ $5n - 3 = 182$ ✓ $5n = 185$ ✓ $n = 37$ ✓ $T_{37} = 182$	CA for equating to 182 CA for answer	(2)
3.1.5	1; 3; 10 ✓✓✓	AAA for answers	
3.2.1	163 ✓	AA for correct answer	(2)
3.2.2	second difference $= 6$ ✓ $2a = 6$ $a = 3$ ✓ $3a + b = 19$ $3(3) + b = 19$ $b = 10$ ✓ $a + b + c = 51$ $3 + 10 + c = 51$ $c = 38$ ✓ $\therefore T_n = 3n^2 + 10n + 38$ ✓	A for value of second difference A for value of a CA for value of b CA for value of c CA for expression for T_n	(5)
3.2.4	$3n^2 + 10n + 38 = 4063$ ✓ $3n^2 + 10n - 4025 = 0$ ✓ $n = \frac{-10 \pm \sqrt{(10)^2 - 4(3)(-4025)}}{2(3)}$ ✓ $= \frac{-10 \pm \sqrt{48400}}{6}$ $= \frac{-10 \pm 220}{6}$ $= 35$ or $38{,}33$ $\therefore T_{35} = 4063$ ✓ OR $3n^2 + 10n + 38 = 4063$ ✓ $3n^2 + 10n - 4025 = 0$ ✓ $(3n + 115)(n - 35) = 0$ ✓ $n = 35$ or $38{,}33$ $\therefore T_{35} = 4063$ ✓	CA for equating to 4063 CA for standard form CA for substitution in correct formula CA for answer OR CA for equating to 4063 CA for standard form CA for factorisation CA for answer	(4) (4) **[21]**

QUESTION 4

4.1.1	$f(x) = y = -(x^2 + 2x - 3)$ ✓ $= -(x^2 + 2x + 1 - 1 - 3)$ ✓ $= -[(x+1)^2 - 4]$ $= -(x+1)^2 + 4$ ✓	A for $-(x^2 + 2x - 3)$ CA for add 1, subtract 1 CA for answer	(3)
4.1.2 and 4.1.5		4.1.2: graph of f: A for shape A for y-intercept AA for x-intercepts A for turning point 4.1.5: graph of g: A for x-intercept A for y-intercept	(5) (2)
4.1.3	$y \leq 4$ ✓✓	CA; CA for answer	(2)
4.1.4	reflection of f in the x-axis ✓✓	AA for answer	(2)
4.1.6 (a)	$x = 1$; -1 ✓✓	CA; CA for correct answers	(2)
4.1.6 (b)	$-3 < x < 1$ ✓✓	CA; CA for correct answer	(2)
4.2		A for parabola that is concave up A for no x-intercepts A for turning point with negative x-coordinate and positive y-coordinate (i.e. in second quadrant)	(3) **[21]**

QUESTION 5

5.1	$p=-2$ ✓ $q=-1$ ✓	A for value of p A for value of q (2)
5.2	$y=\frac{a}{x-2}-1$ ✓ $0=\frac{a}{-2-2}-1$ ✓ $\frac{a}{-4}=1$ $a=-4$ ✓	CA for substitution of values of p and q CA for substitution of $(-2;0)$ CA for answer (3)
5.3	$\frac{1}{4}=t^2$ ✓ $t=\pm\sqrt{\frac{1}{4}}$ ✓ $t=\frac{1}{2}$ ✓	A for substitution of $\left(2;\frac{1}{4}\right)$ CA for $\pm\sqrt{\frac{1}{4}}$ CA for answer (3)
5.4	Average gradient $=\frac{g(2)-g(-2)}{2-(-2)}$ ✓ $=\frac{\left(\frac{1}{2}\right)^2-\left(\frac{1}{2}\right)^{-2}}{4}$ ✓ $=\frac{\frac{1}{4}-4}{4}$ $=\frac{-\frac{15}{16}}{4}$ $=-\frac{15}{64}$ ✓	A for formula A for substitution CA for answer (3)
5.5	$y=0$ ✓✓	AA for answer (2)
5.6	$D(0;1)$ ✓	A for answer (1)

5.7	$y=-x+c$ ✓ $-1=-(2)+c$ ✓ $c=1$ $y=-x+1$ ✓ OR $y=-(x+p)+q$ ✓ $=-(x-2)-1$ ✓ $=-x+1$ ✓	A for substitution of gradient of -1 A for substitution of $(2;-1)$ A for answer (3) OR A for formula A for substitution in formula A for answer (3)
5.8	$E(4;-3)$ ✓✓	A for x-coordinate; A for y-coordinate (2) **[19]**

TOTAL = 100