

KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 11

MATHEMATICS

COMMON TEST

JUNE 2021

MARKS: 50

TIME: 1 hour

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. Number the answers correctly according to the numbering system used in this question paper.
4. Clearly show ALL calculations, diagrams, graphs, etc. which 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. Diagrams are NOT necessarily drawn to scale.
9. A DIAGRAM SHEET for QUESTION 3.2 is attached at the end of this question paper. Detach the DIAGRAM SHEET and hand it in together with your ANSWER BOOK.
10. Write neatly and legibly.

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QUESTION 1

The first three terms of a quadratic number pattern are 50 ; 35 and 24.

1.1 Write down the next two terms in this number pattern. (2)

1.2 Determine the general term of this number pattern in the form $T_n = an^2 + bn + c$. (4)

1.3 Calculate the value of the 30^{th} first difference of this number pattern. (3)

[9]

QUESTION 2

Given: $f(x) = -2x^2 - 4x + 30$

2.1 Determine the x-intercepts of f. (3)

2.2 Determine the equation of the axis of symmetry of f. (2)

2.3 Determine the range of f. (2)

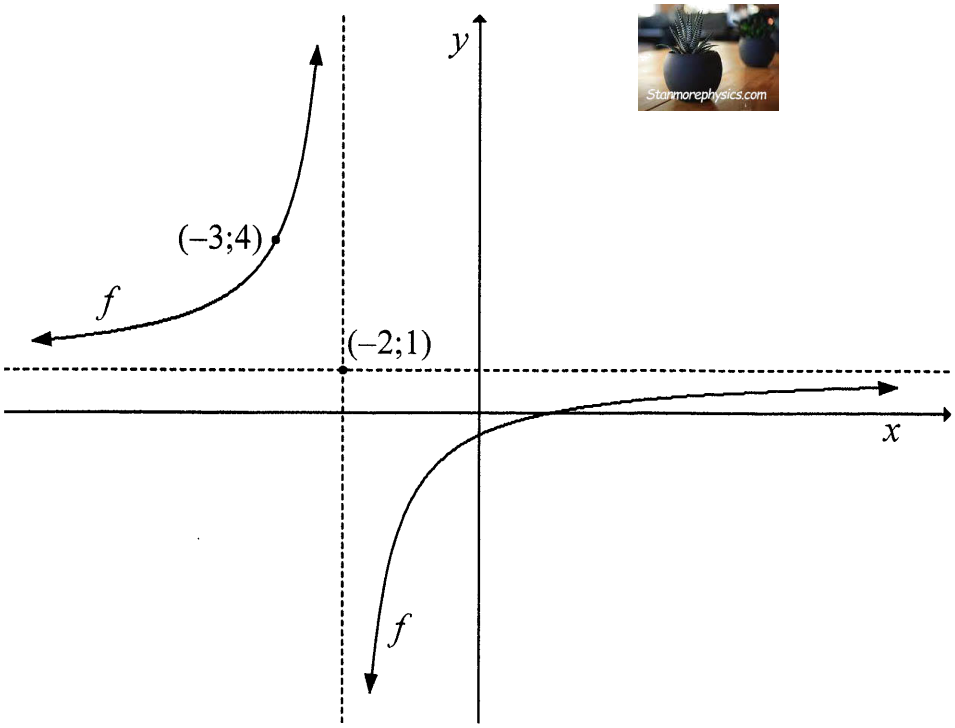
2.4 Graph g is obtained by reflecting graph f in the x-axis and then translating it 4 units to the right. Determine the equation of graph g, in the form $g(x) = a(x + p)^2 + q$. (3)

[10]

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QUESTION 3

The diagram below shows the graph of hyperbola f passing through the point $(-3;4)$ and having asymptotes intersecting at $(-2;1)$.



3.1 Determine the equation of f in the form $f(x)=\frac{a}{x+p}+q$. (3)

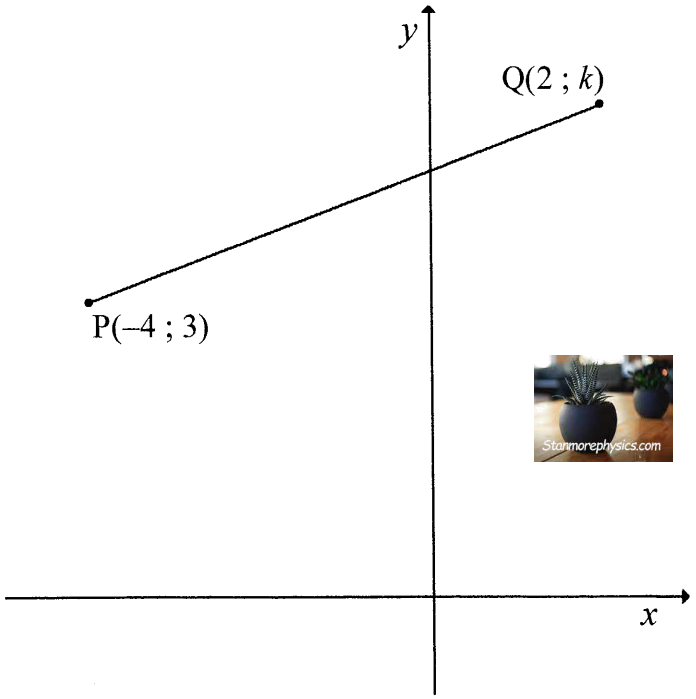
3.2 The graph f is drawn on the grid on the diagram sheet. On the same grid, sketch the graph of $g(x)=2^{-x}-4$. Clearly label all the intercepts that g makes with the axes and show any asymptotes of g. (5)

3.3 If it is given that f and g intersect at $(-3;4)$ and $(-1;-2)$, determine the values of x for which $g(x)\geq f(x)$. (3)

[11]

QUESTION 4

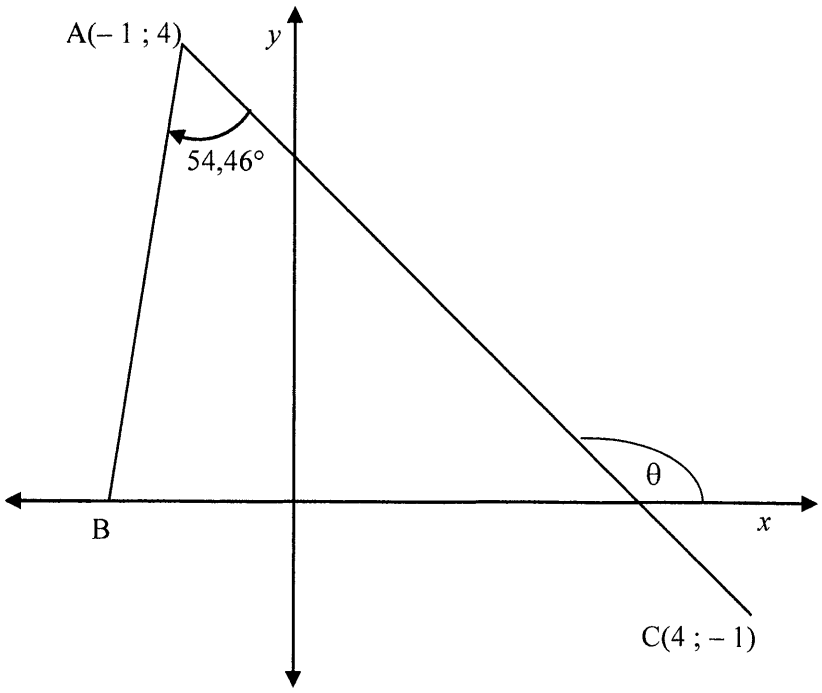
4.1 P$(-4;3)$ and Q$(2;k)$ are two points in the Cartesian plane such that the gradient of PQ is positive and the distance PQ is $2\sqrt{10}$ units.



4.1.1 Show that $k = 5$. (3)

4.1.2 Determine the equation of PQ. (4)

4.2 In the diagram A(–1 ; 4) and C(4 ; –1) are points in a Cartesian plane. B is a point on the x-axis such that $\hat{BAC} = 54{,}46°$.



4.2.1 Calculate the size of (θ), angle of inclination of AC. (3)

4.2.2 Calculate the coordinates of B. (4)

[14]

QUESTION 5

Consider the following equation: $3\sin^2 x + \cos^2 x - 5 = 7\sin x$.

5.1 Show that the equation $3\sin^2 x + \cos^2 x - 5 = 7\sin x$ can be written as $2\sin^2 x - 7\sin x - 4 = 0$. (1)

5.2 Hence, or otherwise, determine the general solution of $3\sin^2 x + \cos^2 x - 5 = 7\sin x$. (5)

[6]

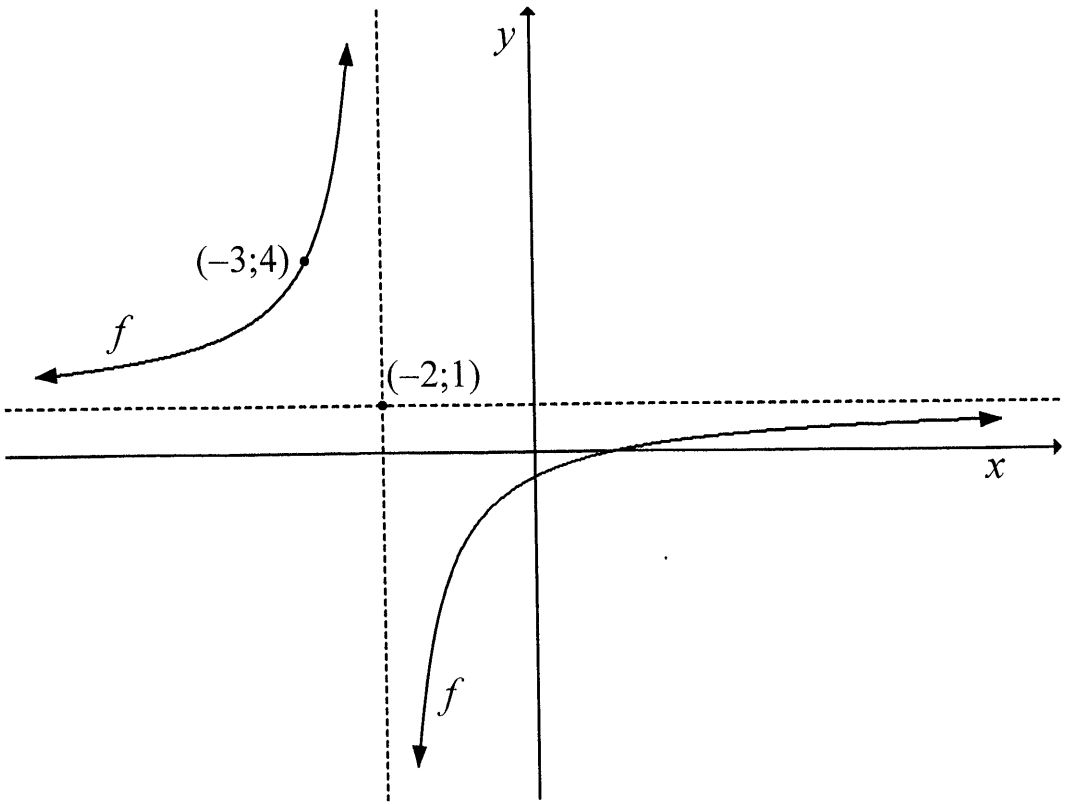
TOTAL: 50

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NAME & SURNAME:

DIAGRAM SHEET

QUESTION 3.2



TEAR OFF

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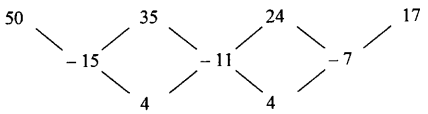
MARKING GUIDELINE

MARKS: 50

This marking guideline consists of 7 pages.

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QUESTION 1

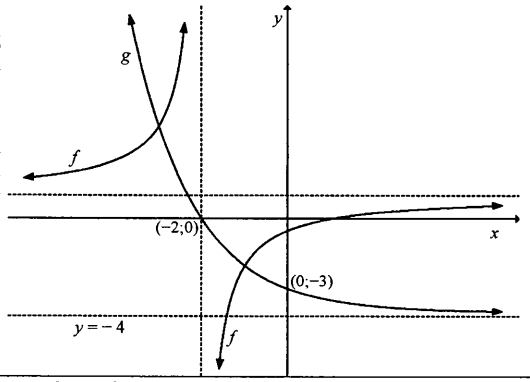
1.1	 17; 14	✓ 17 ✓ 14 (2)
1.2	$2a=4$ $a=2$ $3a+b=-15$ $3(2)+b=-15$ $b=-21$ $a+b+c=50$ $2+(-21)+c=50$ $c=69$ $T_n=2n^2-21n+69$	✓ value of a ✓ value of b ✓ value of c ✓ T_n (4)
1.3	First differences pattern: $-15;-11;-7;\ldots$ $T_n=an+b$ $T_n=4n-19$ $T_n=4(30)-19$ $=101$	✓ $T_n=4n-19$ ✓ substitution ✓ answer (3)
		[9]

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QUESTION 2

2.1	For x-intercepts, substitute $y=0$: $y=-2x^2-4x+30$ $-2x^2-4x+30=0$ $x^2+2x-15=0$ $(x+5)(x-3)=0$ $x=-5$ or $x=3$	✓ substitute $y=0$ ✓ factors ✓ both answers (3)
2.2	$x=\frac{-b}{2a}$ $=\frac{-(-4)}{2(-2)}$ $=-1$ **OR** $x=\frac{-5+3}{2}$ $=-1$	✓ substitution ✓ answer (2) **OR** ✓ substitution ✓ answer (2)
2.3	$f(-1)=-2(-1)^2-4(-1)+30$ $=32$ Range: $y\le 32$ **OR** $y\in(-\infty;32]$	✓ substitute $y=-1$ ✓ $y\le 32$ **OR** $y\in(-\infty;32]$ (2)
2.4	$f(x)=-2(x+1)^2+32$ $-f(x)=2(x+1)^2-32$ $g(x)=2(x+1-4)^2-32$ $g(x)=2(x-3)^2-32$ **OR** Turning point of f: $(-1;32)$ Turning point of g: $(3;-32)$ $\therefore g(x)=2(x-3)^2-32$	$f(x)=-2(x+1)^2+32$ ✓ for reflection in x-axis ✓ translation of 4 units right ✓ $g(x)=2(x-3)^2-32$ (3) **OR** ✓ for $a=2$ ✓ for $(x-3)$ ✓ for minimum value of -32 (3)
		[10]

QUESTION 3

3.1	$y=\frac{a}{x+p}+q$ $y=\frac{a}{x+2}+1$ Substitute $(-3;4)$ $4=\frac{a}{-3+2}+1$ $3=\frac{a}{-1}$ $a=-3$ $y=\frac{-3}{x+2}+1$	✓ $y=\frac{a}{x+2}+1$ ✓ $4=\frac{a}{-3+2}+1$ ✓ $y=\frac{-3}{x+2}+1$ (3)
3.2	For x-intercept, substitute $y=0$: $0=2^{-x}-4$ $2^{-x}=4$ $x=-2$  	✓ $x=-2$ ✓ shape Indicating the: ✓ x-intercept ✓ y-intercept ✓ asymptote (5)
3.3	$x\le -3$ or $-2<x\le -1$ **OR** $x\in(-\infty;-3]\cup(-2;-1]$	✓ $x\le -3$ ✓✓ $-2<x\le -1$ (3) **OR** ✓ $(-\infty;-3]$ ✓✓ $(-2;-1]$ (3)
		[11]

QUESTION 4

4.1.1	$2\sqrt{10} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ $2\sqrt{10} = \sqrt{[2-(-4)]^2 + (k-3)^2}$ $40 = (k-3)^2 + (2+4)^2$ $40 = k^2 - 6k + 9 + 36$ $k^2 - 6k + 5 = 0$ $(k-1)(k-5) = 0$ $k \neq 1$ or $k = 5$	✓ substitution ✓ squaring both sides ✓ factorisation (3)
4.1.2	$m = \frac{y_2 - y_1}{x - x_1}$ $= \frac{3-5}{-4-2}$ $= \frac{1}{3}$ $y - y_1 = m(x - x_1)$ $\qquad y = mx + c$ Substitute $(-4;3)$ and $m = \frac{1}{3}$: $y - 3 = \frac{1}{3}(x-(-4))$ OR $3 = \frac{1}{3}(-4) + c$ $y - 3 = \frac{1}{3}x + \frac{4}{3}$ $\qquad c = \frac{13}{3}$ $y = \frac{1}{3}x + \frac{13}{3}$ $\qquad y = \frac{1}{3}x + \frac{13}{3}$	✓ substitution ✓ value of m ✓ substitution ✓ answer (4)

4.2.1	$m_{AC} = \frac{y_2 - y_1}{x_2 - x_1}$ $= \frac{-1-4}{4-(-1)}$ $= -1$ $\tan\theta = -1$ Reference angle: 45° Angle of inclination $= 180° - 45° = 135°$	✓ $m_{AC} = -1$ ✓ reference angle: 45° ✓ answer: 135° (3)
4.2.2	Angle of inclination of AB $= 135° - 54{,}46°$ $= 80{,}54°$ $\therefore m_{AB} = \tan 80{,}54°$ $= 6$ Also: $m_{AB} = \frac{4-0}{-1-x}$ $\therefore 6 = \frac{4-0}{-1-x}$ $-6 - 6x = 4$ $x = -\frac{5}{3}$ $B\left(-\frac{5}{3};0\right)$ OR Angle of inclination of AB $= 135° - 54{,}46°$ $= 80{,}54°$ $\therefore m_{AB} = \tan 80{,}54°$ $= 6$ Equation of AB: $y = 6x + c$ Substitute $(-1;4)$: $4 = 6(-1) + c$ $c = 10$ $\therefore y = 6x + 10$ Substitute $y = 0$: $\therefore 0 = 6x + 10$ $\therefore x = -\frac{5}{3}$ $B\left(-\frac{5}{3};0\right)$	✓ 80,54° ✓ $m_{AB} = 6$ ✓ equating ✓ $x = -\frac{5}{3}$ (4) OR ✓ 80,54° ✓ $m_{AB} = 6$ ✓ equation of AB ✓ $x = -\frac{5}{3}$ (4)
		[14]

QUESTION 5

5.1	$3\sin^2 x+\cos^2 x-5=7\sin x$ $3\sin^2 x+1-\sin^2 x-5=7\sin x$ $2\sin^2 x-7\sin x-4=0$	✓ $\cos^2 x=1-\sin^2 x$ (1)
5.2	$2\sin^2 x-7\sin x-4=0$ $(2\sin x+1)(\sin x-4)=0$ $\sin x=-\frac{1}{2}$ or $\sin x=4$ Ref. $\angle$: 30° no solution $x=180^\circ+30^\circ+k.360^\circ$ (third quadrant) $=210^\circ+k.360^\circ$ or $x=360^\circ-30^\circ+k.360^\circ$ (fourth quadrant) $=330^\circ+k.360^\circ$ $k\in Z$	✓ factors ✓ $\sin x=-\frac{1}{2}$ or $\sin x=4$ ✓ no solution ✓ $x=210^\circ$ or $x=330^\circ$ ✓ $+k.360^\circ$; $k\in Z$ (5)
		[6]

TOTAL: 50

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