



KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA



**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

MATHEMATICS

COMMON TEST

JUNE 2022

Stanmorephysics.com

MARKS: 100

TIME: 2 hours

**This question paper consists of 6 pages and
2 DIAGRAM SHEETS.**

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, 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. TWO DIAGRAM SHEETS for QUESTION 3.2, QUESTION 4, and QUESTION 5 are attached at the end of this question paper.
Detach the DIAGRAM SHEETS and hand in together with your ANSWER BOOK.
10. Write neatly and legibly.

QUESTION 1

1.1 Consider the following linear number pattern: 11 ; 17 ; 23 ; 29 ; ; 299 .

1.1.1 Determine T_n , the general term of this pattern, in the form $T_n = an + b$. (2)

1.1.2 Calculate the value of the 20th term in this pattern. (2)

1.1.3 Calculate the number of terms in this pattern. (2)

1.1.4 The terms of this linear number pattern is the sequence of 1st differences of a quadratic number pattern, i.e. the 1st differences of the quadratic number pattern are 11 ; 17 ; 23 ; ...
If the fifth term of this quadratic number pattern is 100, what will be the value of the second term? (2)

1.2 Consider the following quadratic number pattern: -16 ; -12 ; -4 ; 8 ;

1.2.1 Write down the next two terms in the pattern. (2)

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

1.2.3 Show that all the terms of this number pattern are even numbers. (2)

1.2.4 A new pattern with general term P_n is formed such that $P_n = T_n - 128$. How many negative terms will there be in this new pattern? (4)

[20]

QUESTION 2

Given: $f(x) = -x^2 + 3x + 10$

2.1 Calculate the coordinates of the turning point of f . (3)

2.2 Write down the range of f . (1)

2.3 Calculate the x -intercepts of f . (3)

2.4 Sketch the graph of f , clearly indicating all the intercepts with the axes and the coordinates of the turning point. (4)

2.5 For which values of k will $-x^2 + 3x + 10 = k$ have two positive, unequal real roots? (2)

2.6 The graph of f is translated 2 units to the right and 3 units down to obtain the graph of g . Write down the equation of g in the form $g(x) = a(x + p)^2 + q$. (3)

[16]

QUESTION 3

3.1 Given: $h(x) = \left(\frac{1}{3}\right)^x + 4$

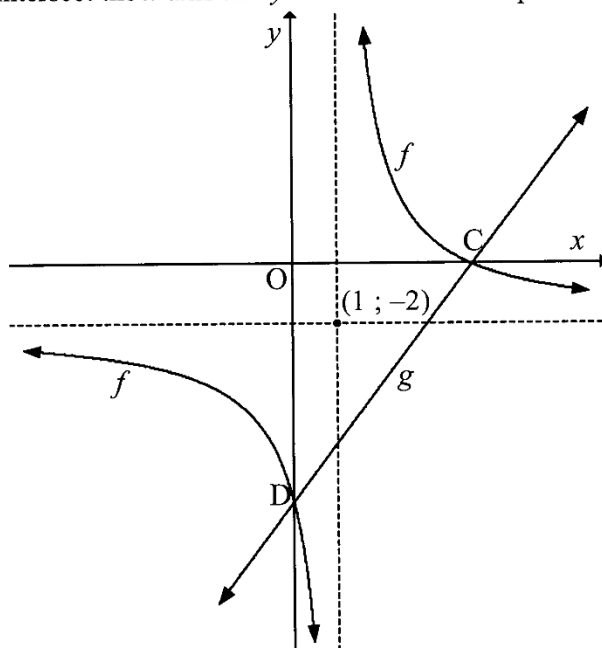
3.1.1 Write down the equation of the asymptote of h . (1)

3.1.2 Draw a sketch graph of h , clearly indicating the asymptote and any intercepts with the axes. (3)

3.1.3 Two transformations are applied to h to obtain the graph of $m(x) = -3^x - 4$. Write down the two transformations. (2)

3.2 The diagram below shows the graphs of $f(x) = \frac{a}{x+p} + q$ and $g(x) = mx - 8$.

- The asymptotes of f intersect at $(1; -2)$.
- Graphs f and g intersect the x -axis and y -axis at C and D respectively.



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

3.2.2 Write down the domain of f . (1)

3.2.3 Calculate the value of a . (3)

3.2.4 Calculate the value of m . (4)

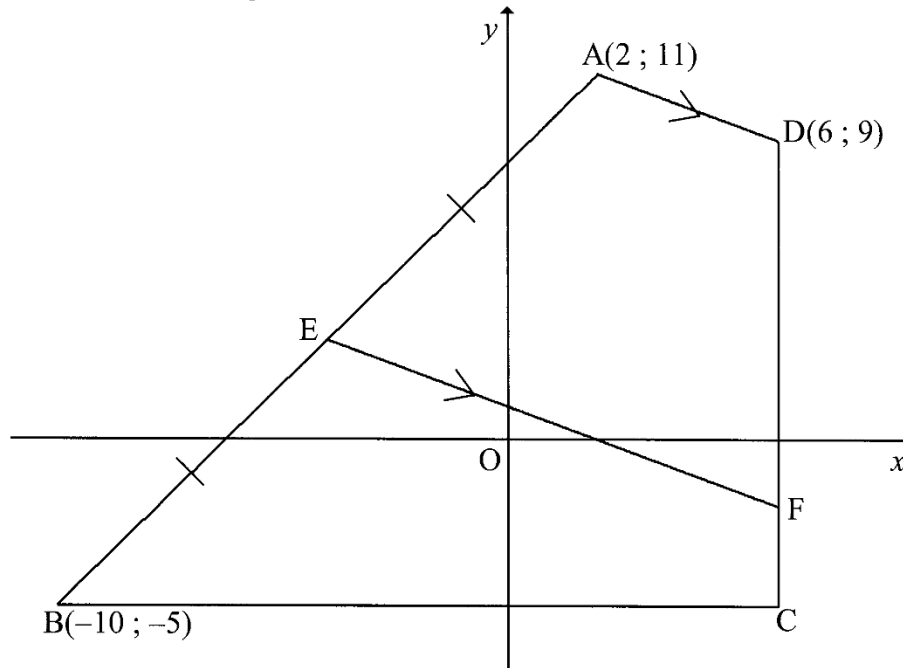
3.2.5 Determine the equation of the axis of symmetry of g that has a positive gradient. (2)

3.2.6 For which values of x will $f(x) \leq g(x)$? (3)

[21]

QUESTION 4

In the diagram below, $A(2 ; 11)$, $B(-10 ; -5)$, C and $D(6 ; 9)$ are the vertices of a quadrilateral in the Cartesian plane. BC is a horizontal line and CD a vertical line. E is the midpoint of AB . F is a point on CD such that EF is parallel to AD .

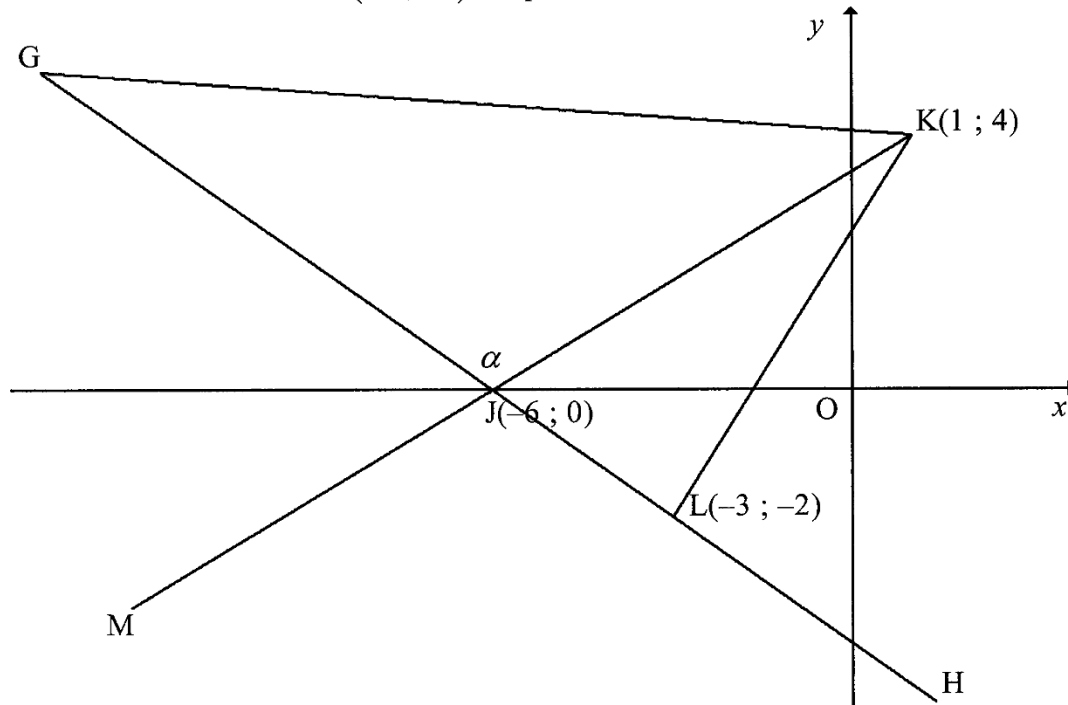


- 4.1 Write down the coordinates of C . (2)
- 4.2 Calculate the coordinates of E . (2)
- 4.3 Determine the equation of EF . (4)
- 4.4 Calculate the coordinates of F . (2)

[10]

QUESTION 5

In the diagram below, straight line GH cuts the x -axis at $J(-6; 0)$. K is the point $(1; 4)$. KJ is produced to M and GK is drawn. $L(-3; -2)$ is a point on GH and KL is drawn. $\hat{GJK} = \alpha$.



- 5.1 Calculate the gradient of GH. (2)
- 5.2 Calculate the angle of inclination of MK. (4)
- 5.3 Determine the size of angle α . (3)
- 5.4 Prove that $KL \perp JL$. (3)
- 5.5 Calculate the area of ΔKJL . (5)

[17]

QUESTION 6

- 6.1 Prove that $(1 - \sin^2 \theta)(1 + \tan^2 \theta) = 1$. (3)
- 6.2 Solve for x if $\sin(2x + 30^\circ) = -0,4$ and $x \in [-90^\circ; 90^\circ]$ (7)
- 6.3 Determine the general solution of $3 \sin x \cos x - 4 \cos^2 x = 0$. (6)

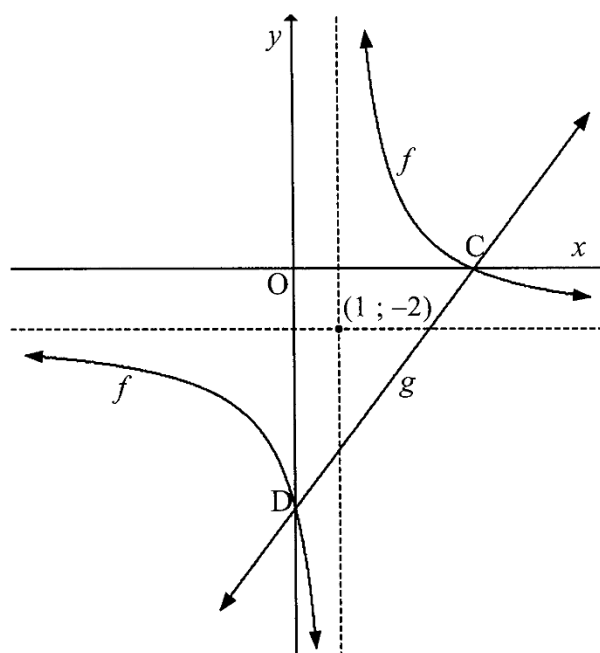
[16]

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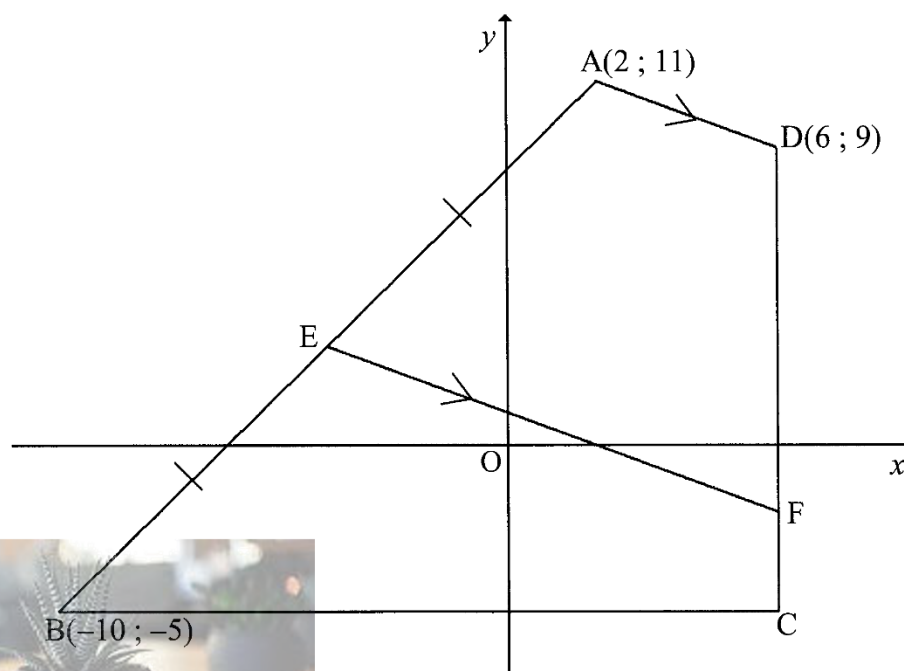
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DIAGRAM SHEET 1

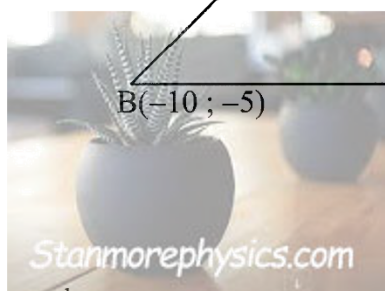
QUESTION 3.2



QUESTION 4



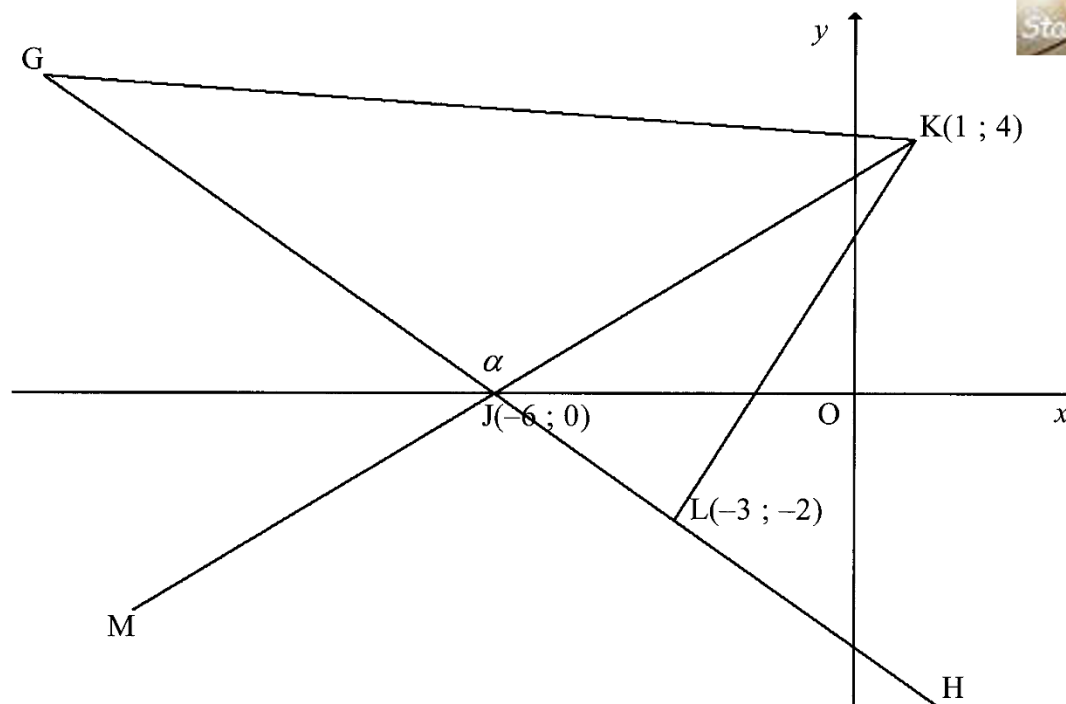
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DIAGRAM SHEET 2

QUESTION 5



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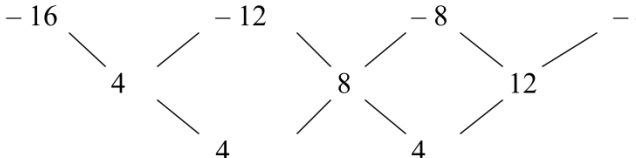
MARKING GUIDELINE

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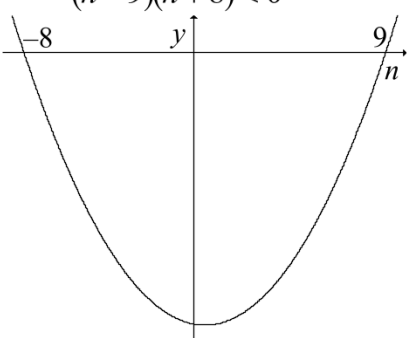
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These marking guideline consist of 8 pages.

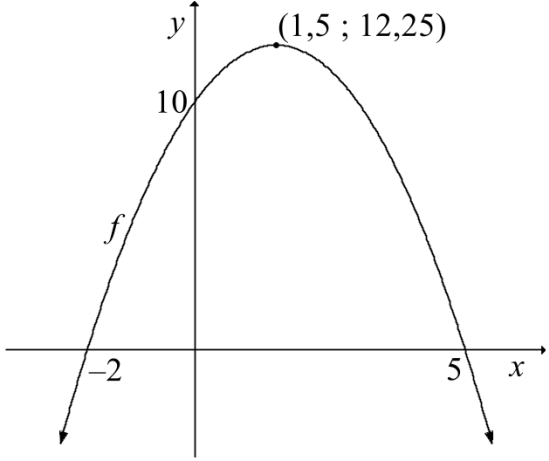
QUESTION 1

1.1.1	$T_n = an + b$ $T_n = 6n + b$ $T_1 = 6(1) + b = 11$ $b = 11 - 6 = 5$ $T_n = 6n + 5$ 	✓ ✓ $6n + 5$ (2)
1.1.2	$T_n = 6n + 5$ $T_{20} = 6(20) + 5$ $= 125$	✓ substitution ✓ answer (2)
1.1.3	$299 = 6n + 5$ $6n = 294$ $n = 49$ There are 49 terms in the pattern.	✓ substitution ✓ answer (2)
1.1.4	Quadratic number pattern: Term 1 Term 2 Term 3 Term 4 100 \ / \ / \ / 11 17 23 29 Term 2 = $100 - (17 + 23 + 29)$ $= 31$	✓ $100 - (17 + 23 + 29)$ ✓ answer (2)
1.2.1	24 ; 44	✓ 24 ✓ 44 (2)
1.2.2	 Second difference = 4 $a = \frac{2nd \text{ difference}}{2}$ $= 2$ first 1st difference = $3a + b = 4$ $3(2) + b = 4$ $b = -2$ Term 1 = $a + b + c = -16$ $2 - 2 + c = -16$ $c = -16$ Therefore: $T_n = 2n^2 - 2n - 16$	✓ value of a ✓ value of b ✓ value of c ✓ answer (4)

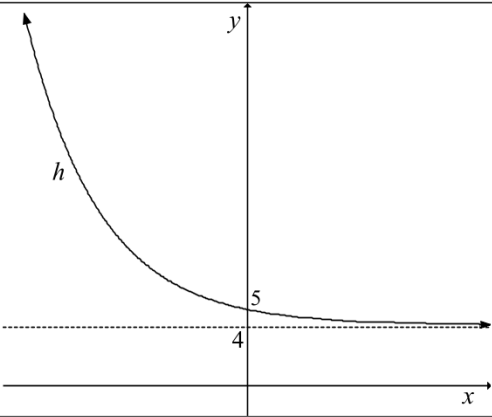
GRADE 11
Marking Guideline

1.2.3	$T_n = 2n^2 - 2n - 16$ $= 2(n^2 - n - 8)$ Because n is a natural number, $n^2 - n - 8$ will also be a natural number. And: $2(\text{a natural number})$ will always be even. OR The given terms in the number pattern are even. The 1st differences between terms are also even. An even number plus an even number will always give an even number. Therefore all terms are even numbers.	✓ $2(n^2 - n - 8)$ ✓ reasoning: multiples of 2 (2) OR ✓ given terms are even ✓ reasoning (2)
1.2.4	$P_n = T_n - 128 = 2n^2 - 2n - 144$ Let $P_n < 0$ $\therefore 2n^2 - 2n - 144 < 0$ $n^2 - n - 72 < 0$ $(n - 9)(n + 8) < 0$  $\therefore -8 < n < 9$ But $n \in \mathbb{N}$, so $n > 0$: $\therefore 0 < n < 9$ $\therefore$ there are 8 negative terms. Answer only: 1 mark only	✓ expression for P_n ✓ $2n^2 - 2n - 144 < 0$ ✓ solution for inequality ✓ answer (4)
[20]		

QUESTION 2

2.1	$x = -\frac{b}{2a}$ $= -\frac{-3}{2(-1)}$ $= \frac{3}{2}$ $f\left(\frac{3}{2}\right) = -\left(\frac{3}{2}\right)^2 + 3\left(\frac{3}{2}\right) + 10$ $= \frac{49}{4} = 12\frac{1}{4}$ Turning point: $\left(\frac{3}{2}; 12\frac{1}{4}\right)$	 ✓ substitution ✓ x-value of TP ✓ y-value of TP (3)
2.2	$y \leq 12\frac{1}{4}$ OR $y \in (-\infty; 12,25]$	✓ answer (1)
2.3	$-x^2 + 3x + 10 = 0$ $x^2 - 3x - 10 = 0$ $(x+2)(x-5) = 0$ $x = -2$ or $x = 5$	✓ $f(x) = 0$ ✓ factors ✓ x-values (3)
2.4		✓ shape ✓ x-intercepts ✓ y-intercept ✓ turning point (4)
2.5	$10 < k < 12\frac{1}{4}$ OR $k \in \left(10; 12\frac{1}{4}\right)$	✓ ✓ answer (2)
2.6	$g(x) = -\left(x - \frac{7}{2}\right)^2 + 9\frac{1}{4}$	✓ - (value of $a = -1$) ✓ $-\frac{7}{2}$ (value of $p = -\frac{7}{2}$) ✓ $+9\frac{1}{4}$ (value of $q = 9\frac{1}{4}$) (3)
		[16]

QUESTION 3

3.1.1	$y = 4$	✓ answer (1)
3.1.2		✓ shape ✓ asymptote ✓ y-intercept (3)
3.1.3	reflection in x -axis reflection in y -axis	✓ reflection in x -axis ✓ reflection in y -axis (2)
3.2.1	$p = -1$ $q = -2$	✓ $p = -1$ ✓ $q = -2$ (2)
3.2.2	$x \in R$, but $x \neq 1$ OR $x \in (-\infty ; 1) \text{ or } (1 ; \infty)$	✓ $x \in R$, but $x \neq 1$ (1) OR ✓ $x \in (-\infty ; 1) \text{ or } (1 ; \infty)$ (1)
3.2.3	Coordinates of D: $(0 ; -8)$ Equation of f : $y = \frac{a}{x-1} - 2$ Substitute $(0 ; -8)$: $-8 = \frac{a}{0-1} - 2$ $a = 8 - 2$ $a = 6$	✓ $D(0 ; -8)$ ✓ substitution ✓ answer (3)
3.2.4	C is the x -intercept of f . Substitute $y = 0$: $0 = \frac{6}{x-1} - 2$ $2 = \frac{6}{x-1}$ $2x - 2 = 6$ $x = 4$ $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-8 - 0}{0 - 4}$ $= 2$	✓ substitution ✓ x -coordinate of C ✓ substitution ✓ answer (4)
3.2.5	$y = x + c$ Substitute $(1; -2)$: $-2 = 1 + c$ $c = -3$ $y = x - 3$	✓ ✓ $x - 3$ (2)

GRADE 11
Marking Guideline

3.2.6	$0 \leq x < 1$ or $x \geq 4$ OR $x \in [0 ; 1)$ or $[4 ; \infty)$	$\checkmark \checkmark 0 \leq x < 1$ $\checkmark x \geq 4$ (3) OR $\checkmark \checkmark x \in [0 ; 1)$ $\checkmark [4 ; \infty)$ (3)
[21]		

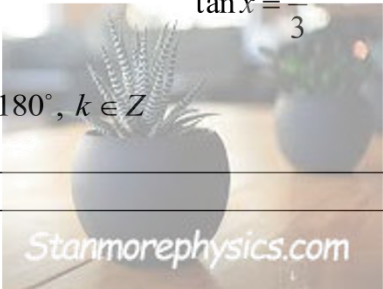
QUESTION 4

4.1	$C(6 ; -5)$	$\checkmark 6$ $\checkmark -5$ (2)
4.2	$E\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$ $=\left(\frac{-10 + 2}{2}, \frac{-5 + 11}{2}\right)$ $=(-4 ; 3)$ Answer only: full marks	$\checkmark$ substitution $\checkmark$ answer (2)
4.3	$m_{AD} = \frac{y_2 - y_1}{x_2 - x_1}$ $= \frac{9 - 11}{6 - 2}$ $= -\frac{1}{2}$ $m_{EF} = m_{AD} = -\frac{1}{2}$ Substitute m_{EF} and coordinates of E: $y = mx + c$ $3 = \left(-\frac{1}{2}\right)(-4) + c$ $3 = 2 + c$ $c = 1$ $y = -\frac{1}{2}x + 1$	$\checkmark$ substitution in gradient formula $\checkmark m_{EF}$ $\checkmark$ substitution in formula for equation of line $\checkmark$ answer (4)
4.4	At F: $x = 6$ $y = -\frac{1}{2}(6) + 1$ $y = -2$ $F(6 ; -2)$	$\checkmark$ substitution of $x = 6$ in equation for EF. $\checkmark y = -2$ (2)
[10]		

QUESTION 5

5.1	$m_{GH} = \frac{0 - (-2)}{-6 - (-3)}$ $= -\frac{2}{3}$	✓ substitution ✓ answer (2)
5.2	$m_{MK} = \frac{y_2 - y_1}{x_2 - x_1}$ $= \frac{4 - 0}{1 - (-6)}$ $= \frac{4}{7}$ $\tan \hat{KJO} = m_{MK} = \frac{4}{7}$ $\hat{KJO} = 29,74^\circ$	✓ substitution ✓ answer ✓ $\tan \hat{KJO} = \frac{4}{7}$ ✓ answer (4)
5.3	$\tan \hat{GJO} = m_{GH} = -\frac{2}{3}$ $\hat{GJO} = 180^\circ - 33,69^\circ$ $= 146,31^\circ$ $\alpha = \hat{GJO} - \hat{KJO}$ $= 146,31^\circ - 29,74^\circ$ $= 116,57^\circ$	✓ size of $\hat{GJO}$ ✓ subtracting ✓ answer (3)
5.4	$m_{KL} = \frac{4 - (-2)}{1 - (-3)}$ $= \frac{3}{2}$ $m_{KL} \times m_{JL} = -\frac{2}{3} \times \frac{3}{2} = -1$ Therefore $KL \perp JL$.	✓ substitution in gradient formula for KL ✓ gradient of KL ✓ multiplying gradients and getting a product of -1 (3)
5.5	$JL = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ $= \sqrt{(-2 - 0)^2 + [-3 - (-6)]^2}$ $= \sqrt{13} \text{ units}$ $KL = \sqrt{(-2 - 4)^2 + (-3 - 1)^2}$ $= \sqrt{52} \text{ OR } 2\sqrt{13} \text{ units}$ Area of $\Delta KJL = \frac{1}{2} \times \text{base} \times \text{height}$ $= \frac{1}{2} \times JL \times KL$ $= \frac{1}{2} \times \sqrt{13} \times 2\sqrt{13}$ $= 13 \text{ square units}$	✓ substitution in distance formula for JL ✓ length of JL ✓ length of KL ✓ substitution in formula for area of triangle ✓ answer (5)

QUESTION 6

6.1	$\text{LHS} = (1 - \sin^2 \theta)(1 + \tan^2 \theta)$ $= (\cos^2 \theta) \left(1 + \frac{\sin^2 \theta}{\cos^2 \theta} \right)$ $= \cos^2 \theta + \sin^2 \theta$ $= 1$ $= \text{RHS}$ 	$\checkmark 1 - \sin^2 \theta = \cos^2 \theta$ $\checkmark \tan^2 \theta = \frac{\sin^2 \theta}{\cos^2 \theta}$ $\checkmark \cos^2 \theta + \sin^2 \theta$ (3)
6.2	$\sin(2x + 30^\circ) = -0,4$ $\text{reference } \angle = 23,58^\circ$ $2x + 30^\circ = 180^\circ + 23,58^\circ + k \cdot 360^\circ, k \in \mathbb{Z}$ $2x = 173,58^\circ + k \cdot 360^\circ$ $x = 86,79^\circ + k \cdot 180^\circ$ or $2x + 30^\circ = 360^\circ - 23,58^\circ + k \cdot 360^\circ, k \in \mathbb{Z}$ $2x = 306,42^\circ + k \cdot 360^\circ$ $x = 153,21^\circ + k \cdot 180^\circ$ In the interval $[-90^\circ; 90^\circ]$: $x = 86,79^\circ$ or $-26,79^\circ$	$\checkmark \text{reference } \angle = 23,58^\circ$ $\checkmark 2x + 30^\circ = 180^\circ + 23,58^\circ + k \cdot 360^\circ$ $\checkmark x = 86,79^\circ + k \cdot 180^\circ$ $\checkmark 2x + 30^\circ = 360^\circ - 23,58^\circ + k \cdot 360^\circ$ $\checkmark x = 153,21^\circ + k \cdot 180^\circ$ $\checkmark 86,79^\circ$ $\checkmark -26,79^\circ$ (7)
6.3	$3 \sin x \cos x - 4 \cos^2 x = 0$ $\cos x(3 \sin x - 4 \cos x) = 0$ $\cos x = 0 \quad \text{or} \quad 3 \sin x - 4 \cos x = 0$ $x = 90^\circ + k \cdot 180^\circ, k \in \mathbb{Z} \quad \text{or} \quad 3 \sin x = 4 \cos x$ $\frac{\sin x}{\cos x} = \frac{4}{3}$ $\tan x = \frac{4}{3}$ $x = 53,13^\circ + k \cdot 180^\circ, k \in \mathbb{Z}$ 	$\checkmark \text{factorisation}$ $\checkmark \text{both equations}$ $\checkmark x = 90^\circ + k \cdot 180^\circ$ $\checkmark \tan x = \frac{4}{3}$ $\checkmark x = 53,13^\circ$ $\checkmark +k \cdot 180^\circ; k \in \mathbb{Z}$ (6)
		[16]

TOTAL: 100