



education

Department:  
Education  
PROVINCE OF KWAZULU-NATAL

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 11**

**MATHEMATICS P2**

**COMMON TEST**

**JUNE 2018**

**MARKS:** 100

**TIME:** 2 hours

This question paper consists of 6 pages.

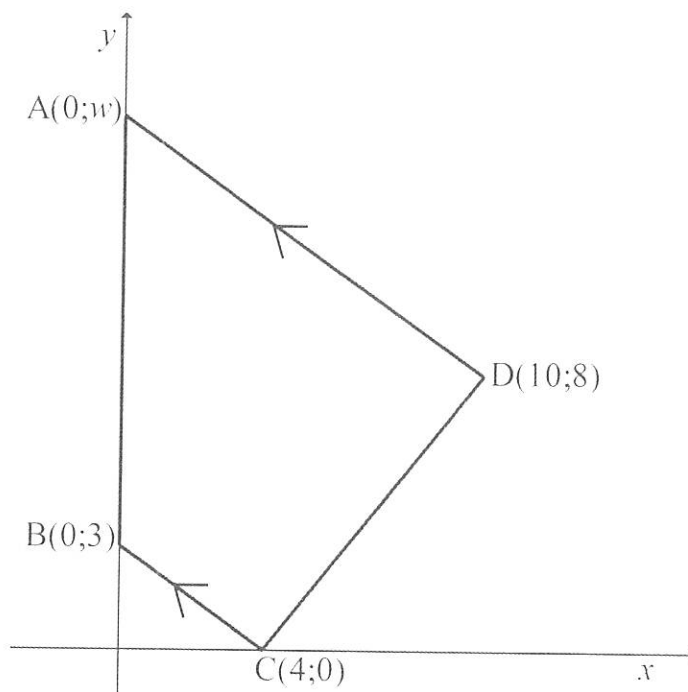
**INSTRUCTIONS AND INFORMATION**

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, 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**

$A(0 ; w)$ ,  $B(0 ; 3)$ ,  $C(4 ; 0)$  and  $D(10 ; 8)$  are the vertices of a quadrilateral in the Cartesian plane.  $AD$  is parallel to  $BC$ .



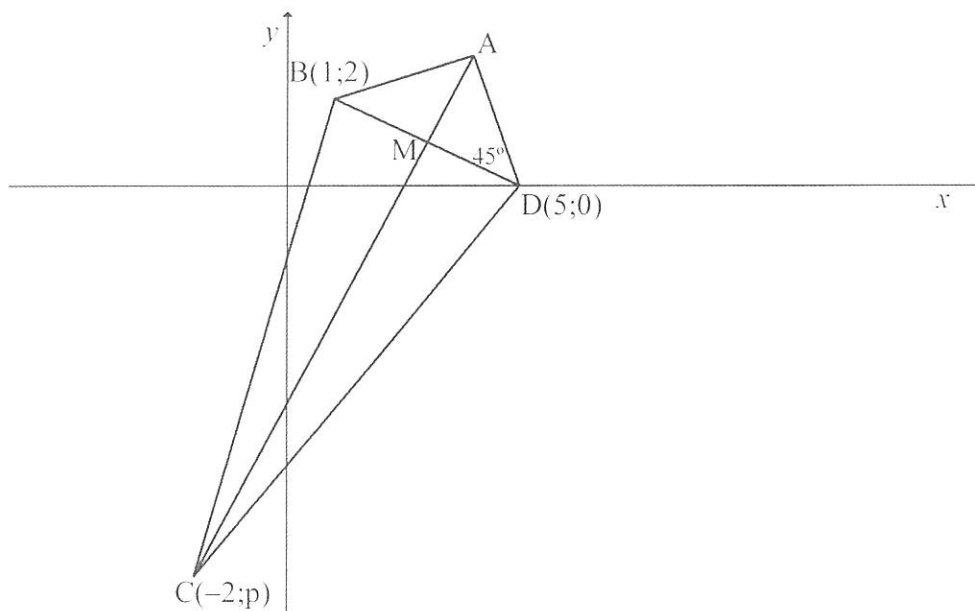
- 1.1
- 1.1.1 Calculate the gradient of  $CD$ . (2)
- 1.1.2 Hence, determine the angle of inclination of  $CD$ . (2)
- 1.2 Prove that  $\hat{BCD} = 90^\circ$ . (3)
- 1.3
- 1.3.1 Write down the gradient of  $AD$ . (1)
- 1.3.2 Hence, or otherwise, calculate the value of  $w$ . (3)
- 1.4 If it is given that  $w = 15\frac{1}{2}$ , calculate the length of  $AD$ . (3)
- 1.5 Calculate the area of quadrilateral  $ABCD$ . (6)
- [20]**

**QUESTION 2**

A, B(1 ; 2), C(-2 ; p) and D(5 ; 0) are the vertices of a KITE.

M is the point of intersection of the diagonals of the kite.

$\hat{A}DB = 45^\circ$ .



- 2.1 Determine the coordinates of M. (4)
- 2.2 Calculate the value of  $p$ . (6)
- 2.3 If  $p = -9$ , determine the equation of AC. (5)
- 2.4 Determine the angle of inclination of AD. (5)
- 2.5 Determine the coordinates of A. (6)
- [26]**

**QUESTION 3**

3.1 If  $\tan \theta = \frac{3}{4}$  and  $\theta \in [90^\circ; 360^\circ]$ , determine the value of  $2 \sin \theta \cdot \cos \theta$  without the use of a calculator. (4)

3.2 Simplify without the use of a calculator:

3.2.1 
$$\frac{\sin(360^\circ - x) + \cos(90^\circ + x)}{\sin(180^\circ - x) + \tan 540^\circ}$$
 (5)

3.2.2 
$$\cos 330^\circ \cdot \tan(-120^\circ) + \sin 73^\circ \cdot \left(\frac{1}{\cos 197^\circ}\right)$$
 (6)

[15]

**QUESTION 4**

4.1 The identity  $\frac{(\sin x - \cos x)^2 - 1}{\sin^2 x - 1} = 2 \tan x$  is given.

4.1.1 Prove the identity. (5)

4.1.2 For which values of  $x$  in the interval  $0^\circ \leq x \leq 360^\circ$  will the identity in 4.1.1 not be defined? (3)

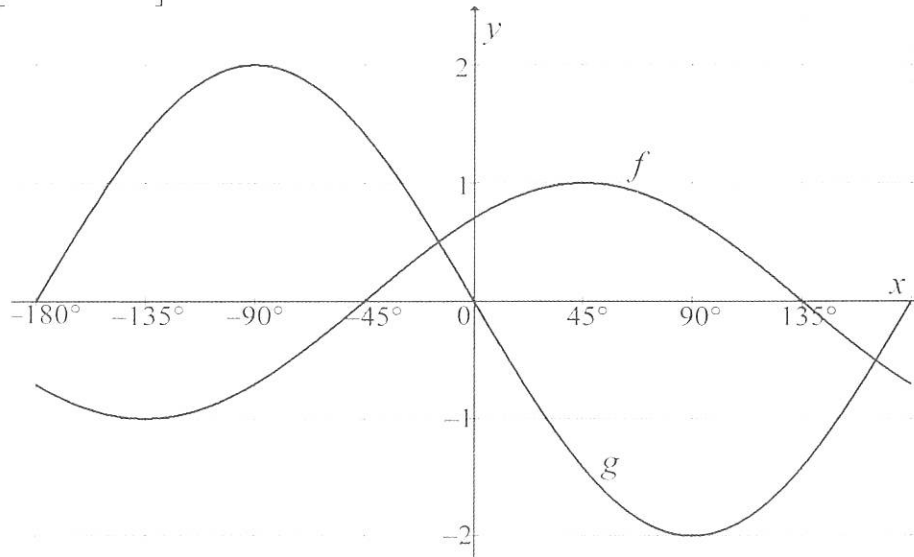
4.2 Solve for  $x$  if  $\tan(3x + 40^\circ) = -1$  and  $x \in [-90^\circ; 90^\circ]$ . (5)

4.3 Determine the general solution of  $2 \sin x = \sqrt{3 + 3 \cos x}$ . (8)

[21]

**QUESTION 5**

5.1 The sketch represents the graphs of  $f(x) = a \cos(x + b)$  and  $g(x) = c \sin x$  for  $x \in [-180^\circ; 180^\circ]$ .



5.1.1 Write down the values of  $a$ ,  $b$  and  $c$ . (3)

5.1.2 If the points of intersection of  $f$  and  $g$  are  $(-14,64^\circ; k)$  and  $(m; -0,51)$ , write down the values of  $k$  and  $m$ . (4)

5.1.3 For which values of  $x$  in the interval  $[-180^\circ; 0^\circ]$  will  
 (a)  $f(x) - g(x) < 0$ ? (2)  
 (b)  $f(x) \cdot g(x) \geq 0$ ? (2)

5.1.4 Determine the minimum value of  $h(x)$  if  $h(x) = f(x) + 2$ . (2)

5.2

5.2.1 Draw a sketch graph of  $m(x) = \tan 2x$  for  $x \in [0^\circ; 90^\circ]$ . (3)

5.2.2 Describe how the graph  $m$  has to be transformed to form the graph  $n$  where  $n(x) = \tan(2x + 50^\circ)$ . (2)

[18]

**TOTAL MARKS: 100**



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MARKING GUIDELINE

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**GRADE 11**

MARKS: 100

This marking guideline consists of 8 pages.

QUESTION 1

1.1.1	$m_{CD} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{8 - 0}{10 - 4} = \frac{8}{6} = \frac{4}{3}$	✓ substituting in gradient formula ✓ answer (2)
1.1.2	$\tan \theta = m_{CD} = \frac{4}{3}$ $\theta = 53,13^\circ$	✓ $\tan \theta = \frac{4}{3}$ ✓ answer (2)
1.2	$m_{BC} = \frac{3 - 0}{0 - 4} = -\frac{3}{4}$ $m_{CD} \times m_{BC} = \frac{4}{3} \times -\frac{3}{4} = -1$ <p>Therefore <math>\widehat{BCD} = 90^\circ</math>.</p>	✓ gradient of BC ✓ multiplying gradients ✓ answer of -1 and concluding (3)
1.3.1	$m_{AD} = -\frac{4}{3}$	✓ answer (1)
1.3.2	$\frac{3}{w - 8} = \frac{4}{0 - 10}$ $30 = 4(w - 8)$ $30 = 4w - 32$ $w = \frac{31}{2}$ $w = 15\frac{1}{2}$	✓ substitution in gradient formula ✓ simplification ✓ answer (3)
1.4	$AD = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = \sqrt{(0 - 10)^2 + (\frac{31}{2} - 8)^2}$ $= \sqrt{\frac{625}{4}} = \frac{25}{2} = 12\frac{1}{2} \text{ units}$	✓ substitution into quadratic formula ✓ simplification ✓ answer (3)

1.5	<p> <math>BC = \sqrt{(0-4)^2 + (3-0)^2} = 5</math>  <math>CD = \sqrt{(10-4)^2 + (8-0)^2} = 10</math>            Area of ABCD = area of trapezium  <math>= \frac{1}{2}(\text{sum of parallel sides}) \times \text{height}</math>  <math>= \frac{1}{2}(5 + 12\frac{1}{2})(10)</math>  <math>= 87\frac{1}{2}</math> square units         </p> <p><b>OR</b></p> <p> <math>BC = \sqrt{(0-4)^2 + (3-0)^2} = 5</math>  <math>CD = \sqrt{(10-4)^2 + (8-0)^2} = 10</math>            Area of ABCD = area of rectangle + area of triangle  <math>= (\ell \times b) + (\frac{1}{2}bh)</math>  <math>= (5 \times 10) + [\frac{1}{2} \times 10 \times (12\frac{1}{2} - 5)]</math>  <math>= 87\frac{1}{2}</math> square units         </p> <p><b>OR</b></p> <p> <math>BC = \sqrt{(0-4)^2 + (3-0)^2} = 5</math>  <math>CD = \sqrt{(10-4)^2 + (8-0)^2} = 10</math>            Area of ABCD = area of <math>\triangle BCD</math> + area of <math>\triangle ABD</math>  <math>= (\frac{1}{2} \times 5 \times 10) + [\frac{1}{2} \times (15\frac{1}{2} - 3) \times 10]</math>  <math>= 25 + 62\frac{1}{2}</math>  <math>= 87\frac{1}{2}</math> square units         </p>	<p> <math>\checkmark</math> length of BC  <math>\checkmark</math> length of CD  <math>\checkmark</math> formula  <math>\checkmark</math> substitution of <math>(5 + 12\frac{1}{2})</math>  <math>\checkmark</math> substitution of 10  <math>\checkmark</math> answer (6)         </p> <p><b>OR</b></p> <p> <math>\checkmark</math> length of BC  <math>\checkmark</math> length of CD  <math>\checkmark</math> substitution of <math>(5 \times 10)</math>  <math>\checkmark \checkmark [\frac{1}{2} \times 10 \times (12\frac{1}{2} - 5)]</math>  <math>\checkmark</math> answer (6)         </p> <p><b>OR</b></p> <p> <math>\checkmark</math> length of BC  <math>\checkmark</math> length of CD  <math>\checkmark (\frac{1}{2} \times 5 \times 10)</math>  <math>\checkmark \checkmark [\frac{1}{2} \times (15\frac{1}{2} - 3) \times 10]</math>  <math>\checkmark</math> answer (6)         </p>
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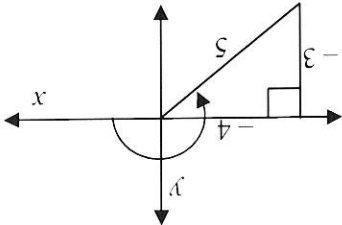
[18]

QUESTION 2

2.1	$x_M = \frac{x_1 + x_2}{2} = \frac{1+5}{2} = \frac{6}{2} = 3$ $y_M = \frac{y_1 + y_2}{2} = \frac{2+0}{2} = \frac{2}{2} = 1$ <p>M(3;1)</p>	✓ substitution for $x_M$ ✓ answer for $x_M$ ✓ substitution for $y_M$ ✓ answer for $y_M$
2.2	$BC = CD$ $\sqrt{(-2-1)^2 + (d-2)^2} = \sqrt{(-2-5)^2 + (d-0)^2}$ $\sqrt{9+d^2-4d+4} = \sqrt{49+d^2}$ $\sqrt{d^2-4d+13} = \sqrt{d^2+49}$ $d^2 - 4d + 13 = d^2 + 49$ $-4d = 36$ $d = -9$	✓ BC = CD ✓ LHS substitution in distance formula ✓ RHS substitution in distance formula ✓ simplifying ✓ squaring both sides ✓ answer
2.3	$m_{CM} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - (-9)}{3 - (-2)} = \frac{10}{5} = 2$ $y = 2x + c$ <p>Substitute (-2; -9):</p> $-9 = 2(-2) + c$ $c = -5$ $y = 2x - 5$	✓ substitute in gradient formula ✓ value of gradient ✓ substitute in straight line formula ✓ value of c ✓ equation
2.4	$m_{BD} = \frac{0-2}{5-1} = -\frac{2}{4} = -\frac{1}{2}$ $\tan \widehat{BDX} = -\frac{1}{2}$ $\widehat{BDX} = 180^\circ - 26,57^\circ = 153,43^\circ$ <p>Angle of inclination of AD = <math>153,43^\circ - 45^\circ = 108,43^\circ</math></p>	✓ gradient of BD ✓ $\tan \widehat{BDX} = m_{BD}$ ✓ angle of inclination of BD ✓ $153,43^\circ - 45^\circ$ ✓ answer

<p>2.5</p>	<p> <math>m_{AD} = \tan 108,43^\circ</math>  <math>= -3</math>                      Equation of AD:  <math>y = -3x + c</math>                      Substitute (5;0):  <math>0 = -3(5) + c</math>  <math>c = 15</math>  <math>y = -3x + 15</math>                      Solve simultaneous equations for AC and AD:  <math>2x - 5 = -3x + 15</math>  <math>5x = 20</math>  <math>x = 4</math>  <math>y = 3</math>                      A(4;3)                 </p> <p><b>OR</b></p> <p>                     DM = AM  <math>= BM</math> [sides opposite equal angles]  <math>= \sqrt{5}</math>                      AB = AD  <math>= \sqrt{10}</math> [Theorem of Pythagoras]                 </p> <p style="text-align: center;"> <math>AB = AD</math>  <math>\sqrt{(x-1)^2 + (y-2)^2} = \sqrt{(x-5)^2 + (y-0)^2}</math>  <math>x^2 - 2x + 1 + y^2 - 4y + 4 = x^2 - 10x + 25 + y^2</math>  <math>8x - 4y = 20</math>  <math>y = 2x - 5 \dots \dots \dots \text{line 1}</math>  <math>AD = \sqrt{10}</math>  <math>\sqrt{(x-5)^2 + (y-0)^2} = \sqrt{10}</math>  <math>x^2 - 10x + 25 + y^2 = 10 \dots \dots \dots \text{line 2}</math>  <math>x^2 - 10x + 25 + (2x-5)^2 = 10</math>  <math>x^2 - 10x + 25 + 4x^2 - 20x + 25 = 10</math>  <math>5x^2 - 30x + 40 = 0</math>  <math>x^2 - 6x + 8 = 0</math>  <math>(x-4)(x-2) = 0</math>  <math>x = 2 \text{ or } x = 4</math>                      N/A  <math>y = 3</math> </p>	<p> <math>\checkmark</math> gradient of AD  <math>\checkmark</math> substituting (5 ; 0)  <math>\checkmark</math> equation of AD  <math>\checkmark</math> solving simultaneously  <math>\checkmark</math> value of <math>x</math>  <math>\checkmark</math> value of <math>y</math> </p> <p style="text-align: right;">(6)</p> <p><b>OR</b></p> <p> <math>\checkmark DM = AM = BM = \sqrt{5}</math>  <math>\checkmark \sqrt{(x-1)^2 + (y-2)^2}</math>  <math>= \sqrt{(x-5)^2 + (y-0)^2}</math>  <math>\checkmark</math> simplification to <math>y = 2x - 5</math>  <math>\checkmark \sqrt{(x-5)^2 + (y-0)^2} = \sqrt{10}</math> </p> <p> <math>\checkmark x = 4</math>  <math>\checkmark y = 3</math> </p> <p style="text-align: right;">(6)</p>
<b>[26]</b>		

QUESTION 3

<p>3.1</p>	 $2 \sin \theta \cos \theta = 2 \left( -\frac{3}{5} \right) \left( -\frac{4}{5} \right) = \frac{24}{25}$	<p>✓ sketch</p> <p>✓ substitution of <math>-\frac{3}{5}</math></p> <p>✓ substitution of <math>-\frac{4}{5}</math></p> <p>✓ answer</p> <p>(4)</p>
<p>3.2.1</p>	$\frac{\sin(360^\circ - x) + \cos(90^\circ + x)}{\sin(180^\circ - x) + \tan 540^\circ} = \frac{-\sin x + (-\sin x)}{\sin x + \tan 180^\circ} = \frac{-2 \sin x}{\sin x + 0} = -2$	<p>✓ <math>-\sin x</math> and ✓ <math>-\sin x</math> in numerator</p> <p>✓ <math>\sin x</math> and ✓ <math>\tan 180^\circ</math> in denominator</p> <p>✓ answer</p> <p>(5)</p>
<p>3.2.2</p>	$\cos 330^\circ \tan(-120^\circ) + \sin 73^\circ \cdot \left( \frac{\cos 197^\circ}{1} \right) = \cos 30^\circ \cdot -\tan 120^\circ + \sin 73^\circ \cdot \left( \frac{-\cos 17^\circ}{1} \right) = \cos 30^\circ \cdot \tan 60^\circ - \frac{\sin 73^\circ}{\sin 73^\circ} = \left( \sqrt{3} \right) \left( \frac{2}{1} \right) \cdot \left( -1 \right) = \frac{2}{3} - 1 = \frac{-1}{2}$	<p>✓ <math>\cos 30^\circ</math></p> <p>✓ <math>-\cos 17^\circ</math></p> <p>✓ <math>\tan 60^\circ</math></p> <p>✓ <math>\frac{\sin 73^\circ}{\sin 73^\circ}</math> (OR: <math>\frac{\cos 17^\circ}{\cos 17^\circ}</math>)</p> <p>✓ special angle values</p> <p>✓ answer</p> <p>(6)</p>

**QUESTION 4**

<p>4.1.1</p>	$\frac{(\sin x - \cos x)^2 - 1}{\sin^2 x - 1}$ $= \frac{\sin^2 x - 2 \sin x \cos x + \cos^2 x - 1}{\sin^2 x - 1}$ $= \frac{-2 \sin x \cos x + \sin^2 x + \cos^2 x - 1}{\sin^2 x - 1}$ $= \frac{-2 \sin x \cos x + 1 - 1}{-(1 - \sin^2 x)}$ $= \frac{-2 \sin x \cos x}{-\cos^2 x}$ $= \frac{2 \sin x}{\cos x}$ $= 2 \tan x$	<p>✓ multiplying out</p> <p>✓ applying identity <math>\sin^2 x + \cos^2 x = 1</math></p> <p>✓ <math>-(1 - \sin^2 x)</math></p> <p>✓ applying identity <math>1 - \sin^2 x = \cos^2 x</math></p> <p>✓ simplification</p> <p>(5)</p>
<p>4.1.2</p>	$\sin^2 x - 1 = 0$ $\sin^2 x = 1$ $\sin x = -1 \quad \text{or} \quad \sin x = 1$ $x = 270^\circ \quad \text{or} \quad x = 90^\circ$	<p>✓ <math>\sin^2 x - 1 = 0</math></p> <p>✓ <math>270^\circ</math></p> <p>✓ <math>90^\circ</math></p> <p>(3)</p>
<p>4.2</p>	$\tan(3x + 40^\circ) = -1$ <p>reference angle: <math>45^\circ</math></p> $3x + 40^\circ = 180^\circ - 45^\circ + n.360^\circ \quad \text{or} \quad 3x + 40^\circ = 360^\circ - 45^\circ + n.360^\circ$ $3x = 95^\circ + n.360^\circ \qquad \qquad \qquad 3x = 275^\circ + n.360^\circ$ $x = 31,67^\circ + n.120^\circ \qquad \qquad \qquad x = 91,67^\circ + n.120^\circ$ $x = -88,33^\circ \quad \text{or} \quad 31,67^\circ \qquad \qquad \qquad x = -28,33^\circ$ <p>where <math>n \in \mathbb{Z}</math></p> <p><b>OR</b></p> $3x + 40^\circ = 180^\circ - 45^\circ + n.180^\circ$ $3x = 95^\circ + n.180^\circ$ $x = 31,67^\circ + n.60^\circ$ $x = -88,33^\circ \quad \text{or} \quad -28,33^\circ \quad \text{or} \quad 31,67^\circ$ <p>where <math>n \in \mathbb{Z}</math></p>	<p>✓ <math>3x + 40^\circ = 180^\circ - 45^\circ + n.360^\circ</math></p> <p>✓</p> <p>✓ <math>3x + 40^\circ = 360^\circ - 45^\circ + n.360^\circ</math></p> <p>✓ <math>-88,33^\circ</math></p> <p>✓ <math>31,67^\circ</math></p> <p>✓ <math>-28,33^\circ</math></p> <p>(5)</p> <p><b>OR</b></p> <p>✓ <math>180^\circ - 45^\circ</math></p> <p>✓ <math>+n.180^\circ</math></p> <p>✓ <math>-88,33^\circ</math></p> <p>✓ <math>31,67^\circ</math></p> <p>✓ <math>-28,33^\circ</math></p> <p>(5)</p>

5.1.1	$a = 1$ $b = -45^\circ$ $c = -2$	$a = 1$ $k = 0,51$ $m = 165,36$	$a = 1$ $b = -45^\circ$ $c = -2$ factors	(3)
5.1.2	$k = 0,51$ $m = 165,36$	$k = 0,51$ $m = 165,36$	$k = 0,51$ $m = 165,36$	(4)
5.1.3(a)	$-180^\circ < x < -14,64^\circ$	$-180^\circ < x < -14,64^\circ$	answer	(2)
5.1.3(b)	$-45^\circ \leq x \leq 0^\circ$	$-45^\circ \leq x \leq 0^\circ$	answer	(2)
5.1.4	$-1 + 2 = 1$	$-1 + 2 = 1$	answer	(2)
5.2.1		$(22,5^\circ; 1)$ $(67,5^\circ; -1)$	shape asymptote at $x = 45^\circ$ indicated $(22,5^\circ; 1)$ and $(67,5^\circ; -1)$	(3)
5.2.2	$m$ has to be translated (shifted) by $25^\circ$ to the left.	$m$ has to be translated (shifted) by $25^\circ$ to the left.	shifted to the left by $25^\circ$	(2)

[18]

QUESTION 5

4.3	$2 \sin x = \sqrt{3 + 3 \cos x}$ $4 \sin^2 x = 3 + 3 \cos x$ $4(1 - \cos^2 x) = 3 + 3 \cos x$ $4 - 4 \cos^2 x = 3 + 3 \cos x$ $4 \cos^2 x + 3 \cos x - 1 = 0$ $(4 \cos x - 1)(\cos x + 1) = 0$ $\cos x = \frac{1}{4}$ or $\cos x = -1$ $x = 75,52^\circ + n.360^\circ$ or $x = 284,48^\circ + n.360^\circ$ or $x = 180^\circ + n.360^\circ$ for $n \in \mathbb{Z}$	$1 - \cos^2 x$ standard form $\cos x = \frac{1}{4}$ or $\cos x = -1$ $n \in \mathbb{Z}$ answers	(8)
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[21]