education

Department:
Education
PROVINCE OF KWAZULU-NATAL

NATIONAL SENIOR CERTIFICATE

GRADE 11

MATHEMATICS P1

COMMON TEST

JUNE 2019

MARKS: **100**

TIME: **2 hours**

This question paper consists of 7 pages.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions:

1. This question paper consists of 6 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, graphs, et cetera, which you have used in determining the 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 to TWO decimal places, unless stated otherwise.
8. Diagrams are NOT necessarily drawn to scale.
9. Write neatly and legibly.

QUESTION 1

1.1 Solve for x in each of the following:

1.1.1 $x(2x-5)=0$ (2)

1.1.2 $2x^2-x-7=0$ (correct to TWO decimal places) (3)

1.1.3 $x-\sqrt{2x-1}=2$ (5)

1.1.4 $3x^2+7x-6\geq 0$ (3)

1.1.5 $3^x\left(x+\frac{1}{3}\right)<0$ (3)

1.2 Solve simultaneously for x and y:

$x-4y=5$ and $x^2-2xy-3y^2=0$ (6)

[22]

QUESTION 2

2.1 Simplify fully, WITHOUT using a calculator:

2.1.1 $\left(\frac{2}{\sqrt{3}}-\frac{\sqrt{3}}{2}\right)^2$ (2)

2.1.2 $\frac{\sqrt{72}}{\sqrt{8}+\sqrt{98}}$ (3)

2.1.3 $\frac{6(3^{n+1})}{3^{n(n-1)}}\div\frac{2.9^{n+1}}{3^{n^2-1}}$ (4)

2.2. Solve for x:

$3^x.5+3^{x+1}=216$ (3)

2.3 If $6^x=5$, calculate the value of $\frac{18^x}{2^{-x}}$ (3)

[15]

QUESTION 3

3.1 Write down the next TWO terms of the quadratic sequence:
5 ; 10; 17 ;… (2)

3.2 The first four terms of a quadratic sequence are
$(x-3)$; $(-2x+2)$; $(3x+11)$ and $(4x+12)$.
Calculate the value of x. (4)

3.3 Consider the quadratic pattern: 3 ; 7 ; 13 ; 21 ; …

3.3.1 Determine the n^{th} term (T_n) of the pattern in the form $T_n = an^2 + bn + c$. (4)

3.3.2 Which term of the pattern will be the first to exceed 463? (4)

3.3.3 Between which TWO consecutive terms in the sequence is the first difference equal to 102? (4)

3.3.4 Consider the number pattern:

Row 1: 3
Row 2: 5 7
Row 3: 9 11 13
Row 4: 15 17 19 21

Calculate the number at the end of the 60^{th} row. (3)

3.4 The following is a linear pattern: 6 ; p ; q ; r ; 42 ; …

Determine the values of p, q and r. (4)
[25]

QUESTION 4

The hyperbola, *f*, is defined by $f(x)=\frac{3}{x-2}+1$.

4.1 Write down the equations of the asymptotes of *f*. (2)

4.2 Write down the *y*-intercept of *f*. (1)

4.3 Determine the *x*-intercept of *f*. (2)

4.4 Sketch the graph of f, showing all intercepts with the axes and any asymptotes. (3)

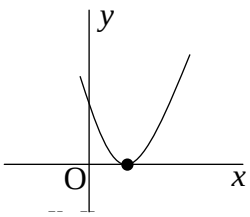
4.5 Write down the domain of *h*, if $h(x)=f(x-2)$. (2)

[10]

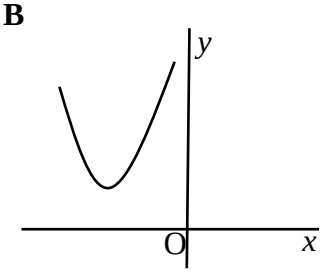
QUESTION 5

5.1 The following are graphs defined by $y=ax^2+bx+c$.

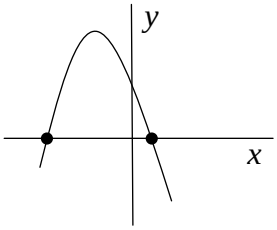
A



B



C



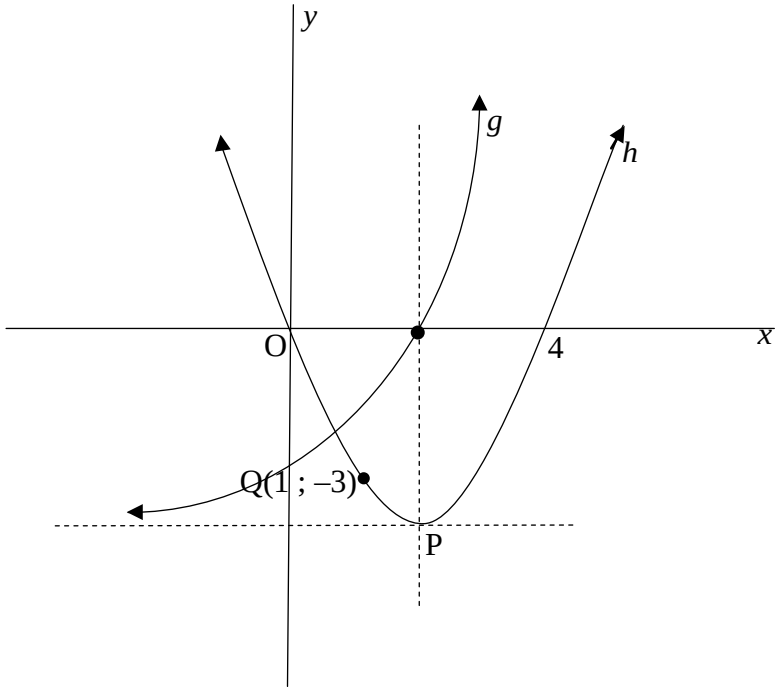
Match each of the following statements below with an associated graph above.
You must only write down the letter of the corresponding graph.

5.1.1 $b^2-4ac>0$ (1)

5.1.2 $b^2-4ac=0$ (1)

5.1.3 $b^2-4ac<0$ (1)

5.2 The sketch below shows the graphs of $y = k^x + t$ and $y = ax^2 + bx + c$.
The x-intercepts of h are (0 ; 0) and (0 ; 4). Q(1 ; –3) is a point on h.
The horizontal line through P, the turning point of h, is the asymptote of g.
The x-intercept of g lies on the axis of symmetry of h.



5.2.1 Show that $a = 1$ and $b = -4$. (3)

5.2.2 Determine the coordinates of P, the turning point of h. (2)

5.2.3 Write down the range of h. (1)

5.2.4 Write down the value of t. (1)

5.2.5 Hence, calculate the value of k. (2)

5.2.6 For which value(s) of r will the roots of $x^2 - 4x + r$ be non-real? (2)

[14]

QUESTION 6

Given the functions $p(x) = -2x^2 - 5x + 3$ and $q(x) = mx + 3$.
The angle of inclination of q is $135°$.

6.1 Determine the intercepts of p with the x and y axes. (3)

6.2 Determine the coordinates of the turning point of p. (2)

6.3 Write down the value of m, the gradient of q. (1)

6.4 Sketch the graphs of p and q on the same set of axes. Clearly indicate ALL the intercepts with the axes as well as the coordinates of the turning point. (5)

6.5 Determine the value of k for which the straight line $y = -x + k$ will be a tangent to p. (3)

[14]

TOTAL MARKS: 100

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MARKING GUIDELINE

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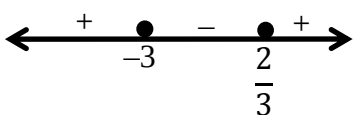
GRADE 11

MARKS: **100**

This marking guideline consists of 9 pages.

QUESTION 1

1.1.1	$x(2x-5)=0$ $x=0$ or $x=\frac{5}{2}$	✓ $x=0$ ✓ $x=\frac{5}{2}$ (2)
1.1.2	$2x^2-x-7=0$ $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ $x=\frac{-(-1)\pm\sqrt{(-1)^2-4(2)(-7)}}{2(2)}$ $x=2{,}14$ or $x=-1{,}64$	✓ substitution into quadratic formula ✓ answer ✓answer (3)
1.1.3	$x-\sqrt{2x-1}=2$ $x-2=\sqrt{2x-1}$ $x^2-4x+4=2x-1$ $x^2-6x+5=0$ $(x-5)(x-1)=0$ $x=5$ or $x\neq 1$	✓ isolate surd ✓ square both sides ✓ standard form ✓ answer ✓ $x\neq -1$ (5)
1.1.4	$3x^2+7x-6\geq 0$ $(3x-2)(x+3)\geq 0$  $x\leq -3$ or $x\geq\frac{2}{3}$	✓ factors ✓✓ answers (3)
1.1.5	$3^x\left(x+\frac{1}{3}\right)<0$ $3^x>0$ for all real values of x $\therefore x+\frac{1}{3}<0$ $\therefore x<-\frac{1}{3}$	✓ $3^x>0$ ✓ $x+\frac{1}{3}<0$ ✓ answer (3)
1.2	$x-4y=5$ and $x^2-2xy-3y^2=0$ $x=5+4y$ $(5+4y)^2-2y(5+4y)-3y^2=0$ $25+40y+16y^2-10y-8y^2-3y^2=0$ $5y^2+30y+25=0$ $y^2+6y+5=0$ $(y+5)(y+1)=0$ $y=-5$ *or* $y=-1$ $x=-15$ *or* $x=1$	✓making x the subject of the formula ✓substitution ✓ simplification ✓ standard form ✓y values ✓x values (6)

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	OR $4y = x - 5$ $y = \frac{x-5}{4}$ $x^2 - 2x\left(\frac{x-5}{4}\right) - 3\left(\frac{x-5}{4}\right)^2 = 0$ $16x^2 - 8x^2 + 40x - 3x^2 + 30x - 75 = 0$ $5x^2 + 70x - 75 = 0$ $x^2 + 14x - 15 = 0$ $(x + 15)(x - 1) = 0$ $x = -15 \quad or \quad x = 1$ $y = -5 \quad or \quad y = -1$	✓making y the subject of the formula ✓substitution ✓ simplification ✓ standard form ✓x values ✓y values (6)
		[22]

QUESTION 2

2.1.1	$\left(\frac{2}{\sqrt{3}} - \frac{\sqrt{3}}{2}\right)^2$ $= \frac{4}{3} - 2 + \frac{3}{4}$ $= \frac{1}{12}$	✓ for correct expansion ✓answer (2)
2.1.2	$\frac{\sqrt{72}}{\sqrt{8} + \sqrt{98}}$ $= \frac{\sqrt{36 \times 2}}{\sqrt{4 \times 2} + \sqrt{49 \times 2}}$ $= \frac{6\sqrt{2}}{2\sqrt{2} + 7\sqrt{2}}$ $= \frac{6\sqrt{2}}{9\sqrt{2}}$ $= \frac{2}{3}$	✓ simplifying surds ✓ adding like surds ✓ answer (3)

2.1.3	$\frac{6(3^{n+1})}{3^{n(n-1)}} \div \frac{2.9^{n+1}}{3^{n^2-1}}$ $= \frac{6.3^n.3^1}{3^{n^2}.3^{-n}} \times \frac{3^{n^2}.3^{-1}}{2.3^{2n}.3^2}$ $= \frac{1}{3}$ **OR** $\frac{6(3^{n+1})}{3^{n(n-1)}} \div \frac{2.9^{n+1}}{3^{n^2-1}}$ $= 6.3^{n+1-n^2+n} \div 2.3^{2n+2-n^2+1}$ $= \frac{6.3^{-n^2+2n+1}}{2.3^{-n^2+2n+3}}$ $= \frac{3^{-n^2+2n+2}}{3^{-n^2+2n+3}}$ $= \frac{1}{3}$	✓ writing as prime bases ✓ simplification using exp. laws ✓ ÷ to × and invert 2nd fraction ✓ answer (4) ✓ writing as prime bases ✓ simplification using laws ✓ simplification using laws ✓ answer (4)
2.2	$3^x.5+3^{x+1}=216$ $3^x.5+3^x.3^1=216$ $8.3^x=216$ $3^x=27$ $3^x=3^3$ $x=3$	✓ simplification to 8.3^x ✓ $3^x=27$ ✓ answer (3)
2.3	$\frac{18^x}{2^{-x}}$ $= \frac{(3.6)^x}{2^{-x}}$ $= 3^x.6^x.2^x$ $= (36)^x$ or $(6^x)^2$ $= 5^2$ $= 25$ **OR** $\frac{18^x}{2^{-x}}$ $= \frac{2^x.3^{2x}}{2^{-x}}$ $= 2^{2x}.3^{2x}$ $= (6^x)^2$ $= 5^2$ $= 25$	✓simplification suing exp. laws ✓for writing as $(36)^x$ or $(6^x)^2$ ✓ answer (3) ✓simplification suing exp. laws ✓for writing as $(36)^x$ or $(6^x)^2$ ✓ answer (3)
		[15]

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QUESTION 3

3.1	26 ; 37	✓✓ answers (2)
3.2	$x-3$ $\quad -2x+2$ $\quad 3x+11$ $\quad 4x+12$ $-3x+5$ $\quad 5x+9$ $\quad x+1$ $8x+4$ $\quad -4x-8$ $5x+9+3x-5 = x+1-5x-9$ $8x+4 = -4x-8$ $x = -1$	✓ 1st difference ✓ 2nd difference ✓ equating 2nd differences ✓ answer (4)
3.3.1	3 7 13 21 4 6 8 2 2 $2a = 2$ $\quad 3a+b = 4$ $\quad a+b+c = 3$ $a = 1$ $\quad b = 1$ $\quad c = 1$ $T_n = n^2+n+1$	✓ $a = 1$ ✓ b value ✓ c value ✓ answer (4)
3.3.2	$n^2+n+1 > 463$ $n^2+n-462 > 0$ $(n-21)(n+22) > 0$ + o – o + −22 21 ∴ The 22nd term will be the first to exceed 463	✓ $T_n > 463$ ✓ standard form ✓ factors or quadratic formula ✓answer (4)
3.3.3	n^{th} term of 1st difference: $T_n = 2n+2$ $2n+2 = 102$ $n = 50$ ∴ between T_{50} and T_{51}	✓ $T_n = 2n+2$ ✓ equating T_n to 102 ✓ value of n ✓ answer (4)
3.3.4	The nos. at the end of the rows are: 3 ; 7 ; 13 ; 21 ; … $\therefore T_n = n^2+n+1$ $\therefore T_{60} = (60)^2+60+1$ $= 3661$	✓ T_n from 3.3.1 ✓ substitution of 60 for n into Tn ✓ answer (3)

3.4	6 ; p ; q ; r ; 42 ; … 6 + 4(common difference) = 42 4(common difference) = 36 common difference = 9 $\therefore p = 15$ $\therefore q = 24$ $\therefore r = 33$ **OR** 6 ; p ; q ; r ; 42 ; … $T_n = bn + c$ $6 = b + c \ldots T_1 = 6$ $42 = 5b + c \ldots T_5 = 42$ $4b = 36$ $b = 9$ $\therefore p = 15$ $\therefore q = 24$ $\therefore r = 33$	✓ 6 + 4(common difference) = 42 ✓ common difference ✓ value of p ✓ values of q and r (4) ✓ setting up equations ✓ common difference ✓ value of p ✓ values of q and r (4)
		[25]

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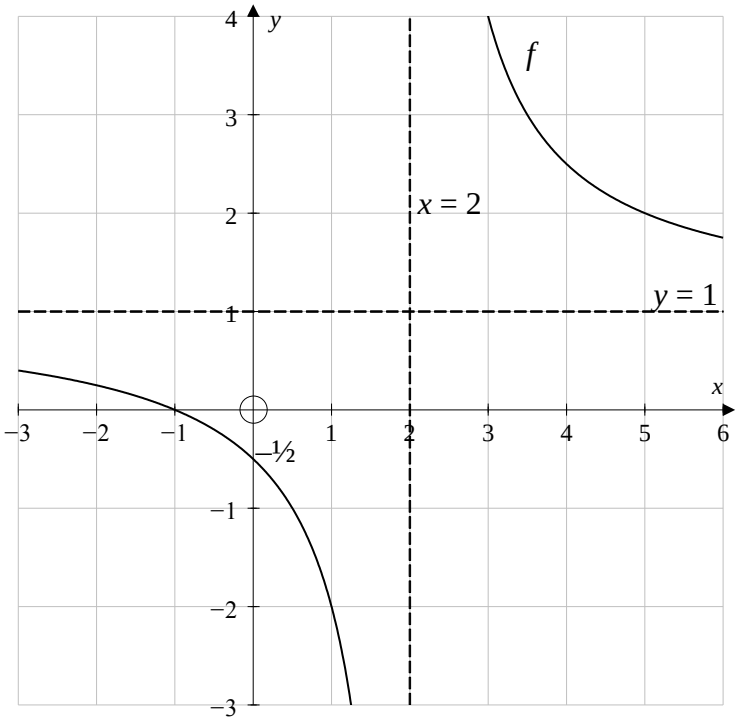
QUESTION 4

4.1	$f(x)=\frac{3}{x-2}+1$ $x = 2$ $y = 1$	✓ $x = 2$ ✓ $y = 1$ (2)
4.2	y-intercept $y=-\frac{1}{2}$	✓ answer (1)
4.3	x intercept $\frac{3}{x-2}+1=0$ $x-2=-3$ $x=-1$	✓ set $y = 0$ ✓answer (2)
4.4		✓ both asymptotes ✓x and y intercepts ✓ shape (3)
4.5	$h(x)=\frac{3}{x-4}+1$ Domain: $\{x/\ x\ \varepsilon\ R\ ;\ x \neq 4\}$	✓✓ answer (2)
		[10]

QUESTION 5

5.1.1	C	✓ answer (1)
5.1.2	A	✓ answer (1)
5.1.3	B	✓ answer (1)
5.2.1	$y = a(x)(x-4)$ $-3 = a\,(1)(1-4)$ $1 = a$ $y = x(x-4)$ $= x^2 - 4x$ $b = -4$	✓ substituting *x*-intercepts ✓ substituting $(1\,;-3)$ ✓ writing eqn. in standard form (3)
5.2.2	$x = 2$ $y = 2^2 - 4(2)$ $= -4$ $P(2\,;-4)$	✓ $x = 2$ ✓ $y = -4$ (2)
5.2.3	$y \in [-4;\infty)$ **OR** $y \geq -4$	✓ answer (1) ✓ answer (1)
5.2.4	$t = -4$	✓ answer (1)
5.2.5	$y = k^x + t$ $0 = k^2 - 4$ $4 = k^2$ $\therefore\ k = 2$	✓ substituting –4 , 0 and 2 ✓ answer (2)
5.2.6	$r > 4$ **OR** $r \in (4\,;\infty)$	✓✓ answer (2) ✓✓ answer (2)
		[14]

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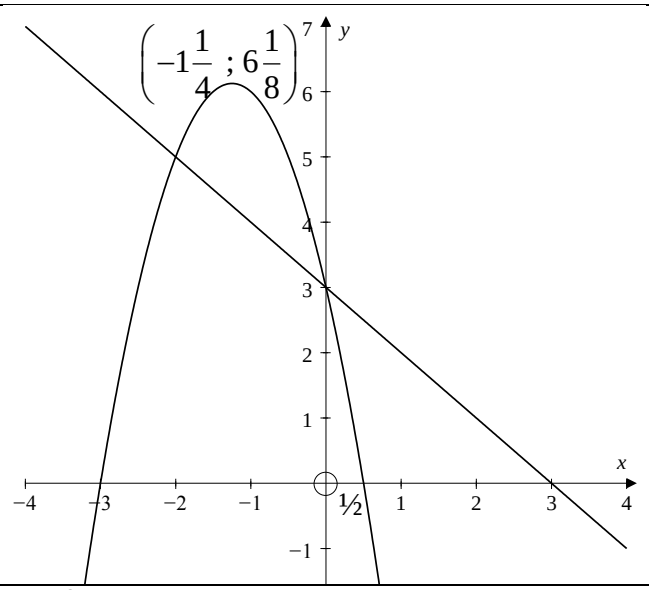
QUESTION 6

6.1	x-intercepts: $-2x^2 - 5x + 3 = 0$ $2x^2 + 5x - 3 = 0$ $(2x - 1)(x + 3) = 0$ $x = \frac{1}{2}$ or $x = -3$ y-intercept: (0 ; 3)	✓ factors ✓ x-intercepts ✓ y-intercept (3)
6.2	Axis of symmetry: $x = \frac{x_1 + x_2}{2}$ or $x = \frac{-b}{2a}$ $x = \frac{-3 + \frac{1}{2}}{2}$ or $x = \frac{-(-5)}{2(-2)}$ $x = -\frac{5}{4}$ Maximum value: $y = -2(\frac{-5}{4})^2 - 5\left(\frac{-5}{4}\right) + 3$ $y = \frac{49}{8}$ ∴ Turning point: $\left(-1\frac{1}{4} ; 6\frac{1}{8}\right)$	✓ x–coordinate ✓ y–coordinate (2)
6.3	$m = tan\,135°$ $m = -1$	✓ answer (1)
6.4		✓ y intercept of p ✓ x intercepts of p ✓ turning point of p ✓ y intercept of q ✓ x intercept of q (5)
6.5	$-2x^2 - 5x + 3 = -x + k$ $-2x^2 - 4x + 3 - k = 0$ $(-4)^2 - 4(-2)(3 - k) = 0$ $16 + 24 - 8k = 0$ $k = 5$	✓ equating ✓ substituting into $b^2 - 4ac = 0$ ✓ answer (3)
		[14]

TOTAL: 100