



# basic education

Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL  
SENIOR CERTIFICATE  
*NASIONALE  
SENIOR SERTIFIKAAT***

**GRADE/*GRAAD* 11**

**MATHEMATICS P2/*WISKUNDE V2***

**NOVEMBER 2016**

**MEMORANDUM**

**MARKS/*PUNTE*: 150**

**This memorandum consists of 20 pages.  
*Hierdie memorandum bestaan uit 20 bladsye.***

**NOTE:**

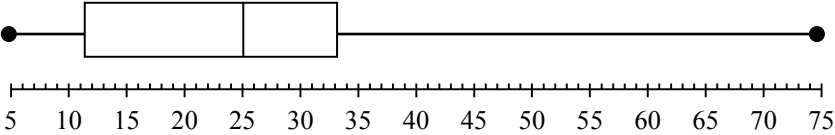
- If a candidate answered a question TWICE, mark only the FIRST attempt.
- If a candidate crossed out an answer and did not redo it, mark the crossed-out answer.
- Consistent accuracy applies to ALL aspects of the marking memorandum.
- Assuming values/answers in order to solve a problem is unacceptable.

**LET WEL:**

- As 'n kandidaat 'n vraag TWEE keer beantwoord het, sien slegs die EERSTE poging na.
- As 'n kandidaat 'n antwoord deurgehaal en nie oorgedoen het nie, sien die deurgehaalde antwoord na.
- Volgehoue akkuraatheid is op ALLE aspekte van die memorandum van toepassing.
- Dit is onaanvaarbaar om waardes/antwoorde te veronderstel om 'n probleem op te los.

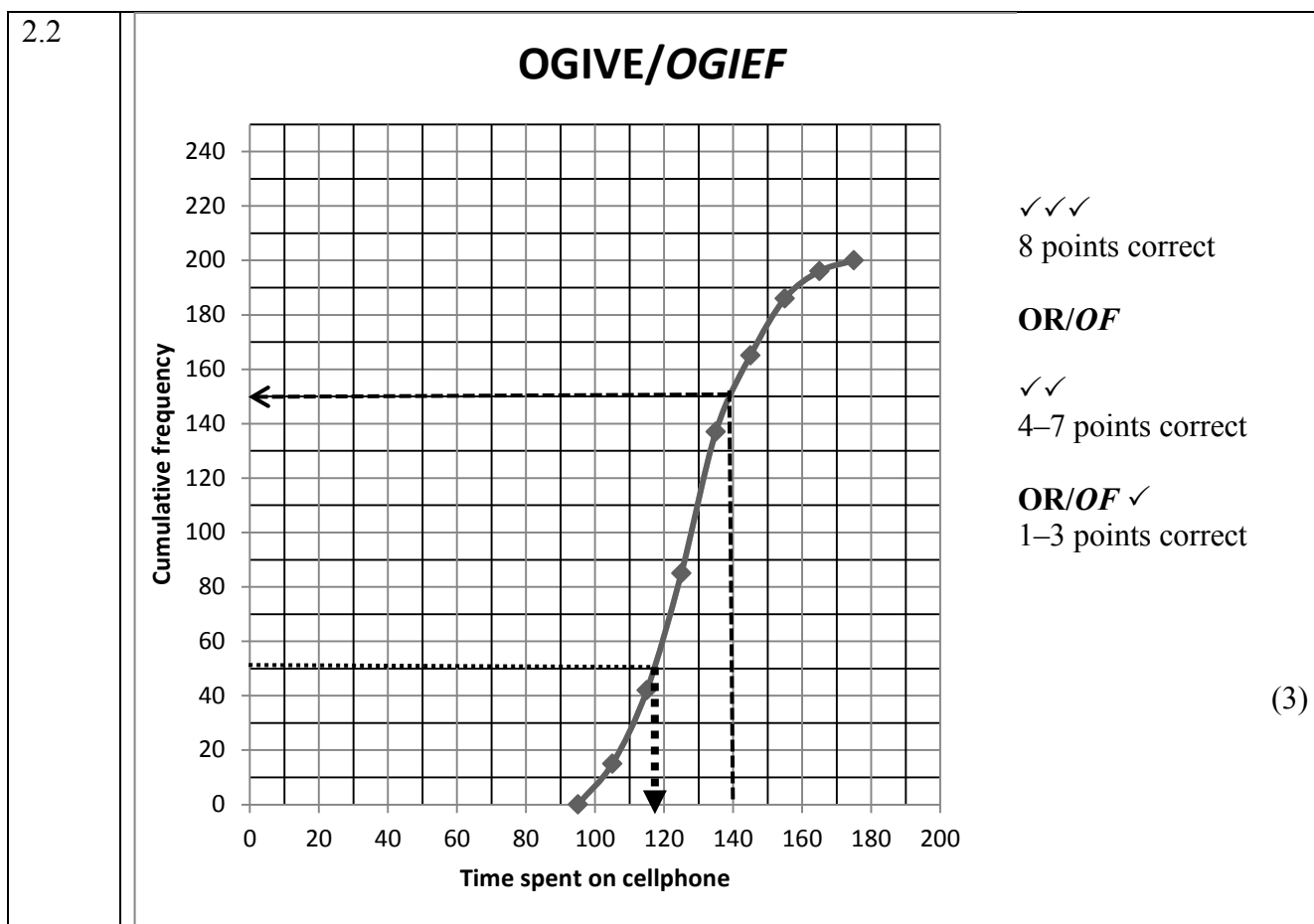
**QUESTION/VRAAG 1**

5	8	15	20	25	27	31	36	75
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1.1	Range/Omvang = $75 - 5$ = 70	✓ answer/antw (1)
1.2	Std dev/Std afwyking = 19,56	✓ ✓ answer/antw (2)
1.3	Median/Mediaan = 25	✓ answer/antw (1)
1.4	$Q_1 = \frac{8+15}{2} = 11,5$ $Q_2 = \frac{31+36}{2} = 33,5$ IQR = $Q_3 - Q_1$ = $33,5 - 11,5$ = 22	✓ $Q_1 = 11,5$ ✓ $Q_3 = 33,5$  ✓ answer/antw (3)
1.5		✓ box/mond ✓ whiskers/snor ✓ min and max (maks) (3)
1.6	Skewed to the right/skeef na regs Positively skewed/positief skeef	✓ answer/antw (1)
1.7	Outlier/uitskieter = 75  <b>OR/OF</b> $33.5 + 1.5(22) = 66.5$ Outlier/uitskieter = 75	✓ answer/antw  ✓ answer/antw (1) <b>[12]</b>

**QUESTION/VRAAG 2**

2.1	<b>TIME SPENT/ TYD SPANDEER (IN MINUTES/ MINUTE)</b>	<b>FREQUENCY FREKWENSIE <math>f</math></b>	<b>CUMULATIVE FREQUENCY/ KUMULATIEWE FREKWENSIE <math>f</math></b>	✓✓ correct CF values/ korrekte KF-waardes  (2)
	$95 < x \leq 105$	15	15	
	$105 < x \leq 115$	27	42	
	$115 < x \leq 125$	43	85	
	$125 < x \leq 135$	52	137	
	$135 < x \leq 145$	28	165	
	$145 < x \leq 155$	21	186	
	$155 < x \leq 165$	10	196	
	$165 < x \leq 175$	4	200	



2.3	$Q_1 = 118$  Accept any answer between (115 and 120)	✓ ✓ answer/antw  (2)
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2.4	$Number\ of\ learners / Getal\ leerders = 200 - 150 = 50$  Accept 150 or any other reading between (145 and 155)	✓ 150 ✓ 50  (2) <b>[9]</b>
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## QUESTION/VRAAG 3

3.1	$M = \left( \frac{x_1 + x_2}{2} ; \frac{y_1 + y_2}{2} \right)$ $= \left( \frac{6+2}{2} ; \frac{-2+15}{2} \right)$ $= \left( 4 ; \frac{13}{2} \right)$	✓ subst into/in midpt form/ midpnt vorm. ✓ answer/antw (2)
3.2	$m_{BC} = \frac{y_2 - y_1}{x_2 - x_1}$ $= \frac{15 - 3}{2 - (-4)}$ $= 2$ $m_{MN} = m_{BC} = 2 \quad [BC \parallel MN]$	✓ subst into gradient form./subst in gradiëntvorm ✓ answer/antw ✓ gradients equal/ gradiënte gelyk (3)
3.3	$y - y_1 = m(x - x_1) \qquad y = mx + c$ $y - \frac{13}{2} = 2(x - 4) \qquad \frac{13}{2} = 2(4) + c$ $y = 2x - \frac{3}{2} \quad \text{OR/OF} \qquad -\frac{3}{2} = c$ $\qquad \qquad \qquad y = 2x - \frac{3}{2}$	✓ subst $\left( 4 ; \frac{13}{2} \right)$ and $m = 2$ into str line eq. ✓ answer/antw (2)

<p>3.4</p>	<p>N is a midpoint of AC [Line through midpoint of one side parallel to second side]</p> $N\left(\frac{-4+6}{2}; \frac{3+(-2)}{2}\right)$ $= N\left(1; \frac{1}{2}\right)$ <p><b>OR/OF</b></p> $m_{AC} = \frac{3-(-2)}{(-4)-6}$ $= -\frac{1}{2}$ <p>Equation of AC</p> $y - y_1 = m(x - x_1)$ $y - 3 = -\frac{1}{2}(x - (-4))$ $y = -\frac{1}{2}x + 1$ $-\frac{1}{2}x + 1 = 2x - \frac{3}{2}$ $-x + 2 = 4x - 3$ $x = 1$ $y = 2(1) - \frac{3}{2}$ $= \frac{1}{2}$ $N\left(1; \frac{1}{2}\right)$	<p>✓ S ✓ R ✓ x-value/waarde ✓ y-value/waarde</p> <p>(4)</p> <p>✓ gradient of AC</p> <p>✓ equation of AC ✓ equating/gelykstelling</p> <p>✓ <math>N\left(1; \frac{1}{2}\right)</math></p> <p>(4)</p>
<p>3.5</p>	<p>N is the midpoint of BD and the midpoint of AC [diagonals of parm bisect] <i>N is die midpt v BD en midpt v AC [hoeklyne van parm halveer]</i></p> $\left(\frac{2+x}{2}; \frac{y+15}{2}\right) = \left(1; \frac{1}{2}\right)$ $\frac{2+x}{2} = 1 \qquad \frac{y+15}{2} = \frac{1}{2}$ $x = 0 \qquad y = -14$ $D(0; -14)$	<p>✓ <math>\frac{2+x}{2} = 1</math> ✓ <math>\frac{y+15}{2} = \frac{1}{2}</math> ✓ <math>x = 0</math> ✓ <math>y = -14</math></p> <p>(4)</p>

	<p><b>OR/OF</b> From B to A</p> <p><math>(x; y) \rightarrow (x+4; y-17)</math> <math>D(-4+4; 3-17)</math> <math>D(0; -14)</math></p>	<p>✓ <math>x+4</math> ✓ <math>y-17</math> ✓ subst ✓ <math>D(0; -14)</math></p> <p>(4) <b>[15]</b></p>
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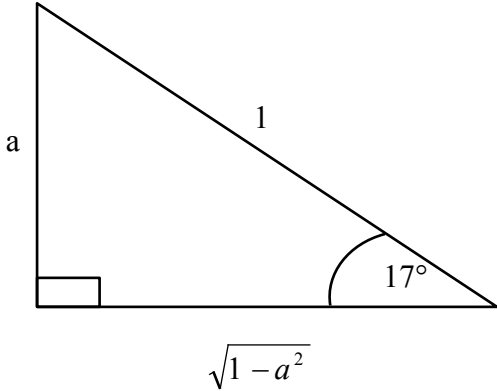
**QUESTION/VRAAG 4**

4.1	$m_{MP} = m_{PN}$ $\frac{2-0}{0-k} = \frac{4-2}{3-0}$ $\frac{2}{-k} = \frac{2}{3}$ $k = -3$	✓ $m_{MP} = m_{PN}$ ✓ subst. into gradient form. ✓ answer/antw (3)
4.2	$\tan \alpha = m_{PN}$ $\tan \alpha = \frac{2}{3}$ $\alpha = 33,69^\circ$ $\tan \beta = m_{AB}$ $\tan \beta = -\frac{1}{2}$ $\beta = -26,57^\circ + 180^\circ$ $= 153,43^\circ$ $\theta = 153,43^\circ - 33,69^\circ$ $= 119,74^\circ$	✓ $\alpha = 33,69^\circ$ ✓ $\tan \beta = -\frac{1}{2}$ ✓ $153,43^\circ$ ✓ $119,74^\circ$ (4)
4.3	$-\frac{1}{2}x + 4 = 0$ $x = 8$ $R(8;0)$ $MR = 8 - (-3)$ $= 11 \text{ units}$	✓ $y = 0$ ✓ $R(8;0)$ ✓ answer/antw (3)
4.4	$\text{Area of } \triangle MNR = \frac{1}{2}(MR) \cdot \perp \text{ height}$ $= \frac{1}{2}(11)(y - \text{value of } N)$ $= \frac{1}{2}(11)(4)$ $= 22 \text{ sq units/vk eenh}$ <b>OR/OF</b>	✓ area formula ✓ subst y-value of N ✓ answer/antw

	$MN = \sqrt{(3 - (-3))^2 + (4 - 0)^2}$ $= \sqrt{36 + 16}$ $= \sqrt{52} \text{ units/eenh}$ $\text{Area of/Opp van } \triangle MNR = \frac{1}{2} \times \sqrt{52} \times 11 \times \sin 33,69^\circ$ $= 21,999$ $\approx 22 \text{ sq units/vk eenh}$	<p>✓ <math>\sqrt{52}</math></p> <p>✓ subst in area form</p> <p>✓ answer/antw</p> <p>(3) <b>[13]</b></p>
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**QUESTION/VRAAG 5**

<p>5.1.1</p>	$x^2 + y^2 = r^2$ $(-8)^2 + (t)^2 = 17^2$ $t^2 = 225$ $t = -15$	<p>✓ subst in pyth ✓ answer/antw (2)</p>
<p>5.1.2(a)</p>	$\cos(-\theta)$ $= \cos \theta$ $= \frac{-8}{17}$	<p>✓ <math>\cos \theta</math> ✓ answer/antw (2)</p>
<p>5.1.2(b)</p>	$1 - \sin \theta = 1 - \frac{-15}{17}$ $= \frac{17}{17} + \frac{15}{17}$ $= \frac{32}{17}$	<p>✓ subst  ✓ answer/antw (2)</p>
<p>5.2.1</p>	$\tan 17^\circ = \frac{a}{\sqrt{1-a^2}}$ 	<p>✓ sketch ✓ <math>\sqrt{1-a^2}</math> ✓ answer/antw (3)</p>
<p>5.2.2</p>	$\sin 107^\circ$ $= \sin(90^\circ + 17^\circ)$ $= \cos 17^\circ$ $= \sqrt{1-a^2}$ <p><b>OR/OF</b></p> $\sin 107^\circ$ $= \sin(180^\circ - 73^\circ)$ $= \sin 73^\circ$ $= \sqrt{1-a^2}$	<p>✓ <math>\cos 17^\circ</math> ✓ <math>\sqrt{1-a^2}</math> (2)</p> <p>✓ <math>\sin 73^\circ</math> ✓ <math>\sqrt{1-a^2}</math> (2)</p>

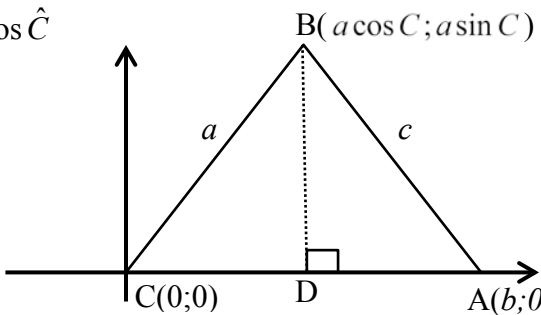
<p>5.2.3</p>	$\begin{aligned} & \cos^2 253^\circ + \sin^2 557^\circ \\ & = (-\cos 73^\circ)^2 + (-\sin 17^\circ)^2 \\ & = (-a)^2 + (-a)^2 \\ & = 2a^2 \end{aligned}$	<p>✓ <math>\cos^2 73^\circ</math>                  ✓ <math>\sin^2 17^\circ</math>                  ✓ subst of ratios                  ✓ answer/antw                  (4)</p>
<p>5.3</p>	$\begin{aligned} & \frac{\cos(180^\circ + 45^\circ)\sin(180^\circ - 45^\circ) + \sin(360^\circ - 30^\circ)}{\tan(180^\circ + 45^\circ)} \\ & = \frac{(-\cos 45^\circ) \cdot (\sin 45^\circ) - \sin 30^\circ}{\tan 45^\circ} \\ & = \frac{\left(-\frac{\sqrt{2}}{2}\right)\left(\frac{\sqrt{2}}{2}\right) - \frac{1}{2}}{1} \\ & = -1 \end{aligned}$	<p>✓ <math>-\cos 45^\circ</math>                  ✓ <math>\sin 45^\circ</math>                  ✓ <math>-\sin 30^\circ</math>                  ✓ <math>\tan 45^\circ</math>                  ✓ numerator/teller                  ✓ answer/antw  <b>Answer only:</b>  <b>1 mark out of 6 (6)</b></p>
<p>5.4</p>	$\begin{aligned} RHS &= \frac{-1}{\tan^2 x \cdot \cos^2 x} \\ &= \frac{-1}{\frac{\sin^2 x}{\cos^2 x} \times \cos^2 x} \\ &= \frac{-1}{\sin^2 x} \\ &= \frac{-1}{1 - \cos^2 x} \\ &= \frac{1}{\cos^2 x - 1} \\ &= \frac{1}{(\cos x + 1)(\cos x - 1)} \\ &= LHS \end{aligned}$ <p><b>OR/OF</b></p>	<p>✓ <math>\tan x = \frac{\sin x}{\cos x}</math>                  ✓                  simplification/vereenv.                  ✓ identity                  ✓ factors                  (4)</p>

	$LHS = \frac{1}{(\cos x + 1)(\cos x - 1)}$ $= \frac{1}{\cos^2 x - 1}$ $= \frac{1}{-\sin^2 x}$ $= \frac{-1}{\sin^2 x}$ $= \frac{-1}{\frac{\sin^2 x}{\cos^2 x} \times \frac{\cos^2 x}{1}}$ $= \frac{-1}{\tan^2 x \cdot \cos^2 x}$ <p><b>OR/OF</b></p> $RHS = \frac{-\cos^2 x}{\sin^2 x \cdot \cos^2 x}$ $= \frac{-1}{\sin^2 x}$ $LHS = \frac{1}{\cos^2 x - 1}$ $= \frac{1}{-\sin^2 x}$ <p><math>RHS = LHS</math></p>	$\checkmark \cos^2 x - 1$ $\checkmark -\sin^2 x$ $\checkmark \frac{-1}{\sin^2 x}$ $\checkmark \frac{\sin^2 x}{\cos^2 x} \times \frac{\cos^2 x}{1}$ (4) $\checkmark \frac{1}{\tan^2 x} = \frac{\cos^2 x}{\sin^2 x}$ $\checkmark \frac{-1}{\sin^2 x}$ $\checkmark \cos^2 x - 1$ $\checkmark -\sin^2 x$ (4)
<p>5.5</p>	$2 \sin x \cos x - \cos x = 0$ $\cos x(2 \sin x - 1) = 0$ $\cos x = 0 \qquad \text{or} \qquad \sin x = \frac{1}{2}$ $x = 90^\circ + 360^\circ \cdot k, \quad k \in Z \qquad x = 30^\circ + 360^\circ \cdot k, \quad k \in Z$ <p style="text-align: center;"><i>or</i></p> $x = 270^\circ + 360^\circ \cdot k, \quad k \in Z \qquad x = 150^\circ + 360^\circ \cdot k, \quad k \in Z$	$\checkmark$ factors $\checkmark$ both equations/ <i>beide verg.</i> $\checkmark$ both general solutions for $\cos x = 0$ $\checkmark \checkmark$ general solutions for $\sin x = \frac{1}{2}$ $\checkmark k \in Z$ <p style="text-align: right;">(6)  <b>[31]</b></p>

**QUESTION/VRAAG 6**

6.1	$b = 30^\circ$	✓ answer/antw (1)
6.2	$360^\circ$	✓ answer/antw (1)
6.3	$f(x) = g(x)$  $x = -150^\circ$  $x = 30^\circ$	✓ $x = -150^\circ$  ✓ $x = 30^\circ$  (2)
6.4	$\sin(90^\circ - x) > g(x)$ $\cos x > g(x)$ $f(x) > g(x)$ $x \in (-150^\circ; 30^\circ)$ or $-150^\circ < x < 30^\circ$	✓ $\cos x$  ✓ end points/eindpnte  ✓ notation/notasie  (3)
6.5	Range: $y \in [2; 4]$ or $2 \leq y \leq 4$	✓ end points/eindpnte  ✓ notation/notasie  (2)
		<b>[9]</b>

**QUESTION/VRAAG 7**

<p>7.1</p>	<p><math>AB^2 = AD^2 + BD^2</math> [pythagoras]</p> <p><math>c^2 = (b - a \cos \hat{C})^2 + (a \sin \hat{C})^2</math></p> <p><math>= b^2 - 2ab \cos \hat{C} + a^2 \cos^2 \hat{C} + a^2 \sin^2 \hat{C}</math></p> <p><math>= b^2 - 2ab \cos \hat{C} + a^2 (\cos^2 \hat{C} + \sin^2 \hat{C})</math></p> <p><math>= a^2 + b^2 - 2ab \cos \hat{C}</math></p> 	<ul style="list-style-type: none"> <li>✓ <math>B(a \cos C; a \sin C)</math></li> <li>✓ <math>A(b; 0)</math></li> <li>✓ distance formula/ <i>afstbdfor.</i></li> <li>✓ expansion/<i>ontwikk.</i></li> <li>✓ common factor</li> <li>✓ square identity</li> </ul> <p style="text-align: right;">(6)</p>
<p>7.1.2</p>	<p><math>c^2 = a^2 + b^2 - 2ab \cos \hat{C}</math></p> <p><math>\therefore \cos \hat{C} = \frac{a^2 + b^2 - c^2}{2ab}</math></p> <p><math>RHS = \frac{(a + b)^2 - c^2}{2ab}</math></p> <p><math>= \frac{a^2 + 2ab + b^2 - c^2}{2ab}</math></p> <p><math>= \frac{a^2 + b^2 - c^2}{2ab} + \frac{2ab}{2ab}</math></p> <p><math>= \cos \hat{C} + 1</math></p> <p><math>= LHS</math></p> <p><b>OR/OF</b></p> <p><math>c^2 = a^2 + b^2 - 2ab \cos C</math></p> <p><math>2ab \cos C = a^2 + b^2 - c^2</math></p> <p><math>2ab + 2ab \cos C = a^2 + 2ab + b^2 - c^2</math></p> <p><math>2ab(1 + \cos C) = (a + b)^2 - c^2</math></p> <p><math>1 + \cos C = \frac{(a + b)^2 - c^2}{2ab}</math></p>	<ul style="list-style-type: none"> <li>✓ making cos C subject of form</li> <li>✓ simplifying</li> <li>✓ expansion/<i>ontwikk.</i></li> <li>✓ subst cos C</li> </ul> <p style="text-align: right;">(4)</p> <ul style="list-style-type: none"> <li>✓ making <math>2ab \cos C</math> the subject of the formula</li> <li>✓ adding 2ab on both sides of equation</li> <li>✓ common factor</li> <li>✓ factorise the trinomial/<i>drieterm</i></li> </ul> <p style="text-align: right;">(4)</p>

7.2.1	<p style="text-align: center;">In <math>\triangle ABD</math></p> $\frac{BD}{\sin 109,6^\circ} = \frac{90,52}{\sin 31,23^\circ}$ $BD = \frac{90,52 \times \sin 109,16^\circ}{\sin 31,23^\circ}$ $= 164,92 \text{ m}$	<p>✓ sine rule/<i>sinusreël</i></p> <p>✓ subst</p> <p>✓ answer/<i>antw.</i></p> <p style="text-align: right;">(3)</p>
7.2.2	$CD^2 = 164,92^2 + 235^2 - 2 \times 164,92 \times 235 \times \cos 48,88^\circ$ $CD^2 = 31448,4874$ $CD = 177,34 \text{ m}$	<p>✓ cos rule/<i>cosinusreël</i></p> <p>✓ subst</p> <p>✓ answer/<i>antw.</i></p> <p style="text-align: right;">(3)</p>
		<b>[16]</b>

**QUESTION/VRAAG 8**

8.1	$\tan 35,5^\circ = \frac{0,5}{AB}$ $AB = \frac{0,5}{\tan 35,5^\circ}$ $= 0,7 \text{ m}$	✓ subst  ✓ answer/antw (2)
8.2	$\text{Volume of cone} = \frac{1}{3} \times \pi (0,5)^2 \times 0,7$ $= 0,18 \text{ m}^3$ $\text{Volume of a cylinder} = \pi (0,5)^2 \times 1,1$ $= 0,86 \text{ m}^3$ $\frac{3}{4} \text{ of volume} = \frac{3}{4} \times (0,18 + 0,86)$ $= \frac{3}{4} \times (1,04) \text{ m}^3$ $= 0,78 \text{ m}^3$ $\text{Time taken by pump} = \frac{0,78 \text{ m}^3}{0,52 \text{ m}^3/\text{h}}$ $= 1,5 \text{ hours}$	✓ V of cone/keël  ✓ V of cylinder   ✓ 0,78 m <sup>3</sup>   ✓ answer/antw (4)

**[6]**

**QUESTION/VRAAG 9**

9.1	Equal to twice the angle subtended by the arc at the circumference	✓ ✓ answer/antw (2)
9.2.1	$\hat{R} = 30$ [ $\angle$ at centre = $2 \times \angle$ at circumference]	✓ S ✓ R (2)
9.2.2	$\hat{NST} = 30^\circ$ [equal chords subtends equal angles]	✓ S ✓ R (2) <b>[6]</b>



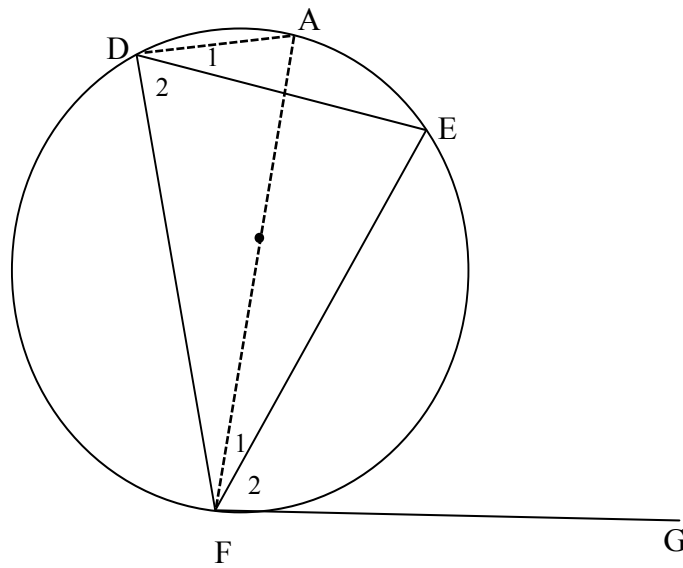
**QUESTION/VRAAG 10**

<p>10.1</p>	<p><math>D\hat{E}G = x + 20^\circ</math> [alt <math>\angle</math>'s, ED    FG]</p> <p><b>OR/OF</b></p> <p><math>D\hat{E}G = 170^\circ - 2x</math> [opp angles of cyclic quad]</p>	<p>✓ S ✓R (2)</p> <p>✓ S ✓R (2)</p>
<p>10.2</p>	<p><math>x + 20^\circ + 2x + 10^\circ = 180^\circ</math> [opp <math>\angle</math> of cyclic quad]  <math>3x = 150^\circ</math>  <math>x = 50^\circ</math>  <math>D\hat{H}G = 2(50^\circ) + 10^\circ</math>  <math>= 110^\circ</math></p> <p><b>OR/OF</b></p> <p><math>x + 20^\circ = 170^\circ - 2x</math> [alt <math>\angle</math>'s, ED    FG]  <math>3x = 150^\circ</math>  <math>x = 50</math>  <math>D\hat{H}G = 2(50^\circ) + 10^\circ</math>  <math>= 110^\circ</math></p>	<p>✓ S ✓R                  ✓ answer/antw                  ✓ <math>110^\circ</math>                  (4)</p> <p>✓ S ✓R                  ✓ answer/antw                  ✓ <math>110^\circ</math>                  (4)</p> <p>(4)  <b>[6]</b></p>

**QUESTION/VRAAG 11**

11.1	$SP = SR$ [tangents from the same point] $\hat{P}RS = 42,83^\circ$ [ $\hat{\angle}$ 's between equal sides] $\hat{O}RS = 90^\circ$ [tan $\perp$ rad] $\hat{O}RN = 90^\circ - 42,83^\circ$ $= 47,17^\circ$ $\hat{N}OR = 90^\circ - 47,17^\circ$ [sum $\hat{\angle}$ 's of $\Delta$ ] $= 42,83^\circ$	✓ S ✓ S ✓ R ✓ $\hat{O}RN$ ✓ answer/antw (5)
11.2	$Let\ OR = x$ $OS = x + 9$ $\hat{O}RS = 90^\circ$ [tan $\perp$ rad] $x^2 + 15^2 = (x + 9)^2$ [Pythagoras] $x^2 + 225 = x^2 + 18x + 81$ $18x = 144$ $x = 8units$ $radius = 8units$	✓ S ✓ S ✓ Using Pythagoras ✓ answer/antw (4)
		<b>[9]</b>

**QUESTION/VRAAG 12**



<p>12.1</p>	<p>Construction: Draw diameter AOF. Join A to D.  <math>\hat{F}_1 + \hat{F}_2 = 90^\circ</math> [tan <math>\perp</math> diameter]  <math>\hat{D}_1 = \hat{F}_1</math> [<math>\angle</math>'s in the same segment]  <math>\hat{D}_1 + \hat{D}_2 = 90^\circ</math> [<math>\angle</math> in a semi circle]  <math>\therefore \hat{F}_2 = \hat{D}_2</math>  <math>E\hat{F}G = F\hat{D}E</math></p>	<p>✓ Constr                  ✓ S                  ✓ R                  ✓ S ✓ R                  (5)</p>
<p>12.2.1</p>	<p><math>B\hat{A}C = 90^\circ</math> [<math>\angle</math> in a semi circle]  <math>\hat{E}_2 = 90^\circ</math> [line drawn from centre to midpont of chord]  <math>\therefore B\hat{A}C = \hat{E}_2</math>   <math>BA \parallel OD</math> [corresp. <math>\angle</math>'s are equal]   <b>OR/OF</b>   <math>B\hat{A}C = 90^\circ</math> [<math>\angle</math> in a semi circle]  <math>\hat{E}_4 = 90^\circ</math> [Line from centre to midpo int of chord]  <math>B\hat{A}C = \hat{E}_4</math>   <math>\Rightarrow BA \parallel OD</math> [Alt <math>\angle</math>'s are equal]</p>	<p>✓ S / R                  ✓ S ✓ R                  ✓ R                  (4)                   ✓ S / R                  ✓ S ✓ R                  ✓ R</p>

<p>12.2.2</p>	<p><math>\hat{A}_1 = x</math>  <math>\hat{B} = x</math> [tan – chord theorem]  <math>\hat{O}_1 = x</math> [corresp <math>\angle</math>'s equal, <math>AB \parallel OD</math>]  <math>\hat{A}_1 = \hat{O}_1</math>  <math>\therefore AOCD</math> is a cyclic quadrilateral [conv. <math>\angle</math>'s in the same segment]  <b>OR/OF</b>                    Let <math>\hat{O}_1 = a</math>  <math>\hat{C}_1 = 90^\circ - a</math> [int. <math>\angle</math>'s of <math>\Delta</math>]  <math>\therefore \hat{A}_2 = 90^\circ - a</math> [<math>\angle</math>'s opp = sides]  <math>\therefore \hat{A}_1 = a</math> [tan <math>\perp</math> rad]  <math>\therefore \hat{O}_1 = \hat{A}_1</math>  <math>\therefore AOCD</math> is a cyclic quadrilateral. [Converse <math>\angle</math>'s in the same segment]</p>	<p><math>\checkmark</math> S <math>\checkmark</math> R  <math>\checkmark</math> S <math>\checkmark</math> R  <math>\checkmark</math> R      <math>\checkmark</math> S  <math>\checkmark</math> S  <math>\checkmark</math> S <math>\checkmark</math> R    <math>\checkmark</math> R                    (5)                            (5)</p>
<p>12.2.3</p>	<p><math>A\hat{O}C = 2x</math> [<math>\angle</math> at centre = <math>2 \times \angle</math> at circumf.]  <math>\hat{O}_1 = x</math>  <math>\therefore \hat{O}_2 = x</math>  <math>\hat{C}_2 = \hat{O}_2 = x</math> [<math>\angle</math>'s in the same segment]  <math>\therefore \hat{C}_2 = \hat{B} = x</math>  <math>\therefore DC</math> is a tan gent to circle [conv. tan – chord ]    <b>OR/OF</b>    <math>O\hat{C}D = 90^\circ</math> [opp <math>\angle</math>'s of cyclic quadrilateral]  <math>\therefore CD</math> is a tan gent. [Converse tan <math>\perp</math> rad]    <b>OR/OF</b>  <math>\hat{B} = \hat{A}_3</math> [<math>\angle</math>'s opp = sides]  <math>\hat{A}_3 = O_2</math> [Alt <math>\angle</math>'s;  <math>\hat{O}_2 = \hat{C}_2</math> [Angles in the same segment]  <math>\therefore \hat{C}_2 = \hat{B}</math>  <math>\therefore DC</math> is a tan gent. [Converse tan – chord ]</p>	<p><math>\checkmark</math> S <math>\checkmark</math> R      <math>\checkmark</math> S / R    <math>\checkmark</math> R                    (4)      <math>\checkmark</math> S <math>\checkmark</math> R  <math>\checkmark</math> S <math>\checkmark</math> R                    (4)    <math>\checkmark</math> S / R  <math>\checkmark</math> S / R  <math>\checkmark</math> S / R    <math>\checkmark</math> R                    (4)</p>
		<p>[18]</p>

TOTAL/TOTAAL: 150